Cold Cathode Tough Gauge 200

Instruction Manual

Rev. 1.02

MPC MIRAPRO

ESP60168

Contents

1. Safety Precautions

Incorrect use or handling of this product may cause damage to the product or lead to a serious accident. In order to prevent accidents, please read this instruction manual thoroughly and be sure to use this product correctly.

Items that are marked with the "Danger", "Warning" and "Caution" symbols are items that require particular attention. Failure to obey these precautions may lead to injury to the operator or damage to the equipment. These instructions are essential for safety. Therefore, be sure to follow the instructions and handle the product correctly.

Definition of symbols used in this manual

 Caution	 Caution - Electric Shock	 Caution - Hot

Definition of "Danger", "Warning" and "Caution" used in this manual

 **Danger**	Incorrect handling of this device will result in the imminent danger of death or serious injury to the user.
 **Warning**	Incorrect handling of this device will result in a hazardous situation that may result in death or serious injury.
 **Caution**	Incorrect handling of this device will result in a hazardous situation that may result in injury to the user or damage to equipment.

1.1. Device Installation

 **Danger**	Be sure that the frame ground of vacuum equipment is connected correctly to the earth. Incorrect earthing may result in electric shock or equipment malfunction.
	Do not disassemble this device irrespective of whether the power is switched on because high voltage power supply is used.
	Do not modify the device.

 **Caution**	Vibration or impact may cause distortion and broken wires or malfunctions in the electrodes inside the sensor. Install the sensors in location that is not subject to vibrations or impact.
	Always use shielded cables for the input and output cables for external signals, and connect the shield to the frame ground of the controller via a connector shell.
	Take measures to prevent noise from occurring in serial interface cables and analog voltage input/output cables, such as winding the ferrite core, etc.

1.2. Device Handling

 **Danger**	Do not touch the controller or sensors during or immediately after operation, as there is a risk of electric shock

 **Warning**	Do not insert or pull out controllers when the power is switched on. Doing so may cause electric shock or malfunctions. Always be sure to turn the power off before inserting or pulling out controllers.
 **Warning**	Do not touch sensors during or immediately after operation. There is a risk of burning.

 **Caution**	Vibration or impact from transporting sensors by courier, etc. or carrying sensors may cause distortion and broken wires or malfunctions in the electrodes inside the sensor. When transporting or carrying sensors, be careful not to submit the sensors to vibration or impact.
	Before using this product, check that none of the markings or labels are missing. If labels are peeling or if you have lost the instruction manual and are unsure of how to operate or handle the device, contact MIRAPRO Co., Ltd. before attempting to use the device.

1.3. General Safety Precautions

 **Caution**	Be sure to implement the precautionary measures required for the process medium to be used in accordance with the applicable laws and regulations.
	Be careful of any reactions that may occur in the process medium caused by the heat generated by this product.
	Be careful of ignition or explosion of flammable gas caused by the high voltage generated by this product.
	Irrespective of the type of work, always be sure to implement the required precautionary measures in accordance with the applicable laws and regulations. Also, be particularly careful to follow the safety precautions detailed in this manual.
	Before starting work, check that there is no contamination in any of the vacuum parts. When handling contaminated parts, be sure to implement the required precautionary measures in accordance with the applicable laws and regulations.
	Be sure to thoroughly inform other users of the safety precautions.

1.4. Other Precautions

 **Caution**	Transportation • Do not drop or strike this product. Doing so may cause injury or damage to the device or the functions. • When transporting the product, be sure to minimize mechanical vibration and impact as much as possible. Failure to do so may damage the product functions.

 **Caution**	Overseas Transportation • This product is considered as strategic goods under the Foreign Exchange Control Law and Foreign Trade Management Law, and transportation of this product outside Japan is governed by these laws. Please contact MIRAPRO Co., Ltd. in such circumstances.

 **Warning**	Returning this Product • Before returning products to MIRAPRO Co., Ltd. for servicing or repairs, be sure to check that there are no harmful substances in the products. (E.g.: Radioactive substances, toxic substances, corrosive substances, harmful bacteria, etc.) • As prescribed in the Industrial Safety and Health Law and Poisonous and Deleterious Substances Control Law, be sure to write the name of the gas(ses) on the repair request from and include the form with the product.

 **Caution**	Disposal • Parts that are contaminated with harmful materials may be detrimental to health. • Before starting work, check that none of the parts are contaminated with harmful materials. • When handling contaminated parts, observe all related laws and regulations and implement the required precautionary measures.

 **Caution**	Inspections • It is possible that this product will deteriorate depending on factors such as the period of use, frequency of use, usage environment and storage period, etc., and we therefore recommend requesting regular inspections from the product distributor or MIRAPRO Co., Ltd.

 **Caution**	This product measures pressure while heating the cathode, and is therefore more resistant to contamination than standard cold cathode vacuum gauges. However, the product may not function correctly with excessive contamination.

1.5. Liability and Warranty

In order to use this product safely, users must comply with the precautions detailed above. In cases in which the instructions in this manual are not followed or this product is not used in accordance with the instructions, MIRAPRO Co., Ltd. shall not accept any liability for any issue that occurs and shall not be liable for any type of compensation. Furthermore, all liability pertaining to the process medium shall be borne by the end user.

Additionally, all of the work described in this manual must only be performed by persons who have received the appropriate training and have the necessary experience to undertake such work, or persons instructed by the end user.

2. Specifications

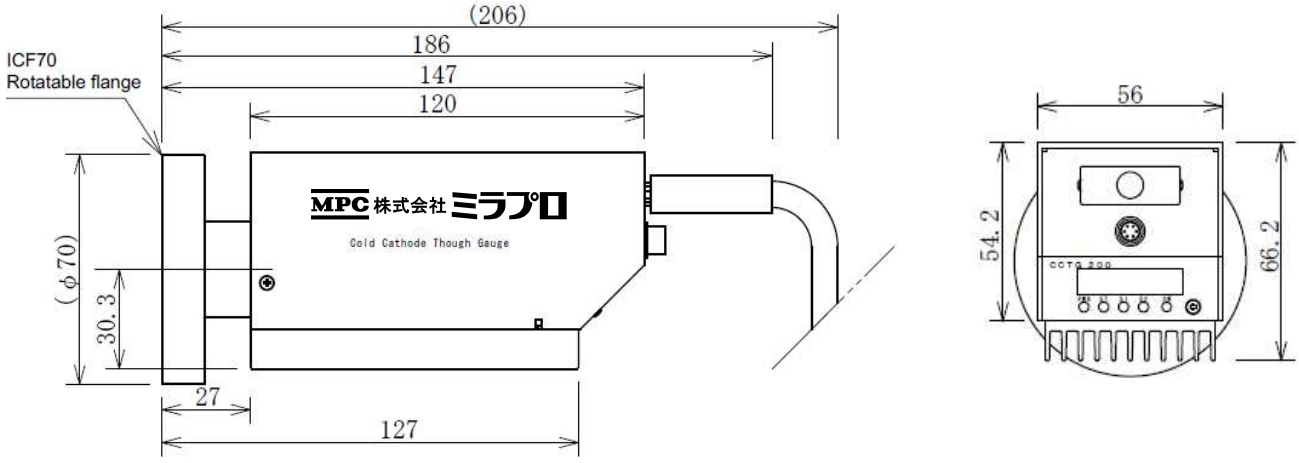
Measurement pressure range	1×10^{-8}Pa to 0.1Pa
Type of controller	CCTGC200, CCTGC200C (With combination mode)
Flange	NW25 type (SUS model: CCTGH200- NW25) CF70 Rotating flange type (SUS model: CCTGH200- CF70)
Internal seal	CCTGH200- NW25 have a viton seal (maximum baking temperature: 150°C) CCTGH200- CF70 has a metallic o-ring seal
Weight	Sensor NW25 type (SUS): 800g, CF070 type: 1.1kg
Magnetic flux leakage	Less than 200 gauss 1cm from the yoke surface
Bias	3kV - 500V Optimal control (automatic control of voltage to the optimal voltage for the measurement pressure)
Power supply	DC24V 1A
Power consumption	Maximum power consumption : 24W(When degas and external gauges are connected) Power consumption during measurement : 7.2VA (in 500°C tough mode)
Tough mode temperature	300°C, 500°C, 600°C available selections
Degas temperature	700°C (2 mins)
Screen display	Seven segment indicator (4 digit), indicator lights (power, status, set-point 1 and 2)
Input/output connector	I/O connector (PCR connector), External gauge connection connector (HR10 connector) (CCTG200C only)
External input	Measurement ON/OFF, degas ON/OFF, tough mode ON/OFF, general input
External output	Measurement status signal *1, 2 Alarm signal, Warning signal *2 Set-point 2 system *2, 3
Pressure signal output	Pressure signals are output as voltage. (0 to10V× 2ch) Output signal format can be selected by the user from LOG, LIN, or COMP. (See "8.2.3. Output Control (Output Voltage Setting)")
External interface	RS232C Interface (PCR connector)
Operating environment temperature	0 to 40°C

*1. Output when normal measurement is performed.

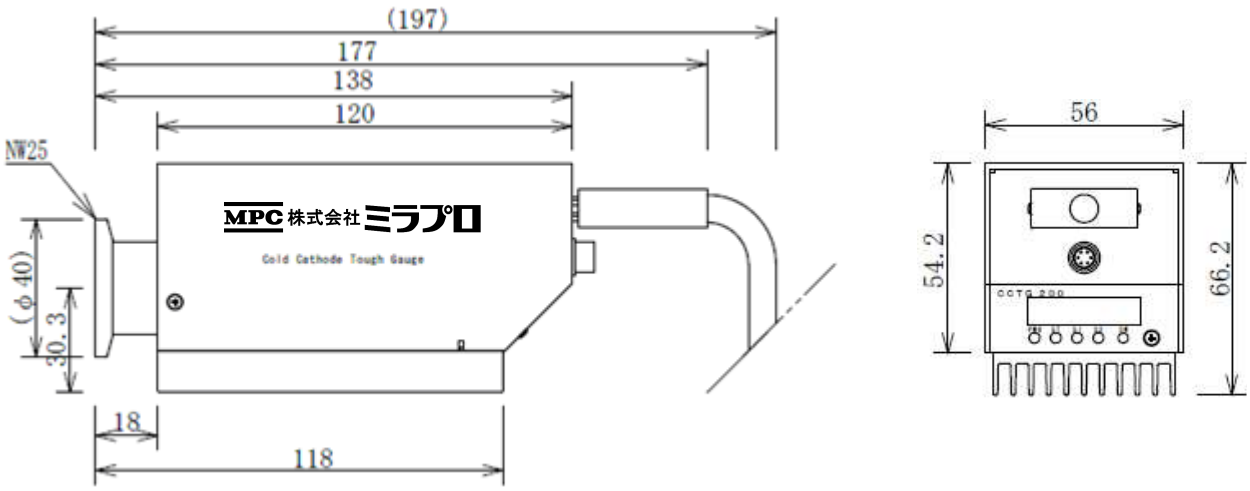
*2. This is the photo coupler isolated open collector output.

*3. Attack point and release point can be set as desired. (See "8.2.2. Set Point (Setting the Set-point)")

3. External Appearance and Dimensions



CCTG200C + CF70 flange type



CCTG200C + NW25 flange type

Fig. 1. External Appearance and Dimensions

4. Names and Operations of Parts

4.1. Indicators, Switches and Connectors

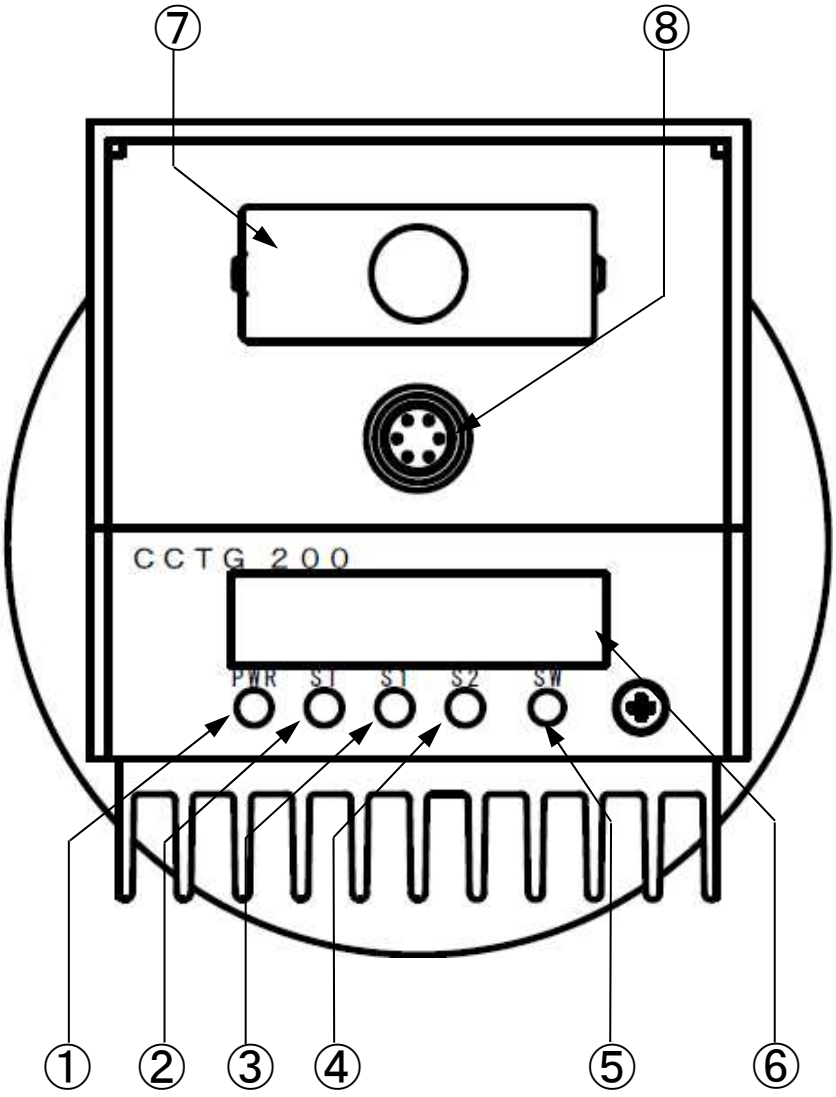


Fig. 2. Indicators, Switches and Connectors

4.1.1. Operations of Indicators and Switches

Number	Name	Function
1	PWR indicator	Remains lit when the power is on.
2	ST indicator	Indicates the status of the CCTG200. Blue: Standby status Blue (Flashing): Measurement status (preparing) White: Measurement status (Off mode) Green: Measurement status (Tough mode) Green (Flashing): Measurement status (degas) Purple: Measurement status from external gauge Red: Alarm occurrence Yellow: Warning occurrence
3	Set-point 1 Indicator	Lights when a pressure that is lower than the set point 1 attack point setting value is reached. Goes out when the pressure is above the release point setting value.
4	Set-point 2 Indicator	Lights when a pressure that is lower than the set point 2 attack point setting value is reached. Goes out when the pressure is above the release point setting value.
5	Measurement switch	Starts measurement when pressed in the standby status (ST indicator lit blue). Stops measurement and switches to the standby status when pressed during the measurement status (ST indicator is lit or flashing white, green or purple). Clears the alarm when pressed during an alarm.
6	Main indicator	Displays the pressure or error codes etc. using 4 digits. (Seven segment indicator)

4.1.2. Operations of Connectors

Number	Name	Details	Connector model	Compatible connector model
7	I/O connector (PCR connector)	Input/output connector for RS232 interface or various signals.	PCR-E20LMD-SL+ (Honda Tsushin Kogyo Co., Ltd)	PCR-S20FS+ (connector) PCR-LS20LA (cover) (Honda Tsushin Kogyo Co., Ltd)
8	External gauge connection connector (HR10 connector) (CCTG200C only)	When combination mode is set, used to connect to an external gauge such as a Pirani gauge, etc. When the external gauge drops below 0.1Pa, the CCTG200 starts measurement automatically.	HR10A-7R-6S (Hirose Electric Co., Ltd)	HR10A-7P-6P (Hirose Electric Co., Ltd)

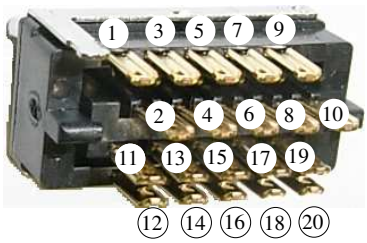
4.2. I/O Connector Pin Configuration

The I/O connector is a 20-pin (male) PCR connector. A 20-pin (female) PCR connector that can be soldered is provided. Please use if required.

Pin number	Name	Details
1	High Voltage	An output terminal for high voltage output signals. When high voltage is output, (measuring voltage) is output. It has a 5-pin contact configuration. *1, 2
2	Alarm out put	An output terminal for alarm signals. It has a 5-pin contact configuration. *1, 3
3	Set point 1	An output terminal for set-point 1 signals. It has a 5-pin contact configuration. *1, 2
4	Set point 2	An output terminal for set-point 2 signals. It has a 5-pin contact configuration. *1 ,2 ,5
5	Output common	Common for the high voltage output signals, alarm signals, and set-point 1 and 2 signals.
6	DC24V- Input	The 24V DC power supply ground terminal.
7	Analog out Ch1	Analog signal output. The measurement voltage is output as a 0 to 10V analog voltage. (Log or linear mantissa, exponent or compound) (See "8.2.3 Output Control (Output Voltage Setting)") *4
8	Analog out Ch2	Analog signal output. The measurement voltage is output as a 0 to 10V analog voltage. (Log or linear mantissa, exponent or compound) (See "8.2.3. Output Control (Output Voltage Setting)") *4
9	Analog GND	The ground terminal for analog signal output.
10	DC24V+ Input	The 24V DC power supply input terminal. Connect to a power supply that has a current capacity greater than 1A.
11	High Voltage On	The input terminal for the voltage measurement (high voltage output) start signal. (0-24V input, less than 3V: Stop measurement, more than 20V: Start measurement) It has a 15-pin contact configuration.*2 Connect to this terminal to start measurement using a signal from an external device.
12	Tough mode On	The input terminal for the tough mode start signal. Tough mode is turned on by the rising edge signal, and off by the falling edge signal. (Less than 3V: Stop tough mode, More than 20V: Start tough mode) It has a 15-pin contact configuration.*2 Connect to this terminal to start/stop tough mode using a signal from an external device.
13	Degas On	The degas start/stop input terminal. (Operates with an input of more than 20V and a pulse width greater than 100ms.) It has a 15-pin contact configuration.*2 Connect to this terminal to start/stop degas using a signal from an external device.

Pin number	Name	Details
14	Reserved	Do not connect anything to this terminal.
15	Input common	Common for the pressure measurement start signal, tough mode start signal and degas start signal.
16	DC24V- Input (spare)	The 24V DC power supply ground terminal. (Spare terminal)
17	TXD	The signal output terminal for the RS232C interface.
18	RXD	The signal output terminal for the RS232C interface.
19	Signal GND	The RS232C ground terminal.
20	DC24V+ Input (spare)	The 24V DC power supply input terminal. (Spare terminal) Connect to a power supply that has a current capacity greater than 1A.

*1. Photo coupler isolated open collector output
*2. Normal open (NO) signal
*3. Normal closed (NC) signal
*4. Output impedance: 440Ω
*5. Set-point 2 signals or warning signals can be set as desired.
(See the instruction manual of the TG Viewer.)



PCR Connector Pin Configuration

4.3. External gauge connection connector pin arrangement (CCTG200C only)

The external gauge connection connector is a 6-pin (female) HR10 connector. A 6-pin (male) HR10 connector that can be soldered is provided. Please use if required. (CCTG200C only)

Pin number	Name	Details
1	DC24V+ Output	This is the 24V DC power supply output terminal. Connect to a device that has a current capacity less than 0.5A.
2	DC24V- Output	This is the 24V DC power supply ground terminal.
3	Analog Input	This is the analog signal input terminal for external gauges.
4	Gauge ID	This is the recognition signal input terminal for external gauges. Use open for incompatible models.
5	Analog GND	This is the ground terminal for analog signal input.
6	NC	Do not connect anything to this terminal.

5. Installation Method

5.1.1. Connecting I/O Connectors

Power supply, input and output of signals and interface are all performed thorough I/O connectors.

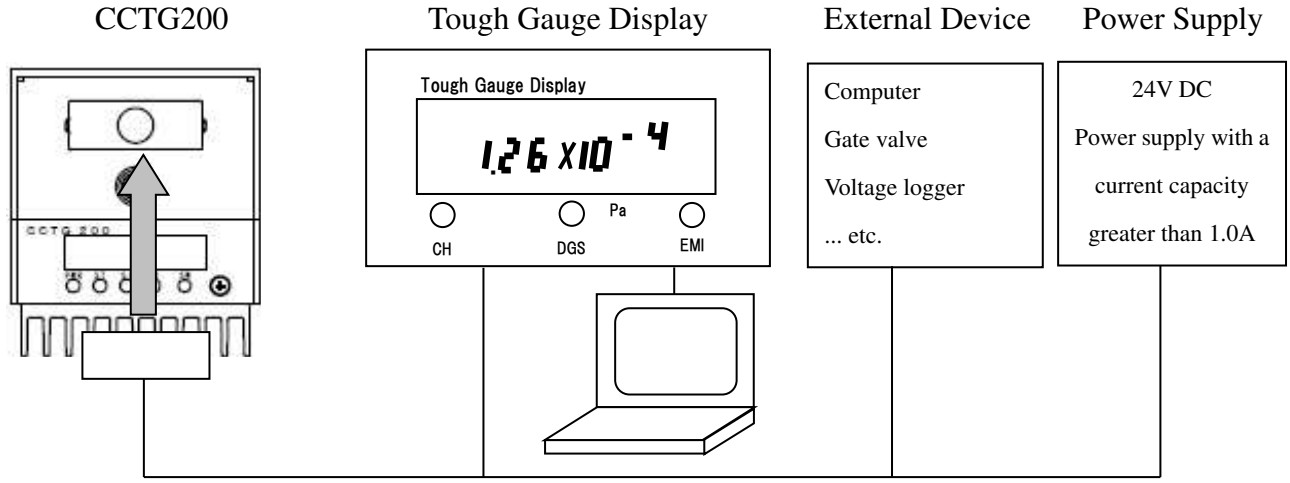
When connecting to a computer via RS232C interface, or inputting/outputting external signals, use a cable to connect to the I/O connector of the CCTG200.

Either purchase a power/interface cable (sold separately) or use the provided I/O connector to prepare your own connection cable. (For details on the pin arrangement and signal, see "4.2. I/O Connector Pin Arrangement")

When the CCTG200 is connected to a computer using a RS232C cable, serial commands or the Windows "TG Viewer" application can be used to log pressure data or operate the tough gauge, and perform monitoring etc. of the status. For details on serial commands, see "Command Manual". Please contact MIRAPRO Co., Ltd. about "TG Viewer".

Also, by connecting the tough gauge display (TGDISP100) (sold separately), the RS232C interface can be used to display the CCTG200 measurement pressure on the display. For details on the tough gauge display, see the display instruction manual.

By connecting the tough gauge display (TGDISP100) to a computer using a USB cable (sold separately), the computer can be used to control the CCTG200 and monitor the pressure, etc. When connecting to a computer via the tough gauge display, use "TG Display Viewer".



Cable (prepared by the customer)

Fig. 3. Connecting I/O Connectors

Caution	When preparing your own cable, be sure that the signals are not mixed. Connecting cables incorrectly may prevent the device from working correctly, may cause damage to the device or power failure.

Warning	Be sure to turn off the power supply when inserting and removing cables. Inserting and removing cables when power is supplied may result in electric shock or damage to equipment.

5.1.2. Connecting External Gauges (CCTG200C only)

The CCTG200C can be used as a combination gauge by inputting the analog signal from an external gauge such as Pirani, etc. to the CCTG200. When connecting an external gauge, combination mode settings and the analog voltage settings for the external gauge need to be configured. Each of the settings are configured using serial commands or the "TG Viewer" Windows application. For details on serial commands, see "Command Manual". For details on "TG Viewer", contact MIRAPRO Co., Ltd.

When the combination mode settings are configured on the CCTG200 and an external gauge is connected, the pressure measured by the external gauge is displayed at the start of measurement. Measurement starts on the CCTG200 when the external gauge is below 0.15Pa, and the pressure display of the CCTG200 switches. Pressure measurement stops on the CCTG200 when the external gauge exceeds 0. 2Pa.

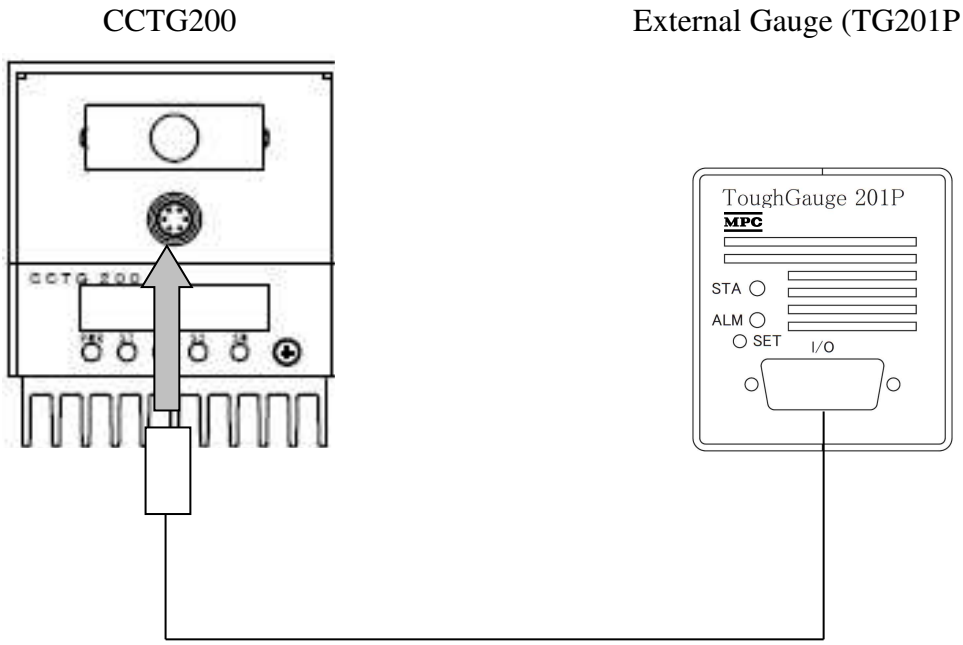
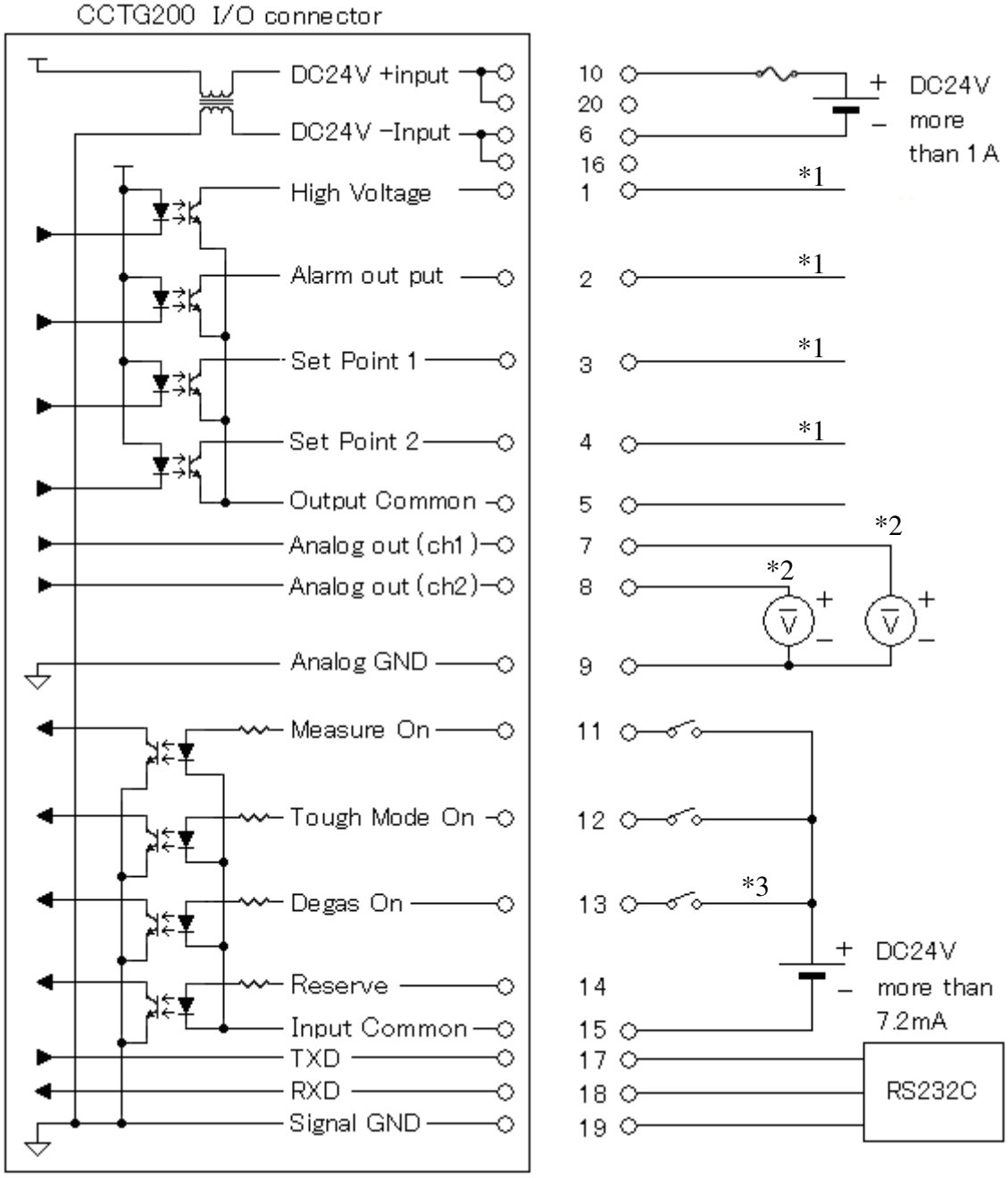


Fig. 4. External Gauge Connection

5.1.3. I/O Signal Wiring Diagram

Fig. 5. shows example connections of the I/O connector signals.



*1. Photo coupler isolated open collector output

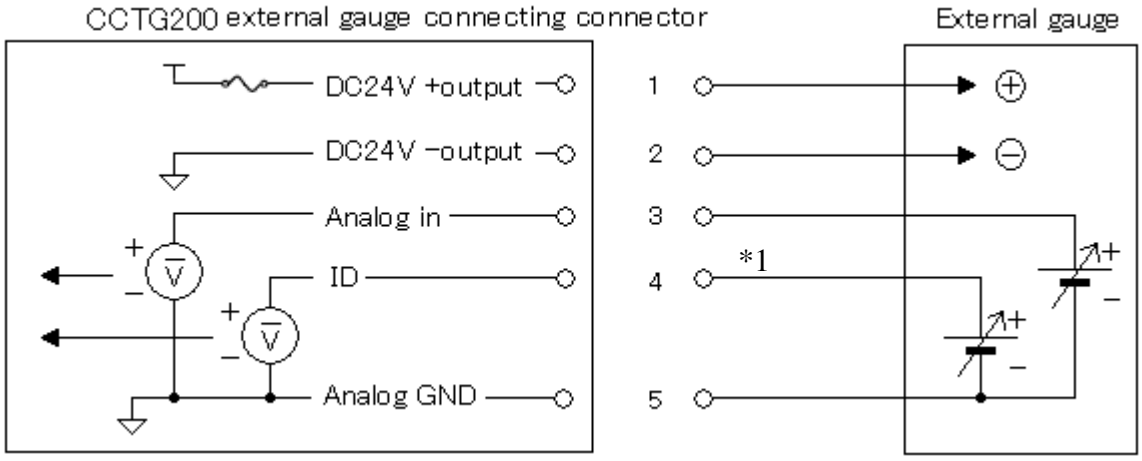
*2. Output impedance: 440Ω

*3. Degassing for 2 minutes starts when an input of more than 20V and a pulse width of more than 100ms is received.

Fig. 5. I/O Connector Signal Wiring Diagram

5.1.4. External Gauge Wiring Diagram (CCTG200C only)

Fig. 6. shows example connections of the external gauge connecting connector signals.



*1. There are limitations on devices that can be automatically recognized.

Fig. 6. External Gauge Wiring Diagram

6. Operating Mode

As shown in Fig. 7., CCTG200 has two operating statuses, measurement mode and standby mode, and the mode is changed by operating switches, serial commands or signal inputs.

The CCTG200 enters standby mode directly after turning on the power supply, and switches to the measurement mode for measuring pressure when measurement is started.

Furthermore, measurement can be performed with an external gauge or with the CCTG200 unit itself. Combination mode settings need to be configured in order to perform measurement with an external gauge. There are 3 operating statuses for measurement with the CCTG200. Off mode in which the cathode is not heated, tough mode in which the pressure is measured while heating the cathode, and degassing in which contamination is removed from the cathode. (See "7. Measurement Methods").

Switch between tough mode and off mode using serial commands or signal inputs.

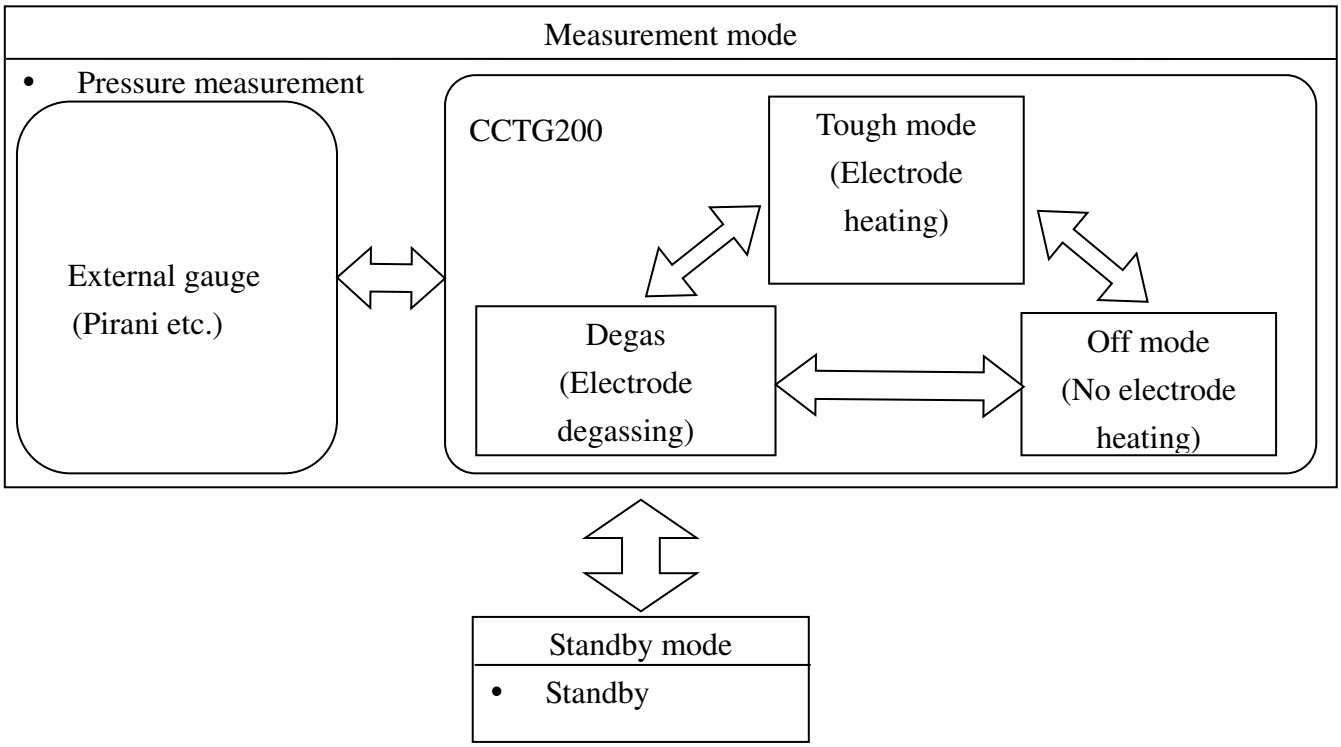


Fig. 7. Switching to Operating Mode

- List of Available Operations in Each Mode

	Measurement mode	Standby mode
Pressure measurement	Available	Unavailable
Cathode heating (Degas/tough mode)	Available	Unavailable
Tough mode temperature switching	Available	Available (Settings only)
Serial Interface	Available	Available

7. Measurement Method

7.1. Starting Measurement

Pressure measurement is started using any of the following methods.

(1) Pressing the measurement switch "SW".
(2) Sending a measurement start serial command.
(3) Pressing the "EMI" button on the "TGDISP100 (tough gauge display)" more than 2 seconds.
(4) Pressing the "Start measurement" button in "TG Viewer" or "TG Display Viewer".
(5) Inputting the Measure On signal (see "4.2. I/O Connector Pin Arrangement")

* For details on serial commands, see "Command Manual".
* For details on the "TGDISP100 (tough gauge display)", see the "TG Display Instruction Manual".
* For details on "TV Viewer" and "TG Display Viewer", see the "TG Viewer" or "TG Display Viewer" instruction manual

7.1.1. Measurement Mode

(1) Measurement can be started when "----" is displayed in the main indicator (see "Fig. 8. Standby mode screen") using any of the methods described in "7.1. Starting Measurement".
(2) Immediately after measurement is started, a low pressure may be displayed until the discharge stabilizes.
(3) When pressure measurement is started, the ST indicator changes to green (during tough mode) or white (off mode), and the main indicator changes to the pressure display. The two upper digits represent the mantissa section and the two lower digits represent the exponent section. "Fig. 9. Pressure Measurement Screen" is 3.1×10^{-2}.

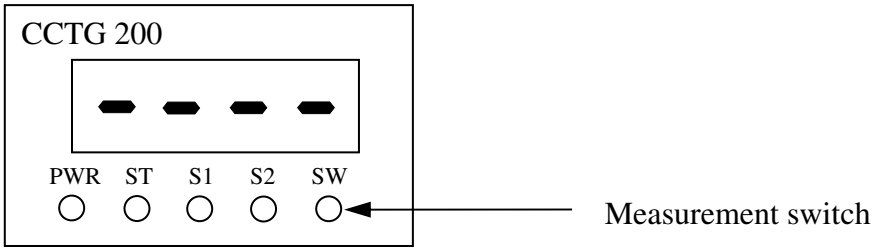


Fig. 8. Standby Mode Screen

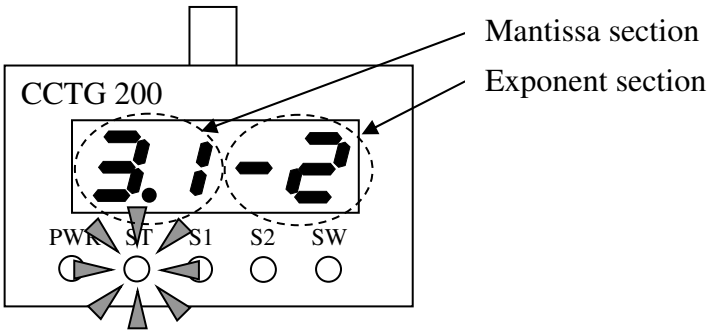


Fig. 9. Pressure Measurement Screen

7.2. Ending Measurement

Pressure measurement is stopped using any of the following methods.

(1) Pressing the measurement switch "SW".
(2) Sending a measurement end serial command.
(3) Pressing the "EMI" button on the "TGDISP100 (tough gauge display)" more than two seconds.
(4) Pressing the "Stop measurement" button in "TG Viewer" or "TG Display Viewer".
(5) Turning the Measure Control signal off (see "4.2. I/O Connector Pin Arrangement")

* For details on serial commands, see "Command Manual".
* For details on the "TGDISP100 (tough gauge display)", see the "TG Display Instruction Manual".
* For details on "TG Viewer" and "TG Display Viewer", see the "TG Viewer" or "TG Display Viewer" instruction manual.

7.3. Tough Mode

In tough mode, pressure is measured while the cathode is heated. Measuring the pressure in tough mode reduces the risk of contaminants adhering to the electrode.

The electrode temperature in tough mode can be selected from 300°C, 500°C, and 600°C. Try switching the tough mode temperature in the actual usage environment to find the appropriate tough mode temperature. The CCTG200 has the tough mode set to 500°C as the default setting. When the tough mode temperature is switched, changes in the electrode temperature cause changes in the temperature around the sensor, which may cause fluctuations in pressure around the sensor. For this reason, differences may occur in the display pressure when the tough mode temperature is changed in high vacuum and ultrahigh vacuum conditions.

* The tough mode setting temperature is a guide and is not an accurate temperature.

7.4. Warnings

The alarm indicator will flash in yellow if warning is caused such as when the sensor cathode cannot be heated. (Fig.10. Warning (E.g.))

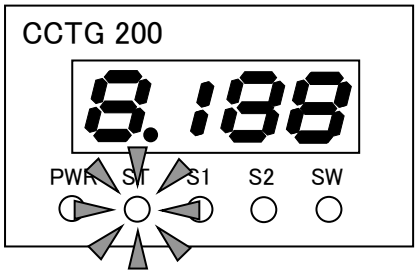


Fig. 10. Warning (E.g.)

It is possible to undertake pressure measurement even though a warning occurs. However there is a possibly of a malfunction of sensor cathode heating for tough mode or degas. So please replace the sensor as soon as possible. Contact MIRAPRO Co., Ltd. for details on replacement or maintenance of sensor electrode.

7.5. Alarms

(1) In cases where alarm occur such as when the pressure exceeds the measuring range or when an error occurs in an electrode, the ST indicator flashes red, an error code is displayed in the seven segment indicator, and pressure measurement stops. (Fig. 11. Stopping Measurement (E.g.))

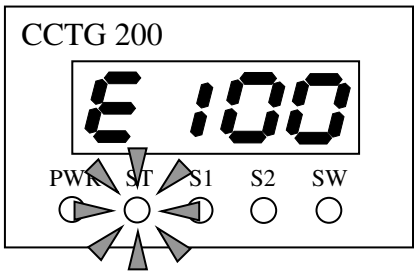


Fig. 11. Stopping Measurement (E.g.)

In cases where measurement mode is stopped due to an alarm, remove the cause of the alarm.
Alarms can be canceled by pressing the SW key.
For details on alarm codes, see "11. Troubleshooting".

7.6. Sensor Replacement and Maintenance

When sensors are replaced, a margin of error of approximately 50% from the correct pressure occurs. Please contact MIRAPRO Co., Ltd. if sensor adjustment is required.

The internal seal section maintains a vacuum seal using a viton (rubber) or metal O-ring. Parts such as the anode or cathode can be washed or replaced by removing this O-ring.

Contact MIRAPRO Co., Ltd. for details on replacement or maintenance of these parts.

Caution	When replacing a sensor that is in use, be sure that the sensor has fully cooled before replacement. Replacing directly after use may result in burns because the sensor is still hot.

8. Various Setting Items

Each of the various settings are configured by connecting a computer to the RS232C connection. This section explains the main setting items.

Each of the various settings are configured by connecting a computer to the RS232C connection and using the "TG Viewer" or "TG Display Viewer" applications, or by using serial commands. For details on the commands such as format or parameter, and for details on other commands, see the "Command Manual". For details on how to operate "TG Viewer" or "TG Display Viewer", see the "TG Viewer" or "TG Display Viewer" instruction manuals.

Serial commands can be issued by connecting a computer to the RS232C connector and using terminal software. Terminal software must be prepared by the customer.

8.1. List of Setting Items

The following 10 items can be set in the setting mode. For details on the items, see "8.2. Setting Items".

(1) Unit (Display pressure unit setting)
(2) Set Point 1 Attack (Set-point 1 attack point setting)
(3) Set Point 1 Release (Set-point 1 release point setting)
(4) Set Point 2 Attack (Set-point 2 attack point setting)
(5) Set Point 2 Release (Set-point 2 release point setting)
(6) Output Control (Analog output setting)
(7) Tough Mode (Tough mode setting)
(8) Discharge Trigger (Discharge trigger setting)
(9) Sensitivity (Sensitivity setting)
(10) Combination (External gauge setting) (CCTG200C only)

8.2. Setting Items

8.2.1. Unit (Display pressure unit setting)

The display pressure unit can be selected from Pascal (Pa), torr (Torr) or millibar (mbar). Even if the pressure unit is switched, the setting values of Set Point 1 and 2 are automatically converted, and there is no need to reconfigure the settings. (Default setting Pa)

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.2.2. Set Point (Setting the Set-point)

When the measured pressure falls lower than the value set as the set-point, an external signal is output to the terminal. This function can be used to control functions such as opening and closing of the gate valve of the vacuum equipment.

There are two types of settings for the set-point setting values, the Attack Point and Release Point. The Attack Point is the setting value that turns the signal output ON, and the Release Point is the setting value that turns the signal output OFF. (See "Fig. 12. Set-point Signal Output")

There are two types of set-point systems, and attack points and set-points can be set individually for each system.

(Default settings: Attack Point: 1.0 x 10^{-8}Pa for both set-points 1 and 2, Release Point: 1.0 x 10^{-8}Pa)

* Be sure to set so that the Attack Point is smaller than the Release Point. If the Attack Point and Release Point are equal, the set-points are disabled.

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

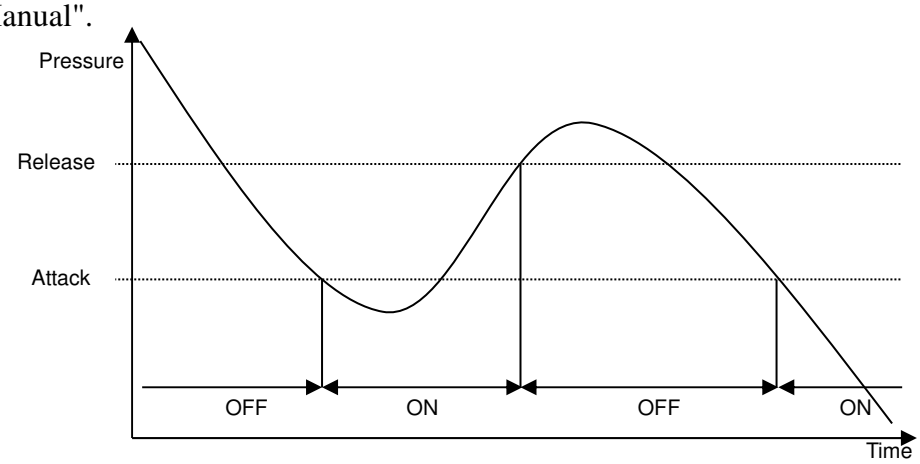


Fig. 12. Set-point Signal Output

When the measured pressure falls below the Attack Point, S1 or S2 indicator lights and the external output signal turns on. (See "4.2. I/O Connector Pin Configuration")

When the measured pressure falls is higher than the Release Point, S1 or S2 indicator turns off and the external output signal turns off.

8.2.3. Output Control (Output Voltage Setting)

The format of the 0 - 10V analog signal output as the measured pressure value can be set.

LOG (logarithm), MAN (linear mantissa), EXP (linear exponent) and LIN (compound linear) can be set for the analog signal, and should be set in accordance with the required use.

(Default setting LOG)

* For details on the setting method, see the "TG Viewer Instruction Manual" or the "Command Manual".

- Description of each signal format

Analog out Ch1 and Analog out Ch2 are used for the analog signal, and the measurement pressure is output at a voltage between 0 to 10V.

10V is output from Analog out when atmosphere is measured or when measurement is stopped. Nothing is output when an error occurs.

1. LOG (Logarithm)

The measured pressure value is logarithmically compressed and output as a voltage from Ch 1. When the pressure is 1×10^{-8}Pa (1×10^{-10} Torr) the output is 0.25V, but when around 10^{-7}Pa (around 10^{-9} Torr) the output is 1V ... each time one digit increases, the output voltage increases by 0.75V each.

When the measured pressure is taken as P

Ch1 = (log (P) + C) × 0.75 [V]

(Pa: C = 8.333, Torr: C = 10.333, mbar: C = 10.333)

the output voltage of Ch1 can be calculated using the calculation formula.

The pressure can be calculated back from the voltage using the formula $P=10^{(Ch1/0.75-C)}$.

E.g.1) Example calculation when LOG is selected

1) When 2.7×10^{-4}Pa
   Analog out: $(\log(2.7\times10^{-4}) + 8.333)\times0.75 \approx 3.57$V
2) When 2.7×10^{-4} Torr
   Analog out: $(\log(2.7\times10^{-4}) + 10.333)\times0.75 \approx 5.07$V
3) When 2.7×10^{-4} mbar
   Analog out: $(\log(2.7\times10^{-4}) + 10.333)\times0.75 \approx 5.07$V

E.g.2) Example reverse calculation when LOG is selected (when Ch1=4.43V)

1) When Pa is used
   Pressure: $10^{(4.43/0.75-8.333)} \approx 3.7\times10^{-3}$ [Pa]
2) When Torr is used
   Pressure: $10^{(4.43/0.75-10.333)} \approx 3.7\times10^{-5}$ [Torr]
3) When mbar is used
   Pressure: $10^{(4.43/0.75-10.333)} \approx 3.7\times10^{-5}$ [mbar]

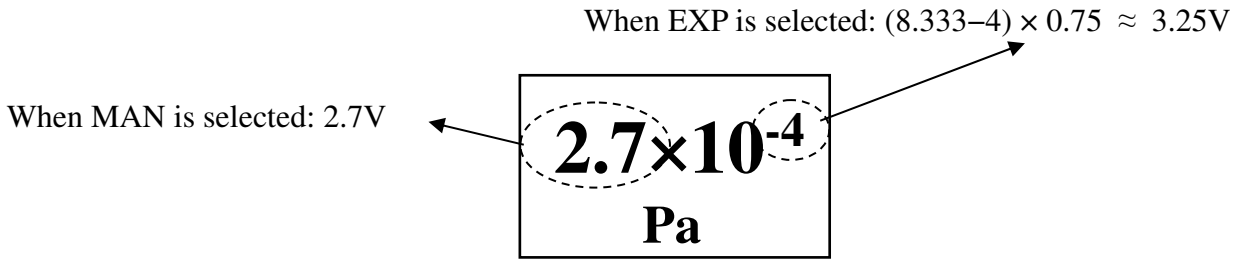
2. MAN (Mantissa)

The linear mantissa section of the measured pressure value is output from Analog out.

There are hysteresis of 0.8 - 1.0 for digit switching. The digit is switched to the upper digit at 10.0V when the pressure is increasing, and switched to the lower digit at 0.8V when the pressure is decreasing.

When the pressure is taken as A.BC $\times 10^{E}$,

Analog out ＝A.BC [V]



E.g.) Example calculation when MAN is selected

1) When 2.7 $\times 10^{-4}$Pa
   Analog out: 2.7V
2) When 2.7 $\times 10^{-4}$Torr
   Analog out: 2.7V
3) When 2.7 $\times 10^{-4}$mbar
   Analog out: 2.7V

3. EXP (Exponential)

The linear exponent section of the measured pressure value is output from Analog out.

When the pressure is taken as A.BC $\times$ 10^{E},

Analog out = (X+E) × 0.75 [V]

(Pa: X = 8.333, Torr: X = 10.333, mbar: X = 10.333)

the output voltage of Analog out can be calculated using the calculation formula.

E.g.) Example calculation when EXP is selected

1) When 2.7 × 10^{-4} Pa
   Analog out: (8.333−4) × 0.75 ≈ 3.25V
2) When 2.7 × 10^{-4} Torr
   Analog out: (10.333−4) × 0.75 ≈ 4.75V
3) When 2.7 × 10^{-4} mbar
   Analog out: (10.333−4) × 0.75 ≈ 4.75V

4. LIN (Linear)

When linear output is set, the relationship between the voltage and pressure output from Analog out is as shown below.

When the measured pressure is taken as P

Analog out = (Pressure mantissa×1/20) + (Pressure exponent + C) /2 [V]

(Pa: C = 13, Torr: C = 15, mbar: C = 15)

the output voltage of Analog out can be calculated using the calculation formula.

E.g.) Example calculation when LIN is selected

1) When $2.7 \times 10^{+2}$ Pa
   Analog out: (2.7×1/20) + (2+13) /2 ≈ 7.63V
2) When $2.7 \times 10^{+2}$ Torr
   Analog out: (2.7×1/20) + (2+15) /2 ≈ 8.63V
3) When $2.7 \times 10^{+2}$ mbar
   Analog out: (2.7×1/20) + (2+15) /2 ≈ 8.63V

For details of the relationship between measured pressure and Analog out voltage at each setting, see Fig. 13 to Fig. 30.

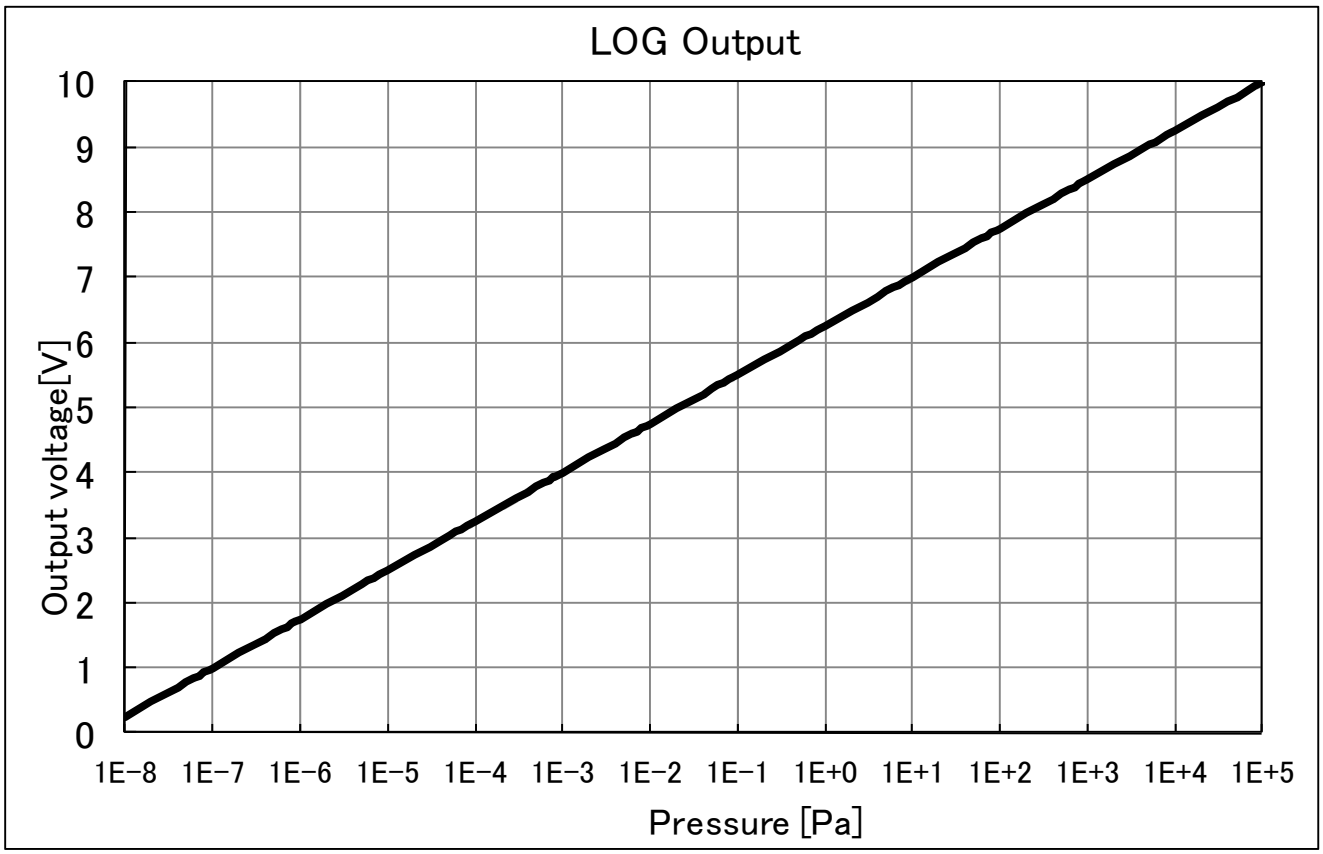


Fig. 13. LOG Output [Pa]

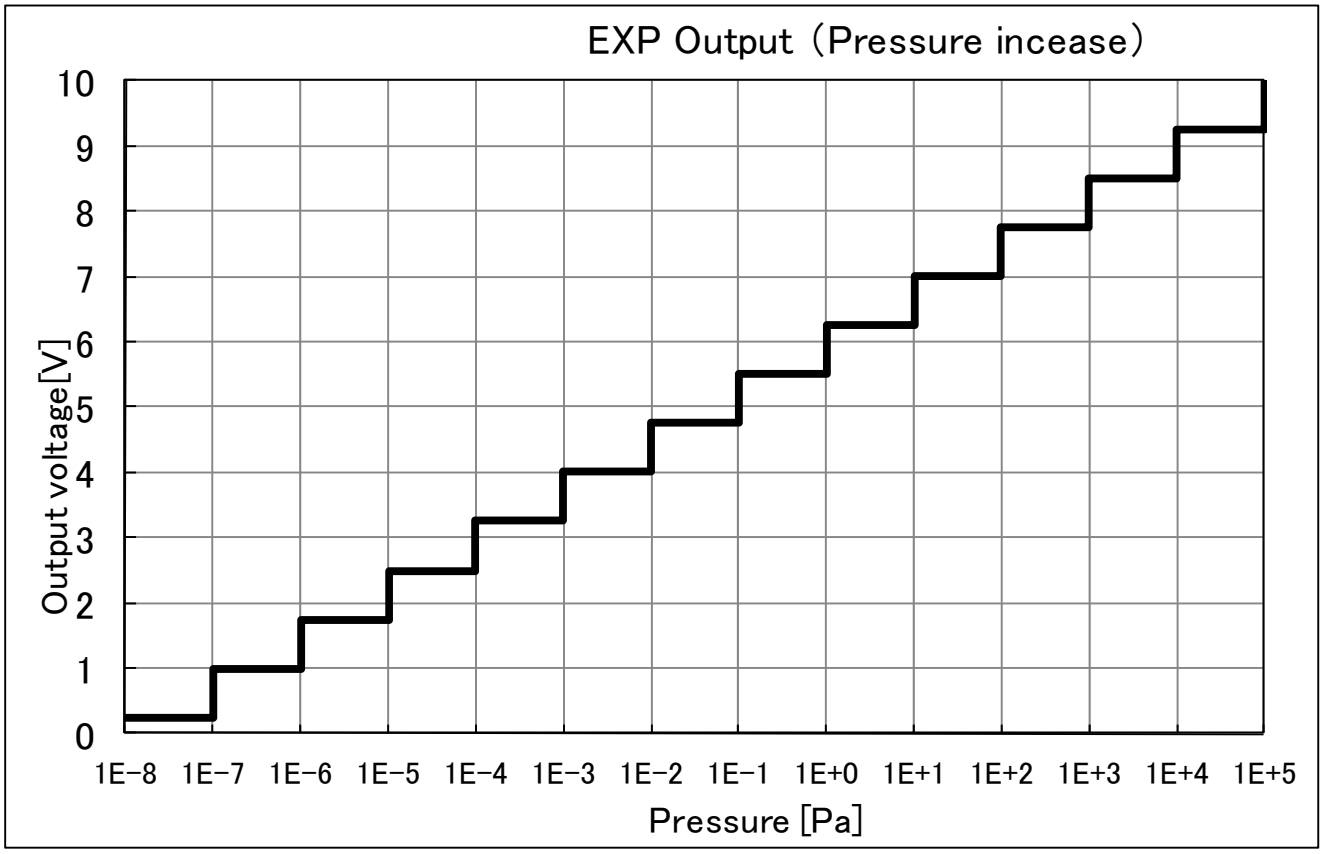


Fig. 14. EXP Output (Pressure increase) [Pa]

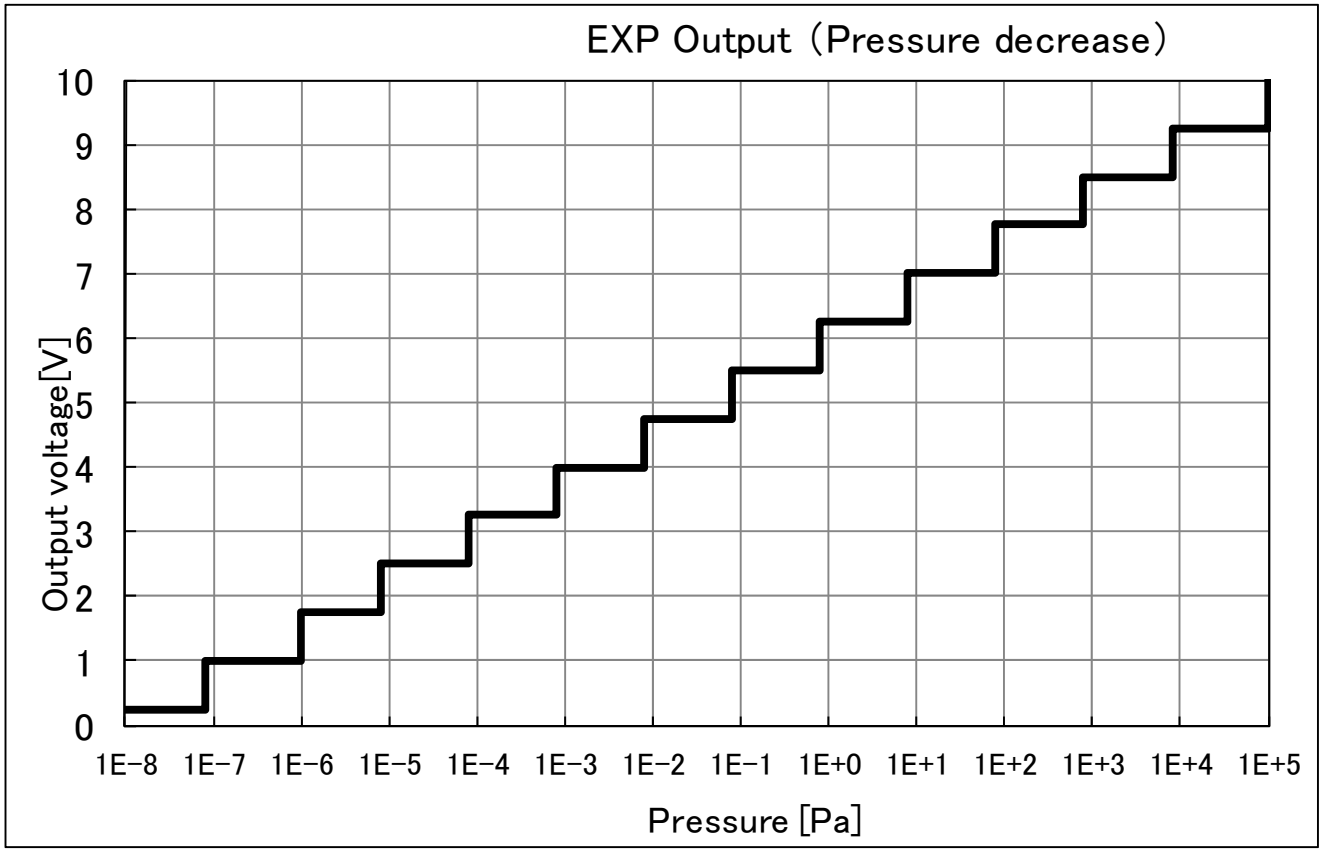


Fig. 15. EXP Output (Pressure decrease) [Pa]

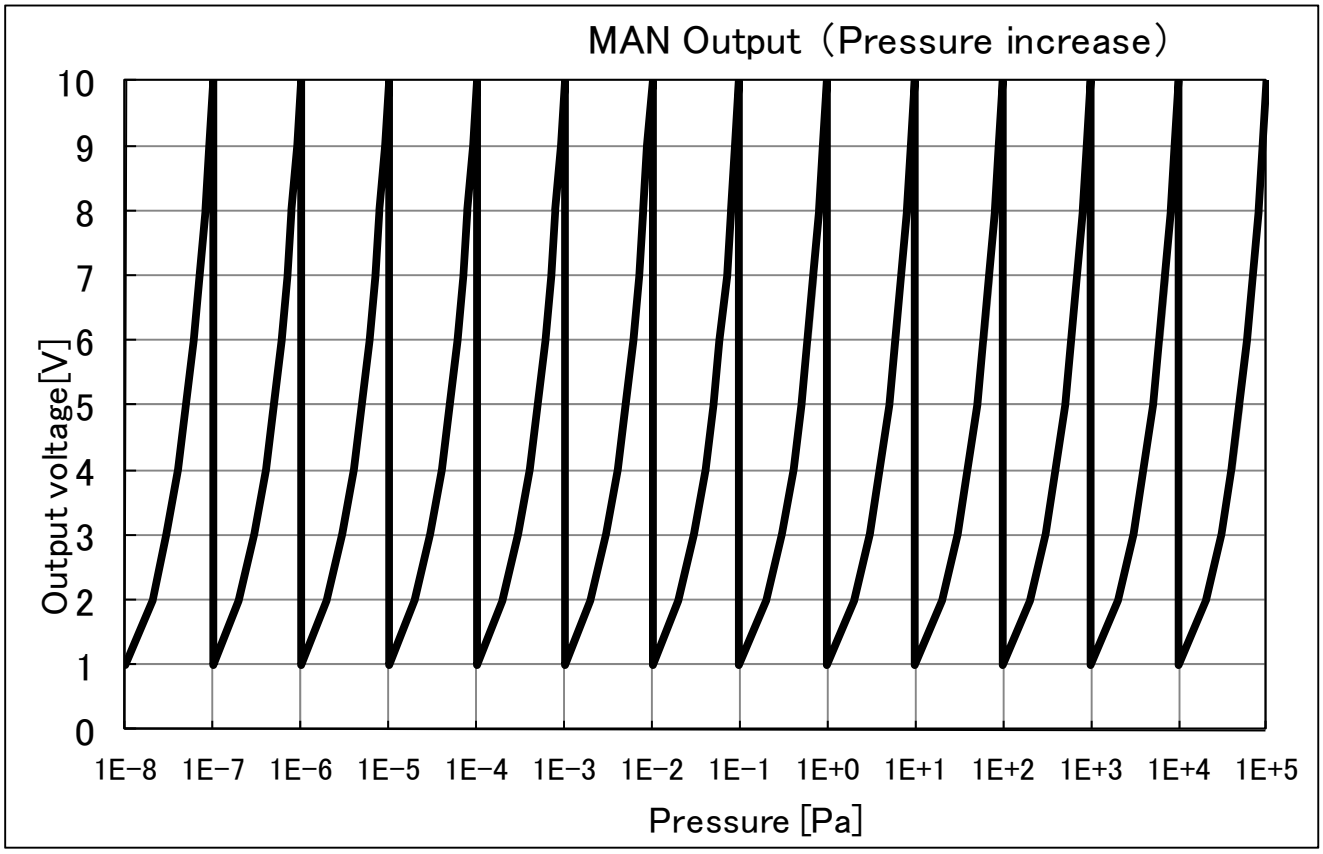


Fig. 16. MAN Output (Pressure increase) [Pa]

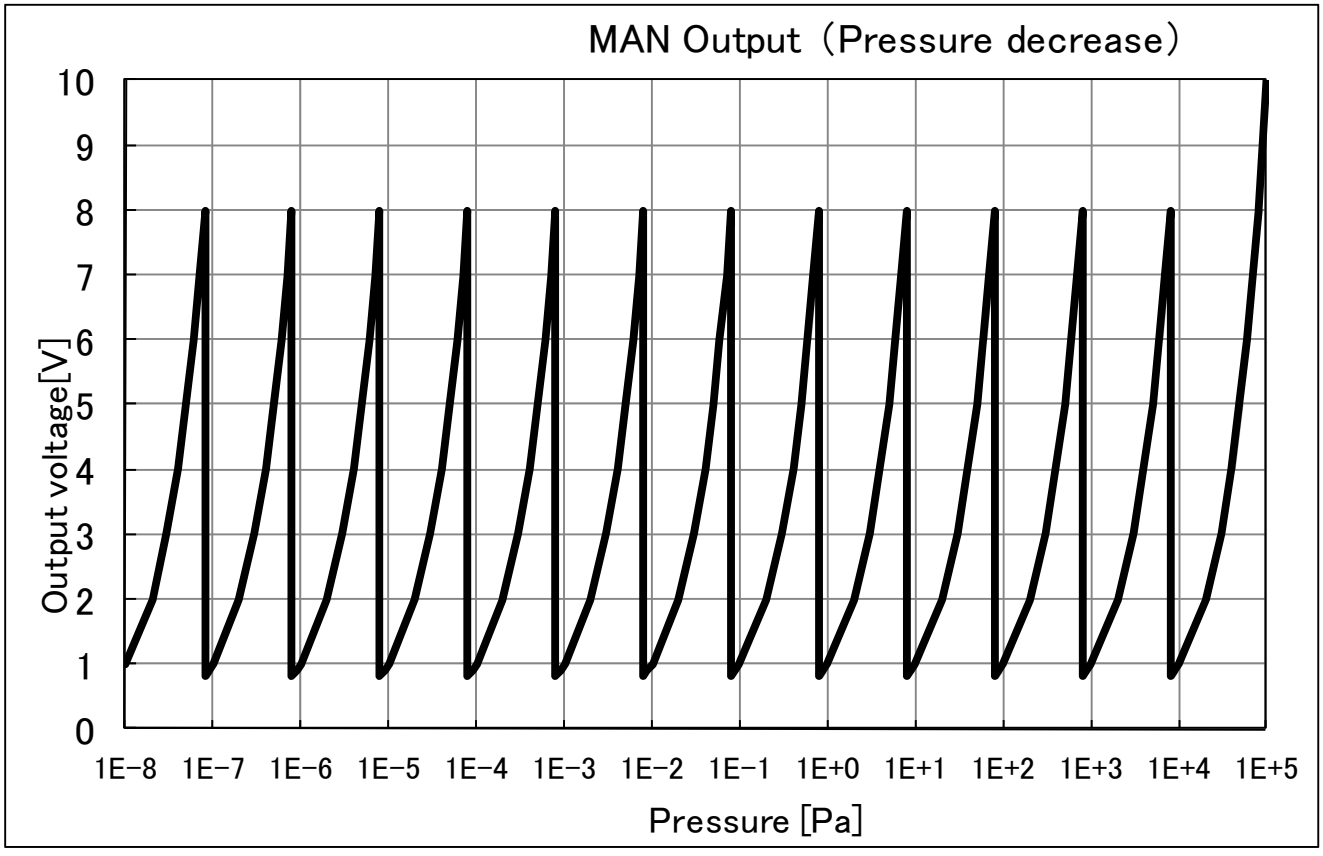


Fig. 17. MAN Output (Pressure decrease) [Pa]

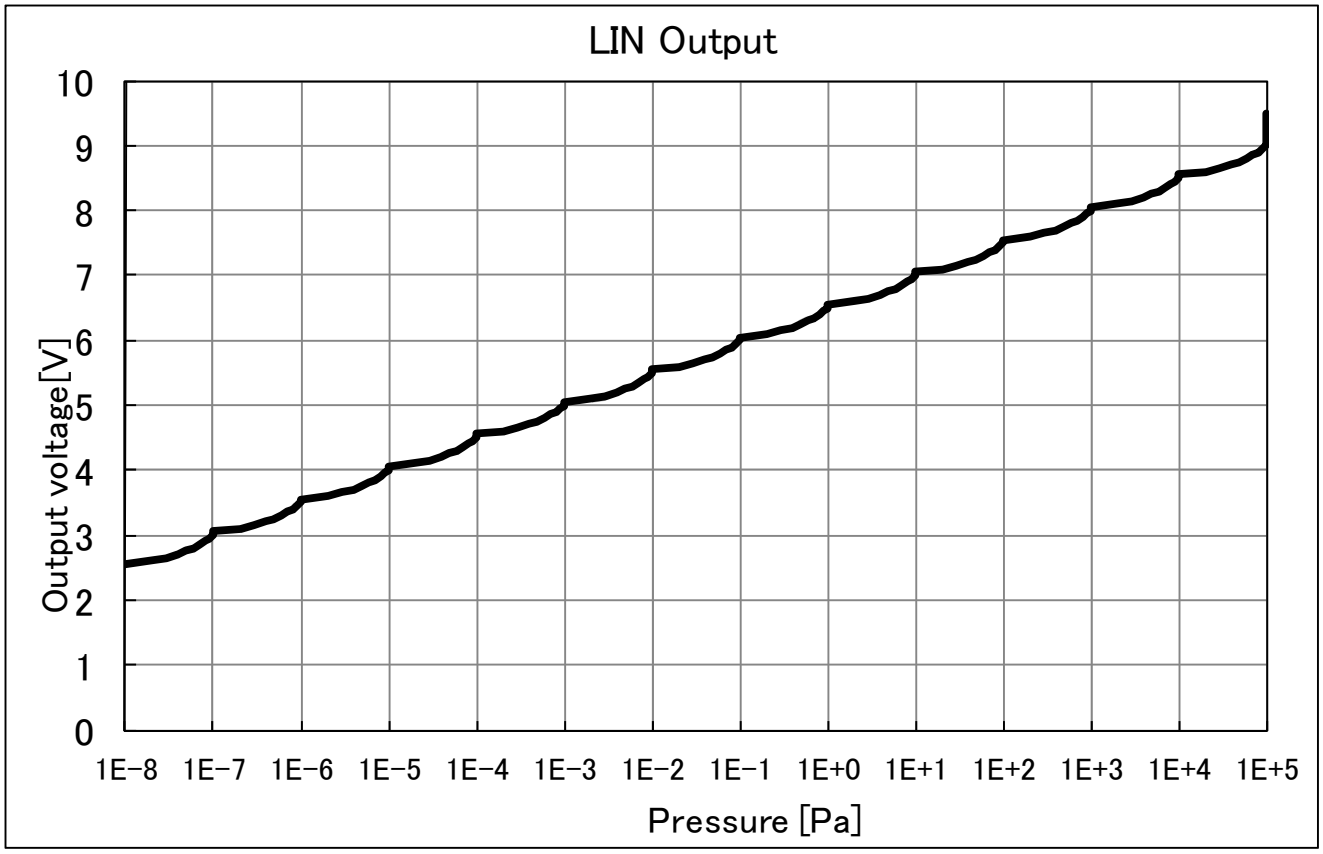


Fig. 18. LIN Output [Pa]

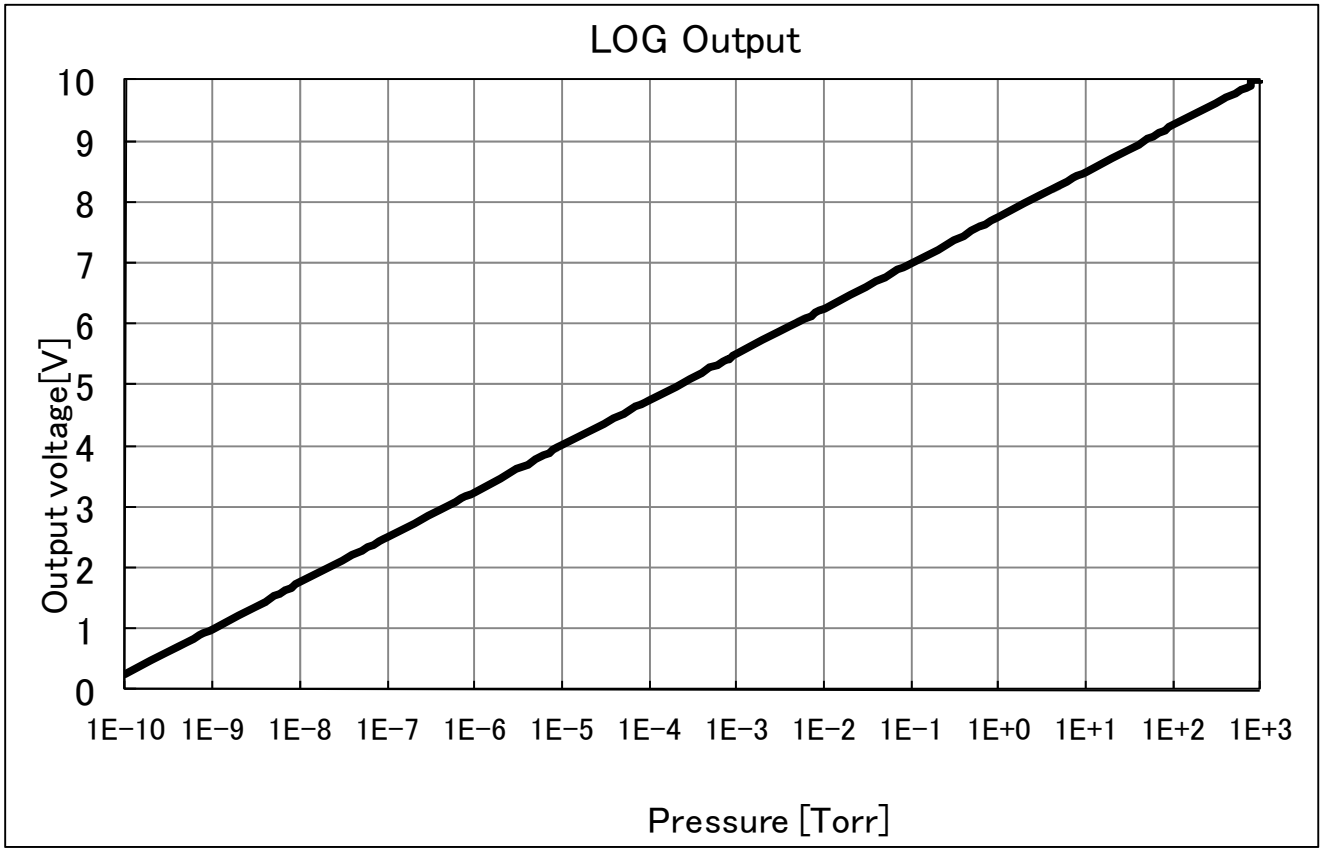


Fig. 19. LOG Output [Torr]

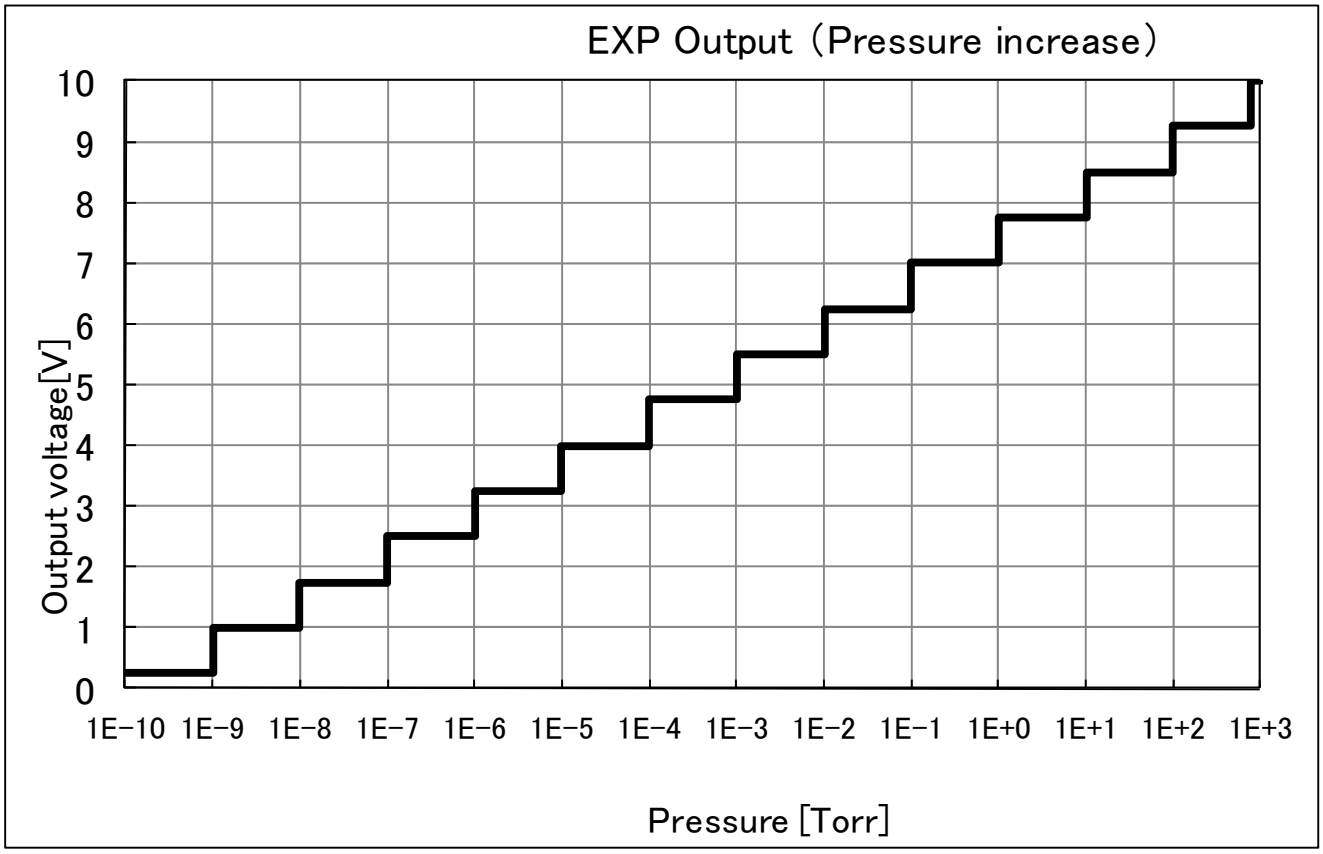


Fig. 20. EXP Output (Pressure increase) [Torr]

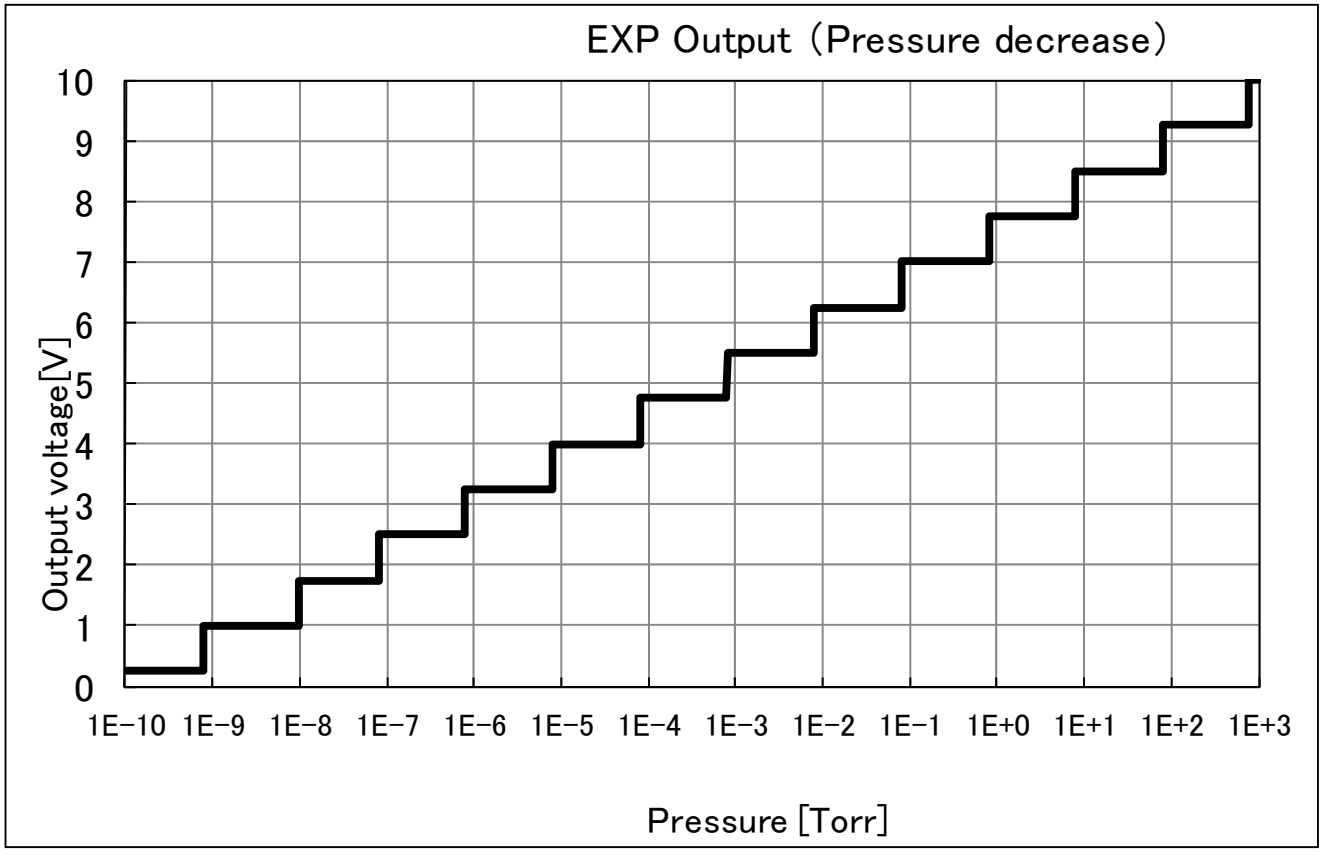


Fig. 21. EXP Output (Pressure decrease) [Torr]

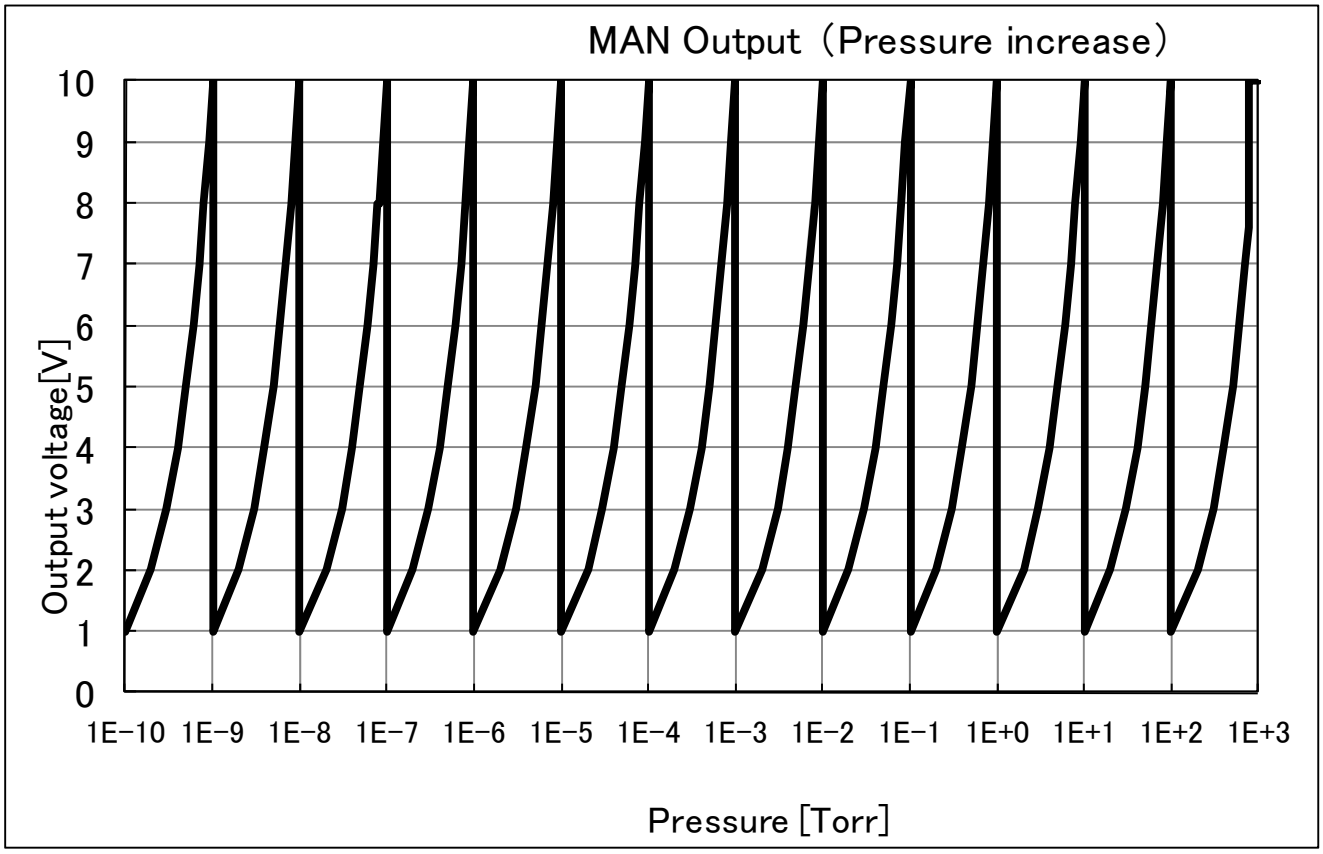


Fig. 22. MAN Output (Pressure increase) [Torr]

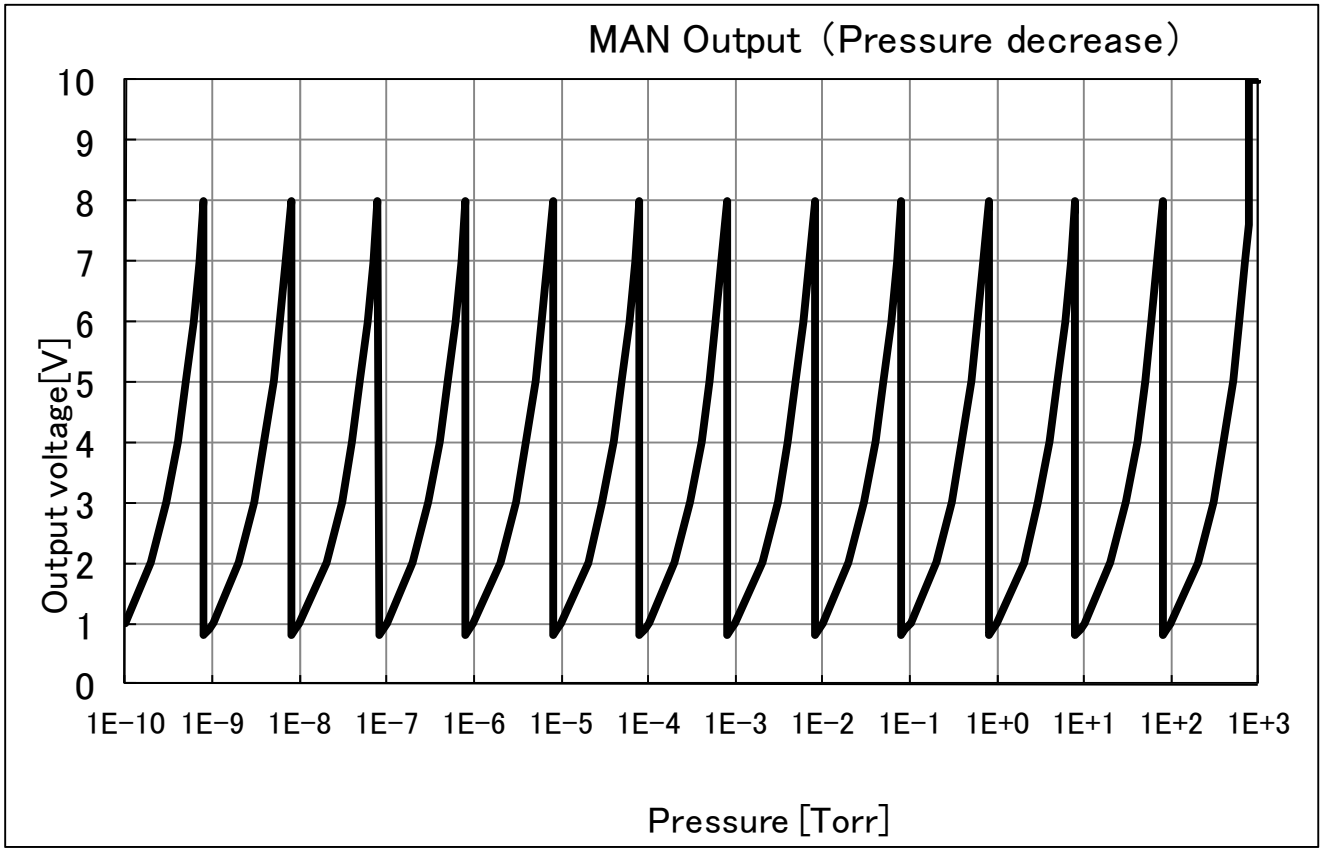


Fig. 23. MAN Output (Pressure decrease) [Torr]

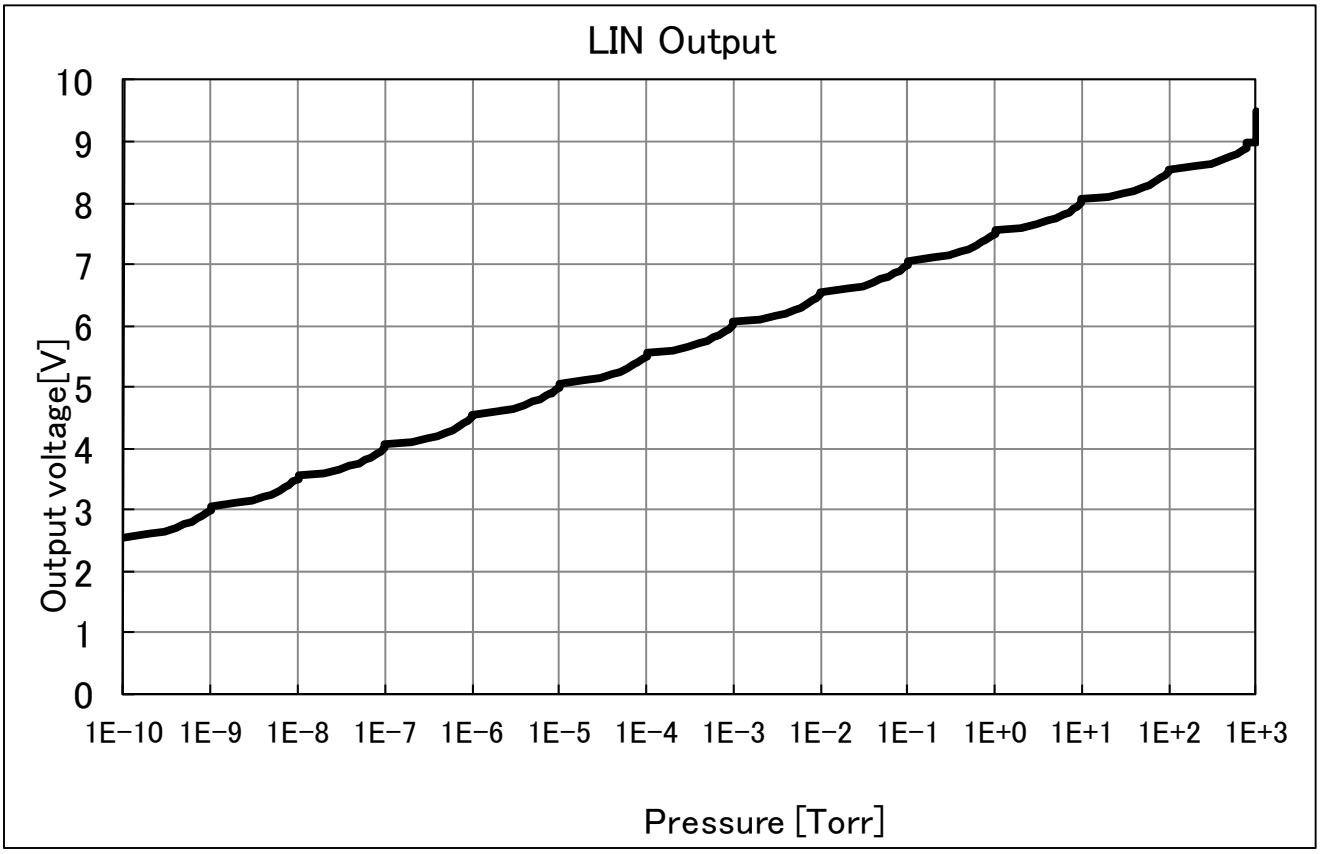


Fig. 24. LIN Output [Torr]

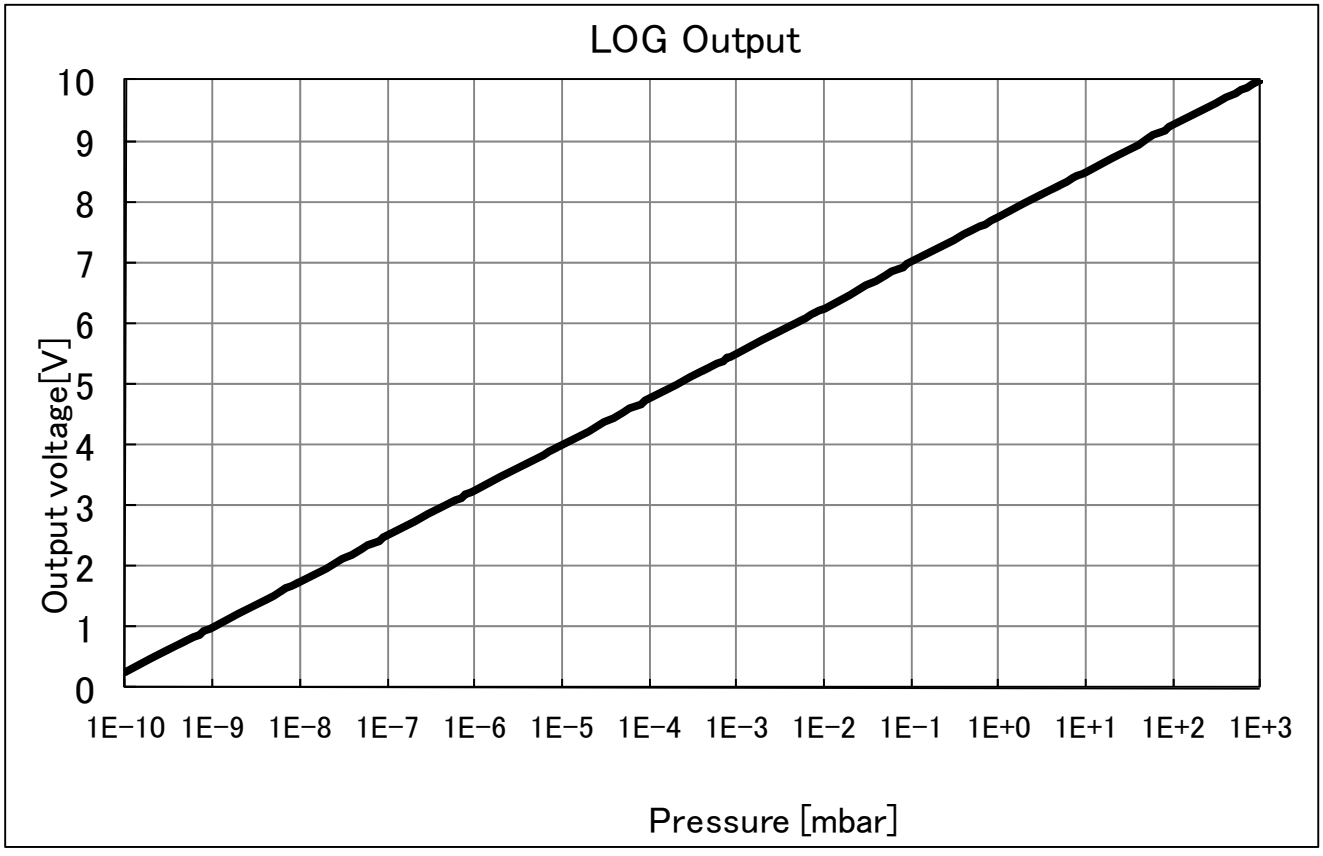


Fig. 25. LOG Output [mbar]

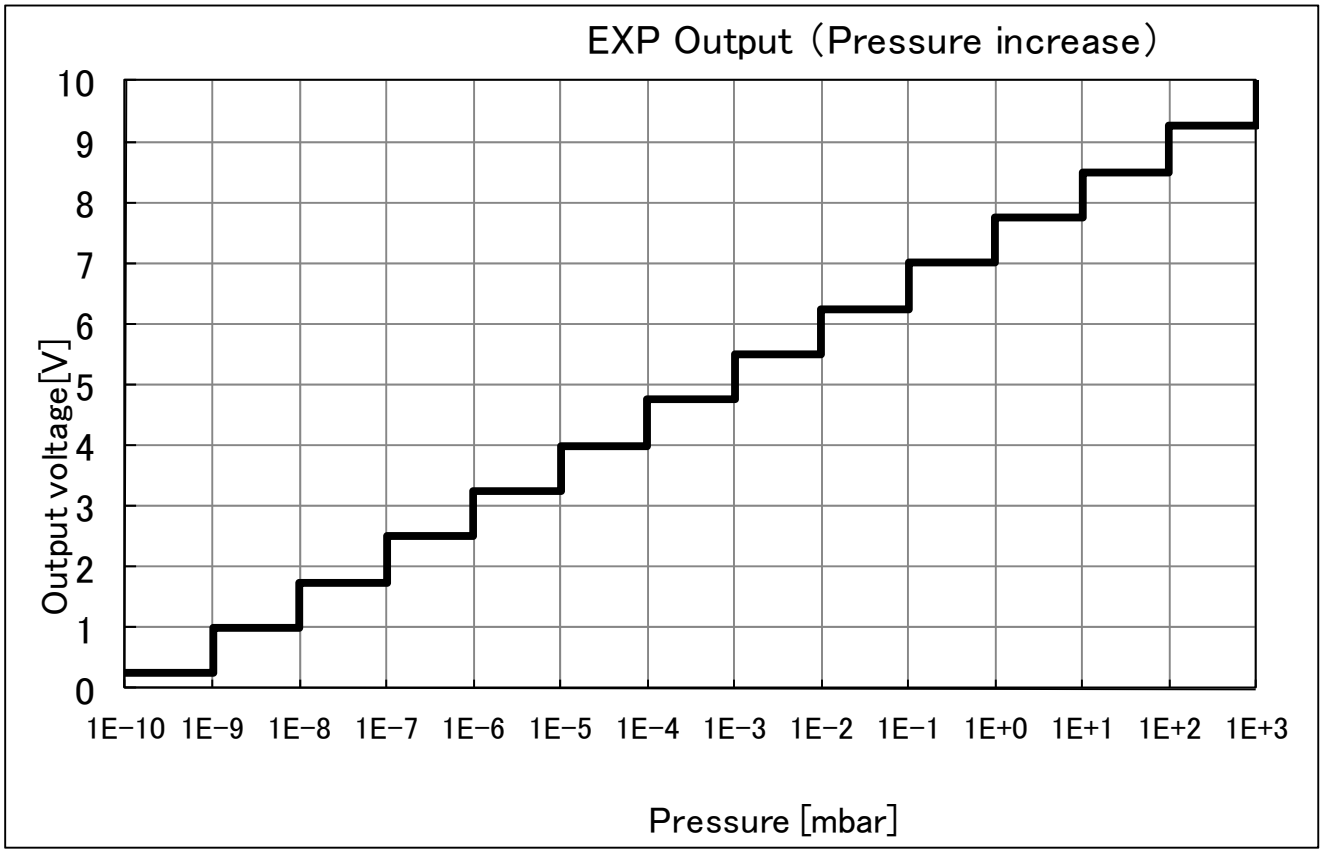


Fig. 26. EXP Output (Pressure increase) [mbar]

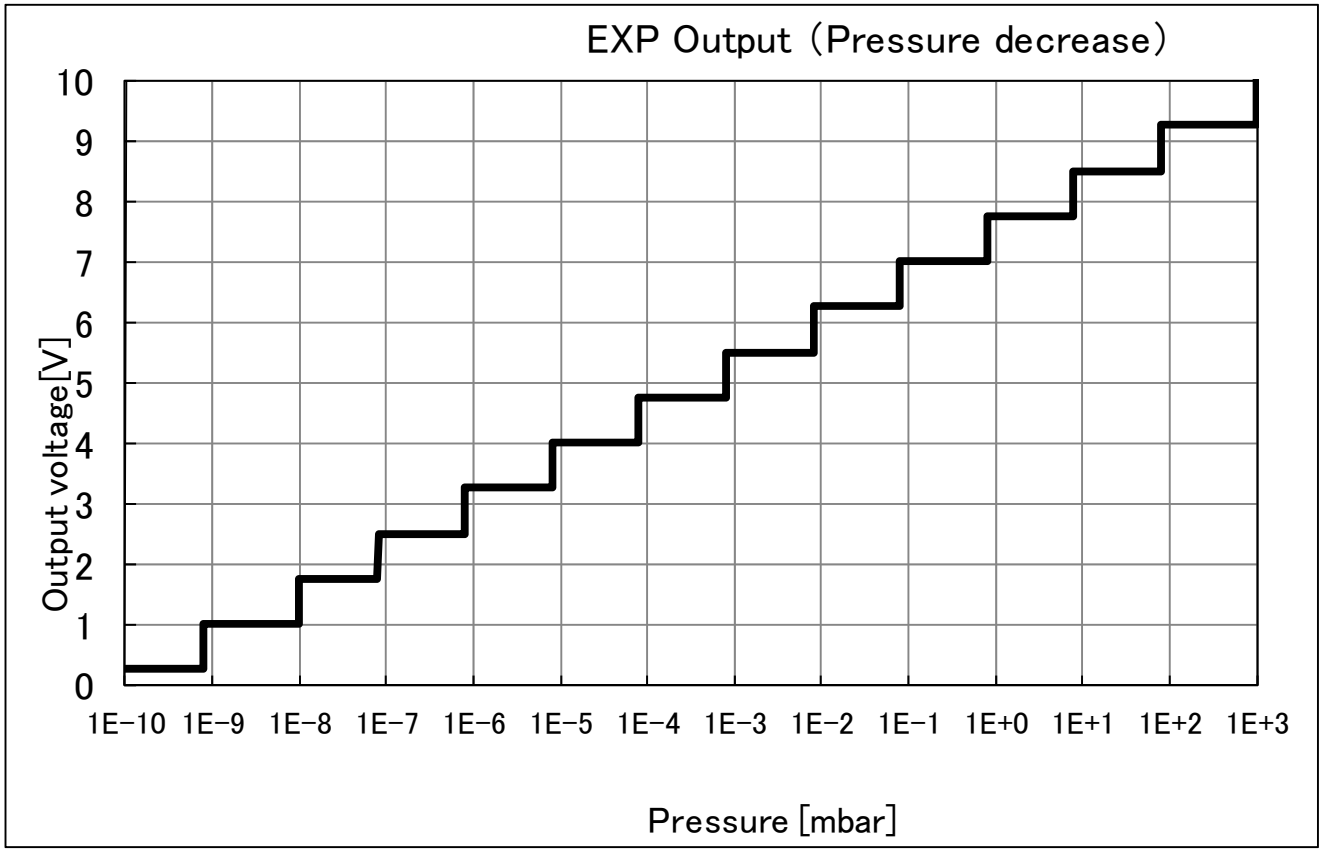


Fig. 27. EXP Output (Pressure decrease) [mbar]

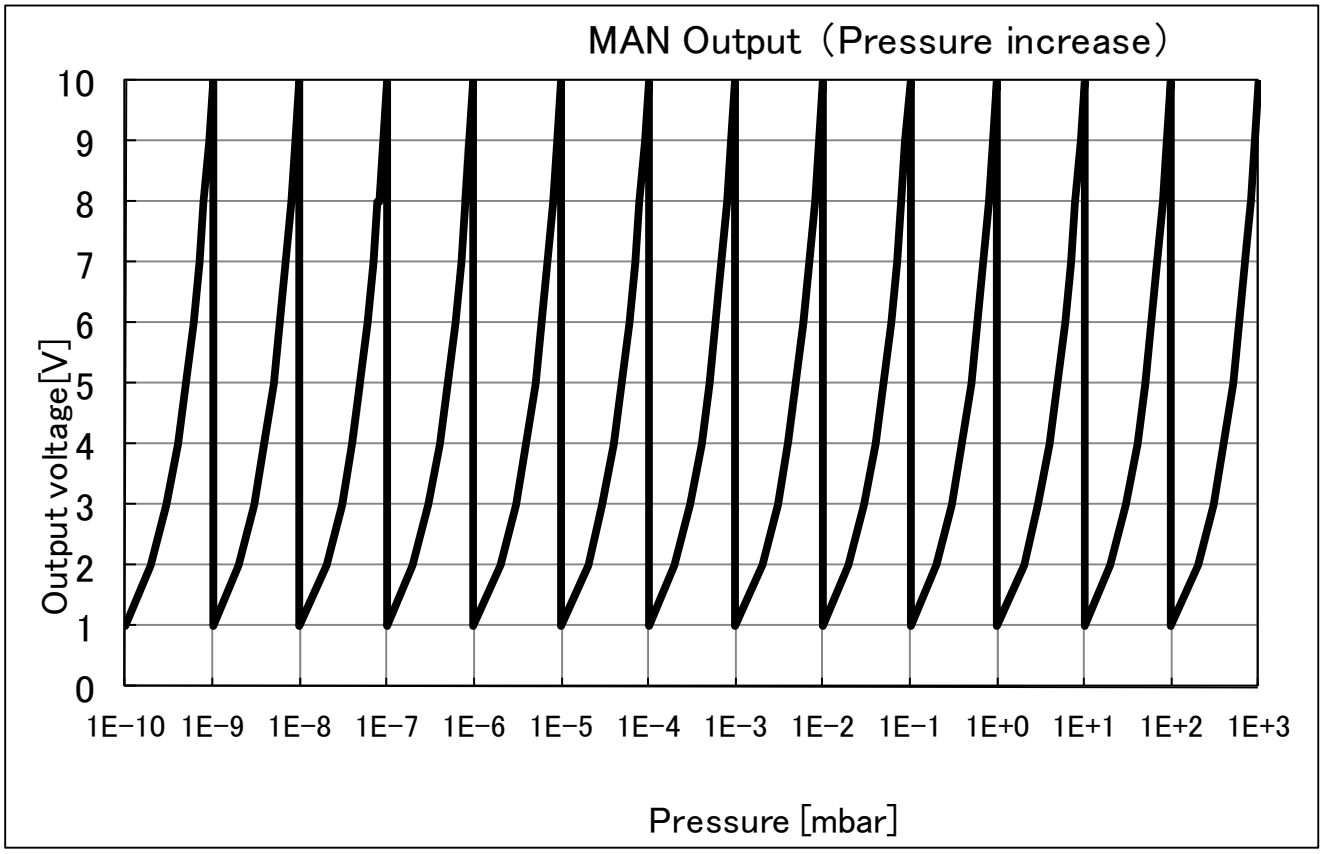


Fig. 28. MAN Output (Pressure increase) [mbar]

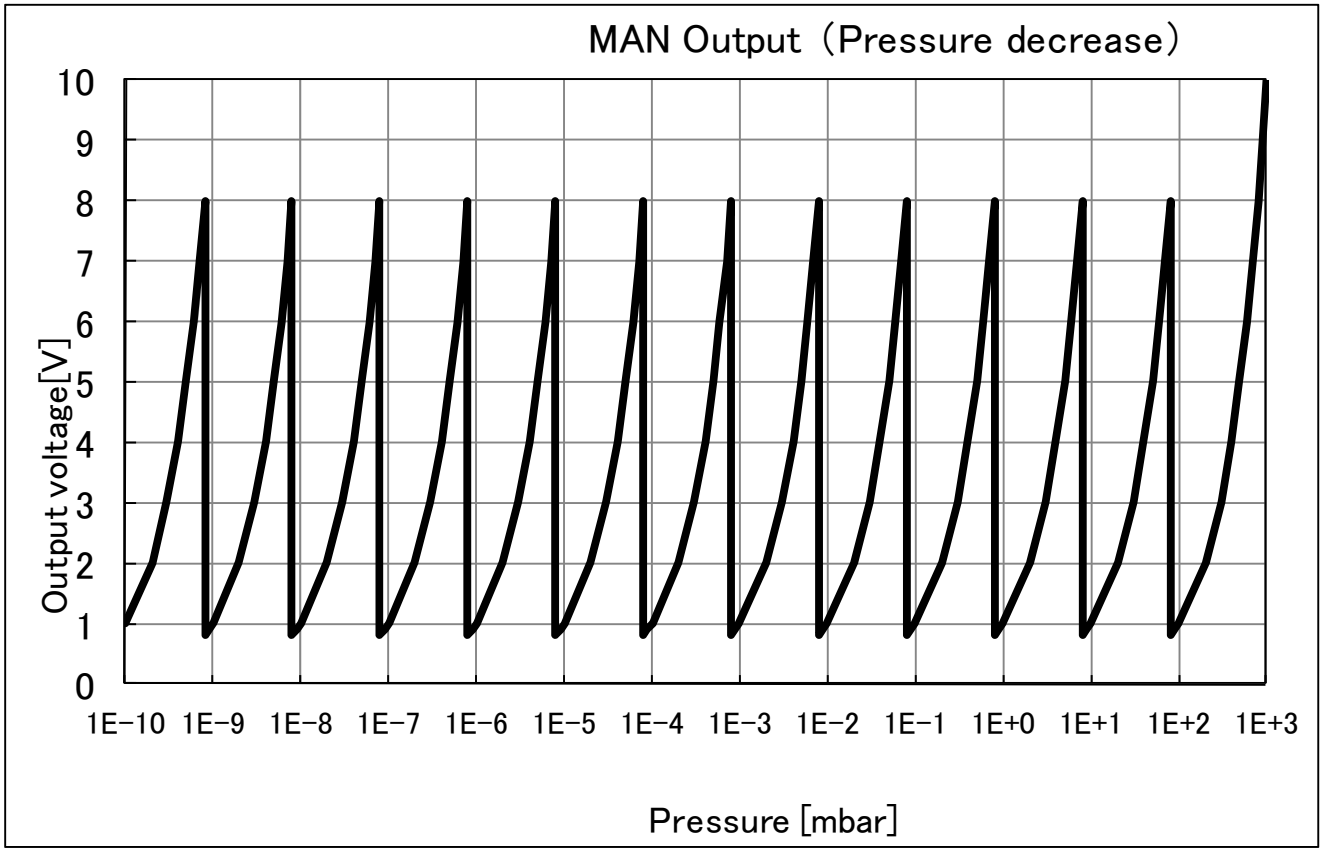


Fig. 29. MAN Output (Pressure decrease) [mbar]

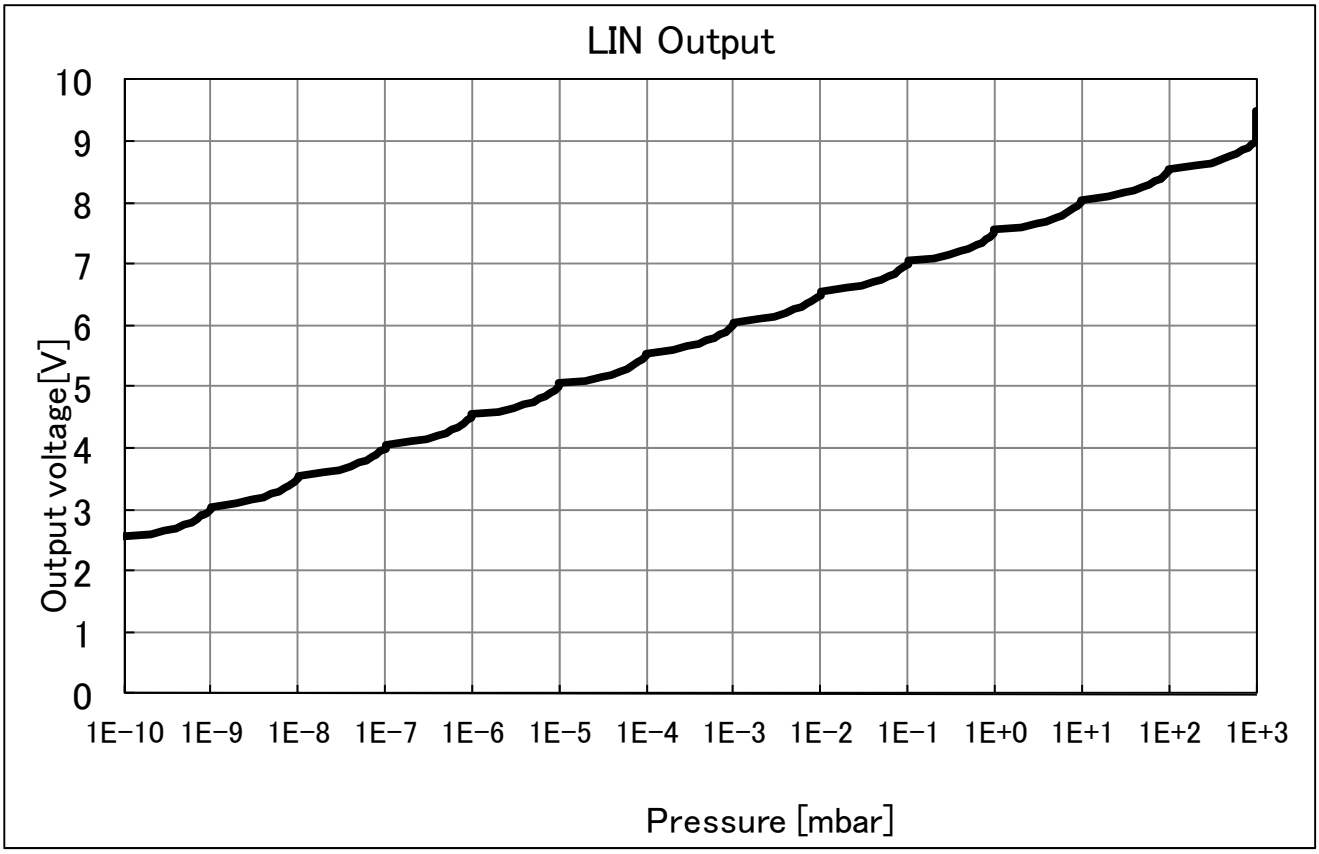


Fig. 30. LIN Output [mbar]

8.2.4. Tough Mode (Tough Mode Temperature Settings)

Tough mode can be turned ON/OFF, and the cathode heating temperature when tough mode is used can be set. The temperature can be selected from 300°C, 500°C and 600°C. (Default setting 500°C)

The temperature settings are a guide.

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.2.5. Discharge Trigger (Discharge Trigger Settings)

Set the trigger for starting discharge. Select from High Voltage or OFF. (Default setting OFF)

When High Voltage is selected, if discharge stops during pressure measurement, a high voltage (3kV) is automatically applied making it easier to start discharge. When High Voltage is selected, measurement is automatically stopped for safety reasons when the measurement pressure exceeds 0.2Pa. However, when OFF is selected, a high voltage (3kV) is not applied even when discharge is stopped. Measurement is continued even if the measurement pressure exceeds 0.2Pa.

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.2.6. Sensitivity (Sensitivity Settings)

Set the sensitivity of the CCTG200. Configure these settings to align with a standard gauge to compare with a standard pressure gauge.

The pressure is multiplied by the set value. (Default setting 1.00)

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.2.7. Combination (External Gauge Setting) (CCTG200C only)

Set whether there is a connection to an external device and the type of external device. When an external device is set, the CCTG200 automatically starts measurement when the external device falls below 0.15Pa. Similarly, when the external device exceeds 0.2Pa, the CCTG200 stops measurement. The type of external device can be set as either log output or linear output.

When the Analog out voltage is set to V, the pressure calculation formula for the log output is

$$\text{Pressure} = 10^{A(V-B)}$$

The pressure calculation formula for linear output is

$$\text{Pressure} = \frac{V}{10} \times C$$

The A, B and C values can be set as desired.

(Default setting: No external device)

* For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.2.8. External Output (Output Signal Setting)

Pin-4 (set point 2) output can be set as warning signal.
The logic of each output can also be selected between positive and negative.
(Default setting: Output 4 is set point 2 signal (Normal open))

For details on the setting method, see the "TG Viewer" or "TG Display Viewer" instruction manuals, or the "Command Manual".

8.3. Setting Value List

The default values and setting ranges of each of the setting items are indicated in "Table 1. Setting Value List".

Table 1. Setting Value List

Setting Item		Default Setting Value	Setting Value Range
Unit		Pa	Pa, Torr, mbar
Set Point 1 Attack		1.0E-08Pa	1.0E-08Pa to 1.0E+05Pa 1.0E-10Torr to 7.5E+02Torr 1.0E-10mbar to 1.0E+03mbar
Set Point 1 Release			
Set Point 2 Attack			
Set Point 2 Release			
Output Control		LOG	LOG, EXP, MAN, LIN
Tough Mode		500°C	OFF, 300°C, 500°C, 600°C
Discharge Trigger		OFF	OFF, High Voltage
Sensitivity		1.00	0.01 to 99.99
Combination	Combi	No	Yes, No
	Type	Log	Log, Liner
	A	10.0	1 to 1E+5
	B	3.572	0.01 to 99.99
	C	7.780	0.01 to 99.99
External Output	4-pin	Set point 2 (NO)	Set point 2, Warning Output (Each has NO and NC)

9. Communication Interface

When the CCTG200 is connected to a computer using an RS232C cable, a dedicated application (TG Viewer) can be used to log pressure data or operate the tough gauge, and perform monitoring etc. of the status. Please contact MIRAPRO Co., Ltd. about "TG Viewer" and the instruction manual. For details, see the "TG Viewer Instruction manual.

9.1. RS232C

Table 2. RS232C Interface Specifications

Item	Spec
Interface method	Full duplex, start-stop synchronization
Bit rate	38,400bps
Data bits	8-bit
Parity bits	None
Stop bits	1-bit
Flow control	None

10. Sensitivity Differences with Different Types of Gas

The CCTG200 is a magnetron-type cold cathode vacuum gauge, and therefore the display values differ due to different measured gases even at the same pressure.

Hydrogen reduces the sensitivity of the sensor, and therefore the display is lower (0.4 times) than when nitrogen is measured.

Argon increases the sensitivity of the sensor, and therefore the display is higher (1.2 times) than when nitrogen is measured.

The sensitivity of the sensor is not different to that of when nitrogen is measured in the case of air or oxygen, etc.

11. Troubleshooting

If the CCTG200 is operating incorrectly or you think there is a problem, check the following items.

Table 3. Troubleshooting

Symptom	Possible Cause and Solution
"E602" is displayed and the pressure cannot be measured	• The CCTG200 cannot measure pressure that exceeds 0.1Pa. Evacuate sufficiently and try measuring again. (When the "8.2.5. Discharge Trigger (Discharge Trigger Settings)" settings are OFF, this alarm does not occur)
"E400", "E401" or "E410" is displayed and the pressure cannot be measured	• The heating current for the set temperature cannot flow due to a bad connection in the connector or electrode, etc. Check the connection between the sensor and the controller after power off, and then restart measurement. If the error still occurs, there may be malfunction of sensor such as bad connection of electrodes. Contact MIRAPRO Co., Ltd. • The error may stop occurring when measuring the pressure with tough mode turned off. (However, the pressure may not be measured correctly.)
"E500" is displayed and the pressure cannot be measured	• The correct high voltage cannot be output due to a controller malfunction, etc. • The insulation level between the anode and case may have deteriorated. Check whether a short is occurring between the anode and case. If a short is occurring, the sensor is damaged. Contact MIRAPRO Co., Ltd.
"1.0^{-8}" (for Pa) is displayed for a long time (more than 5 minutes).	• The pressure may have actually reached less than the 10^{-8}Pa level in the ultrahigh vacuum or extreme high vacuum cases. In all other systems, the discharge may have stopped and the CCTG200 may not be operating correctly. If "1.0^{-8}" (for Pa) is displayed for a long time (more than 5 minutes), contact MIRAPRO Co., Ltd. • When the "8.2.5. Discharge Trigger (Discharge Trigger Setting)" setting is set to High Voltage, it is easier for discharge to start, even for ultrahigh vacuum pressure. • Due to the cathode heating function and optimized control circuit, the CCTG200 can start discharge easier than standard cold cathode vacuum gauges. However, in extremely low pressure in ultrahigh vacuums, discharge start may be delayed. The time it takes for discharge to start differs greatly depending on the measurement environment and pressure, etc.
Pressure display is unstable	• Sputtering equipment, etc. may be affected by plasma. If this occurs frequently, contact MIRAPRO Co., Ltd.
Cannot change the set-point value	• When setting to a low pressure, change the setting from the Attack Point first. When setting to a high pressure change the Release Point settings first. • * The set-point settings cannot be set so that Attack Point ≦ Release Point. (See "Fig. 12. Set-point Signal Output")
Set-points do not operate	• The set-points are disabled when the Attack Point is equal to the Release Point.
Cannot start or stop measurement	• Measurement cannot be started during an alarm. Press the SW key to cancel the alarm.

If an alarm occurs, check the error code displayed in the main indicator and see "Table 4. Alarm List".

Table 4. Alarm List

Error Code	Error Details	Possible Cause and Solution
E100 E600	Internal temperature of the controller is too high.	Check whether the ambient temperature is above 40°C. Use a fan etc. to cool the controller and try measuring again.
E200	There is a malfunction in the internal power supply	The power supply voltage of the CCTG200 is lower or higher than the rated voltage. Check the voltage of the main power supply and for voltage fluctuations.
E210	There is a malfunction in the internal voltage	The standard voltage of the CCTG200 is lower or higher than the rated voltage. Check the voltage of the main power supply and for voltage fluctuations. If there is a source of noise near the device, move the source away from the device.
E300 E310 E320	There is a parameter error	Failed to read the set parameters. Restart (turn off/on) the main power supply. If this does not improve the symptoms, contact MIRAPRO Co., Ltd.
E500	There is a malfunction in the high voltage	The correct high voltage cannot be output. The controller may be damaged, or the insulation level between the anode and case may have deteriorated. If this occurs frequently, contact MIRAPRO Co., Ltd.
E601	Measurement error in the external gauge	An error has occurred in the external connection gauge. Check the external connection gauge. For details on the external connection gauge, see the instruction manual of the external gauge. For models other than CCTG200C, do not set the Combination setting to "Yes".
E602	Over-pressure	The pressure is higher than the measurable pressure range for the CCTG. Check that the pressure is within the range of 0.1 - $1.0e^{-8}$Pa.
E910	Memory error	The internal memory is not operating correctly.

Table 5. Warning List

Error Code	Error Details	Possible Cause and Solution
E400 E401	Cannot heat the sensor cathode	There is a malfunction in the CCTG200 electrode, and electrical heating cannot be performed normally. Pressure measurement may be possible by turning tough mode off, but the pressure will not be measured correctly. Therefore, replace the sensor as soon as possible.
E410	The sensor cathode has deteriorated	The electrode of the CCTG200 has deteriorated. Continuing to use this state may cause unexpected accidents to occur due to breakage of the electrode. Replace the sensor as soon as possible.
E900	Alarm log full	The alarm log contains more than 500 entries.

MIRAPRO

Contact

MIRAPRO Co., Ltd.

#103 Yaguchi bldg., kasuga, tsukuba-shi, Ibaraki-ken, Japan 305-0821

TEL: 029-893-4451　FAX: 029-893-6269

URL: https://www.mirapro.co.jp/