# MC100
## Pneumatic Pressure Standard

# USER'S MANUAL

**YOKOGAWA ◆**
Yokogawa Electric Corporation

Thank you for purchasing the Pneumatic Pressure Standard MC100.
This User's Manual contains useful information about the functions, operating procedure, and handling precautions of the Pneumatic Pressure Standard. To ensure correct use, please read this manual thoroughly before operation.
Keep this 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 instrument'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.

## Trademarks

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- Other company and product names are trademarks or registered trademarks of their respective holders.

## Revisions

First Edition:     June 2000

# Checking the Contents of the Package

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

**MC100**

The model name and other information are written on the name plate located on the rear panel of the instrument (see the figure below). Check that your order is correct with the code table below. When inquiring about the product, please quote the model name, suffix code, and instrument number (NO.).
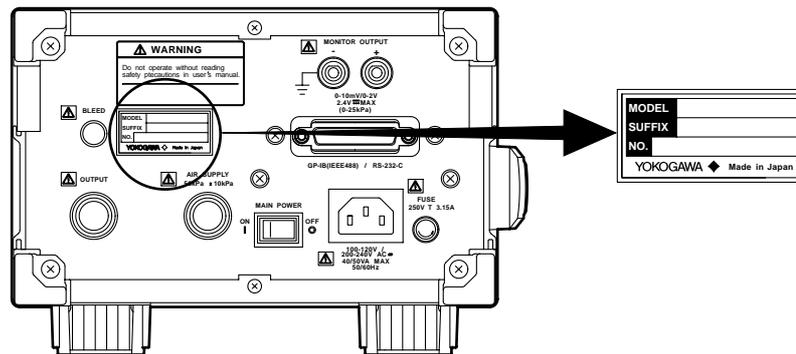


**MODEL (Model name)**

| Model Code | Notes |
| --- | --- |
| 767401 | Output range: 0 to 25 kPa |
| 767402 | Output range: 0 to 200 kPa |

**SUFFIX (Suffix code)**

| Suffix Code | | Specifications |
| --- | --- | --- |
| Pressure unit | -U1 | Displayed unit: kPa |
| | -U2 | Displayed unit: kPa, kgf/cm$^2$, mmH$_2$O, and mmHg |
| | -U3 | Displayed unit: kPa, psi, inH$_2$O, and inHg |
| Communication | -C1 | GP-IB interface |
| | -C2 | Serial (former EIA-232 (RS-232)) interface |
| I/O connection section | -P1 | Rc1/4 |
| | -P2 | 1/4NPT internal thread |
| Power cord | -D | UL/CSA Standard Power Cord (Maximum Rated Voltage: 125 V, Maximum Rated Current: 7 A) |
| | -F | VDE Standard Power Cord (Maximum Rated Voltage: 250 V, Maximum Rated Current: 10 A) |
| | -R | SAA Standard Power Cord (Maximum Rated Voltage: 240 V, Maximum Rated Current: 10 A) |
| | -Q | BS Standard Power Cord (Maximum Rated Voltage: 250 V, Maximum Rated Current: 5 A) |

***Note***

We recommend you keep the packing box. The box is useful when you need to transport the instrument.

## Standard Accessories

The following standard accessories are supplied with the instrument. Check that all contents are present and that they are undamaged. If you detect any problems, contact your nearest YOKOGAWA dealer.

**Power cord (one of the following power cords is supplied according to the instrument's suffix codes)**

**UL/CSA standard A1006WD**     **VDE standard A1009WD**     **BS standard A1054WD**     **SAA standard A1024WD**

D     F     Q     R
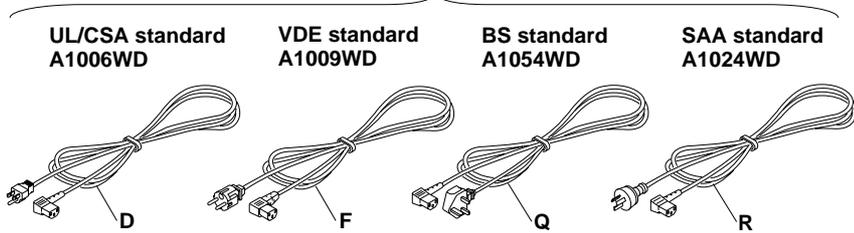
**Power fuse (2 pieces) (a spare, attached to the fuse holder) A1113EF**

**Rubber feet (2 pieces) A9088ZM**

**Joint connector (Connector assembly for Rc, for the φ4×φ6 vinyl tube: 2 sets) B9310RR**

**User's Manual (this manual) (1)**

## Optional Accessories

The following optional accessories are available for purchase separately. When you receive the order, check that all contents are present and that they are undamaged. For information and ordering, contact your nearest YOKOGAWA dealer.

| Part Name | Part Number | Quantity |
|---|---|---|
| Connector assembly for Rc (for the φ4×φ6 vinyl tube) | B9310RR | 1 |
| Simple connector assembly (for the φ4×φ6 vinyl tube) | B9310ZH | 1 |
| Adapter (JIS, R1/4-Rc1/8) | G9612BG | 1 |
| Adapter (ANSI, R1/4-1/4NPT internal thread) | G9612BJ | 1 |
| Adapter (ANSI, R1/4-1/8NPT internal thread) | G9612BW | 1 |

**Connector assembly for Rc B9310RR**     **Simple connector assembly B9310ZH**

**Adapter (JIS) G9612BG**     **Adapter (ANSI) G9612BJ**     **Adapter (ANSI) G9612BW**

# Safety Precautions

This instrument is an IEC safety class I instrument (provided with terminal for protective earth grounding).
The following general safety precautions must be observed during all phases of operation. YOKOGAWA Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

For your safety, the following symbols are used on this instrument.

⚠ "Handle with care." (To avoid injury, death, or damage to the instrument, the operator must refer to the explanation in the User's Manual or Service Manual.)

⏚ "Functional ground terminal." Do not use this terminal as a protective ground terminal.

∿ Alternating current

⎓ DC

| ON (power)

○ OFF (power)

⎍ ON (power) state

⎎ OFF (power) state

**Make sure to comply with the following safety precautions. Not complying might result in injury or death.**

## WARNING

- **Power Supply**
  Ensure that the source voltage matches the voltage of the power supply before turning ON the power.
- **Power Cord and Plug**
  To prevent the possibility of electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. Do not invalidate this protection by using an extension cord without protective earth grounding.
- **Protective Grounding**
  Make sure to connect the protective grounding to prevent electric shock before turning ON the power. The power cord that comes with the instrument is a three-pin type power cord. Connect the power cord to a properly grounded three-pin outlet.
- **Necessity of Protective Grounding**
  Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so poses a potential shock hazard.
- **Defect of Protective Grounding**
  Do not operate the instrument when the protective earth or the fuse might be defective. Also, make sure to check them before operation.
- **Fuse**
  To avoid fire, only use a fuse that has a rating (current, voltage, and type) that is specified by the instrument. When replacing the fuse, turn OFF the power switch and remove the power cord from the outlet beforehand. Do not use a fuse that is outside the specifications or short the fuse holder.
- **Do Not Operate in Explosive Atmosphere**
  Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such environments is very dangerous.
- **Restrictions on the fluids that can be used**
  - Do not apply gases that are flammable, explosive, poisonous, or corrosive or gases at high-temperature to the pipe section.
  - Liquids cannot be used with this instrument.
- **Restrictions on the input pressure**
  Applying a pressure exceeding the prescribed allowable input can damage the instrument. In addition, the applied pressure may be passed on to the device that is connected to the output connector, and cause secondary accidents.
- **Do Not Remove Covers**
  The cover should be removed by YOKOGAWA's qualified personnel only.
- **External connectionExternal connection**
  Connect the protective grounding before connecting to the item under measurement or to an external control unit.

# How to Use This Manual

## Structure of the Manual

This User's Manual consists of the following 6 chapters and an appendix.

| Preparation | Chapter 1 Overview of the Pneumatic Pressure Standard MC100<br>Chapter 2 Before Operation | If you are using the instrument for the first time, make sure to read this section. |
|---|---|---|
| Operation | Chapter 3 Output Configuration Examples and Operating Procedure | Explains configuration examples and operation. Make sure to read this section. |
| Communications | Chapter 4 Using the Communication Functions | Explains the communication functions. |
| Others | Chapter 5 Troubleshooting, Maintenance, and Calibration<br>Chapter 6 Specifications<br>Appendix | Refer to this section as necessary. |

## Conventions

### Symbols

The following symbols are used in this manual.

⚠️    A symbol mark affixed to the instrument.  Indicates danger to personnel or instrument and the operator must refer to the User's Manual.  The symbol is used in the User's Manual to indicate the reference.

**WARNING**    Describes precautions that should be observed to prevent injury or death to the user.

**CAUTION**    Describes precautions that should be observed to prevent minor or moderate injury, or damage to the instrument.

*Note*    Provides important information for the proper operation of the instrument.

**Symbols used on pages in which operating procedures are given.**

On pages that describe the operating procedures in Chapter 2 through 4, the following symbols are used to distinguish the procedures from their explanations.

**Explanation**   Describes the details of the settings and the restrictions that exist with the operating procedure.

**Example**   Indicates configuration examples when operating the MC100.

**Procedure**   Carry out the procedure according to the step numbers. The procedure is given with the premise that the user is carrying out the procedure for the first time. Therefore, if you are modifying the settings, you may not need to carry out all the steps.

In this manual, pressure units that are not specifically noted signify gauge pressure.

# Contents

# 1.1    Operating Principles

The MC100 is a pressure servo system comprised of a pressure setting section, a needle-type servo valve, and a silicon resonant sensor.

The pressure setting section computes the command value that is to be passed to the motor based on the pressure value specified through the operation keys or communication commands and the pressure value derived by the pressure computing section.  The value is converted into an electric signal by the D/A converter.  The electric signal passes through the current amp to drive the motor.

The servo valve consists of a needle valve, a valve seat, and a drive mechanism that includes the motor and gear train.  Part of the pneumatic supply pressure (Ps) escapes through the gap between the needle valve and the valve seat.  The motor rotation is speed-reduced and transmitted to the screw shaft by the gear train.  Then, screw shaft rotation causes the needle valve to move in the direction indicated by the arrow in the above figure so as to vary the cross-sectional area between the needle valve and valve seat, thereby controlling output pneumatic pressure (Po).  Part of the output pneumatic pressure enters the pressure sensor and is fed back to the pressure computing section above.

If the output pressure is greater than the specified pressure, the pressure setting section controls the motor so that the cross-sectional area of the needle valve is decreased, and vice versa.  In other words, the pressure setting section controls the motor so that the difference between the specified pressure and the output pressure is reduced to zero.  Consequently, stable output pressure corresponding to the specified value can be obtained.

# 1.2    Functions

**Pressure Output**

The MC100 has three pressure output modes.
You can switch the mode only when the output is turned OFF.

- **Manual output mode (divider output)**
  The output pressure range, from 0 to the specified value, is equally divided into any number from 1 to 20 (m divisions) and an arbitrary pressure (n level) is output continuously.
  The output mode is reset to manual output mode when pressure output is turned OFF with the **OUTPUT key** or when the MC100 is turned ON.

- **Auto-step output mode**
  The divider output equal to (n/m x the specified pressure) is automatically output in a specified step pattern using specified intervals.
  The value of n is the start step (the initial pressure when the output is started).
  The MC100 outputs different levels of pressure in the following order: n/m (start)$\rightarrow$(n+1)/m$\rightarrow$•••$\rightarrow$m/m (maximum output)$\rightarrow$•••$\rightarrow$(n−1)/m$\rightarrow$n/m(end).  You can use the repeat function to repeat the auto-step output.

- **Sweep output mode**
  In this mode, pressure output changes from 0% to 100% or 100% to 0% of the specified pressure within the specified interval.  You can use the repeat function to repeat the sweep output.

**Zero Calibration**

Compensates the influence received from the varying environment in order to maintain the accuracy of the pressure output.

**Alarm**

Lights the ALARM indication LED and turns OFF the pressure output, if abnormal source pressure is detected during operation.

**Monitor Output**

Outputs voltage signals in accordance with the pressure setting condition (up to the maximum setting).

**Communication Function**

Provides remote control and data output via the specified interface (GP-IB or serial (former EIA-232 (RS-232)).

# 1.3　Outline of the Operation

The following flow chart shows the operation of the MC100.

| | | |
|---|---|---|
| Power ON | ------- | Power switch: ON |

Internal initialization

Model name indication　⎫ Internal operations

Output-ready state

| | | |
|---|---|---|
| Zero calibration after warm-up | ------- | ZERO CAL key |
| Pressure value setting | ------- | Setting keys |

Output mode ————— Manual output mode

| | | |
|---|---|---|
| Interval setting | ------- | INTERVAL key |

Output mode selection ————— Manual output mode

Auto-step output mode ------- AUTO STEP key
Sweep output mode ------- SWEEP key

| | | |
|---|---|---|
| Repeat setting | ------- | REPEAT key |
| Pressure output | ------- | OUTPUT key: ON |
| Pressure output termination | ------- | OUTPUT key: OFF |
| Power OFF | ------- | Power switch: OFF |

# 1.4 Names and Function of Parts

**Front Panel**
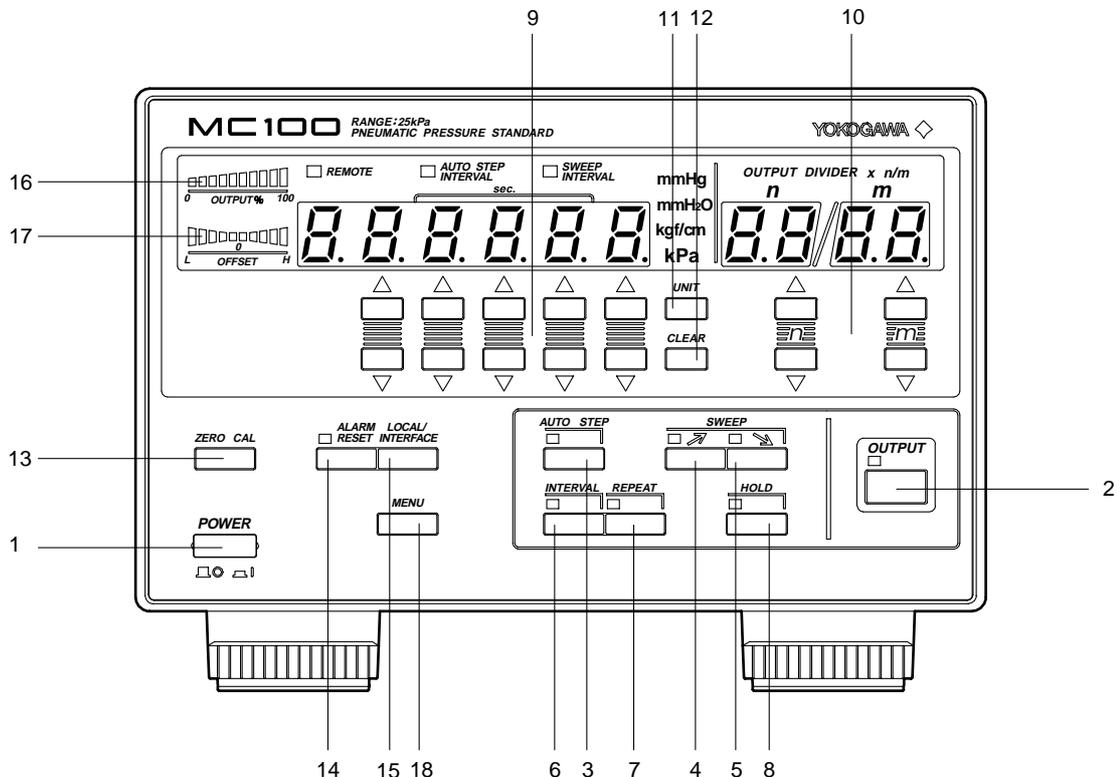


**1 Power switch**

Switch used to turn ON/OFF the power.

**2 OUTPUT key**

Key used to turn ON/OFF the pressure output. When the output is turned ON, the LED lights and the specified pressure is output from the output connector of the rear panel.

**3 AUTO STEP key (operable only when the OUTPUT key is OFF.)**

Key used to turn ON/OFF the auto-step output mode. The LED located above and to the left of the key lights when this mode is turned ON.

**4 SWEEP ↗ key**

Key used to turn ON/OFF the rising sweep mode. The LED located above and to the left of the key lights when this mode is turned ON. While outputting pressure in the falling sweep mode, you can press this key to switch to the rising sweep mode.

**5 SWEEP ↘ key**

Key used to turn ON/OFF the falling sweep output mode. The LED located above and to the left of the key lights when this mode is turned ON. While outputting pressure in the rising sweep mode, you can press this key to switch to the falling sweep mode.

**6 INTERVAL key**

Key used to set the interval for the auto-step output mode and sweep output mode. When you press this key, the display shows values in the following order: the interval for the auto-step output mode, the interval for the sweep output mode, and the specified pressure value. The LED lights when the interval is being displayed. The interval is set using UP (△) and DOWN (▽) **pressure setting keys** that are provided for each digit.

**7 REPEAT key**

Key used to turn ON/OFF the repeat function. The LED located above and to the left of the key lights when this mode is turned ON.

When you press this key, pressure output in the auto-step output mode or sweep output mode is repeated.

**8 HOLD key**

If you press this key while outputting pressure in the auto-step output mode or sweep output mode, the MC100 temporarily stops its operation and holds the pressure level. When you press the key again, the auto-step operation or sweep operation resumes from the point where it was stopped. The LED located above and to the left of the key lights when the hold function is turned ON.

**9 Pressure setting keys**

Keys used to set the output pressure values. Each digit is provided with UP ($\triangle$) and DOWN ($\triangledown$) keys that increment or decrement the value. This key is also used to set the interval for the auto-step output mode and sweep output mode.

In the auto-step mode and sweep mode, you cannot change the pressure value or the interval.

**10 Divider ratio setting keys (operable when AUTO STEP and SWEEP keys are OFF.)**

Keys used to set the divider ratio n/m. UP ($\triangle$) and DOWN ($\triangledown$) keys are available.

Range: denominator m = 1 to 20, numerator n = 0 to m.

**11 UNIT key**

Key used to switch the displayed pressure unit.

**12 CLEAR key**

Sets the pressure value to zero. You cannot do this while outputting pressure in the auto-step output mode or sweep mode.

**13 ZERO CAL key**

Key used to carry out zero calibration. You cannot carry out zero calibration while the output is ON.

**14 ALARM RESET key**

Key used to reset the source pressure alarm function. The LED lights when an alarm occurs. It turns OFF when you reset the alarm.

**15 LOCAL/INTERFACE key**

When the MC100 is in the remote control mode via the GP-IB or serial (former EIA-232 (RS-232)) interface, you can press this key to release the remote control mode. When the MC100 is in the local mode (REMOTE indicator LED is OFF), you can set communication parameters.

**16 Output monitor**

Indicates the output condition with respect to the specified value (100%).

**17 Offset monitor**

Indicates the stability of the final output value in terms of deviation.

**18 MENU key**

Key used to set the load capacity, monitor output range, and beep sound (ON/OFF).

**Rear Panel**
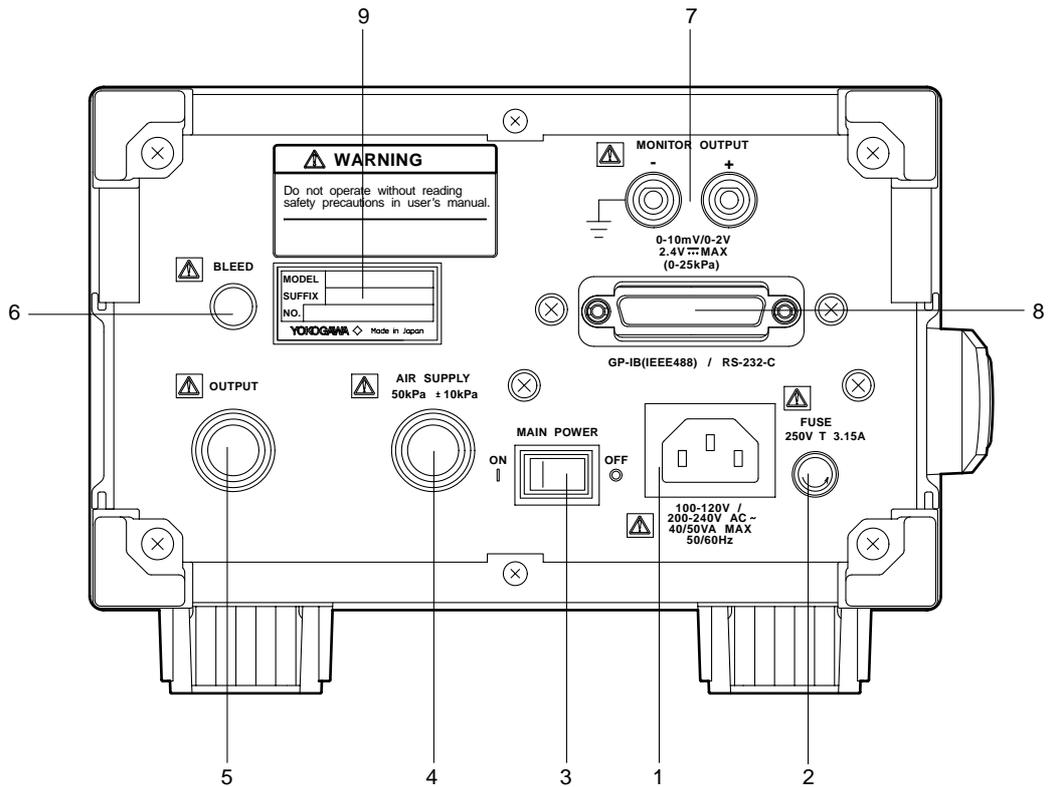


**1  Power connector**

Three-pin connector with a protective grounding terminal.  Connect the power cord that came with the MC100 to this connector.  Make sure to perform protective grounding to prevent the possibility of electric shock.  Ensure that the power supply matches voltage and frequency requirements.

**2  Fuse**

Time lag fuse rated for 250 V and 3.15 A.

**3  Main power switch**

Turns ON/OFF the commercial power supply input.  When you turn OFF this switch, the primary side of the power circuit is cut off.

**4  Pressure source connector**

The size is Rc1/4 internal thread (SUFFIX (suffix code):P1) or 1/4NPT internal thread (SUFFIX (suffix code):P2).  A connector is preinstalled at the factory.  A vinyl, nylon, or other tube ($\phi$4 mm i/d $\times$ $\phi$6 mm o/d) can be connected to it.  The pressure source must be applied through a filtered reducing valve or similar apparatus.

**5  Output connector**

The size is Rc1/4 internal thread (SUFFIX (suffix code): P1) or 1/4NPT internal thread (SUFFIX (suffix code): P2).  A connector is preinstalled at the factory.  A vinyl, nylon, or other tube ($\phi$4 mm i/d $\times$ $\phi$6 mm o/d) can be connected to it.

**6  Bleed outlet**

Air from the servo valve is discharged from this outlet.  Do not obstruct this outlet.

**7  Monitor output terminal**

Outputs either 0 to 10 mV/full scale or 0 to 2 V/full scale according to the setting.  The output voltage corresponds to the following specified pressure:

For the 76740: 0 to 25 kPa.

For the 767402: 0 to 200 kPa.

**8  Communication interface connector**

GP-IB or serial (former EIA-232 (RS-232)) interface connector used to connect a controller (PC) using a communication cable.

**9  Name plate**

## Digital Numbers and Characters

Because the MC100 uses a 7-segment LED display, numbers, alphabets, and operation symbols are represented using special characters as follows.  Some of the characters are not used.

| | | | |
|---|---|---|---|
| 0 → $0$ | A → $A$ | K → $K$ | U → $U$ |
| 1 → $1$ | B → $b$ | L → $L$ | V → $V$ |
| 2 → $2$ | C → $C$ lowercasec → $c$ | M → $\bar{n}$ | W → $W$ |
| 3 → $3$ | D → $d$ | N → $n$ | X → $X$ |
| 4 → $4$ | E → $E$ | O → $o$ | Y → $y$ |
| 5 → $5$ | F → $F$ | P → $P$ | Z → $\bar{z}$ |
| 6 → $6$ | G → $G$ | Q → $q$ | + → $+$ |
| 7 → $7$ | H → $H$ lowercaseh → $h$ R → $r$ | | – → $-$ |
| 8 → $8$ | I → $I$ | S → $5$ | × → $n$ |
| 9 → $9$ | J → $J$ | T → $t$ | ÷ → $\div$ |

# 2.1    Precautions on the Use of the Instrument

**2**

## Safety Precautions

- Before using the instrument, make sure to read the "Safety Precautions" given on pages iv and v.
- Do not remove the cover from the instrument.
  Some sections inside the instrument have high voltages that are extremely dangerous.  For internal inspection or adjustment, contact your nearest YOKOGAWA dealer as listed on the back cover of this manual.
- Never continue to use the instrument if there are any symptoms of trouble such as strange odors or smoke coming from the instrument.  In such cases, immediately turn OFF the power switch and the main power switch and unplug the power cord.  In addition, cut off the power supply and source pressure of instruments that are connected to the I/O sections and remove connections such as tubes.  If such abnormal symptoms occur, contact your nearest YOKOGAWA dealer as listed on the back cover of this manual.
- Nothing should be placed on top of the power cord.  The power cord should also be kept away from any heat sources.  When unplugging the power cord from the outlet, never pull by the cord itself.  Always hold and pull by the plug.  If the power cord is damaged, contact your dealer for replacement.  Refer to page iii for the part number of the appropriate power cord when placing an order.

## General Handling Precautions

- When carrying the instrument, first disconnect the power cord and connection cables, and then lift the instrument by the handle on the left side panel.
- Do not bring charged objects near the input terminals.  This can damage the internal circuitry.
- Do not pour volatile agents on the case or operation panel nor leave them in contact with rubber or PVC products for long periods of time.  This can cause discoloration.
- Make sure heating elements such as soldering bits do not come in contact with the operation panel.
- If you are not going to use the instrument for a long period of time, unplug the power cord from the outlet.
- When cleaning the case or the operation panel, first remove the power cord from the outlet.  Then, wipe with a dry, soft cloth.  Do not use volatile chemicals as this may cause discoloring and deformation.

# 2.2 Installation

**Installation Condition**

Install the instrument in a place that meets the following conditions.

- **Ambient temperature and humidity**

  Use the instrument in the following environment.
  - Ambient temperature: 5 to 40°C
  - Ambient humidity: 20 to 80%RH, no condensation.

*Note*
- Condensation may occur if the instrument is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. In this case, let the instrument adjust to the new environment for at least an hour before using the instrument.
- There are vent holes on the top and bottom sides of the instrument. Do not cover these vents or the bleed hole on the rear side. Allow at least 2 cm of space above the vents on the top side.

Do not install the instrument in the following places:
- In direct sunlight or near heat sources.
- Where an excessive amount of soot, steam, dust, or corrosive gases are present.
- Near magnetic field sources.
- Near high voltage equipment or power lines.
- Where the level of mechanical vibration is high.
- In an unstable location.
- In a location where the altitude exceeds 2000 m.

**Installation Position**

Place the instrument in a horizontal position or inclined position using the stand (see the figure below).
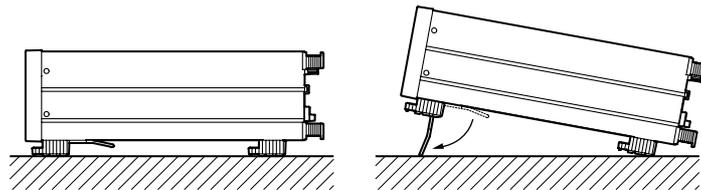
# 2.3    Connecting the Power Supply

**Before Connecting the Power Supply**

ìFollow the warnings and cautions below when connecting the power supply to avoid the danger of electric shock and damage to the instrument.

⚠

### WARNING

*   Ensure that the supply voltage matches the rated supply voltage of the instrument before connecting the power cable.
*   Check that the main power switch (rear panel) and the power switch (front panel) are turned OFF before connecting the power cord.
*   To prevent the possibility of electric shock or fire, be sure to use the power cord supplied by YOKOGAWA.
*   Make sure to perform protective earth grounding to prevent the possibility of electric shock.  Connect the power cord to a three-pin power outlet with a protective earth terminal.
*   To prevent fire, only use a fuse with the specified rating (current, voltage, and type).  For fuse replacement, see section 5.2, "Storing the MC100 and Replacing the Fuse" (page 5-3).
*   Do not invalidate protection by using an extension cord without protective earth grounding.

⚠

### CAUTION

*   Before turning OFF the power, set the pressure output value to zero using the **pressure setting keys** or the **CLEAR key**.  (See section 2.5, "Pressure Output Preparation" (page 2-8).)
*   If you have turned ON the power and operated the setting keys and **OUTPUT key**, do not inadvertently turn OFF the power.  This may cause the source pressure to be output directly when you connect the source pressure.

## Connection Procedure

**1.** Confirm that the main power switch located on the rear panel and the power switch on the front panel are turned OFF.

**2.** Connect the power cord plug to the power connector on the rear panel.  (Use the power cord that came with the package.)

**3.** Connect the other end of the cord to an outlet that meets the following conditions.

| | |
|---|---|
| Rated supply voltage | 100-120 VAC/200-240 VAC |
| Permitted supply voltage range | 90-120 VAC/180-240 VAC |
| Rated supply voltage frequency | 50/60 Hz |
| Permitted supply voltage frequency range | 47 to 63 Hz |



**3-pin outlet**

**Power cord**
**(included in the package)**
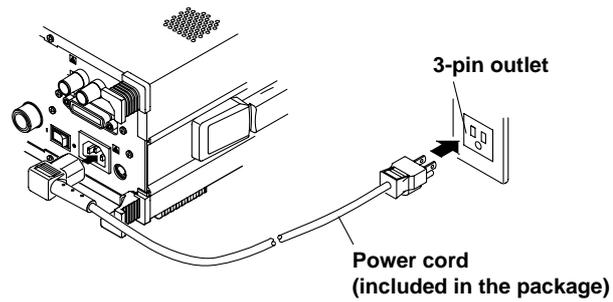
# 2.4    Turning ON/OFF the Power Switch

## Things to Check before Turning ON the Power

- Is the instrument properly installed? → See section 2.2, "Installation" (page 2-2).
- Is the power cord properly connected? → See section 2.3, "Connect the Power Supply" (page 2-3).

## Position of the Power Switch

There are two power switches.  One is the main power switch located at the center of the rear panel.  The other is the power switch located at the lower left corner of the front panel.  Normally, you will leave the main power switch turned ON, and use only the power switch to turn ON/OFF the MC100.

**Front Panel**                                                   **Rear Panel**
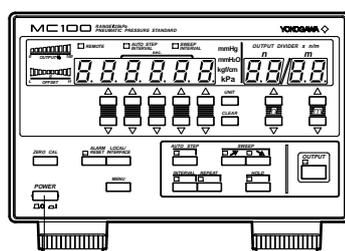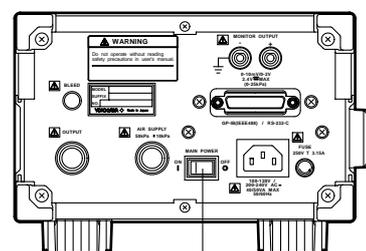


**Power Switch**                                                 **Main power switch**

## Operation to Turn ON/OFF the Power Switch

**Main power switch on the rear panel**

Press the switch to the "| (ON)" side to turn it ON.

**Power switch on the front panel**

The power switch is a push button.  Press once to turn it "ON" and press again to turn it "OFF."

---

### CAUTION

Before turning OFF the power switch, press the **pressure setting keys** or **CLEAR key** to set the output pressure to zero, confirm that the output pressure is zero, and turn OFF the **OUTPUT key**.

---

## Power Down Operation

The MC100 backs up the setup data existing immediately before the power is turned OFF.  The MC100 starts up using the stored setup data the next time the power is turned ON.  However, some of the information are not backed up.  For details, see "A List of Factory Default Values" (page 2-7).

***Note***

- The life of the lithium battery that is used to store the settings is approximately five years when the MC100 is used in an ambient temperature of 23°C.  When the battery performance deteriorates, the MC100 will no longer be able to save the setup data.  In such case, you must quickly replace the lithium battery.  The user cannot replace the lithium battery.  Contact your nearest YOKOGAWA dealer for replacement.
- The warm-up time required to satisfy all specifications is approximately five minutes.

---

## Power Up Operation and Display

When you turn ON the power switch, the MC100 automatically performs a self-test. The self-test entails checking the pressure sensor and memory. If the pressure sensor and memory are operating normally, the MC100 shows the following opening message and enters the output-ready state.

If an error code remains on the display as a result of the self-test, the MC100 will not operate properly. In this case, turn OFF the power switch and the main power switch, and contact your nearest YOKOGAWA dealer as listed on the back cover of this manual. When contacting your dealer, notify the model name and instrument No. on the name plate on the rear panel and the error code that was displayed.

*Note*

For error information corresponding to the error code, see section 5.1, "Troubleshooting" (page 5-1).

## Opening Message

Power switch: ON

↓

Self-test

↓

**For the 767401 (25 kPa model)**    **For the 767402 (200 kPa model)**

| 767401 | 767402 |

Model name indication

↓

| 1.0 1 |

Version indication

↓

**When equipped with the GP-IB interface**    **When equipped with the serial (RS-232) interface**

| GP ib | r 5232 |

Communication interface indication

↓

Output-ready state
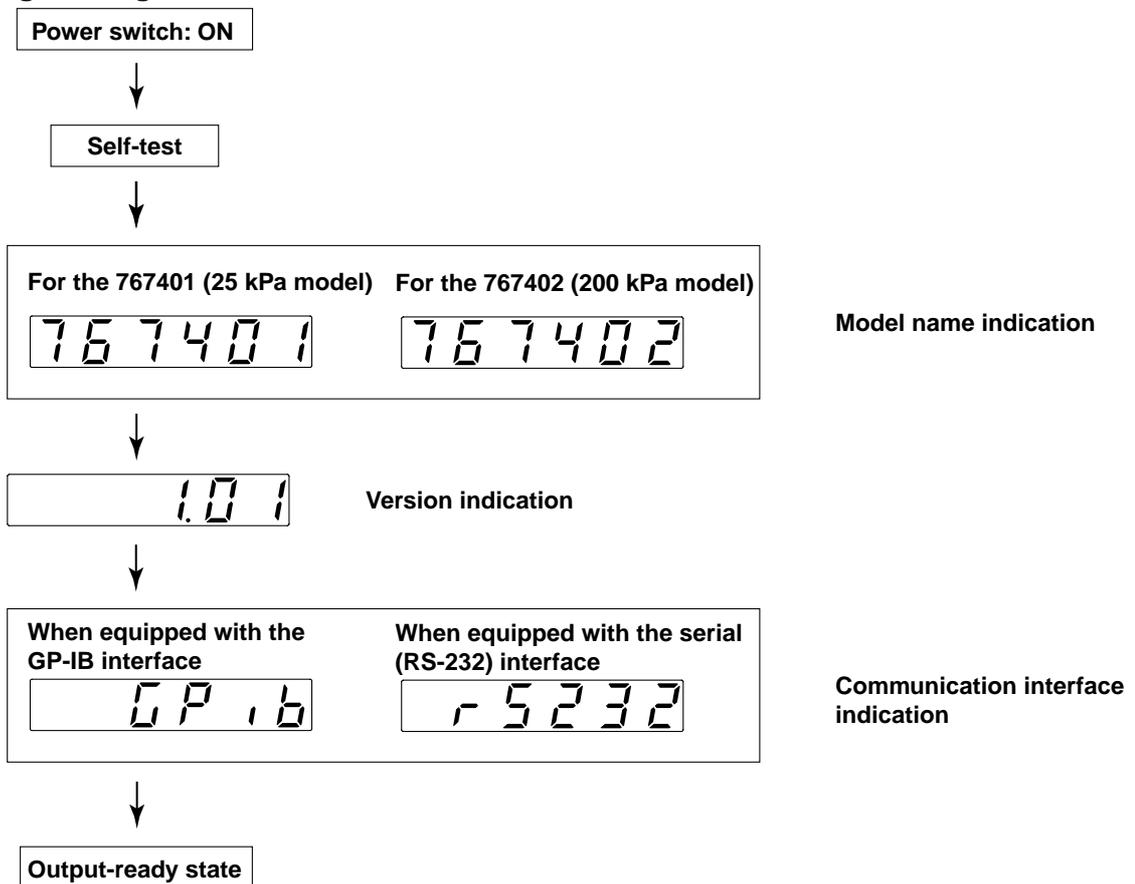
## A List of Factory Default Values

| Item | Factory Default Value | Backup [1] |
|---|---|---|
| Pressure zero CAL value | 0 | Yes |
| Pressure unit | kPa | Yes |
| Pressure value | 0 | No |
| Divider ratio value | 1/1 | No |
| Pressure output | OFF | No |
| Output mode | Manual (divider ratio) | No |
| Auto-step interval | 10 s | Yes |
| Sweep interval | 15 s | Yes |
| Repeat output | OFF | No |
| Hold | OFF | No |
| Load capacity | small | Yes |
| Monitor output | L (10 mV) | Yes |
| Beep sound | ON | Yes |
| **Communication settings (common to GP-IB and serial)** | | |
| (Output data) header | Yes | Yes (command H) |
| Status byte mask value | 29 | Yes (command MS) |
| **When equipped with the GP-IB interface** | | |
| GP-IB board | Addressable mode only | Yes |
| Address | 1 | Yes |
| Delimiter | 0 (CR+LF+EOI) | Yes (command DL) |
| **When equipped with the serial interface** | | |
| Serial (RS-232) mode | Normal mode only | Yes |
| Handshaking mode | 0 | Yes |
| Format | 0 | Yes |
| Baud rate | 9600 | Yes |
| Delimiter | 0 (CR+LF) | Yes (command DL) |

[1] Yes: Backed up.  No: Not backed up.

## Initializing Setup Data

The following two methods are available in initializing the setup data to their factory default values:

• Keep pressing the **CLEAR key** until the model name and version indication appears when you turn ON the power switch.

• Transmit the "RC" communication command from the controller (however, communication settings will not be initialized).

# 2.5 Pressure Output Preparation

**Connecting the Source Pressure**

1. Confirm that the main power switch and the main power switch are turned OFF.
2. Confirm that the instrument output connector is open.
3. Securely connect the pressure source to the pressure source connector on the rear panel via the filtered reducing valve.
   Use a $\phi$4 mm i/d $\times$ $\phi$6 mm o/d vinyl tube for piping, and connect it with the supplied joint connector.
4. Gradually open the reducing valve and set the source pressure to 50$\pm$10 kPa (for the 767401) or 280$\pm$20 kPa (767402).

---

## ⚠ CAUTION

- Use a stable pressure source with minimum pressure variations.
- Use a filtered reducing valve or attach a filter to the reducing valve.
- If you are operating multiple MC100s in parallel from a single pressure source, connect them as follows in order to stabilize the output.



Good Example                        Bad Example

---
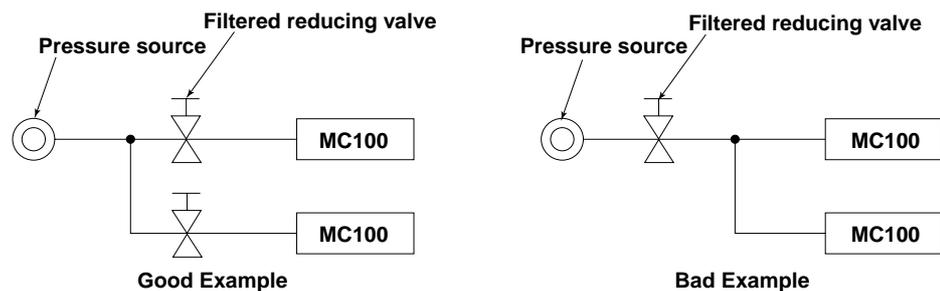
**Connecting the Output Connector**

## ⚠ CAUTION

- Before connecting the MC100 and the device to be calibrated, press the **pressure setting keys** or **CLEAR key** to set the output pressure to zero and confirm that the output pressure is zero.
- Do not obstruct the bleed outlet of the rear panel (with your fingers, for example). Otherwise, proper output will be hindered.

---

Connect the output connector on the rear panel and the input of the device.

For connection, use the same $\phi$4 mm i/d $\times$ $\phi$6 mm o/d vinyl tube as with the pressure source (or something similar).

For setting the load capacity, see section 2.7, "Setting the Load Capacity" (page 2-12).

*Note*

Confirm that there are no leaks in the device that is to be connected.

## Zero Calibration

Turn ON the power switch. With the **OUTPUT key** on the front panel turned OFF, warm up the instrument for five minutes. Then, press the **ZERO CAL key** and confirm that the offset monitor is at the green level.



**Offset monitor**

**ZERO CAL key**

**Lights when the output is ON**

**OUTPUT key**
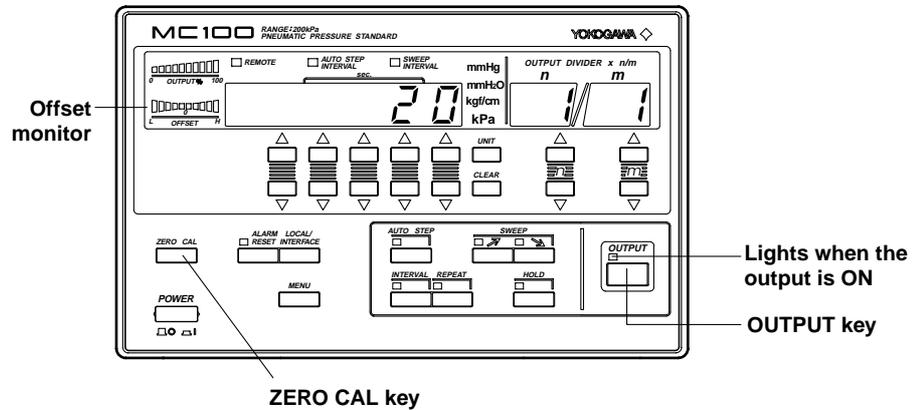
**Note**
- When performing zero calibration, if the input pressure value and the initial value differ by more than the value specified below, an error code appears.
  767401: 5 kPa
  767402: 20 kPa
- It takes approximately 2 s for zero calibration to finish after you press the **ZERO CAL key**.

## Cutting Off the Source Pressure

Always turn OFF the power switch and the **OUTPUT key** before cutting off the source power.

### CAUTION

- If you cut off the source pressure before you turn OFF the **OUTPUT key**, the MC100 will detect abnormal source pressure, and the ALARM indication LED will light. (See section 2.9, "Alarm Function" (page 2-14).)

## 2.6 Setting the Pressure Display Unit, Output Pressure, Divider Ratio and Turning ON/OFF the Pressure Output

### Setting the Pressure Display Unit

Using the **UNIT key**, select the desired unit of pressure to be displayed.

The pressure unit varies depending on the suffix code.

- When SUFFIX (suffix code) is U1: kPa (The displayed unit will not change even if you press the **UNIT key**.)
- When SUFFIX (suffix code) is U2: kPa→kgf/cm$^2$→mmH$_2$O→mmHg→kPa...
- When SUFFIX (suffix code) is U3: kPa→psi→inH$_2$O→inHg→kPa...

***Note***

Switching to a pressure display unit with different display resolution can cause an error in the displayed output pressure value due to the effects from the conversion coefficient. For details related to the display resolution (selectable range) and conversion coefficient, see "Selectable range for each pressure display unit and conversion coefficient to kPa" below.

### Setting the Output Pressure

- **Setting the output pressure**

  A one-to-one correspondence exists between each digit of the specified value on the display and the key immediately below the digit.

  The decimal point is fixed according to the type of unit.
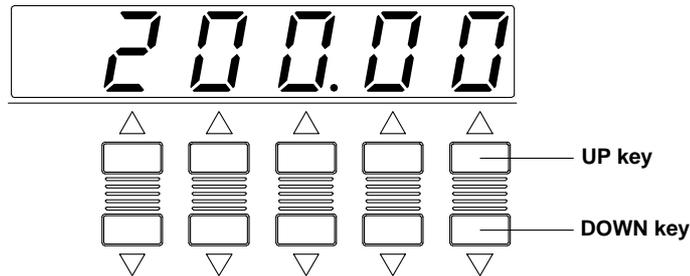
  

- **Selectable range for each pressure display unit and conversion coefficient to kPa**

| Pressure Display Unit | Selectable Range (767401) | Selectable Range (767402) | Conversion Coefficient to kPa |
|---|---|---|---|
| kPa | 0.000 to 30.000 | 0.00 to 240.00 | 1 |
| kgf/cm2 | 0.00000 to 0.30591 | 0.0000 to 2.4473 | $9.80665×10^1$ |
| mmH2O | 0.0 to 3059.1 | 0 to 24473 | $9.80665×10^{-3}$ |
| mmHg | 0.00 to 225.01 | 0.0 to 1800.1 | $1.333224×10^{-1}$ |
| psi | 0.0000 to 4.3511 | 0.000 to 34.809 | 6.894757 |
| inH2O | 0.00 to 120.43 | 0.00 to 963.51 | $2.490889×10^{-1}$ |
| inHg | 0.0000 to 8.8589 | 0.000 to 70.871 | 3.386388 |

### Setting the Divider Ratio

Specify the value to be output using a fractional value with respect to the specified value.

Pressure value actually output = the specified value $\times \dfrac{n}{m}$

Range:   $m = 1$ to 20, $n = 0$ to $m$

Value $n$ cannot exceed value $m$.

A one-to-one correspondence exists between each digit of the value shown in the $n$ and $m$ display section and the key immediately below the digit.

Use these **divider ratio setting keys** to set the divider output.
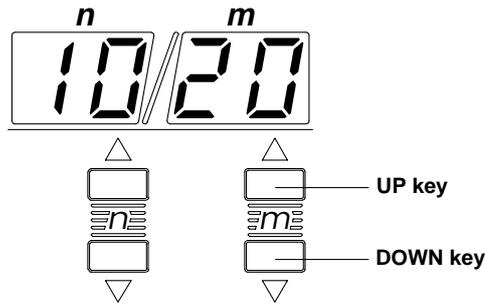


### Turning ON/OFF the Pressure Output

Use the **OUTPUT key** to turn ON/OFF the pressure output.  Press once to turn it "ON" and press again to turn it "OFF."  When you press the **OUTPUT key** and the pressure output is ON, the OUTPUT indication LED located above and to the left of the key lights. When turning OFF the **OUTPUT key**, set the output to zero.

- **During manual (divider ratio) output**
  Press the pressure setting keys or the **CLEAR key** to set the value to 0, wait for the offset monitor to turn green, and then turn OFF the **OUTPUT key**.
- **During auto-step output**
  Turn OFF the **OUTPUT key** when the value $n$ is at the smallest value.
- **During sweep output**
  Turn OFF the **OUTPUT key** when the output is at 0%.

---

## CAUTION

To abort the pressure output, set the output pressure to zero and then turn OFF the **OUTPUT key**.  If you happen to turn OFF the **OUTPUT key** in the middle of the output, the source pressure may directly be output as output pressure the next time the **OUTPUT key** is turned ON.  In such case, remove the output connector temporarily, set the pressure to zero, and output the pressure.

---

# 2.7 Setting the Load Capacity

Set the load capacity of the output destination.

Select the approximate load capacity from the following three types:

$5\bar{n}ALL$ (Small): 0 to 100 cc

$\bar{n}iddLE$ (Middle): 100 to 500 cc

$LArGE$ (Large): 500 to 1000 cc

**Procedure**

1. Press the **MENU key**.
   The display shows the following:

   $$5\bar{n}ALL \qquad /L.B$$
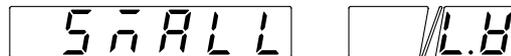
2. Press the lowest digit pressure setting key and set the load capacity.

   $$5\bar{n}ALL \qquad /L.B$$
   
   **or**
   
   $$\bar{n}iddLE \qquad /L.B$$
   
   **or**
   
   $$LArGE \qquad /L.B$$
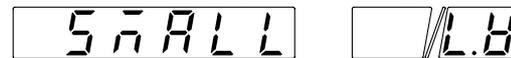
   **Press these keys to set the load capacity.**

3. When you are done, press the **MENU key** three times.

   **Note**

   The response speed of the MC100 varies depending on the load capacity.

# 2.8  Setting the Interval

**Explanation**

When using the auto-step output mode or sweep output mode to output pressure, set the interval of each step or the sweep period as the interval.

**Range and resolution**

| Mode Selectable | Range | Resolution |
| --- | --- | --- |
| Auto-step output mode | 10 to 600 s | 5 s |
| Sweep output mode | 15 to 600 s | 5 s |

**Definition of the interval**

• During auto-step output mode

• Sweep output mode

Interval

Transition period   Hold period

Interval

**Procedure**

Lights when setting the interval for the auto-step output mode

Lights when setting the interval for the sweep output mode

Interval

Key used to set the interval
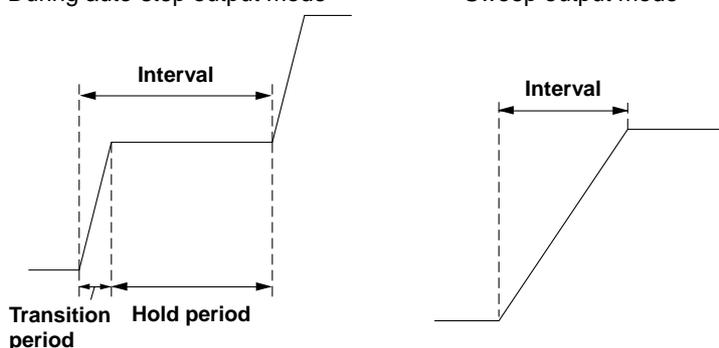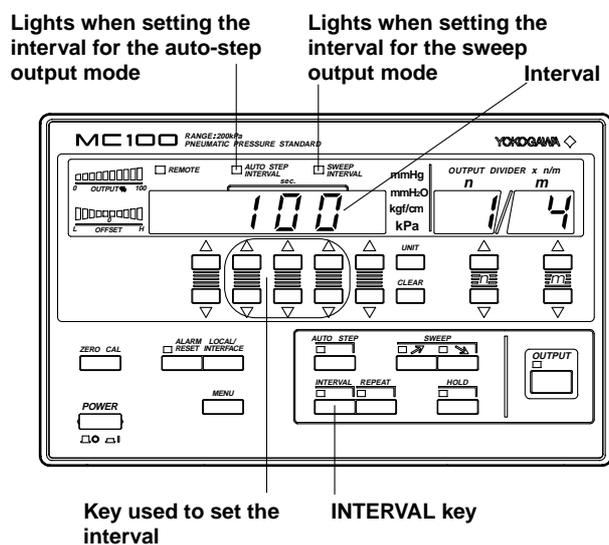
INTERVAL key

1. Confirm that the **OUTPUT key** is OFF.
2. Press the **INTERVAL key** and set the interval for the auto-step output mode or sweep output mode.  To set the interval for the auto-step output mode, turn ON the AUTO STEP INTERVAL indication LED.  To set the interval for the sweep output mode, turn ON the SWEEP INTERVAL indication LED.
3. The display shows the interval.
4. Set the interval using the **pressure setting keys**.
5. When you are done, press the **INTERVAL key**.

# 2.9 Alarm Function

**Explanation**

An alarm occurs in the following cases. When an alarm occurs, the ALARM indication LED located above and to the left of the **ALARM RESET key** lights, and the output turns OFF.

- When the source pressure falls below the specified pressure (when the input piping that is supplying the pressure comes off during operation, for example) or when the source pressure is too large.
- When the output piping comes off while outputting pressure.
- When the load capacity is too large.
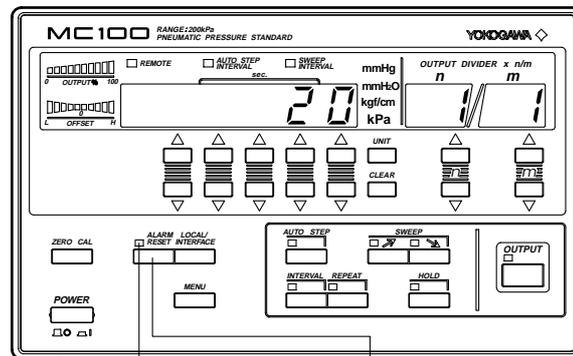


**Lights when an alarm occurs.**    **ALARM RESET key**

**Procedure**

Make sure to follow the procedure below when releasing the alarm.

---

## CAUTION

If you do not release the alarm according to the following procedure, a pressure nearly equal to the source pressure will be output when you release the alarm using the **ALARM RESET key**. Be careful, because excessive pressure will be applied to the connected device.

---



ALARM indication LED          ALARM RESET key
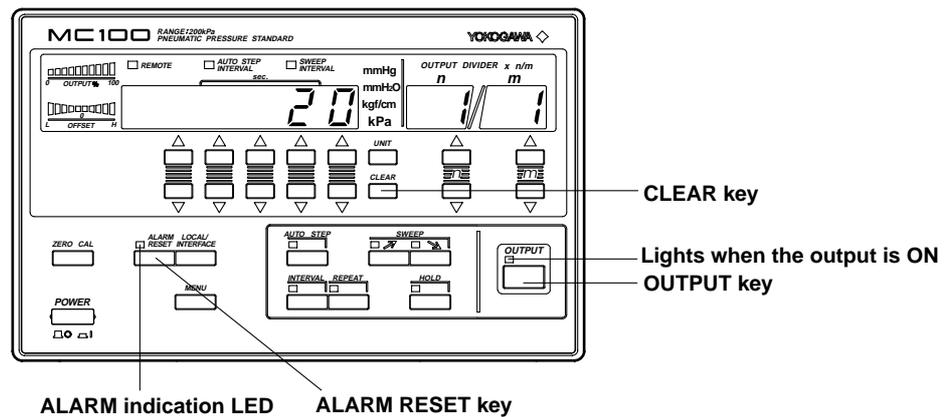
1. Disconnect the tube from the output connector on the rear panel.
2. Check the piping and setting of the source pressure and make adjustments to correct the cause of the alarm.
3. Press the **ALARM RESET key**. Confirm that the ALARM indication LED turns OFF.
4. Set the output value to zero using the **CLEAR key**.
5. Press the **OUTPUT key** and output the pressure for at least 10 s.
6. Turn OFF the **OUTPUT key**, and then turn OFF the main power switch and the power switch. Connect the tube to the output connector on the rear panel.
7. Turn ON the main power switch and power switch, and then press the **OUTPUT key**. The output resumes.

# 2.10 Monitor Output

You can output voltage signals in accordance with the pressure setting condition (up to the maximum setting) from the monitor output terminal on the rear panel.

**Monitor output terminal**

⚠

## CAUTION

Do not short the monitor output terminal or apply external voltage to it.  This can damage the MC100.



**Monitor output terminal**
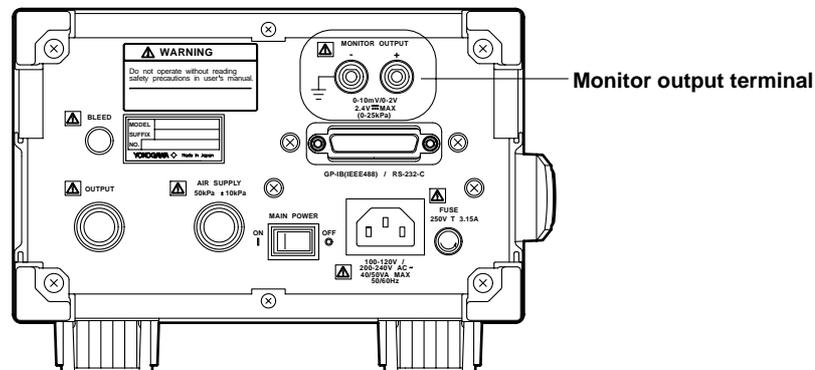
**Setting the monitor output range**
Set the range of voltage signals to be output to the monitor output terminal.
Select the range from the following two types:
$r n G - L$(Low):    0 to 10 mV/full scale (12 mV max)
$r n G - H$(High):   0 to 2 V/full scale (2.4 V max)

**1.** Press the **MENU key** twice.
The display shows the following:
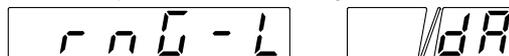


**2.** Press the lowest digit pressure setting key and set the range.
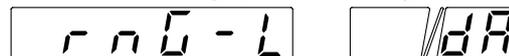


**or**



**Press these keys to set the range.**

**3.** When you are done, press the **MENU key** twice.

**Note**
The monitor output value is zero when the alarm is active and the **OUTPUT key** is OFF.

# 2.11 Turning ON/OFF the Beep Sound

Turn ON or OFF the beep sound.

When you turn ON the beep sound, beeps will sound in the following cases:

- When the output value reaches the specified value (100%) during auto-step output or sweep output.
- When zero calibration is finished.

*Note*

Beep will always sound when an alarm occurs regardless of the beep sound setting.

**Procedure**

1. Press the **MENU key** three times.
   The display shows the following:

   | on | /bP |

2. Press the lowest digit **pressure setting key** and set ON or OFF.

   | on | /bP |

   **or**

   | oFF | /bP |
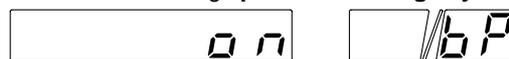
   **Press these keys to set ON or OFF.**

3. When you are done, press the **MENU key**.

# 2.12 Output Monitor and Offset Monitor

## Output Monitor

This monitor indicates the ratio (%) of the output with respect to the specified value.
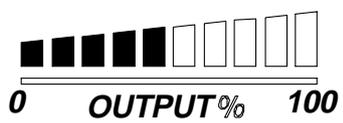
| Display example | Description |
|---|---|
| <br>0　　OUTPUT%　100 | • When n/m is 1/2 during the manual (divider ratio) output mode.<br>• When n/m is at 1/2 during auto-step output mode.<br>• When the output is at 50% in the sweep output mode. |

## Offset Monitor

This monitor indicates the output pressure condition. If the green section is ON, the output is stable.
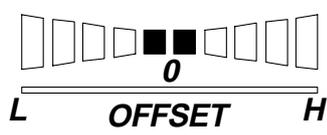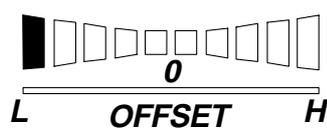
| Display example | Description |
|---|---|
| 0<br>L　OFFSET　H | • The output is stable. |
| 0<br>L　OFFSET　H | • The final output value is lower than the specified value. |
| 0<br>L　OFFSET　H | • The final output value is higher than the specified value. |
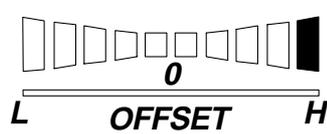
**Note**

Note that the actual pressure output may be delayed with respect to the pressure output that is indicated by the output monitor, offset monitor, or the output from the monitor output terminal (analog output) depending on the piping and load capacity on the output side.

# 3.1    Manual Output (Divider Output)

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Pressure: 20 kPa, divider ratio: set to n=1 and m=1, and then change to n=1 and m=2.

**Output condition**

Output the specified value → Output 1/2 the specified value → Output OFF
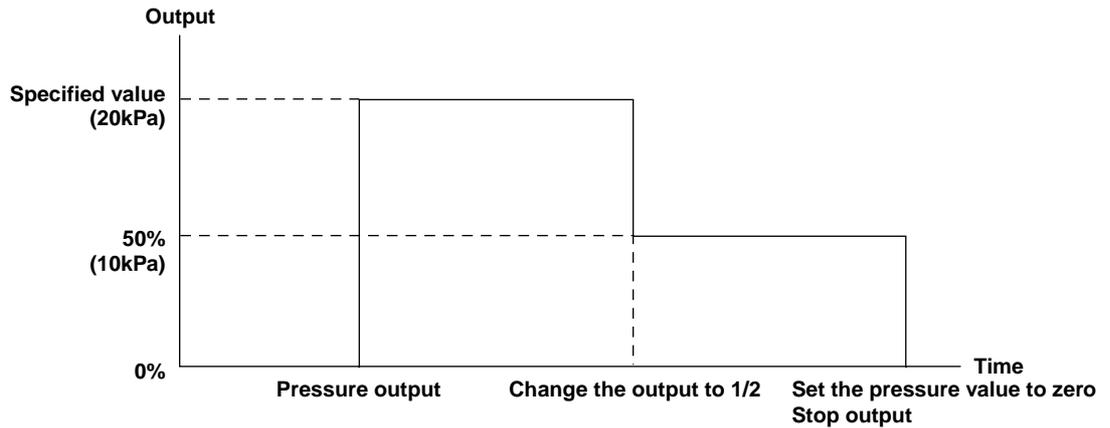


**Output**

Specified value (20kPa)

50% (10kPa)

0%

Pressure output          Change the output to 1/2          Set the pressure value to zero
Stop output

Time

**Procedure**



Set the pressure    Select the unit

Set the divider ratio

Lights when the output is ON
OUTPUT key

Confirm that the LED is OFF

1.    Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
      If any of the LEDs are ON, press the keys to turn them OFF.

2.    Using the **pressure setting keys**, set the pressure to "20."

3.    Press the **UNIT key** to turn ON "kPa."  If the suffix code of the MC100 that you are using is "U1," this step is not necessary.

4.    Using the **divider ratio setting keys**, set n and m to "1."

5.    Turn ON the **OUTPUT key** to start the output.  The LED located above and to the left of the key lights when the output is turned ON.

6.    Set the value m of the divider ratio to "2."  The output pressure drops to 1/2.

7.    Press the **pressure setting keys** or the CLEAR key to set the output pressure to "0."

8.    Press the **pressure setting keys** to set the output pressure to "0."  When the output turns OFF, the OUTPUT indication LED located above and to the left of the key turns OFF.

# 3.2 Auto-Step Output

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, start step: 1/4 the specified value

**Output condition**

Output 1/4 the specified value → output 2/4 the specified value → output 3/4 the specified value → output 4/4 the specified value → output 3/4 the specified value → output 2/4 the specified value → output 1/4 the specified value → output OFF
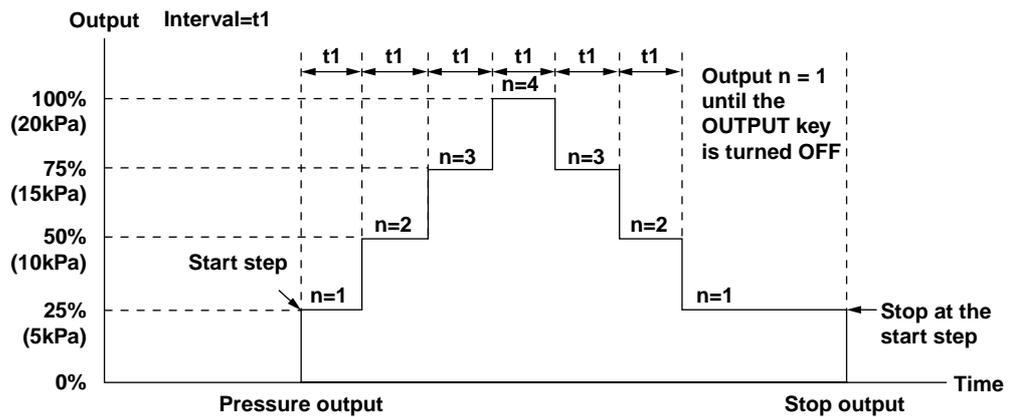
**Procedure**
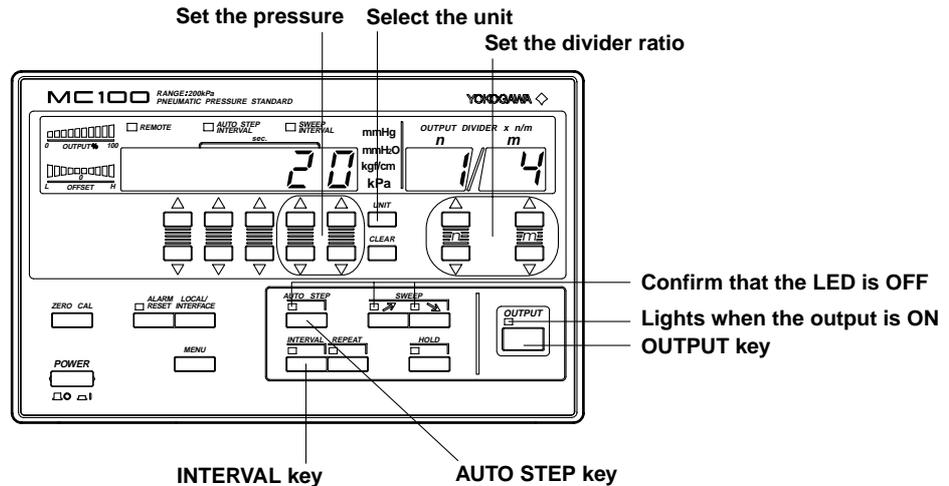
Set the pressure   Select the unit
                   Set the divider ratio



Confirm that the LED is OFF
Lights when the output is ON
OUTPUT key

INTERVAL key         AUTO STEP key

1.  Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and
    falling SWEEP indication LED are OFF.
    If any of the LEDs are ON, press the keys to turn them OFF.
2.  Using the **pressure setting keys**, set the pressure to "20."
3.  Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are
    using is "U1," this step is not necessary.
4.  Using the **divider ratio keys**, set m (number of divisions) to "4" and n (start step) to
    "1."
5.  Press the **INTERVAL key**. The display shows the auto-step output interval.
6.  Press the **pressure setting keys** to set the interval to "60" s. For the procedure on
    setting the interval, see section 2.8, "Setting the Interval" (page 2-13).
7.  Press the **AUTO STEP key** to select the auto-step output mode. The AUTO STEP
    indication LED lights.
8.  Press the **OUTPUT key** to turn ON the output. The LED located above and to the
    left of the key lights when the output is turned ON. The output changes according
    to the example in the figure on the previous page. When the value n returns to the
    minimum value (the start step, 1 in this case), auto-step operation stops. The
    MC100 continues to output the pressure at the minimum level.
9.  Check that the value n is at the minimum value (the start step, 1 in this case) and
    press the **OUTPUT key** to turn OFF the output. When the output turns OFF, the
    LED located above and to the left of the key turns OFF.

*   **The following figure shows the output pattern when the output is repeated
    using the repeat function
    (See section 3.4, "Repeating the Output" (page 3-14).)**



Start step (n=1 in this example)

3

Output Configuration Examples and Operating Procedure
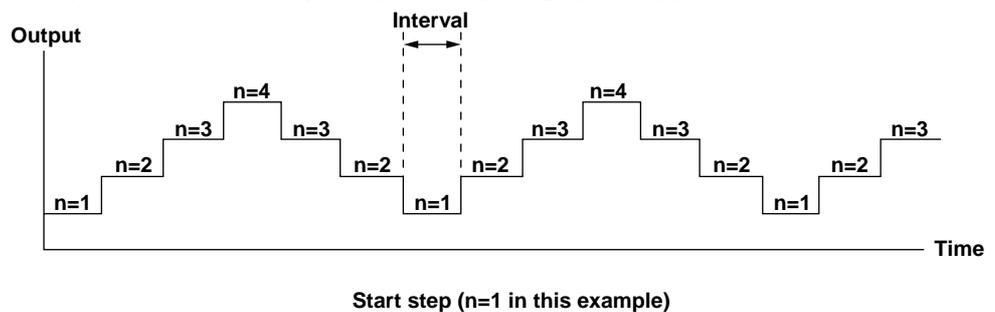
# 3.3 Sweep Output

## Performing the Rising Sweep

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, sweep condition: rising sweep

**Procedure**



1. Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
   If any of the LEDs are ON, press the keys to turn them OFF.
2. Using the **pressure setting keys**, set the pressure to "20."
3. Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are using is "U1," this step is not necessary.
4. Press the **INTERVAL key**. The display shows the sweep interval.
5. Press the **pressure setting keys** to set the sweep interval to "60" s.
   For the procedure on setting the sweep interval, see section 2.8, "Setting the Interval" (page 2-13).
6. Press the **SWEEP ↗ key** to select the rising sweep output mode. The rising sweep indication LED lights.
7. Press the **OUTPUT key** to turn ON the output. The LED located above and to the left of the key lights when the output is turned ON. When the output monitor indicates 100%, the output pressure reaches the specified value (20 kPa in this case). The MC100 continues to output the specified pressure.
8. To turn OFF the output, press the **SWEEP ↘ key** to select the falling sweep mode. The falling sweep indication LED lights.
9. Confirm that the output pressure is zero, and then press the **OUTPUT key** to turn the output OFF. When the output turns OFF, the LED located above and to the left of the key turns OFF.

3

Output Configuration Examples and Operating Procedure

## Performing the Falling Sweep

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, sweep condition: falling sweep with hold period
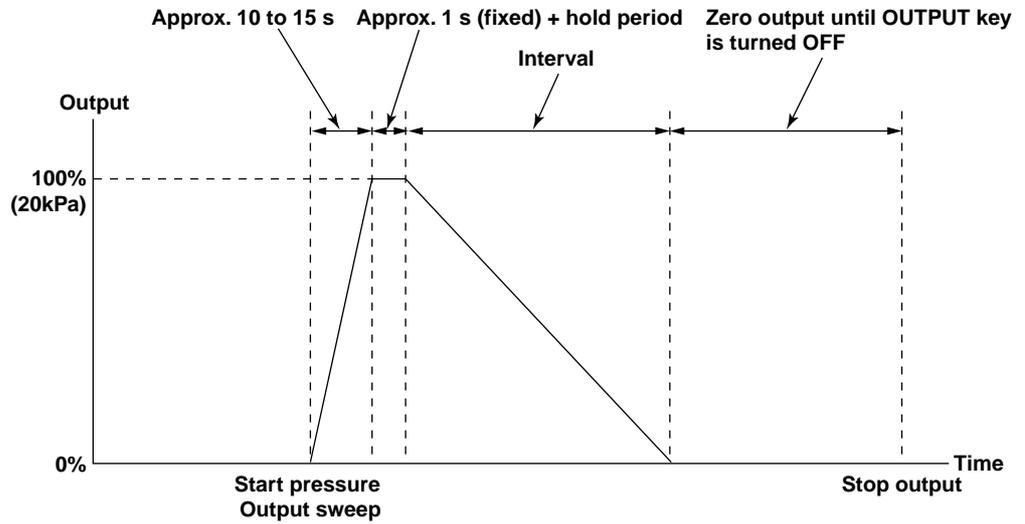
**Procedure**

**Output Monitor   Set the pressure  Select the unit**
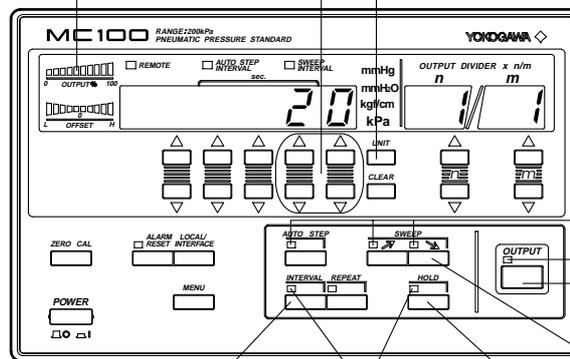


**Confirm that the LED is OFF**
**Lights when the output is ON**
**OUTPUT key**

**INTERVAL key    Lights when turned ON    HOLD key   SWEEP ↘ key**

1.  Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
    If any of the LEDs are ON, press the keys to turn them OFF.
2.  Using the **pressure setting keys**, set the pressure to "20."
3.  Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are using is "U1," this step is not necessary.
4.  Press the **INTERVAL key**. The display shows the sweep interval.
5.  Press the **pressure setting keys** to set the sweep interval to "60" s.
    For the procedure on setting the sweep interval, see section 2.8, "Setting the Interval" (page 2-13).
6.  Press the **SWEEP ↘ key** to select the falling sweep output mode. The falling sweep indication LED lights.
7.  Press the **OUTPUT key** to turn ON the output. The LED located above and to the left of the key lights when the output is turned ON.
8.  Press the **HOLD key** to turn ON the hold function. The LED located above and to the left of the key lights when the hold function is turned ON. For the procedure to hold the output, see section 3.5, "Holding the Output" (page 3-15).
9.  Confirm that the output rises to 100% on the output monitor.
10. Press the **HOLD key** to turn OFF the hold function. When the hold function is turned OFF, the LED located above and to the left of the key turns OFF, and the sweep operation starts. When the output monitor indicates 0%, the output pressure is zero. However, the output operation continues.
11. Confirm that the output pressure is zero, and then press the **OUTPUT key** to turn the output OFF. When the output turns OFF, the LED located above and to the left of the key turns OFF.

*Note*

In some cases during falling sweep output, pressure output may start before reaching 100% of the specified value depending on the size of the load. Therefore, always follow the procedure above.

**3**

**Output Configuration Examples and Operating Procedure**

## Performing Falling Sweep after the Completion of the Rising Sweep

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, sweep condition: rising sweep and falling sweep

**Procedure**

Output Monitor  Set the pressure Select the unit



Confirm that the LED is OFF
Lights when the output is ON
OUTPUT key

Lights when turned ON    INTERVAL key    SWEEP⁄ key   SWEEP key

1. Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
   If any of the LEDs are ON, press the keys to turn them OFF.

2. Using the **pressure setting keys**, set the pressure to "20."

3. Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are using is "U1," this step is not necessary.

4. Press the **INTERVAL key**. The display shows the sweep interval.

5. Press the **pressure setting keys** to set the sweep interval to "60" s.
   For the procedure on setting the sweep interval, see section 2.8, "Setting the Interval" (page 2-13).

6. Press the **SWEEP ⁄ key** to select the rising sweep output mode. The rising sweep indication LED lights.

7. Press the **OUTPUT key** to turn ON the output. The LED located above and to the left of the key lights when the output is turned ON. When the output monitor indicates 100%, the output pressure reaches the specified value (20 kPa in this case). The MC100 continues to output the specified pressure.

8. Press the **SWEEP key** to select the falling sweep output mode. The falling sweep indication LED lights. When the output monitor indicates 0%, the output pressure is zero. However, the output operation continues.

9. Confirm that the output pressure is zero, and then press the **OUTPUT key** to turn the output OFF. When the output turns OFF, the LED located above and to the left of the key turns OFF.

3

Output Configuration Examples and Operating Procedure

### Performing Rising Sweep by Pressing the SWEEP ↗ Key after or during the Falling Sweep Operation

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, sweep condition: rising sweep and falling sweep

**Approx. 1 s fixed**

**Hold state until the OUTPUT key is turned OFF**

**Output**    **Interval**    **Arbitrary period**    **Interval**

**100%**
**(20kPa)**

**0%**    **Time**
**Falling sweep output mode**    **Rising sweep output mode**    **Stop output**
**Pressure output**

**Procedure**

Output Monitor　Set the pressure　Select the unit



Confirm that the LED is OFF
Lights when the output is ON
OUTPUT key

Lights when turned ON　INTERVAL key　SWEEP↗ key　SWEEP↘ key

1. Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
   If any of the LEDs are ON, press the keys to turn them OFF.
2. Using the **pressure setting keys**, set the pressure to "20."
3. Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are using is "U1," this step is not necessary.
4. Press the **INTERVAL key**. The display shows the sweep interval.
5. Press the **pressure setting keys** to set the sweep interval to "60" s.
   For the procedure on setting the sweep interval, see section 2.8, "Setting the Interval" (page 2-13).
6. Press the **SWEEP ↘ key** to select the falling sweep output mode. The falling sweep indication LED lights.
7. Press the **OUTPUT key** to turn ON the output. The LED located above and to the left of the key lights when the output is turned ON. When the output monitor indicates 100%, the output pressure reaches the specified value (20 kPa in this case). The MC100 outputs the specified pressure for approximately 1 s. Then, the MC100 performs falling sweep and the output pressure reaches zero. However, the output operation continues. The output monitor indicates 0% at this point.
8. Press the **SWEEP ↗ key** to select the rising sweep output mode. The rising sweep indication LED lights. When the output monitor indicates 100%, the output pressure reaches the specified value (20 kPa in this case). The MC100 continues to output the specified pressure.
9. To turn OFF the output, press the **SWEEP ↘ key** to select the falling sweep mode. The falling sweep indication LED lights. When the output monitor indicates 0%, the output pressure is zero. However, the output operation continues.
10. Confirm that the output pressure is zero, and then press the **OUTPUT key** to turn the output OFF. When the output turns OFF, the LED located above and to the left of the key turns OFF.

3

Output Configuration Examples and Operating Procedure

**Performing Rising Sweep Repeatedly with the Repeat Function (see section 3.4, "Repeating the Output" (page 3-15)).**

**Example**

The following settings will be used to explain the output procedure.

**Condition**

Maximum pressure: 20 kPa, interval: 60 s, sweep condition: rising sweep and falling sweep, with repeat function

**Procedure**

Set the pressure   Select the unit



Offset Monitor

Confirm that the LED is OFF
Lights when the output is ON
OUTPUT key

INTERVAL key   Lights when turned ON   REPEAT key   SWEEP ⟋ key   SWEEP ⟍ key

1. Confirm that the AUTO STEP indication LED, rising SWEEP indication LED, and falling SWEEP indication LED are OFF.
   If any of the LEDs are ON, press the keys to turn them OFF.

2. Using the **pressure setting keys**, set the pressure to "20."

3. Press the **UNIT key** to turn ON "kPa." If the suffix code of the MC100 that you are using is "U1," this step is not necessary.

4. Press the **INTERVAL key**. The display shows the sweep interval.

5. Press the **pressure setting keys** to set the sweep interval to "60" s.
   For the procedure on setting the sweep interval, see section 2.8, "Setting the Interval" (page 2-13).

6. Press the **SWEEP ⟋ key** to select the rising sweep output mode. The rising sweep indication LED lights.

7. Press the **OUTPUT key** to turn ON the output. The LED located above and to the left of the key lights when the output is turned ON.

8. Press the **REPEAT key** to turn ON the repeat function. The LED located above and to the left of the key lights when the repeat function is turned ON. Repeat function continues until you turn OFF the output. For the procedure to repeat the output, see section 3,4, "Repeating the Output" (page 3-14).

9. To turn OFF the output, press the **REPEAT key** to turn OFF the repeat function.

10. Confirm that the output pressure stabilizes on the offset monitor, and then press the **SWEEP ⟍ key** to select the falling sweep mode. The falling sweep indication LED lights.

11. Confirm that the output pressure is zero, and then press the **OUTPUT key** to turn the output OFF. When the output turns OFF, the LED located above and to the left of the key turns OFF.

*Note*

If you specify and execute the repeat function in the falling sweep mode, the output starts with the falling sweep.

**3**

Output Configuration Examples and Operating Procedure

# 3.4 Repeating the Output

If you use the repeat output function, auto-step and sweep operations can be repeated.

## Setting the Repeat Function

You can specify the repeat function in the following range.

- **During the auto-step output mode (with n = 1 and m = 4)**

**Output**

OUTPUT key: ON

AUTO STEP key: ON

**The REPEAT key is valid in this range.**

- **During the sweep output mode**

**Output**

OUTPUT key: ON

SWEEP key: ON
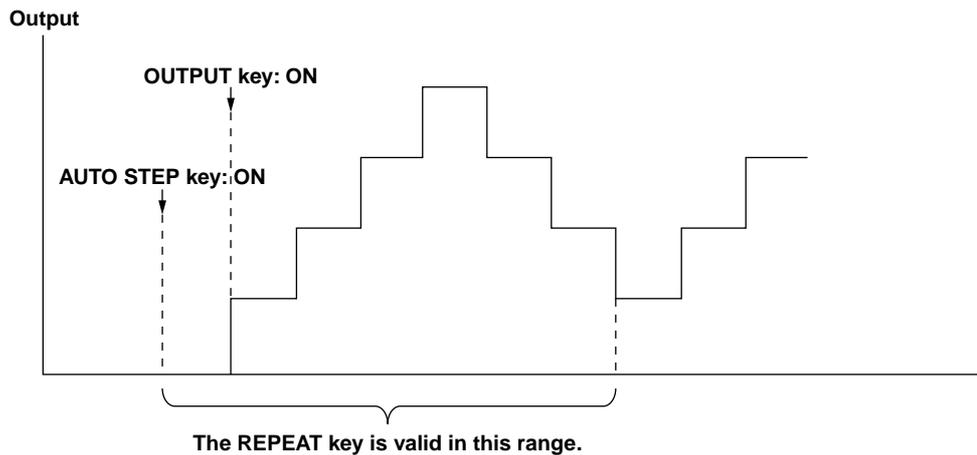
**The REPEAT key is valid in this range.**
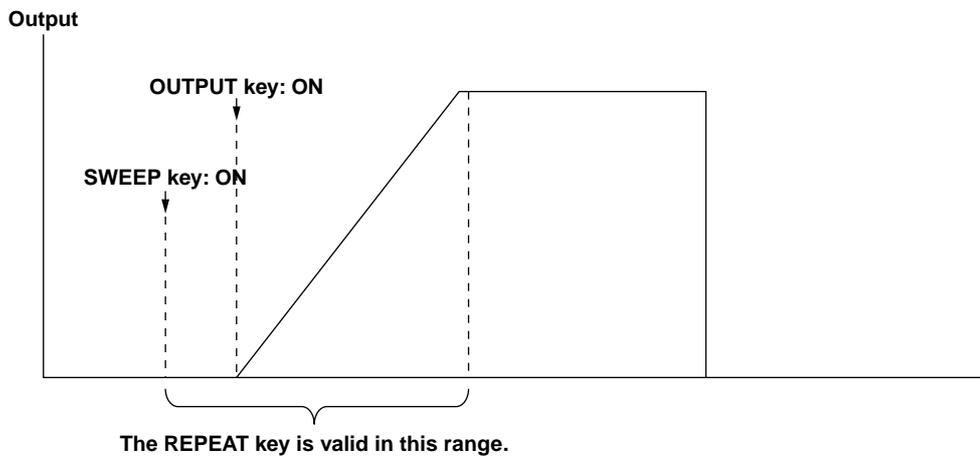
## Releasing the Repeat Function during Output Operation

Press the **REPEAT key** to release the repeat function during output operation.

The output after you press the **REPEAT key** is as follows:

- Auto-step output mode:   Perform the present cycle.
- Sweep output mode:   Perform the sweep up to 100% during the rising sweep, down to 0% during the falling sweep.

# 3.5    Holding the Output

Press **HOLD key** to hold the output during auto-step or sweep operation.
When the output is held, the auto-step or sweep operation is paused and the current pressure is held.
The output period is as follows.

## During the Auto-Step Output Mode

Specified interval=A + B                    Specified interval=AA + BB

B    AA                    BB

Hold ON        Hold OFF

A

Hold OFF

Hold ON
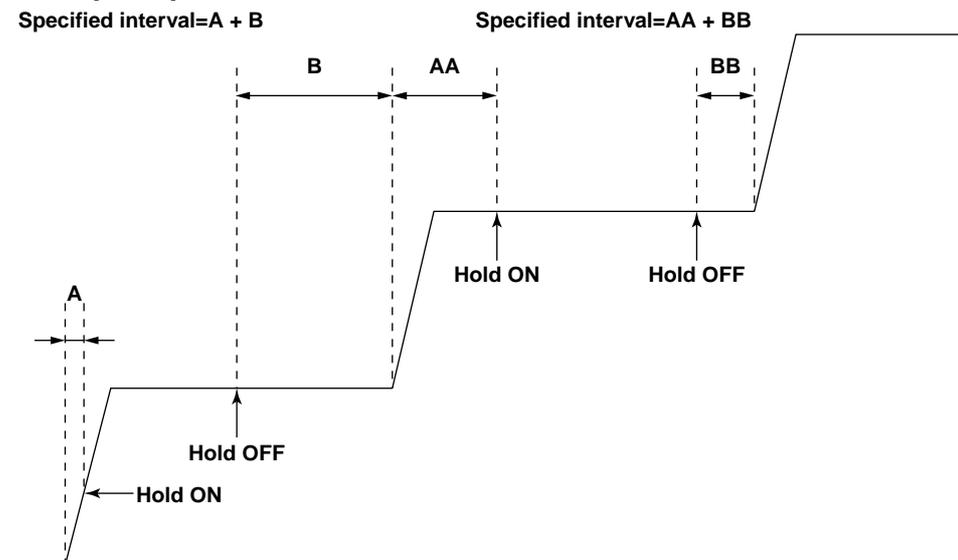
*Note*

If you specify the hold function in the middle of the rising or falling step, the value is held at the next step value.

## During the Sweep Output Mode

Specified interval=A + B          B

A

Hold ON        Hold OFF
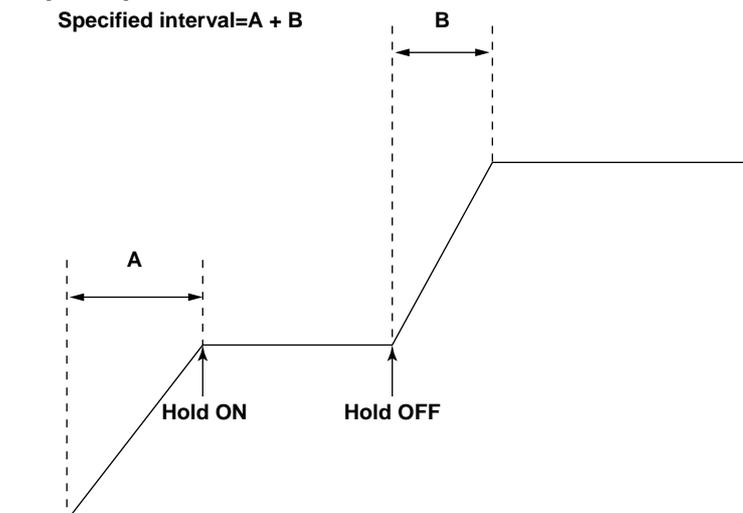
*Note*

It takes several seconds for the pressure to stabilize after the hold function is turned ON.

Output Configuration Examples and Operating Procedure

# 4.1    GP-IB Interface

The GP-IB interface can be used to control the MC100 remotely (using a controller) and output various types of data.

## Functions Available through the GP-IB Interface

| Function | Description |
|---|---|
| Listener function | • Functions available through panel key operation (excludes the power switch operation)<br>• Request to receive setup data<br>• Request to receive panel setting information<br>• Request to receive status |
| Talker function | • Output setup data<br>• Output panel setting information<br>• Output status byte<br>• Output status |

## Listener Function

• The listener function enables remote control of settings that can be accessed through the panel keys, except for the power switch.  It also enables output of setup data in response to a command received from the controller.

• The listener function carries out operations according to the communication command received from the talker when the ATN (Attention) signal line is "False."

• The communication commands used by the MC100 consists of:

Command + Parameter + Terminator

ASCII codes are used to set these commands.

- • Command:    Defined by one or two upper-case alphabet characters.
- • Parameter:    Defined by numerical values (ASCII codes).
- • Terminator:    CR LF
        LF
        EOI
        ; (semicolon)

## Talker Function

• The talker function enables output of setup data, panel setting information, status byte, and status.

## GP-IB Interface Specifications

- Electrical and mechanical specifications: Conforms to IEEE St'd 488-1978
- Functional specifications: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, and C0
- Code: ISO (ASCII) code
- Address setting: Specify the address between 0 and 30.
- Cancel remote mode: Clear remote mode by pressing the **LOCAL/ INTERFACE key** (except when LOCAL LOCKOUT is enabled by the controller).

- **Functional specifications**

| Function | Subset Name | Description |
|---|---|---|
| Source handshaking | SH1 | All transmit handshaking functions available |
| Acceptor handshaking | AH1 | All receive handshaking functions available |
| Talker | T6 | Basic talker functions, serial polling functions, and talker cancellation function through MLA (My Listen Address) available |
| Listener | L4 | Basic listener functions and listener cancel function through MTA (My Talk Address) available |
| Service request | SR1 | All service request functions available |
| Remote local | RL1 | All remote/local functions available |
| Parallel polling | PP0 | No parallel polling functions |
| Device clear | DC1 | All device clear functions available |
| Device trigger | DT1 | All device trigger functions available |
| Controller | C0 | No controller functions |

## Interface Messages that the MC100 Supports

- IFC (Interface Clear)
  Releases talker and listener.
- REN (Remote Enable)
  Transits to the remote mode.
- GTL (Go To Local)
  Transits to the local mode.
- SDC (Selective Device Clear), DCL (Device Clear)
  Sets the panel setting information of the MC100 to the same condition as when the MC100 is powered up.
- GET (Group Execute Trigger)
  Executes the commands that change the output setting (O, S, D, UP, DW, DU, and DD). (Same as command "E")
- LLO (Local Lockout)
  Disables the **LOCAL/INTERFACE key** of the front panel and prohibits transition to the local mode.

## Operation to Switch Remote and Local

Remote mode is active when the REMOTE indication LED is ON. All front panel key operations except the **LOCAL/INTERFACE key** are not available.

To clear the remote mode, press the **LOCAL/INTERFACE key**. The REMOTE indication LED turns OFF and the MC100 enters the local mode. However, if Local Lockout is enabled by the controller, you cannot clear the remote mode using the **LOCAL/INTERFACE key**.

**Setting the Address**

Set the address of the MC100 within the following range:

0 to 30

Each device that can be connected via GP-IB has a unique address within the GP-IB system. This address is used to distinguish the device from others. Therefore, when you connect the MC100 to a PC, for example, make sure to assign a unique address to the MC100.

*Note*

While using the GP-IB, do not change the address of the controller or other devices that are connected to the controller.

**Procedure**

1. Press the **LOCAL/INTERFACE key**.
   The display shows the following:

   ```
   |        1    Ad/GP
   ```

2. Press the pressure setting keys located below the address number to set the address number.
3. Press the **LOCAL/INTERFACE key** to return to the pressure display.

**4**

**Using the Communication Functions**

# 4.2    Serial (RS-232) Interface

The serial interface can be used to control the MC100 remotely (using a controller) and output various types of data.

## Functions Available through the Serial Interface

| Function | Description |
| --- | --- |
| Settings | • Functions available through panel key operation (excludes the power switch operation)<br>• Request to receive setup data<br>• Request to receive panel setting information<br>• Request to receive the status byte<br>• Request to receive status |
| Output | • Output setup data<br>• Output status byte<br>• Output status |

## Serial Interface Specifications

- Electrical characteristics:     Conforms to EIA232 (RS-232)
- Connection:                     Pint-to-point
- Communication:                  Full-duplex
- Synchronization:                Start-stop synchronization
- Baud rate:                      1200, 2400, 4800, 9600
- Start bit:                      1 bit
- Data length (word length):      7 or 8 bits
- Parity:                         Even, odd, or no parity
- Stop bit:                       1 or 2 bits
- Hardware handshaking:           Select whether to fix the CA and CB signals to TRUE or use the signal for flow control
- Software handshaking:           Select whether to use the X-on and X-off signals to control the transmission data.
  X-on (ASCII 11H)
  X-off (ASCII 13H)
- Received buffer length:         256 bytes

## Connection via Serial Interface

When you connect the MC100 to a PC, you must set the MC100 so that the handshaking method, data transfer rate, data format, etc. match those on the PC side.
For details on the settings, see the following pages.  In addition, use an interface cable that meets the specifications of the MC100.

## Connector and Signal Names

**Pins 14 through 25 are not used.**



**1    2    3    4    5  Pin 6 is    7    Pins 8 through 13**
**not used.        are not used.**

**RS-232-C connector: DBSP-JB25S or equivalent.**
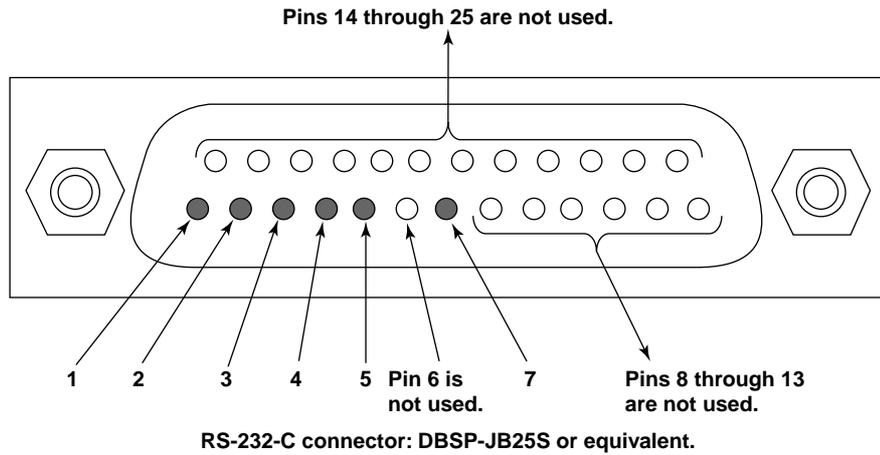
The numbers in the figure indicate pin numbers.

1  AA (GND: Protective Ground):    Grounded to the case.

2  BA (TXD: Transmitted Data):    Transmitted data to the PC.

Signal direction: .................... Output

3  BB (RXD: Received Data):    Received data from the PC.

Signal direction: .................... Input

4  CA (RTS: Request to Send):    Handshaking used to receive data from the PC.

Signal direction: .................... Output

5  CB (CTS: Clear to Send):    Handshaking used to send data to the PC.

Signal direction: .................... Input

7  AB (GND: Signal Ground):    Signal ground.

**Note**

Pins 6 and 8 through 25 are not used.

## Signal Direction

The following figure shows the direction of the signals used by the serial interface of the MC100.
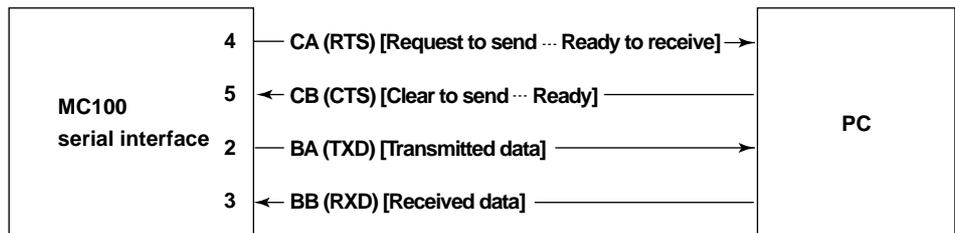
## RS-232 Standard Signals and Their JIS and CCITT Abbreviations

**Signal table**

| Pin No. | Symbol | | | Name |
|---|---|---|---|---|
| (25-pin connector) | RS-232 | CCITT | JIS | |
| 1* | AA (GND) | 101 | FG | Protective ground |
| 7* | AB (GND) | 102 | SG | Signal ground |
| 2* | BA (TXD) | 103 | SD | Transmitted data |
| 3* | BB (RXD) | 104 | RD | Received data |
| 4* | CA (RTS) | 105 | RS | Request to send |
| 5* | CB (CTS) | 106 | CS | Clear to send |
| 6 | CC (CSR) | 107 | DR | Data set ready |
| 20 | CD (DTR) | 108/2 | ER | Data terminal ready |
| 22 | CE (RI) | 125 | CI | Ring indicator |
| 8 | CF (DCD) | 109 | CD | Data channel received carrier detector |
| 21 | CG (-) | 110 | SRS | Data signal quality detector |
| 23 | CH/CI (-) | 111 | SRS | Data signal rate selector |
| 24/15 | DA/DB (TXC) | 113/114 | ST1/ST2 | Transmission signal element timing |
| 17 | DD (RXC) | 115 | RT | Receiver signal element timing |
| 14 | SBA (-) | 118 | BSD | Secondary transmitted data |
| 16 | SBB (-) | 119 | BRD | Secondary received data |
| 19 | SCA (-) | 120 | BRS | Secondary request to send |
| 13 | SCB (-) | 121 | BCS | Secondary clear to send |
| 12 | SCF (-) | 122 | BCD | Secondary received line signal detector |

* Serial (RS-232) interface pins that are used by the MC100.

## Combination of Handshaking Methods

When using the serial interface for transferring data, it is necessary for equipment on both sides to agree on a set of rules to ensure the proper transfer of data. The set of rules is called handshaking. Because there are many handshaking methods that can be used between the MC100 and the PC, one must make sure that the same method is chosen by both the MC100 and the PC.

You can choose any of the four methods shown in the following table through key operation on the MC100.

**Table of Handshaking Methods  (O indicates that it is supported)**

| Mode selection No. (Handshaking method) | Data Transmission Control (Control used to send data to a PC) | | | Data Reception Control (Control used to receive data from a PC) | | |
|---|---|---|---|---|---|---|
| | Software handshaking | Hardware handshaking | | Software handshaking | Hardware handshaking | |
| | Stops transmission when X-off is received. Resume when X-on is received. | Stops transmission when CB (CTS) is false. Resume when it is true. | No handshaking | Send X-off when the received data buffer is 3/4th filled. Send X-on when the received data buffer becomes 1/4th filled. | Set CA (RTS) to False when the received data buffer is 3/4th filled. Set to True when the received data buffer becomes 1/4th filled. | No handshaking |
| 0(OFF-OFF) | | | ○ | | | ○ |
| 1(XON-XON) | ○ | | | ○ | | |
| 2(XON-RTS) | ○ | | | | ○ | |
| 3(CTS-RTS) | | ○ | | | ○ | |

## Description of Each Handshaking Method

- **OFF-OFF**

  **Data transmission control**

  There is no handshaking between the MC100 and the PC. The "X-off" and "X-on" signals are treated as data, and the CB (CTS) signal is ignored.

  **Data reception control**

  There is no handshaking between the MC100 and the PC. When the received buffer becomes full, all overflow data are discarded. Therefore, the PC program must be designed so that the received buffers of both the MC100 and the PC do not become full. The CA (RTS) signal is fixed to True.

- **XON-XON**

  **Data transmission control**

  Software handshaking is performed between the MC100 and the PC. When an "X-off" code is received while sending data to the PC, the instrument stops the data transmission. When it receives the next "X-on" code, it resumes the data transmission. The CB (CTS) signal received from the PC is ignored.

  **Data reception control**

  Software handshaking is performed between the MC100 and the PC. When the free area of the receive buffer decreases to 64 bytes, the MC100 sends an "X-off" code. When the free area increases to 192 bytes, it sends an "X-on" code. The CA (RTS) signal is fixed to True.

- **XON-RTS**

  **Data transmission control**

  Software handshaking is performed between the MC100 and the PC.  When an "X-off' code is received while sending data to the PC, the instrument stops the data transmission.  When it receives the next "X-on" code, it resumes the data transmission.  The CB (CTS) signal received from the PC is ignored.

  **Data reception control**

  Hardware handshaking is performed between the MC100 and the PC.  When the free area of the receive buffer decreases to 64 bytes, the instrument sets "CA (RTS)=False."  When the free area increases to 192 bytes, it sets "CA (RTS)=True."

- **CTS-RTS**

  **Data transmission control**

  Hardware handshaking is performed between the MC100 and the PC.  When the CB (CTS) signal becomes False while sending data to the PC, the instrument stops the data transmission.  When the CB (CTS) signal becomes True, it resumes the data transmission.  The "X-off" and "X-on" signals are treated as data.

  **Data reception control**

  Hardware handshaking is performed between the MC100 and the PC.  When the free area of the receive buffer decreases to 64 bytes, the instrument sets "CA (RTS)=False."  When the free area increases to 192 bytes, it sets "CA (RTS)=True."

## Precautions Regarding Data Receiving Control

When handshaking is used to control the reception of data, data may still be sent from the PC even if the free space in the receive buffer drops below 64 bytes.  In this case, after the receive buffer becomes full, the excess data will be lost, whether or not handshaking is in effect.  Data storage of data resumes when there is free space in the buffer.

|  | 256 bytes | |
|---|---|---|
| **Used** | | **Free, 64 bytes** |
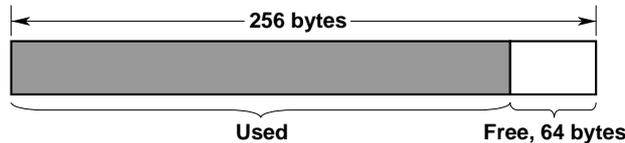
**When handshaking is used, data reception will stop when the free space in the buffer drops to 64 bytes due to the inability to keep up with the data transfer.**

| **Used** | **Free, 192 bytes** |
|---|---|

**After data reception stops, data continue to be passed to the internal program.  When the free space in the buffer increases to 192 bytes, data reception resumes.**

| **Used** |
|---|
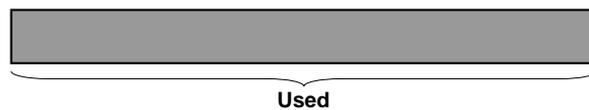
**If the buffer becomes full, data that overflow are discarded regardless of the handshaking.**

**Data Receiving Control through Handshaking**

## Setting the Data Format

The serial interface of the MC100 performs communications using start-stop synchronization. In start-stop synchronization, characters are transmitted one at a time. Each character consists of a start bit, data bits, a parity bit, and a stop bit (see the following figure).
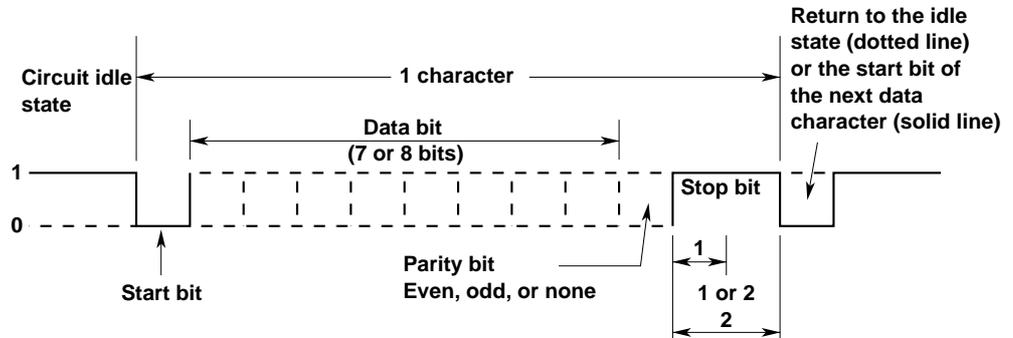


## Setting the Serial Communication

Carry out the following settings when using a PC to set information that can be specified through key operation on the MC100 or when outputting setup data or output value data to the PC.

- **Selecting the handshaking method**

  Select the transmit data control and receive data control from the following.

| Setting | Handshaking Method |
| --- | --- |
| 0 | OFF-OFF |
| 1 | XON-XON |
| 2 | XON-RTS |
| 3 | CTS-RTS |

- **Selecting the data format**

  Select the combination of data length, parity, and stop bit from the following.

| Setting | Data Length | Parity Bit | Stop Bit |
| --- | --- | --- | --- |
| 0 | 8 | None | 1 |
| 1 | 7 | Odd | 1 |
| 2 | 7 | Even | 1 |
| 3 | 7 | None | 2 |

- **Selecting the baud rate**

  Select the baud rate from the following.

  1200

  2400

  4800

  9600

**4**

Using the Communication Functions

**Procedure**

1.  Press the **LOCAL/INTERFACE key**.

**Setting the handshaking method**

2.  The display shows the following:

    | 0 | HA/rS |

3.  Press the lowest digit pressure setting keys to set the handshaking method.
4.  Press the **LOCAL/INTERFACE key**.

**Setting the data format**

5.  The display shows the following:

    | 0 | dF/rS |

6.  Press the lowest digit pressure setting keys to set the data format.
7.  Press the **LOCAL/INTERFACE key**.

**Setting the baud rate**

8.  The display shows the following:

    | 9600 | br/rS |

9.  Press the lowest digit pressure setting keys to set the baud rate.
10. Press the **LOCAL/INTERFACE key**.

# 4.3 Communication Commands

## Commands Common to the GP-IB and Serial Interfaces

| Item | Description | Program Data | Page |
|------|-------------|--------------|------|
| (1) | Set the unit | UNm | 4-12 |
| (2) | Set the output data | Sm, UPm, DWm | 4-12, 4-13 |
| (3) | Set the divider output | Dn/m, DUm, DDm | 4-13, 4-14 |
| (4) | Turn ON/OFF output | Om | 4-14 |
| (5) | Trigger | E, <GET> | 4-14 |
| (6) | Initialize settings | RC | 4-14 |
| (7) | Set auto-step and sweep | RUm | 4-14 |
| (8) | Set the interval | ASm, SWm | 4-15 |
| (9) | Set the repeat function | Mm | 4-15 |
| (10) | Set the hold function | HDm | 4-15 |
| (11) | Set the load capacity | LVm | 4-15 |
| (12) | Setting the monitor output range | DRm | 4-15 |
| (13) | Turn ON/OFF the beep sound | BPm | 4-16 |
| (14) | Output setup data | OS | 4-16 |
| (15) | Output output value data | OD | 4-16 |
| (16) | Output status | OC | 4-16 |
| (17) | Set the terminator of the output data | DLm | 4-17 |
| (18) | Set the header | Hm | 4-17 |
| (19) | Set zero calibration | ZA | 4-17 |
| (20) | Reset the source pressure alarm | AR | 4-17 |
| (21) | Mask the status byte | MSm | 4-17 |

## Command for the Serial Interface (Dedicated)

| Item | Description | Program Data | Page |
|------|-------------|--------------|------|
| (22) | Set remote control | ESC R | 4-18 |
| (23) | Set local control | ESC L | 4-18 |
| (24) | Clear device | ESC C | 4-18 |
| (25) | Output status byte | ESC S | 4-18 |

# 4.4 Description of Commands

The sample programs provided in this section are for explaining the usage of each command. When actually using the program, refer to section 4.5, "Sample Program," and make appropriate alterations to suit your application.

## (1) Set the unit
### UNm

| | |
|---|---|
| **Function** | Selects the desired unit of pressure to be displayed. |
| **Syntax** | UNm<terminator> |

m=0: kgf/cm$^2$ (only for U2)
  2: kPa
  4: mmH$_2$O (only for U2)
  5: mmHg (only for U2)
  6: psi (only for U3)
  7: inH$_2$O (only for U3)
  8: inHg (only for U3)

| | |
|---|---|
| **Description** | The selectable units vary depending on the SUFFIX (suffix code) that you selected at the time of purchase. |

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="UN2" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"UN2"
END
```

## (2) Set the output data
### Sm

| | |
|---|---|
| **Function** | Sets the pressure value. |
| **Syntax** | Sm<terminator> |

When the pressure display unit is kPa (UN2)
m=0.000 to 30.000 (for 767401)
m=0.00 to 240.00 (for 767402)

| | |
|---|---|
| **Description** | • This command is executed by the trigger command, "E" <GET>. |
| | • The value is expressed in floating-point representation. |
| | • For the range of pressure values for pressure display units other than kPa, see section 2.6, "Setting the Pressure Display Unit, Output Pressure, Divider Ratio and Turning ON/OFF the Pressure Output" (page 2-10). |

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="S20.500" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"S20.500"
PRINT #1,"E"
END
```

## UPm

**Function**    Increments the specified output data by each digit.

**Syntax**    UPm<terminator>

m=0: Increments the one's digit value.

  1: Increments the ten's digit value.

  2: Increments the hundred's digit value.

  3: Increments the thousand's digit value.

  4: Increments the ten thousand's digit value.

**Description**    This command is executed by the trigger command, "E" <GET>.

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="UP2" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"UP2"
PRINT #1,"E"
END
```

## DWm

**Function**    Decrements the specified output data by each digit.

**Syntax**    DWm<terminator>

m=0:Decrements the one's digit value.

  1:Decrements the ten's digit value.

  2:Decrements the hundred's digit value.

  3:Decrements the thousand's digit value.

  4:Decrements the ten thousand's digit value.

**Description**    This command is executed by the trigger command, "E" <GET>.

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="DW2" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"DW2"
PRINT #1,"E"
END
```

## (3) Set the divider output

## Dn/m

**Function**    Set the value n/m.

**Syntax**    Dn/m<terminator>

m=1 to 20 (denominator of the divider ratio).

n=0 to m (numerator of the divider ratio)

**Description**    This command is executed by the trigger command, "E" <GET>.

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="D1/2" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"D1/2"
PRINT #1,"E"
END
```

## DUm

**Function**    Increments the value of n or m.

**Syntax**    DUm<terminator>

m= 0: Increments the value of n.

  1: Increments the value of m.

**Description**    This command is executed by the trigger command, "E" <GET>.

**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="DU0" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"DU0"
PRINT #1,"E"
END
```

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**Using the Communication Functions**

### DDm
**Function**     Decrements the value of n or m.
**Syntax**       `DDm<terminator>`
                 `m= 0: Decrements the value of n.`
                 `   1: Decrements the value of m.`
**Description**  This command is executed by the trigger command, "E" `<GET>`.
**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="DD0" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"DD0"
PRINT #1,"E"
END
```

## (4) Turns ON/OFF the output
### Om
**Function**     Turns ON/OFF the output.
**Syntax**       `Om<terminator>`
                 `m=0: Output OFF`
                 `   1: Output ON`
**Description**  This command is executed by the trigger command, "E" `<GET>`.
**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="O1" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"O1"
PRINT #1,"E"
END
```

## (5) Trigger
### E
**Function**     Executes output of data and output ON and OFF.
**Syntax**       `E<terminator>`
                 `<GET>`
**Description**  `<GET>` is valid only for GP-IB.

## (6) Initialize settings
### RC
**Function**     Initializes all setup data of the MC100. However, communication settings are not initialized.
**Syntax**       `RC<terminator>`
**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="RC" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"RC"
END
```

## (7) Set auto-step and sweep
### RUm
**Function**     Sets or stops the auto-step or sweep function.
**Syntax**       `RUm<terminator>`
                 `m=0: Release.`
                 `   1: Set auto-step.`
                 `   2: Set sweep ↗.`
                 `   3: Set sweep ↘.`
**Description**  RU0: Corresponds to turning OFF the AUTO STEP key and SWEEP ↗/↘ keys.
                 RU1: Corresponds to turning ON the AUTO STEP key.
                 RU2: Corresponds to pressing the SWEEP ↗ key.
                 RU3: Corresponds to pressing the SWEEP ↘ key.
**Sample program**

**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="RU1" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"RU1"
END
```

## (8) Set the interval
### ASm
**Function**    Sets the interval for auto-step operation.

**Syntax**    `ASm<terminator>`

    `m=10 to 600 (s)  Resolution of m: 5 s`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="AS100" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"AS100"`
    `END`

### SWm
**Function**    Sets the interval for sweep operation.

**Syntax**    `SWm<terminator>`

    `m=15 to 600 (s)  Resolution of m: 5 s`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="SW200" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"SW200"`
    `END`

## (9) Set the repeat function
### Mm
**Function**    Turns ON/OFF the repeat function.

**Syntax**    `Mm<terminator>`

    `m=0: Repeat the operation.`

    `1: Do not repeat the operation.`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="M0" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"M0"`
    `END`

## (10) Set the hold function
### HDm
**Function**    Turns ON/OFF the hold function.

**Syntax**    `HDm<terminator>`

    `m=0: Hold OFF`

    `1: Hold ON`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="HD1" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"HD1"`
    `END`

## (11) Set the load capacity
### LVm
**Function**    Sets the load capacity.

**Syntax**    `LVm<terminator>`

    `m=0: Small (0 to 100 cc)`

    `1: Middle (100 to 500 cc)`

    `2: Large (500 to 1000 cc)`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="LV0" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"LV0"`
    `END`

## (12) Set the monitor output range
### DRm
**Function**    Sets the monitor output range.

**Syntax**    `DRm<terminator>`

    `m=0: (Low)  10 mV/Full Scale`

    `1: (High) 2 V/Full Scale`

**Sample program**

    **[GP-IB]**

    `DEVICE$="DEV1" CALL IBFIND(DEVICE$,`
    `MC%) CALL IBSIC(MC%)`
    `CMD$="DR0" CALL IBWRT(MC%,CMD$)`
    `END`

    **[Serial]**

    `OPEN "COM1:" AS #1`
    `PRINT #1,"DR0"`
    `END`

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Using the Communication Functions

## (13) Turn ON/OFF the beep sound
### BPm
**Function**   Turns ON/OFF the beep sound.
**Syntax**   BPm<terminator>

      m=0: Beep sound OFF

       1: Beep sound ON

**Sample program**

```
[GP-IB]
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="BP1" CALL IBWRT(MC%,CMD$)
END
[Serial]
OPEN "COM1:" AS #1
PRINT #1,"BP1"
END
```

## (14) Output setup data
### OS
**Function**   Outputs the current panel setup data
      (information).
**Syntax**   OS<terminator>
**Description**   For details on the setup data output format,
      see page App-4.

**Sample program**

```
[GP-IB]
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="OS" CALL IBWRT(MC%,CMD$)
LOOP1
D$=SPACE$(20) CALL IBRD(MC%,D$)
D$=LEFT(D$,IBCNT%-2)
PRINT D$
IF D$<>"END" GOTO LOOP1
END
[Serial]
OPEN "COM1:" AS #1
PRINT #1,"OS"
LOOP1:
INPUT #1;D$
PRINT D$
IF D$<>"END" GOTO LOOP1
END
```

## (15) Output output value data
### OD
**Function**   Outputs the specified output value data.
**Syntax**   OD<terminator>
**Description**   For details on the output format of the
      output value data, see page App-3.

**Output example**

      NMP$a$100.00, 1/1 CRLF

**Sample program**

```
[GP-IB]
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="OD" CALL IBWRT(MC%,CMD$)
CMD$="E" CALL IBWRT(MC%,CMD$)
PRINT D$
END
[Serial]
OPEN "COM1:" AS #1
PRINT #1,"OD"
LINE INPUT #1;D$
PRINT D$
END
```

## (16) Output status
### OC
**Function**   Outputs the current status.
**Syntax**   OC<terminator>(data: 0 to 127)
**Output example**

      STS1=127 CRLF

**Description**   • For details on the status output format,
      see page App-4.

      • The 8-bit binary value is represented in
      decimal notation.

**Sample program**

```
[GP-IB]
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="OC" CALL IBWRT(MC%,CMD$)
D$=SPACE$(20) CALL IBRD(MC%,D$)
D$=LEFT(D$,IBCNT%-2)
PRINT D$
END
[Serial]
OPEN "COM1:" AS #1
PRINT #1,"OC"
LINE INPUT #1;D$
PRINT D$
END
```

## (17) Set the terminator of the output data
### DLm
**Function** Sets the terminator of the output data.
**Syntax** `DLm<terminator>(GP-IB)`
`m=0: CR/LF/EOI`
`   1: LF`
`   2: EOI`
`DLm<terminator>(serial)`
`m=0: CR/LF`
`   1: LF`
`   2: CR`
**Sample program**
**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="DL0" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"DL0"
END
```

## (18) Set the header
### Hm
**Function** Sets whether or not to attach a header to the output data.
**Syntax** `Hm<terminator>`
`m=0: No header`
`   1: Attach header`
**Sample program**
**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="H1" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"H1"
END
```

## (19) Set zero calibration
### ZA
**Function** Performs zero calibration.
**Syntax** `ZA<terminator>`
**Sample program**
**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="ZA" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"ZA"
END
```

## (20) Reset the source pressure alarm
### AR
**Function** If the source pressure alarm is activated due to abnormal source pressure, this command resets the alarm.
**Syntax** `AR<terminator>`
**Sample program**
**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="AR" CALL IBWRT(MC%,CMD$)
END
```
**[Serial]**
```
OPEN "COM1:" AS #1
PRINT #1,"AR"
END
```

## (21) Mask the status byte
### MSm
**Function** Sets the cause of the interrupt of the status byte. The specified cause is activated and an interrupt to be generated.
**Syntax** `MSm<terminator>`
`m = 0 to 29`
**Description** For details on the status byte, see page App-3.
**Sample program**
**[GP-IB]**
```
DEVICE$="DEV1" CALL IBFIND(DEVICE$,
MC%) CALL IBSIC(MC%)
CMD$="MS1" CALL IBWRT(MC%,CMD$)
CMD$="O0E" CALL IBWRT(MC%,CMD$)
POLL 1,B CALL IBRSP(MC%,B%)
CMD$="O1E" CALL IBWRT(MC%,CMD$)
LOOP1
POLL 1,B CALL IBRSP(MC%,B5)
PRINT B%
IF (B% AND &H40)=0 GOTO LOOP1
END
```
**[Serial]**
```
OPEN "COM:" AS #1
PRINT #1,"MS1"
PRINT #1,"O0E"
PRINT #1,CHR$(&H1B)+"S"
INPUT #1,D$
PRINT #1,"O1E"
LOOP1
PRINT #1,CHR$(&H1B)+"S"
INPUT #1,D$
PRINT D$
IF (VAL(MID$(D$,6))AND &H40)=0 GOTO
LOOP1
END
```

## (22) Set remote control (for serial only)
### ESC R

| | |
|---|---|
| **Function** | Enables the MC100 to be remotely controlled via serial communications. Once in the remote mode, panel key operations are not allowed. |
| **Syntax** | `ESC R<terminator>` |
| **Description** | • ESC=1BH in the ASCII character code set. |
| | • For details on the ASCII character codes, see page App-2. |

## (23) Set local control (for serial only)
### ESC L

| | |
|---|---|
| **Function** | Sets the MC100 to the local mode from the remote mode via serial communications. Panel key operations are possible in the local mode. |
| **Syntax** | `ESC L<terminator>` |
| **Description** | • ESC=1BH in the ASCII character code set. |
| | • For details on the ASCII character codes, see page App-2. |

## (24) Clear device (for serial only)
### ESC C

| | |
|---|---|
| **Function** | Sets the panel setting information of the MC100 to the same condition as when the MC100 is powered up. |
| **Syntax** | `ESC C<terminator>` |
| **Description** | • ESC=1BH in the ASCII character code set. |
| | • For details on the ASCII character codes, see page App-2. |

## (25) Output status byte
### ESC S

| | |
|---|---|
| **Function** | Outputs the status byte (for serial communications). |
| **Syntax** | `ESC S<terminator>` |
| **Output example** | `STS0=125CRLF (for serial communications)` |
| **Description** | • ESC=1BH in the ASCII character code set. |
| | • For details on the ASCII character codes, see page App-2. |
| | • For details on the status byte, see page App-4. |

# 4.5 Sample Program

### Environment

Model: MS-DOS computer equipped with AT-GPIB/TNT IEEE-488.2 board from National Instruments.

Language: Quick BASIC

### Sample 1

- **GP-IB**

```
'****************************************************************************
'*                                                                         *
'*  MC100 Sample Program1 for GP-IB interface                              *
'*                              Microsoft QuickBASIC 4.0/4.5 Version        *
'*                                                                         *
'****************************************************************************
'*                                                                         *
'*  Set the pressure to 200.00 kPa, divider ratio to 1/1, and turn ON the  *
'*  output.  Then, read and display the setup data.  When a key is pressed, *
'*  the pressure is set to zero and the output is stopped.  (Before         *
'*  executing the following program, allow at least five minutes of warm-up *
'*  after turning ON the power and perform zero calibration by pressing the *
'*  ZERO CAL key.)                                                          *
'*                                                                         *
'****************************************************************************
'
REM $INCLUDE: 'qbdecl.bas'
'
'/*  Initialize GP-IB  */
'
BORD$ = "GPIB0": CALL IBFIND(BORD$, BD%)
CALL IBSIC(BD%)
DEVICE$ = "DEV1": CALL IBFIND(DEVICE$, MC%)
CALL IBSIC(MC%)
V% = 1: CALL IBSRE(BD%, V%)                      ' Set to remote mode
'
'
'/*  Set the MC100  */
'
CMD$ = "S200": CALL IBWRT(MC%, CMD$)             ' Pressure: 200.00 kPa
CMD$ = "D1/1": CALL IBWRT(MC%, CMD$)             ' Divider ratio: 1/1
CMD$ = "O1E" : CALL IBWRT(MC%, CMD$)             ' Output: on
'
'
'/*  Read setup data  */
'
CMD$ = "OD" : CALL IBWRT(MC%, CMD$)              ' Output setup data
D$ = SPACE$(20)
CALL IBRD(MC%, D$)
PRINT LEFT$(D$, IBCNT% - 2)
'
'
'/*  Determine output stop  */
'
PRINT "Press a key to abort."
WHILE (INKEY$="")
WEND
```

```
CMD$ = "S0E" : CALL IBWRT(MC%, CMD$)              ' Pressure: 0 kPa
'
FOR I = 1 TO 5000                                 ' Wait period (enough time for the
output pressure to drop to 0 kPa)
    FOR J = 1 TO 1000
    NEXT J
NEXT I
'
CMD$ = "O0E" : CALL IBWRT(MC%, CMD$)              ' Output: off
'
'
'/*  Terminate GP-IB  */
'
V% = 0: CALL IBSRE(BD%, V%)                        ' Set to local mode
'
'
END
```

- **Serial (RS-232)**

```
'************************************************************************
'*                                                                      *
'*  MC100 Sample Program1 for RS-232 interface                          *
'*                             Microsoft QuickBASIC 4.0/4.5 Version      *
'*                                                                      *
'*        Rate:9600 Parity:None CHR:8 STOPBIT:1 XON/XON Term:CR+LF       *
'*                                                                      *
'************************************************************************
'
'/*  Initialize RS-232  */
'
OPEN "COM1:9600,N,8,1,ASC,CS0,DS0,LF" FOR RANDOM AS #1
'
'
'/*  Set the MC100  */
'
PRINT #1, CHR$(&H1B)+"R"                          ' Set to remote mode
'
'
PRINT #1, "S200"                                  ' Pressure: 200.00 kPa
PRINT #1, "D1/1"                                  ' Divider ratio: 1/1
PRINT #1, "O1E"                                   ' Output: on
'
'
'/*  Read setup data  */
'
PRINT #1, "OD"                                    ' Output setup data
LINE INPUT #1, D$
PRINT D$
'
'
'/*  Determine output stop  */
'
PRINT "Press a key to abort."
WHILE (INKEY$="")
WEND
PRINT #1, "S0E"                                   ' Pressure: 0 kPa
'
FOR I = 1 TO 5000                                 ' Wait period
    FOR J = 1 TO 1000
    NEXT J
NEXT I
'
PRINT #1, "O0E"                                   ' Output: off
'
'
'/*  Terminate RS-232  */
'
PRINT #1, CHR$(&H1B)+"L"                          ' Set to local mode
CLOSE #1
'
'
END
```

**4**

**Using the Communication Functions**

# 5.1    Troubleshooting

## Items to Check when Problems Occur

If the MC100 is not operating correctly after performing the following corrective actions, the corrective action indicates "Servicing required," or other problems are detected, contact your nearest YOKOGAWA dealer as listed on the back cover of this manual.

| Symptom | Items to Check | Page |
|---|---|---|
| Nothing shows up on the display when the power switch is turned ON. | • Is the main power switch turned ON? | 2-5 |
| The output pressure value is not correct. | • Are the ambient temperature and humidity within the allowed ranges? | 2-2, 6-2 |
| | • Are the connections correct? | 2-8 |
| Cannot operate the keys. | • Is "REMOTE" showing on the upper left corner of the display? | 4-2 |
| Cannot configure or control the MC100 via the GP-IB interface. | • Is the GP-IB address of the MC100 written in the program match the GP-IB address specified on the MC100? | 4-3 |
| | • Are the electrical and mechanical specifications of the IEEE Standard 488-1978 satisfied? | 4-2 |
| Cannot configure or control the MC100 via the serial interface. | • Are the communication specifications between the MC100 and controller matched? | 4-4 |

## Error Code Description and Corrective Actions

| Error No. | Error Description | Cause of the Error | Corrective Action |
|---|---|---|---|
| 05 | Output operation error | • Pressed the ZERO CAL key while outputting pressure.<br>• Pressed the OUTPUT key during zero calibration.<br>• Executed auto-step operation with the pressure set to 0 or with the divider ratio set to n = m.<br>• Executed sweep operation with the pressure set to 0. | |
| 08 | Abnormal source pressure (too small) | The source pressure is too small. | Apply a prescribed source pressure and press the ALARM RESET key. |
| 09 | Abnormal source pressure (too large) | The source pressure is too large. | Apply a prescribed source pressure and press the ALARM RESET key. |
| 11 | Communication command error | Received a command that is not used by the MC100. | Check that the command you sent is correct. |
| 12 | Parameter error | Specified a parameter outside the allowed range. | Correct the value so that the parameter is within the allowed range. |
| 17 | Zero calibration error | Pressed the ZERO CAL key when the standard pressure is off by a great amount with respect to the initial value. | Remove the residual pressure of the load and try again. |
| 60* | Setup data backup error (other than communi-cation settings) | The panel setting information other than communication settings is corrupt. | The panel setting information other than communication settings will be reset. |
| 61* | Setup data backup error (communication settings) | Communication settings are corrupt. | The communication settings will be reset. |
| 70 | Motor error | The driving section of the pressure output is abnormal. | Servicing required. |
| 71 | Motor error | The driving section of the pressure output is abnormal. | Servicing required. |
| 72 | Motor error | The driving section of the pressure output is abnormal. | Servicing required. |
| 73 | Motor error | The driving section of the pressure output is abnormal. | Servicing required. |
| 83* | EEPROM error (pressure control value) | EEPROM contents (pressure control value) are corrupt. | Servicing required. |
| 84* | EEPROM error (monitor output calibration value) | EEPROM contents (monitor output calibration value) are corrupt. | Servicing required. |

| Error No. | Error Description | Cause of the Error | Corrective Action |
| --- | --- | --- | --- |
| 90 | Output pressure detection error | The output pressure detection section is abnormal. | Servicing required. |
| 91 | Output pressure detection error | The output pressure detection section is abnormal. | Servicing required. |
| 92 | Output pressure detection error | The output pressure detection section is abnormal. | Servicing required. |
| 93 | Output pressure detection error | The output pressure detection section is abnormal. | Servicing required. |
| 94 | Output pressure detection error | The output pressure detection section is abnormal. | Servicing required. |
| 95 | Hardware error | The hardware is abnormal. | Servicing required. |
| 96 | Hardware error | The hardware is abnormal. | Servicing required. |
| 97 | Hardware error | The hardware is abnormal. | Servicing required. |
| 98 | Hardware error | The hardware is abnormal. | Servicing required. |
| 99 | Hardware error | The hardware is abnormal. | Servicing required. |

\* If an error appears during power up, the error remains displayed until a key is pressed.

# 5.2 Storing the MC100 and Replacing the Fuse

## Storage

When storing the MC100, avoid the following locations:

- Where the humidity is high.
- In direct sunlight or in a hot place.
- Near heat sources
- Where mechanical vibration is high.
- In a place filled with dirt, dust, salt, and corrosive gases.

## Replacing the Fuse

⚠

### WARNING

- To prevent the possibility of fire, always use a fuse with the specified rating.
- Never use the MC100 with the fuse holder shorted.

- **Location of the fuse**

  The fuse is attached to the fuse holder located to the right of the power connector on the rear panel.
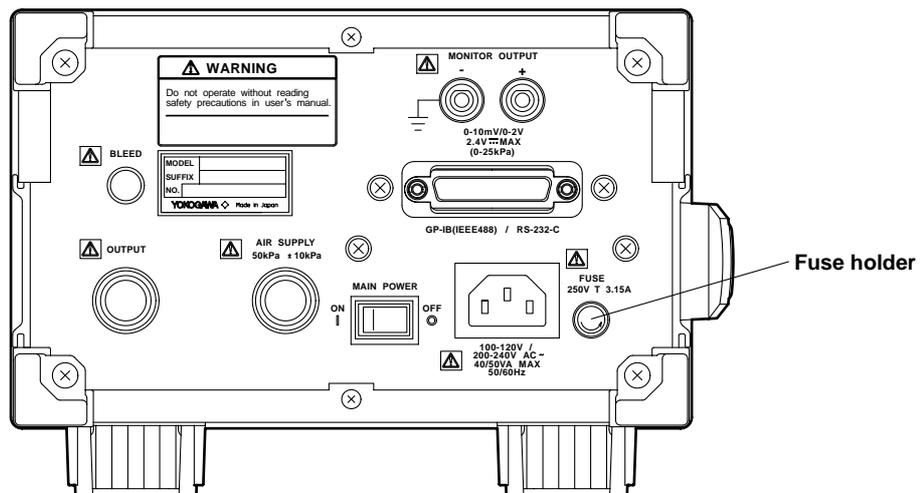


- **Fuse rating**

  Rated voltage     Time lag fuse rated for 250 V and 3.15 A.
                    (Order part number: A1113EF)

- **Procedure for replacing the fuse**

  **1.** Turn OFF the main power switch and the power switch.
  **2.** Remove the power cord from the outlet and inlet.
  **3.** Remove the fuse holder cap and replace with the spare fuse provided.

# 5.3 Calibration

We recommend that you calibrate the MC100 once every six months to assure its measurement accuracy over a long period of time.
To have your MC100 calibrated, contact your nearest YOKOGAWA dealer as listed on the back cover of this manual.

## 5.4    Recommended Replacement Parts

The one-year warranty applies only to the main unit of the instrument (starting from the day of delivery) and does not cover any other items nor expendable items (items which wear out).  We recommend periodic replacement so that you will be able to use the MC100 for a long period of time.  Contact your nearest YOKOGAWA dealer for replacement parts.

| Parts Name | Part Number | Replacement Period |
|---|---|---|
| Motor Assembly | B9984EP | Approx. 2000 hours at normal use |

# 6.1    Specifications

| Model | 767401 | 767402 |
|---|---|---|
| Source pressure[1] | 50±10 kPa | 280±20 kPa |
| Maximum source pressure | 100 kPa | 500 kPa |
| Pressure output range[2] | 0 to 25.000 kPa | 0 to 200.00 kPa |
| Minimum resolution | 0.001 kPa | 0.01 kPa |
| Accuracy (at reference test conditions[3]) | Including calibration accuracy:     ±0.05% of full scale<br>Excluding calibration accuracy:     ±0.045% of full scale | |
| Output noise | ±0.02% of full scale | |
| Pressure display unit | Select from the following at the time of purchase:<br>kPa<br>kPa, kgf/cm$^2$, mmHg, mmH$_2$O<br>kPa, psi, inHg, inH$_2$O | |
| Output settings<br>  Manual (divider ratio)<br>  output<br>  Auto-step output<br>    Interval<br>    Repetition<br>  Sweep output<br><br><br>    Interval<br>    Repetition | 4.5-digit setting<br>Outputs a pressure equal to the specified value x n/m (n = 0 to m, m = 1 to 20), where n/m is less than or equal to 100%.<br>Outputs manual (divider ratio) output using a specified step pattern.<br>10 s to 600 s (10 minutes) at 5-s increments.<br>Once or infinite number of times (can be stopped)<br>Outputs pressure in a increasing and decreasing linear fashion between 0% and 100% of the specified pressure over the specified interval.<br>(no load condition (10 cc or less))<br>15 s to 600 s (10 minutes) at 5 s intervals.<br>Once or infinite number of times (can be stopped) | |
| Output monitor | Displays 0% to 100% with respect to the specified value on a 10-segment LED bar graph.<br>Sounds the buzzer when the output value reaches the specified value (100%) during auto-step output or sweep output. | |
| Offset monitor | Indicates the deviation from the final value. | |
| Temperature coefficient<br>  Zero drift<br>  Sensitivity | <br>±0.003% of full scale/°C[4]<br>±0.002% of full scale/°C[4] | |
| Tilt sensitivity | Front and back 90: ±0.1% of full scale[4]<br>Left and right 30: ±2.5% of full scale[4] | Front and back 90: ±0.01% of full scale[4]<br>Left and right 30: ±0.2% of full scale[4] |
| Communication interface | Select GP-IB or serial at the time of purchase. | |

[1]  Use a filtered reducing valve for the source pressure and provide stable pressure.
[2]  Can output up to 120%, but the accuracy is not guaranteed.
[3]  Reference test conditions:  Ambient temperature: 23±3°C.  Use a source pressure through a filtered reducing valve.  Dry supply air at 23°C.
[4]  Full scale: Indicates the pressure output range.

**6**

**Specifications**

- **General Specifications**

| | |
|---|---|
| Composition: | Pressure setting section, servo valve, and pressure sensor, all in a single unit |
| Operating principle: | Uses a needle valve type servo valve |
| Pressure sensor: | Silicon resonant sensor |
| Source pressure: | Dry air at 5 to 40°C with minimal temperature fluctuation |
| Input/Output connection: | Select Rc1/4 or NPT1/4 internal thread (provided on the rear panel) at the time of purchase |
| Output response time: | Approx. 5 s (time it takes for the output to settle within ±0.1% of full scale) under no-load condition (10 cc or less) for any single 20% to 25% divider output step |
| Monitor output: | Allows monitoring of the output condition through voltage output (up to the maximum specified output) 0 to 10 mV/full scale or 0 to 2 V/full scale |
| Calibration interval: | Approx. 6 months |
| Air consumption: | Approx. 30 l/min (when using source pressure that meets the specifications) |
| Pressure value display: | 7-segment LED (4.5 digits, character height: approx. 15 mm) |
| Error indication: | ALARM indication at low or excessive source pressure |
| Operating environment: | Temperature      5 to 40°C |
| | Humidity           20 to 80%RH, no condensation |
| Warm-up time: | Approx. 5 minutes |
| Rated supply voltage range: | 100-120 VAC/200-240 VAC |
| Permitted supply voltage range: | 90 to 132 VAC/180 to 264 VAC |
| Rated supply voltage frequency: | 50/60 Hz |
| Permitted supply voltage frequency range: | |
| | 47 to 63 Hz |
| Withstand voltage: | 1,500 VAC at 50/60 Hz for one minute (between the AC power supply and case) |
| Insulation Resistance: | 100 MΩ or more at 500 VDC (between the AC power supply and case) |
| Power consumption: | 100-120 VAC 40 VA MAX/200-240 VAC 50 VA MAX |
| External dimensions: | Approx. 132 x 213 x 400 mm (projections excluded) |
| Weight: | Approx. 9.5 kg |
| Standard Accessories: | Power cord (1), rubber feet for the hind feet (2), power fuse (2), joint connector (2), and User's Manual (this manual, 1) |

## 6.2    Dimensional Drawings

Unit: mm

**Rear view**

13    213    27    400

132

21
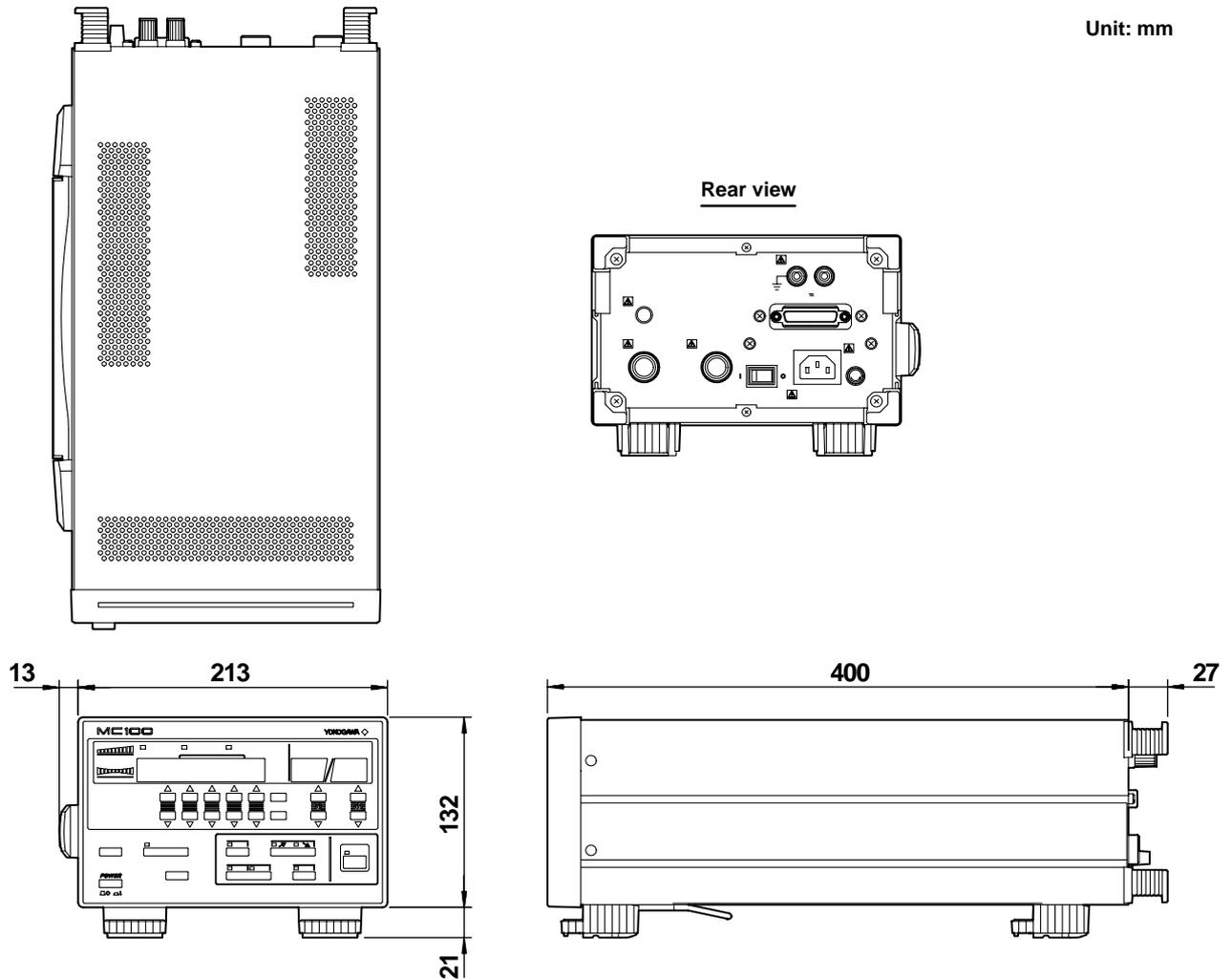
**If not specified, the tolerance is ±3%.  However, in cases of less than 10 mm, the tolerance is ±0.3%.**

6

Specifications

# Appendix 1   Calibrating a Pneumatic Industrial Instrument

## Calibrating a Pressure Transmitter

The model varies depending on the pressure range.

| Pressure Range | Pressure standard |
|---|---|
| 0 to 25 kPa | 767401 |
| 25 kPa to 200 kPa | 767402 |

The following figure shows a calibration example of a pneumatic differential transmitter.

**Calibration of a pneumatic differential pressure transmitter**

**Calibration of an electronic differential pressure transmitter**

**App**
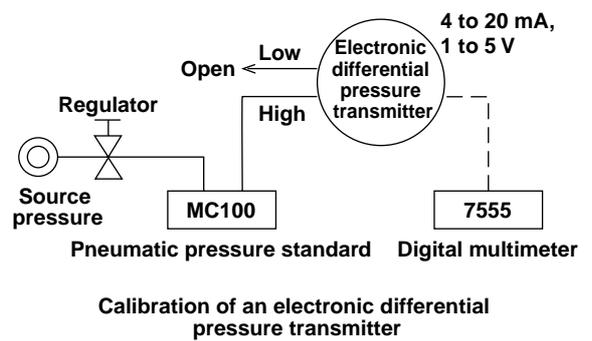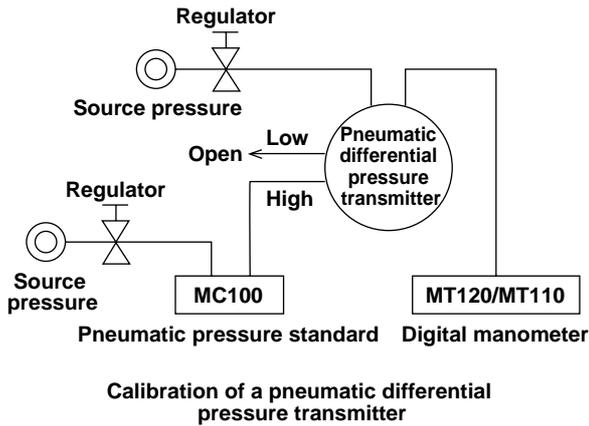
**Appendix**

The following table shows the ASCII character codes.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **0** | NUL (oct 0, hex 0, dec 0) | DEL (oct 20, hex 10, dec 16) | SP (oct 40, GP-IB 0, hex 20, dec 32) | 0 (oct 60, GP-IB 16, hex 30, dec 48) | @ (oct 100, GP-IB 0, hex 40, dec 64) | P (oct 120, GP-IB 16, hex 50, dec 80) | ' (oct 140, GP-IB 0, hex 60, dec 96) | p (oct 160, GP-IB 16, hex 70, dec 112) |
| **1** | SOH (oct 1, GTL, hex 1, dec 1) | DC1 (oct 21, LLO, hex 11, dec 17) | ! (oct 41, GP-IB 1, hex 21, dec 33) | 1 (oct 61, GP-IB 17, hex 31, dec 49) | A (oct 101, GP-IB 1, hex 41, dec 65) | Q (oct 121, GP-IB 17, hex 51, dec 81) | a (oct 141, GP-IB 1, hex 61, dec 97) | q (oct 161, GP-IB 17, hex 71, dec 113) |
| **2** | STX (oct 2, hex 2, dec 2) | DC2 (oct 22, hex 12, dec 18) | " (oct 42, GP-IB 2, hex 22, dec 34) | 2 (oct 62, GP-IB 18, hex 32, dec 50) | B (oct 102, GP-IB 2, hex 42, dec 66) | R (oct 122, GP-IB 18, hex 52, dec 82) | b (oct 142, GP-IB 2, hex 62, dec 98) | r (oct 162, GP-IB 18, hex 72, dec 114) |
| **3** | ETX (oct 3, hex 3, dec 3) | DC3 (oct 23, hex 13, dec 19) | # (oct 43, GP-IB 3, hex 23, dec 35) | 3 (oct 63, GP-IB 19, hex 33, dec 51) | C (oct 103, GP-IB 3, hex 43, dec 67) | S (oct 123, GP-IB 19, hex 53, dec 83) | c (oct 143, GP-IB 3, hex 63, dec 99) | s (oct 163, GP-IB 19, hex 73, dec 115) |
| **4** | EOT (oct 4, SDC, hex 4, dec 4) | DC4 (oct 24, DCL, hex 14, dec 20) | $ (oct 44, GP-IB 4, hex 24, dec 36) | 4 (oct 64, GP-IB 20, hex 34, dec 52) | D (oct 104, GP-IB 4, hex 44, dec 68) | T (oct 124, GP-IB 20, hex 54, dec 84) | d (oct 144, GP-IB 4, hex 64, dec 100) | t (oct 164, GP-IB 20, hex 74, dec 116) |
| **5** | ENQ (oct 5, PPC, hex 5, dec 5) | NAK (oct 25, PPU, hex 15, dec 21) | % (oct 45, GP-IB 5, hex 25, dec 37) | 5 (oct 65, GP-IB 21, hex 35, dec 53) | E (oct 105, GP-IB 5, hex 45, dec 69) | U (oct 125, GP-IB 21, hex 55, dec 85) | e (oct 145, GP-IB 5, hex 65, dec 101) | u (oct 165, GP-IB 21, hex 75, dec 117) |
| **6** | ACK (oct 6, hex 6, dec 6) | SYN (oct 26, hex 16, dec 22) | & (oct 46, GP-IB 6, hex 26, dec 38) | 6 (oct 66, GP-IB 22, hex 36, dec 54) | F (oct 106, GP-IB 6, hex 46, dec 70) | V (oct 126, GP-IB 22, hex 56, dec 86) | f (oct 146, GP-IB 6, hex 66, dec 102) | v (oct 166, GP-IB 22, hex 76, dec 118) |
| **7** | BEL (oct 7, hex 7, dec 7) | ETB (oct 27, hex 17, dec 23) | ' (oct 47, GP-IB 7, hex 27, dec 39) | 7 (oct 67, GP-IB 23, hex 37, dec 55) | G (oct 107, GP-IB 7, hex 47, dec 71) | W (oct 127, GP-IB 23, hex 57, dec 87) | g (oct 147, GP-IB 7, hex 67, dec 103) | w (oct 167, GP-IB 23, hex 77, dec 119) |
| **8** | BS (oct 10, GET, hex 8, dec 8) | CAN (oct 30, SPE, hex 18, dec 24) | ( (oct 50, GP-IB 8, hex 28, dec 40) | 8 (oct 70, GP-IB 24, hex 38, dec 56) | H (oct 110, GP-IB 8, hex 48, dec 72) | X (oct 130, GP-IB 24, hex 58, dec 88) | h (oct 150, GP-IB 8, hex 68, dec 104) | x (oct 170, GP-IB 24, hex 78, dec 120) |
| **9** | HT (oct 11, TCT, hex 9, dec 9) | EM (oct 31, SPD, hex 19, dec 25) | ) (oct 51, GP-IB 9, hex 29, dec 41) | 9 (oct 71, GP-IB 25, hex 39, dec 57) | I (oct 111, GP-IB 9, hex 49, dec 73) | Y (oct 131, GP-IB 25, hex 59, dec 89) | i (oct 151, GP-IB 9, hex 69, dec 105) | y (oct 171, GP-IB 25, hex 79, dec 121) |
| **A** | LF (oct 12, hex A, dec 10) | SUB (oct 32, hex 1A, dec 26) | * (oct 52, GP-IB 10, hex 2A, dec 42) | : (oct 72, GP-IB 26, hex 3A, dec 58) | J (oct 112, GP-IB 10, hex 4A, dec 74) | Z (oct 132, GP-IB 26, hex 5A, dec 90) | j (oct 152, GP-IB 10, hex 6A, dec 106) | z (oct 172, GP-IB 26, hex 7A, dec 122) |
| **B** | VT (oct 13, hex B, dec 11) | ESC (oct 33, hex 1B, dec 27) | + (oct 53, GP-IB 11, hex 2B, dec 43) | ; (oct 73, GP-IB 27, hex 3B, dec 59) | K (oct 113, GP-IB 11, hex 4B, dec 75) | [ (oct 133, GP-IB 27, hex 5B, dec 91) | k (oct 153, GP-IB 11, hex 6B, dec 107) | { (oct 173, GP-IB 27, hex 7B, dec 123) |
| **C** | FF (oct 14, hex C, dec 12) | FS (oct 34, hex 1C, dec 28) | , (oct 54, GP-IB 12, hex 2C, dec 44) | < (oct 74, GP-IB 28, hex 3C, dec 60) | L (oct 114, GP-IB 12, hex 4C, dec 76) | \ (oct 134, GP-IB 28, hex 5C, dec 92) | l (oct 154, GP-IB 12, hex 6C, dec 108) | \| (oct 174, GP-IB 28, hex 7C, dec 124) |
| **D** | CR (oct 15, hex D, dec 13) | GS (oct 35, hex 1D, dec 29) | - (oct 55, GP-IB 13, hex 2D, dec 45) | = (oct 75, GP-IB 29, hex 3D, dec 61) | M (oct 115, GP-IB 13, hex 4D, dec 77) | ] (oct 135, GP-IB 29, hex 5D, dec 93) | m (oct 155, GP-IB 13, hex 6D, dec 109) | } (oct 175, GP-IB 29, hex 7D, dec 125) |
| **E** | SO (oct 16, hex E, dec 14) | RS (oct 36, hex 1E, dec 30) | . (oct 56, GP-IB 14, hex 2E, dec 46) | > (oct 76, GP-IB 30, hex 3E, dec 62) | N (oct 116, GP-IB 14, hex 4E, dec 78) | ^ (oct 136, GP-IB 30, hex 5E, dec 94) | n (oct 156, GP-IB 14, hex 6E, dec 110) | ~ (oct 176, GP-IB 30, hex 7E, dec 126) |
| **F** | SI (oct 17, hex F, dec 15) | US (oct 37, hex 1F, dec 31) | / (oct 57, GP-IB 15, hex 2F, dec 47) | ? (oct 77, UNL, hex 3F, dec 63) | O (oct 117, GP-IB 15, hex 4F, dec 79) | _ (oct 137, UNT, hex 5F, dec 95) | o (oct 157, GP-IB 15, hex 6F, dec 111) | DEL (RUBOUT) (oct 177, hex 7F, dec 127) |
| | **Address Command** | **Universal Command** | **Listener Address** | | **Talker Address** | | **Secondary Command** | |

**Example**

Octal → | 25 | PPU | ← GP-IB code
**NAK** ← ASCII character code
Hexadecimal → | 15 | 21 | ← Decimal
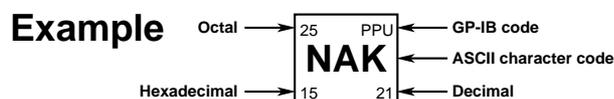
# Appendix 3  Communication Format

## Status Byte Format (for <ESC S> command)

| bit8<br>DIO8<br>0<br>(fixed) | bit7<br>DIO7<br>Service<br>request | bit6<br>DIO6<br>Error | bit5<br>DIO5<br>Completion<br>of the<br>AUTO STEP<br>or SWEEP<br>function | bit4<br>DIO4<br>Abnormal<br>source<br>pressure | bit3<br>DIO3<br>Syntax<br>error | bit2<br>DIO2<br>0<br>(fixed) | bit1<br>DIO1<br>Output<br>change<br>completion |
|---|---|---|---|---|---|---|---|

bit8: Fixed to 0.

bit7: Service request.  Set to "1" when at least one of the bits 6, 5, 4, 3, and 1 becomes a 1.

bit6: Set to "1" when either a syntax error or an abnormal source pressure condition occurs.

bit5: Set to "1" when auto-step or sweep operation terminates.

bit4: Set to "1" when an abnormal source pressure condition occurs.

bit3: Set to "1" when a syntax error occurs.

bit2: Fixed to 0.

bit1: Set to "1" when change in the output completes.

### Note

If a load capacitance is connected to the output side, the actual pressure output is delayed with respect to the output change completion signal of bit 1.

## Output Format of the Output Value Data

### Data block composition

Each data block consists of a header section (4 bytes), a data section (up to 13 bytes), and a terminator.

| Header | Data | Terminator |
|---|---|---|

### Header section

The header section consists of 4 bytes (h1 to h4).

| h1 | h2 | h3 | h4 |
|---|---|---|---|

h1:      Source pressure condition

N: Normal

E: Abnormal source pressure (too large)

e: Abnormal source pressure (too small)

h2:      Output pressure condition

M: Output stability

H: Output is higher than the specified value

L: Output is lower than the specified value

h3-h4:      Output pressure unit

Pa: kPa

kg: $kgf/cm^2$

HO: $mmH_2O$

Hg: mmHg

ps: psi

iO: $inH_2O$

ig: inHg

**Data section**

| d1 | d2 | d3 | d4 | d5 | d6 | d7 | d8 | d9 | d10 | d11 | d12 | d13 |
|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|

The data section consists of a maximum of 13 bytes (d1 to d13). The numerical section is justified to the left, and unneeded digits are packed.

d1-d7:       Number (up to 6 digits) + a decimal point

d8:           , (comma)

d9-d10:      Numerator of the divider ratio (n), a number (up to 2 digits)

                    0 to m (denominator of the divider ratio)

d11:          / (slash)

d12-d13:    Denominator of the divider ratio (m) , a number (up to 2 digits)

                    1 to 20

**Terminator**

CRLF (+EOI)

LF

EOI

*Note*

   If a load capacitance is connected to the output side, the actual pressure output is delayed with respect to the output stable signal.

## Output Format of Status Output

| bit8<br>0<br>(fixed) | bit7<br>Calibration<br>function<br>operation<br>status | bit6<br>Hold<br>function<br>operation<br>status | bit5<br>Output<br>ON/OFF<br>status | bit4<br>Output<br>change<br>status | bit3<br>Previous<br>communi-<br>cation<br>command<br>error<br>information | bit2<br>SWEEP<br>function<br>operation<br>status | bit1<br>AUTO STEP<br>function<br>operation<br>status |
|---|---|---|---|---|---|---|---|

bit8:    Fixed to 0.

bit7:    Set to "1" while the calibration function (zero calibration) is in progress.

bit6:    Set to "1" while the hold function is in progress.

bit5:    Set to "1" when the output is ON.

bit4:    Set to "1" until the output stabilizes during the sweep operation when the output value is changed in the output ON state or when the output is turned ON.

bit3:    Set to "1" when a communication command error other than <GET> occurs.

bit2:    Set to "1" while the sweep function is in progress.

bit1:    Set to "1" while the auto-step function is in progress.

*Note*

   If a load capacitance is connected to the output side, the actual pressure output is delayed with respect to the output change signal of bit 4.

## Output Format of Setup Data

Line 1:   Model, software version number

Line 2:   Unit, pressure value, and divider ratio value

Line 3:   Auto-step interval, sweep interval, and repeat function settings

Line 4:   END (end of output)

Output example   MDL767401REV1.01 CRLF

                UN2S20.000D1/1 CRLF

                AS10SW15M1 CRLF

                END CRLF

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