TSUBAKI

EHM400006010R3

Shock Monitor

Electric power detection type overload protector

Instruction Manual

Model No.: TSM4000
TSM4000P

Basic Type for General Industrial Machinery

⚠CAUTION

- Please read this instruction manual carefully and understand the contents before starting the installation, connection (wiring), operation, and maintenance/inspection of this product.
- Ensure that this instruction manual is delivered to the end users who will actually use this product.
- Keep this instruction manual safe from loss until this product is discarded.
- This product is subject to change without prior notice.

TSUBAKIMOTO CHAIN CO.

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Table of Contents

1. Introduction

Thank you for purchasing the Shock Monitor.
This instruction manual describes from the installation, wiring, operation, through maintenance and inspection of the Shock Monitor. Please read this manual carefully and take due caution while handling the device.

2. Safety Precautions

- Be sure to read this manual and other attached documents carefully before starting the installation, wiring, operation, and maintenance/inspection to ensure proper use.
- Familiarize yourself with all of the knowledge of the devices, safety information, and precautions before using the Shock Monitor.
- After reading this manual, be sure to keep it in a place where users can access any time.
- This instruction uses two levels of safety precautions: WARNING and CAUTION.

⚠ **WARNING**	Failure to follow instructions may lead to dangerous situations where death or severe injury can occur.
⚠ **CAUTION**	Failure to follow instructions may lead to dangerous situation where medium to light injury or property damage can occur.

Even if the instructions are followed, a serious consequence may result depending on the situation.
Be sure to exercise due caution and follow all of these important instructions.

⚠ WARNING

- Use the product described in this instruction manual by observing safety-related laws and regulations such as Ordinance on Industrial Safety and Health.
- Observe the following during the installation, removal, or maintenance/inspection of the product:
  (1) Turn off the power switch.
  (2) Do not go below any equipment which may fall and drop.
  (3) Secure moving parts of the equipment so that they will not move unexpectedly.
  (4) Wear appropriate clothing and protective gear for the work.
- Before starting trial operation or regular inspection, be sure to confirm the operation so that the Shock Monitor properly works as a protection device.
- The Shock Monitor main unit is subject to conditions when it is used for a megger test. Follow the instruction in the instruction manual.
- Do not work while the line is live. Be sure to turn off the power before starting work. **Otherwise, an electric shock may result.**
- The wiring, energization/operation, and maintenance/inspection of the Shock Monitor must be done by an engineer with expert knowledge. **Otherwise, an electric shock, injury, or fire may result.**
- Be sure to ground Terminal E of the Shock Monitor. **Otherwise, an accident may result.**
- When using a 400 VAC motor power supply, ensure that the Shock Monitor unit and 400 V resistor are connected properly. **Otherwise, an electric shock or fire may result.**

⚠ CAUTION

- Ensure that this instruction manual is delivered to the end users. Also, let the end users carefully read the manual before using the Shock Monitor to ensure correct use.
- If you do not have the instruction manual, contact your TC dealer or a TC sales office and request a copy by specifying the product name, model number, etc.
- Do not disassemble the product or make additional work for modification.
- This product contains **several consumable parts (electrolytic capacitor, relay, etc.)**. Check functions and operation periodically according to the instruction manual. If any malfunction is found, contact your dealer for repair.
- **Do not use the Shock Monitor in an atmosphere where any corrosive gas exists. Sulfidizing gases (SO_2, H_2S), in particular, cause corrosion of copper and copper alloy used in the printed circuit boards and components, resulting in breakdowns. Corrosion is further promoted in a highly humid environment.**
- Do not allow the entry of foreign matter such as lint, paper pieces, woodchips, dust, or metal chips into the Shock Monitor.
- Clean off dirt periodically because it may cause overheating of the product or fire.
- When discarding the product, dispose it as industrial waste.
- Terminal E of the Shock Monitor is connected to a noise filter. **This terminal must be grounded.** Otherwise, the product may not operate properly due to disturbance. (Refer to page 7.)
- Leakage current of 0.5 mA at maximum will flow the grounding wire from the power supply through the capacitor inside the noise filter. Consider this leakage current when selecting an earth leakage circuit breaker.
- **To prevent noises, route the sensor cable at least 15 cm away from an inverter, a servo driver unit, and other lines.**

3. Usage

3.1 What is a Shock Monitor?

The Shock Monitor TSM4000 is a product intended for load monitoring and overload protection of general industrial machinery by detecting the consumed power supplied to a motor (3-phase induction motor).

Target machinery

General industrial machinery such as conveyors, mixers, and pumps

Load detection method

The Shock Monitor captures the voltage and current of the motor used for driving equipment and detects the power consumption of the motor.

Overload recognition method

The Shock Monitor compares the detected load with the preset overload detection level. When the overload status continues for a specified period (Shock Time) or longer, the monitor notifies an external device of the abnormal load.

Three types of abnormal signals, two for upper limit (overload) and one for lower limit (underload), are provided, which can be used as a predictive signal or a motor stop signal.

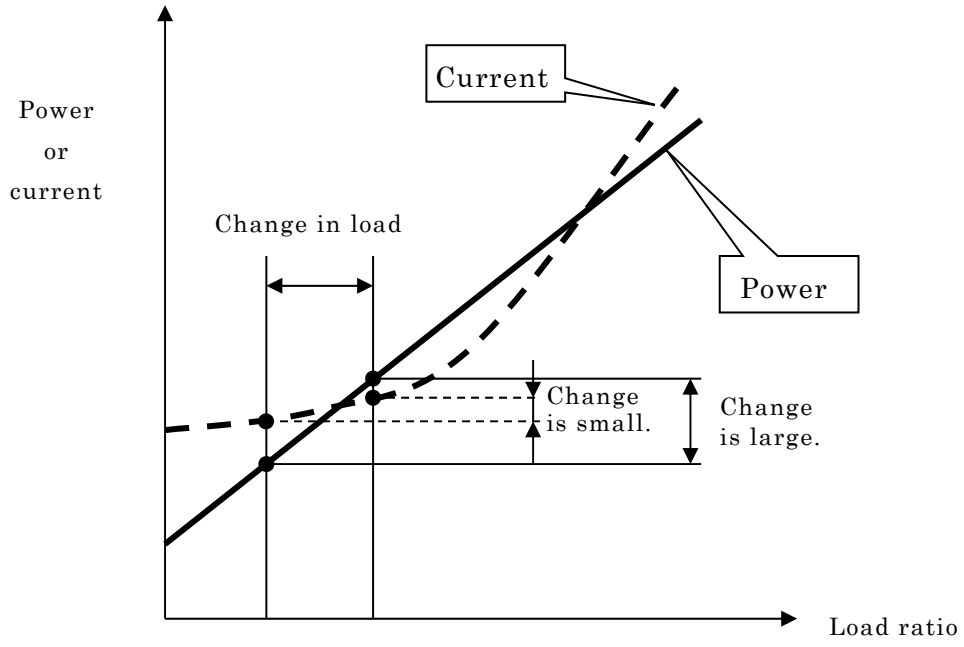
The load recognition is suspended for a preset time (Start Time) when the motor starts in order to avoid erroneous output during acceleration.

3.2 Electric power detection function

What is the electric power of a motor?

It is the amount of energy required to generate torque of a motor and is referred to as effective electric power. It is calculated as: Voltage x Current x Power factor.

The motor current is affected by motor voltage and hardly changes under light load. On the contrary, the electric power has an almost proportional relationship with the motor torque at a constant frequency. Consequently, it is possible to detect the change in the load by using electric power, even when the load is light.



Change in power/current vs. Change in load

Electric power detection by Shock Monitor

The Shock Monitor allows electric power detection with simple wiring by detecting the current of one phase of the three-phase electric power and providing the result for three phases through internal calculation.

4. Checking the Package Contents

Check the following about the product you purchased.

(1) Do the model number and specifications on the name plate match your order?

(2) Were there any damages suffered during transportation?

(3) Are the following contents included? (For their appearances, refer to the outer dimensions on page 24.)

Shock Monitor unit (including a socket): TSM4000 (Panel mounting type: TSM4000P)

Current sensor: TSM-U*** or TSM-M***

Sensor cable: TSM4-S01

4.1 Model number meaning (Main unit + Current sensor)

● The model number of the combination of the main unit and current sensor consists of the model numbers of the main unit and sensor as follows:

TSM4000 - U010

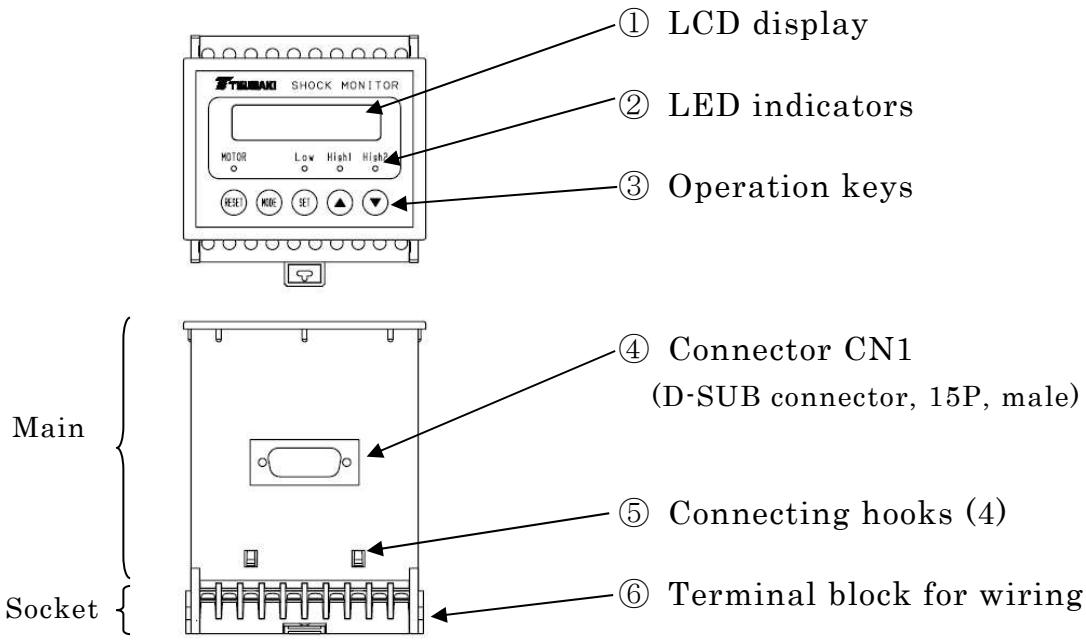
Model No. of the main unit — Model No. of the current sensor (Last 4 digits of TSM-U010)

● The model number of the sensor cable indicates the cable length as follows:

TSM4-S01 ..."01" means 1 m cable

The TSM4-S01 sensor cable is included as an accessory. If this cable length is insufficient, optional cables of 3 m, 5 m, 10 m, 20 m and 30 m are available. Contact TC when necessary.

5. Part Names



① LCD display ...Shows load ratio, setting values and parameter settings.

② LED indicators ...Indicates that the motor is running and that the output relay is activated.

③ Operation keys ...Keys used for switching the displayed mode or for changing parameters.

④ Connector CN1 ...Connector for using signals such as control input or analog output.

⑤ Connecting hooks ...Used to connect/disconnect the main unit to/from the socket.
For connection, fully insert the main unit until the hooks lock securely.
For disconnection, press down the four hooks simultaneously and remove the main unit from the socket.

⑥ Terminal block for wiring...Terminals for connecting an operational power supply, motor voltage, relay output, current sensor cable, etc.

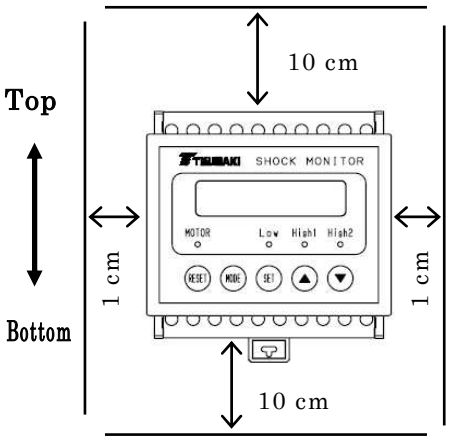
6. Installation

6.1 Installation environment

Install the Shock Monitor in a place where the following conditions are satisfied:

- Location where the ambient temperature is between 0 to 50°C and the Shock Monitor is not exposed to direct sunlight
- Location where the relative humidity is between 45 to 85%, no condensation or freezing occurs, and no water splashes onto the Shock Monitor
- Location where no dust, corrosive gases, or oil mist exist
- Location where the altitude is 1000 m or less and vibration is 4.9 m/s^2 or less

6.2 Mounting orientation and space



- Mounting method

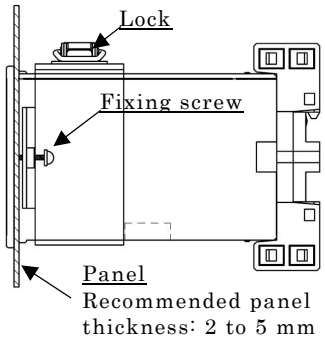
  Insert M4 screws into the DIN rail or the mounting holes of the socket and attach the main unit. Mount the Shock Monitor so that its panel is oriented vertical to the ground. Mounting it upside down or horizontally may cause overheating and breakdown.

- Space

  To ensure the dissipation of the heat generated from the Shock Monitor, provide spaces as shown in the figure on the left from other equipment, walls, and wiring ducts.

- Panel mounting type (TSM4000P)

  Mount the Shock Monitor as shown in the figure on the right.



Tighten the fixing screw with the tightening torque of 0.12 to 0.16 N・m. Provide a space of 50 mm or more above the main unit housing to allow access to the lock.

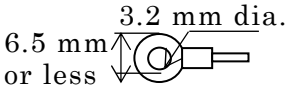
⚠CAUTION	■ Do not allow the entry of foreign matter such as lint, paper pieces, woodchips, dust, or metal chips into the Shock Monitor. **Otherwise, a fire or accident may result.**

7. Wiring

① Complete wiring by using only the socket before attaching the Shock Monitor main unit to the socket.

② Connect a commercial power supply of 90 to 250 VAC, 50/60Hz or a DC power supply of 90 to 250 VDC (no polarity) to the POWER terminals (11 and 12). Do not connect the output from an inverter or a servo driver. An erroneous connection as such may cause breakdown.

③ Use a ring type crimp terminal shown on the right to connect the power supply cable and the terminal block for wiring.
Limit the tightening torque to 0.5 to 0.6 N・m.

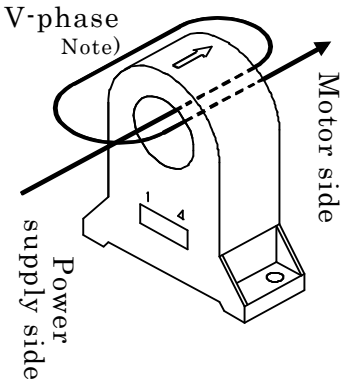


④ When the connection (wiring) is completed, check the following:
a. Are the wires connected properly?
b. Are there any remaining disconnected wires?
c. Are there any short-circuits or ground fault conditions occurring between terminals or wires?

⑤ After the connection is complete, fully insert the main unit to the socket until the hooks lock securely.

⚠WARNING	● Be sure to ground the grounding wire. **Otherwise, an electric shock or fire may result.** ● The wiring must be done by an electric work specialist. ● Confirm that the power is turned off before start wiring work. **Otherwise, an electric shock may result.**

⑥ Current sensor



To detect motor current, pass the V-phase motor wire through the sensor in the direction from the power supply side to motor side as shown by the arrow. Make sure that the direction of the wire matches with the arrow on the top of the current sensor. The number of times to pass the wire through the sensor depends on the motor capacity and voltage. Refer to the following table for the specified number.
The figure on the left shows the case where the number of times to pass the wire through the sensor is two (2).

(Note) Refer to the connection diagrams on pages 10 and 11 for the current sensor wiring and be sure to pass through the motor wire of the correct phase which is connected with the voltage input terminal V[2] of the TSM4000. If the wire of the other phase is connected, or the wire is passed through in the opposite direction, the electric power cannot be detected properly. This wiring is unrelated to the positive/reverse phase of the power supply or of the forward/reverse rotation switching of the motor.

■ Number of times to pass the wire through the sensor

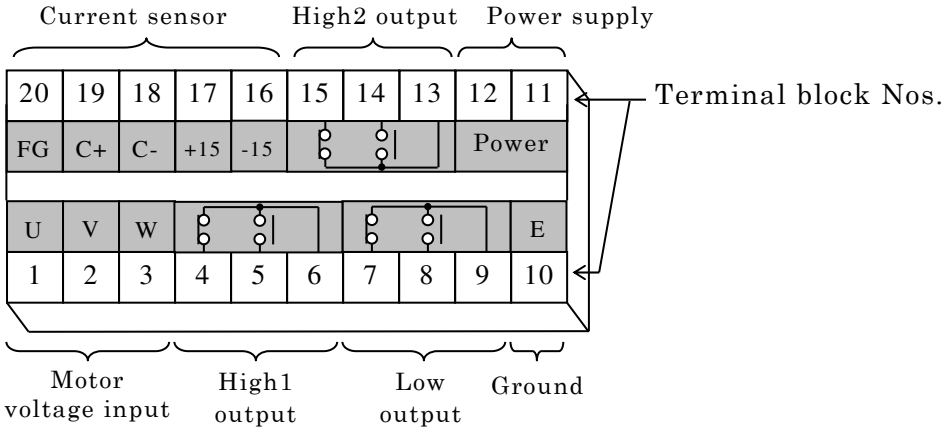
Motor capacity (kW)	200/220 VAC motor			400/440 VAC motor		
	Motor rated current (A)	Sensor model No.	No. of times to pass wire through sensor	Motor rated current (A)	Sensor model No.	No. of times to pass wire through sensor
0.1	0.71	TSM-U010	6	0.36	TSM-U010	12
0.2	1.4	TSM-U010	3	0.70	TSM-U010	6
0.4	2.3	TSM-U010	2	1.2	TSM-U010	3
0.75	3.6	TSM-U050	6	1.8	TSM-U010	2
1.5	6.6	TSM-U050	3	3.3	TSM-U050	6
2.2	9.2	TSM-U050	2	4.6	TSM-U050	5
3.7	15	TSM-U050	1	7.5	TSM-U050	3
5.5	22	TSM-U050	1	11	TSM-U050	2
7.5	29	TSM-U100	1	15	TSM-U050	1
11	42	TSM-U100	1	21	TSM-U050	1
15	55	TSM-U150	1	28	TSM-U100	1
18.5	67	TSM-U150	1	34	TSM-U100	1
22	78	TSM-U200	1	39	TSM-U100	1
30	107	TSM-M300	1	54	TSM-U150	1
37	132	TSM-M300	1	66	TSM-U150	1
45	160	TSM-M400	1	80	TSM-U200	1
55	198	TSM-M600	1	99	TSM-M300	1
75	270	TSM-M600	1	135	TSM-M300	1
90	320	TSM-M800	1	160	TSM-M400	1
110	384	TSM-M800	1	192	TSM-M400	1

The motor rated current values in the table are for reference only.

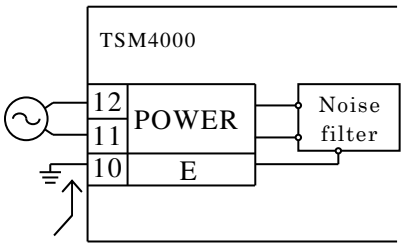
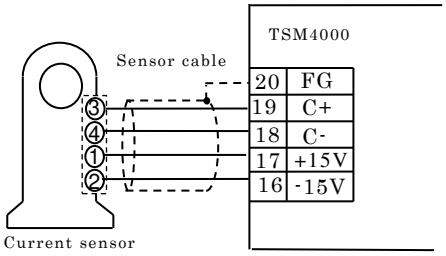
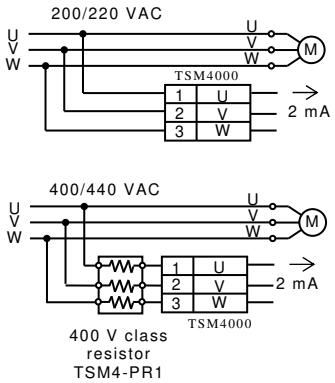
■ Connecting the sensor cable to the main unit

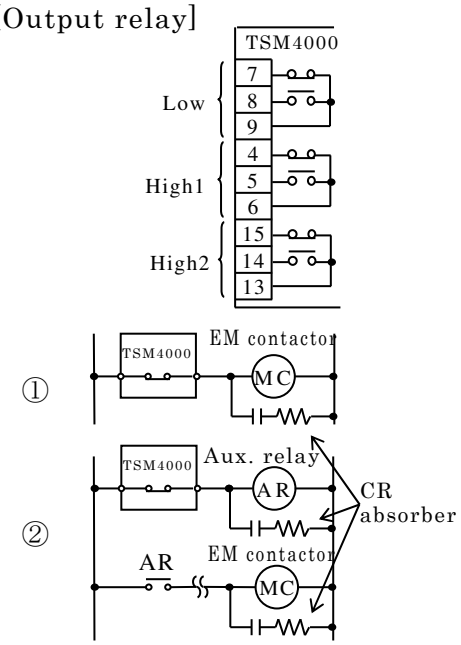
Connect the sensor cable TSM4-S01 included in the package properly to the current sensor and Shock Monitor main unit respectively. If the cable length is insufficient, longer cables are optionally available. Refer to page 4 for the model number of the sensor cable and contact TC for ordering.

8. Terminal Functions

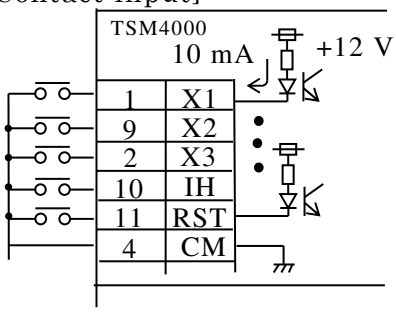
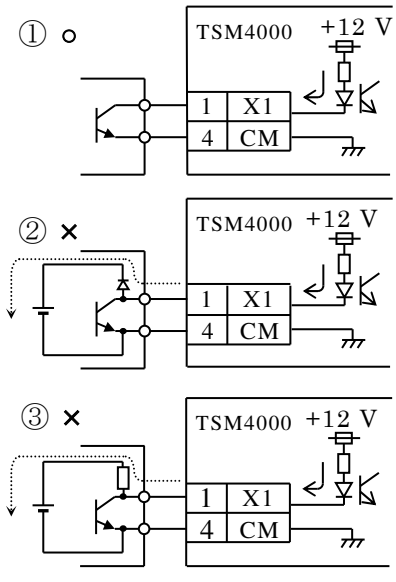


8.1 Terminal block

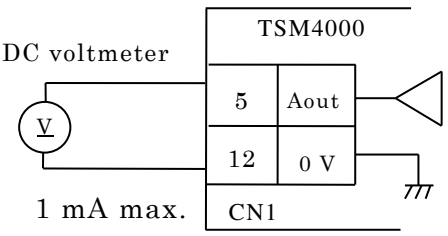
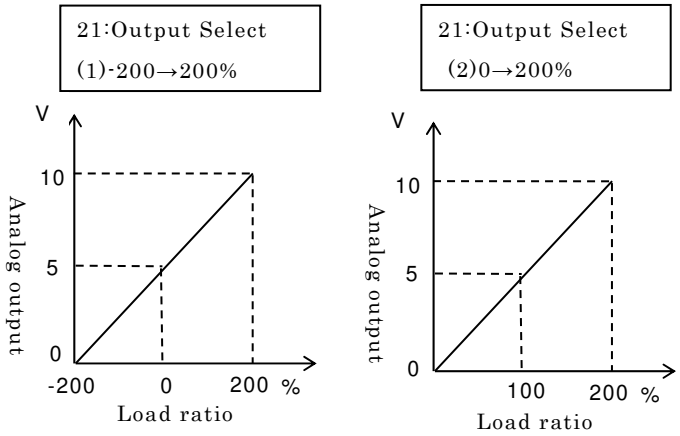
Terminal	Description
[Power supply/ground]  Leakage current 0.5 mA max.	● Power supply (Terminals 11 and 12) ・ Terminals used to connect the power supply for the Shock Monitor. Connect a commercial power supply of 90 to 250 VAC or a DC power supply of 90 to 250 VDC (no polarity). Never connect the output of an inverter or a servo driver (which may cause breakdown). ● E (Terminal 10) ・ A noise filter is connected. **This terminal must be grounded.** ・ Leakage current of 0.5 mA at maximum will flow the grounding wire from the power supply through the capacitor inside the noise filter.
[Sensor cable connection]  	・ Connector used to input the signals from the current sensor. **⚠ CAUTION** **To prevent noises, route the sensor cable at least 15 cm away from an inverter, a servo driver unit, and their output lines.**
[Voltage input]  	●U, V, W (Terminals 1, 2, 3) ・Terminals used to input the voltage applied to the motor into the Shock Monitor. When a 400 V class motor is connected, be sure to connect the 400 V class resistor as shown on the left. Direct connection of a 400 V class motor may cause breakdown. A current of about 2 mA (AC) will flow through each terminal.

Terminal	Description
[Output relay] 	● Output relay High1 (Terminals 4, 5, 6), High2 (Terminals 13, 14, 15), Low (Terminals 7, 8, 9) ・Output terminals used to notify external devices of an alarm or overload condition. Three relay signals, High1, High2, and Low will be output. **Contact specification: 1c contact: 250 VAC, 0.5A (Inductive load cosφ = 0.4)** Notes: ・When an electromagnetic contactor is connected as shown in the left figure ①, limit the operating coil capacity to less than 100 VA at power-on and to less than 10 VA during retention. If an electromagnetic contactor with larger capacity is connected, activate an auxiliary relay with the output of the Shock Monitor as shown in the left figure ②, and then open/close the electromagnetic contactor with the contact of the auxiliary relay. ・As shown in the left figure, mount a CR absorber to the coils of the electromagnetic contactor and auxiliary relay to prevent noise generation. ・When a sequencer photocoupler input which operates with minute current (10 mA or less) is connected, activate a relay for minute current with a relay output, and then connect the contact of the relay for minute current to a sequencer photocoupler input.

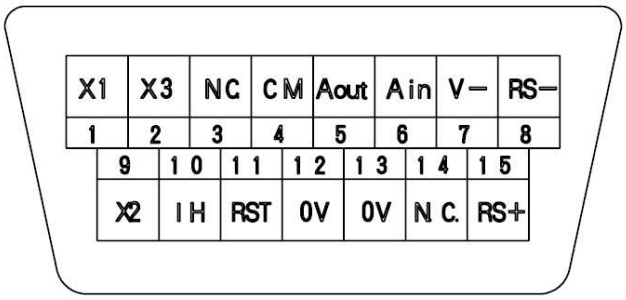
8.2 Connector CN1

Terminal	Description
[Contact input]  [Non-contact input] 	● X1, X2, X3 (CN1 pin Nos. 1, 9, 2) Up to eight levels can be selected by using the combination of the ON (short-circuit) and OFF (open) statuses of terminals X1, X2, and X3. If a number larger than the value set for parameter "5: Process" is chosen, the selection will be [1]. ● IH (CN1 pin No. 10) ・ When IH is set to ON, load monitoring stops within the period set for "17: Inhibit Time", and the load ratio display shows flashing 0%. If the relay output of the Shock Monitor is unnecessarily activated during the acceleration/deceleration of inverter operation, set IH to ON. ●RST (CN1 pin No. 11) ・ Turning RST ON resets a relay in the self-holding status. Note: When setting [Non-contact input], be sure to use an open collector signal shown in the left figure ①. Using ② or ③ may cause malfunction due to a detour circuit which may be created depending on the condition of the power supply.

Process No.	X1 - CM	X2 - CM	X3 - CM
Process [1]	OFF	OFF	OFF
Process [2]	ON	OFF	OFF
Process [3]	OFF	ON	OFF
Process [4]	ON	ON	OFF
Process [5]	OFF	OFF	ON
Process [6]	ON	OFF	ON
Process [7]	OFF	ON	ON
Process [8]	ON	ON	ON

Terminal	Description
Analog output  	・ During the monitoring in the Monitor mode, the load ratio is output as DC voltage signals. The output mode is switched with parameter 21:Output Select. The maximum output current is 1 mA. 

● Connector CN1 pin layout and I/O cable color

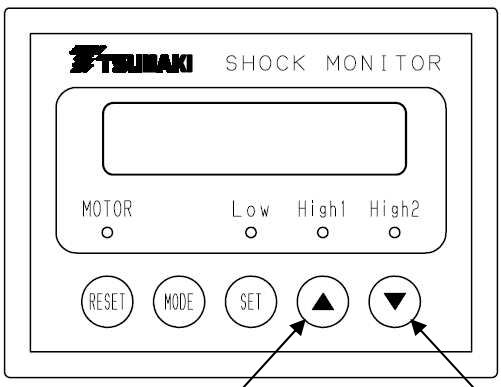


Color	Pin No.	Signal name
Black	1	X1
White	2	X3
	3	N.C.
Red	4	CM
Green	5	Aout
Yellow	6	Ain
Brown	7	V−
Blue	8	RS−
Purple	9	X2
Gray	10	IH
Pink	11	RST
Sky blue	12	0V
	13	0V
	14	N.C.
Orange	15	RS+

● LCD contrast adjustment

If the LCD display is difficult to read, adjust it with the ▲ or ▼ key while holding down the SET key.

(Note that setting the display too dark shortens the life of the LCD.)

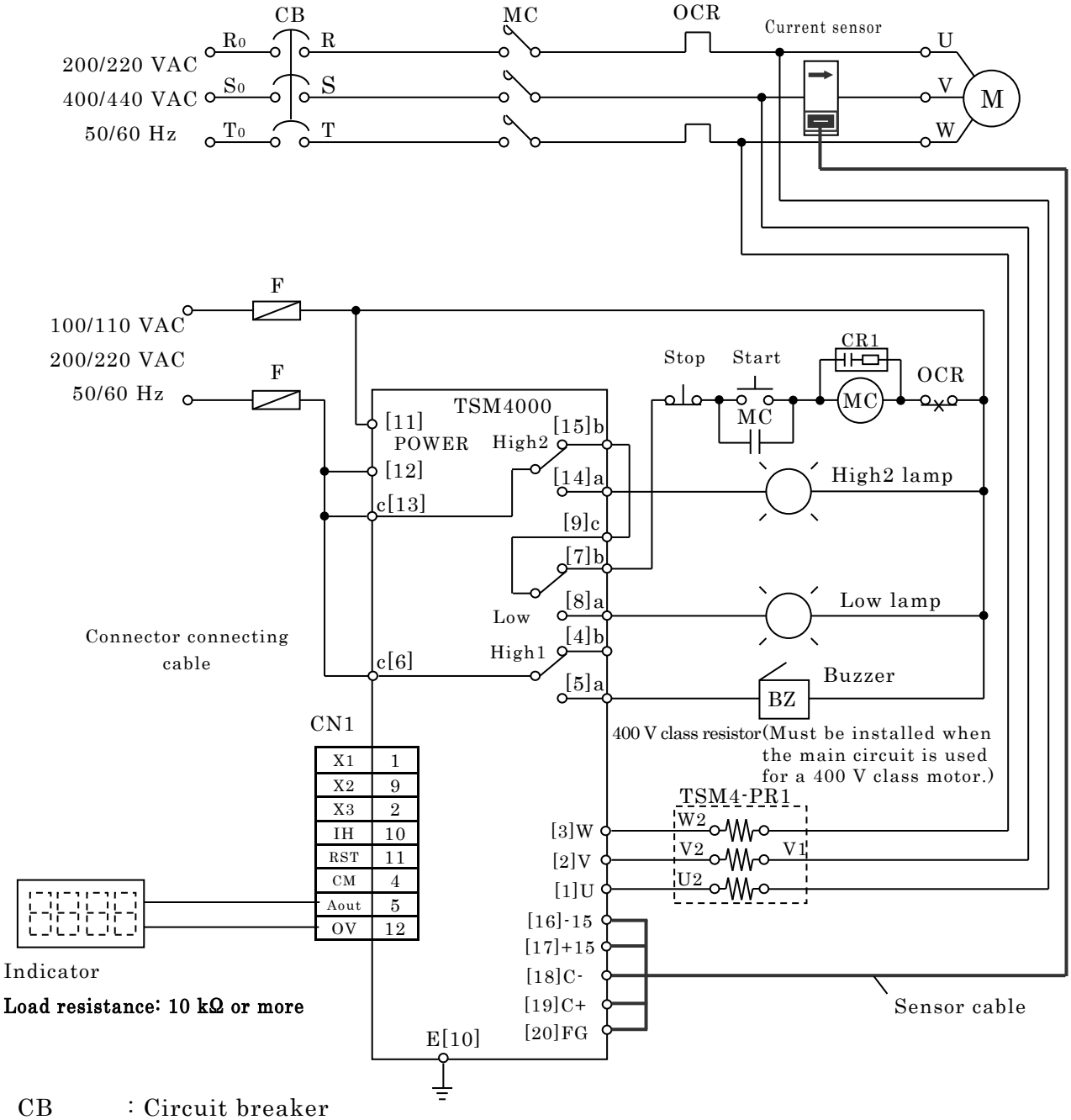


Hold down the SET key and press ▲ to make the display darker.

Hold down the SET key and press ▼ to make the display lighter.

9. Connection Diagram

9.1 Basic connection (Driven by commercial power supply)



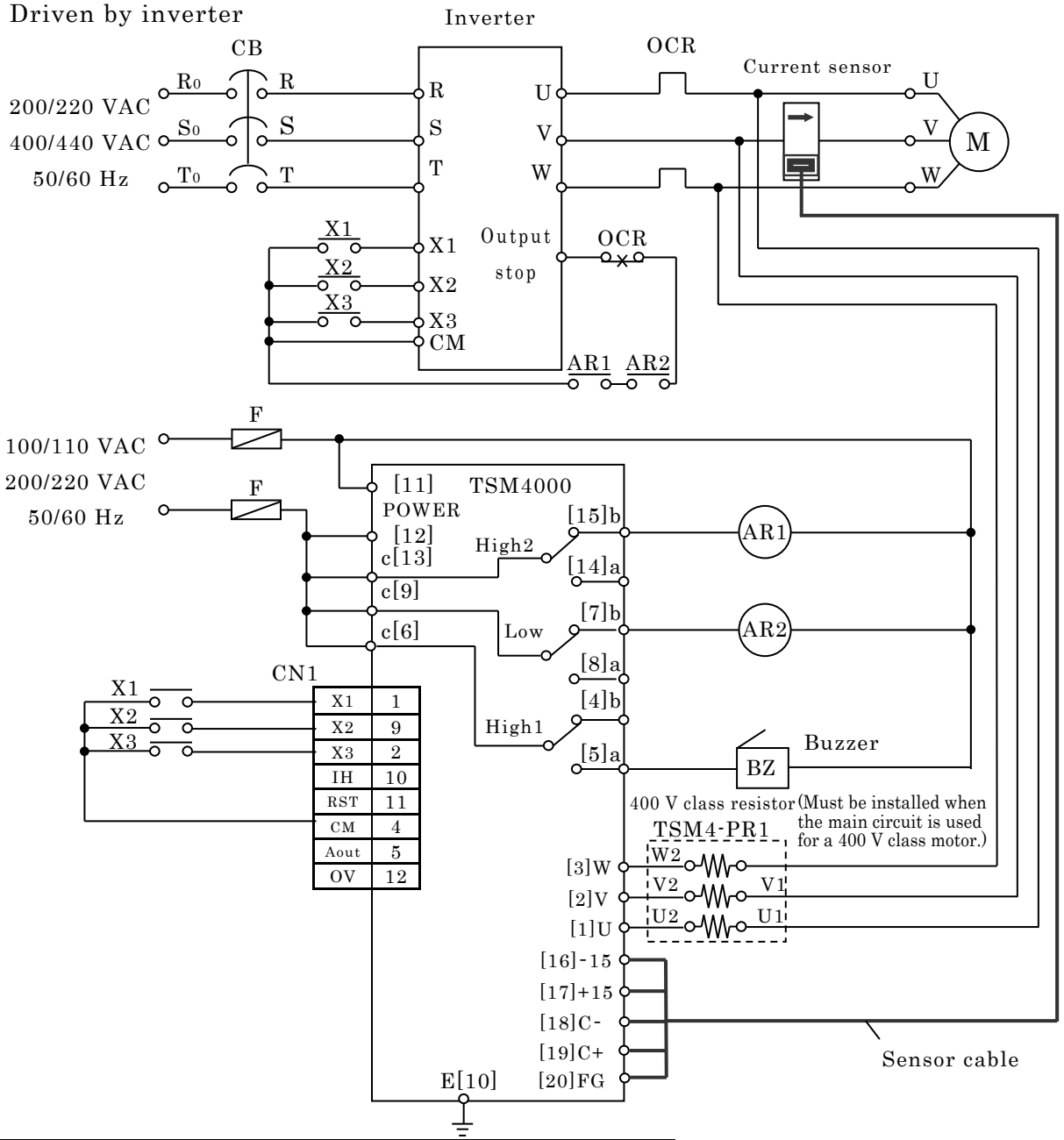
CB : Circuit breaker
F : Fuse
MC : Electromagnetic contactor for motor
OCR : Overcurrent relay
CR1 : CR absorber (surge absorbing element)

This diagram shows the case where the electromagnetic coil capacity of the electromagnetic contactor for motor [MC] is less than 100 VA at power-on and less than 10 VA during retention.

Notes:

(1) Use a current sensor which satisfies the requirement for motor capacity and voltage, and pass the motor wire through the sensor in the specified direction for the specified number of times.
(2) Set the current sensor on the phase connected to the voltage detection terminal [2] (V-phase) of the Shock Monitor.
(3) To monitor a 400V class motor, install the optional 400 V class resistor TSM4-PR1.
(4) This connection diagram shows the wiring when parameter 20:H2 Relay Logic is set to (2) Normal Logic.

9.2 Driven by inverter



X1-CM	X2-CM	X3-CM	Inverter	Shock Monitor Process No.
OFF	OFF	OFF	Frequency [1]	Process [1]
ON	OFF	OFF	Frequency [2]	Process [2]
OFF	ON	OFF	Frequency [3]	Process [3]
ON	ON	OFF	Frequency [4]	Process [4]
OFF	OFF	ON	Frequency [5]	Process [5]
ON	OFF	ON	Frequency [6]	Process [6]
OFF	ON	ON	Frequency [7]	Process [7]
ON	ON	ON	Frequency [8]	Process [8]

CB : Circuit breaker
F : Fuse
OCR: Overcurrent relay

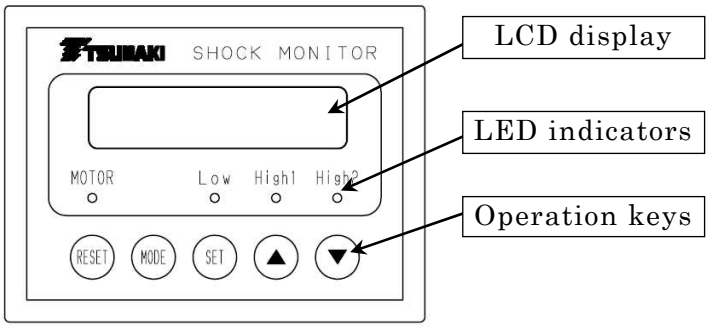
ON : Short-circuit
OFF : Open

Notes:

(1) Use a current sensor which satisfies the requirement for motor capacity and voltage, and pass the motor wire through the sensor in the specified direction for the specified number of times.
(2) Set the current sensor on the phase connected to the voltage detection terminal [2] (V-phase) of the Shock Monitor.
(3) To monitor a 400V class motor, install the optional 400 V class resistor TSM4-PR1.
(4) Use relays for minute current for the contacts used for the input to [X1], [X2], and [X3].
(5) Connect a commercial power supply to the operational power supply. (Do not connect the secondary side of the inverter.)
(6) This connection diagram shows the wiring when parameter 20:H2 Relay Logic is set to (2) Normal Logic.

10 Operation

The Shock Monitor TSM4000 provides Monitor mode, Test mode, and Program mode, which can be selected with the MODE key.



10.1 LED indicators and operation keys

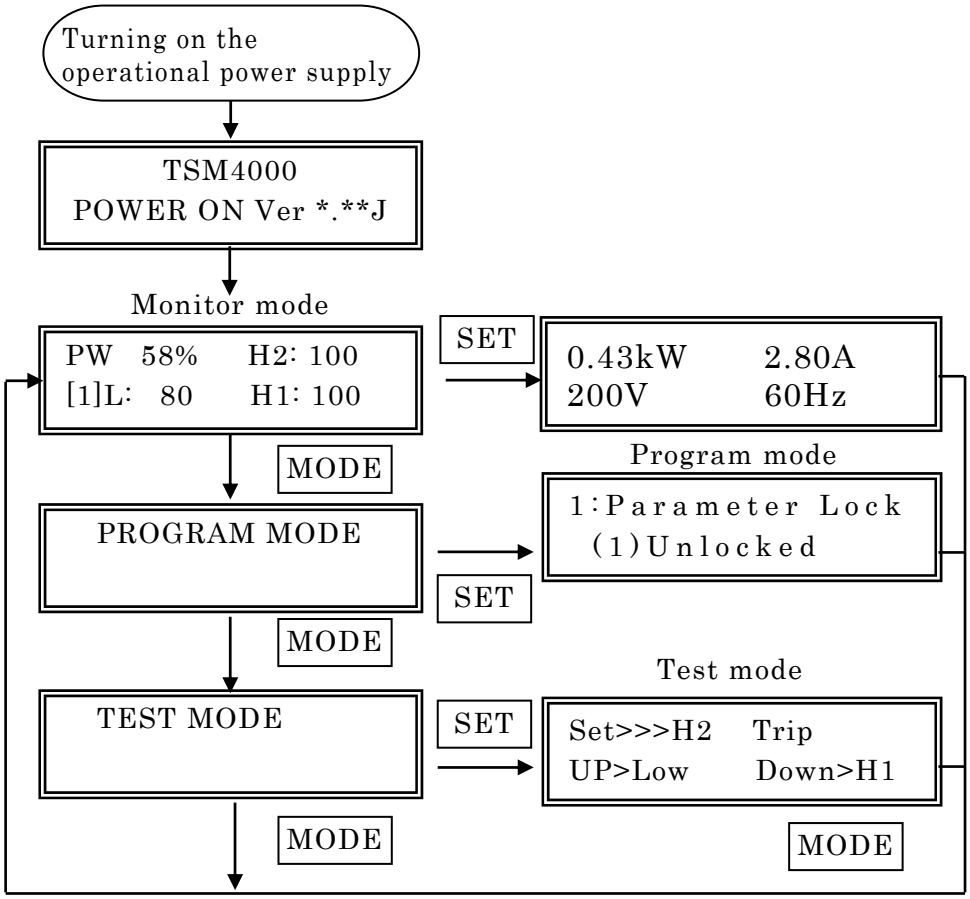
		Monitor mode	Test mode (LCD shows "TEST MODE".)	Program mode
LED indicator	MOTOR	・Illuminates when the input power of the motor exceeds 5% or the current exceeds 10% (flashes within the Start Time).		
	Low	・Illuminates when the load reaches or goes below the Low level. ・Flashes when relay output Low is activated.	・Flashes when relay output Low is activated.	
	High1	・Illuminates when the load reaches or exceeds the High1 level. ・Flashes when relay output High1 is activated.	・Flashes when relay output High1 is activated.	
	High2	・Illuminates when the load reaches or exceeds the High2 level. ・Flashes when relay output High2 is activated.	・Flashes when relay output High2 is activated.	
Operation key	RESET	・Reset the self-holding status of the output relay.	・Reset the self-holding status of the output relay.	・Return to parameter 1.
	MODE	・Show the Test/Program mode switching screen.	・Change to the Monitor mode.	・Change to the Monitor mode.
	SET	・Change the monitor screen.	・Conduct the operation test of the relays. (Relay output, LED indicator) *1	・Save the parameter and move to the next parameter.
	▲	Hold down SET and press ▲ to make the LCD contrast darker.	・Select the relay to activate. (High2⇒Low⇒High1)	・Select data or increment a setting value.
	▼	Hold down SET and press ▼ to make the LCD contrast lighter.	・Select the relay to activate. (High2⇒High1⇒Low)	・Select data or decrement a setting value.

*1 While the motor is stopped, the relay output is activated after the Start Time or Shock Time whichever is longer elapses; while the motor is running, the relay output is activated after the Shock Time elapses.

10.2 Switching modes

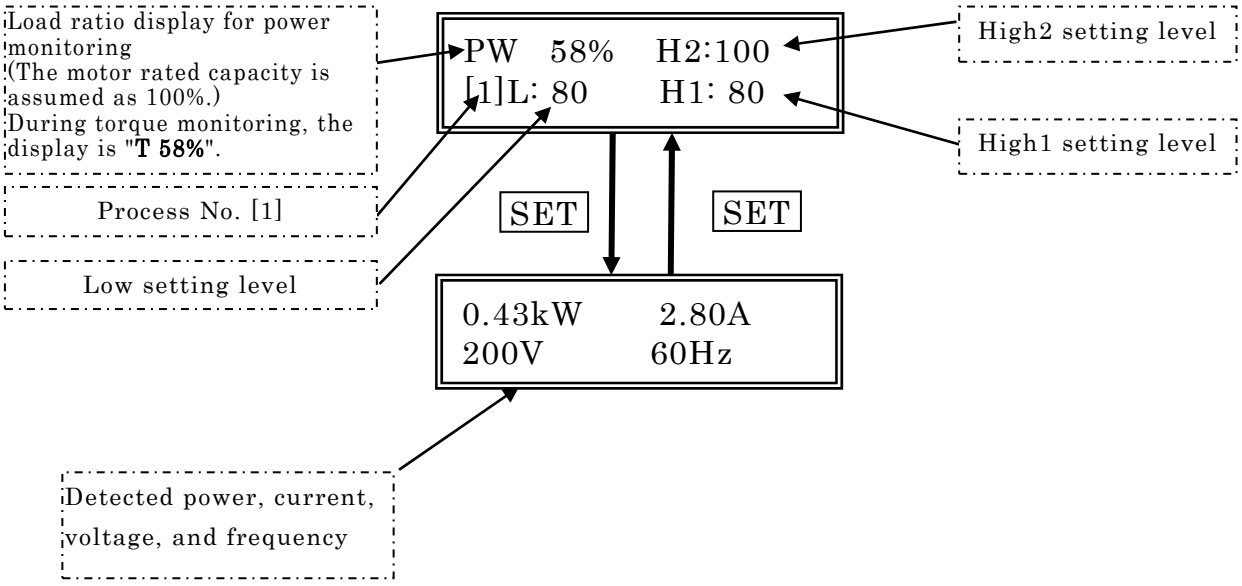
When the Shock Monitor is turned on, the initial screen is displayed for about three seconds, and then the device enters the Monitor mode.
The Monitor mode is used for load monitoring.

To change parameters, press the MODE key to go to the Program mode selection screen. Press the SET key to change to the Program mode.
On the MODE selection screen, press the MODE key again to go to the Test mode selection screen.
Press the SET key here to change to the Test mode. In the Test mode, you can activate the output relay to issue outputs.
Press the MODE key to return to the Monitor mode.



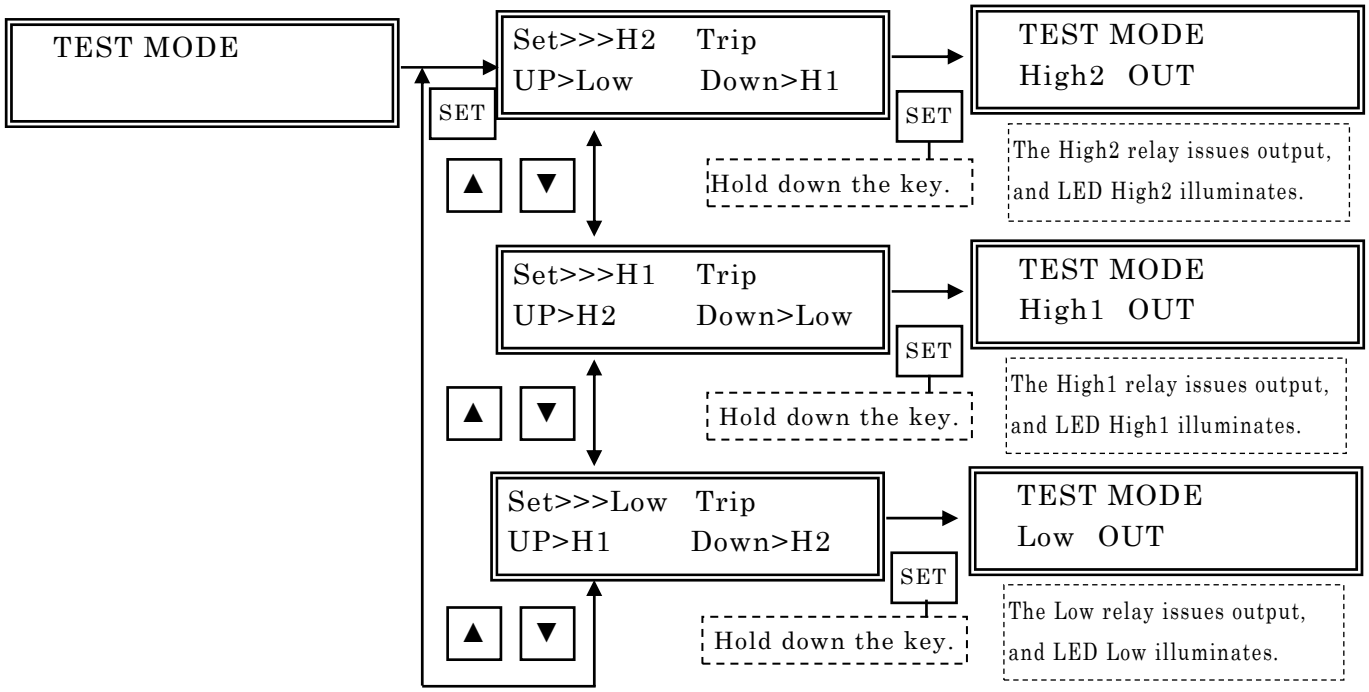
10.3 Monitor mode

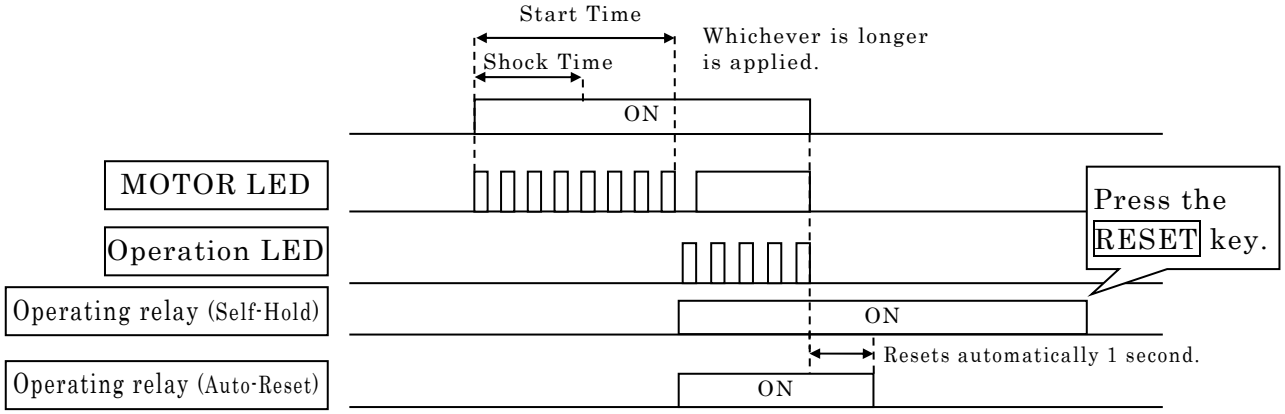
The Monitor mode is used to actually monitor the load. The LCD display shows the current load ratio or the maximum load ratio detected, the current process [No.], and the setting values for Low, High1, and High2. The display switches from the current load ratio to the maximum load ratio detected while High2 is illuminating or flashing. For power monitoring, the displayed load ratio is a value calculated on the assumption that the selected motor capacity is 100%. For torque monitoring, it is a value calculated on the assumption that the rated torque at 60 Hz is 100%.



10.4 Test mode

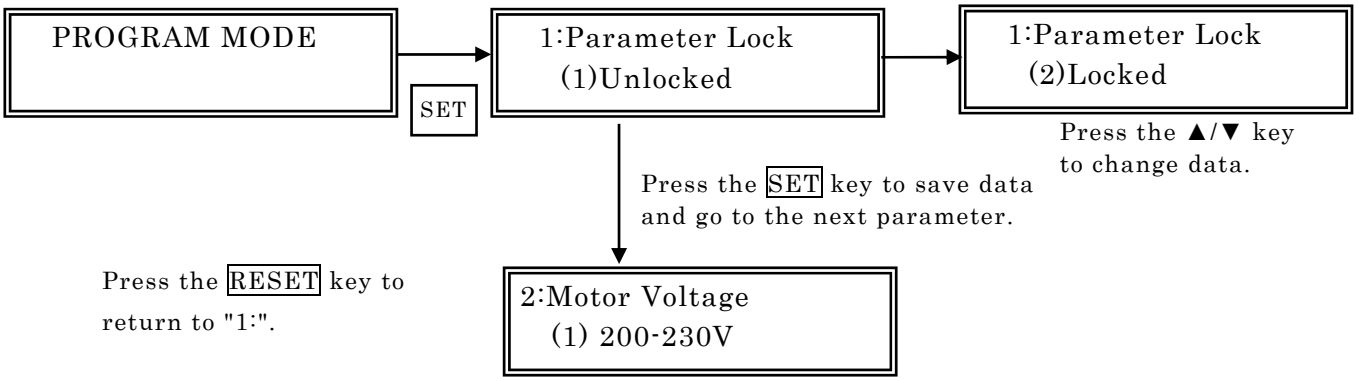
In the Test mode, you can check the operation of the output relays and LED indicators. Since load monitoring is disabled in the Test mode, be sure to return to the Monitor mode after the operation (or after pressing RESET when the relay output is in the self-holding status).





10.5 Program mode

The Program mode is used for changing and checking parameters.



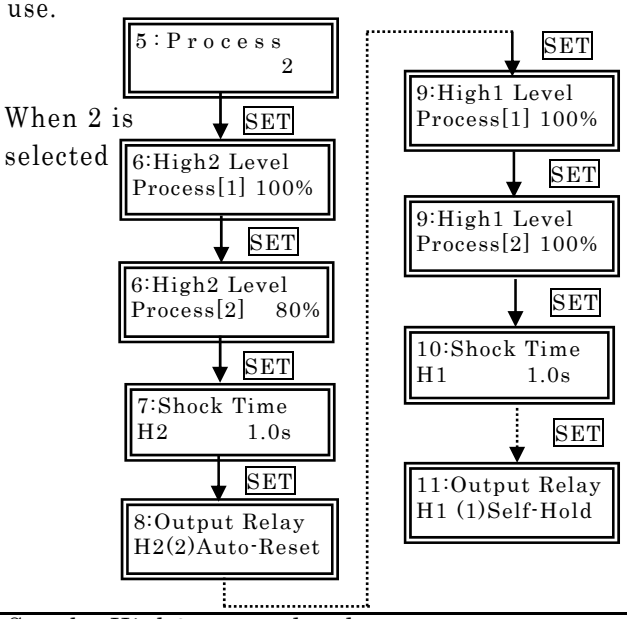
■ Parameter description and setting procedure

Parameter (Default data is shown.)	Data		Description
1:Parameter Lock (1)Unlocked ▲ ...Select data. ▼ SET…Make the set data effective.	(1)Unlocked		・All parameters can be changed.
	(2)Locked		・Parameters other than the current parameter cannot be changed.
Motor voltage setting 2: Motor Voltage (1)200-230V ▲ ...Select data. ▼ SET…Make the set data effective.	(1)200-230V		・Select (1) to monitor a 200 V class motor. The allowable maximum voltage is 250 VAC.
	(2)380-460V		・Select (2) to monitor a 400 V class motor. The allowable maximum voltage is 500 VAC. Monitoring a 400 V class motor requires the installation of the optional 400 V class resistor.
Motor capacity setting 3:Motor kW (4) 0.75kW ▲ ...Select data. ▼ SET…Make the set data effective.	(1)0.1kW	(11)15kW	Set the capacity of the motor to be monitored. The load ratio display of the Shock Monitor shows 100% when this motor capacity is detected. When a motor other than listed is used, select the nearest capacity.
	(2)0.2kW	(12)18.5kW	
	(3)0.4kW	(13)22kW	
	(4)0.75kW	(14)30kW	
	(5)1.5kW	(15)37kW	
	(6)2.2kW	(16)45kW	
	(7)3.7kW	(17)55kW	
	(8)5.5kW	(18)75kW	
	(9)7.5kW	(19)90kW	
	(10)11kW	(20)110kW	
Start Time setting 4:Start Time 3.0s ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	0.1 to 20.0 s (Minimum setting increment: 0.1 s)		・To prevent unnecessary operation during the startup period of the motor, the Shock Monitor disables the relay output function for a specified period after it is started, even in the Monitor mode. ・Counting starts when the detected electric power reaches 5% or the current reaches 10% of the rated current. ・Set the period as short as possible based on the startup time of the motor. ・The Start Time starts when the Shock Monitor returns from the Test mode or Program mode to the Monitor mode.

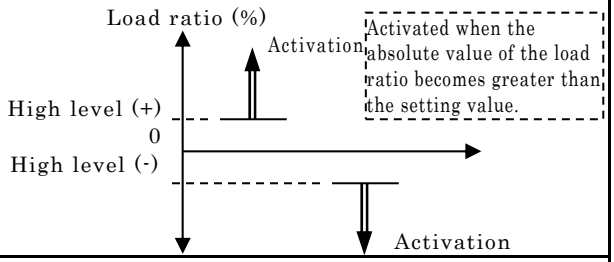
<table>
<tr><th>Parameter
(Default data is shown.)</th><th>Data</th><th>Description</th></tr>
<tr><td>No. of selected detection levels

5:Process
1

▲…Increment the setting value.
▼…Decrement the setting value.

SET…Make the set data effective.</td><td>1 to 8</td><td>There are up to eight possible combinations of the statuses of 6:High2 Level, 9:High1 Level, and 12:Low Level. Select how many combinations to use.
 
</td></tr>
<tr><td>6:High2 Level
Process[1] 100%

▲…Increment the setting value.
▼…Decrement the setting value.

SET…Make the set data effective.</td><td>High2
-200 to -5%
5 to 200%</td><td>Set the High2 output level.
Output is activated when the load ratio reaches or exceeds this setting value for the period specified at 7:Shock Time or longer.
 
</td></tr>
<tr><td>Shock Time setting

7:Shock Time
H2 1.0s

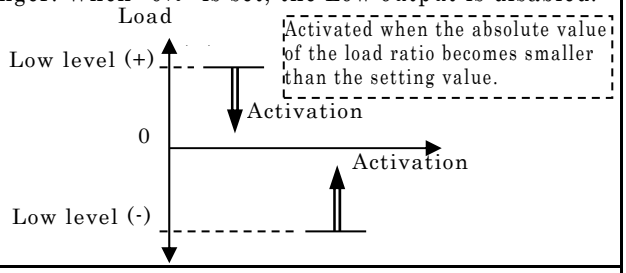
▲…Increment the setting value.
▼…Decrement the setting value.

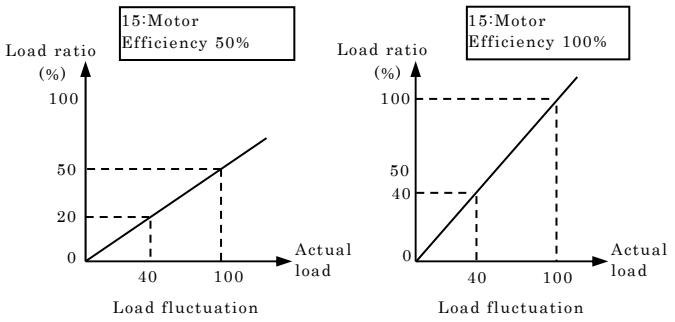
SET…Make the set data effective.</td><td>MIN
(Shock Time: Minimum)</td><td>[Time required for detection and output]
・Motor power supply frequency: 50 Hz or more
… Approx. 50 ms
・Motor power supply frequency: Less than 50 Hz
… 2 cycles + Approx. 10 ms
(Example: 40 Hz・・・・60 ms)</td></tr>
<tr><td></td><td>0.1 to 10.0 s
(Minimum setting increment: 0.1 s)</td><td>・Period between the instant when the load ratio reaches or exceeds the setting value and the instant when the relay output is activated.
・If the load ratio goes below the value of 6:High2 Level within the specified period, the relay output is not activated.</td></tr>
<tr><td>Relay output mode setting

8:Output Relay
H2 (1)Self-Hold

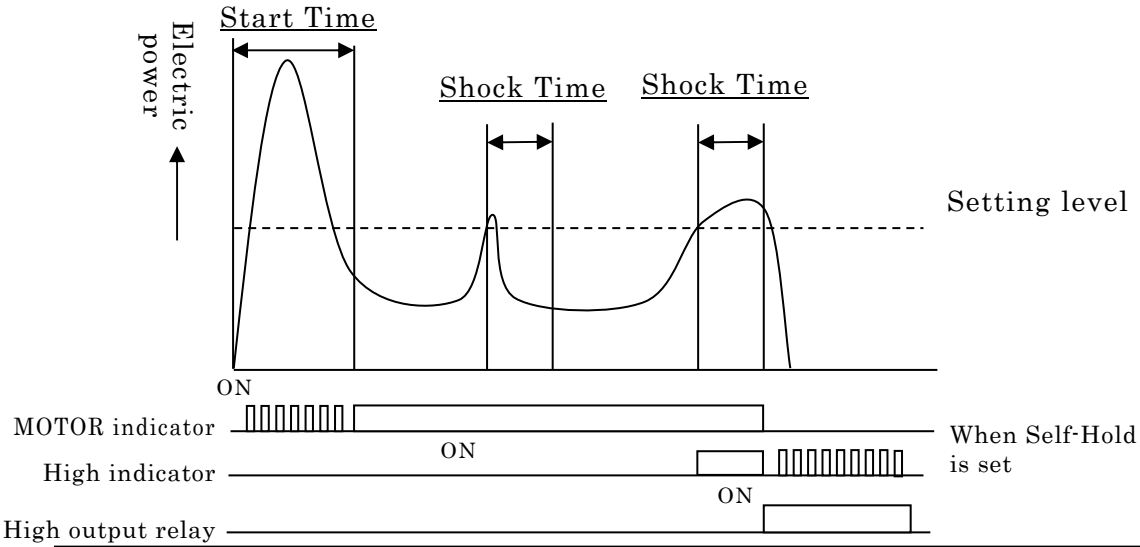
▲
▼ …Select data.

SET…Make the set data effective.</td><td>(1)Self-Hold
(Self holding)</td><td>The status of the relay output is retained. The status is reset by pressing the RESET key or by an input to the [RST] terminal.</td></tr>
<tr><td></td><td>(2)Auto-Reset
(Automatic reset)</td><td>The status is reset one second after the relay output condition is cleared.</td></tr>
</table>

Parameter (Default data is shown.)	Data	Description
9:High1 Level Process[1] 80% ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	High1 -200 to -5% 5 to 200%	Set the High1 output level. Output is activated when the load ratio reaches or exceeds this setting value for the period specified at 10:Shock Time or longer.
10:Shock Time H1 1.0s ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	MIN (Shock Time: Minimum)	[Time required for detection and output] ・Motor power supply frequency: 50 Hz or more …Approx. 50 ms ・Motor power supply frequency: Less than 50 Hz … 2 cycles + Approx. 10 ms (Example: 40 Hz…60 ms)
	0.1 to 10.0 s (Minimum setting increment: 0.1 s)	・Period between the instant when the load ratio reaches or exceeds the setting value and the instant when the relay output is activated. ・If the load ratio goes below the value of 9:High1 Level within the specified period, the relay output is not activated.
11:Output Relay H1 (2)Auto-Reset ▲ ▼…Select data. SET…Make the set data effective.	(1)Self-Hold (Self holding)	The status of the relay output is retained. The status is reset by pressing the RESET key or by an input to the [RST] terminal.
	(2)Auto-Reset (Automatic reset)	The status is reset one second after the relay output condition is cleared.
12:Low Level Process[1] 0% ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	Low -99 to 0 to 99%	Set the Low output level. Output is activated when the load ratio reaches or goes below this setting value for the period specified at 13:Shock Time or longer. When "0%" is set, the Low output is disabled. 
13:Shock Time L 1.0s ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	MIN (Shock Time: Minimum)	[Time required for detection and output] ・Motor power supply frequency: 50 Hz or more …Approx. 50 ms ・Motor power supply frequency: Less than 50 Hz … 2 cycles + Approx. 10 ms (Example: 40 Hz…60 ms)
	0.1 to 10.0 s (Minimum setting increment: 0.1 s)	・Period between the instant when the load ratio reaches or goes below the setting value and the instant when the relay output is activated. ・If the load ratio exceeds the value of 12:Low Level within the specified period, the relay output is not activated.
14:Output Relay L (1)Self-Hold ▲ ▼…Select data. SET…Make the set data effective.	(1)Self-Hold (Self holding)	The status of the relay output is retained. The status is reset by pressing the RESET key or by an input to the [RST] terminal.
	(2)Auto-Reset (Automatic reset)	The status is reset one second after the relay output condition is cleared.

Parameter (Default data is shown.)	Data	Description
Display scale 15:Motor Efficiency 100% ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	10 to 100	・Set the scale of the load ratio to the actual load. ・Setting 50% changes the result as follows. 
Number of moving average sampling times 16:Response 5 times ▲…Increment the setting value. ▼…Decrement the setting value. SET…Make the set data effective.	1 to 50	・Set the number of sampling times for calculating the moving average (average of the latest sampling values) of the load detected by the Shock Monitor. ・This moving average value is assumed as the load ratio and used for monitoring, LCD display, and analog output. ・Increasing the number of sampling times reduces the display fluctuation; however, it takes the following period at the longest for level detection. Motor power supply frequency: 50 Hz or more Detection time = 20 ms x (Setting value of Parameter 16) Motor power supply frequency: Less than 50 Hz Detection time = 1 cycle x (Setting value of Parameter 16)
17:Inhibit Time IH ▲ ▼ …Select data. SET…Make the set data effective.	IH	・Load monitoring is disabled while the input signal IH is ON. The load ratio display shows flashing 0%. ・When the input signal IH turns OFF and the load ratio has reached or exceeded the setting level for the Shock Time period or longer, the relay output is activated immediately.
	0.1 to 10.0 s	・When the input signal IH turns from OFF to ON, load monitoring is disabled within this specified time. ・After the process switching signals X1, X2, and X3 are changed, load monitoring is disabled within this specified time. ・When this specified time elapses and the load ratio has reached or exceeded the setting level for the Shock Time period or longer, the relay output is activated immediately.
18:Auto Inhibit (2)Off ▲ ▼ …Select data. SET…Make the set data effective.	(1)On	When the Shock Monitor detects the change in the motor power supply frequency and the frequency continues changing at the rate of 4 Hz or higher per second, inhibit function is activated regardless of the inhibit time setting.
	(2)Off	The Auto Inhibit is disabled.
19:POWER/TORQUE (1)POWER ▲ ▼ …Select data. SET…Make the set data effective.	(1)POWER	・Load is monitored based on the input electric power value of the motor.
	(2)TORQUE	・Load is monitored based on the torque value calculated from the motor's input electric power and motor current frequency.

Parameter (Default data is shown.)	Data	Description
20:H2Relay Logic (2)Normal Logic ▲ ...Select data. ▼ SET…Make the set data effective.	(1)Fail Safe	・The High2 output relay will operate under normal condition, and will not operate when trip occurs. This setting becomes effective when you press the MODE key to enter the Monitor mode after making the setting. When the power is turned on, the relay turns ON within six seconds at maximum. Normal condition —Between terminals 13 and 14: Closed, Between terminals 13 and 15: Open Trip —Between terminals 13 and 14: Open, Between terminals 13 and 15: Closed
	(2)Normal Logic	・The High2 output relay will not operate under normal condition, and will operate when trip occurs. Normal condition —Between terminals 13 and 14: Open, Between terminals 13 and 15: Closed Trip —Between terminals 13 and 14: Closed, Between terminals 13 and 15: Open When the power is turned on, the relay turns ON after a delay of 3.5 seconds at maximum.
Analog output selection 21:Output Select (2) 0→200% ▲ ...Select data. ▼ SET…Make the set data effective.	(1)-200→200%	The load ratio of -200 to 200% is output within the range from 0 to 10 VDC.
	(2)0→200%	The load ratio of 0 to 200% is output within the range from 0 to 10 VDC.
LCD backlight setting 22:LCD Backlight (1)Always ▲ ...Select data. ▼ SET…Make the set data effective.	(1)Always	The backlight illuminates all the time.
	(2)2min	The backlight will turn off two minutes after the last key operation on the panel. After the backlight turns off, it illuminates again when any key is pressed.
23:Trip Test (1)Motor On/Off ▲ ...Select data. ▼ SET…Make the set data effective.	(1)Motor On/Off	・In the Test mode, the operation of the relay outputs Low, High1, and High2 can be checked regardless of whether the motor is running or stopped.
	(2)Motor Off	・In the Test mode, the operation of the relay outputs Low, High1, and High2 can be checked when the motor is stopped, but cannot be checked when the motor is running.



* When the motor starts, the counting of the Start Time and Shock Time starts simultaneously. Consequently, the longer one will be effective.

*1 Torque monitoring

When parameter 19: POWER/TORQUE is set to (2) TORQUE, the monitoring can be performed using a torque calculation value. The torque monitoring compares a torque calculation value (%) with a preset overload level (specified as % of the torque). This function is especially useful when the frequency is arbitrarily changed by inverter operation.

Torque calculation formula

For torque monitoring, the Shock Monitor calculates a torque value using the following formula and three elements: Detected electric power (%), Frequency of the motor supply voltage, and Estimated motor copper loss (%). (The torque at 60 Hz is assumed as 100%.)

$$\text{Torque calculation value (\%)} = \frac{(\text{Detected electric power} - \text{Estimated motor copper loss}) \times 60}{\text{Frequency}}$$

Differences between the electric power monitoring and torque monitoring during inverter operation

When an inverter is used for variable speed operation, setting the frequency to half makes both of the work and motor current consumption be about half, even when the load torque is constant. In case of power monitoring, when you set the frequency to half, it is difficult to detect overload accurately unless you also set the overload detection level to half by using the multi-step switching function. On the contrary, torque monitoring eliminates the need for changing the overload detection level by dividing the halved detected power with the frequency of the motor supply voltage read with the Shock Monitor. This function is especially useful when the motor is operated with stepless, arbitrary frequencies.

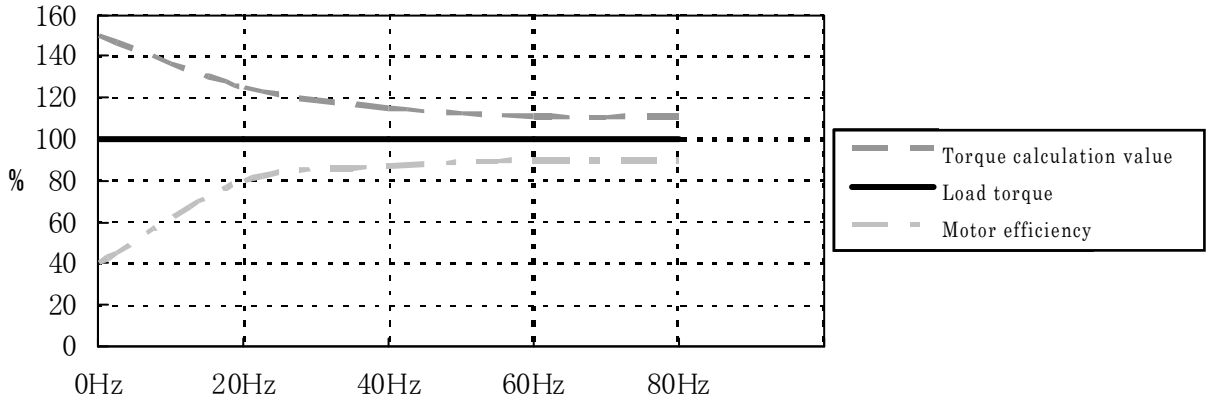
Notes on torque monitoring

- The torque calculation value is based on the rated torque at 60 Hz.
- In order to minimize an error in the torque calculation value, the calculation is adjusted by subtracting an estimated motor copper loss. Note, however, that when you use low frequency (about 20 Hz or less), the detected electric power in the above formula as well as the frequency in the denominator become smaller, which makes the error far greater.

Torque calculation value for various frequencies

Since the motor efficiency is extremely low at lower frequencies, the error in the torque calculation value of the Shock Monitor becomes greater as shown in the graph below.

Motor efficiency vs. Torque calculation value of Shock Monitor



As the graph shows, when torque monitoring is performed at low frequencies, the torque calculation value becomes larger, resulting in frequent activation of the output relay. If you need to use 20 Hz or lower frequencies for positioning or other operation, it is recommended to fix the low-speed frequency as well as to use the multi-step setting.

11. Troubleshooting

Problem	Inspection item	Inspection result	Countermeasure
The LCD display shows nothing.	Wiring of the operational power supply (Between terminals 11 and 12)	No wiring installed.	Install the wiring properly.
	Operational power supply voltage (Between terminals 11 and 12)	Less than 90 VAC	Provide voltage of 90 to 250 VAC.
		90 to 250 VAC	Replace or repair Shock Monitor.
The LCD display is illegible.	Adjust the contrast (Refer to page 9.).	The display becomes dark.	Re-adjust the contrast.
		The display does not improve.	Replace or repair Shock Monitor.
Output is activated immediately after Shock Monitor starts.	In the Program mode, check the setting value of 4:Start Time.	Short	Set a little longer value.
		Long (It is clear that the output is activated within the setting value.)	Replace or repair Shock Monitor.
Even when a long value is set to 4:Start Time (20 seconds max.), the relay is activated as soon as the time is up.	Startup time of the motor Acceleration time of the inverter	Longer than 20 seconds	Review the motor capacity.
			Set a shorter acceleration time.
	In the Monitor mode, check the load ratio and setting level at startup.	The setting value is small.	Set a larger value in the Program mode.
		Wrong detection level is selected.	Check the process switching input.
The load ratio is shown as 0%.	Is the current sensor and main unit connected?	The sensor cable is disconnected.	Connect the cable properly.
	Does the V-phase motor wire pass through the current sensor?	・No wire passes through the sensor. ・Other phase	Install the wiring properly.
	Check the wiring of the voltage input U, V, W (Terminals 1, 2, 3).	・No wiring installed or wiring is disconnected. ・Incorrect wiring	Install the wiring properly.
Although the motor starts, the displayed load ratio is wrong with respect to the actual load.	Model number of the current sensor	Wrong	Replace with a correct sensor.
	Does the V-phase motor wire pass through the current sensor?	Other phase (U-phase or W-phase)	Install the wiring properly.
	Is the No. of times to pass the wire through the sensor correct?	Wrong	
	Check the wiring of the voltage input U, V, W (Terminals 1, 2, 3).	・No wiring installed or wiring is disconnected. ・Incorrect wiring	Install the wiring properly.
	In the Monitor mode, check that the correct motor has been selected.	The selection does not correspond with the actual motor.	Set the parameters (2 and 3) properly.
	Start the motor, change the display screen, and check the voltage and current values.	The load ratio far deviate from the displayed current value.	Repair Shock Monitor. Replace Shock Monitor.
The displayed load ratio is negative.	Is the motor operation status negative torque?	Rapid deceleration is caused by inverter operation.	If the actual torque is negative, the display is not abnormal.
		The operation is affected by load.	If the actual torque is negative, the display is not abnormal.
	Check the wiring of the voltage input U, V, W (Terminals 1, 2, 3).	・No wiring installed or wiring is disconnected. ・Incorrect wiring	Install the wiring properly.
	Does the motor wire pass through the current sensor in the right direction? (Does the direction match with the arrow on the top of the current sensor?)	Opposite direction	Install the wiring properly.
		The load torque is positive and the motor wire correctly passes through the current sensor.	・Replace Shock Monitor. ・Repair Shock Monitor.
Although the load ratio display is correct, the relay output is not activated.	In the Monitor mode, check the multi-step selection and level setting values.	The process switching selection is incorrect. (X1, X2, X3)	Set the detection level selection input properly.
		The level setting values are not set properly.	Set appropriate values.
	In the Program mode, check the Shock Time.	Too long.	Set a shorter value.

Problem	Inspection item	Inspection result	Countermeasure
The LED indicator (High1, High2, Low) illuminates, but the relay output is not activated.	Is the load fluctuation too great?	The load fluctuates greatly and it instantaneously exceeds the setting level repeatedly.	Set the parameters (6, 9, 12, and 16) properly.
		The load does not fluctuate and there is a great difference from the setting level.	Repair Shock Monitor.
The relay output is activated as soon as Shock Monitor is turned ON.	Is the motor starts when Shock Monitor is turned ON?	The displayed load is larger than the setting value.	Set the parameters (6 and 9) properly.
		The output is activated even when the motor is stopped and the displayed load is 0. (Shock Monitor is used in a highly humid environment with corrosive gas.)	Repair Shock Monitor.

12. Trip Reset Procedure

(1) Inspect the equipment for any abnormalities.
(2) If an abnormality is found, eliminate the cause and reset the equipment to normal status.
(3) If the relay output is in self-holding status, press the RESET key to reset it. To use an external signal to reset the relay, short-circuit 11 (RST) and 4 (COM) in the connector CN1. The reset is also possible by turning off the operational power supply for the Shock Monitor for a short time.
(4) After confirming steps (1), (2), and (3), restart the equipment.

13. Precautions on Maintenance/Inspection

Be sure to observe the following during the maintenance/inspection work.

(1) To prevent secondary damage, clean up the surrounding area and ensure safety during the work.
⚠ (2) Before inspecting the installation or connection of the Shock Monitor, be sure to turn off the power to make the machine completely stop and the LCD display of the Shock Monitor completely turn off. Ensure that the Shock Monitor will not be turned on accidentally.
(3) Observe the guidelines listed in the Labor Safety and Health Regulation.
⚠ (4) When conducting a megger test or dielectric withstanding voltage test, remove the Shock Monitor main unit from the socket to avoid test voltage.

14. Periodic Inspection

(1) Inspect that the "MOTOR" LED indicator of the Shock Monitor illuminates while the motor is running, and the load ratio value on the LCD display is normal.(Daily inspection)
(2) In the Test mode, inspect the operation of the relay outputs Low, High1, and High2 on a regular basis.
(3) Inspect for looseness in the installation of the Shock Monitor main unit and current sensor on a regular basis.
(4) Inspect for looseness in the terminal connection of the Shock Monitor main unit and sensor cable connection on a regular basis.
(5) Although the life of the Shock Monitor varies depending on the installation environment and operating time, **the life of the electrolytic capacitor is normally about 10 years under continuous energization at annual average ambient temperature of 30°C**. It is recommended to overhaul the Shock Monitor or replace it with a new one before any problem occurs.
(6) The brightness of the LCD display varies depending on the ambient temperature and operating time. If the display becomes illegible, adjust the contrast.

Perform the periodic inspection during trial operation, and when the equipment was moved, and when the wiring was changed.

15. For Your Safety

(1) If any danger is expected as a result of the operation of Shock Monitor, be sure to take measures to avoid such danger.
(2) Also, give due consideration on the equipment side so that, even if Shock Monitor does not operate normally, no dangerous situation would develop.

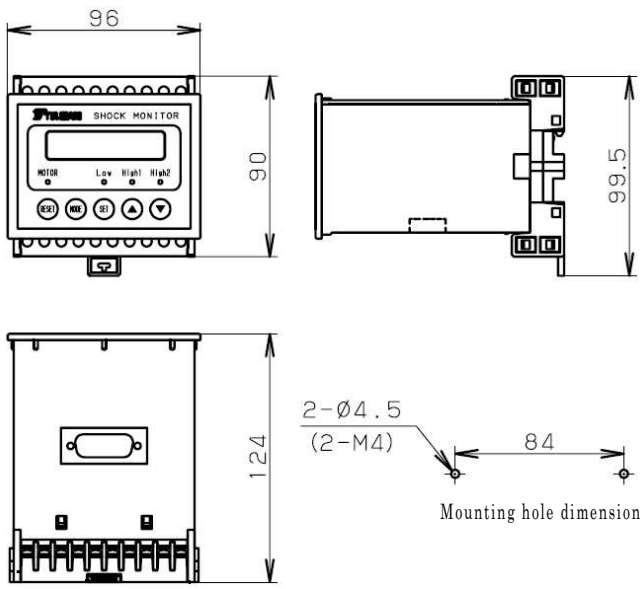
16. Specifications

Model number			TSM4000	TSM4000P
Applicable motor		Capacity	0.1 to 110 kW	
		Voltage	3-phase, 200/220 VAC or 400/440 VAC	
		Power supply frequency	5 to 120 Hz	
Operational power supply voltage			Commercial power supply 90 to 250 VAC 50/60 Hz, 90 to 250 VDC No polarity	
Input	Terminals 1, 2, 3		250 VAC max. *1	
	Current sensor		±15 V	
Setting	Power setting range	Lower limit (Low)	-99 to 99%	
		Upper limit 1 (High1)	-200 to -5% 5 to 200%	
		Upper limit 2 (High2)		
	Start Time setting range		0.1 to 20.0 s	
	Shock Time setting range		MIN or 0.1 to 10.0 s When the motor power supply frequency is 50 Hz or more, the Shock Time for "MIN" is approximately 50 ms. *2	
	No. of processes		1 to 8	
	Response		1 to 50	
Display	Power percentage display range		-200 to +200%	
	Voltage display range		0 to 500 V (Resolution: 1% of motor rated voltage)	
	Current display range		0.01 to 999 A (Resolution: 1% of motor rated current)	
	Frequency display range		5 to 120 Hz	
Output	Relay contact output (Low, High1, High2)	Contact capacity	1c contact: 250 VAC, 0.5A (Inductive load cosφ = 0.4) 30 VDC, 0.4 A (Inductive load) 110 VDC, 0.2A (Inductive load)	
		Minimum load	24 VDC, 4 mA	
		Life	100,000 times of operation	
	Analog output signal		0 to 10 VDC	
Other	Inhibit function		[IH] or 0.1 to 10.0 s	
	Test function		Operation check of relays Low, High1 and High2 in Test mode	
	Peak-hold function		Displays the maximum load ratio determined while High2 is illuminating or flashing.	
Power consumption			10 VA (Inrush current 5A within 5 ms)	
Approximate weight			1.0 kg	
Operating environment		Ambient temperature	0 to +50℃	
		Relative humidity	45 to 85% RH, no condensation	
		Altitude	1,000 m max.	
		Vibration	4.9 m/s^2	
		Atmosphere	No oil mist, corrosive gases, and dust	
Mounting			DIN rail, screw mounting	Panel mounting

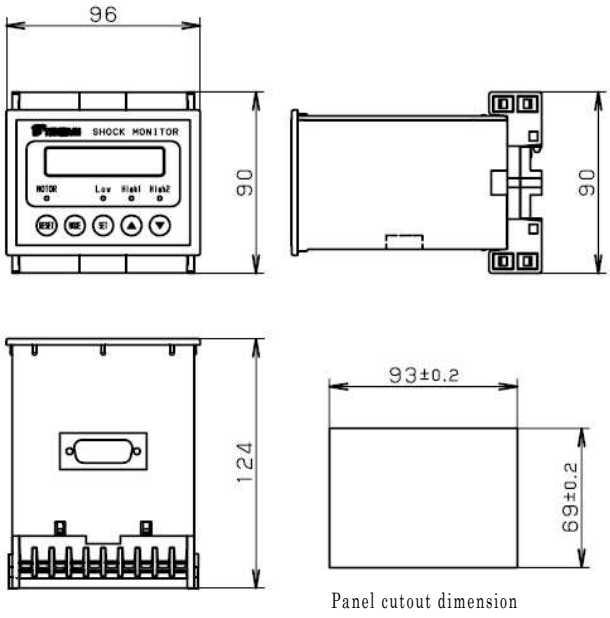
Note) *1. To use a 400/440 VAC motor, the optional 400 V class resistor "TSM4-PR1" is required.
*2. When the motor power supply frequency is less than 50 Hz, the Shock Time for "MIN" is 2 cycles of the power supply frequency + Approx. 10 ms. (Example for the case of 50 Hz: 40 + 10 = 50 ms)

17. Outer Dimensions

■Main unit TSM4000

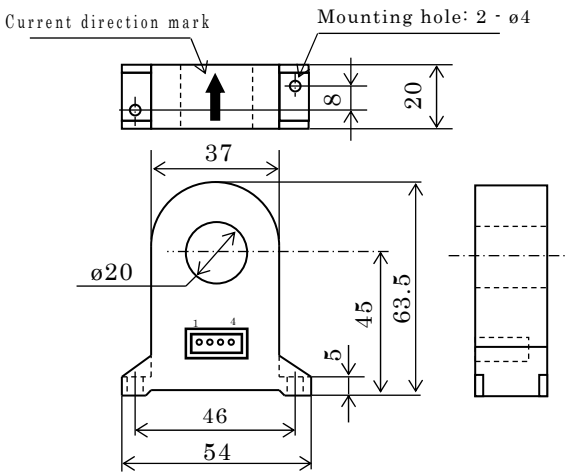


TSM4000P

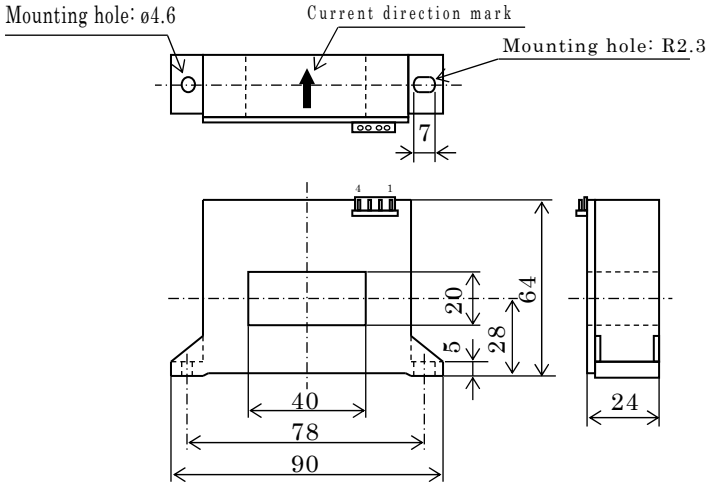


■Current sensor

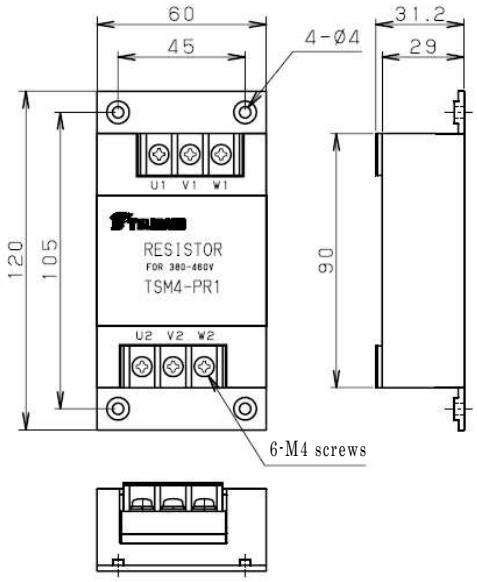
TSM-U010, TSM-U050, TSM-U100
TSM-U150, TSM-U200



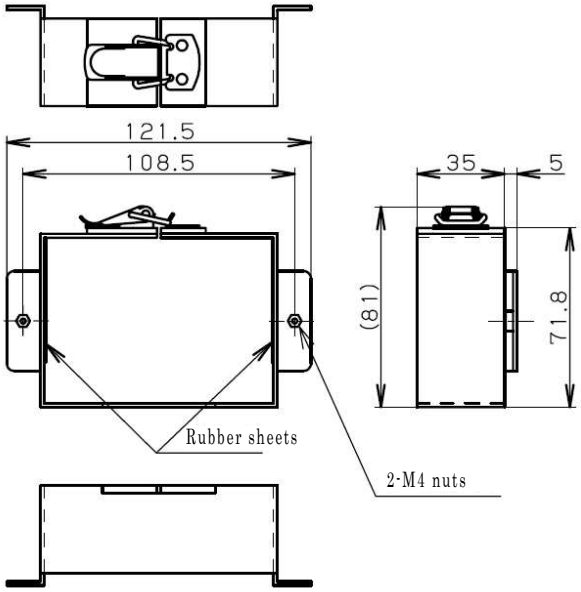
TSM-M300, TSM-M400, TSM-M600
TSM-M800



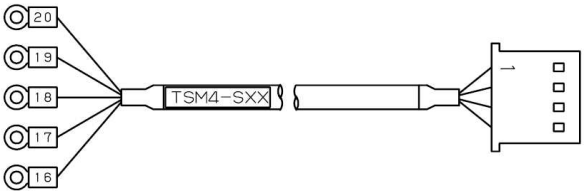
■400 V class resistor
TSM4-PR1



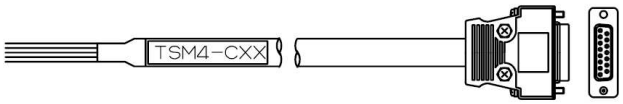
■ Panel mounting bracket (for TSM4000P)
TSM4-PL1



■Sensor cable
TSM4-S01, TSM4-S03, TSM4-S05
TSM4-S10, TSM4-S20, TSM4-S30



■I/O cable
TSM4-C01
TSM4-C03



18. Warranty

18.1 Free warranty period

TC shall offer free warranty period of 18 months after the shipment from the factory or 12 months after the beginning of the use (counted from the completion of the installation of the TC product into your equipment), whichever is shorter.

18.2 Warranty coverage

Any failure or malfunction occurred in the TC product within the free warranty period shall be repaired or be handled by replacing the failed part with no charge through the return of the product to TC, as long as the proper installation, usage, and maintenance in accordance with the instruction manual are provided by the customer.
Note, however, that this free warranty shall cover only the TC product delivered to the customer and the following expenses shall not be covered by the warranty.

(1) The cost for the removal or installation of the TC product from or to the customer's equipment for the purpose of replacement or repair, and the cost associated with such work.
(2) The transportation cost for sending the customer's equipment to the customer's repair plant or other place.
(3) The lost earnings of the customer resulted from the failure and/or repair, as well as other increased damages.

18.3 Paid warranty

Even within the free warranty period, if a failure or malfunction occurs in the TC product due to any of the following causes, the investigation/repair shall be charged.

(1) The customer did not install the TC product properly in accordance with the instruction manual.
(2) The customer did not handle the product properly and/or did not provide sufficient maintenance.
(3) The failure or malfunction was resulted from improper connection between the TC product and other equipment.
(4) The customer changed the structure of the TC product such as modification.
(5) The TC product was not repaired at TC or TC-designated plants.
(6) The TC product was not used in the appropriate operating environment described in the instruction manual.
(7) The failure or malfunction was caused by force majeure such as disasters or by illegal behavior of a third party.
(8) The failure of the TC product was caused incidentally by the malfunction of the customer's equipment.
(9) The failure was caused by the installed customer-supplied part or by the part used in accordance with the designation of the customer.
(10) The failure was caused by failed wiring or incorrect parameter setting conducted by the customer.
(11) The product has reached its life which is normal for the operating condition.
(12) Damage occurred due to the cause for which TC was not liable.

Table of parameter settings

No.	Parameter	Data		Step	Description	Default setting
1	Parameter Lock	(1)Unlocked			Parameters can be changed.	(1)
		(2)Locked			Parameters cannot be changed.	
2	Motor Voltage	(1)200-230V			3-phase, 200 V class motor voltage	(1)
		(2)380-460V			3-phase, 400 V class motor voltage	
3	Motor kW	(1)0.1kW	(11)15kW		Motor capacity setting	(4) 0.75kW
		(2)0.2kW	(12)18.5kW			
		(3)0.4kW	(13)22kW			
		(4)0.75kW	(14)30kW			
		(5)1.5kW	(15)37kW			
		(6)2.2kW	(16)45kW			
		(7)3.7kW	(17)55kW			
		(8)5.5kW	(18)75kW			
		(9)7.5kW	(19)90kW			
		(10)11kW	(20)110kW			
4	Start Time	0.1 to 20.0 s		0.1 s	Start Time setting	3.0
5	Process	1 to 8		1	No. of processes to be used	1
6	High2 Level	-200 to 5%,5 to 200%		1	Value of upper limit 2 for process 1	100
7	Shock Time H2	MIN		(30 ms)	Shock Time setting for upper limit 2	1.0
		0.1 to 10.0 s		0.1 s		
8	Output Relay H2	(1)Self-Hold			Output operation mode selection (High2)	(1)
		(2)Auto-Reset				
9	High1 Level	-200 to 5%,5 to 200%		1	Value of upper limit 1 for process 1	80
10	Shock Time H1	MIN		(30 ms)	Shock Time setting for upper limit 1	1.0
		0.1 to 10.0 s		0.1 s		
11	Output Relay H1	(1)Self-Hold			Output operation mode selection (High1)	(2)
		(2)Auto-Reset				
12	Low Level	-99 to 0 to 99%		1	Value of lower limit for process 1	0
13	Shock Time L	MIN		(30 ms)	Shock Time setting for lower limit	1.0
		0.1 to 10.0 s		0.1 s		
14	Output Relay L	(1)Self-Hold			Output operation mode selection (Low)	(1)
		(2)Auto-Reset				
15	Motor Efficiency	10 to 100%		1	Motor efficiency	100
16	Response	1 to 50		1	No. of moving averaging times	5
17	Inhibit Time	IH			Inhibit time setting	IH
		0.1 to 10.0 s		0.1 s		
18	Auto Inhibit	(1)On			Auto Inhibit setting	(2)
		(2)Off				
19	POWER/TORQUE	(1)POWER			Monitoring of motor input power value	(1)
		(2)TORQUE			Monitoring of torque calculated from power	
20	H2 Relay Logic	(1)Fail safe			Fail safe setting	(2)
		(2)Normal logic				
21	Output Select	(1)-200→200%			Analog output setting	(2)
		(2)0→200%				
22	LCD Backlight	(1)Always			Backlight illumination time setting	(1)
		(2)2min				
23	Trip Test	(1)Motor On/Off			Selection of Test mode setting while motor is running	(1)
		(2)Motor Off				

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