ONOSOKKI

TS-2800

DIGITAL TORQUE METER

INSTRUCTION MANUAL

ONO SOKKI CO., LTD.

Warranty

1. This product is covered by a warranty for a period of one year from the date of purchase.
2. This warranty covers free-of-charge repair for defects judged to be the responsibility of the manufacturer, i.e., defects occurred while the product is used under normal operating conditions according to descriptions in this manual and notices on the unit label.
3. For free-of-charge repair, contact either your sales representative or our sales office nearby.
4. The following failures will be handled on a fee basis even during the warranty period.
    (a) Failures occurring through misuse, mis-operation, or modification
    (b) Failures occurring through mishandling (dropping) or transportation
    (c) Failures occurring through natural calamities (fires, earthquakes, flooding, and lightening), environmental disruption, or abnormal voltage.
   * For repairs after the warranty period expired, contact your sales representative or our sales office nearby.

Introduction

This instruction manual is intended for the users of the TS-2800 torque meter. This manual describes the name and functions of each section of the product and its basic operational procedure.

We recommend you to read this manual thoroughly before using your TS-2800 torque meter.

This manual contains some precautions which, if ignored, could cause property damage. Be sure to follow the operational procedure described in this manual.
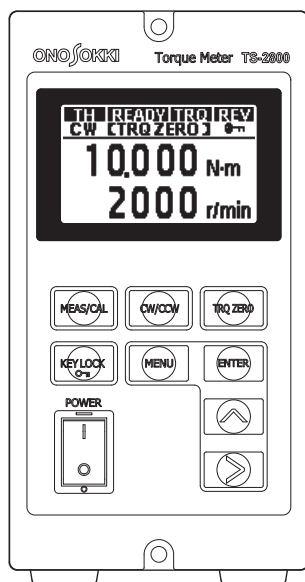
CAUTION !

- Your TS-2800 torque meter has been subjected to strict inspections before shipment in order to verify that it operates normally.

- After the product is delivered, first make sure that it has not been damaged during transportation and check each operation with reference to this manual.

- If the product is damaged or does not operate normally as described in this manual, contact the nearest Ono Sokki sales office or the distributor where you purchased the product.

For Your Safety

To ensure safe and proper use of the TS-2800 torque meter, be sure to understand warnings and precautions described in this manual and this chapter before using the product.

When operating the torque meter, follow the directions described in this manual and this chapter.

Ono Sokki, Ltd. bears no responsibility for any warranty regarding damages, failures or injuries resulting from failure to follow instructions on warnings and cautions given in this manual and this chapter.

■ Safety Indications

This manual describes possible danger or risks of the product or those you may encounter if relevant direction is ignored, and measures for avoiding such danger or risk.

A warning label is stuck on or near portions of the product with possible danger or risk.

In this manual, two terms WARNING and CAUTION are used depending on the degree of danger or risk possible. Each term has the following meaning.

⚠ WARNING	Failure to follow the instruction can lead to death or serious injury.
⚠ CAUTION	Failure to follow the instruction can lead to burn or other injury or property damage.

Precautions and notices for danger are given by three different symbols: Attention, Prohibition, and Mandatory. Each symbol has the following meaning.

Symbol	Definition	Meaning	Example
△	Attention	Indicates that failure to follow the instruction could lead to a risk of danger. The drawing in the symbol indicates the type of danger involved.	⚠
⊘	Prohibition	Indicates actions that must not be taken. The drawing in or near the symbol indicates the action that is prohibited.	⊘
●	Mandatory	Indicates an action that is mandatory. The drawing in the symbol indicates the action that you must do to avoid the danger.	⬤

■ Meaning of Warning Symbols and Labels

● Attention

⚡	Indicates a risk of electric shock.
✋	Indicates a risk of injury.
🔥	Indicates a risk of smoking or ignition.
⚠	Indicates a general precaution or warning.

● Prohibition

🚫	Do not disassemble, repair, or modify the product. It may cause electric shock or fire.
🚫	Do not use the instrument on locations subject to water or other liquid. Getting water may cause electric shock or ignition.
🚫	Do not bring the product close to fire. It may cause ignition.
🚫	Do not touch the product while your hands are wet. It may cause electric shock.
🚫	Do not touch the specified portion. Otherwise, it may cause personal injury such as electric shock or burn.
🚫	Indicates a general action which is prohibited.

● Mandatory

🔌	Unplug the power cable from the outlet. Otherwise, it may cause fire or electric shock.
❗	Indicates a general precaution or warning. Be sure to follow the relevant directions.

To ensure safe and proper use of the TS-2800 torque meter, be sure to understand warnings and precautions described in this chapter before using the product.

■ General Precautions

 WARNING

	• Use the product within the specified voltage. The standard specified voltage is 100 to 240 VAC. Using the product outside the specified voltage is very dangerous, causing fire or electric shock. Also, it may cause damages to the product. Before turning on the power, ensure that the power supply voltage is adequate.
	• Do not operate the product on locations where there is gas or steam. Using the product where steam or combustible or explosive gas is present is very dangerous as there is a risk of an explosion.
	• Avoid using the product under high temperature. Using this product at a high temperature that exceeds the operating limit is very dangerous, which could lead to fire. Avoid using the product under high temperature.
	• Do not interfere with heat dissipation. If heat is accumulated inside the product, it may cause fire. Place the product in a well-ventilated area, away from the wall, not blocking ventilation holes. Do not install the product on its side. It may cause fire.
	• Do not use the product opened or disassembled. Using the product opened or disassembled may cause a trouble, such as a failure or an electric shock. When it is necessary to make internal adjustments, inspection or repair of the product, contact the nearest Ono Sokki sales office or the distributor where you purchased it.
	• Do not splash or spill water on the product. It may cause a fire or electric shock due to short-circuit or heating. If water is sprayed over the product, disconnect the power cable immediately and contact the nearest Ono Sokki sales office or the distributor where you purchased the product.
	• Use the product within the operating temperature range (0 to +40°C). Note, however, that even within the operating temperature range, condensation may occur in the product if it is stored or used in locations subject to temperature changes. This may cause failure or malfunction. • This is a class A product. Do not use it in the residential area.
	Notice about electromagnetic environment • This product is intended the equipment to be used in industrial electromagnetic environment. • This is a class A product. In a domestic environment this product may cause radio inter- ference in which case the user may be required to take adequate measures.

■ Precautions on Electric Shock

 WARNING

	• Never cut the internal and external protective grounding lines of the product or never remove the wiring of the protective grounding terminal. It may cause electric shock or damages to the instrument.
	• Before connecting the product to the measurement target or external control circuit, make sure that the product is securely grounded and protected and that the power to the product is turned off. Connecting the product without protective grounding or with the power on is very dangerous because there is a risk of electric shock.
	• Before touching the voltage output section or the circuit connected to the voltage output section of the product, make sure in advance that the power is turned off. Touching the circuit with the power to the product on is very dangerous because there is a risk of electric shock.
	• Be sure that the power supply meets specified voltage requirements. Using any power voltage other than the specified voltage is very dangerous because there is a risk of electric shock, fire, or damage to the instrument.
	• If you hear thunder, do not touch any metal part or plug of the instrument. Conducted lightning may cause electric shock. Do not use the instrument outdoors when you hear thunder.

■ If a Problem Occurs

 WARNING

	• Immediately unplug the product if any metal, water, or foreign object should fall inside of it. Using the product under such condition may cause fire or electric shock. Immediately unplug the product, and contact the nearest Ono Sokki sales office or the distributor where you purchased the product as soon as possible.
	• If you perceive smoke, noise, or abnormal smelling coming from the product or if you accidentally drop or damage it, immediately unplug the product. Using the product under such conditions is very dangerous as it may cause fire or electric shock. After unplugging the product, promptly contact the nearest Ono Sokki sales office or the distributor where you purchased it.

■ Protective Grounding

⚠ **WARNING**

	• Be sure to ground the product to ensure safety and noise removal. Failure to do the protective grounding may cause electric shock. If the protective grounding is not performed or may not be performed securely, do not power on the product.
	• For grounding with a 3-pin plug, insert the three-pin plug of the supplied AC power cable into a 3-prong outlet as shown in the figure below.

■ Power Cable

⚠ **WARNING**
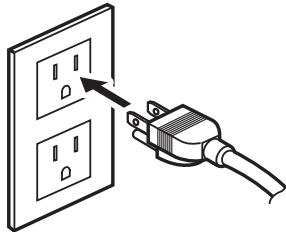
	• Use the power cable and plug supplied with the product or those specified by Ono Sokki. • Use the standard AC power cable at 125 VAC or less. When using the product in more than 125 VAC voltage, be sure to use the specified power cable (withstand voltage 250 VAC or more) provided as an option by Ono Sokki.
	• If the product is expected to be not used for a long period, be sure to unplug the power plug from the AC outlet. Failure to do so is very dangerous because there is a risk of electric shock or fire from a short circuit due to degraded insulation.

	• Do not use an extension cable without protective grounding for the 3-prong power cable. Doing so disables the protective grounding.
	• To prevent electric shock, be sure to set the power switch to the OFF position (○) before connecting or disconnecting the power cable.
	• Be sure to use the power cable that satisfies the following specifications. Using an inadequate power cable may cause fire or other hazards. • Power cable specifications (USA/CSA-certified detachable cable) Cable length: 2m Type: STV (3-pin cable) Rating: AC125V Size of wire: AWG18
	• The protective grounding of the power cable is class I. Thus, be sure to connect the protective grounding terminal.

■ Installation

⚠ CAUTION

	• Do not install the product in an unstable place. The product may drop or fall down, causing injuries or damage to the product.
	• Do not put any large or heavy item on the product. The item placed on the product may drop or fall down, causing injuries or damage to the product.
	• Do not install the product in locations where there is oily smoke, steam, high humidity, or a lot of dust. Electricity could conduct the oil, water or dust to cause a fire or electric shock.
	• Do not install the product in locations where temperature exceeds the operating temperature range or it will be subject to direct sunlight. Otherwise, it may cause fire.
	• When mounting the TS-2800 on a panel or rack, use the structure that supports the bottom of the TS-2800.

■ Power Cable

<div style="text-align:center">⚠ CAUTION</div>

🚫	• Be sure to hold the power plug when connecting or disconnecting the power cable. Pulling the cable may damage or tear off the cable, which could lead to fire or electric shock.
	• Do not connect or disconnect the power cable with wet hands. It may cause electric shock.
	• Keep the power cable away from heat equipment and any thing that generates high temperature. Otherwise, the covering of the power cable may be melt, causing fire or electric shock.

■ Precautions in Measurement

<div style="text-align:center">⚠ CAUTION</div>

🚫	• Do not attach or detach I/O connectors during measurement. It may cause abnormal operation of external devices.
	• Do not turn off power during measurement. External devices connected to the product may cause an abnormality.
	• When using measurements as the feedback signal for control, ensure interlock with the READY signal output from the REMOTE connector.
	• The TRQ IN [TH] connector on the rear panel includes a +24V output to supply power to the torque detector. Never short-circuit the connector.
	• Be careful of the voltage output for the revolution detector. • The REVO IN connector on the back panel includes a +12 V output (C pin) to supply power to the revolution detector. Do not short-circuit the connector.
	• Do not short-circuit the analog voltage output. • Do not short-circuit the + and - pins of the TRQ OUT and REV OUT connectors on the rear panel. It may cause failure.
	• When connecting the product to the torque detector, be sure to use the signal cable (supplied or purchased separately) specified by Ono Sokki. Using another cable may not only affect the accuracy of measurements but also may damage the product.

■ Cleaning

⚠ CAUTION

🚫	• Wipe the dirt attached to the product with a soft dry cloth. If it is extremely dirty, wipe with a cloth moistened with neutral detergent. Note that before beginning to wipe, firmly wring the moistened cloth.
	• Do not use organic solvents (alcohol, ether, paint thinner, etc.) because they may deform or discolor the product.

Checking Supplied Items

Make sure that you have all the items for the TS-2800 torque meter with reference to the following list.

■ Supplied items

Number	Product name	Model	Quantity	Remarks
①	Torque meter	TS-2800	1	Main unit
②	AC power cable	AX-203	1	
③	Connector	FK-MC 0,5/8-ST-2,5	1	For remote control (torque meter supplied with this connector on)
④	Instruction Manual	–	1	This manual

①

②

③ *Mounted on the main unit

④
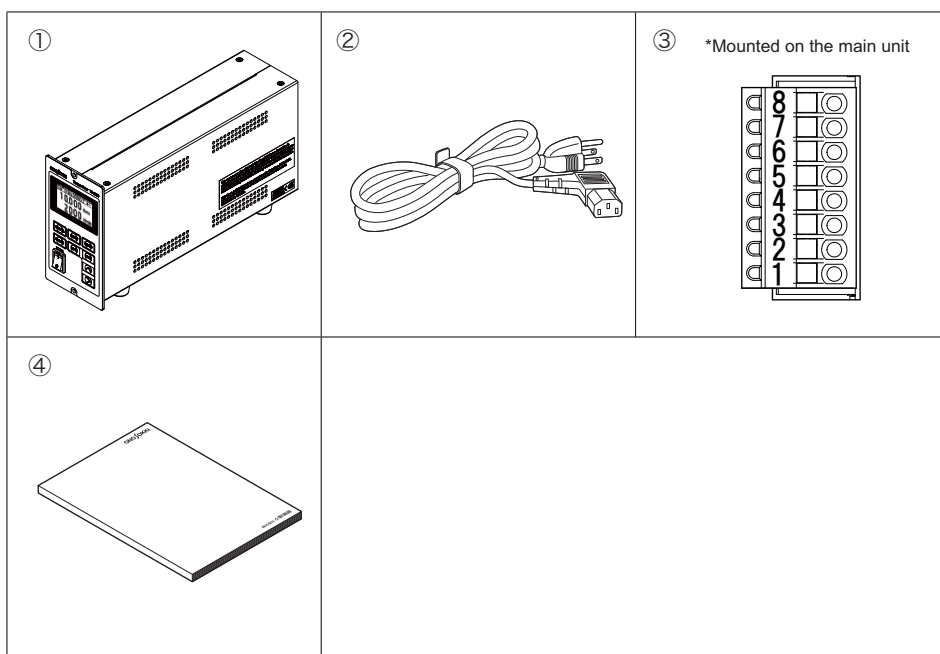
CAUTION !
- If any item is missing or damaged, immediately contact the nearest Ono Sokki sales office or the distributor where you purchased the product.
- The items shown above are supplied with the standard unit. Optional devices are not included. If you have purchased optional devices, also make sure that you have all the purchased optional items.

CONTENTS

1. Overview of TS-2800 Torque Meter

1.1 Overview of TS-2800

The TS-2800 torque meter is designed to be used with Ono Sokki's torque detectors.

The TS-2800 torque meter is used in combination with a torque detector of phase-difference method using an electromagnetic gear (including SS, MD, DD, and DSTP series; hereafter collectively called SS type torque detector) or with a TH type torque detector (phase-difference method using electromagnetic induction theory; hereafter called TH type torque detector). In these combinations, the torque meter can convert the detected phase difference signal into torque values. This torque meter automatically recognizes the SS type and TH type torque detectors.

The TS-2800 torque meter is equipped with an analog voltage output as standard. By connecting the analog voltage output to external devices such as a data recorder and analyzer, measurements can be recorded and analyzed continuously.

The TS-2800 torque meter is also equipped with a standard digital output via which the meter can be connected to a data processor.

■ Feature of TS-2800

- Compact size: 76 mm wide, 142 mm high, and 262 mm deep.

- Usable in the range from 100 VAC to 240 VAC without switching between the 100 V system and 200 V system power supplies

- Automatically distinguishes the SS type and TH type torque detectors

- Easy to connect to the control system, recorder, and data processor because the analog output is isolated.

- Easy to connect to external recorders by using RS-232C and BCD outputs (options) as external device interfaces.

- Analog output response (time constant) is selectable depending on the application.

- A fourth-order Butterworth low-pass filter can be selected. (Available when the TS-0281 High-speed response output function (option) is installed.)

- Can output an input rotation detector signal as a pulse signal. (Available when the TS-0284 Rotation pulse output function is installed.)

1.2 System Composition (Connections of Peripheral Devices)

The TS-2800 torque meter can be connected to Ono Sokki's SS type torque detectors and TH type torque detectors as well as other recording or data processing devices depending on the application.

The following figure shows some of the peripheral devices that can be connected to the TS-2800 torque meter.

FFT analyzer

DS-3000

Analog voltage output

Recorder

Remote contact input/output

PLC
(Programmable Logic Controller)

RS-232C output

PLC
(Programmable Logic Controller)

Digital output

BCD digital gauge

Rotation detector

Rectangular wave signal output
(MP-981, etc.)

Torque detector

TH type torque detector

TS-2800

*Option

Torque signal input
〈TRQ IN [TH]〉

〈TRQ OUT〉

〈REVO OUT〉

〈REMOTE〉

〈RS-232C〉

〈BCD OUT〉

〈REVO IN〉
Rotation signal input

Torque signal input
〈TRQ IN [SS]〉

SS series, standard type	
DSTP series, heavy duty type	
DD series, compatible with high-speed rotation	
MD series, compatible with small torque	

SS type torque detector

Torque detector

Note
• For selection of peripheral devices suitable for your application and details on the configuration of torque measurement system, contact the nearest Ono Sokki sales office or the distributor.

1.3   Precautions on TS-2800 Wiring

In recent years, there is an increasing number of testing instruments that use or measure inverters.

The inverter may generate noise due to its working mechanism, and the noise adversely affect the peripheral devices, including the torque meters.

The extent of impact cannot be determined simply, since various factors (such as inverter noise amount, signal line laying conditions, device installation conditions, distance from the inverter) interact with one another.

Observing the following precautions on wiring will help to reduce troubles that could be caused by the inverter noise.

Ono Sokki recommends you to observe the following precautions on wiring since they are also effective to reduce other troubles.

■ Precautions on Wiring

● **Take measures against radiated noise on the inverter and motor sides.**

● **Separate the main circuit I/O wire of the inverter from the power and signal lines of the torque meter (torque detector cable and rotation detector cable).**
The separation distance should be at least 300 mm. If ensuring an enough distance is difficult or the separation is not effective, pass the power and signal cables of the torque meter through metal ducts, then grounding one side of the cables.

● **Use the supplied power and signal cables.**

● **Be sure to ground the frame on which the torque detector is installed.**

● **Use different power systems for the torque meter and the inverter.**
If there is no effect, provide a noise-cut transformer such as for anti-EMI.

2. Component Names and Functions

2.1 Display, Keys and Switches on the Front Panel
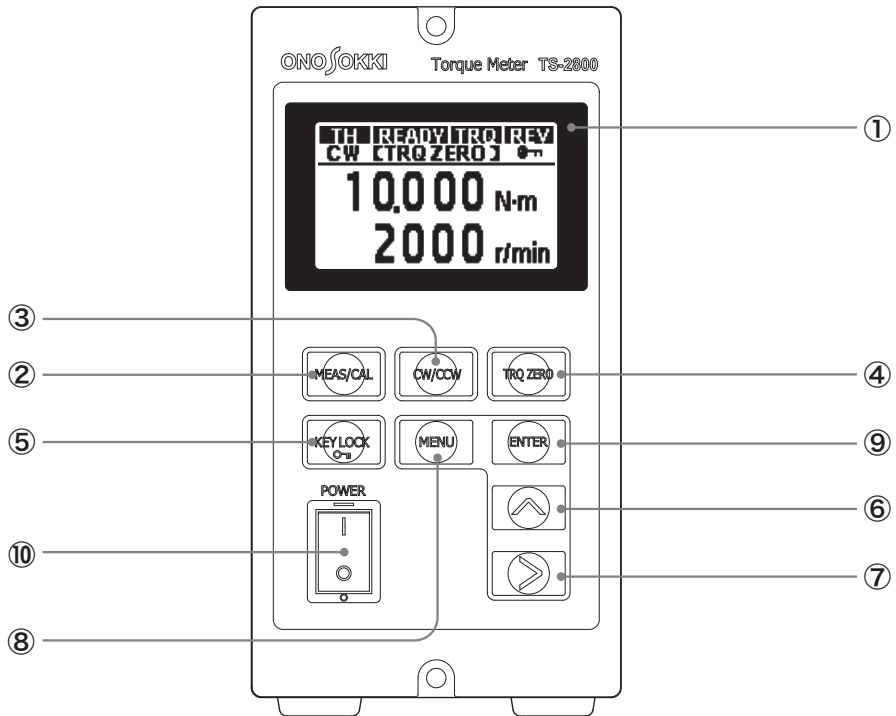
① **Display**

Shows digital values of measurements or the status of measurement.

For details, refer to the page 19 "Individual Indications on the Display".

② **MEAS/CAL key**

Switches between the measurement mode (MEAS) and the calibration mode (CAL).

The measurement mode (MEAS) and the calibration mode (CAL) are alternated each time the key is pressed down for 3 seconds.

③ **CW/CCW key**

Pressing down the key for 3 seconds switches between CW (clockwise) and CCW (counterclockwise). Other functions are available depending on the type of the torque detector connected.

For SS type: The key sets the rotation direction of the rotating body to be measured. The key switches between the torque zero-point correction values for each rotation direction.

For TH type: The key sets the polarity of torque output. The torque generated with CW selected is output as a positive value and shown on the display. When CW is selected, the rotating body rotates clockwise viewed from the drive side.

CAUTION !

*   Note that the CW/CCW key is enabled when the KEY LOCK ☞ is hidden (unlocked) and the external input of the rotation direction is OFF (refer to the page 47 "Setting Rotation Direction and Torque Polarity").

④ **TRQ ZERO key**

Correct the zero point of torque.

Pressing down the key for 3 seconds shows [TRQ ZERO] on the display, and executes the correction calculation. Upon completion of correction processing, [TRQ ZERO] disappears from the display.

Other functions are available depending on the type of the torque detector connected.

For SS type: The key performs zero-point correction of torque in the rotation direction selected by the CW/CCW key. Individual correction values in CW and CCW are saved.

For TH type: The key performs zero-point correction of torque. Unlike the SS type torque detectors, the same value is saved for both CW and CCW because there is no value difference between the both rotation directions due to the principle of detection.

CAUTION !

*   The TRQ ZERO key becomes available when the KEY LOCK ☞ is hidden (unlocked).

⑤ **KEY LOCK key**

This key prevents malfunction that could be caused by accidental key operation. While the KEY LOCK key is enabled, any other keys are disabled.

Pressing down the KEY LOCK key for 3 seconds in unlocked status switches to the locked status with the key icon ⚷ indicated.

Pressing down the KEY LOCK key for 3 seconds in locked status switches to the unlocked status and ⚷ disappears from the display.

Note

• KEY LOCK key status during measurement
Set KEY LOCK icon ⚷ on the display and lock the other keys to prevent their incorrect operation during measurement.

⑥ ⟨⟨⟩ **key**

This key is used when a parameter value is input.

Each time the ⟨⟨⟩ key is pressed, the selected item or setting is changed or the numeric value at the cursor is incremented by one.

⑦ ⟨⟩⟩ **key**

This key is used when a parameter value is input.

Pressing the ⟨⟩⟩ key moves the cursor indicating the input position to the right.

⑧ **MENU key**

This key is used to change to the setting mode.

Pressing down the MENU key for 3 seconds switches to the setting mode in which conditions can be set or changed.

Pressing the MEAS/CAL key in setting mode changes back to the normal measurement mode.

⑨ **ENTER key**

This key is used when a parameter value is input.

Pressing the ENTER key decides the setting or moves to the next setting item.

⑩ **POWER switch**

This switch turns on or off the power to the TS-2800 torque meter.

Pressing the POWER switch upward (|) turns on the power.

Pressing the POWER switch downward (○) turns off the power.

2.2   Individual Indications on the Display
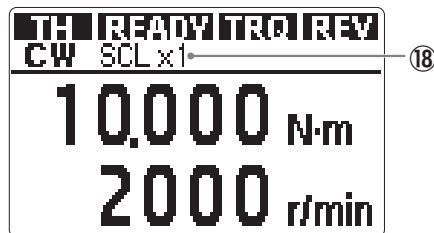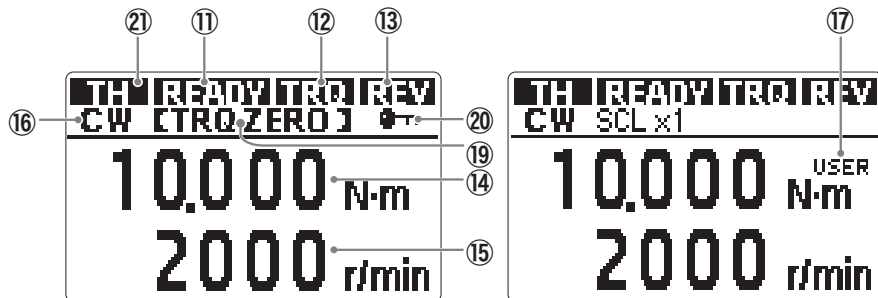
⑪ **READY**

READY is normally displayed during measurement.

This item is indicated when all of the following conditions are satisfied.

• **TRQ** is indicated.

• The CLR IN pin of the REMOTE connector is open.

• In measurement mode

⑫ **TRQ**

TRQ is indicated when the measurement signals (both SIG1 and SIG2) are input from the SS type torque detector or TH type torque detector.

This item blinks if the torque measurement value exceeds the torque capacity (for TH type, rated torque).

⑬ **REV**

REV is indicated when a signal is input from a rotation detector such as electromagnetic rotation detector MP-981.

This item blinks if the measurement value of rotation speed exceeds the rotation capacity setting.

⑭ **Torque value**

Indicates the torque value.

With SS type torque detectors, the value is indicated in four digits with polarity. With TH type torque detectors, it can be indicated in four or five digits (selectable) with polarity.

⑮ **Rotation speed**

Indicates the value of rotation speed.

The value can be indicated in five digits.

⑯ **CW·CCW**

Indicates the direction selected by the CW/CCW key or by the direction input by the external rotation direction changeover function.

* For the polarity settings of the rotation direction, refer to the description on the rotation directions. For SS type, the polarity means the rotation direction of the shaft, and for TH type, it means the torque direction.

⑰ **USER**

This item is indicated when the torque value is adjusted by the user (when the adjusted value is other than 1.0000).

⑱ **SCL**

Indicates the full scale setting for the analog output TRQ OUT of torque value.

⑲ **[TRQ ZERO]**

This item is indicated for about 1 second when the TRQ ZERO key is pressed to execute zero adjustment.

⑳ ⌐o

This icon is indicated in the locked status by pressing down the KEY LOCK.

㉑ **Detector type**

The type of the connected detector is indicated.

SS is indicated for the SS type torque detectors, and TH is displayed for the TH type torque detectors.

2.3 Connectors on the Rear Panel
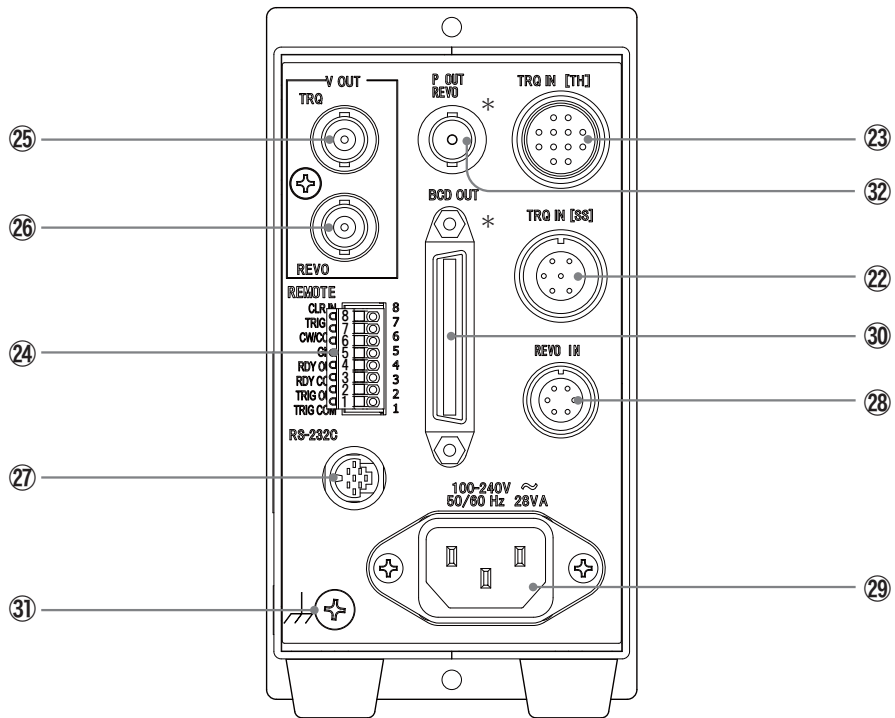
*Option
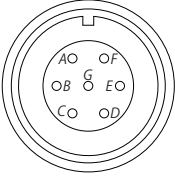
The connector is mounted only when the relevant optional device is supplied.

㉒ **TRQ IN [SS]**

This is the signal input connector to the SS type torque detector. Besides the SS series, other series of phase-difference torque detectors such as MD, DD, and DSTP can be connected to this connector.

Applicable connector (plug): TRC116-12A10-7M10.5 (Tajimi Electronics)

Connector (receptacle): TRC116-23A10-7F (Tajimi Electronics)

Pin assignment (receptacle)	Pin	Signal name
	A	SIG1
	B	SIG2
	C	SIG1GND
	D	SIG2GND
	E	NC
	F	GND
	G	NC

㉓ **TRQ IN [TH]**
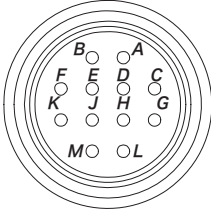
CAUTION !

*   The TRQ IN connector has a +24V voltage output pin C to supply power to the TH type torque detector. Never short-circuit this pin C.

This connector is used to input signals from the TH type torque detector.
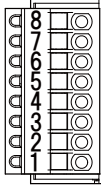
Applicable connector (plug): R03-PB12M

Connector (receptacle): R03-R12F

Pin assignment (receptacle)	Pin	Signal name
	A	SIG1 +
	B	SIG1 -
	C	+24V
	D	N.C. (Not connected)
	E	SIG1 Shield
	F	SIG2 +
	G	GND
	H	Reserved
	J	SIG2 Shield
	K	SIG2 -
	L	Reserved
	M	Reserved

㉔ **REMOTE**

This connector is used to input/output external control signals.

Applicable connector	FK-MC0,5/8-ST-2,5 (Phoenix Contact)		
Pin assignment	Pin	Signal name	Remarks
	8	CLR IN	Contact input (Common is common.)
	7	TRIG IN	
	6	CW/CCW Switch	
	5	GND	
	4	READY OUT	No-voltage contact output (Common is separate.)
	3	READY OUT COM-1	
	2	TRIG OUT	
	1	TRIG OUT COM-2	

㉕ **V OUT TRQ**
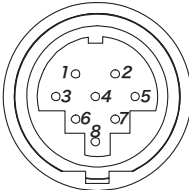
This connector is used for analog voltage output of torque data. Applicable connectors are C02 type (BNC) connectors.

㉖ **V OUT REVO**

This connector is used for analog voltage output of rotation speed data. Applicable connectors are C02 type (BNC) connectors.

㉗ **RS-232C**

Interface connector to RS-232C.
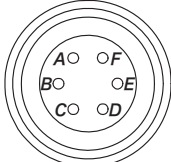
Applicable cable	AX-5022, 2 m (Ono Sokki)		
Applicable connector	HR212-10P8PSAT3042 (Hirose Electric)		
	Pin No.	Signal name	Function	Input/output
Pin assignment	1	FG(AA)	N.C. (Not connected)	-
	2	RxD(BB)	Data reception	Input
	3	TxD(BA)	Data transmission	Output
	4	CTS(CB)	Clear to transmission	Input
	5	RTS(CA)	Transmission request	Output
	6	-	N.C. (Not connected)	-
	7	SG(AB)	Signal ground	-
	8	-	N.C. (Not connected)	-

㉘ **REVO IN**

This connector is used to input signals from the rotation detector.

Applicable connector (plug): R03-PB6M

Connector (receptacle): R03-R6F

Pin assignment (receptacle)	Pin	Signal name
	A	SIG
	B	N.C. (Not connected)
	C	12V
	D	GND
	E	SIG COM
	F	12V COM

CAUTION !

* Do not make short-circuit the pin C to any other pin. If the pin C is made short-circuit, the power fuse for the rotation detector will be blown off.

㉙ **AC INPUT**

This connector is used to input the AC power signal.

Applicable cable	AX-203 (accessory)
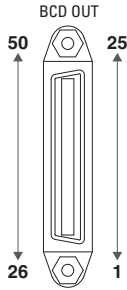
CAUTION !

* Use the power cable and plug supplied with the torque meter or those specified by Ono Sokki.
Use the standard AC power cable at 125 VAC or less. When using the product at over 125 VAC, be sure to use the specified power cable (withstand voltage: 250 VAC or more) provided as an option by Ono Sokki.
Be sure to use 3-prong outlets. (Refer to the page 6.)

㉚ **BCD OUT (optional)**

This connector is used for BCD output of torque and rotation speed data.

For details, refer to the page 74 "TS-0283: BCD Output".

Applicable plug	DX40-50P (Hirose Electric)		
Plug cover	DX-50-CV1 (Hirose Electric)		

Pin assignment

BCD OUT

50 ← ↑ → 25

26 ← ↓ → 1

Pin No.	Signal name	Pin No.	Signal name
1	Torque data $1×10^0$	26	Rotation speed data $2×10^1$
2	$2×10^0$	27	$4×10^1$
3	$4×10^0$	28	$8×10^1$
4	$8×10^0$	29	$1×10^2$
5	$1×10^1$	30	$2×10^2$
6	$2×10^1$	31	$4×10^2$
7	$4×10^1$	32	$8×10^2$
8	$8×10^1$	33	$1×10^3$
9	$1×10^2$	34	$2×10^3$
10	$2×10^2$	35	$4×10^3$
11	$4×10^2$	36	$8×10^3$
12	$8×10^2$	37	$1×10^4$
13	$1×10^3$	38	$2×10^4$
14	$2×10^3$	39	$4×10^4$
15	$4×10^3$	40	$8×10^4$
16	$8×10^3$	41	N.C. (not connected)
17	$1×10^4$	42	Torque polarity output "−"
18	$2×10^4$	43	Torque polarity output "+"
19	$4×10^4$	44	N.C. (not connected)
20	$8×10^4$	45	N.C. (not connected)
21	Rotation speed data $1×10^0$	46	N.C. (not connected)
22	$2×10^0$	47	$\overline{\text{HOLD input}}$
23	$4×10^0$	48	$\overline{\text{BUSY input}}$
24	$8×10^0$	49	$\overline{\text{Print command output}}$
25	$1×10^1$	50	Common

*The upper bar of the signal name indicates negative logic input/output.

㉛ **Functional ground terminal**

This terminal is used for functional grounding.

CAUTION !

* When performing measurement, be sure to connect the functional ground of the torque detector and the functional ground terminal of the torque meter.

㉜ **Rotation speed pulse output (option)**

This connector is used to output rotation speed pulses.

Applicable connectors are C02 type (BNC) connectors.

2.4   Lateral Face
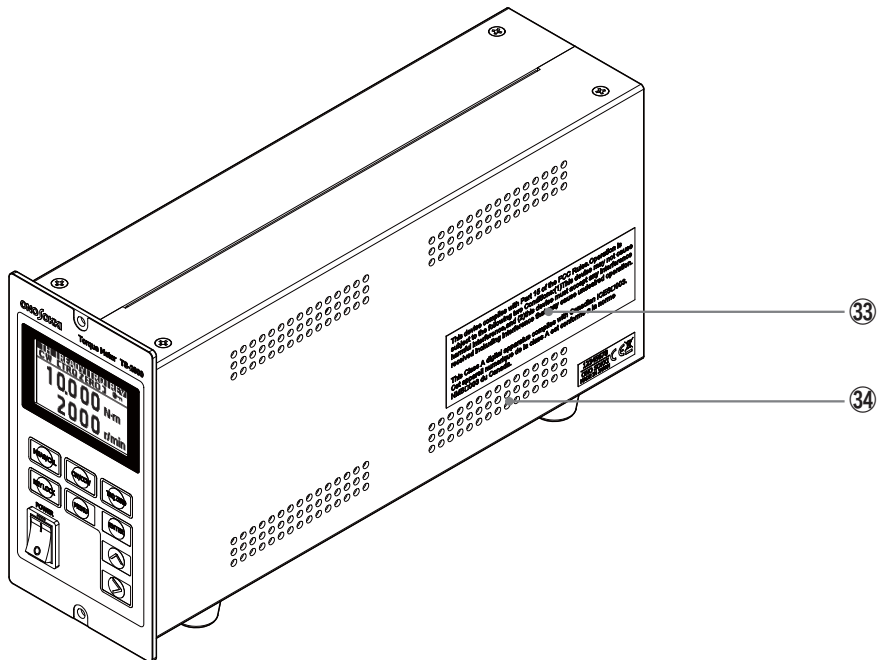
㉝ **FCC label**

This is a certification label required for use in North America.

Do not stain or peel it.

㉞ **Vents**

These vents are provided to release internal heat to keep normal operation.

CAUTION !

*   Never block the vent holes. There is a risk of overheating which could cause malfunction or fire. Make sure to keep a clearance of at least 13 cm between the vents and surrounding objects to ensure good airflow.

3. Preparing for Torque Measurement

3.1 Simple Flow to Prepare for Torque Measurement

* The TH type torque detector and the SS type torque detector switch automatically.

```
                    ┌─────────────────────────────────┐
                    │        Connect the detector.     │
                    └─────────────────────────────────┘
                         │                    │
                         ▼                    ▼
┌───────────────────────────────┐  ┌──────────────────────────────────────────────────────┐
│ When a TH type torque detector│  │ When an SS type torque detector is connected (Turn on  │
│         is connected          │  │              the motor power.)                         │
└───────────────────────────────┘  └──────────────────────────────────────────────────────┘
                         │                    │
                         ▼                    ▼
                    ┌─────────────────────────────────┐
                    │            Power on              │
                    └─────────────────────────────────┘
        Press down the MENU         Press down the MENU
        key                         key
                         │                    │
                         ▼                    ▼
┌───────────────────────────────┐  ┌───────────────────────────────┐
│   Set rotation speed capacity.│  │      Set torque capacity.     │
└───────────────────────────────┘  └───────────────────────────────┘
        Press the MENU key                   │
                         │                    ▼
                         ▼         ┌───────────────────────────────┐
┌───────────────────────────────┐  │      Set torque factor.       │
│    Press the TRQ ZERO key.    │  └───────────────────────────────┘
└───────────────────────────────┘                │
                         │                        ▼
                         │         ┌───────────────────────────────┐
                         │         │  Set rotation speed capacity. │
                         │         └───────────────────────────────┘
                         │              Press the MENU key
                         │                        │
                         │                        ▼
                         │         ┌───────────────────────────────┐
                         │         │    Press the TRQ ZERO key.    │
                         │         └───────────────────────────────┘
                         │                        │
                         ▼                        ▼
┌───────────────────────────────────────────────────────────────────────────┐
│ Measurement is available if READY and TRQ are indicated on the display.    │
└───────────────────────────────────────────────────────────────────────────┘
```

* If analog output zero and full adjustments are required, refer to the page 53 "5.3 Calibration Procedure" and perform calibration.

3.2 Basic Procedure for Measurement

This section describes the basic procedure for torque measurement using the TS-2800.

For details of each step, refer to the indicated page.

Step 1 | Connecting to the Torque Detector

Connect the TS-2800 to an SS type or TH type
torque detector.

Refer to 3.3, "Connecting to the Torque Detector".

Step 2 | Connecting to the Rotation Detector

Connect a rotation detector such as MP-981.

Refer to 3.4, "Connecting to the Rotation Detector".

Step 3 | Turning Power on to TS-2800

Set the POWER switch on the TS-2800 to ON.
When the SS type torque detector is used,
set also the POWER switch of the detector to ON.

Refer to 3.5, "Turning Power on to TS-2800".

Step 4 | Input of TS-2800 Settings

Input numerical values for the TS-2800 settings.
Note: Settings vary depending on the type of the
torque detector used (SS type or TH type).

Refer to 4.2, "Input of TS-2800 Settings".

Step 5 | Setting the Rotation Direction (CW/CCW)

Changes the rotation direction according to
the torque output direction.

Refer to 4.3, "Setting Rotation Direction/ Torque Polarity".

Step 6 | Setting the Zero-point Correction Value of Torque

Set the torque zero-point value.

Refer to 4.4, "Torque Zero Point Setting".

Step 7 | Starting Measurement

After completion of preparation, start measurement.

3.3 Connecting to the Torque Detector

When turned on, the TS-2800 torque meter automatically recognizes the type of the connected torque detector (SS type or TH type). This torque meter starts in the TH mode when a TH type torque meter is connected, and does in the SS mode when another series of torque meter is connected. Do not connect both TH type and SS type detectors concurrently.

CAUTION !

* The TS-2800 torque meter is designed to be used with the phase-difference method torque detectors including the SS type or TH type torque detectors by Ono Sokki. Thus, it cannot be used with other torque detectors that are not specified.

In the following procedure, connect a torque detector to the TRQ IN connector on the rear panel of the torque meter.

1. **Confirm the power is off.**

Make sure that the power to the torque meter is off.

2. **Connect the torque detector to the torque meter.**

Connect the TH-0100 series signal cable (sold separately) to the torque signal input terminal TRQ IN (TH) on the rear panel of the torque meter, or connect the TS cable (sold separately) to the terminal TRQ IN (SS).

* Only one torque meter (either TH or SS type) can be connected with the torque meter.
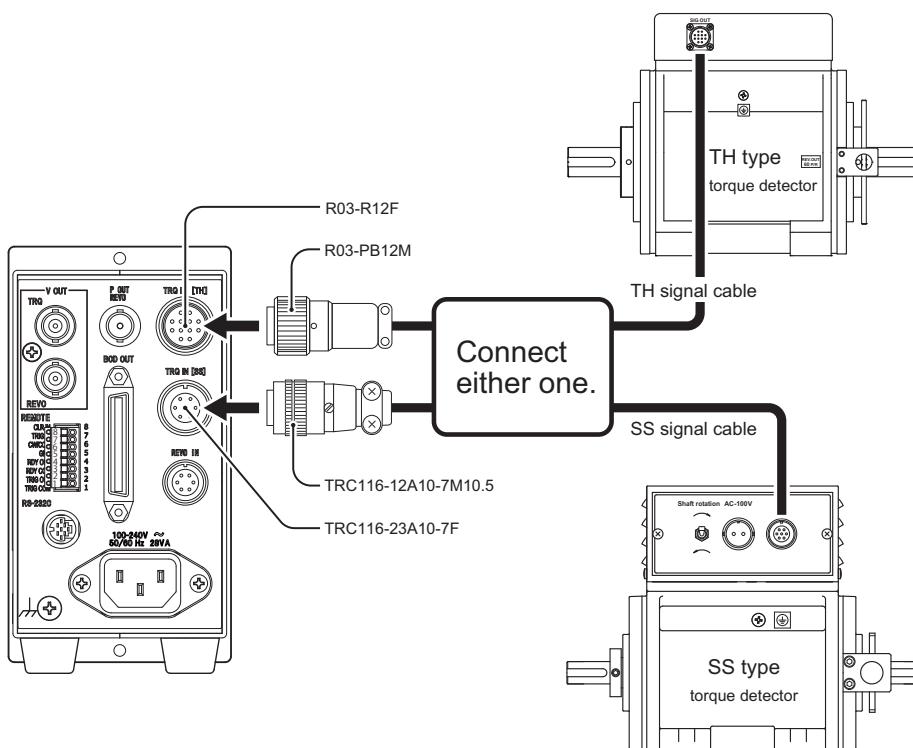
3.4 Connecting to the Rotation Detector

In the following procedure, connect a rotation detector to the REVO IN connector provided on the rear panel of the TS-2800 torque meter.

When using the rotation detector that outputs rectangular waves, such as MP-981, connect the dedicated signal cable to the rotation signal input (REVO IN) terminal on the rear panel of the torque meter.

Select the signal cable according to the model of the rotation detector. When connecting to the MP-981/MP-9820 rotation detector, for example, use the MX-8100 series signal cable.
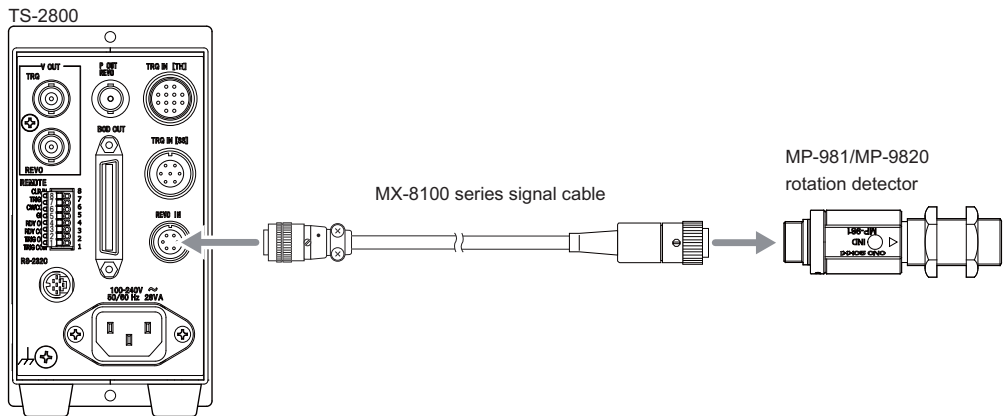
3.5 Turning Power on to TS-2800

CAUTION !

* For safety and noise removal, use the supplied or specified 3-pole power cable and be sure to perform protective grounding. Failure to do the protective grounding may cause electric shock. If the protective grounding is not performed or may not be performed securely, do not power on the product.

In the following procedure, turn on the power to the torque meter and peripheral devices.

1. Check the connections of peripheral devices.

Make sure that relevant peripheral devices are correctly connected to the torque detector and to the torque meter.

2. Confirm the power to the torque meter and peripheral devices is turned off.

Make sure that the power to the TS-2800 torque meter and the peripheral devices are all turned off.

3. Supply power to the torque meter.

Using the power cable supplied with the product, connect the AC power to the AC INPUT connector on the rear panel of the torque meter.

4. Turn on the power to the torque detector and peripheral devices.

Turn on the power switches of the peripheral devices connected to the torque meter.

5. Turn on the power to the torque meter.

Press the POWER switch on the front panel of the TS-2800 upward (|) to turn on the power to the meter.

Note: Be sure to use the supplied cable at 125 VAC or less.

100 to 240 VAC
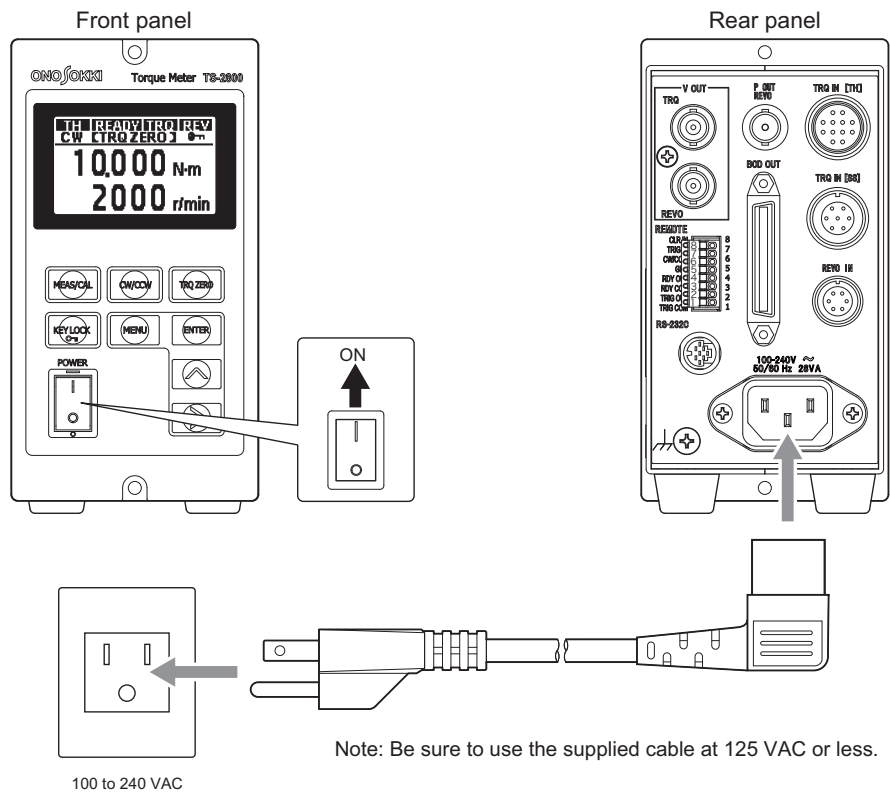
4. Setting Measurement Conditions

This section describes the conditions that are set on the TS-2800 torque meter.

For details on the preparation for the hardware, refer to the page 27 "3. Preparing for Torque Measurement".

4.1 Key Operation for Setting Measurement Conditions

■ Key operations and functions

Measurement conditions can be set using keys MEAS/CAL, MENU, ENTER, ⌃ , and ⌄ provided on the front panel of the TS-2800 torque meter.

The operations and functions of individual keys are as follows.

TS-2800

MEAS/CAL : Exits the setting mode and shifts to the measurement mode.

ENTER : Decides the setting and moves to the next item.

⌃ : Changes the settings and set values.

⌄ : Moves the input position (digit).

MENU : Starts settings.
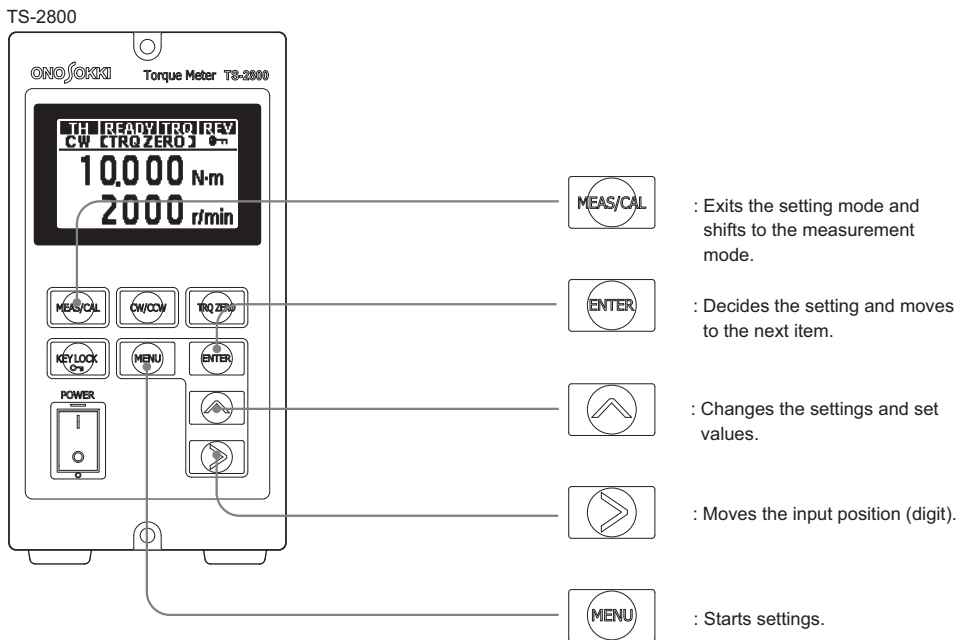
Key	Function	Description
MENU	Start of setting	Pressing down the key for about 3 seconds changes to the setting mode.
MEAS/CAL	End of setting	Exits the setting mode and changes to the measurement mode.
ENTER	Deciding the setting and switching items	In the condition setting mode, this key is used to determine the setting and to move to the next item.
⌃	Changing the selection and settings	Changes the selected items and set values.
⌄	Moving input position (digit)	Moves the input position (digit).

4.2   Input of TS-2800 Settings

When a new torque detector is connected to the TS-2800 torque meter, the condition values related to measurement should be set on the torque meter in the following procedure.

■ Switching the setting items in the setting mode

First, press down the MENU key for about 3 seconds to start the setting mode.

You can switch the items to set up by pressing the ENTER key.

When the ENTER key is pressed at the last setting item, the first item is indicated again.

Press the MEAS/CAL key to exit the setting mode and return to the measurement mode.

4.2.1 Setting values when connected to an SS type torque detector

* For the case of TH type torque meters, refer to the section 4.2.3.

■ Switching the setting mode

The setting items are indicated in the following order. For details of the setting items, refer to "4.2.2 Operation menu (with SS type torque detectors)".

Press down the MENU key for 3 seconds to change to the setting mode.
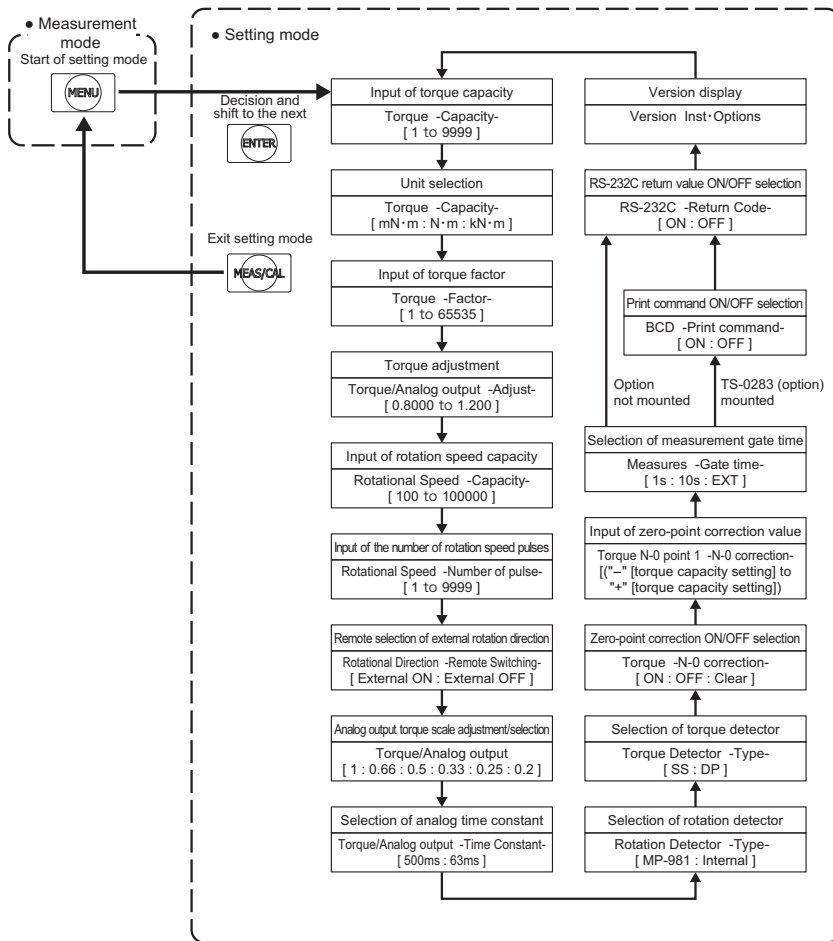
4.2.2 Operation menu (with SS type torque detectors)

■ Changing parameters when an SS type torque detector is connected

● Switching to the setting mode

Pressing down the MENU key for 3 seconds in measurement mode changes to the setting mode, showing the torque capacity setting screen. On each setting screen, pressing the ENTER key sets the current value and switches to the next item to be set. If the MEAS/CAL key is pressed instead of the ENTER key, the value is not changed, returning to the measurement mode.

● Setting the torque capacity and unit

Input the torque capacity value specified with the torque detector.

The torque value input here becomes the full-scale value of analog output.

When the torque capacity is 5 mN·m, a +10 V is output at 5 mN·m.

Input range: 1 to 9999

Press the ENTER key to move the cursor to the unit field. Then, press the ⟨⟨⟩⟩ key to select the unit.

Selectable unit: mN·m, N·m and kN·m

● Setting the torque factor

Input the torque factor specified with the torque detector.

Input range: 1 to 65535

● **Torque adjustment**

The torque value and analog output can be multiplied by a coefficient according to the usage condition of your instruments.

The input coefficient and the result of calculation are as follows:

Result of calculation = torque value × coefficient

When this function is used (for a numeric value other than 1.0000), USER is shown above the unit field, indicating a calculated value.

```
SS READY TRQ REV
CW  SCL x1

Torque/Analog output
-Adjust-
--------------------------
      10000
```
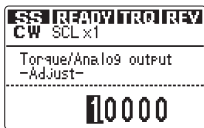
Input range: 0.8000 to 1.2000

* Adjustment mode screen (example)

```
SS READY TRQ REV
CW  SCL x1

10.000 N·m USER

 2000 r/min
```

For the details of analog output calibration, refer to the page 53 "5.3 Calibration Procedure".

● **Rotation speed capacity**

The rotation speed that is set here becomes the full-scale value of analog output.

When 10,000 r/min is set, a +10 V is output at 10,000 r/min.
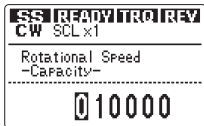
```
SS READY TRQ REV
CW  SCL x1

Rotational Speed
-Capacity-
--------------------------
   010000
```

Input range: 100 to 100000

● **Rotation speed pulses**

Input the number of pulses per rotation of the rotation detector.

Example: When the rotation detecting gear generates 60 pulses per rotation, input 60.

```
SS READY TRQ REV
CW  SCL x1

Rotational Speed
-Number of pulses-
--------------------------
   0060
```

Input range: 1 to 9999

● **Remotely changing the rotation direction**

Specify whether to enable (ON) or disable (OFF) the function that changes the rotation direction through the REMOTE terminal on the rear panel.

When this function is activated, it disables the CW/CCW key on the front panel.

```
SS READY TRQ REV
CW  SCL x1

Rotational Direction
 -Remote Switching-
---------------------
        External OFF
```

Selectable setting: External ON or External OFF

● **Analog output scale adjustment**

Adjust the analog output scale.

Calculation example:

The analog voltage output at torque input in the torque capacity setting becomes as follows:

Scale setting ×1: 10 V output

Scale setting × 0.5: 5 V output

```
SS READY TRQ REV
CW  SCL x1

Torque/Analog output
---------------------
            x1
```
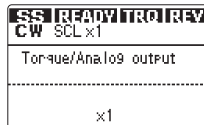
Selectable scale: × 1, × 0.66, × 0.5, × 0.33, × 0.25 or × 0.2

● **Time constant setting**

Set the response of torque analog output.

```
SS READY TRQ REV
CW  SCL x1

Torque/Analog output
  -Time Constant-
---------------------
            63 ms
```
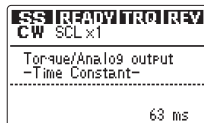
Selectable value: 500 ms or 63 ms

* When an optional device for TS-0282 (charging time constant for DD) is implemented, the selectable values are changed to 63 ms and 16 ms, and 500 ms can not be selected.

● **Selection of the rotation detector**

Select the rotation detector to be used, and set the torque signal as MP-981 or INT.

```
SS READY TRQ REV
CW  SCL x1

Rotation Detector
  -Type-
---------------------
          MP-981
```
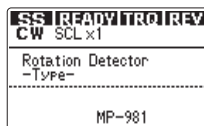
Selectable setting: MP-981 or INT

MP-981:   Applicable when using an electromagnetic rotation detector connected to the REVO IN on the rear panel

          Applicable detectors are MP-981 and MP-9820.

INT: Applicable for rotation measurement using the SIG2 signal of the SS type detector

For rotation speed pulse setting in this case, use the value of P/R indicated on the nameplate of the torque detector.

Be careful not to rotate the detector motor when using an SS type detector except for DP series. If the motor is rotated, the rotation speed can not be measured correctly.

● **Connected-torque detector selection**

Select the type of the connected torque detector. Select DP for the DP series, and select SS for other types.

```
SS READY TRQ REV
CW  SCL x1
Torque Detector
-Type-
            SS
```
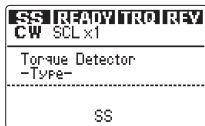
Selectable series: SS or DP

● **N-0 (zero-point) correction setting**

What is N-0?

Even when the shaft is rotating without load, a numeric value may be indicated on the torque meter owing to the frequency characteristics of the torque detector and meter and the friction torque of the detector. For an accurate measurement, the deviation can be corrected through "N-0 correction".

Set up to five points of correction values for individual rotation speeds. In every measurement at the specified maximum rotation speed or lower, the corrected torque values are displayed or output.

To cancel the windage loss of the test machine or the friction torque of the bearing, the N-0 correction is required, but only when such situations can be reproduced. No correction is required when the deviation is small enough. When inputting a correction value for N-0 correction, you can refer to the table of non-load characteristics on the test record (provided with the torque detector). Note that, when the load torque is measured with a small-torque detector, verification data needs to be obtained, not using the values of the test record as they are. For details, refer to the instruction manual for the small-torque detector.

Enable or disable the N-0 correction function, and set the correction value.
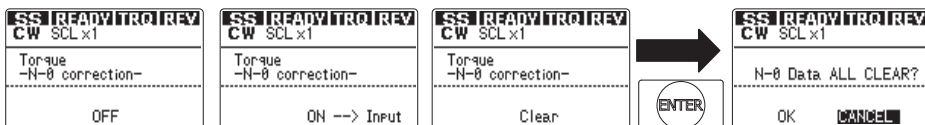
```
SS READY TRQ REV     SS READY TRQ REV     SS READY TRQ REV              SS READY TRQ REV
CW  SCL x1           CW  SCL x1           CW  SCL x1                    CW  SCL x1
Torque              Torque              Torque                        N-0 Data ALL CLEAR?
-N-0 correction-    -N-0 correction-    -N-0 correction-
                                                         ⟶
        OFF                ON --> Input          Clear       ENTER        OK    CANCEL
```

Selectable setting: ON, OFF or Clear

ON: Correction enabled

OFF: Correction disabled

Clear: Clears all the current correction values for rotation direction to zero.

Input of N-0 correction values

CAUTION !

* N-0 correction values cannot be input when the torque adjustment function is enabled (when the adjustment value is other than 1.0000) (see page 35). The setting of ON, OFF or CLEAR can be changed. When performing N-0 correction, disable the torque adjustment function, obtain correction data, and input it. If the torque adjustment function is enabled during measurement, the torque adjustment also applies to the N-0 correction value.

Pressing the [⟩] key while N-0 correction setting screen is shown changes to the correction value input screen.

The input procedure is as follows:

Setup the torque value at the point No. 1
Setting range: – (torque capacity value) to + (torque capacity value)
(The same range also applies to Nos. 2 to 5.)

```
SS  Torque N-0 Point 1
CW  -N-0 correction-
      +100.0 mN·m
      001000 r/min
```

↓

Setup the rotation speed value at the point No. 1
Setting range: 0 to the value set in Rotational Speed -Capacity-
(The same range also applies to Nos. 2 to 5.)

```
SS  Torque N-0 Point 1
CW  -N-0 correction-
      +100.0 mN·m
      001000 r/min
```

↓

Set up the torque value at the point No. 2.

↓

Set up the rotation speed value at the point No. 2.

↓

↓

↓

Set up the torque value at the point No. 5.

↓

Set up the rotation speed value at the point No. 5.

Example: Setup of N-0 correction values for clockwise rotation (4 points)

Prepare a table similar to the following, and record the indicated torque value at each rotation speed by rotating the detection axis with a motor.

Point	No.1	No.2	No.3	No.4
Rotational speed	500	1800	4000	6000
Correction value	−8	+6	−5	−5

For example, suppose that the measurements has resulted in as in the table, then the zero-point characteristics for this case is assumed to be as shown in the dotted line (---). The graph line from 500 to 3000 r/min is not smooth. Then, a finer correction is available by measuring the torque, for example, at 1000 r/min and adding the measurement to the graph.

● **Measurement gate time**

The measurement gate time to calculate values can be changed.

This setting changes the update time of the following items:

• Torque calculation value and interval average value of rotation speed

• BCD output update time

• RS-232C command: RLO and MLO transmission interval

```
SS
CW  SCL ×1
Measures
-Gate time-
.............................
          1 s
```

Selectable setting: 1 s, 10 s or EXT

• EXT performs update in synchronization with the input of external trigger signal.

● **Print command ON/OFF setting**

*This setting item is relevant to the users who implement an optional device with BCD function.

ON: Outputs the print command every "measurement gate time".

OFF: Outputs the print command only when the HOLD signal is input.

For the output timing of the print command, refer to "8.3.3 Timing chart".

```
SS READY TRQ REV
CW  SCL ×1
BCD
-Print command-
.............................
          OFF
```

Selectable setting: ON or OFF

● **RS-232C return code setting**

Specify whether to use a return value in RS communication. (Only for setting parameter)

ON (enabled): Returns a return value after the parameter setting command is received.

OFF (disabled): Returns no return value after the parameter setting command is received.

```
SS READY TRQ REV
CW  SCL ×1
RS
-Return Code-
.............................
          ON
```

Selectable setting: ON or OFF

Note

* The return code is always invalid in RS-232C communication of TS-2700. The return code is always valid in TH-5100. Be careful when changing the old model to a new one.

● **Version display**

Information on the TS-2800 software versions and the functions of optional devices are displayed.

```
SS READY TRQ REV
CW  SCL ×1
Version    Inst.Options
.............................
CPU   0018 High Response
DSP   0013 BCD Out
FPGA  0002 Rev Pulse Out
```

Software information

• CPU version

• DSP version

- FPGA version

Optional function and device

- High Response: TS-0282, Changing time constant for DD

- BCD Out: TS-0283, BCD output function

- Rev Pulse Out: TS-0284, Rotation pulse output function

4.2.3 Setting values when connected to a TH type torque detector

* For the case of SS type torque meters, refer to the section 4.2.1.

■ Switching the setting mode

The setting items are indicated in the following order. For details of the setting items, refer to "4.2.4 Operation menu (with TH type torque detectors)".

● Menu flow for TH type torque detectors

Press down the MENU key for 3 seconds to change to the MENU mode.
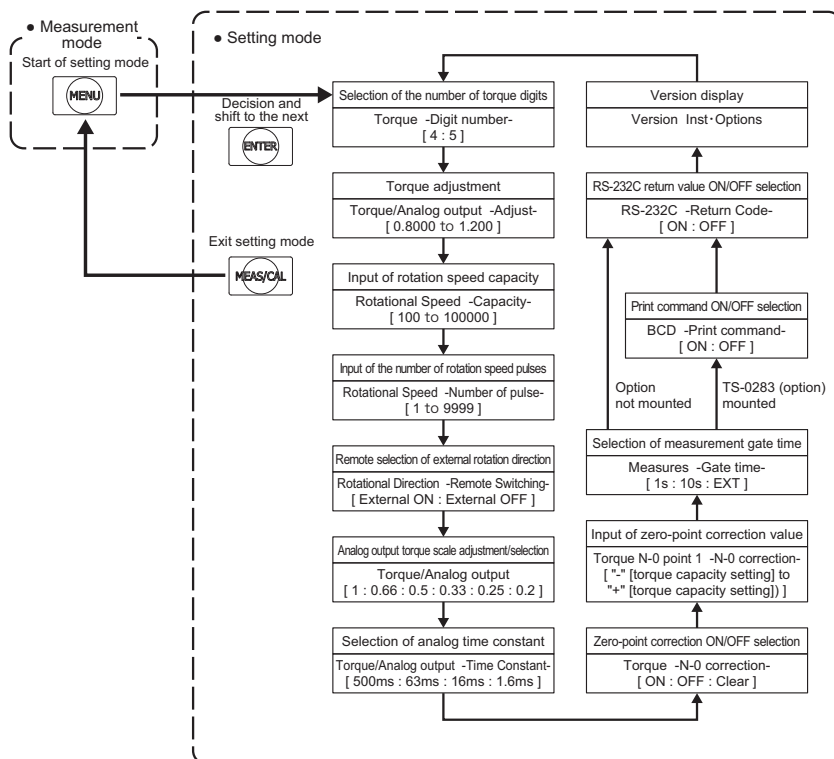
4.2.4   Operation menu (with TH type torque detectors)

■ Changing parameters when a TH type torque detector is connected

● Switching to the setting mode

Pressing down the MENU key for about 3 seconds in measurement mode changes to the setting mode, showing the torque indication digit setting screen. On each setting screen, pressing the [ENTER] key to set a value. If the [MEAS/CAL] is pressed instead of [ENTER], the value is not changed, returning to the measurement mode.

● Torque indication digit setting

Set the number of digits to indicate torque values.

```
┌─────────────────────────┐
│ TH  READY TRQ REV       │
│ CW  SCL×1               │
│ ─────────────────────── │
│ Torque                  │
│ -Digit number-          │
│ ─────────────────────── │
│                         │
│           4             │
└─────────────────────────┘
```
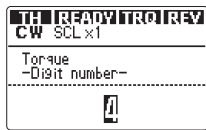
Available setting: 4 or 5

● Torque adjustment

The torque value and analog output can be multiplied by a coefficient according to the usage condition of your instruments.

The calculating formula is as follows:

Result of calculation = torque value × coefficient

When this function is used (for a numeric value other than 1.0000), USER   is shown above the unit field, indicating a calculated value.

```
┌─────────────────────────┐
│ TH  READY TRQ REV       │
│ CW  SCL×1               │
│ ─────────────────────── │
│ Torque/Analog output    │
│ -Adjust-                │
│ ─────────────────────── │
│        1.0000           │
└─────────────────────────┘
```
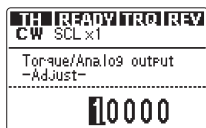
Input range: 0.8000 to 1.2000

For the details of analog output calibration, refer to the page 53 "5.3 Calibration Procedure".

● Rotation speed capacity

The rotation speed that is set here becomes the full-scale value of analog output.

When 8000 r/min is set, a +10 V is output at 8000 r/min.
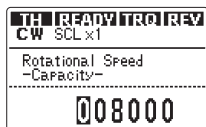
```
┌─────────────────────────┐
│ TH  READY TRQ REV       │
│ CW  SCL×1               │
│ ─────────────────────── │
│ Rotational Speed        │
│ -Capacity-              │
│ ─────────────────────── │
│       008000            │
└─────────────────────────┘
```

Input range: 100 to 100000

● **Rotation speed pulses**

Input the number of pulses per rotation of the rotation detector.

Example: When the rotation detecting gear generates 60 pulses per rotation, input 60.

```
TH  READY TRQ REV
CW  SCL x1
Rotational Speed
 -Number of pulses-
----------------------
         0060
```

Input range: 1 to 9999

● **Remotely changing the rotation direction**

Specify whether to enable (ON) or disable (OFF) the function that changes the rotation direction through the REMOTE terminal on the rear panel.

When this function is activated, it disables the CW/CCW key on the front panel.

```
TH  READY TRQ REV
CW  SCL x1
Rotational Direction
 -Remote Switching-
----------------------
          External OFF
```

Selectable setting: External ON or External OFF

● **Analog output scale adjustment**

Adjust the analog output scale.

Output example:

The analog output voltage versus the rated torque input to the TH type torque detector is as follows:

Scale setting ×1: 10 V output

Scale setting × 0.5: 5 V output

```
TH  READY TRQ REV
CW  SCL x1
Torque/Analog output
----------------------
          x1
```
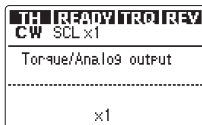
Selectable scale: × 1, × 0.66, × 0.5, × 0.33, × 0.25 or × 0.2

● **Settings of time constant and low-pass filter (LPF)**

Set the response of torque analog output.Low-pass filter is also selectable when the optional device TS-0281 (High-speed response output function for TH series) is implemented.

```
TH  READY TRQ REV
CW  SCL x1
Torque/Analog output
 -Time Constant-
----------------------
          16 ms
```
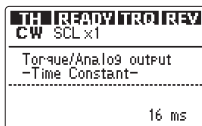
Selectable value: 500 ms, 63 ms, 16 ms or 1.6 ms

* When the TS-0281 (High-speed response output function for TH series) is implemented.

Selectable item: 500 ms, 63 ms, 16 ms, 1.6 ms, 0.8 ms, 0.4 ms, 0.16 ms, 50 Hz, 100 Hz, 500 Hz, 1 kHz or 5 kHz

● N-0 (zero-point) correction setting

What is N-0?

Even when the shaft is rotating with no load, a numeric value may be indicated on the torque meter owing to the frequency characteristics of the torque detector and meter and the friction torque of the detector. For an accurate measurement, the deviation can be corrected through "N-0 correction".
Set up to five points of correction values for individual rotation speeds. In every measurement at the specified maximum rotation speed or lower, the corrected torque values are displayed or output.
To cancel the windage loss of the test machine or the friction torque of the bearing, the N-0 correction is required, but only when such situations can be reproduced. No correction is required when the deviation is small enough. When inputting a correction value for N-0 correction, you can refer to the table of non-load characteristics on the test record (provided with the torque detector). Note that, when the load torque is measured with a small-torque detector, verification data needs to be obtained, not using the values of the test record as they are. For details, refer to the instruction manual for the small-torque detector.

Pressing the ENTER key while the time constant setting screen is shown changes to the Zero correction ON/OFF selection screen.

In this screen, specify whether to enable N-0 correction.
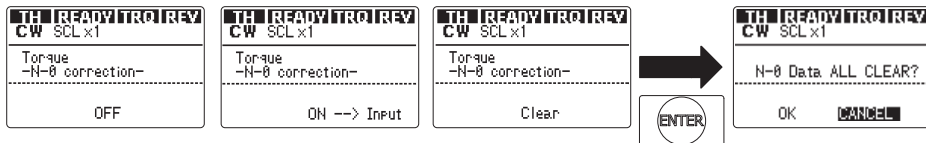
Selectable setting: ON, OFF or Clear

ON: Correction enabled

OFF: Correction disabled

Clear: Clears all the current correction values for rotation direction to zero.

About N-0 data input

CAUTION !

* N-0 correction values cannot be input when the torque adjustment function is enabled (when the adjustment value is other than 1.0000) (see page 42). The setting of ON, OFF or CLEAR can be changed. When performing N-0 correction, disable the torque adjustment function, obtain correction data, and input it. If the torque adjustment function is enabled during measurement, the torque adjustment also applies to the N-0 correction value.

Pressing the ⊗ key while N-0 correction setting screen is shown changes to the correction value input screen.

The input procedure is as follows:

Setup the torque value at the point No. 1
Setting range: (torque capacity value) to + (torque capacity value)
(The same range also applies to Nos. 2 to 5.)

↓

Setup the rotation speed value at the point No. 1
Setting range: 0 to the value set in Rotational Speed -Capacity-
(The same range also applies to Nos. 2 to 5.)

```
TH  Torque N-0 Point 1
CW  -N-0 correction-

    + 100.0 mN·m

    00 1000 r/min
```

↓

Set up the torque value at the point No. 2.

↓

Set up the rotation speed value at the point No. 2.

↓

↓

↓

Set up the torque value at the point No. 5.

↓

Set up the rotation speed value at the point No. 5.

Example: Setup of N-0 correction values for clockwise rotation (4 points)

Prepare a table similar to the following, and record the indicated torque value at each rotation speed by rotating the detection axis with a motor.

Point	No.1	No.2	No.3	No.4
Rotational speed	500	1800	4000	6000
Correction value	−8	+6	−5	−5

For example, suppose that the measurements has resulted in as in the table, then the zero-point characteristics for this case is assumed to be as shown in the dotted line (---). The graph line from 500 to 3000 r/min is not smooth. Then, a finer correction is available by measuring the torque, for example, at 1000 r/min and adding the measurement to the graph.

● **Measurement gate time**

The measurement gate time to calculate values can be changed.

This setting changes the measurement gates of the following items:

•   Torque calculation value and interval average value of rotation speed

•   BCD output update time

•   RS-232C command: RLO and MLO transmission interval

```
TH  SCL ×1
CW
Measures
-Gate time-

        1 s
```

Selectable setting: 1 s, 10 s or EXT

* EXT performs update in synchronization with the input of external trigger signal.

45
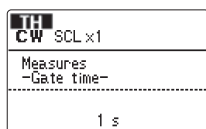
● **Print command ON/OFF setting**

* This setting item is relevant to the users who implement an optional device with BCD function.

When ON is selected, the print command is output at BCD update.

Refer to the timing chart for the output timing of the print command.

```
TH  READY TRQ REV
CW  SCL×1

BCD
-Print command-
..............................

        OFF
```

Selectable setting: ON or OFF

● **RS-232C return code setting**

Specify whether to use return codes in RS communication. (Only for setting parameter)

ON (enabled): Returns a return code (refer to Return code list on page 72) after the parameter setting command is received.

OFF (disabled): Returns no return code after the parameter setting command is received.

```
TH  READY TRQ REV
CW  SCL×1

RS-232C
-Return Code-
..............................

         ON
```

Selectable setting: ON or OFF

Note

* The return code is always invalid in RS-232C communication of TS-2700. The return code is always valid in TH-5100. Be careful when changing the old model to a new one.

● **Version display**

Information on the TS-2800 software versions and the functions of optional devices are displayed.

```
TH  READY TRQ REV
CW  SCL×1

Version    Inst·Options
..............................
CPU   0018 High Response
DSP   0013 BCD Out
FPGA  0002 Rev Pulse Out
```

Software information

• CPU version

• DSP version

• FPGA version

Optional function and device

• High Response: TS-0281, High-speed response output function for TH series

• BCD Out: TS-0283, BCD output function

• Rev Pulse Out: TS-0284, Rotation pulse output function

4.3   Setting Rotation Direction and Torque Polarity

This function sets the rotation direction of the rotating shaft to be measured or the positive direction (+) of torque. Note that the settings are different depending on the connected detector.

For SS type torque detector

Set CW/CCW according to the rotation direction viewed from the drive side of the shaft to be measured. The positive direction of torque is the same as the rotation direction.

TH type torque detector

Set the torque direction to be defined as positive direction. The direction is determined by CW or CCW viewed from the drive side of the detector.

Definition of torque direction and shaft rotation direction

(Viewed from the drive side)

TH type torque detector
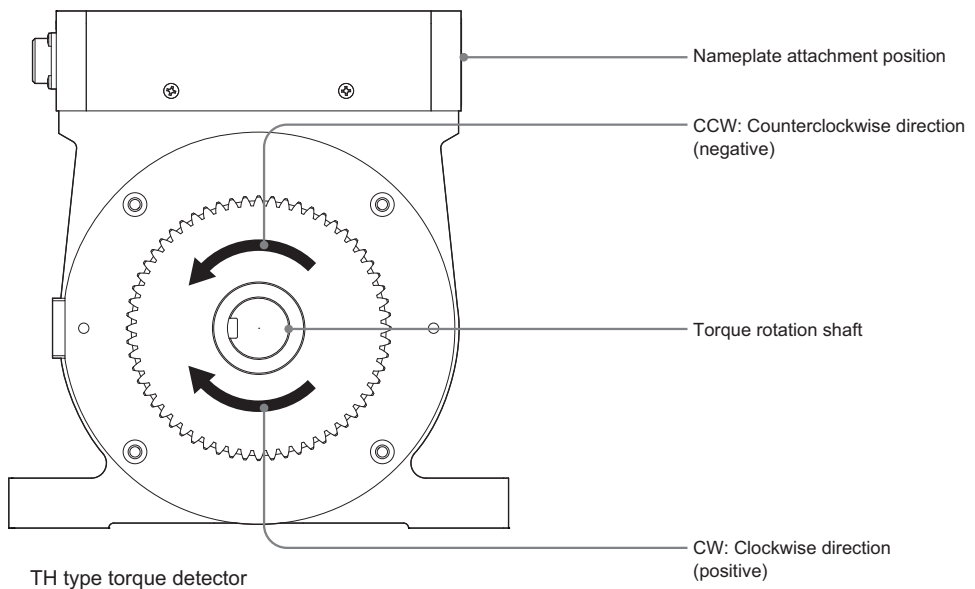
■ Recommended settings

We recommend you to make the following settings to prevent a mismatch with the setting of the rotation direction of the detector used.

● SS type torque detector

The SS type torque detectors have the switch to set the rotation direction of the shaft as shown at (B) in the following figure. Be sure that the rotation direction of the shaft, the shaft rotation direction set by the detector, and the rotation direction set by the torque meter are the same. With this setting, the torque generated by the driving device can be measured as positive from 0 r/min of rotation speed.

To change the rotation direction of the shaft, change the rotation direction setting of the torque detector with its changeover switch and the setting of the torque meter.

Note that, on SS type torque detectors, the torque is not measured when the shaft rotates in the direction opposite to the direction set by the torque detector.
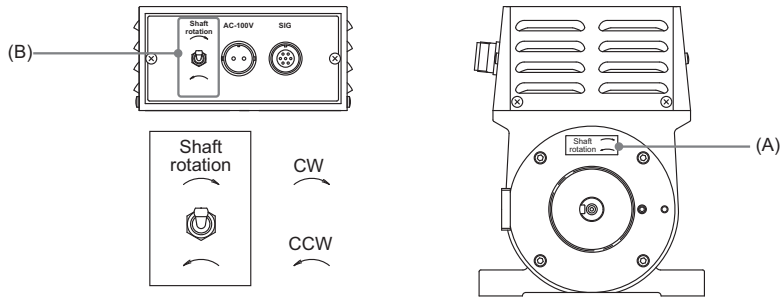
Rotation direction*	Twisting: CW		Twisting: CCW		
	Drive side	Load side	Drive side	Load side	Switch direction
CW	+	-	-	+	CW
CCW	-	+	+	-	CCW

*: Rotation direction viewed from the drive side of the torque detector

● **TH type torque detector**

The TH type torque detectors do not have a switch to set the rotation direction of the shaft. Within the rated rotation speed of the detector, the torque can be measured continuously regardless of the rotation direction and rotation speed.

When the TH type torque detector is used, the rotation direction (CW/CCW) set by this torque meter should be the same as the torque direction viewed from the drive side which the meter outputs as positive (+). Usually, for measurement of driving torque, the rotation direction of the shaft should be the same as the setting by the torque meter.

On TH type torque detectors, the torque can measured in forward and reverse rotations continuously. When measuring a machine that continuously runs in either forward or reverse direction, fix this setting to either CW or CCW. When the rotation direction decided matches the actual torque direction, the torque measured will be output in a positive value (+); otherwise, the torque will be output in a negative value (-).

■ Setting procedure

● **Setting the rotation direction by the CW/CCW key**

The procedure for setting the rotation direction by the CW/CCW key provided on the front panel of the torque meter is as follows:

1. **Setting the remote setting of the rotation direction to OFF by the MENU key**

Press the MENU key to change to the setting mode and set the remote input of the rotation direction to OFF.

2. **Change the rotation direction using the CW/CCW key.**

The rotation direction is alternately switched (clockwise and counterclockwise) by pressing the CW/CCW key on the front panel of the torque meter.

● **Changing the rotation direction through an external contact**

1. **Setting the remote setting of the rotation direction to ON by the MENU key**

    Press the MENU to change to the setting mode. Select ON in the remote rotation direction setting screen and then press the ENTER key to decide it.

2. **Disconnect pins 5 and 6 of the REMOTE connector to set CW, or connect the pins to set CCW.**

    The LCD shows the current direction.

4.4 Torque Zero Setting

CAUTION !

*   When CLR of the REMOTE function is Close, torque zero setting is not executed.

*   When any parameter has been changed in the torque meter, be sure to reset the torque zero value.

1. **Ensure the connection with the torque detector, and put the detector shaft in non-load status.**

    (The non-load status means that the coupling of one or both ends of the shaft of the torque detector is released.)

2. **Check for signal inputs with the TS-2800 torque meter.**

    Confirm that string TRQ is indicated in the measurement screen on the LCD.

    Confirm that ⊙╍ is not indicated in the status field on the upper part of the measurement screen.

3. **Press down the TRQ ZERO key on the front panel of the TS-2800.**

    Pressing down the TRQ ZERO key shows TRQ ZERO in the measurement screen.

    After zero correction is finished, the TRQ ZERO indication disappears from the screen and the torque value becomes 0.

    However, owning to variations within the range of precision, the torque value may not become 0.

    * Setting on SS type torque detectors

    Set the torque zero by switching the CW/CCW key according to the rotation directions to be measured.

5. Analog Output

5.1 Torque Analog Voltage Output

Torque analog voltage is output from the VOUT-TRQ connector on the rear panel of the torque meter. Full-scale output voltage is ±10 V.

On the SS type torque detectors, the output voltage reaches the full-scale value when the torque is at the certified capacity value. On the TH type detectors, the output voltage reaches the full-scale value when the detector generates the rated torque.
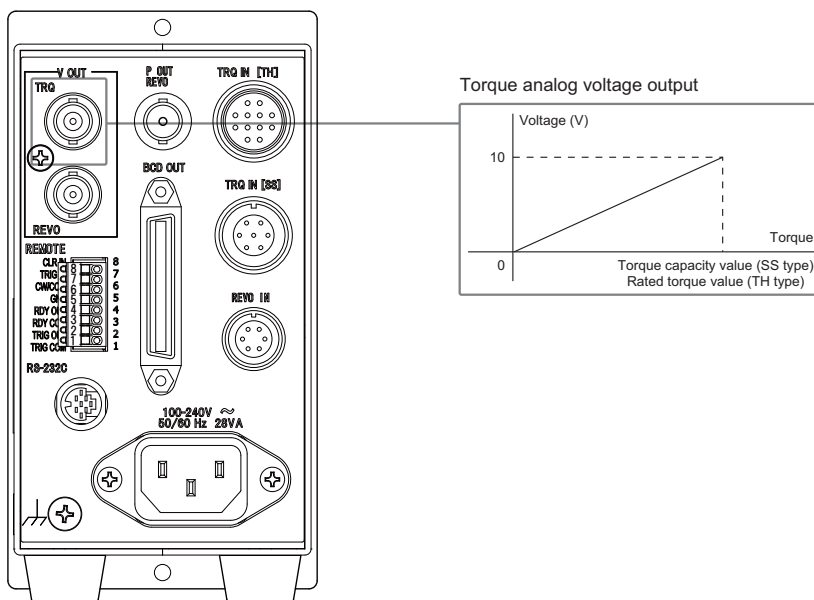
■ **Specifications of output signal from TRQ OUT connector**

Output voltage	10 V (maximum output)
Output connector	C02-type (BNC) connector
Appropriate load	10 kΩ or more

■ Time constant

Figure 1 — Stepwise torque or rotation speed, 100%, t=0

Figure 2 — Analog output, 63%, t=0, Sampling time, Calculation time, τ
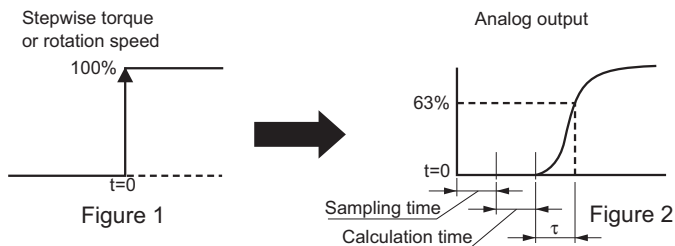
When a stepwise torque is applied to the torque detector as shown in Figure 1, analog output is given as shown in Figure 2. The time taken for the output voltage reaches 63% is referred to as time constant. When time constant τ = 16 ms is set, for example, the time taken to reach 63% when stepwise torque is applied as shown above is 16 ms.

The TS-2800 torque meter employs this digital filtering using the exponential averaging method.

Cut-off frequency fc and time constant τ generally referred to as filter characteristics, have the relationship of $\tau \approx 1/2 \pi$ fc.

When τ = 16 ms, for example, fc $\approx$ 10 Hz is obtained.

The exponential averaging process works as the primary low-pass filter in the filtering.

For optional devices and functions, refer to "8.1 TS-0281: High-speed Response Output Function for TH Series", "8.2 TS-0282: Changing Time Constant for DD Series".

5.2 Rotation Speed Voltage Output

CAUTION !

* Precision of rotation speeds is guaranteed when the rotation pulse input frequency is 10 Hz or higher.

Rotation speed analog voltage is output from the V OUT REVO connector on the rear panel of the torque meter. The output voltage at the maximum rotation speed is +10 V.

Rotation speed voltage output
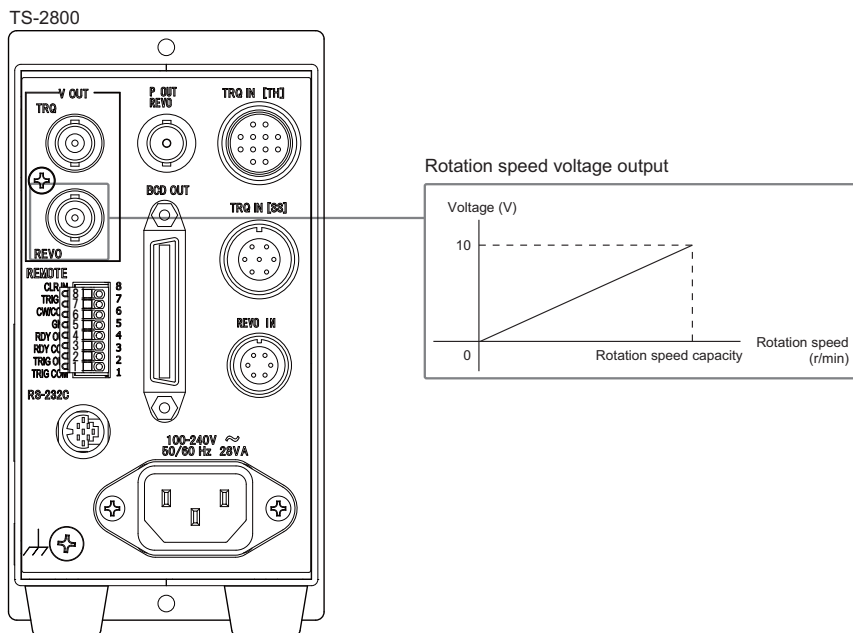
■ Specification of output signals from the REVO OUT connector

Output voltage	0 to +10V
Output connector	C02-type (BNC) connector
Appropriate load	10 kΩ or more

5.3   Calibration Procedure

5.3.1 Procedure for calibrating torque voltage output

Torque voltage output is calibrated in the following procedure:

1. **Prepare a digital voltmeter.**

Connect the input connector of the digital voltmeter to the V OUT TRQ connector on the rear panel of the torque meter.
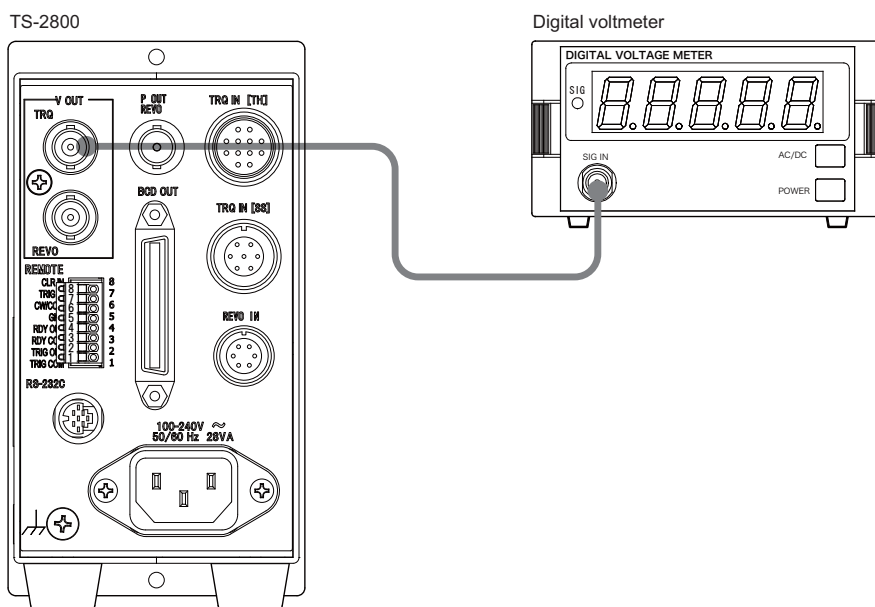
2. **Switch the menu screen to the voltage calibration screen.**

Press down the MEAS/CAL key on the front panel of the torque meter to change to the calibration mode. After the screen Torque/Analog output -Calibration zero- is shown, voltage at zero-torque is output through the rear panel of the torque meter.

3. **Set the zero-torque voltage indicated on the digital voltmeter in the torque meter.**

Input the zero-torque voltage, indicated on the digital voltmeter in step 2, with a numeric value in the unit of V (ex.: for +20 mV, input "+0.020".

Numeric values that can be input range from 0 to ±0.999.

Use the ⌃ and ⟩ keys on the front panel of the torque meter to input numeric values.

After entering a numeric value, press the ENTER key to decide it. The Torque/Analog output -Calibration full- screen appears.

53

4. **Input the full-scale voltage indicated on the digital voltmeter.**

After adjustment of zero-torque values is finished, the full-scale voltage is output from the output terminal.

Input the full-scale value indicated on the digital voltmeter into the torque meter, in the unit of V, for full-scale value adjustment.

Input range: 9.000 to 10.999

Use the ⬡ and ⬡ keys to input a value.

5. **Return to the normal mode.**

Press the MEAS/CAL key on the front panel to return to the measurement mode.

5.3.2 Procedure for calibrating rotation speed voltage output

A digital voltmeter is used to calibrate the rotation speed voltage output.

1. **Prepare a digital voltmeter.**

Connect the input connector of the digital voltmeter to the V OUT REVO connector on the rear panel.
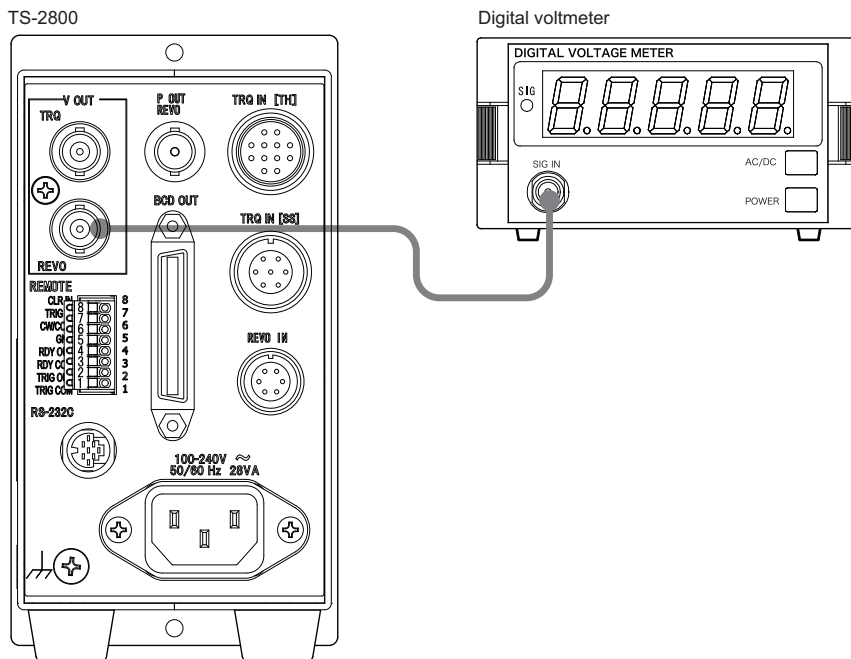
2. **Switch the menu screen to the calibration screen.**

Press down the MEAS/CAL key to change to the torque voltage output calibration screen.

Pressing the ENTER key twice. Then, the rotation speed voltage output calibration screen (Rotational Speed -Calibration zero-) appears.

Voltage equivalent to 0 r/min is output from the V OUT REVO terminal.

3. **Input the value indicated on the digital voltmeter.**

Input the zero-torque voltage, displayed in the digital voltmeter in step 2, with a numeric value in the unit of V (ex.: for +20 mV, input +0.020).

Numeric values that can be input range from 0 to ±0.999.

Use the ⟨∧⟩ and ⟨≫⟩ keys on the front panel to input numeric values.

After entering a numeric value, press the ENTER key to decide it. The Rotational Speed - Calibration full- screen appears.

4. **Input the full-scale voltage indicated on the digital voltmeter.**

Input the full-scale value indicated on the digital voltmeter into the TS-2800, in the unit of V, for full-scale value adjustment.

Input range: 9.000 to 10.999

Use the ⟨∧⟩ and ⟨≫⟩ keys to input a value.

5. **Return to the normal mode.**

Press the MEAS/CAL key on the front panel to return to the measurement mode.

6. External Control Function

The TS-2800 torque meter can be controlled by inputting control I/O signals of external devices through the REMOTE connector.

TS-2800

REMOTE connector

*Refer to ㉔ REMOTE on page 23.
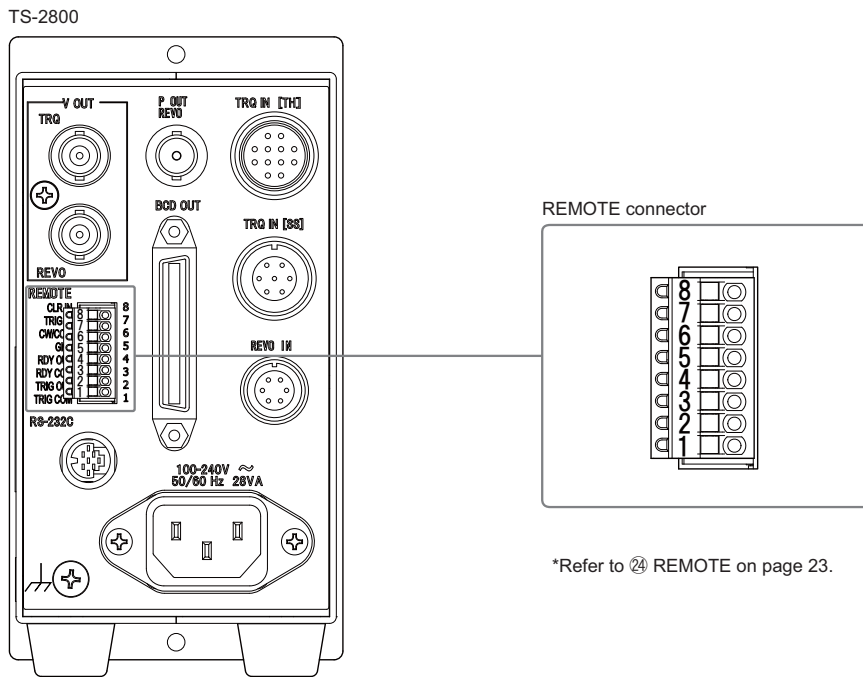
6.1 Input Signal (contact input: pins 5 to 8)

■ CW and CCW switching function

The rotation directions (CW and CCW) can be switched externally. For details of the rotation direction settings, refer to "4.3 Setting Rotation Direction and Torque Polarity".

The CW/CCW switching function is enabled only when the conditions specified in page 37 and page 43 "Remotely changing the rotation direction" are all met.

Contact input	Open	CW
	Closed	CCW
Logic input	Hi	CW
	Lo	CCW

■ CLR IN function

While the contact input is closed (logic input Lo), the analog and digital inputs are forcibly set to 0.

At this time, torque zero correction is not executed.

For details of torque zero correction, refer to the page 49 "4.4 Torque Zero Setting".

■ TRIG IN function

The TRIG IN function updates the display and BCD (option) data in synchronization with the input signal of TRIG IN.

Data is changed when the input to TRIG IN changes from Open to Closed (from Hi to Lo in logic).

The TRIG IN function is enabled when the items described in page 39 and page 45 "Measurement gate time" are set to EXT.

Input interval	100 ms to 32 s
Recommended interface	the page 76 "HOLD/BUSY inputs"
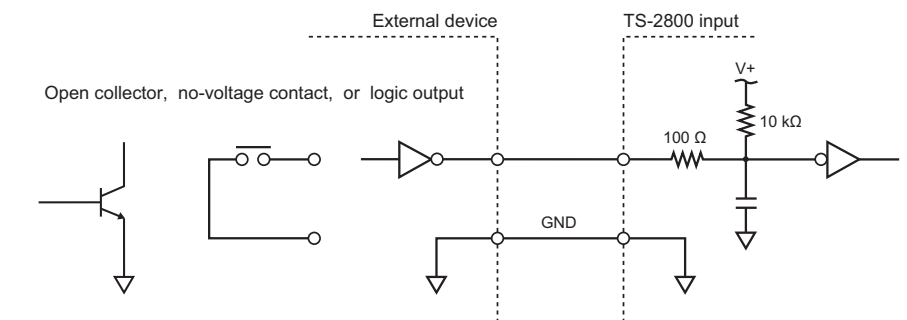
In Open Collector

Residual voltage: 1.4 V or less

In contact input

Load voltage	5 VDC or more
Load current	100 mA or more
ON resistance	10 Ω or less
OFF resistance	500 kΩ or more

In voltage input

Input Lo level voltage	0 to 1.4 V
Input Hi level voltage	4 to 5.25 V

6.2 Output Signal (MOSFET relay output: pins 1 to 4)

■ TRIG OUT function

The TRIG OUT function outputs signals synchronous with the gate time set as in page 39 and page 45 "Measurement gate time".

Display and BCD (option) data is updated at a down-arrow (↓) in the following figure.

TRIG OUT is output in synchronization with TRIG IN.

```
                        0.5s
                        Open
Gate time 1 s                       0.5s
                                    Closed

                        5s
                        Open
Gate time 10 s                      5s
                                    Closed


                        Open
Gate time External
TRIG IN                             Closed


                        Open
TRIG OUT                            Closed
```
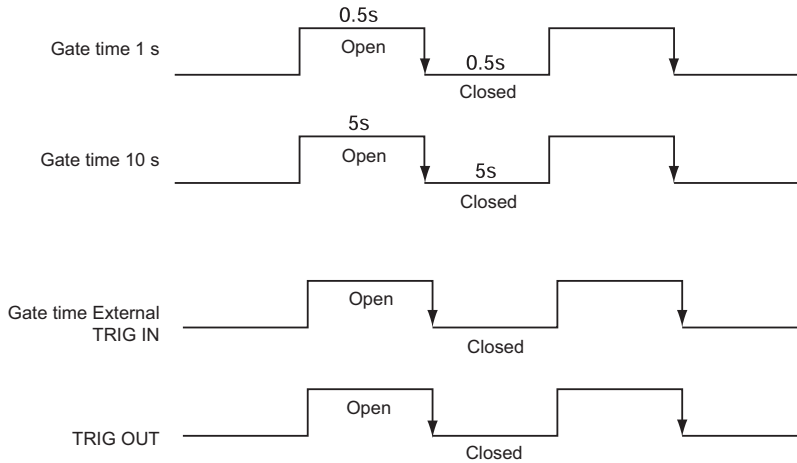
■ READY OUT function

The contact is closed during measurement.

When signal output from other than the torque meter is used as control feedback signals, use the READ OUT function to ensure interlocked operation for the safety.

The system changes to the measurement mode when all of the following three conditions are met:

Condition	Setting
MEAS/CAL selection	MEAS
TRQ	Indicated
REMOTE CLR IN	Open

● Recommended interface

Ono Sokki recommends the following circuit for the interface.

Load voltage	30 VDC or less
Load current	100 mA or less
ON resistance	10 Ω or less
OFF resistance	500 kΩ or more
Rated dielectric withstand voltage	30 V
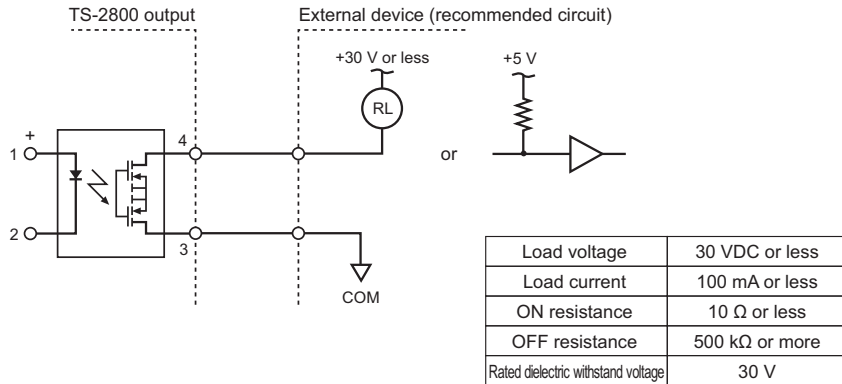
Note: Although the output is isolated, the rated dielectric withstand voltage is 30 V.

6.3 Overview of Synchronous Operation Procedure

Synchronous operation is the function that enables multiple TS-2800 torque meters to operate in the same way and timing.

The synchronous operation uses the gate time (update timing of display and BCD (option) data) of the TS-2800 torque meters.

The indicated value at this time is the mean value from TRIG IN to the next TRIG IN.

■ Example of synchronous operation system

The example provided here describes the case of three torque detectors to which TS-2800 torque meters ① ② ③ are connected respectively (assuming that the torque meters ② and ③ are synchronized with TRIT OUT of the meter ① decided by the conditions of page 56 "Input Signal (contact input: pins 5 to 8)").

• Connect TS-2800 torque meters individually to three torque detectors.

• Connect between TRIG OUT and TRIG IN of the REMOTE connector on the rear panel of each TS-2800 torque meter as shown in the following figure.

• Set the gate time of the torque meter ① to 1or 10 as described in page 39 and page 45 "Measurement gate time".

• Set the gate time of the torque meters ② and ③ to EXT as described in page 39 and page 45 "Measurement gate time".

Connect in advance the torque meters individually to SS type or TH type torque detectors and complete the operational settings by referring to the page 33 "Input of TS-2800 Settings".
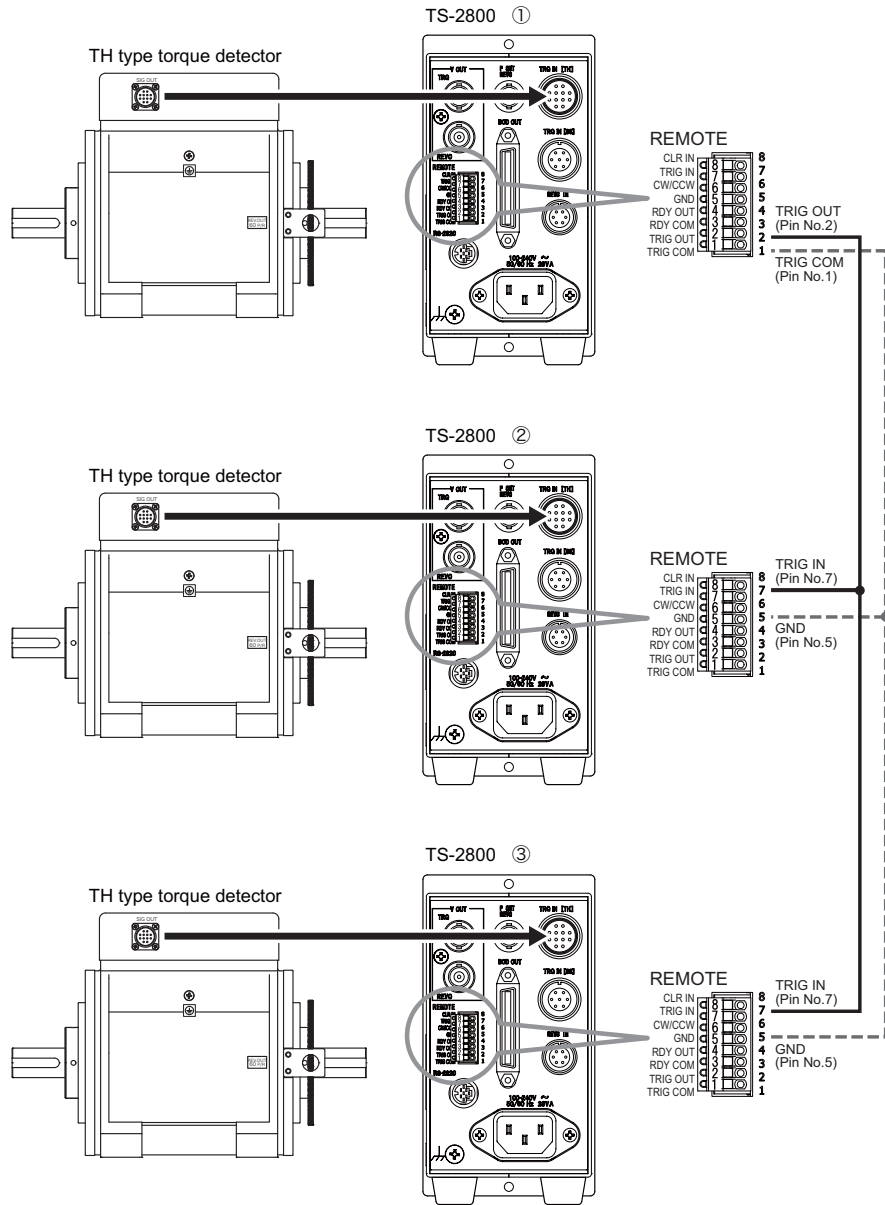
Example of synchronous operation system

7. Serial Interface (RS-232C)

7.1 Overview of RS-232C

The TS-2800 torque meter has an RS-232C interface connector on the rear panel.

Through the RS-232C interface, torque meter data can be read from a personal computer or a PLC (Programmable Logic Controller).
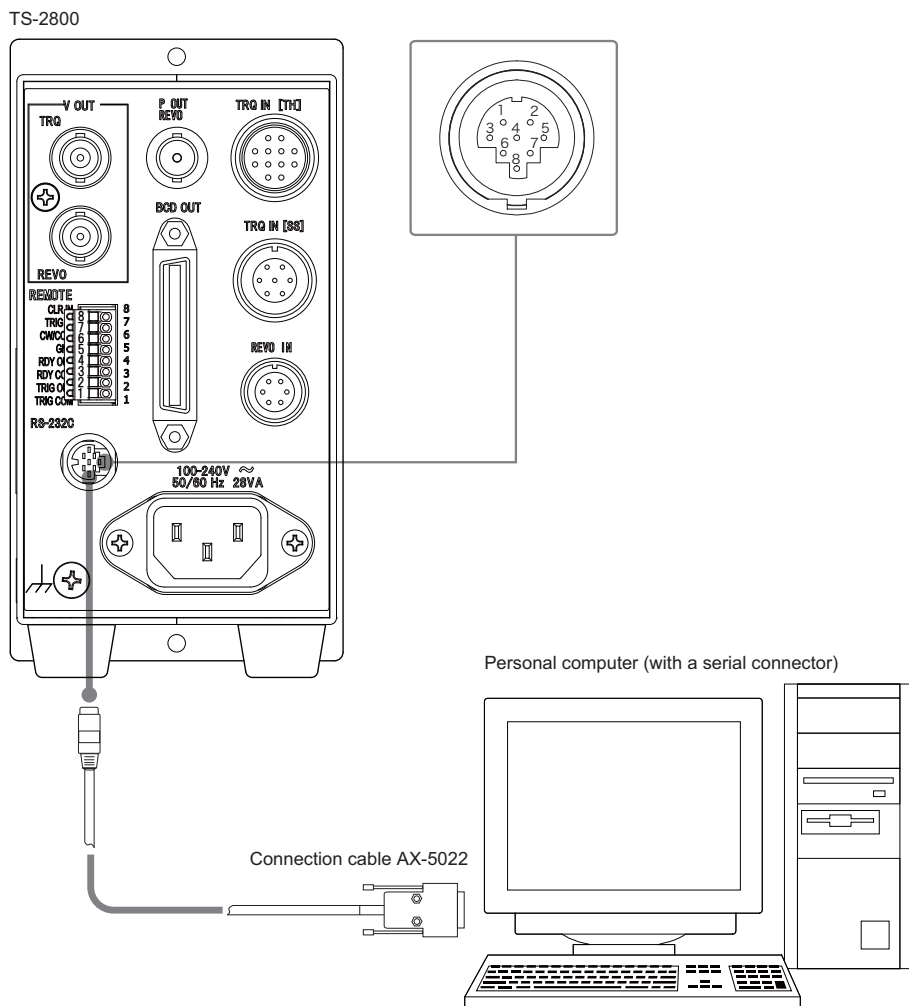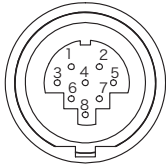
Example of serial interface connection

7.2   Serial Interface Specifications

■ RS-232C Interface Specifications

Standard	Complies with EIA and JIS X5101
Communication mode	Asynchronous full-duplex mode
Baud rate	9600 bps
Data bit length	8 bits
Parity check	None
Stop bit length	1 bit
Flow control	Hardware control
Terminator	Transmission data + CR + LF
Connector	HR12-10R-8SD (Hirose Electric)

■ Connector and pin assignments

Applicable connector	HR212-10P8PSAT3042 (Hirose Electric)

	Pin No.	Signal name	Function	Input/output
	1	FG(AA)	N.C. (Not connected)	-
	2	RxD(BB)	Data reception	Input
	3	TxD(BA)	Data transmission	Output
Pin assignment	4	CTS(CB)	Clear to transmission	Input
	5	RTS(CA)	Transmission request	Output
	6	-	Reserved	-
	7	SG(AB)	Signal ground	-
	8	-	Reserved	-

■ Applicable connector and cable specifications

Applicable connector	HR212-10P8PSAT3042 (Hirose Electric)
Applicable cable	AX-5022 (D-sub 9-pin type) 2 m (Ono Sokki) • RS-232C cable (option) for PC/AT-compatible connection

About 2.0 m

TS-2800 side   PC side

Connecting diagram

Shield ●	Case
(FG) ① ●	① (DCD)
(RxD) ② ●	② (RxD)
(TxD) ③ ●	③ (TxD)
(CTS) ④ ●	④ (DTR)
(RTS) ⑤ ●	⑤ (GND)
(–) ⑥ ●	⑥ (DSR)
(SG) ⑦ ●	⑦ (RTS)
(–) ⑧ ●	⑧ (CTS)
	⑨ (RI)
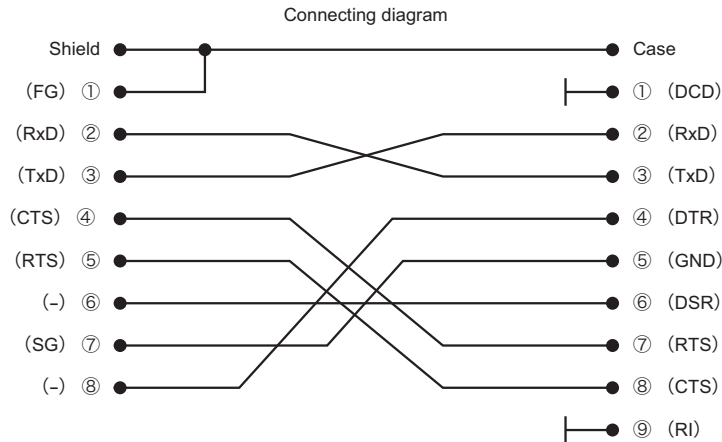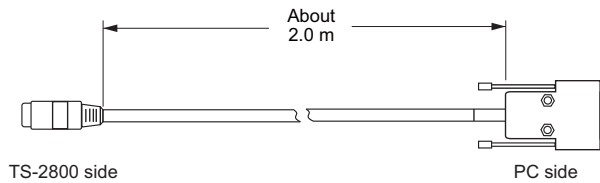
7.3   RS-232C Commands

■ Command format

The command terminator is CR (0DH) + LF (0AH).

"CR + LF" is added to an output from the TS-2800 torque meter.

A setting command stated with the brackets omitted becomes a command to read the setting. Thus, the brackets are not required in the actual command statement.

CAUTION !

*   The return code output function is set to ON (enabled) by default. When the setting command is sent to the TS-2800, a return code is always returned. So, the torque meter does not accept another command unless data is received. If you have been using other models such as TS-2600 or TS-2700 (which return no return code) and you wish to use this model without receiving return codes, refer to "4. Setting Measurement Conditions", and select OFF (disable) in the RS-232C return code setting.

■ Command

● Measurement command

MTD	Reads the torque readout.	
	Parameter	None
	Read data	Torque readout (value indicated at the top row)
		No unit data
		Left-justified
		No blank
		Negative sign present
		Example: -0.52

RTD	Reads the torque readout. (TS-2700/TH-5100-compatible command)	
	TH-2700	
	Parameter	None
	Read data	Torque readout (value indicated at the top row)
		No unit data
		Left-justified, zero-suppressed, no blank
		Negative sign only
	TH-5100	
	Parameter	None
	Read data	Torque readout (value indicated at the top row)
		No unit data
		Sign + numeric value (right-justified)
		Zero-suppressed columns are filled with space.
		Example of 4-digit indication "+5.23": +□5.23 (□ = space)

MRD	Reads the rotation speed readout.	
	Parameter	None
	Read data	Rotation speed readout (value indicated at the bottom row)
		No unit data
		Left-justified
		No blank
		Example: 3200

RRD	Reads the rotation speed readout. (TS-2700/TH-5100-compatible command)	
	TS-2700 and TH-5100	
	Parameter	None
	Read data	Rotation speed readout
		No unit data
		Left-justified, zero-suppressed, blankless

MDD	Outputs the torque and rotation speed readouts by delimiting them with a comma.	
	Parameter	None
	Read data	Torque and rotation speed readouts
		No unit data
		Left-justified
		No blank
		Negative sign is available for torque.
		Example of 5-digit indication of torque "0.123" and rotation speed "4567": 0.123, 4567

RDD	Outputs the torque and rotation speed readouts by delimiting them with a comma. (TS-2700/TH-5100-compatible command)		
	TH-2700		
	Parameter	None	
	Read data	Torque and rotation speed readouts	
		No unit data	
		Left-justified, zero-suppressed, no blank	
		Negative sign only	
		Example: 5.654,300	
	TH-5100		
	Parameter	None	
	Read data	Torque readout □, □rotation speed readout (□: space)	
		Torque	No unit data
			Sign + numeric value (zero-suppressed, right-justified)
			Zero-suppressed columns are filled with space.
		Rotational speed	No unit data
			Zero-suppressed, right-justified, no sign
			Zero-suppressed columns are filled with space.
		Example of 5-digit indication of torque "+0.123" and rotation speed "4567": +□0.123□, □□4567	

MLO	Outputs the torque and rotation speed readouts by delimiting them by a comma every gate time until the MLF command is received.	
	Parameter	None
	Read data	Same data as read by the RDD command
	Description	• EXT trigger Data is output each time Trigger or Clear is input. • INT trigger Data is output every gate time or each time Clear is input.

RLO	Outputs the torque and rotation speed readouts by delimiting them with a comma every gate time until the RLF command is received. (TS-2700/TH-5100-compatible command)	
	TS-2700 and TH-5100	
	Parameter	None
	Read data	Same data as read by the RDD command
	Description	Data is output every gate time (every trigger input, in the case of external gate) or Clear is input.

MLF	Stops continuous output by the MLO or RLO command.	
	Parameter	None
	Read data	None

RLF	Stops continuous output by the RLO or MLO command. (TS-2700/TH-5100-compatible command)	
	Parameter	None
	Read data	None

● **Connected-detector command**

TMM [d]	Reads the detector mode.		
	Parameter	None	
	Read data	d =	0: TH type torque detector
			1: SS type torque detector

● **Parameter setting command**

LDG [t]	Gate time setting		
	Parameter	t =	0 : 1 s
			1 : 10 s
			2 : EXT
	Read data	Returns the gate time code (0, 1 or 2).	

PRN [d]	Print command setting		
	Parameter	d =	0: Hold is used.
			1: Hold not used (gate time synchronization)
	Read data	Returns the print command code (0 or 1).	

● **Torque setting command**

ETR [d]	Torque detector rotation direction		
	Parameter	d =	0: EXT
			1: INT CW
			2: INT CCW
	Read data		Returns the torque detector rotation direction code (0, 1 or 2).

DTR [d]	Torque detector rotation direction (TS-2700/TH-5100-compatible command)		
	TH-2700		
	Parameter	d (torque detector rotation direction code)	
		d =	0: EXT
			1: INT CW
			2: INT CCW
	Read data	d (0, 1 or 2)	
	TH-5100		
	Parameter	d (torque detector rotation direction code)	
		d =	0: INT CW
			1: INT CCW
			2: EXT
	Read data	d (0, 1 or 2)	

DTZ

When an SS type torque detector is connected

DTZ r, [d]	Parameter	r =	0: CW
			1: CCW
		d =	0 to 99999
			-1: Auto zero
	Read data	Zero value	
		No unit	

When a TH type torque detector is connected

DTZ [d]	Parameter	d =	-99999 to -2, 0 to 99999
			-1: Auto zero

Note
- -
*   When setting a parameter with DTZ command
    Read the current value with DTZ command and then send the value obtained by adding the read
    value and the value of torque readout (ignoring the decimal point).

    Example:
    When the read value is 1321 and the torque readout is 3.2, send DTZ1353 (1321 + 32 = 1353).

    When the torque readout is –3.2 with the same read value, send DTZ1289 (1321 – 32 = 1289).
- -

*   With the SS type torque detector, only the current rotation direction can be input. Auto zero is set only for the rotation direction currently indicated.

    If an excessive value or undervalue is entered for the torque zero value, normal measurement may not be performed, outputting an abnormal readout. In such cases, take the following corrective actions:

    With the SS type torque detector, perform Auto Zero process with no load on the detector so that a normal value is indicated.

    With the TH type torque detector, communication with the detector fails and measurement cannot be continued. Send DTZ0, and then turn off the power and turn it on again.

● **Rotation speed setting command**

ERC [d]	Changes the rotation detector capacity.	
	Parameter	d = 100 to 100000
	Read data	Rotation capacity value (no unit data)

DRC [d]	Changes the rotation detector capacity.	
	TH-2700	
	Parameter	d (0 or 1)
		0 = 10000
		1 = 100000
	Read data	d (0, 1 or 2)
		0 = 10000
		1 = 100000
		2 = Other than the above (read with the ERC command)
	TH-5100	
	Parameter	d = 100 to 100000
	Read data	Returns the rotation capacity value.

ERP [d]	Sets the number of rotation speed signal pulses.	
	Parameter	d = 1 to 9999
	Read data	Returns the number of detector teeth.

DRP [d]	Sets the number of pulses of the rotation detector	
	TH-2700	
	Parameter	d = 1 to 9999
	Read data	Returns the number of detector pulses.
	TH-5100	
	Parameter	d (0, 1, 2, 3, 4 or 5)
		0 = 60
		1 = 120
		2 = 180
		3 = 240
		4 = 360
		5 = 720

Read data   d (0, 1, 2, 3, 4, 5 or 6)

         0 = 60

         1 = 120

         2 = 180

         3 = 240

         4 = 360

         5 = 720

         6 = Other than the above (read with the ERP command)

● Analog output setting command

DAT1 [,d]	Sets the torque analog time constant.

• When an SS type torque detector is connected

Normal

Parameter   d =   3: 63 ms

                     6: 500 ms

When the TS-0282 is implemented

Parameter   d =   1: 16 ms

                     3: 63 ms

• When a TH type torque detector is connected

Normal

Parameter   d =   0: 500 ms

                     1: 63 ms

                     2: 16 ms

                     3: 1.6 ms

When the TS-0281 is implemented

Parameter   d =   0: 1.6 ms

                     1: 16 ms

                     2: 63 ms

                     3: 500 ms

                     4: 0.8 ms

                     5: 0.4 ms

                     6: 0.16 ms

                     7 and later: Fourth-order Butterworth LPF

                     7: 50 Hz

                     8: 100 Hz

                     9: 500 Hz

                     A: 1 kHz

                     B: 5 kHz

Read data   Returns the torque analog time constant code.

● **Mode command**

MES	Changes to the measurement mode.		
	Parameter	None	
	Read data	None	

CLCn	Clear control command: Same operation as CLR IN of the external control function		
	Parameter	n =	0: CLR OFF
			1: CLR ON
	Read data	None	

RMD	Reads the operation mode.		
	Parameter	0:	MEAS
		1:	CAL
		2:	TEST
		3:	MENU
	Read data	Returns the operation mode value.	

RCD	Reads the status setting.		
	Parameter	None	
	Read data	a, b, c, d, e, f	
		a: READY	0: OFF 1: ON
		b: TRQ SIG	0: OFF 1: ON
		c: REV SIG	0: OFF 1: ON
		d: CLR	0: OFF 1: ON
		e: TRIG	0: OFF 1: ON
		f: CW/CCW	0: CW 1: CCW

DTNn[r1, t1, ..., r5, t5]	Sets N-0 for the torque meter		
	Parameter	n =	0: CW 1: CCW
		r =	From 0 to rotation speed capacity value
		t =	From 0 to negative and positive (±) torque capacity values (decimal point ignored)
	Read data	r =	From 0 to rotation speed capacity value
		t =	From 0 to negative and positive (±) torque capacity values (decimal point ignored)

DNSn[,f]	N-0 switch for the torque detector		
	Parameter	n=	0: CW 1: CCW
		f =	0: OFF 1: ON 2: CLR
	Read data	0:	OFF
		1:	ON

ADJ[d]	Torque adjustment command			
	Parameter	d:	0.8000 to 1.2000	Adjustment ratio of torque value to be set
	Read data		0.8000 to 1.2000	Adjustment ratio of torque value set

FSS[d]	Analog output scale adjustment command	
	Parameter	d = Scale selection
		0: × 1
		1: × 0.66
		2: × 0.5
		3: × 0.33
		4: × 0.25
		5: × 0.2
	Read data	0 to 5 : Returns the torque capacity value that is set.

● **Commands enabled only when the SS type torque detector is connected**

DTC[d]	Sets the torque capacity.	
	Parameter	d = 1 to 9999: Torque capacity value
	Read data	1 to 9999: Returns the torque capacity value that is set.

DTF[d]	Sets the torque factor.	
	Parameter	d = 1 to 65535: Torque factor value
	Read data	1 to 65535: Torque factor value that is set

DTU[d]	Sets the torque detector unit.	
	Parameter	d = 0 to 2
		0: mN·m
		1: N·m
		2: kN·m
	Read data	0 to 2: Returns the unit that is set.

DTT[d]	Sets the torque detector type.	
	Parameter	d = 0 to 1
		0: SS
		1: DP
	Read data	0 to 1: Returns the detector type that is set.

DRS[d]	Sets the rotation detector type.	
	Parameter	d = 0 or 2
		0: INTERNAL
		2: MP-981
	Read data	0 to 2: Returns the detector type that is set.

■ Return codes

Specify the return value to be returned when a command is received.

• Returns the return value for the read command.

• Returns one of the return values in the following return code list for the setting command.

● **Details of return codes**

Return code	Description
G	Normal setting
ER21	Communication error
ER22	Timeout error
ER23	Command reception buffer overflow
ER24	Unregistered command
ER25	Out of the setting range
ER26	Reserved
ER27	Format error
ER28	Locked
ER29	Reserved
ER30	Terminator error

8. Optional Functions

8.1 TS-0281: High-speed Response Output Function for TH Series

With this optional device, the time constant setting range is extended to minimum 0.16 ms, and the fourth-order Butterworth digital low-pass filter becomes available.

The digital filters are fourth-order Butterworth low-pass filters (LPF). Note that the 5-kHz LPFs including analog filters are fifth-order.

Additional time constant: 0.16 ms, 0.4 ms, 0.8 ms

Additional LPF: 50 Hz, 100 Hz, 500 Hz, 1 kHz, 5 kHz (only 5 kHz is fifth-order)

Note that the parameters available for RS-232C command DAT (time constant setting command) are different from the standard. For details, refer to "7.3 RS-232C Commands".

8.2 TS-0282: Changing Time Constant for DD Series

On the DD series torque detectors, this optional function enables to set a shorter torque time constant than the standard.

The available time constants are different from the standard, and there is no additional constant.

	Available time constant
Standard	500 ms and 63 ms
With TS-0282	63 ms and 16 ms

Note that the parameters available for RS-232C command DAT (time constant setting command) are different from the standard. For details, refer to "7.3 RS-232C Commands".

8.3 TS-0283: BCD Output

Note
- The cable connected to the BCD OUT connector shall be 5 m at longest and should be shielded as needed.
- This section describes the BCD output assuming that the BCD output and print command are connected through the recommended interface to external equipment as they are recognized by the external equipment.

The BCD and print command outputs of the TS-2800 torque meter are all open collector outputs.
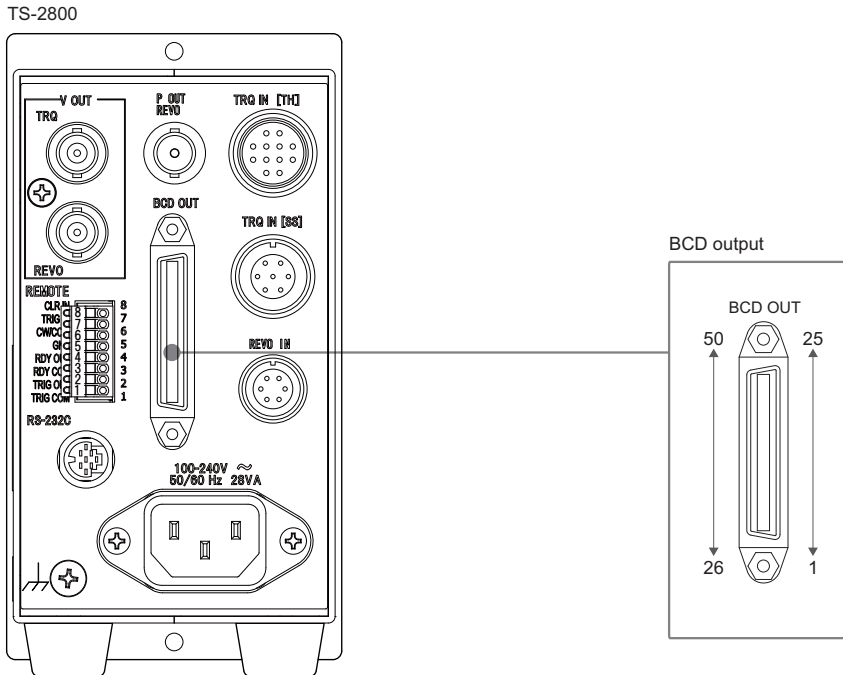
8.3.1 Signal line of BCD output connector

For details of BCD output connector pin assignments, refer to the page 25 "BCD OUT (optional)".

■ **Torque data and rotation speed data output**

Torque data	Pin: 1 to 20	Values are output in five digits. No decimal point is output.
Rotation data	Pin: 21 to 40	Values are output in five digits.
Positive logic parallel output		
Open collector output		

■ Torque data polarity output

Pins 42 (negative output (-)) and 43 (positive output (+))		
Open collector output		
When the measurement value is positive (+)	Pin 42 (negative output (-))	Lo
	Pin 43 (positive output (+))	Hi
When the measurement value is negative (-)	Pin 42 (negative output (-))	Hi
	Pin 43 (positive output (+))	Lo

■ Print command output

Pin 49 (open collector output)

When HOLD signal is input and BCD output is held, the print command signal of negative logic pulse is output (refer to the page 77 "8.3.3 Timing chart").

When the print command is set to ON, the print command signal is output when Clear is input.
The print command is not output for each gate while Clear is being input.

■ HOLD input

Pin 47

When a voltage signal of Lo level (contact closed) is input, BCD output data is held and the print command signal is output. The HOLD state continues while this signal is at the Lo level (contact closed).

■ BUSY input

Pin 48

When a printer has accepted a print command, the printer outputs BUSY signal. This signal is input through this pin.

While the printer is busy, input a Lo level (contact closed) signal.

While this signal is at the Lo level, BCD output is held and no print command is output.

8.3.2 Recommended interface

Ono Sokki recommends the following circuit for the interface.

■ BCD output/Polarity output/Print command output

Output format	Open collector
IC	74LS07 or equivalent
Withstand voltage	24 V or less
Sink current	32 mA or less
Residual voltage	0.6 V or less
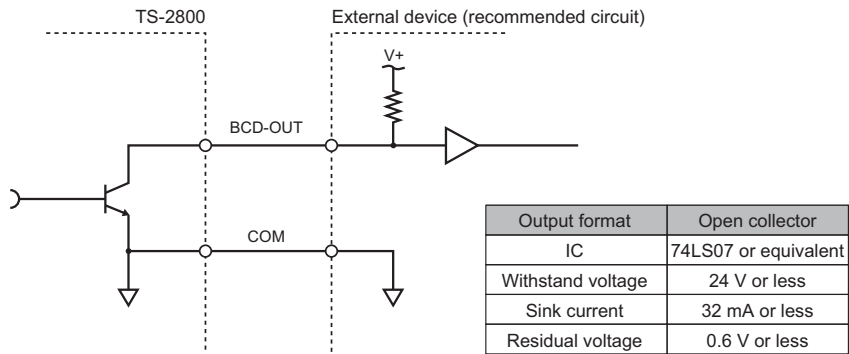
■ HOLD/BUSY inputs

Input signals without chattering.

In Open Collector

Residual voltage: 1.4 V or less

In contact input

Load voltage	5 VDC or more
Load current	100 mA or more
ON resistance	10 Ω or less
OFF resistance	500 kΩ or more

In voltage input

Input Lo level voltage	0 to 1.4 V
Input Hi level voltage	4 to 5.25 V

8.3.3 Timing chart

TS-2800

Printer

Data output/polarity output → Data input

Print command output → Print command input

BUSY input ← BUSY output

HOLD input

Print start
(start of data reading)

■ When HOLD input is not used

When HOLD input is open or at the Hi level, the following pattern is repeated continuously.

When the condition of page 40, page 46 "Print command ON/OFF setting" are set to ON, a print command is output based on the condition (1 s, 10 s or EXT) set in page 39, page 45 "Measurement gate time".
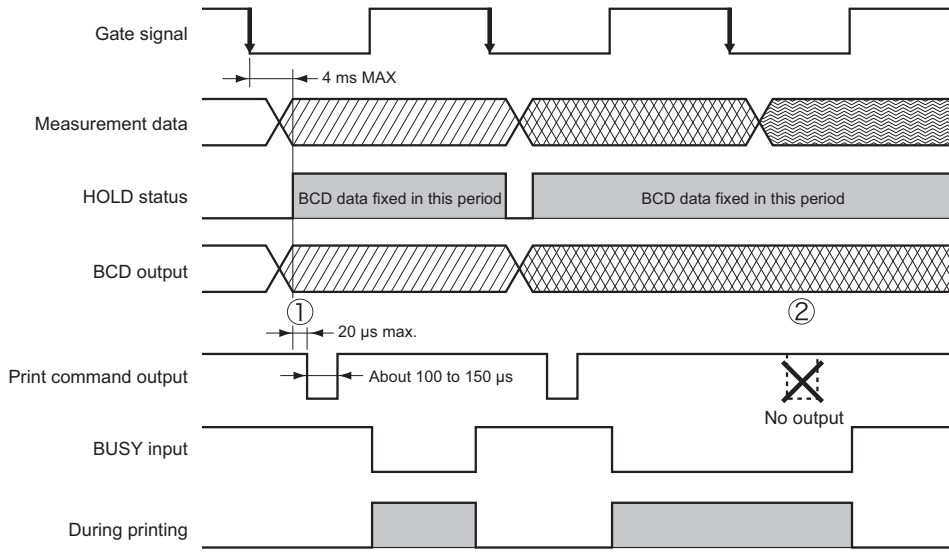
①: BCD data is updated every gate time.

②: During BUSY input, no print command is output and BCD data is not updated either.

■ When HOLD input is used

When HOLD input is used, set the condition of page 40 "Print command ON/OFF setting" to OFF.

In this case, a print command is output only when the HOLD signal is input to pin 47 of the BCD OUT connector.
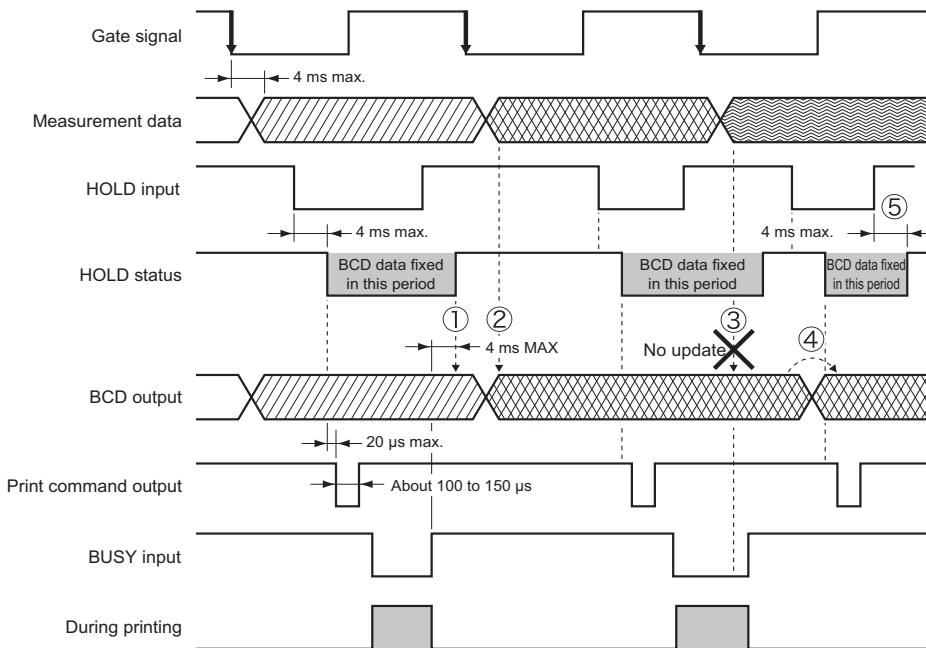
①: After the HOLD status is released, the current data is kept output until measurement data is updated.

②: Along with the update of measurement data, BCD data is also updated;
   however, no print command is output because there is no HOLD input.

③: BCD data is not updated because BUSY input is in progress.

④: Note that if BCD data is not updated after the release of HOLD status, the same data is held again.

⑤: Because of no BUSY input, BCD data is released when HOLD input is released.

8.4   TS-0284: Rotation Speed Pulse Output Function

The rotation speed pulse signal input to the TS-2800 torque meter is output to the outside.

This function depends on the rotation speed detector connected to the TS-2800 torque meter.

Output mode	Hi: +5 V ± 0.5 V Lo: +0.5 V or less TTL output
Connector	BNC

9. Troubleshooting

If your TS-2800 torque meter seems to experience any failures or problems during the operation, refer to the following troubleshooting table and take appropriate corrective actions.

If the problem persists even after taking the corrective actions indicated in this table, contact the nearest Ono Sokki sales office or the distributor where you purchased the product.

Symptom	Cause	Check item	Corrective action
Power cannot be turned on	The switch is not set to ON.	POWER switch	Set the POWER switch to ON. • Refer to the page 30 "3.5 Turning Power on to TS-2800".
	The AC power cable is disconnected.	Connection of the AC power cable	Insert the cable plug into the outlet properly. • Refer to the page 30 "3.5 Turning Power on to TS-2800".
	The AC power cable is broken.	Continuity of AC power cable	Replace the AC power cable.
ERROR is indicated.	–	–	• Contact the nearest Ono Sokki sales office or the distributor where you purchased the product.
A negative torque value is indicated (except for intended settings).	Torque detector setting error	Driving-side and load-side mounting direction, and torque direction setting	Remount the torque detector and re-set up the torque meter.
	Overload is measured.	Reduce the load and measure the torque again.	Replace the torque detector suitable for the capacity.
			A wrong rotation direction is set. • Refer to the page 47 "4.3 Setting Rotation Direction and Torque Polarity".
The value remains zero.	No torque signals are received.	TRQ indication (not displayed)	The signal cable is disconnected. • Refer to the page 29 "3.3 Connecting to the Torque Detector".
TRQ is blinking.	The torque value is out of the measurable range.	–	• Refer to page 49 "4.4 Torque Zero Setting", the page 35 "Setting the torque capacity and unit".
Mismatch of torque	Setting error	Settings of capacity, unit and torque zero correction value	Refer to the page 49 "4.4 Torque Zero Setting". • Contact the nearest Ono Sokki sales office or the distributor where you purchased the product.

Mismatch of rotation speed	Setting error	Settings of rotation detector selection switch and P/R count	Set up the relevant conditions again. • Refer to the page 33 "4.2 Input of TS-2800 Settings".
Zero point drifts	The torque zero correction value is not set.	Setting of zero correction value of torque	Set the zero correction value of torque. • Refer to the page 49 "4.4 Torque Zero Setting".
	Overload was applied during measurement.	Torque zero correction value setting, torque of tested device, sudden start and stop	the page 49 "4.4 Torque Zero Setting". • Contact the nearest Ono Sokki sales office or the distributor where you purchased the product.
	Shaft torque is applied at rest.	Disconnect the shaft and check the zero point.	If the zero point has not drifted, it need not be changed.
Zero point varies and is instable.	Noise	Review of wiring method and grounding	Check the wiring work. • Refer to the page 15 "1.3 Precautions on TS-2800 Wiring".
Analog voltage is not output.	Negative voltage is output due to a torque detector setting error.	Check whether the torque readout is a negative value or negative voltage is output.	Refer to "A negative torque value is indicated" in the previous symptoms.
	Inappropriate load connection	Whether the connected load is 10 kΩ or more	Change the connected load. • Refer to the page 50 "5.1 Torque Analog Voltage Output".
Analog voltage output drifts.	• Analog voltage output is calibrated improperly. • Drift due to temperature or other factors	• Check whether the temperature is within the specified range. • Check whether measurement accuracy is within the specified range.	Calibrate the voltage output for torque or rotation speed. • Refer to the page 51 "Time constant" or the page 53 "5.3 Calibration Procedure". Calibrate the voltage output for torque or rotation. • Refer to the page 49 "4.4 Torque Zero Setting".
"Sensor Error" is indicated.	Poor communication with torque detector	Check the connection of the cable.	• Contact the nearest Ono Sokki sales office or the distributor where you purchased the product.

10. Specifications

10.1 Torque Measurement

■ Input

Connected torque detector	SS, DD, DSTP, MD series	TH series
Input signal	Output of torque detector of phase-difference method using an electromagnetic gear	Output of torque detector of phase-difference method using electromagnetic induction theory
Input impedance	About 2 kΩ (when input signal amplitude is 2 Vpp or less)	120 Ω
Input frequency range	200 Hz to 50 kHz	17 kHz to 23 kHz
Input signal range	0.2 Vpp to 15 Vpp	Line driver input
Connector	TRC116-23A10-7F	R03-R12F

■ Measurement settings

Connected torque detector	SS, DD, DSTP, MD series	TH series
Capacity	1 to 9999	Receiving the value from torque detector
Factor	1 to 65535	Receiving the value from torque detector
Torque correction	0.8000 to 1.2000 Torque value is multiplied by a coefficient.	
Torque-zero correction value	Stored in memory, for each direction (CW and CCW).	Stored in memory.
N-0 correction	Five correction points	
Response	63 ms and 500 ms	1.6 ms, 16 ms, 63 ms and 500 ms

■ Indication

Connected torque detector	SS, DD, DSTP, MD series	TH series
Display	LCD	
Number of digits indicated	Polarity + 4 digits (decimal points depend on the capacity.)	Polarity + 4 or 5 digits selectable (decimal points are given automatically.)
Unit	mN·m, N·m and kN·m	
Display gate time setting	1 s, 10 s and external gate (EXT)	
Accuracy	N-0 correction used: ±0.2%/F.S. ± 1 digit (in 4-digit mode)	±0.1%/F.S. ± 1 digit or ± 0.2%/F.S. ± 1 digit
	N-0 correction not used: ±0.5%/F.S. ± 1 digit (in 4-digit mode)	

* The accuracy depends on the combination with the torque detector.

* F.S.: Full-scale

■ Analog output

Connected torque detector	SS, DD, DSTP, MD series	TH series
Output format	Isolated voltage output: 0 to ±10 V/F.S.	
Response	63 ms and 500 ms	1.6 ms, 16 ms, 63 ms and 500 ms
Accuracy	In combination with detector (1-s average) N-0 correction used: ±0.2%/F.S. N-0 correction not used: ±0.5%/F.S.	In combination with the detector ±0.1%/F.S. or ±0.2%/F.S.
Temperature drift	±0.01%/F.S./ºC	±0.01%/F.S./ºC
Connector	BNC	

10.2 Rotation Speed Measurement

■ Input

Connected torque detector	SS, DD, DSTP, MD series	TH series
Input signal	Rectangular wave of MP-981, etc. and torque detector internal signals	Rectangular wave of MP-981, etc.
Amplifier	Unbalanced DC amplification	
Input impedance	10 kΩ or more	
Input frequency range	1 Hz to 100 kHz (accuracy is ensured at 10 Hz or higher)	
Amplification range of input signal	Hi level: +4 to +30V Lo level: -1 to +1V Pulse width: 3 μ or more	
Supply voltage output	12 VDC ±0.6 V , 100 mA max.	
Connector	R03-R6F	

■ Measurement settings

Connected torque detector	SS, DD, DSTP, MD, TH series
Capacity	200 to 100,000 r/min
Unit	r/min
Minimum measurement rotation speed	1 r/min
Number of detector gears	1 to 9999 P/R

■ Indication

Connected torque detector	SS, DD, DSTP, MD, TH series
Display	LCD
Number of digits indicated	5
Unit	r/min
Display gate time setting	1 s, 10 s and external gate (EXT)
Accuracy	±0.02%/F.S. ± 1 digit

■ Output

Connected torque detector	SS, DD, DSTP, MD series	TH series
Output format	Voltage output: 0 to +10 V/F.S.	
Response	Time constant: 63 ms	Output with a delay of one cycle
Accuracy	Rectangular wave of MP-981, etc.: ±0.1%/F.S. Torque detector internal signals (1-s average): ±0.2%/F.S.	±0.1%/F.S.
Temperature drift	±0.01%/F.S./ºC	

10.3 Controls and Display

■ Display

Connected torque detector	SS, DD, DSTP, MD, TH series
Indication (in measurement mode)	Torque, rotation speed, status, ready for measurement (READY), torque signal input, rotation signal input, CW/CCW
Indications	TH, SS, READY, TRQ, REV, SCL, CW, CCW, TRQ ZERO, ⚷, USER

■ Controls

Connected torque detector	SS, DD, DSTP, MD, TH series
Switch	8 keys MENU, ↑, →, ENT, CW/CCW, TRQ ZERO, KEY LOCK, MEAS/CAL

10.4 Interface (common specifications for all torque detectors)

■ REMOTE

Connected torque detector	SS, DD, DSTP, MD, TH series
Clear input	Contact input: Forcibly set the measured value to 0 when the contact is closed.
Rotation direction selection input	Contact input: Switches between CW and CCW Contact is closed at CCW.
Trigger input	Contact input: At external gate, contact closed is indicated and BCD is updated. OR with the switch on the front panel when the trigger function is used.
Trigger output	Contact output: Set to ON or OFF in synchronization with the display gate time. Example: Set to ON for 0.5 s and OFF for 0.5 s when the gate time is 1 s. Two or more converters can run concurrently using trigger input and output.
Ready (READY)	Contact output: When torque measurement is ready, the contact is closed.
Input	Signal form: When non-voltage contact is input Open voltage: 5.25 V or less Short-circuit current: 1 mA or less
	Signal form: When voltage is input Hi level: +4 to +5.25 V Lo level: 0 to 1.4 V
Output	MOSFET relay: Load voltage, 30 VDC or less Load current: 100 mA or less ON resistance: 10 Ω or less OFF resistance: 500 kΩ or more Rated dielectric withstand voltage: 30 V
Connector	MC0,5/8-G-2,5 (base board), FK-MC0,5/8-ST-2,5 (harness side)

■ Analog output

Connected torque detector	SS, DD, DSTP, MD, TH series
Number of channels	2 ch
Item	Torque, rotation speed
Output scale setting (only for torque)	Select one among 100%, 66.7%, 50%, 33.3%, 25% and 20% (at ±10 V)
Output format	Voltage output Torque: 0 to ±10 V/F.S. (capacity value) Rotation: 0 to +10 V/F.S.
Connector	BNC

■ Communication interface

Connected torque detector	SS, DD, DSTP, MD, TH series
Standard	Complies with EIA and JIS X5101
Communication mode	Asynchronous full-duplex mode
Transmission speed (bps)	9600
Character length	8 bits
Parity check	None
Stop bit	1
Terminator	CR + LF
Connector	HR12-10R-8SDL

■ Optional BCD output

Connected torque detector	SS, DD, DSTP, MD, TH series
Number of channels	2 ch
Number of digits	Torque, rotation speed: 5 digits each, without decimal point
Item	Torque, rotation speed
Update time	1 s, 10 s and external gate (EXT)
Output format	Output of positive logic open collector Withstand voltage: 24 VDC or less Sink current: 32 mA or less Residual voltage: 0.6 V or less
Connector	DX10A-50S

■ Optional rotation speed pulse output

Connected torque detector	SS, DD, DSTP, MD, TH series
Output format	Hi: +5 V ± 0.5 V Lo: +0.5 V or less
Connector	BNC

■ Other optional functions

Connected torque detector	SS, DD, DSTP, MD series	TH series
Additional function	Time constants added: 16 ms, 63 ms	Time constants added: 0.16 ms, 0.4 ms, 0.8 ms LPF added: 50 Hz, 100 Hz, 500 Hz, 1 kHz, 5 kHz

10.5   General Specifications (common for all torque detectors)

Rated power	100 to 240 VAC, 50/60 Hz, 28 VA
Operating temperature range	0 to +40 ºC
Storage temperature range	–10 to +55 ºC
Operating humidity range	0 to 80% (with no condensation)
Safty	IEC61010-1 : Overvoltage Category II Protection Class 1 Pollution Degree 2
Environmental Conditions	Indoor use only
Operting Altitude	2000 m maximum
Withstand voltage	1,500 VAC, 1 minute
Dielectric resistance	10 MΩ or higher (with 500-VDC megger)
External dimensions	76 (W) × 142 (H) × 262 (D), excluding projections
Mass	About 2 kg

10.6 Conforming Standards

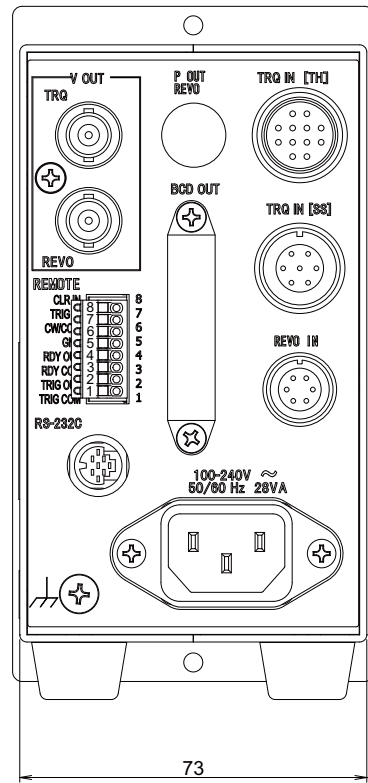| CE Marking	Low Voltage Directive 2014/35/EU EMC Directive 2014/30/EU RoHS Directive 2011/65/EU	Standard EN 61010-1 Standard EN 61326-1 Standard EN IEC 63000
FCC	CFR47 Part15 Subpart B Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.	

* For details , see: https://www.onosokki.co.jp/English/english.htm

10.7 List of Supplied Items

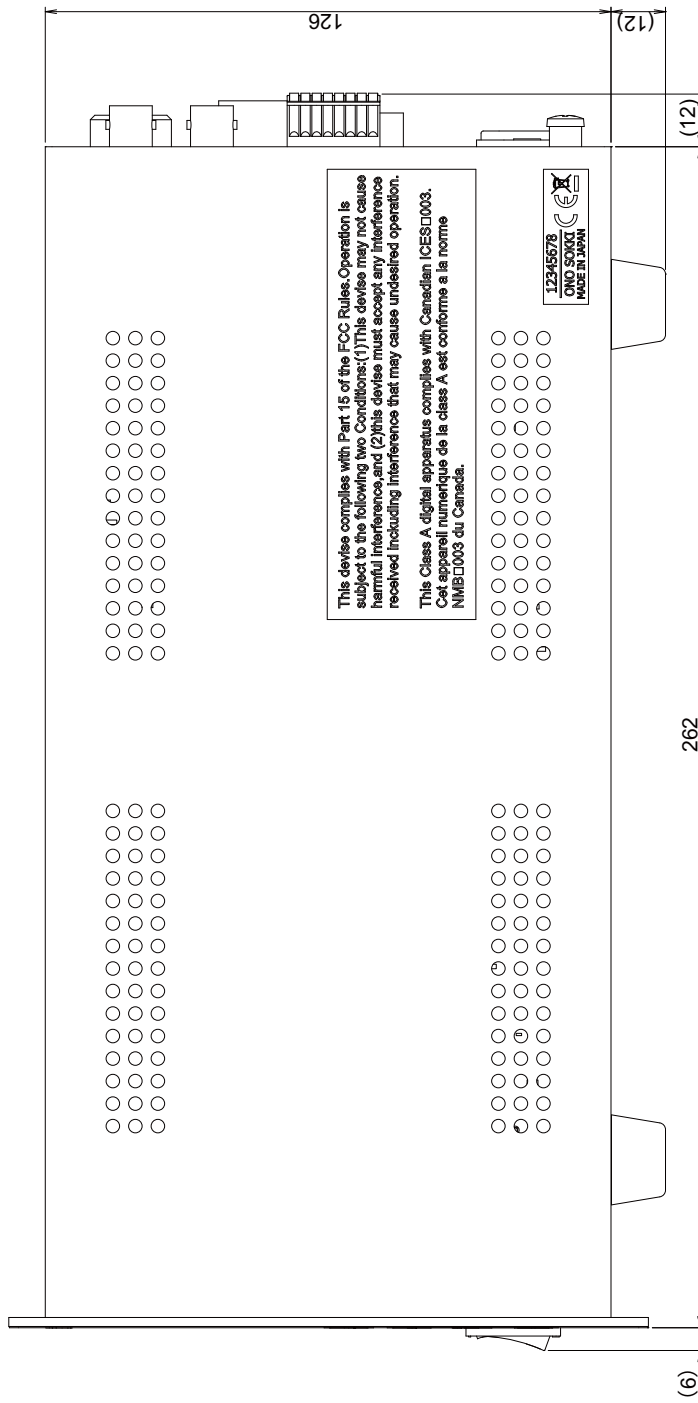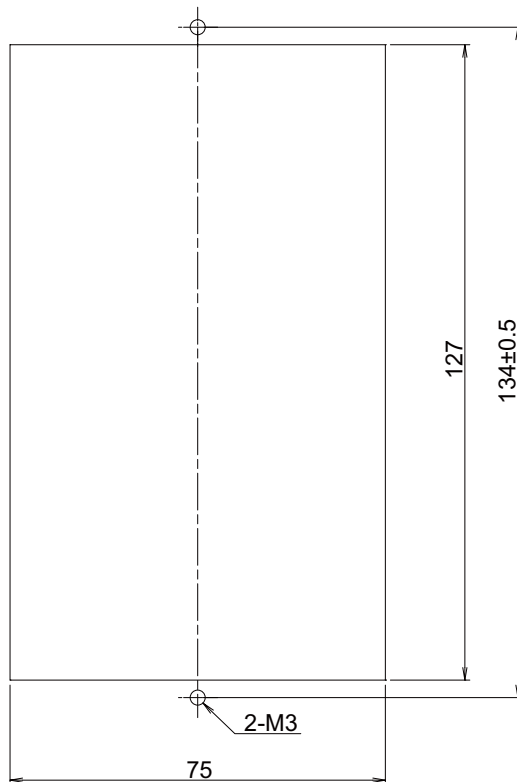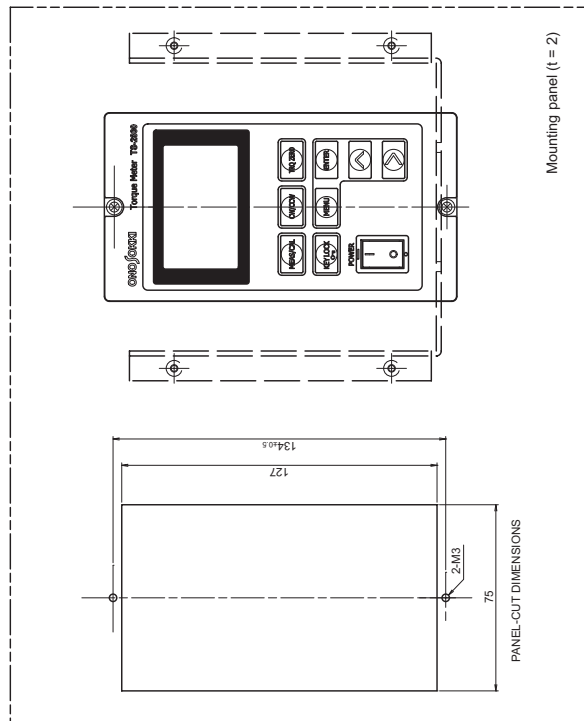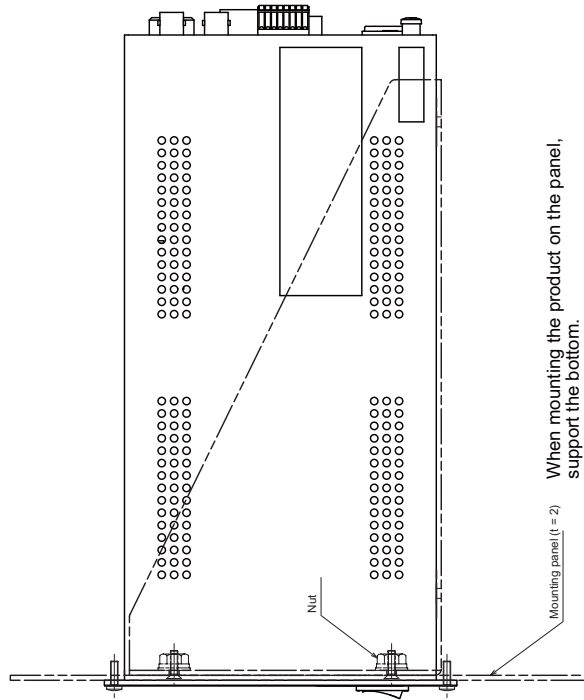| Product name	Model	Quantity	Remarks
AC power cable	AX-203	1	
Connector	FK-MC 0,5/8-ST-2,5	1	For external control (torque meter supplied with this connector on)
Instruction Manual	–	1	This manual

11. External Dimensions

■ **Panel**
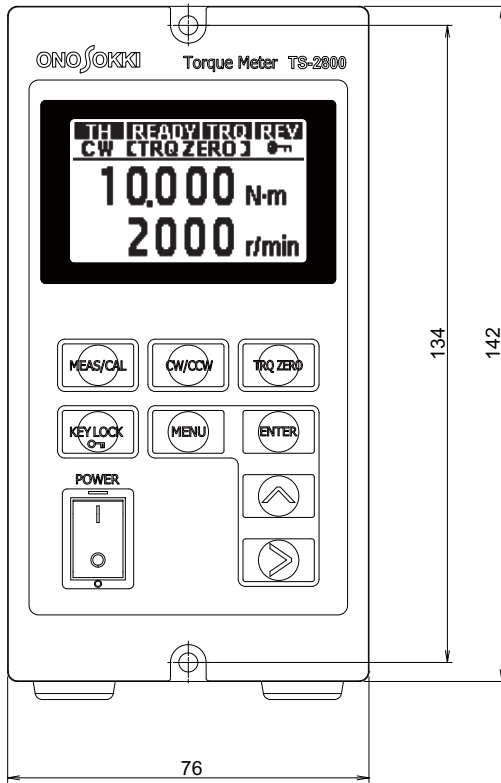
Front panel

Rear panel

■ Side

■ **Panel cutout dimensions**

PANEL-CUT DIMENSIONS

When mounting the product on the panel, support the bottom.

Mounting panel (t = 2)

Nut

Mounting panel (t = 2)

134±0.5

127

2-M3

75

PANEL-CUT DIMENSIONS

ONO SOKKI