



Changes for the Better

Magnetic Contactors and Magnetic Starters
INSTRUCTION MANUAL

for a greener tomorrow



MS-T Series

Safety Precautions


Please read this Instruction Manual and enclosed documents before starting mounting, operation, maintenance and inspections to ensure correct usage. Thoroughly understand the equipment and device, safety information and precautions before starting operation. The safety precautions are ranked as "WARNING" and "CAUTION" in this Instruction Manual.

WARNING

If handling is mistaken, a dangerous situation may occur, leading to fatal or major injuries.

CAUTION

If handling is mistaken, a dangerous situation may occur, leading to medium or minor injuries, or only material damage.

Note that some items described as  CAUTION may lead to serious results depending on the situation. Both instruction levels must be observed because they are very important for safety.

- The contents of this Instruction Manual are subject to change without notice.
- Mitsubishi Electric will not be held responsible for any damage caused by repairs, disassembly or modifications by a party other than Mitsubishi or a Mitsubishi Electric Service Center.
- For the use in high-reliability-requiring applications such as nuclear energy control, moving objects including vehicles, traffic light control, medical purposes, etc., please contact Mitsubishi.
- Despite our continuous efforts to improve the quality and reliability of our product, the product could fail. Vibration, shocks, improper wiring to the magnetic contactor may also cause a failure and may also lead to a serious consequence such as a machine malfunction and power supply short-circuit. Take measures to prevent secondary damage such as personal injuries or fires resulting from this product's failure and malfunction.
- Store the "Instruction manual" and "Precautions for Use" enclosed with the product in a place that is easily accessible.

WARNING

- Always disconnect the product from the power source before starting installation, maintenance or inspections. There is a risk of electric shock.
Failure to observe this could result in serious results (machine malfunction, power supply short-circuit, etc.) caused by vibration or impact of the product or by improper wiring, etc.
- Do not touch or go near the product (especially live sections such as terminals) while the power is ON.
Failure to observe this could lead to electric shocks or burns.

CAUTION

- Do not modify or disassemble the MS-T series. The parts such as the contacts or coils cannot be replaced.
Failure to observe this could result in faults.
- Secure a space larger than that specified in the Instruction Manual when mounting the product.
Failure to observe this could lead to burns or fires.
- Use wires that meet the applied voltage, continuity current, and inrush current, and tighten them with the tightening torque specified in the Instruction Manual.
- Always confirm the ratings and specifications, and use the product within the specified ratings and specifications.
Use in an environment that exceeds the ratings or specifications could lead to ground faults or short circuit accidents due to destruction of insulation, fires due to overheating, and damage due to inhibited shut off.

CAUTION

- The areas around the terminals and coils will become hot while the power is ON. Do not touch these without proper care.
- Never manually operate the product in the live state.
- If contacts are by switched excessive currents, or if contacts are welded and do not open due to abnormal wear, deterioration of the contacts, or the end of product life, the machine device could become uncontrollable. Ensure safety by predicting such mechanical constraints and inhibited closing and releasing caused by contact welding.
- If chattering occurs in the operation command contacts, the contacts may become welded and lead to malfunction or fires.
- If smoke is generated due to a short circuit accident, etc., toxic gas may be generated. Make sure not to inhale the toxic gas.
- If the contacts are welded because of wear, there is a risk of fire. Always use this product together with a suitable protection device such as a wiring breaker or fuse.
- The coil's voltage fluctuation range is 85 to 110%, however if a voltage exceeding 100% is applied for a long time, deterioration of the coil insulation will increase, and the mechanical durability will drop. Always use the coil within an average rated voltage of 95 to 100%.
- If a voltage too low in operating a magnetic contactor is applied, a current exceeding the rating may flow to the coil and could soon burn the coil or start a fire.
- If the wiring for the operation circuit is long, the wiring impedance could lower the coil voltage and inhibit contacts from closing when an instantaneous current flows through the coil. Depending on the stray capacitance in the wiring, the contacts may not open even when the coil is de-excited.
- Use in a circuit that contains harmonics or surges could result in coil burning or fires.

Contents

1. Working Environment.....	4
2. Storage and Transportation	6
3. Mounting and Connection	7
3.1 Mounting.....	7
3.2 Connection	8
3.3 Installation Instruction for Accessories of MS-T Series	12
3.3.1 Additional auxiliary contact blocks.....	12
3.3.2 Mechanical interlock kits.....	13
3.3.3 Surge absorber.....	15
3.4 Wiring Diagram.....	16
3.4.1 S-T□	16
3.4.2 S-2×T□.....	17
3.4.3 TH-T□(KP).....	18
3.4.4 MSO-T□(KP)	18
3.4.5 MSO-2×T□(KP).....	19
4. Maintenance and Inspection of Thermal Overload Relay	20
5. Recommended Update Interval	25
6. Maintenance and Inspection Check List	25
7. Troubleshooting List.....	26

1. Working Environment



CAUTION

- Using this product in an environment or atmosphere other than the normal working conditions could lead to failure. Always use the product under the normal working conditions.

The working environment varies as the controller is used in a wide range of applications. However, the product has been manufactured to be used under the following normal working conditions. Measures such as those given in section (2) are required when using the product in an environment differing from the following conditions.

A special-environment model, which takes special environmental measures, is also available upon request.

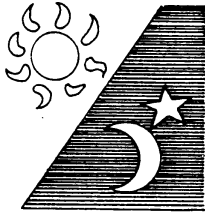
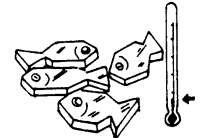

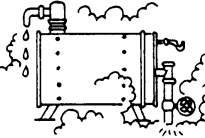
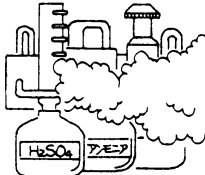
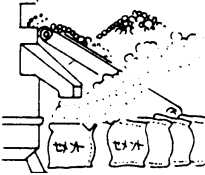
(1) Normal working conditions

- Ambient temperature: -10°C to 40°C (applies to outside of control panel)
Max. daily average temperature 35°C , max. annual average temperature 25°C
- Maximum temperature: 55°C , however, ambient temperature for boxed MS type is 40°C (annual average temperature in the panel is 40°C or less)
Note that the magnetic contactor, magnetic motor starter and thermal overload relay operation characteristics are affected by the ambient temperature.
- Relative humidity: 45 to 85%RH
Note that there must be no dew condensation or freezing.
- Altitude: 2,000m or less
- Vibration: 10 to 55Hz 19.6m/s^2 (Max.)
- Impact: 49m/s^2 (Max.)
- Atmosphere: Low levels of dust, smoke, corrosive gas, water or sodium.
When used in a sealed state for a long time, contact failure, etc., can occur.
Do not use the products in an atmosphere containing flammable gas.
- Storage temperature/ storage humidity : -30°C to 65°C / 45% to 85% RH
Note that there must be no dew condensation or freezing.
Storage temperature refers to ambient temperature during transportation or storage of product. When starting use of the product, the temperature must be within the working temperature.

(2) Special environment measures

The main measures for when using the products under conditions that differ from the normal working conditions are shown on the following page for reference.

There is a limit to how far the environment resistance of the product can be improved. Thus, an appropriate structure for the outer box (panel) storing the product that is outdoor-proof, dust-proof, and corrosion-proof must be used, to prevent damage.

Special environment		Problem points	General measures	For special environment	
				Name	Type
Sudden temperature changes		<ul style="list-style-type: none"> • Rusting or malfunctioning due to dew condensation (freezing) 	<ul style="list-style-type: none"> • Install a space heater to lower the relative humidity. • Move the product to a place with little temperature change. 		
Low temperature	 Freezer storage Low temperature room	<ul style="list-style-type: none"> • Freezing • Malfunctioning or rust due to dew condensation. 	<ul style="list-style-type: none"> • Install a space heater, etc., to increase the temperature. • Dry the area. 		Consult Mitsubishi when the temperature is -10°C or less.
High temperature	 Steel mill Molding forming plant	<ul style="list-style-type: none"> • Malfunctioning • Heat resistance of connected wires • Overheating of insulator 	<ul style="list-style-type: none"> • Lower load current. • Use heat resistant wires. • Do not use in places where the temperature in the panel exceeds 55°C. 		
High humidity	 Chemical plants Pump room	<ul style="list-style-type: none"> • Drop in insulation resistance • Corrosion, rusting 	<ul style="list-style-type: none"> • Place in a waterproof type box, etc. • Inspect regularly. 	<ul style="list-style-type: none"> • Corrosion-proof treatment 	MSO- <input type="checkbox"/> YS (supported by the S-T type magnetic contactor as standard.)
Corrosive gas, sodium	 Petrol refining plant Chemical plant Coastline City water pump room (Chlorine disinfectant)	<ul style="list-style-type: none"> • Corrosion, rusting 	<ul style="list-style-type: none"> • Place anti-corrosive product in corrosion-proof type box, etc. 	<ul style="list-style-type: none"> • Corrosion-proof treatment 	MSO- <input type="checkbox"/> YS (supported by the S-T type magnetic contactor as standard.) Use it in corrosion-proof box.
Dust, moisture	 Cement plant Textile plant	<ul style="list-style-type: none"> • Failure in contact continuity • Failure in mechanism operation • Deterioration of insulation 	<ul style="list-style-type: none"> • Place in a dust-proof box, etc. 		

2. Storage and Transportation



CAUTION

- Take caution to injuries from the edges of the packaging material or the product, or from dropping the product.
- Confirm that no parts have fallen off or been damaged due to accidents during transportation.
- After unpacking the product, do not leave it in a humid or dusty place.
- Do not stand/sit on or place objects on the product.

(1) Storage and transportation

The ambient temperature/humidity when storing or transporting the product must be between -30°C and 65°C / between 45% and 85%RH. The normal working conditions must be established before use.

- Packing and storing

Do not place the product directly on a concrete floor, etc. Always place it on slats or a shelf.

Do not store the product exposed without packaging.

- Avoid humidity

Do not leave the product for long periods in a place with a high humidity level.

- Avoid corrosive gases

Do not leave the product in an atmosphere containing sulfuric gas, ammonium gas or chloric gas.

(2) Precautions for transportation

- Carefully pack and transport.

Do not drop the product during transportation.

When transporting the product after mounting and wiring it to a panel, pack it carefully. The movable parts do not need to be locked during transportation.

- Do not hold by terminals or wires when transporting.

Holding by terminals, thermal overload relays or wires, etc., when transporting the product could lead to damage or dropping.

(3) Long-term storage after mounting and before usage

After completing the product as a panel, the power might not be turned on over a long period. If the product is delivered during construction, cement, concrete and water, etc., can enter the product.

In this case, always protect the product until it is to be used.

3. Mounting and Connection



WARNING • Do not touch or go near the product while the power is ON. Failure to observe this could lead to electric shocks or burns.



CAUTION

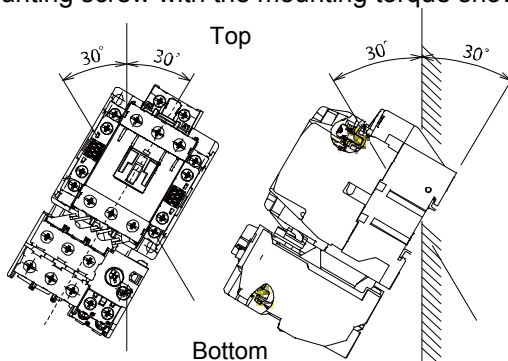
- Make sure that foreign matter does not enter the product during mounting or wiring. There is a risk of load damage or fires resulting from contact faults or operation faults.
- Do not use a product that is damaged during transportation, mounting or wiring. Failure to observe this could lead to fires or malfunctions.
- If the mounting screw size is changed or an insufficient number is used, or if the mounting onto the mounting rail (IEC35mm width) is incomplete, the product may fall off.
- If the control circuit wiring is long, turning OFF the control voltage may not open the circuit because of a stray capacitance.
- Never manually operate the product in a live state. Failure to observe this could lead to electric shocks or burns.
- If the product is stored in a box, always close the cover while the power is ON. Failure to observe this could lead to electric shocks.
- Do not mount the product on the floor or ceiling. Mounting on the floor or ceiling will affect the contact's conductive performance, operation performance, durability, etc.

3.1 Mounting

- Mount the product in a dry place that has little dust, corrosive gas or vibration.
- The correct mounting position is a vertical surface. However, the product can be mounted vertically up to 30° in each direction.
- Tighten the mounting screw with the mounting torque shown in the Table below.



Correct mounting



Tolerable limits to vertical surface

Screw size	Mounting screw tightening torque N•m
M4	1.2 to 1.9



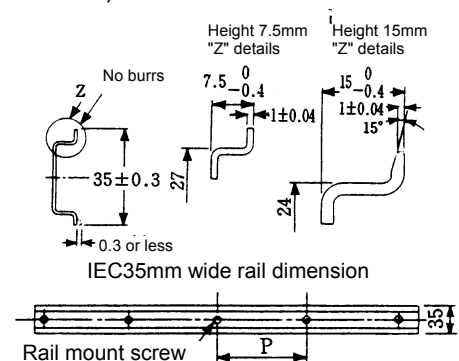
Horizontal mounting
(Excluding reversing type)

If horizontal mounting is unavoidable, turn the product 90° in the counterclockwise direction from the correct vertical mounting state, and mount.

The characteristics will not change much from when the product is mounted horizontally but mechanical endurance may drop somewhat.

This mounting method is not available with the reversing type. Also, the product cannot be mounted horizontally onto a mounting rail (IEC35mm width).

- Mounting on IEC35mm rail
 - The T10 to T32 series and SR-T series can be mounted on an IEC35mm wide rail. The rail height is 7.5 or 15mm. The rail dimensions are shown on the right.
 - When mounting the rail onto a panel, keep the rail mounting screw pitch within the values shown on the right to maintain the mechanical strength.
 - Always maintain the dimensions shown on page 8 as these influence temperature rises and product life.



Height 7.5mm wide rail: P = 250 or less
 Height 15mm wide rail: P = 500 or less
 For each, the dimensions show the case when the device is mounted on a 7.5mm high mounting rail with the clearances shown in Table 1 on page 8.

Interval between mount screws for IEC35mm wide rail

● Minimum mounting clearance

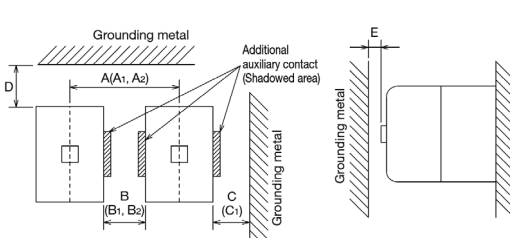
CAUTION • Always observe the specified minimum mounting clearance and arc space. Hot ionized gas will be discharged when the current switches.

Refer to Table 1.

When mounting the Magnetic Contactors side by side, be sure to keep the devices isolated by a distance longer than the dimension shown in the following table. Also, the Magnetic Contactors and adjacent grounding metal should be isolated by a distance longer than the dimension shown in the following table. The content described in () is applied when additionally mounting auxiliary contacts.

Although an arc space is not required in a position above the Magnetic Contactors, it is recommended to provide a space longer than the E dimension shown in the following table in consideration of the product movement caused by variation in depth dimension of Magnetic Contactors and the vibration produced when turning on or releasing the contactor.

Table 1 Minimum mounting separation



Frame	Minimum mounting space				Arc Space (Note 1)	Upper mounting space E
	A(A ₁ , A ₂) dimension [mm]	B(B ₁ , B ₂) dimension [mm]	C (C ₁) dimension [mm]	D dimension [mm]		
T10	41 (A ₁ = 53, A ₂ = 65)	5 (Note 2) (B ₁ = 17, B ₂ = 29)	10 (C ₁ = 22)	15	0	5 (Note 3)
T12	48					
T20	(A ₁ = 60, A ₂ = 72)					
T21	68					
T25	(A ₁ = 80, A ₂ = 92)					
T32	48 (A ₁ = 60, A ₂ = 72)					
SR-T5	48 (A ₁ = 60, A ₂ = 72)	5 (Note 2)	10			
SR-T9	48					

A₁, B₁, C₁ : When an auxiliary contact is added to the shadowed area
A₂, B₂ : When two auxiliary contacts are added to the shadowed area

Mounting space and arc space

Note 1. The value of this arc space is a value of IEC and JIS Standards-based closed circuit shut-off capacity test.

Note 2. Although the B dimension of T10 to T32 allows closely-attached mounting, when continuing to apply current to the device or when mounting a product high in open/close frequency and high utilization on the same rail, the device life may be shortened in terms of temperature increase and impact, so please keep the space between the devices over the minimum value shown in the above table as much as possible when mounting them.

Note 3. E dimension is 3mm when mounting UT-AX2 or UT-AX4 with magnetic contactors.

3.2 Connection

CAUTION

- If the terminal screws become loose, overheating or fires may occur. Always tighten with the specified tightening torque and tighten the screws periodically. An excessive tightening torque could damage the terminal screw.
- A sufficient insulation distance must be secured for the crimp terminal and connection conductor connected to the terminal, if not, short circuits could occur.
- If the wire size is insufficient, overheating or fires could occur. Use wire appropriate for the working conditions.
- If lock paint or a thermo-label, etc., adheres to the wire connection section or contact, overheating or fires could occur due to continuity failures.
- If the terminal screws have been loosened, securely tighten them with the specified tightening torque. Failure to observe this could lead to overheating or fires.

(1) Coil voltage and frequency

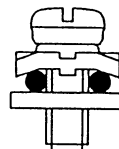
The voltage and frequency of the control circuit must match with the rated indicated voltage and frequency of the coil.

(2) Connection to terminal screw with self-lifting plate

The provided terminal screw with self-lifting plate can be used even when a crimp terminal is used. For the terminal screw with self-lifting plate, wires can be connected with their insulation sheath peeled off.



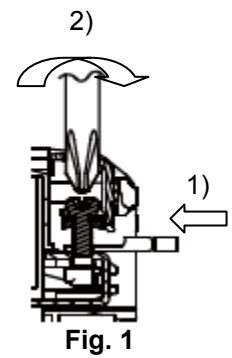
(One wire)



(Two wires)

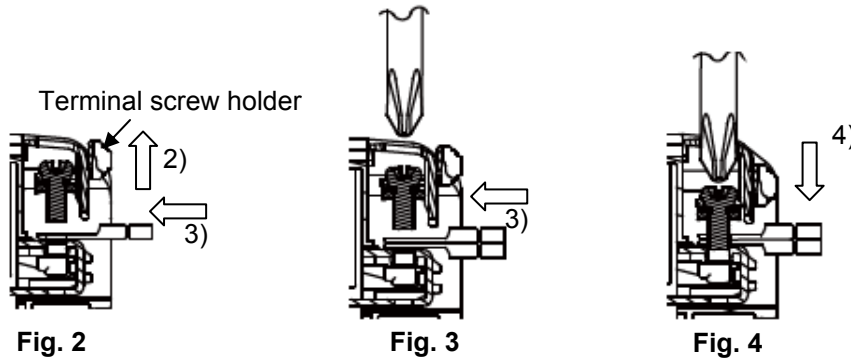
(3) Connection to streamlined wiring terminal (For S-T□BC, SR-T□BC, TH-T□BC)
Bare wire, single wire, Y-type crimp terminal

- 1) Insert the wire and Y-type crimp terminal into the terminal. (Fig. 1)
 When doing so, make sure the insulator such as wire's sleeve does not get caught in the terminal
- 2) Tighten the terminal screw with the specified tightening torque.
- 3) To remove the wire, loosen the terminal screw, and then pull out the wire while holding down the terminal screw holder so it does not lift up.



Round crimp terminal

- 1) Confirm that the terminal screw has been loosened.
- 2) Lift the screw holder for each pole. (Fig. 2) (Note 2)
 - (a) Wiring procedure for one crimp terminal
 - 3) Insert the crimp terminal. (Fig. 2)
 - 4) Lower the screw holder. (Insert the end of the screw, and temporarily fix.)
 - 5) Tighten the screw. (Note 3)
 - 6) To remove the wire, follow the tightening procedure in reverse.
 - (b) Wiring procedure for two crimp terminals
 - 3) Insert two crimp terminals. (Fig. 3)
 - 4) Lower the terminal screw holder. (Temporarily fix the crimp terminals.)(Fig. 4)
 - 5) Tighten the screw. (Note 3)
 - 6) To remove the wire, completely loosen the screw, lift the screw holder, lower the crimp terminal toward the terminal, and remove the wire.



- Note 1. The terminal screw differs from the MS-N series, so make sure that differing types of screws are not used.
 Note 2. If the screw holder cannot be lifted, completely loosen the terminal screw and then lift it up.
 Note 3. When tightening the screw, slightly press down on the screwdriver while rotating it, so that the screw fits in securely.
 Note 4. Also, tighten the terminal screws to which wires have not been connected.

(4) Precautions for connecting crimp terminal

(4-1) Application to circuits exceeding 380V

When using the following types of magnetic motor starters or magnetic relays in circuits where the voltage exceeds 380V with crimp terminal wiring, use of a crimp terminal with insulation tube is recommended.

○	×	
Crimp terminal with insulation tube	Bare crimp terminal	MSO-T10,T12,T20 magnetic motor starter S-T10,T12,T20 magnetic contactor SR-T5,T9 contactor relays TH-T18 thermal overload relay

(4-2) Application to finger protection

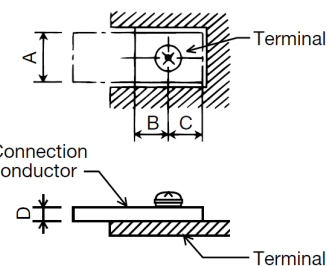
When using the product as a finger protection type with crimp terminals, use the crimp terminal with insulation tube.

- (5) For the applicable wire size and terminal screw tightening torque, refer to Table 2.
- (6) Always ground the metal enclosure.

Table 2 Wire size and tightening torque

Model	Terminal dimension and size/type of screw				Applicable electric wire size [φmm, mm ²]		Connection conductor thickness (D) [mm]	Applicable solderless terminal size (JST Cat No.)		Tightening torque of terminal screw [N·m]	
	Main circuit			Operating circuit	Main circuit	Operating circuit		Main circuit (Note 1)	Main circuit	Operating circuit	Main circuit
	Dimension of terminal portion A x B x C [mm] (Note 1)	Screw size	Screw type	cross slot screw with pressure plate							
SR-T5, T9	—	—	—	M3.5×7.6	—	—	—	—	—	—	—
S-T10, T12, T20	7.5×3.7×4.5	M3.5×7.6	cross slot screw with pressure plate	M3.5×7.6	φ1.6 0.75 to 2.5	φ1.6 0.75 to 2.5	1.6	1.25-3.5 to 2-3.5 5.5-S3	1.25-3.5 to 2-3.5	0.9 to 1.5	0.9 to 1.5
S-T21, T25, T32	10.5×5.2×5.5	M4×10.5		M3.5×7.6	φ1.6 - 2.6 1.25 to 6		3	1.25-4 to 5.5-4		1.2 to 1.9	
TH-T18 (Load side)	7.5×4×4	M3.5×7.6	cross slot screw with pressure plate	M3.5×7.6	φ1.6 0.75 to 2.5	φ1.6 0.75 to 2.5	2	1.25-3.5 to 2-3.5 5.5-S3	1.25-3.5 to 2-3.5	0.9 to 1.5	0.9 to 1.5
TH-T25 (Power side / Load side)	10.2×6.8×5 / 10.2×5.7×5	M4×10.5 / M4×10.5		M3.5×7.6	φ1.6 - 2.6 1.25 to 6		2.5	1.25-4 to 5.5-4		1.2 to 1.9	

Note 1. The dimension of the main circuit terminal is a dimension for board conductor wiring. (See the right diagram) The board conductor thickness (D dimension) must be below the allowable connection conductor thickness stated above because of the length of the terminal screw. In case of wiring with two boards used, the total value of two boards must be below the value (D dimension) shown in the table.



Note 2. In each terminal, two wires or two solderless terminals are allowed to be connected.

Note 3. The cross slot screw with pressure plate of T Series and N Series are same in size but different in pressure plate dimension, so please avoid the mixed use of such screws. This may break the insulation barrier or make the wire likely to fall out.

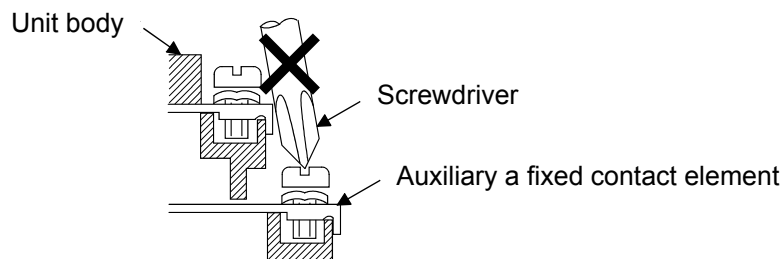
Note 4. When using IEC60529-based finger safe specification, be sure to use an insulation tube-attached solderless terminal.

Note 5. Tightening the 3 terminal screw excessively without wiring may break the screw and consequently disable the tightening, so please avoid such excessive tightening.

Note 6. Operational circuits are coil terminals of magnetic contactors and control circuit terminals of Thermal Overload Relays.

Note 7. Please use swaging tool which is recommended by JST.

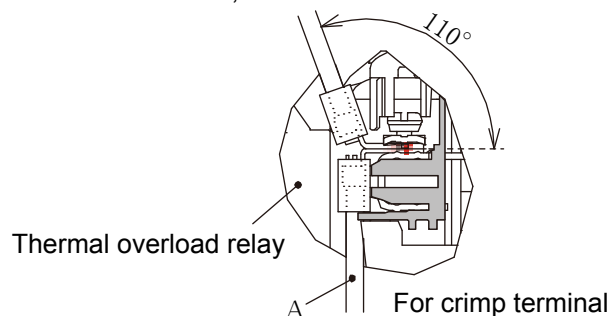
Note 8. For the auxiliary a fixed contact elements of the S-T21 and T25 types, these elements could drop off if its terminal screw is tightened with a screwdriver tilted towards the unit body. Do not tilt the screwdriver towards the unit body when tightening the screw.



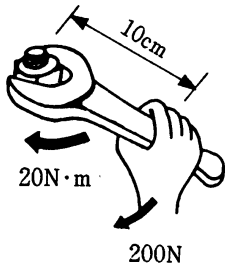
Note 9. Connection to magnetic contactor's load side auxiliary circuit terminal when using magnetic contactor (MSO-(2×) T10 to T20)

Bend the crimp terminal or wire as shown below and connect.

When connecting two crimp terminals or two wires, use a 0.75 to 1.25mm² wire for the "A" wire.



Examples of general tightening torque



A typical male has an arm strength of 200N, so if the tightening tool handle's length is 10cm, the torque will be 20N·m.
($200 \times 0.1 = 20\text{N}\cdot\text{m}$)

Maximum tightening torque of screwdriver [N·m]

Phillips screwdriver (made by VESSEL)	Right hand only	Left hand only	Both hands
No.1 bit 	2.5	2.3	2.8
No.2 bit 	3.6	3.0	3.9
No.3 bit 	4.2	3.9	5.7

1. Hold the screwdriver horizontally, and rotate in the tightening direction.
2. This is an example for a male having a right arm strength of 500N and left arm strength of 450N.

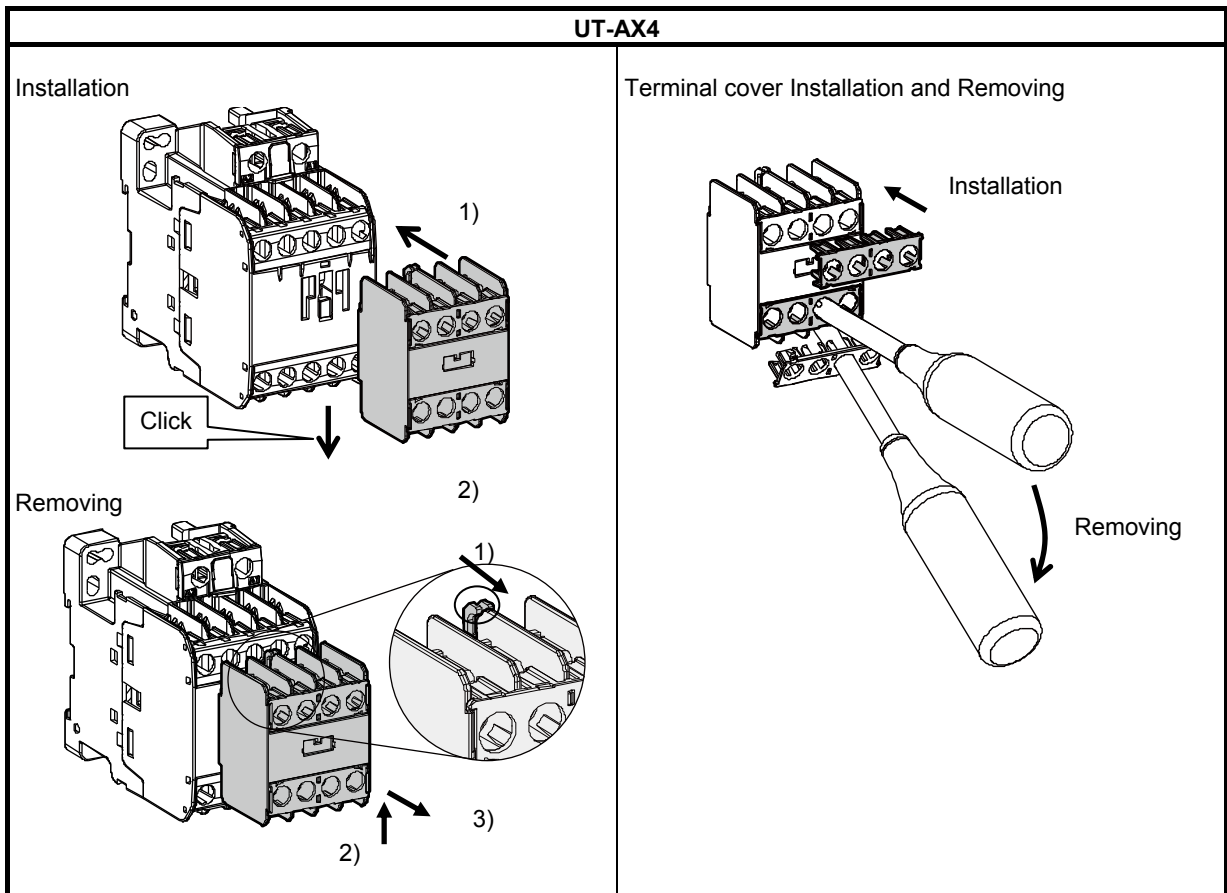
3.3 Installation Instruction for Accessories of MS-T Series

3.3.1 Additional auxiliary contact blocks

(1) Types and applicable magnetic contactors and contactor relays

Types	Contact arrangement	Method	Applicable magnetic contactors and contactor relays	Available number of accessories
UT-AX4	4a (4NO)	Front crip-on	S-T10,S-T12, S-T20,S-T21, S-T25,S-T32,SR-T5	1
	3a1b (3NO1NC)			
	2a2b (2NO2NC)			

(2) Additional auxiliary block mounting procedures



3.3.2 Mechanical interlock kits

CAUTION • When two or more contactors are used, and a short circuit might occur if they turn ON simultaneously. Provide a mechanical interlock to prevent simultaneously contacting of the contacts.

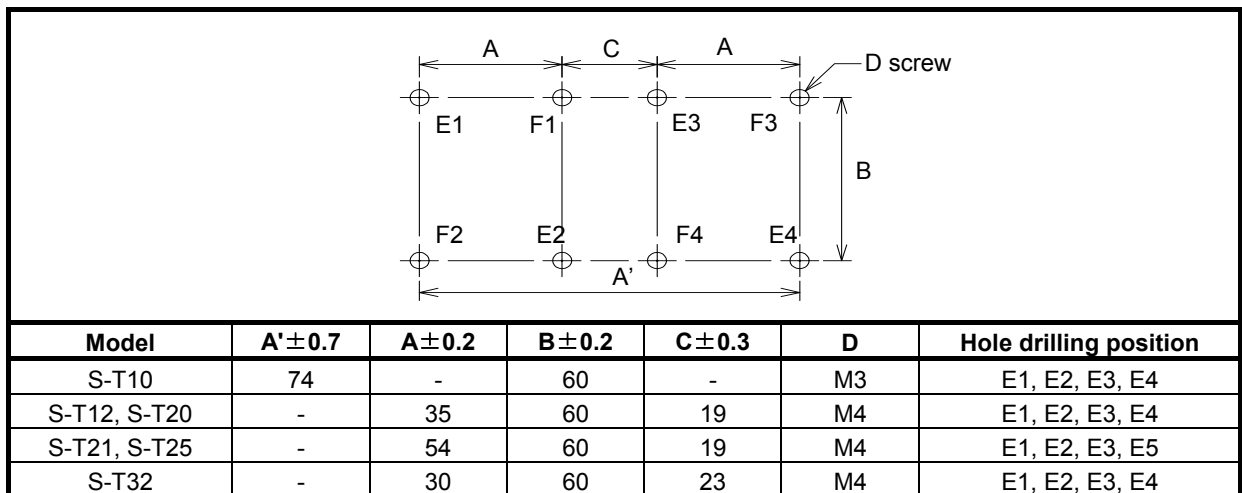
(1) Types and applicable magnetic contactors

Types	Applicable magnetic contactors
UT-ML11	S-T10,S-T12,S-T20
UN-ML21	S-T21,S-T25,S-T32

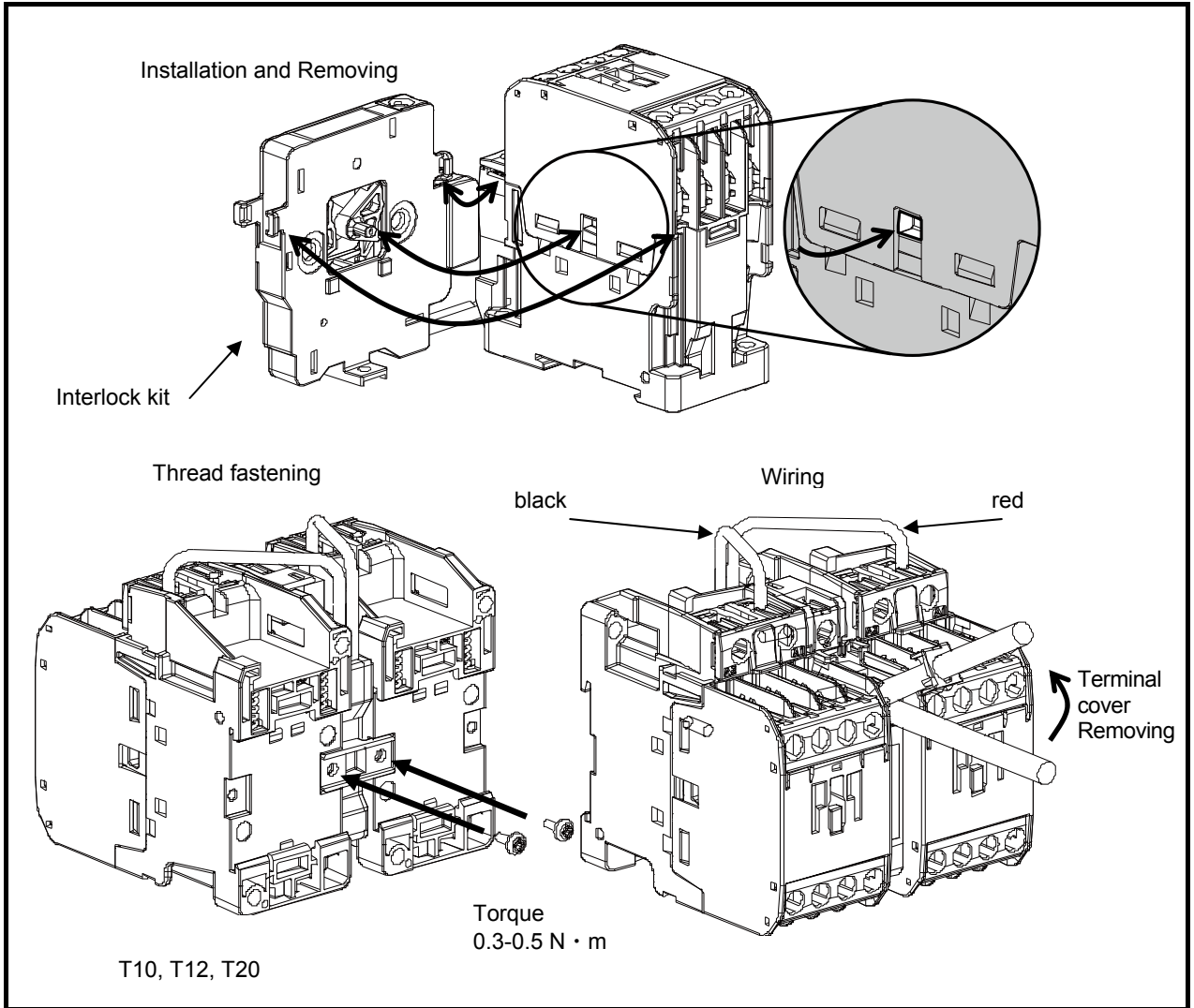
(2) Installation procedures

- 1) Confirm that combination of the interlock kit and magnetic contactors is correct.
- 2) Drill mounting holes according to the dimensions as shown in clause (3).
- 3) Install the interlock kit in both magnetic contactors as shown in clause (4).
- 4) Fix the magnetic contactors onto mounting surface with screws.
- 5) Provide a direct electrical interlock mutual to the magnetic contactors as shown in clause (4) for the reversing type. Use the auxiliary contact on the inner side between the magnetic contactors for the electrical interlock.

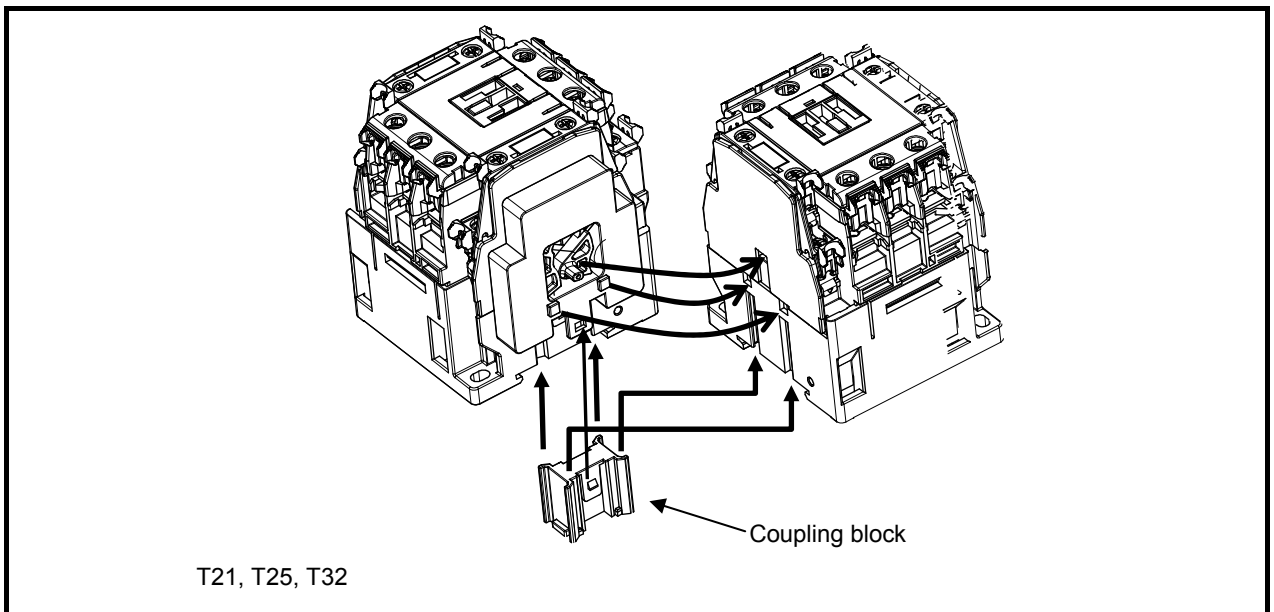
(3) Mounting hole dimensions



(4) Interlock kits mounting procedures
UT-ML11 T10, T12, T20



UN-ML21 T21, T25, T32



3.3.3 Surge absorber



CAUTION

- The varistor (used in the coil , surge absorber , etc.) may emit smoke due to deterioration. Make sure not to near the product during operation, and always use a short-circuit protection device such as a fuse on the operating circuit.
- A surge will be generated from the contact and coil during switching. Avoid danger by connecting a surge absorber, etc.
- Destruction or fires may occur if the surge absorber is used exceeding the rated voltage.

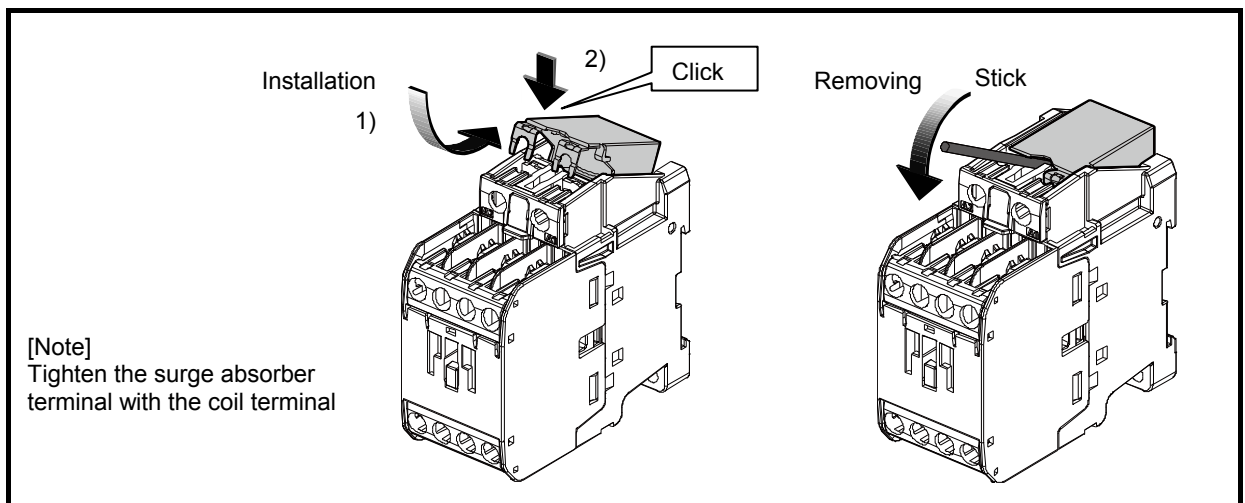
(1) Types and applicable magnetic contactors

Types	Applicable magnetic contactors
UT-SA21	S-T10,S-T12, S-T20,S-T21, S-T25,SR-T5
UT-SA22	
UT-SA23	
UT-SA25	

(2) Applicable voltage range

Rated voltage	Recommend applicable voltage range	Minimum applicable voltage	Remarks
AC 48V	AC24~AC50V, DC24~60V	AC,DC12V	UT-SA25
AC 200V	AC100~AC240V, DC100~220V	AC12V, DC12V	UT-SA21, UT-SA23, UT-SA25 (CR type UT-SA23 is exclusive for AC)
		AC50V, DC60V	UT-SA22
AC 400V	AC346~480V	AC12V	UT-SA21

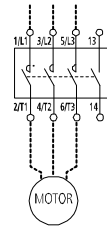
(3) Surge absorber mounting procedures



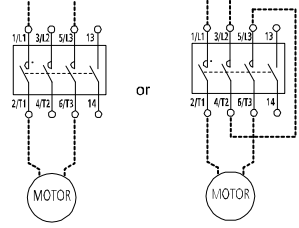
3.4 Wiring Diagram (representative example)

3.4.1 S-T□

3 Phase Motor

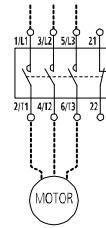


Single Phase Motor

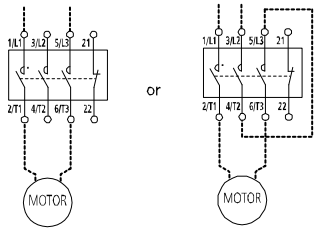


S-T10(1NO)

3 Phase Motor

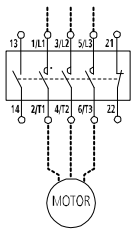


Single Phase Motor

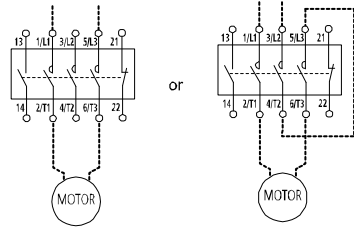


S-T10(1NC)

3 Phase Motor

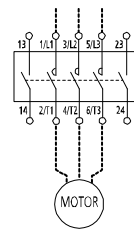


Single Phase Motor

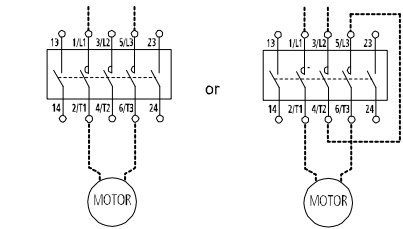


S-T12, T20

3 Phase Motor

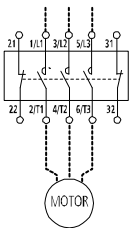


Single Phase Motor

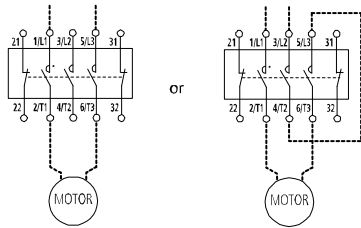


S-T12, T20(2NO)

3 Phase Motor

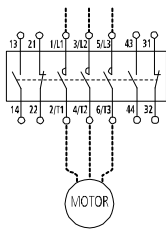


Single Phase Motor

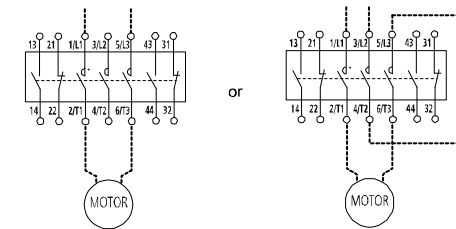


S-T12, T20(2NC)

3 Phase Motor

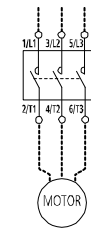


Single Phase Motor

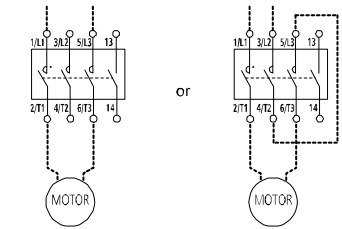


S-T21, T25

3 Phase Motor



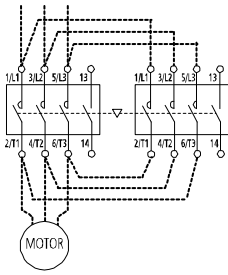
Single Phase Motor



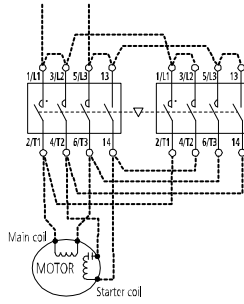
S-T32

3.4.2 S-2×T□

3 Phase Motor

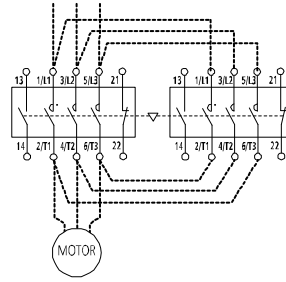


Single Phase Motor

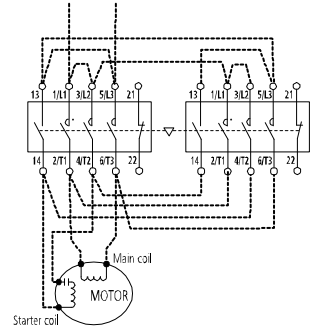


S-2×T10

3 Phase Motor

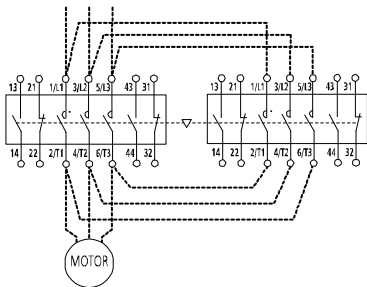


Single Phase Motor

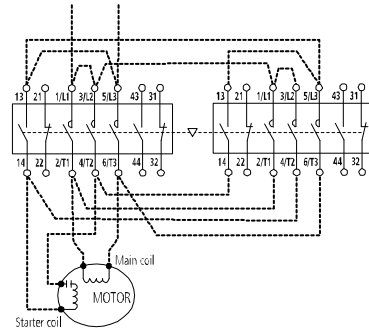


S-2×T12, T20

3 Phase Motor

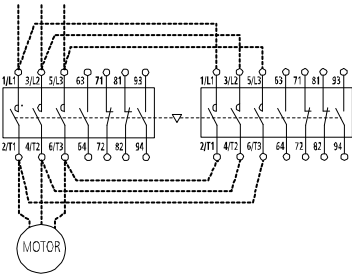


Single Phase Motor

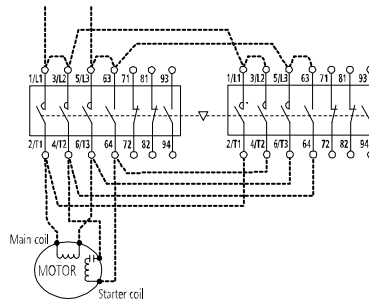


S-2×T21, T25

3 Phase Motor



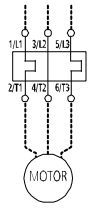
Single Phase Motor



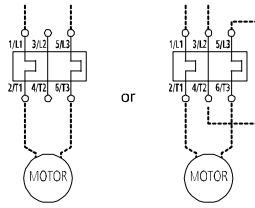
S-2×T32

3.4.3 TH-T□(KP)

3 Phase Motor

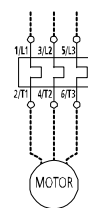


Single Phase Motor

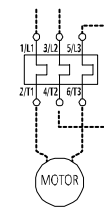


TH-T18, T25

3 Phase Motor



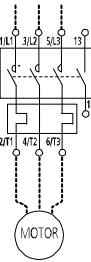
Single Phase Motor



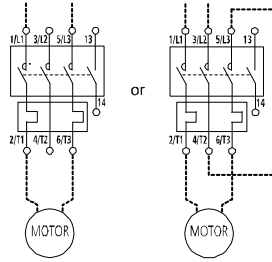
TH-T18KP, T25KP

3.4.4 MSO-T□(KP)

3 Phase Motor

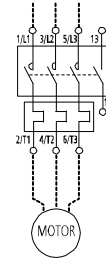


Single Phase Motor

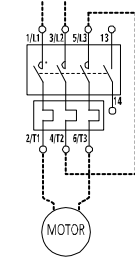


MSO-T10

3 Phase Motor

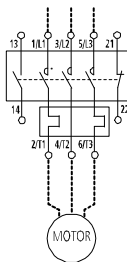


Single Phase Motor

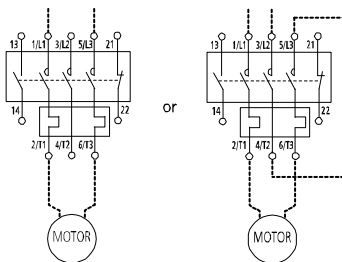


MSO-T10KP

3 Phase Motor

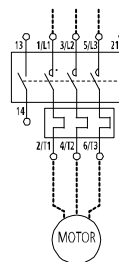


Single Phase Motor

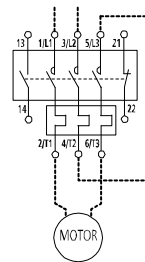


MSO-T12, T20

3 Phase Motor

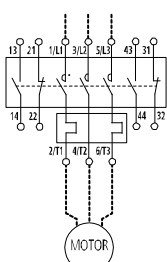


Single Phase Motor

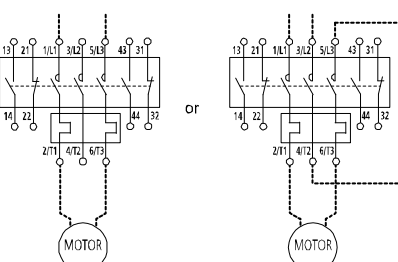


MSO-T12KP, T20KP

3 Phase Motor

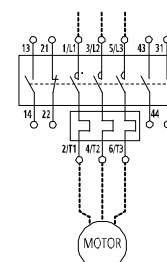


Single Phase Motor

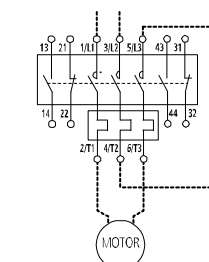


MSO-T21, T25

3 Phase Motor



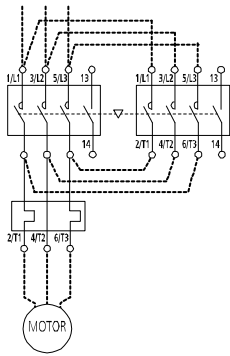
Single Phase Motor



MSO-T21KP, T25KP

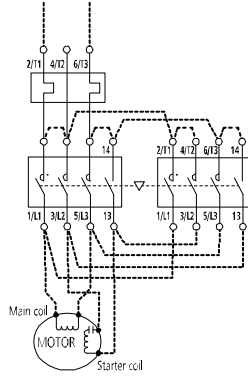
3.4.5 2×T□(KP)

3 Phase Motor

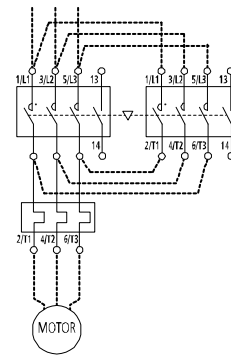


MSO-2 × T10

Single Phase Motor

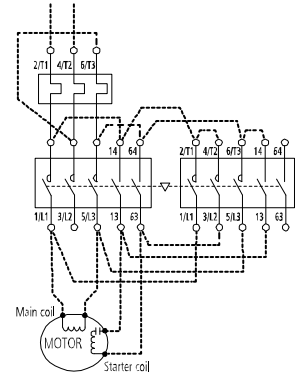


3 Phase Motor

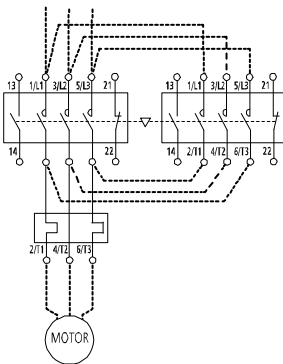


MSO-2 × T10KP

Single Phase Motor

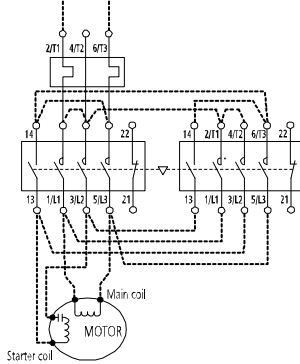


3 Phase Motor

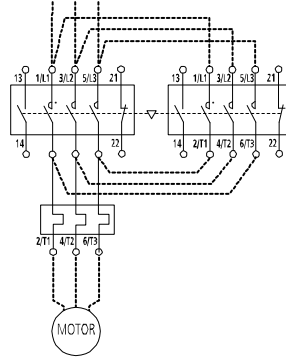


MSO-2 × T12, T20

Single Phase Motor

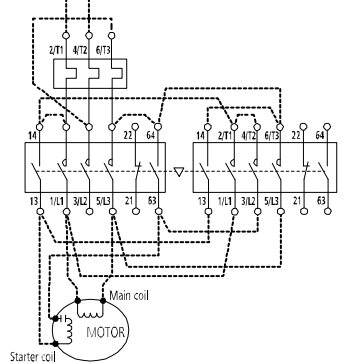


3 Phase Motor

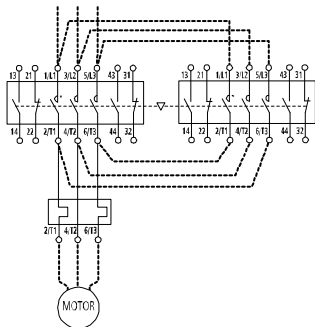


MSO-2 × T12KP, T20KP

Single Phase Motor

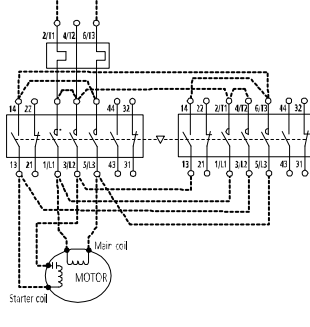


3 Phase Motor

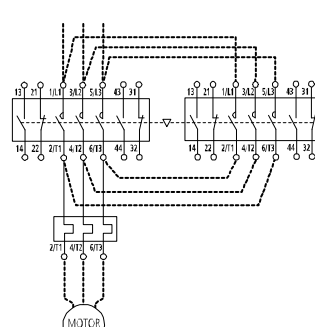


MSO-2 × T21, T25

Single Phase Motor

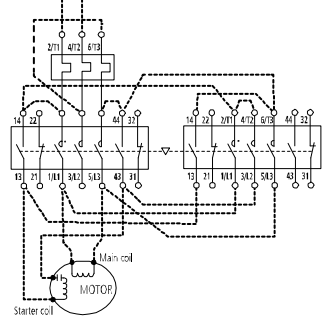


3 Phase Motor



MSO-2 × T21KP, T25KP

Single Phase Motor

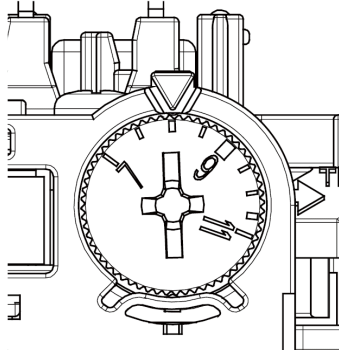


4. Maintenance and Inspection of Thermal Overload Relay

(1) Heater rating and adjustment

For the settling current of the thermal overload relay, select one that matches the motor's full load current. Make fine adjustments by rotating the knob. For example, if the motor's full load current is 8A, use a 9A thermal overload relay, and turn the knob as shown below to set it to the 8A scale position.

Note that an unfavorable trip could occur due to the ambient temperature, wire size, set value error, and time transition changes, etc. Turn the knob to adjust the set position.



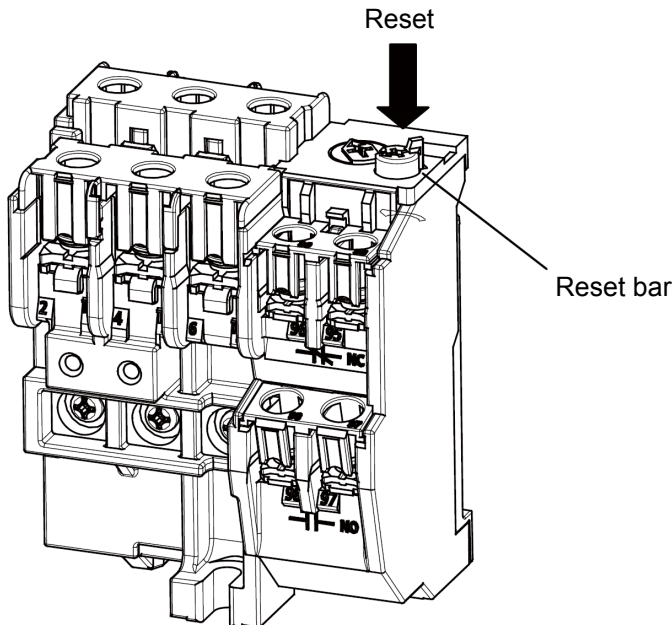
Knob adjustment (for 8A)

[Reset]

If an overcurrent flows to the motor, the thermal overload relay will trip. Check the cause of the overcurrent, take measures, and then press the reset bar to reset the relay. There may be cases when the relay cannot be reset immediately after a trip, but resetting will be possible after the bimetal cools off. For the automatically reset type, the relay will be reset automatically after a short time. (This will differ according to the temperature that the bimetal is heated to, but will be just over 10 seconds to 10 minutes.)

[Do not disassemble]

Never touch the inside of the thermal overload relay. The thermal overload relay has been configured precisely at Mitsubishi before shipping.



(2) Fusing of thermal overload relay

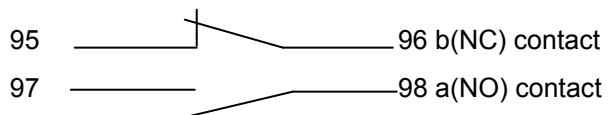
The thermal overload relay is used to protect the motor from burning. It cannot be used as protection against short circuits, so if a short circuit occurs, replace the thermal overload relay.

If a current larger than the heater fuse's I^2t value flows due to a short circuit, etc., the thermal overload relay heater will fuse before it actually operates. To prevent fusing of the heater, use the MCCB of the correct capacity on the power supply side of the magnetic motor starter, or use a saturable reactor on the thermal overload relay to coordinate protection.

If the heater fuses, the bimetal in the thermal overload relay may be curved in the opposite of the correct direction. This is a result of a large amount of heat by the heater fusing, which abnormally heats the bimetal and creates large internal stress, causing permanent deformation.

(3) Contact configuration

For the MS-T series, the thermal overload relay contact is configured as 1NO/1NC contact as shown below. The NO and NC contacts can be used as independent contacts, and differing voltages can also be used.



● Combination of MSO-T10 (BC), T12 (BC), T20 (BC)

[Applicable magnetic contactor and thermal overload relay]

Magnetic starter	Combined devices		
	Magnetic contactor	Thermal overload relay	Connection conductor
MSO-T10	S-T10	TH-T18	—
MSO-T12	S-T12	TH-T18	—
MSO-T20	S-T20	TH-T18	—

[Assembly procedure]

1. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor.
2. Tilt the thermal overload relay, and guide the thermal overload relay's notch A (two places) into the magnetic contactor's indents (two places), and align the position so that the three thermal overload relay main circuit conductors are on the left side of the main terminal screws. (Fig. 1)
3. Press in the thermal overload relay from the B direction, and insert the thermal overload relay's notch A to the magnetic contactor's indent. (Fig. 2)
4. Turn the thermal overload relay in the direction of arrow C, and turn the thermal overload relay notch D to the magnetic contactor's E face. (Fig. 3, 4)
5. Tighten the main terminal screws (2/T1, 4/T2, 6/T3) while pressing the thermal overload relay toward the magnetic contactor's side.

Thermal overload relay's main circuit conductor

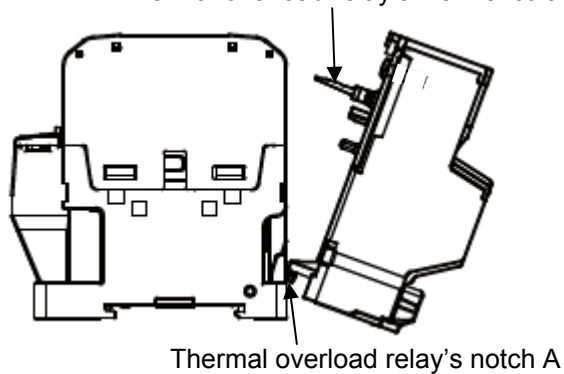


Fig. 1

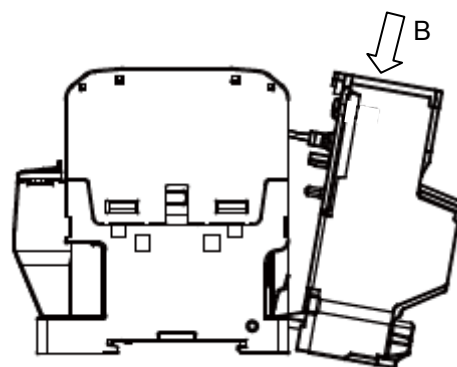


Fig. 2

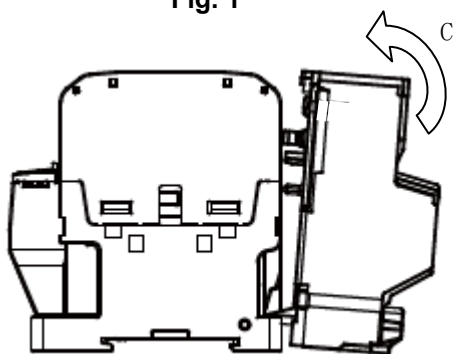


Fig. 3

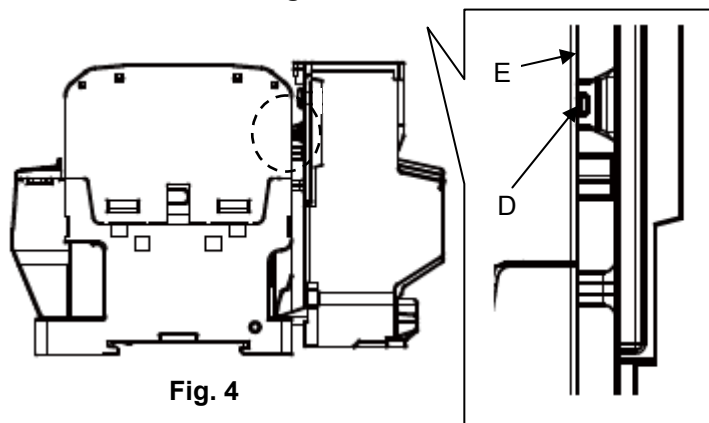


Fig. 4

[Removal procedures]

1. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor.
2. Tilt the thermal overload relay and lift it up in the direction of arrow F. Release the joint of the thermal overload relay notch A and magnetic contactor indent. (Fig. 5)

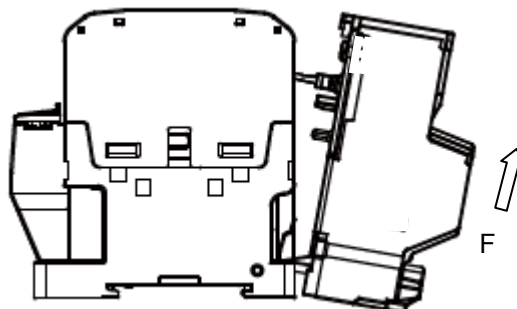


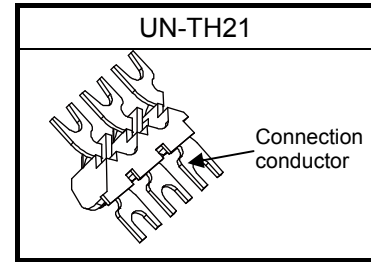
Fig. 5

- Combining MSO-T21 (BC), T25 (BC)
The optional UN-TH21 connection conductor is required for assembly.

[Applicable magnetic contactor and thermal overload relay]

Magnetic starter	Combined devices		
	Magnetic contactor	Thermal overload relay	Connection conductor
MSO-T21	S-T21	TH-T25	UN-TH21
MSO-T25	S-T25	TH-T25	UN-TH21

[Outside view of the connection conductors]



[Assembly procedures]

1. Fix the connecting conductors (a set of 3 pieces) by the screws on the power supply side terminals of the thermal overload relay. (Fig. 1)
2. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor.
3. Tilt the thermal overload relay, and align the thermal overload relay's notch A (two places) into the magnetic contactor's indents (two places). (Fig. 2)
4. Turn the thermal overload relay in the direction of arrow B, and confirm that the thermal overload relay notch section C (one place) is fit into the square hole at the indent on the magnetic contactor. (Fig. 3)
5. Tighten the main terminal screw while pressing the thermal overload relay toward the magnetic contactor side.

Power supply side terminal screw
Connection conductor

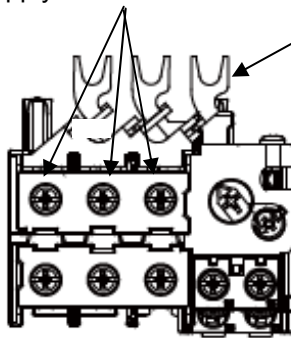
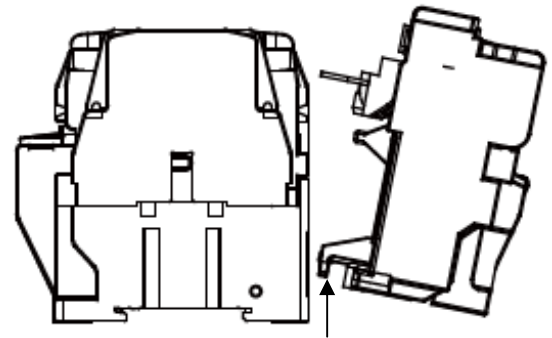
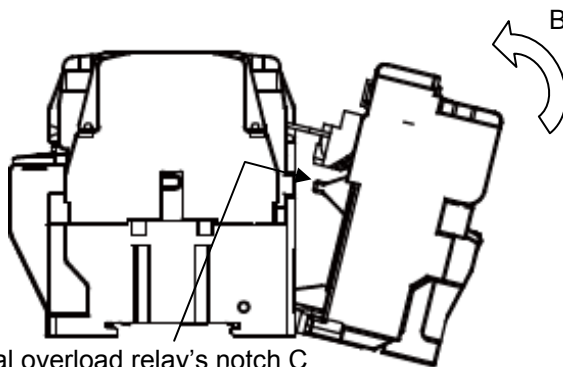


Fig. 1



Thermal overload relay's notch A
Fig. 2



Thermal overload relay's notch C

Fig. 3

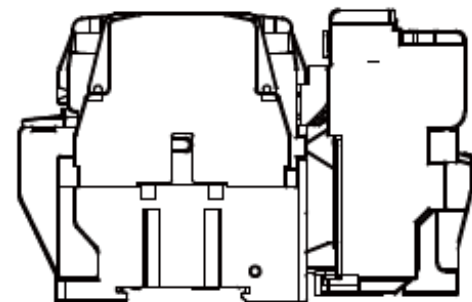


Fig. 4

[Removal procedures]

1. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor.
2. Tilt the thermal overload relay and lift it up in the direction of arrow D. Release the joint of the thermal overload relay notch A and magnetic contactor indent.

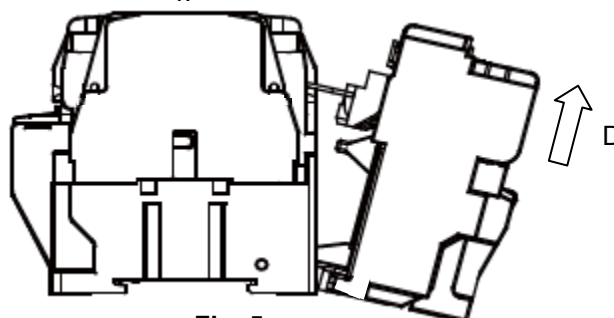


Fig. 5

(4) Ambient temperature and settling current

The TH-T series thermal overload relay is adjusted based on an ambient temperature of 20°C when used in the standard boxed magnetic motor starter (MS type). (The temperature in the control panel for the MSO type magnetic motor starter is 35°C.) The TH-T type thermal overload relay is equipped with an ambient temperature compensation device, so the operating characteristics are less likely to be affected by the ambient temperature changes. Figures 1 and 2 show the minimum operating currents at different temperatures with the reference ambient temperature of 20°C (in-control panel temperature of 35°C).

Thermal overload relay characteristic is affected by the ambient temperature; when the ambient temperature is low, the operating current is large, and when the temperature is high, the operating current is small. If the ambient temperature of where the magnetic motor starter is mounted greatly differs from 20°C (in-control panel temperature of 35°C), the settling current of the thermal overload relay must be compensated according to Figures 1 and 2. The size of the compensation rate is determined by the adjusting dial's position (minimum scale > center scale > maximum scale), so caution is required when compensating. (Note that if the tolerable working temperature of 40°C (55°C) is exceeded, the unit could function at a current less than 100% of the settling current.)

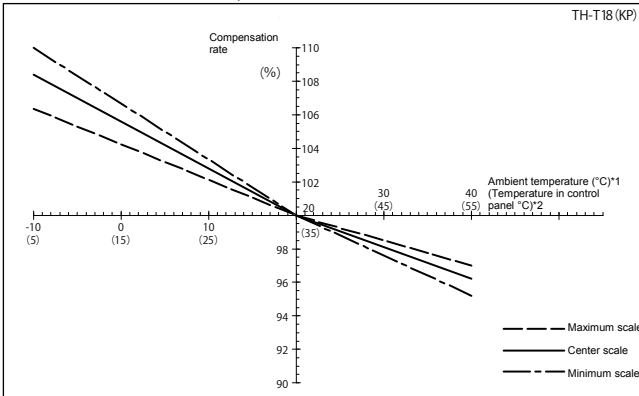


Fig. 1 Ambient temperature compensation curve (T18 frame)

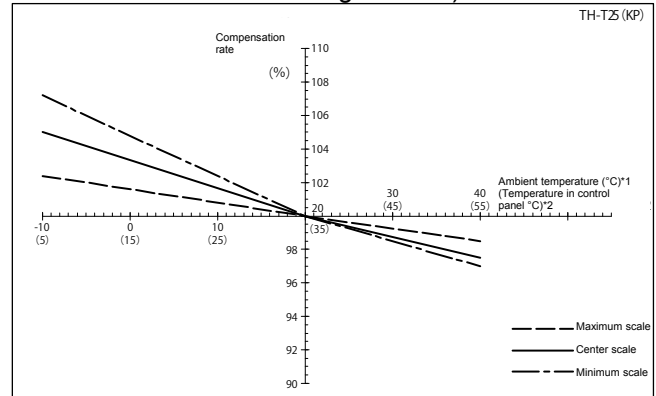


Fig. 2 Ambient temperature compensation curve (T25 frame)

Compensation rate: Percent in respect to the minimum operating current at the ambient temperature of 20°C (in-control panel temperature of 35°C)

<Settling current compensation method>

In the curves in Figures 1 and 2, find the compensation rate at the working ambient temperature. Divide the motor's full load current by the identified compensation rate. The obtained value is the settling value.

(Example: When the TH-T25's ambient temperature is 40°C (55°C inside control panel), the compensate rate at the temperature with the minimum scale is 97% according to Figure 2. If the motor's rated current is 15A, the settling value is obtained as 15.5A (=15÷0.97).)

Note 1: [*1] Applicable ambient temperature for MS type indicates temperature outside the box.

[*2] Indicates temperature including temperature rise in control panel applicable for MSO type.

(5) Connection wire size

The heat generated from the thermal overload relay differs according to the connected wire size, and thus affects the characteristics. The minimum operating current for the TH type has been adjusted with the reference connected wire sizes shown in Table 2, so if a wire thinner than this size is connected, the generated heat will be higher, and the minimum operating current will be smaller. On the other hand, if a thicker wire is used, the minimum operating current will increase.

Thus, when using a wire of a size differing from the reference connection wire size, strictly speaking, the settling current must be compensated. For example, for the TH-T25 type used with the heater nominal and settling current of 15A and with a 6mm² wire, the operating current fluctuation rate is 104% according to Table 2. Using the rate, compensate the scale to the 15×1/1.04 ≈ 14.4 (A).

Table 2 TH type thermal overload relay scale connection wire size and ultimate operating current

Type	Heater designation (A)	Reference connection wire size (mm ²)	Connection wire size (mm ²)	Minimum operating current fluctuation rate (%)
TH-T18 (KP)	0.12 to 15	2	1.25	98
TH-T25 (KP)	0.24 to 11		2.5	103
TH-T25 (KP)	15, 22	3.5	2	97
			6	104

- (6) Prevention of foreign matter entering the display window
Note that the relay may not trip if foreign matter such as wire scraps enters the display window.
- (7) Automatic resetting method

⚠ CAUTION • Secure safety by assuming that accidents may occur due to automatic restarting of the machine device, etc., when the output contact is recovered due to the automatically-reset thermal overload relay, or when the power is recovered after a power failure.

The unit is set to manual reset when shipped from the factory. This can be changed to automatic reset by the user.
However, a stopper is provided at the switching plate to prevent the setting from being changed easily.

TH-T18

[Changeover procedures]

1. Remove the thermal overload relay's auxiliary terminal cover. (Fig. 1)
2. Cut off the stopper, and then press down on the reset bar and slide the switching plate (white) in the direction of arrow X. (Fig. 2)
3. Mount the terminal cover, and confirm that the switching plate is at position A. (Fig. 3)

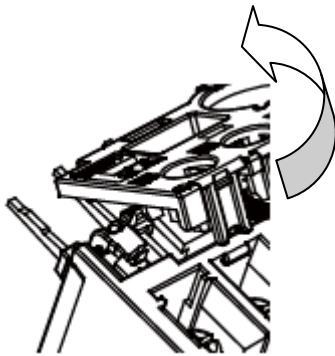


Fig. 1

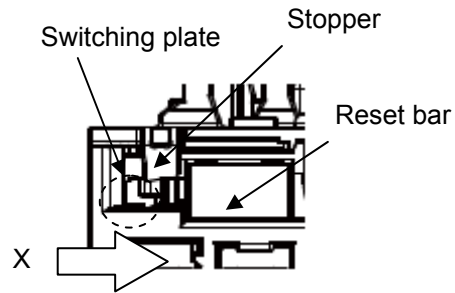


Fig. 2

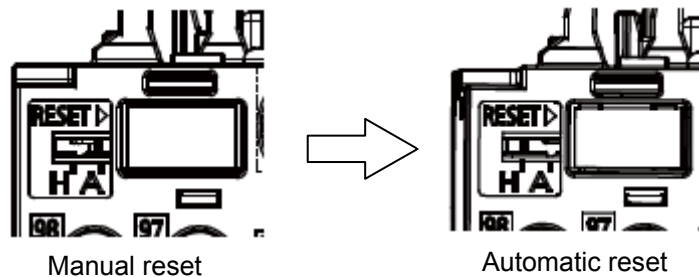


Fig. 3

TH-T25

1. Cut the reset bar's stopper section (shaded section) with a pair of nippers. (Fig. 4)
2. Using a Phillips screwdriver, press in the reset bar and turn it 90° counterclockwise (to position A). (Fig. 5)

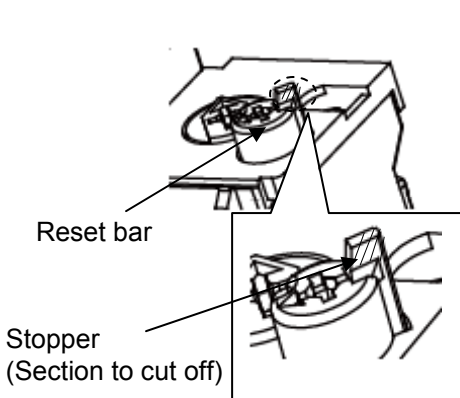


Fig. 4

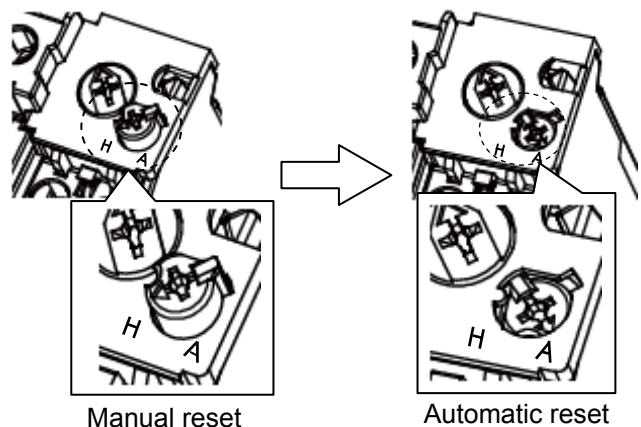


Fig. 5

5. Recommended Update Interval

The recommended update timing for each device is 10 years or the specified number of switching times listed in the catalog, etc.

This recommended update interval is not a value guaranteed in respect to the functions or performance. Instead, it is an interval generally believed to be effective for replacing the part with a new part for economic feasibility, and due to the deterioration of the device component's materials when the product is used under normal working conditions and the following maintenance and inspections are carried out.

6. Maintenance and Inspection Check List

Date:

Magnetic starter, contactor relay

Write after inspecting

Class	Inspection item		Purpose	Details of inspections	Remarks	Results		
Daily inspection	Abnormal noise	Listen	Abnormality	Generation of abnormal noise (Abnormal noise caused by electromagnet fault or damage, etc.)	Per panel (all)			
	Abnormal odor	Smell	Abnormality	Generation of abnormal odor	Per panel (all)			
	Appearance	Visual	Contamination	Existence of water or oil adherence or fault caused by dust	Per panel (all)			
			Breakage	Existence of mold breakage, discoloration or deformation	Per panel (all)			
Periodic inspection (reference: every six months)	Clamp screw	Visual	Loosening	Are any of the clamp screws loose?	All			
	Metal sections	Visual	Rusting, corrosion	Is there any rust or corrosion?	All			
	Movement of movable sections	Manual or electric	Movement fault	Do movable sections move smoothly when operated manually or electromagnetically?	All			
Detailed inspection	Life and function deterioration	Test (Test at Mitsubishi)	The following section indicates the overview of the sampling tests for the items requiring further inspection during the life margin estimation, daily inspection and periodic inspection.					
			Contact contamination	(1) Contact resistance measurement – Existence of contact resistance abnormality				
			Mechanism friction	(2) Operation test – Existence of operating voltage abnormality				
			Layer short circuit	(3) Coil characteristics test – resistance value, current value, and existence of abnormality	Sampling			
			Contact wear	(4) Main dimension measurement – Is value within tolerable value?				
			Contact operation	(5) Contact reliability test – Is value within tolerable value? (reliability test)	Sampling			
			Life margin	(4) Coil life margin test (high temperature continuity, surge test, BDV pin hole test)	Sampling			

7. Troubleshooting List


Trouble	State	Cause	Measures	
Contacts do not close.	A beating sound (loud or quiet) is heard, but contacts do not close.	The coil rating voltage is incorrect.	Replace the correct entire unit.	
		The terminal voltage is low (85% or less).	Modify to the specified voltage.	
		The voltage drop is large	<ul style="list-style-type: none"> Power supply capacity is insufficient. Wiring capacity is insufficient. 	Increase the power supply capacity. Use thicker wires.
		Layer short circuit in coil.	Replace the entire unit.	
		The unit is damaged.	Replace the entire unit.	
	There is no sound.	The wiring is faulty.	Repair the faulty section.	
		Fault in operating switch.	Replace the switch.	
		The fuse is blown.	Replace the fuse.	
		Wire breakage in operating coil or short circuit in operating circuit.	Replace the entire unit.	
Contacts do not open. (Does not return.)	It does not get de-excited.	A voltage is applied on the coil.	Check and modify the circuit.	
		Capacitance between wires for long-distance wiring.	Use a DC operated type.	
		Induction voltage from other wires.	Separate from the other wires.	
		Fault in operating switch	<ul style="list-style-type: none"> Welding Breakage 	Check that the capacity is correct, and replace if necessary. Replace the switch (relay).
	There is no excitation.	The contact is welded.	Replace the entire unit, check the cause, and take measures.	
		Dew has condensed on iron core surface.	Decrease the temperature difference.	
		Attraction due to residual magnetism.	The unit is worn. Replace the entire unit.	
		The unit has deformed due to heat or mounting stress.	Replace the entire unit.	
		The unit is damaged.	Replace the entire unit.	
Coil burning	Burned in short time	The coil rating voltage is incorrect.	Replace with the unit having the correct rating.	
		The applied voltage is incorrect (high).	Replace the entire unit, and modify the voltage.	
		Operating voltage is low, thereby inhibiting attraction.	Replace the entire unit, and modify the voltage.	
		Layer short circuit		
	Burns after a while	Attraction is not possible occasionally (when voltage is 85% or less, etc.)	Replace the entire unit, check the cause, and take measures.	
		Layer short circuit caused by environmental deterioration.	Replace the entire unit, check the cause of deterioration, and take measures.	
		The applied voltage is too high.	Replace the entire unit, and modify the voltage.	
		The in-panel temperature is too high. (55°C or more)	Replace the entire unit, and set the coil temperature to 140°C or less. (Lower the in-panel temperature.)	

Trouble	State	Cause	Measures
Contact welding	No-fuse breaker or fuse blew	Short circuit on load side <ul style="list-style-type: none"> ┌ Insulation deterioration ├ Wiring failure └ Handling mistake Simultaneously closing when using reversing or Δ - Δ starter.	Check the cause and make modifications. If there is a fault with the unit, replace the unit.
	Light welding occurred during use	Chattering occurs.	Check the cause and make modifications.
		The switching frequency is too high.	Lower the frequency or increase the capacity.
		A semi-attraction state is caused by a drop in voltage.	Check and remove the cause of the voltage drop.
		Electrical life	If there is no fault in the unit, replace the entire unit.
	The load is too large.	Replace with a magnetic contactor and motor having the correct capacity.	
Abnormal wear of contact	Arc during switching is large.	The load is too large.	Replace with a magnetic contactor having a large capacity.
		The switching frequency is high.	Select a capacity that matches the frequency.
		The bounce at closing is large.	Check the cause and make modifications.
	The contact's brazed section has fallen off.	The contact chattering is large.	Check the cause and make modifications.
		The switching frequency is too high.	Lower the frequency, or replace with a part having a large capacity.
	The wear is fast.	There is corrosive gas.	Modify the case or installation position.
Simultaneous contact does not take place.		Set to approx. 0.5mm or less.	
Contact failure	Low voltage, low current	Set to 100V 50mA or more if possible. Connect the contacts in parallel (redundancy).	
	The mechanism section is damaged.	Replace the entire unit.	
Terminal burning	Burning of terminals or wires	The terminals were not tightened.	Replace the entire unit. Correctly tighten the screws.
		The terminal screws were not tightened sufficiently.	
		The screws were loosened by vibration or impact.	Prevent vibration and impact.
		The wires are thin.	Replace the wires and entire unit.
		Contact welding or wear (life).	Replace the entire unit.
A beating sound is heard.	The sound is heard occasionally	The core is worn. (The life is up.)	Replace the entire unit.
		The power supply voltage is low.	Check the cause and make modifications.
		There are high levels of corrosive gas or humidity.	Use a DC operated or mechanical latch that prevents entry from external sources.

Trouble	State	Cause	Measures	
A beating sound is heard.	The sound is always heard.	The shading coil has a breakage (life).	Replace the entire unit.	
		Incorrect mounting or distortion of mounting surface.	Change to correct mounting.	
		The coil voltage is incorrect. (Low voltage)	Replace with the entire unit having the correct coil rating.	
		The core is worn. (The life is up.)	Replace the entire unit.	
		Resonance during panel mounting.	Change the mounting structure.	
		Mechanical interlock	Readjust or replace the mechanical interlock.	
	Sound is heard at main circuit section.	A large current is flowing.	Measure the current and remove the cause.	
		The wiring in the enclosure has been separated.	Pass the input and output wiring through the same hole when wiring.	
The thermal overload relay trip.	Trips frequently.	The load is large.	Use a correct load.	
		The switching frequency is too high.	Re-select according to the frequency.	
		The vibration and impact during use is large.	Change the mounting method or place.	
		The relay scale setting is incorrect.	Set to the correct scale.	
		The relay current capacity selection is incorrect.	Replace with the correct current capacity.	
	Occurs when starting.	The starting time is long. (10 s or more)	Re-select the relay, or mount a saturable reactor.	
		The starting current is large.		
		The application is incorrect. (Y-Δ, pole number change, etc.)	Re-select for the correct application.	
		The ambient temperature has risen.	Compensate for the temperature, or change the mounting position.	
		The load is inconsistent.	Correct the load or re-select the motor.	
The thermal overload relay does not function.	-	The relay capacity selection is incorrect.	Re-select the correct rating.	
		The relay scale setting is incorrect.	Set correctly.	
		The relay is damaged.	Replace the relay.	
		The motor has a special structure.	Replace with a special thermal overload relay.	
		The reset bar is being pressed by something.	Remove the obstruction.	
		The resetting is repeated in a short time.	Review the motor capacity.	
		Contact welding (short circuit in the circuit).	Replace the relay.	
		Fault in the magnetic contactor.	Replace the magnetic contactor.	
		The wiring is incorrect or faulty.	Repair the faulty section.	
		Heater fused	A short circuit current flowed.	Replace the relay and improve the protection balance.
	The wiring is incorrect or faulty.		Replace the relay and repair the faulty section.	
	The thermal overload relay cannot be reset.	-	The relay is reset too early.	Wait for the relay to cool before resetting.
			The contacting of the contact is faulty.	Replace the relay.
The wiring is faulty.			Repair the faulty section.	

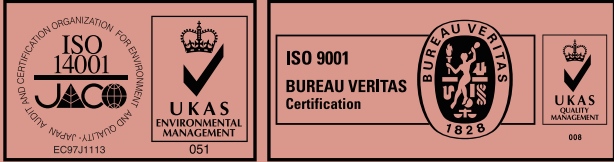
Magnetic Contactors and Magnetic Starters

INSTRUCTION MANUAL

 **Safety Warning**

To ensure proper use of the products listed in this catalog,
please be sure to read the instruction manual prior to use.

Mitsubishi Electric Corporation Nagoya Works is a factory certified for ISO14001 (standards for environmental management systems) and ISO9001 (standards for quality assurance management systems)



 **for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.



MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
www.MitsubishiElectric.co.jp/melfansweb