WELTOUCH®

CT-110E

OPERATION MANUAL

AMADA®

OM1211284
CT-110E-E01-202309

Preface

Thank you for purchasing our product.

- This operation manual describes the proper method of operation, as well as precautions for its use. If you have any questions concerning operation of the controller, read this operation manual.
- Read this operation manual carefully to ensure the proper use of all functions. Keep this operation manual in a safe place for future reference.
- After unpacking the weld control, first confirm that it is not broken and that all accessories are included. If any portion is broken or an accessory is missing, immediately notify your dealer or our sales representative.

Notice

(1) This manual may not be copied, in whole or in part, without our permission.
(2) The contents of this manual are subject to change without notice.
(3) If you have any questions concerning the contents of this manual or find any errors or omissions in it, please notify us.
(4) We will not be liable for problems caused by improper use of this product.

Contents

1. Special Notes

(1) Safety Precautions

Prior to use, read these "Safety Precautions" carefully to gain a full understanding of the proper method of use.

- **The precautions listed here are designed to ensure safe use and proactively prevent risks and damage to the user and other people.**
  All precautions are critical for safety.
  Please read them all.
- **The hazard signs have the following meanings:**

⚠ DANGER

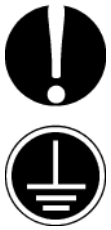
Indicates a **high risk of death** or serious injury if **precautions** are not correctly observed.

⚠ WARNING

Indicates a **risk of death** or serious injury if **precautions** are not correctly observed.

⚠ CAUTION

Indicates a **risk of physical** injury or damage to product if **precautions** are not correctly observed.

	**These symbols indicate "prohibition." They are warnings concerning actions out of the scope of the warranty of the product.**
	**These symbols indicate actions that operators must take.**
	**Each symbol with a triangle indicates a DANGER, WARNING, or CAUTION to the operator.**

⚠ DANGER

Do not touch the inside of the Controller unnecessarily.

Burns or electric shock may result. Do not touch the inside of the Controller other than for maintenance as described in the operation manual.
In the event of a problem, contact our serviceperson for internal inspection and repair.

Never disassemble, repair or modify the Controller.

These actions can cause electric shock and fire. Do not do anything other than the maintenance described in the operation manual.

Never burn, destroy, cut, crush or chemically decompose the Controller.

This product incorporates parts containing gallium arsenide (GaAs).

⚠ WARNING

Do not insert your fingers or hands between the electrodes.

When welding, keep your fingers and hands away from the electrodes.

Do not touch any welded part or electrode during welding or just after completion of welding.

The welded parts of a workpiece, electrodes, and the arm are very hot.
Do not touch them; burns may result.

Ground the Controller.

If the Controller is not grounded, electric shock may result.

Do not expose to water or other liquid.

Exposing electrical components to water or other liquid may result in electric shock or short-circuiting.

Apply the specified supply voltage.

Application of a voltage outside the specified range may result in fire or electric shock.

Use only the specified cables.

Use of a cable of insufficient capacity may result in fire.

Do not damage the power cable or connecting cables.

Do not walk on, twist, or pull on any cable.
The power cable and connecting cables may be broken, and that can cause electric shock, short circuits and fire.
If any part needs to be repaired or replaced, consult us or your distributor.

Stop the operation if any trouble occurs.

Continuous operation after occurrence of a trouble such as burning smell, abnormal sound, abnormal heat, smoke, etc. can cause electric shock and fire. If such a trouble occurs, immediately consult us or your distributor.

Persons with pacemakers must stay clear of the welding machine.

A person who uses a pacemaker must not approach the welding machine or walk around the welding shop while the welding machine is in operation, without being permitted by his/her doctor. The welding machine generates a magnetic field and has effects on the operation of the pacemaker while it is turned on.

Protective gear must be worn.

Put on protective gear such as protective gloves, long-sleeve jacket, leather apron, etc. Spatter can burn the skin if they touch the skin.

Wear protective glasses.

If you look at the flash directly during welding, your eyes may be damaged.
If any spatter gets in your eye, you may lose your eyesight.

⚠ CAUTION

Always use a terminal cover.

Touching the terminal block directly may result in electric shock. Be sure to fit the block with a cover.

Connect the cables securely.

Improper connection of a cable may result in fire or electric shock.

Use proper tools (wire strippers, pressure wire connectors, etc.) for terminal treatment of the connecting cables.

Do not cut the wire conductor; fire or electric shock may result.

Install the Controller on a firm and level surface.

If the Controller falls or drops, injury may result.

Do not place any container of water or other liquid on the Controller.

If water or other liquid spills, insulation will deteriorate, which may result in electrical leakage and/or fire.

Keep combustible matter away from the Controller.

Spatter may ignite combustible matter. If it is impossible to remove all combustible matter, cover it with non-combustible material.

Do not cover the Controller with a blanket, cloth, etc.

Do not cover the Controller with a blanket, cloth, etc. while it is in use. The cover may be overheated and burned.

Do not use this Controller for any purpose other than welding.

Use of this Controller in a manner other than specified can cause electric shock and fire.

Use ear protectors.

Loud noises can damage hearing.

Keep a fire extinguisher nearby.

Keep a fire extinguisher in the welding shop in case of fire.

Maintain and inspect the Controller periodically.

Maintain and inspect the Controller periodically, and repair any damage nearby before starting operation.

(2) Precautions for Handling

Install the Controller securely on a firm and level surface, to ensure that it will not fall.

Do not install the Controller in the following locations:

Damp areas (where the humidity is above 90%), areas where chemicals are handled, dusty areas, areas near a high noise source, areas where water may condense, areas exposed to large amounts of vibration or shock, and areas where temperatures are above 45°C or below 0°C

Clean the exterior of the Controller using a soft, dry cloth or one slightly dampened with water. If the Controller is very dirty, use diluted neutral detergent or alcohol. Do not use paint thinner, benzine, etc., as they may discolor or deform the Controller.

Do not insert a screw, coin, etc. into the Controller, as they may cause a malfunction.

Operate the Controller in accordance with the method described in this operation manual.

Press switches/buttons carefully by hand. Handling them roughly (using a screwdriver or the tip of pen) may result in a malfunction or failure.

Press switches/buttons one at a time. Pressing more than one switch/button at a time may result in a malfunction or failure.

(3) On Disposal

This product incorporates parts containing gallium arsenide (GaAs). At the time of disposal, separate it from general industrial waste or domestic waste and carry out the disposal in accordance with applicable laws and regulations.

2. Features

The WELTOUCH **CT-110E** is a constant/alternating-current resistance weld control with a 15-schedule setting function. It is controlled by a microcomputer, allowing it to be applied to all types of welding. Due to the plating-layer treatment by the pre-stage current, heat treatment by the post-stage current, etc., splashing is prevented, the welding tip is protected from overheating, and an ideal welding current can be set. In addition, the **CT-110E** can be applied to all types of spot-welding machines by selecting the secondary-or primary-current feedback constant-current control and source-voltage fluctuation compensation method. The required items can be set very simply and easily. The **CT-110E** has a wide range of features, as explained below.

1) Indicates the welding current, schedule set No., set time, etc. with an LED.

2) Stores up to 15 schedules according to the materials and thicknesses of the workpieces to be welded.

3) Equipped with the 3-stage power-on system, and upslope and downslope functions.

4) Supplies a stable welding current by the primary and secondary constant-current control method and source-voltage fluctuation compensation method.

5) Has the welding mode applied to the high-tensile steel plate with a high initial resistance

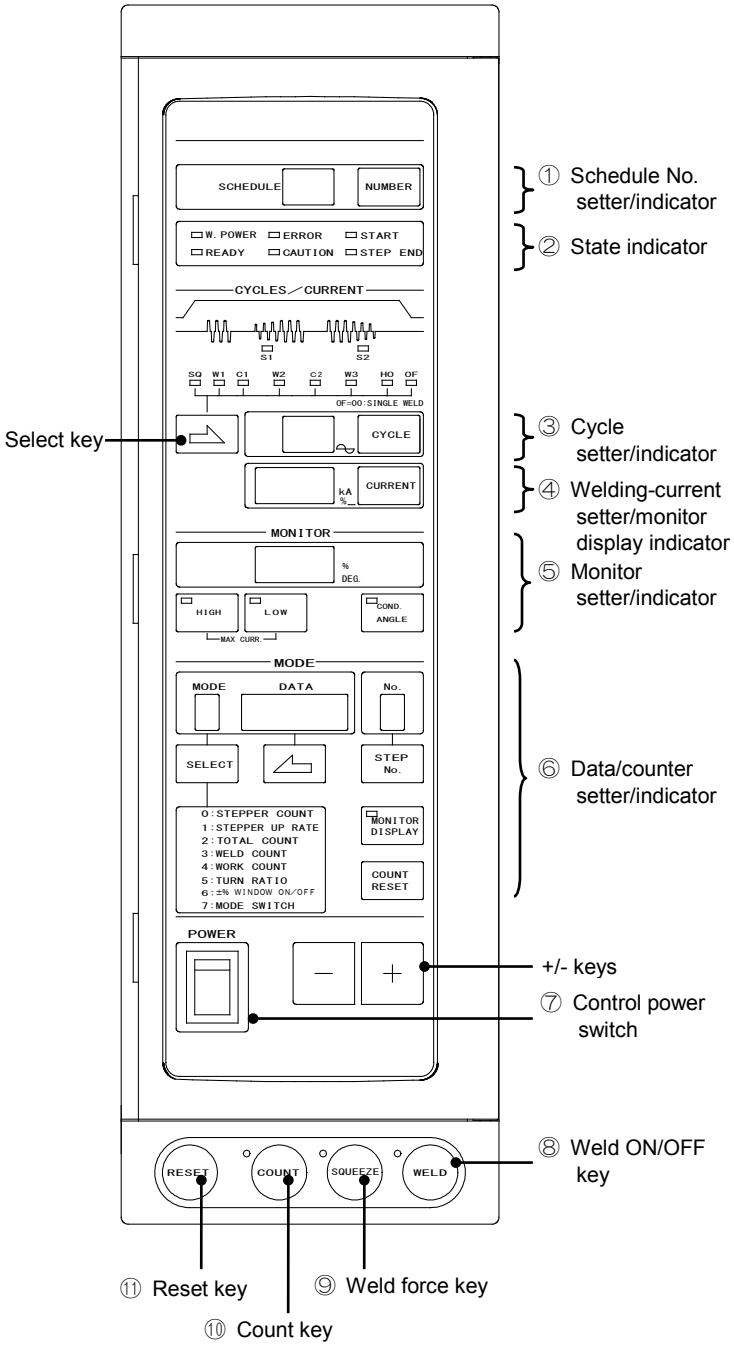
6) Includes functions for monitoring the current and conduction angle.

7) Comes with a cover to protect the touch panel from oil mist.

8) Has three counters to indicate the quantity of products, and other information.

3. Name and Function of Each Section

(1) Front Panel



① **Schedule No. setter/indicator [SCHEDULE]**
Calls a No. to input a schedule and indicates the schedule No.

② **State indicator**
Indicates the current state of the **CT-110E** for confirmation.

③ **Cycle setter/indicator [CYCLES]**
Sets and indicates the cycles of the weld sequence (Squeeze, Weld I, Cool I ---). Lights up the currently executed item to indicate the state during operation.

④ **Welding-current setter/measured-value indicator [CURRENT]**
Sets the welding current (Weld I, Weld II, Weld III) and indicates the measured current.

⑤ **Monitor setter/indicator [MONITOR]**
Sets the upper and lower limits of the set current on High and Low to 0-49%, and monitors the current fluctuation.

⑥ **Data/Counter setter/indicator [MODE]**
Counts the total number of welds, number of welds for a workpiece, and total number of products, and sets and indicates various pieces of data such as the stepper setting of the welding current, error codes, etc.

⑦ **Control power switch [POWER]**
Switch for supplying power to control the **CT-110E**

⑧ **Weld ON/OFF key [WELD]**
Turns welding on and off. Each time this key is pressed, welding is turned on and off alternately.
If this key is turned on, the LED at the upper left comes on; if this key is turned off, the LED goes off.
Press and hold this key for at least 0.5 seconds to turn off welding.
Even if this key is turned on, welding does not start if the external weld ON/OFF input is turned off.

⑨ **Weld-force key [SQUEEZE]**
Each time this key is pressed, the LED at its upper left comes on and goes off alternately. While the LED is lit up, the weld-force mode is selected and the weld force is applied while the start signal [START1,2,4,8] is turned on; however, the weld current does not flow. While the LED is turned off, the normal timer mode is selected.

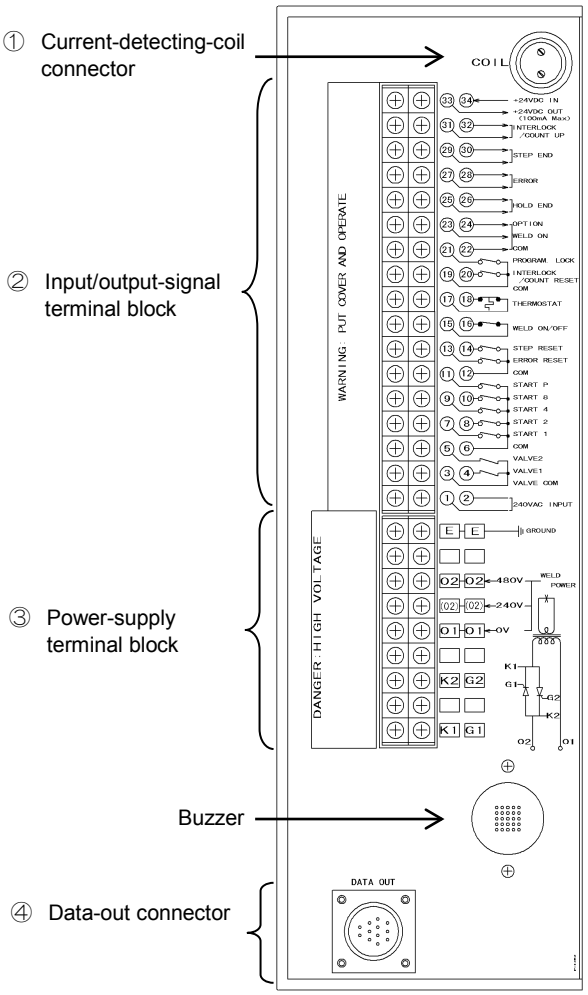
⑩ **Count key [COUNT]**
Each time this key is pressed, the LED at its upper left comes on and goes off alternately. While the LED is lit up, the weld-point counter and production counter can count. While the LED is turned off, the weld-point counter and production counter do not count.

Note: The STEPPER COUNTER and TOTAL COUNTER count regardless of whether the Count key is ON or OFF.

⑪ **Reset key [RESET]**
Functions as a release key in the event of a problem.

Note: This key cannot reset the counter.

(2) Rear Panel



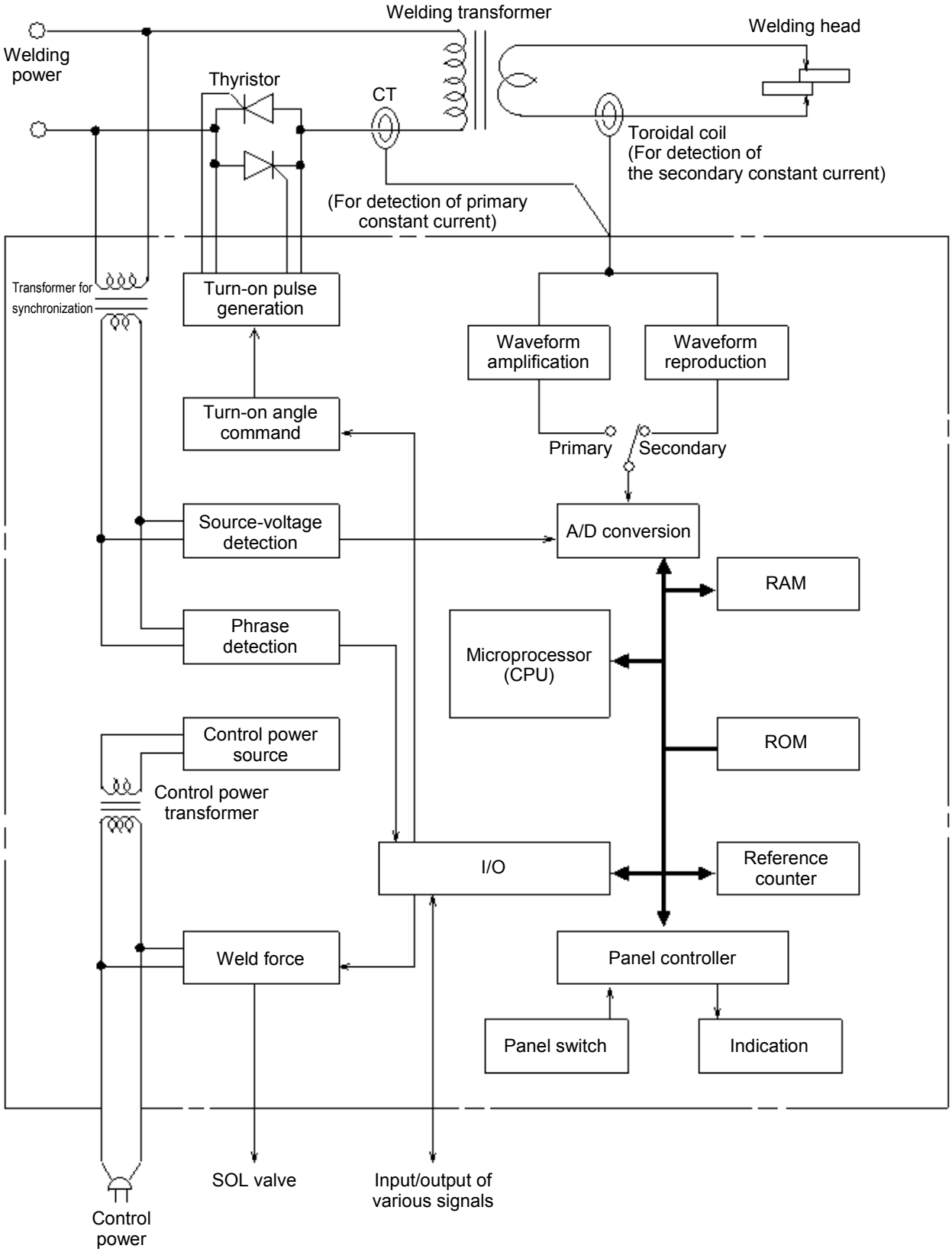
① **Current-detecting-coil connector [COIL]**
Connector for connecting the current-detecting coil (a toroidal coil or a CT coil) to measure the welding current

② **Input/output-signal terminal block**
Terminal block for inputting the start signal and outputting error signals, etc. The terminal size is M3.5.

③ **Power-supply terminal block**
Terminal block for connecting the power supply and the thyristor contactor. The terminal size is M3.5.

④ **[DATA OUT] connector**
Connector for outputting data

(3) Internal Block Diagram

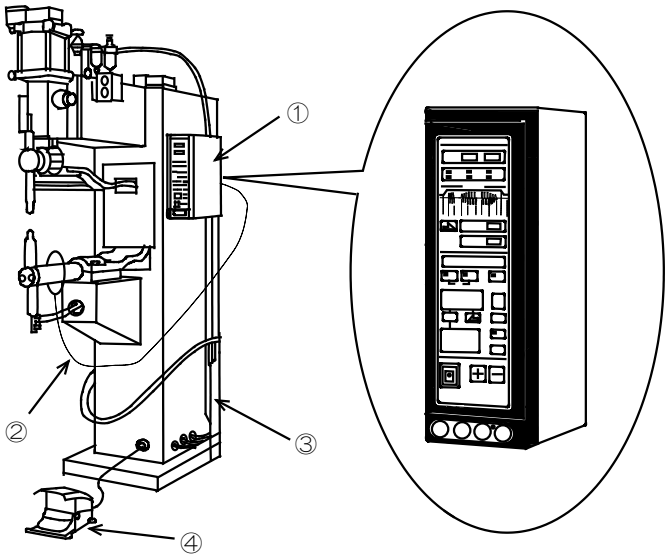


4. Connection

(1) Basic Configuration

1) The general system configuration of the **CT-110E** is as follows:

Example) Installation to stationary welder



① **CT-110E**
The body of the constant-current resistance welding control. Connect Control power to it.

② **Toroidal coil** (Option)
Installed to the stationary welding electrode arm. This is unnecessary in the primary constant current control.

③ **Thyristor contactor**
Connect a welding power source to this device. Normally, this device is built into the body of the welder.

④ **Foot switch**
Used to start up the **CT-110E**, which outputs signals to the welder in order to start welding.

2) Precautions for installation

① Confirm that the control is installed (fixed) securely at the specified locations.

② Confirm the welding power source. The voltages for this device are indicated below the terminal block.

③ Ground the control securely.

(2) Connection of Power Source

1) Connect the power source to the power-supply terminal block mounted on the rear panel.

① Connect the thyristor contactor to the power-supply terminal block on the rear panel of **CT-110E**, as shown below.

② Securely connect each wire. Take care not to mistake the Nos. of the wires.

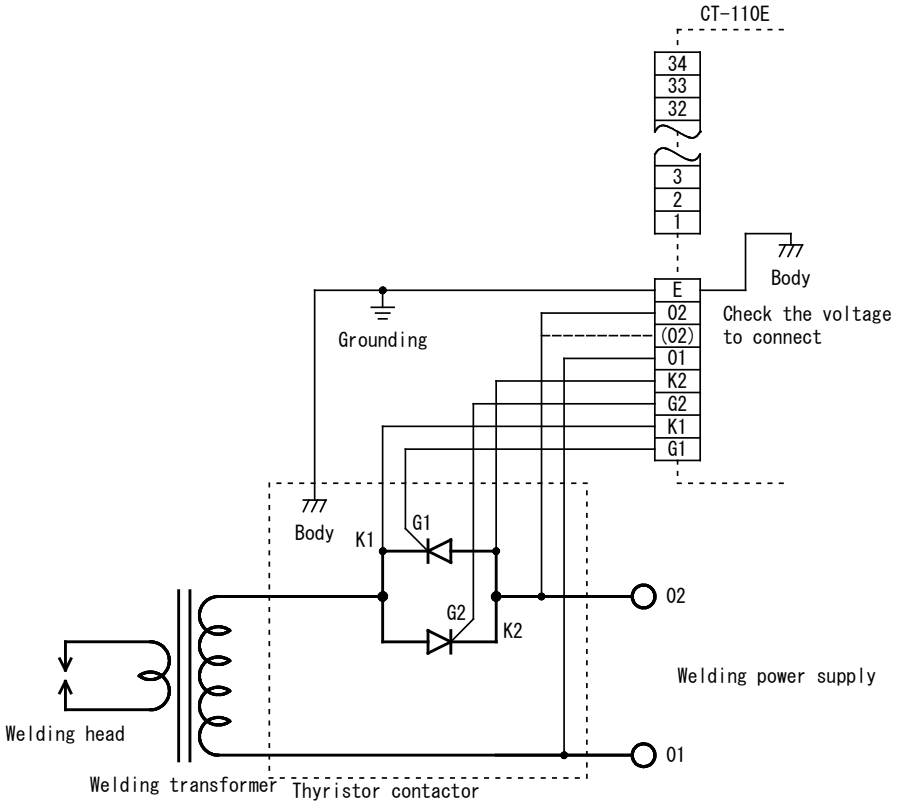
③ Connect to the terminal 02/(02) for the voltage you are using.

[Caution]

The connection of 01, (02) or 02 is important for the operation of the thyristor. If it is connected improperly (if 01 and (02) or 02 are connected inversely), a no-weld error (07) is indicated or the power is not supplied. Accordingly, perform connection properly and securely.
When no power-supply error is detected and the current does not flow even though the power is supplied correctly and **CT-110E** starts normally, make sure that 01 and (02) or 02 are not connected inversely.

④ Be sure to ground the control.
Ground the E terminal (grounding) of **CT-110E** in common with the grounding of the thyristor contactor.

Note: The thyristor contactor, welding transformer, welding head, and connecting cable are optional.



Connection diagram

(3) Installation Method for the Current-Detecting Coil

1) Installation Method for a Toroidal Coil

① Install the toroidal coil to the secondary side of the welding transformer.

If only one welding head is used, install the toroidal coil as shown below:

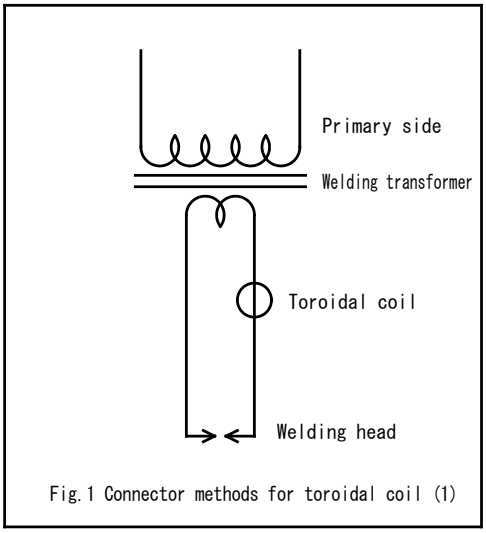


Fig. 1 Connector methods for toroidal coil (1)

If two or more welding heads are used, install the toroidal coil as shown below:

- When only one welding head welds at a time

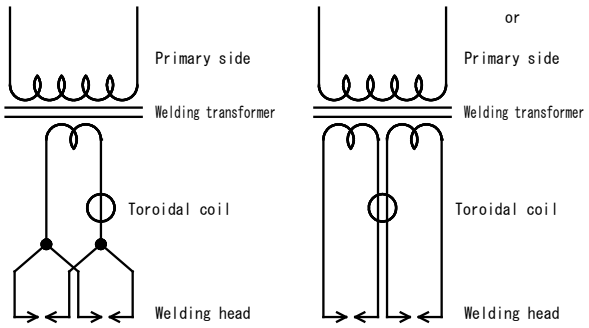


Fig. 2 Connector methods for toroidal coil (2)

- When two or more welding heads weld at a time

  The current of only one circuit is kept constant in this case.

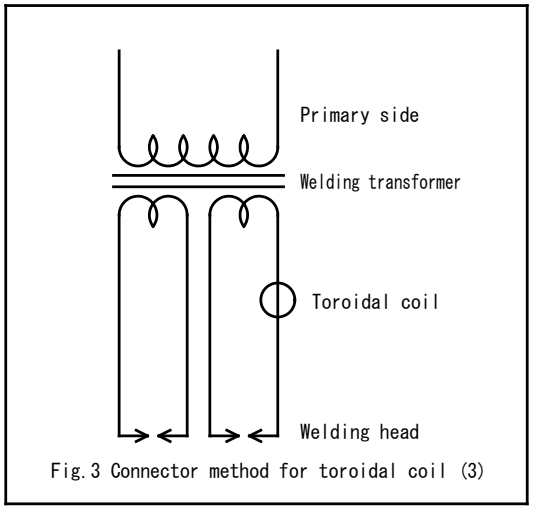


Fig. 3 Connector method for toroidal coil (3)

② Set dip switch DSW1-(2) to the OFF position (see page 4-7).

③ Precautions on installation of the toroidal coil

If the toroidal coil is broken in the constant-current control mode, no power-supply error is detected and the operation stops. A proper installation position must therefore be selected for the toroidal coil so that it will not be broken by the temperature rise of the conductor, mechanism motion, contact with a workpiece, or the like. In addition, secure the toroidal coil to the conductor using a band, etc. If the toroidal coil is wound onto the conductor as shown in Fig. 4-**A**, an error occurs. Accordingly, wind it as shown in Fig. 4-**B**.

Note: No power-supply error is detected in the source-voltage fluctuation compensation control mode.

Note: The thyristor contactor, welding transformer, welding head, and connecting cable are optional.

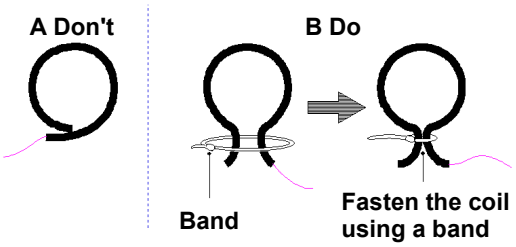


Fig. 4 Making a toroidal-coil loop

④ Checking for breakage and short-circuiting of the toroidal coil

Breakage of and shorts in the toroidal coil can be checked using a tester, as the toroidal coil has the internal resistance shown in Fig. 5.

(Keep in mind that the internal resistance changes depending on the type of toroidal coil.)

Toroidal coil	Internal resistance
MB-400L	35–65Ω
MB-45F	130–165Ω

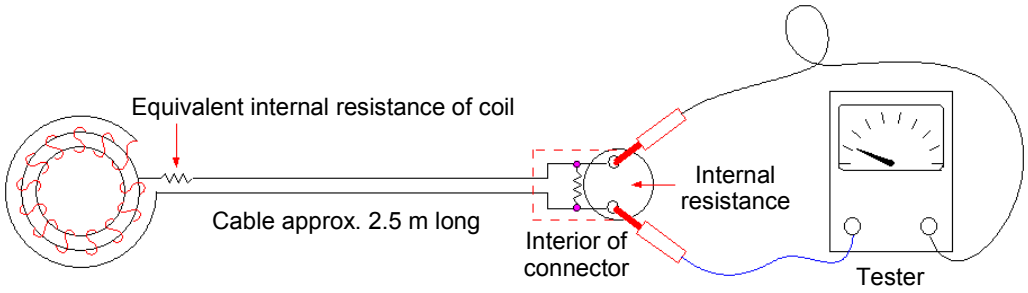


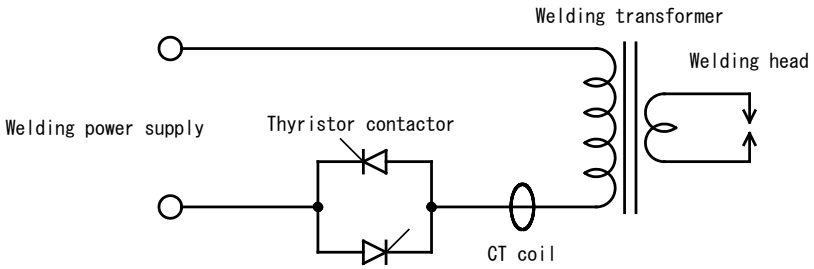
Fig. 5 Internal resistance of toroidal coil

[Caution]

The sensitivity of each toroidal coil is adjusted so that it will detect the current accurately. If the cable is cut halfway and extended, or if the connector is disassembled, the current cannot be kept constant. (When using the toroidal-coil remote, use a special extension cable.)

2) Installation Method for a CT Coil

① Install a CT coil to the primary side of the welding transformer.



② Set dip switch DSW1-(2) to the ON position (see page 4-7).

③ Precautions on use of a CT coil

Use a CT coil with a rated primary current of 600 A and a secondary current of 5 A. Connect a resistor of 0.2 Ω 10 W to its secondary side, then connect both ends to the **CT-110E** using special connector 14-2A (manufactured by KOMINE MUSEN ELECTRIC CORPORATION).

Note: The thyristor contactor, welding transformer, welding head, and connecting cable are optional.

Note: The model number of connector is subject to change without notice. Depending on the part to be changed, the mounting screw shape may change and a necessary tool may be different. For the latest parts information, contact a nearest sales office.

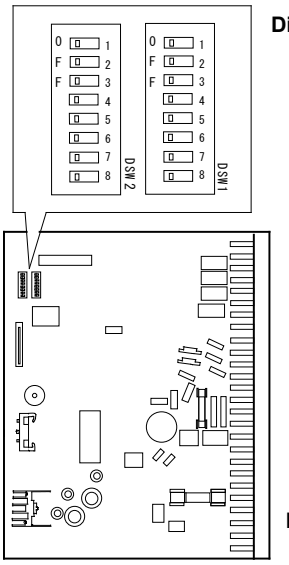
(4) Selecting of Functions

Functions are set using dip switches on the printed-circuit board.

[DANGER! High Voltage]

When removing the cover and setting the dip switches on the board, confirm that the welding power and control power are turned off to ensure safety.

(1) Initial setting of dip switches



Dip switches

Printed circuit board

Factory default setting of dip switches
(All are set to the OFF position.)

DSW1

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DSW2

1	2	3	4	5	6	7	8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

(2) Functions set using dip switches

DSW		ON	OFF
DSW1	1	Source-voltage fluctuation compensation control	Constant-current control
	2	Primary-current feedback	Secondary-current feedback
	3	Output of power-on state signal (Flicker)	Output of power-on timing signal
	4	Parity check---ON	Parity check---OFF
	5	Self-holding of start signal at squeeze	Self-holding of start signal at weld start
	6	Re-power-on---ON	Re-power-on---OFF
	7	Output of holding-finish-signal pulse	Output of holding-finish-signal level
	8	When there is a problem with the current monitor, the holding finish signal is not output and welding cannot be started again.	When there is a problem with the current monitor, a holding finish signal is output and welding can be started again.
DSW2	1	Pulsation function	Repeating function
	2	Interlock function --- ON	Interlock function --- OFF
	3	Start with the schedule No. on the panel.	Start with the external schedule No.
	4	4-schedule start	15-schedule start
	5	Output of data	No output of data
	6	1-cycle control	Half-cycle control
	7	Variable constant-current correction value	Fixed constant-current correction value
	8		Kept turned off

(3) Explanation of the functions of dip switches

① **DSW1-(1):** Selects the constant-current control or source-voltage fluctuation compensation control.
OFF: Constant-current control
ON: Source-voltage fluctuation compensation control

② **DWS1-(2):** Selects the primary current or secondary current to be detected in the constant-current control mode. If a coil is connected for full-wave detection in the source-voltage fluctuation compensation control mode, set this dip switch properly.
OFF: Secondary-current feedback
ON: Primary-current feedback

③ **DSW1-(3):** Selects the signal to be output to Pin 23 in the terminal block on the rear panel.
OFF: Output of the power-on timing signal
ON: Output of flicker
If this switch is set to OFF, the power-on timing signal is output from when Weld I starts until Weld III finishes, regardless of the Weld ON/OFF setting. If it is set to ON, the flicker signal is output only while the power is on during Weld I, Weld II, and Weld III. The power-on timing signal and the flicker signal are output from the power-on signal [WELD ON].

④ **DSW1-(4):** Sets the start-signal parity check function when the controller is started up in the 15-schedule mode
OFF: The parity check will not be conducted.
ON: The parity check will be conducted.
If this switch is set to OFF, the parity check will not be conducted. If it is set to ON, the parity check will be conducted. If a parity error is detected, a start input error signal (Error code [02]) will be output. Odd parity is checked. For details, see “(5) Input Method for Start Signals, 2)” on page 4-11.

⑤ **DSW1-(5):** Selects the self-holding timing for the start signal.
OFF: Self-holding of the start signal at weld start
ON: Self-holding of the start signal at squeeze
If this dip switch is set to OFF, the start signal is held when welding (Weld I) starts. If it is set to ON, the start signal is held when the initial weld force (Squeeze) starts.

⑥ **DSW1-(6):** Sets so that the power will or will not be supplied again when the lower current limit is detected or no current flows.
OFF: Re-power-on --- OFF
ON: Re- power- on --- ON
If this dip switch is set to OFF, power is not supplied again. If it is set to ON, current increased by 5 % is supplied (see"4) Timing chart of re-power-on operation" on page 5-7).

⑦ **DSW1-(7):** Selects the length of time for which the holding finish signal is to be output.
OFF: Output of the holding-finish-signal level
ON: Output of the holding-finish-signal pulse
If this dip switch is set to OFF, the holding finish signal [HOLD END] is output for approximately 0.2 seconds, or while the start signal is being input. If the former is set to ON, the latter is output for 0.2 seconds.

⑧ **DSW1-(8):** Selects the action to be taken in the event of a current monitor error.
OFF: When there is a problem with the current monitor, a holding finish signal is output and welding can be started again.
ON: When there is a problem with the current monitor, a holding finish signal is not output and welding cannot be started again.

⑨ **DSW2-(1):** Selects the pulsation function or repeating function.
OFF: Repeating function
ON: Pulsation function
If this dip switch is set to OFF, the repeating function is selected and, when the weld sequence [OF] LED on the front panel is selected, the [CYCLE] key is used to set the off time in the repeating mode (see 2) on page 5-5). If the dip switch is set to ON, the pulsation function is selected and, when the weld sequence [OF] LED on the front panel is selected, the [CYCLE] key is used to set the number of pulsations (see 1) on page 5-4).

⑩ **DSW2-(2):** Selects ON or OFF of the interlock function.
OFF: Interlock function --- OFF
ON: Interlock function --- ON
If this dip switch is set to OFF, the interlock function is turned off. In such a case, the INTERLOCK/COUNT RESET is used to input the count reset signal [COUNT RESET], and the INTERLOCK/COUNT UP is used to output the count-up signal [COUNT UP] (see 3) on page 5-6). If the dip switch is set to ON, the interlock function is selected. In such a case, the INTERLOCK/COUNT RESET is used to input the interlock signal [INTERLOCK], and the INTERLOCK/COUNT UP is used to output the interlock signal [INTERLOCK].

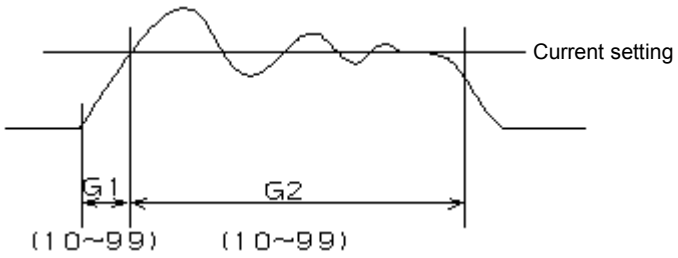
⑪ **DSW2-(3):** Selects a schedule No.
OFF: Start with the external schedule No.
ON: Start with the schedule No. on the panel.
If this dip switch is set to OFF, a schedule No. is selected and the operation starts upon reception of start signal [START 1, 2, 4, and/or 8] from outside.
If the dip switch is set to ON, the operation starts upon reception of a start-signal No. selected using the panel. The schedule can be changed by pressing the SCHEDULE [NUMBER] key.
An external start signal is only for starting welding; the schedule cannot be selected.

⑫ **DSW2-(4):** Selects start in 4-schedule start mode or 15-schedule start mode upon reception of an external start signal.
OFF: 15-schedule start mode
ON: 4-schedule start mode
If this dip switch is set to OFF, 15 schedules made by combining start signals [START 1, 2, 4, and/or 8] are selected. If the dip switch is set to ON, the lowest-numbered start signal among 1, 2, 4, and 8 that is on 20 ms after the first start signal is turned on, is selected.

⑬ **DSW2-(5):** Selects Data Out
OFF: Does not output data
ON: Outputs data
The data-out function is optional. Set this switch to the OFF position when this option is not provided.

⑭ **DSW2-(6):** Selects the control speed in constant-current control
OFF: Half-cycle
ON: 1 cycle

⑮ **DSW2-(7):** Sets the correction value for the constant-current control, or sets it so as to be variable.
OFF: Fixed constant-current correction value
ON: Variable constant-current correction value
This switch should normally be in the OFF position. When the weld control is used with a single-phase welding machine, it is rare for the welding current to rise abnormally to overshoot or for an extremely slow rise-up to occur. In such case, set this switch to the ON position in order to make variable the constant-current correction value. When setting DSW2-(7) to ON, Mode Nos. 8 and 9 are selectable on the panel. Set the correction value for the initial rise (G1) in Mode No. 8 (a larger setting provides a larger amount of correction). Set the correction value for the interval (G2) in Mode No. 9 after the current exceeds the current setting (a larger setting provides a larger amount of correction). When there is a big difference between currents on the plus side and the minus side (the currents are not balanced), set DSW2-(6) to ON (1 cycle).



Shipped at G1 = 50, G2 = 50

(5) Input Method for Start Signals

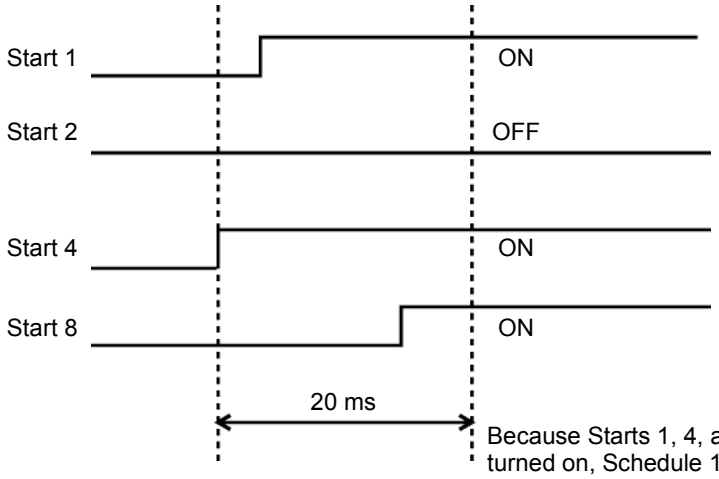
1) When the operation is started in the 15-schedule start mode and the parity check of the start signal is not performed (when DSW-1(4) is set to OFF).

Select up to 15 schedules by inputting the four signals of Start 1, Start 2, Start 4, and Start 8 in Binary Format.

Schedule	Start 1	Start 2	Start 4	Start 8
1	●			
2		●		
3	●	●		
4			●	
5	●		●	
6		●	●	
7	●	●	●	
8				●
9	●			●
10		●		●
11	●	●		●
12			●	●
13	●		●	●
14		●	●	●
15	●	●	●	●

●.....ON
Blank.....OFF

Timing chart for inputting the start signals (when selecting Schedule 13)



The schedule 20 ms after the first input of the start signals is selected.

2) When the operation is started in the 15-schedule start mode and the parity check of the start signal is performed (when DSW-1(4) is set to ON).

Select up to 15 schedules by inputting the four signals of Start 1, Start 2, Start 4, and Start 8 in Binary Format and Start P (Parity).

Schedule	Start 1	Start 2	Start 4	Start 8	Start P
1	●				
2		●			
3	●	●			●
4			●		
5	●		●		●
6		●	●		●
7	●	●	●		
8				●	
9	●			●	●
10		●		●	●
11	●	●		●	
12			●	●	●
13	●		●	●	
14		●	●	●	
15	●	●	●	●	●

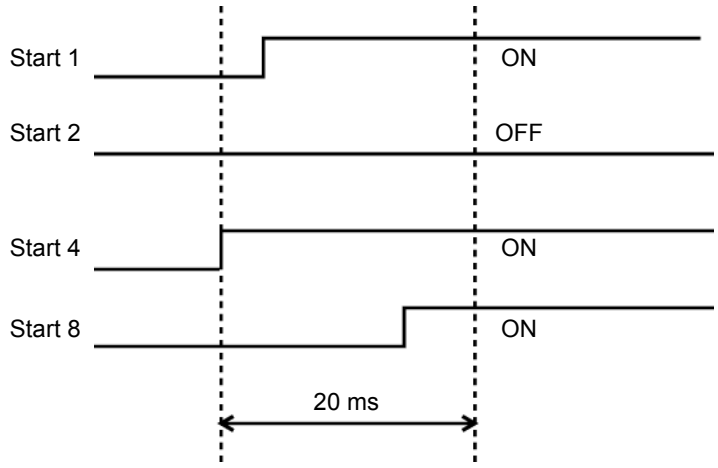
● .....ON (Turn on so that the number of black points, including Start P, will be odd.)
Blank ....OFF

The odd parity is checked. At startup, combine the signals so that the number of Start 1, Start 2, Start 4, Start 8, and Start P signals to be input will be odd. If the number of input signals is even, a start-signal error (Error code [02]) will be output.

3) When the operation is started in the 4-schedule start mode (DSW2-(4) is set to ON)

The start signal will be the lowest-numbered of the signals that are on 20 ms after the first start signal is turned on.

Example)

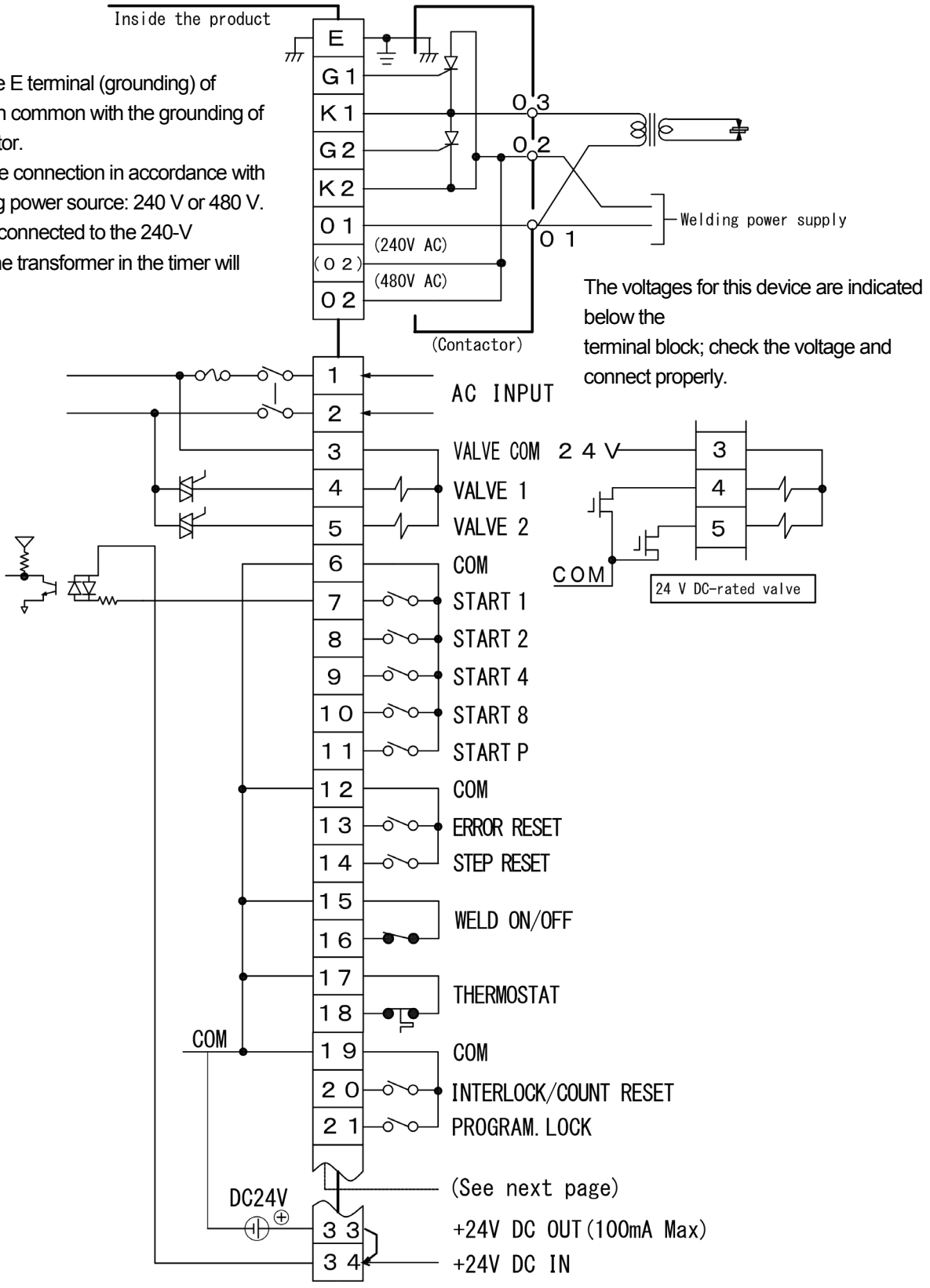


Start 1, Start 4, and Start 8 are on 20 ms after Start 4 is turned on. Accordingly, Start 1, which is the lowest-numbered, is selected.

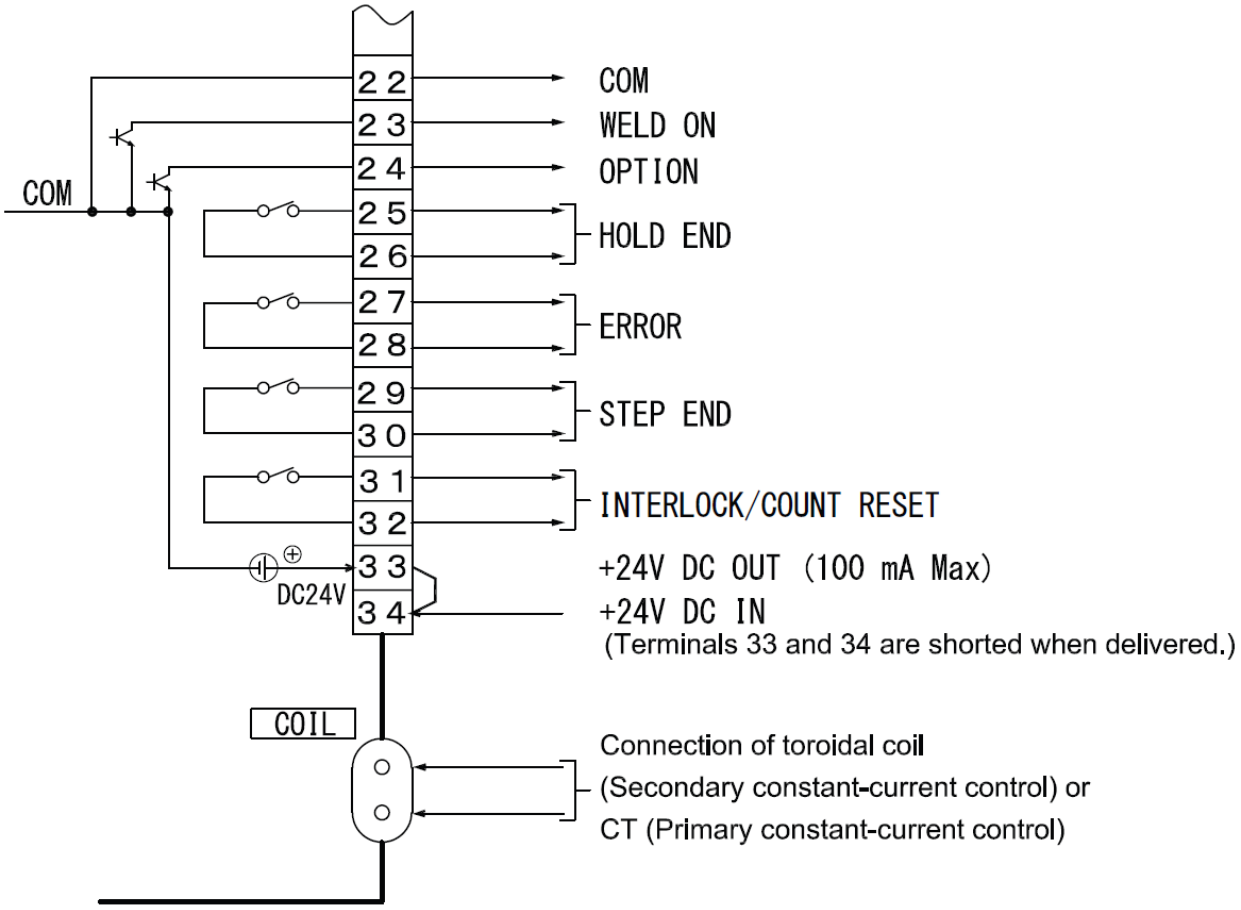
5. Interface

(1) External Input and Output Signals

Ground the E terminal (grounding) of CT-110E in common with the grounding of the contactor.
Change the connection in accordance with the welding power source: 240 V or 480 V.
If 480 V is connected to the 240-V terminal, the transformer in the timer will burn out.



The voltages for this device are indicated below the terminal block; check the voltage and connect properly.



1) Explanation of external input and output signals

Name	Description
E	Ground the E terminal (grounding) in common with the grounding of the contactor.
G1,K1,G2,K2	Connect to each gate terminal of the contactor (thyristor).
O1,(O2),02	The voltage for this equipment are indicated on the terminal block seal, check the voltage and connect properly. O1-(O2) : 240V AC O1- O2 : 480V AC

(Note) Incorrect connection of 480VAC to (O2) may cause equipment failure.

Pin No.	Name	Description
1, 2	AC INPUT	Terminal for inputting control power supply. The voltage for this equipment are indicated on the terminal block seal, check the voltage and connect properly.
3	VALVE COM	Common terminal for valve output Output +24V when 24 V DC-rated valve is selected.
4,5	VALVE 1 VALVE 2	Output terminal for Valve 1 (Schedules 1-7) Output terminal for Valve 2 (Schedules 8-15) [Connection for using 15-schedule mode with a single solenoid valve] When using 15-schedule mode with a single system for a weld force valve, short out pins 4 and 5 and

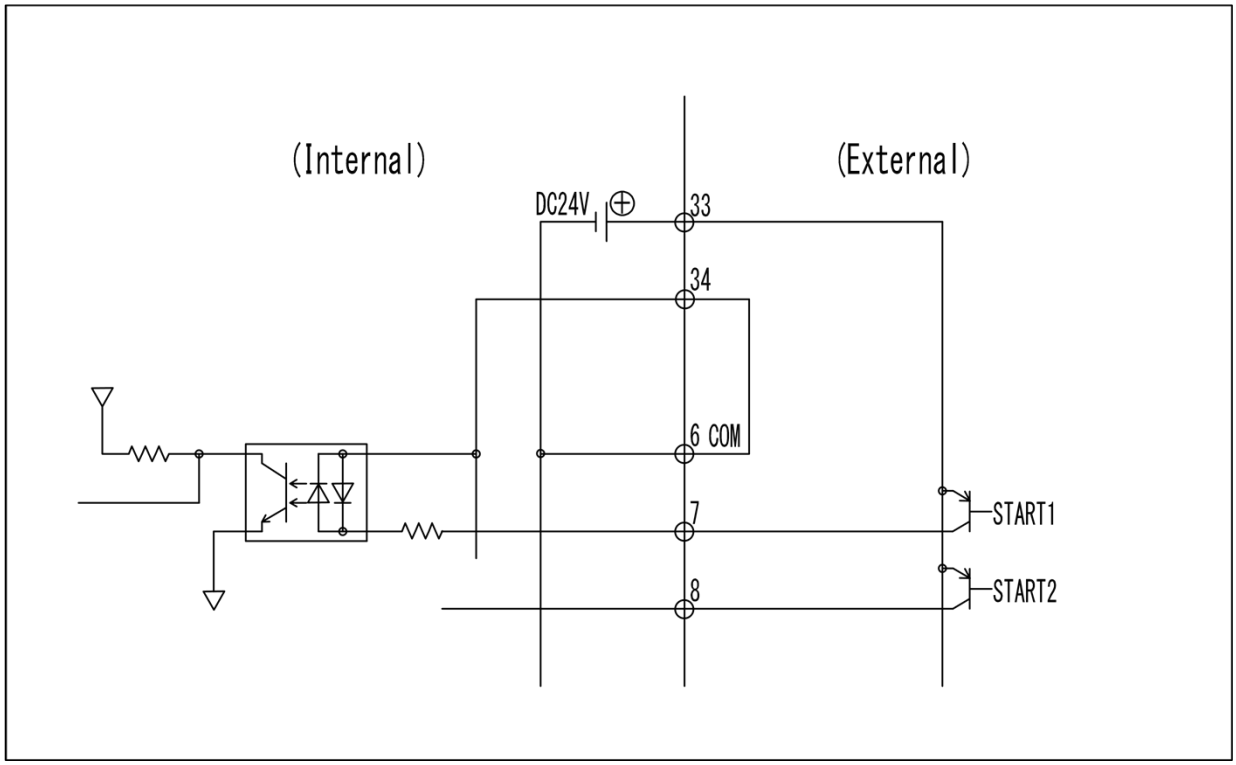
		connect to the solenoid valve.
4,5	VALVE 1 VALVE 2	Outputs AC or DC 24V from the valve number (4: VALVE1, 5: VALVE2) selected from the start input until the end of HOLD.
6	COM	Common terminal. Connected to 0V side of the internal power supply (24V DC).
7 – 11	START 1, START 2, START 4, START 8, START P	・Schedule No. selection signal. ・Schedule No. from 1 to 15 can be selected, in the dip switch setting at shipment from the factory. So input in binary. ・By changing the dip switch settings, it is possible to start with 4 schedule, and start by selecting the schedule No. panel. For details, see "4. Connection (4) (3)Explanation of the functions of dip switches ⑪DSW2-(3)/⑫DSW2-(4)".
12	COM	Common terminal. Connected to 0V side of the internal power supply (24V DC).
13	ERROR RESET	ERROR RESET input terminal. If this is turned on, the error output is reset.
14	STEP RESET	STEP RESET input terminal. If this is turned on, the step completion output is turned off, and the system returns to the first step No.
15, 16	WELD ON/OFF	WELD ON/OFF input terminals If these are ON, welding is enabled; if they are OFF, welding is disabled. Shorted when shipped. Remove it according to the input signal connection method.
17, 18	THERMOSTAT	THERMOSTAT input terminals Connect to the thermostat in the transformer. If this is OFF, a thermostat error signal is output. Shorted when shipped. Remove it according to the input signal connection method.
19	COM	Common terminal. Connected to 0V side of the internal power supply (24V DC).
20	INTERLOCK/ COUNT RESET	INTERLOCK/COUNT RESET input terminal. Input the interlock signal to this terminal when the interlock function is selected. Input the weld-count reset signal when the interlock function is not selected.
21	PROGRAM.LOCK	Terminal for input of PROGRAM LOCK signal If this is OFF, the weld schedule can be changed; if it is ON, the schedule cannot be changed.
22	COM	Common terminal. Connected to 0V side of the internal power supply (24V DC).

Pin No.	Name	Description
23	WELD ON	WELD ON output terminal (Open collector) The output signal depends on the position of internal dip switch DSW1-(3). When the dip switch DSW1-(3)is ON: The signal is output while the power is turned on (Weld I, II, III). Connect to the flicker device. When the dip switch DSW1-(3) is OFF: The signal is output output from the start of (WELD I) to the end of final (WELD III) (It is also output when welding is stopped.) *COOL is not output when DSW1-(3) is ON, and COOL is output when it is OFF.
24	OPTION	Optional output (Open collector)
25, 26	HOLD END	Terminals for output of the HOLD END signal Output upon completion of the hold time. (*)
27, 28	ERROR	Terminals for output of the ERROR signals Output when an error is made. (*)
29, 30	STEP END	Terminals for output of the STEP END signal Output upon completion of the last step. (*)
31, 32	INTERLOCK/ COUNT UP	Terminal for the output of interlock/count-up signals. When the interlock function is turned on, the interlock signal is output. When the interlock function is turned off, the count-up signal is output.
(*) Contact output terminal (contact rating DC24V 20mA) by semiconductor relay. CT-110D and earlier are relay contacts and have different specifications.		
33	+24 V DC OUT	+24V DC output terminal (dedicated for CT-110E) This terminal supplies +24V power to the input/output signal circuit. At shipment, it is compatible with NPN connection that uses the internal power supply by connecting to the 34th terminal (+24V input terminal) in advance. Remove the connection according to the application. Do not use this power supply for other purposes.
34	+24 V DC IN	+24V DC input terminal When connecting NPN, input +24V to pin 34. Use an external power supply, or PNP connections, remove the connect with pin 33. For PNP connection, connect the 0V (COM) side. In this case, indication and content are different.

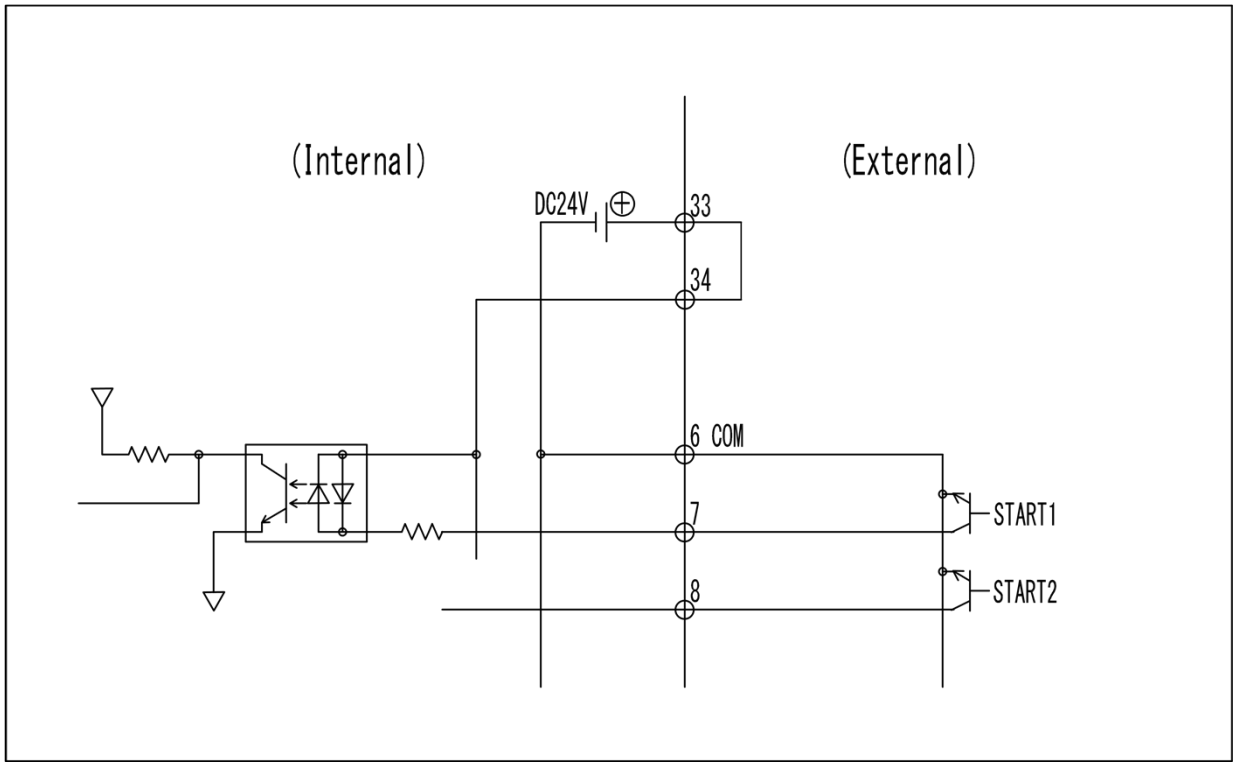
2) Connection of input signals

Wire according to the using PLC(programmable logic contoroller) to be used by referring to ① to ④ . Since terminals 33 and 34 are short-circuited at shipment, remove the short-circuit wire in the cases of ①, ③, and ④.

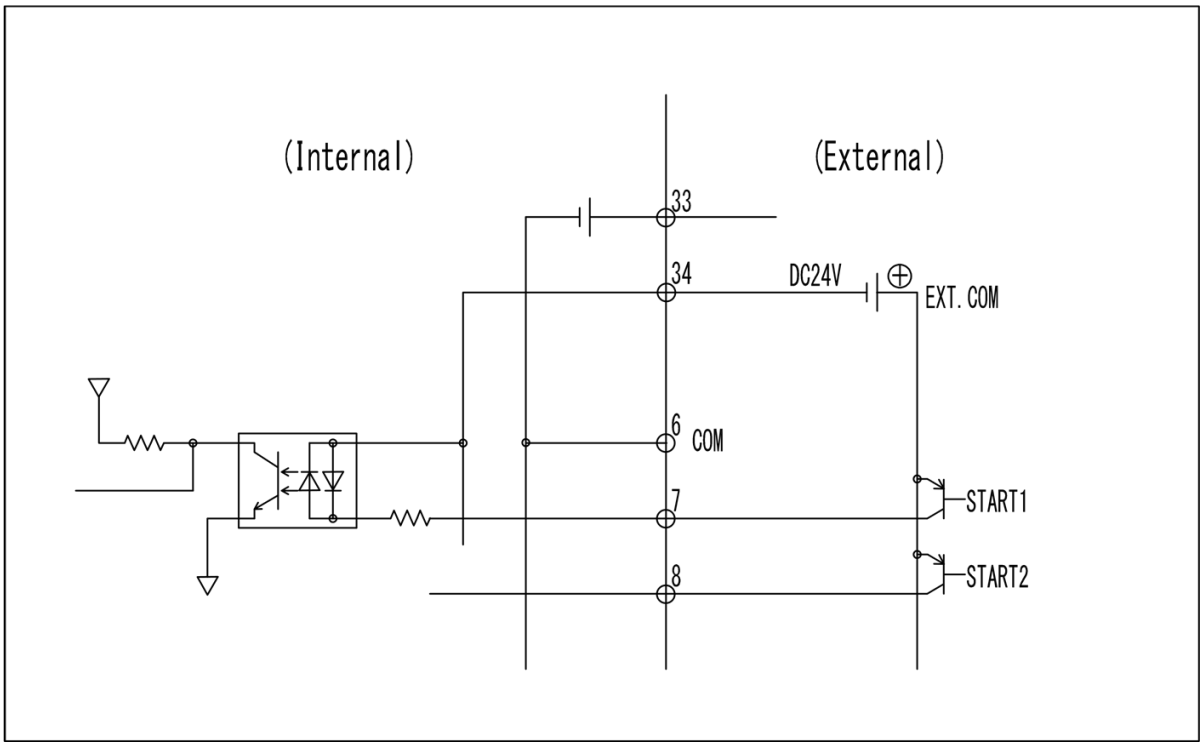
①When connecting to a PNP current output type PLC (when using an internal power supply)
Connect terminal 33 to the emitter side of the PLC and short circuit terminal 34 to the common terminal.



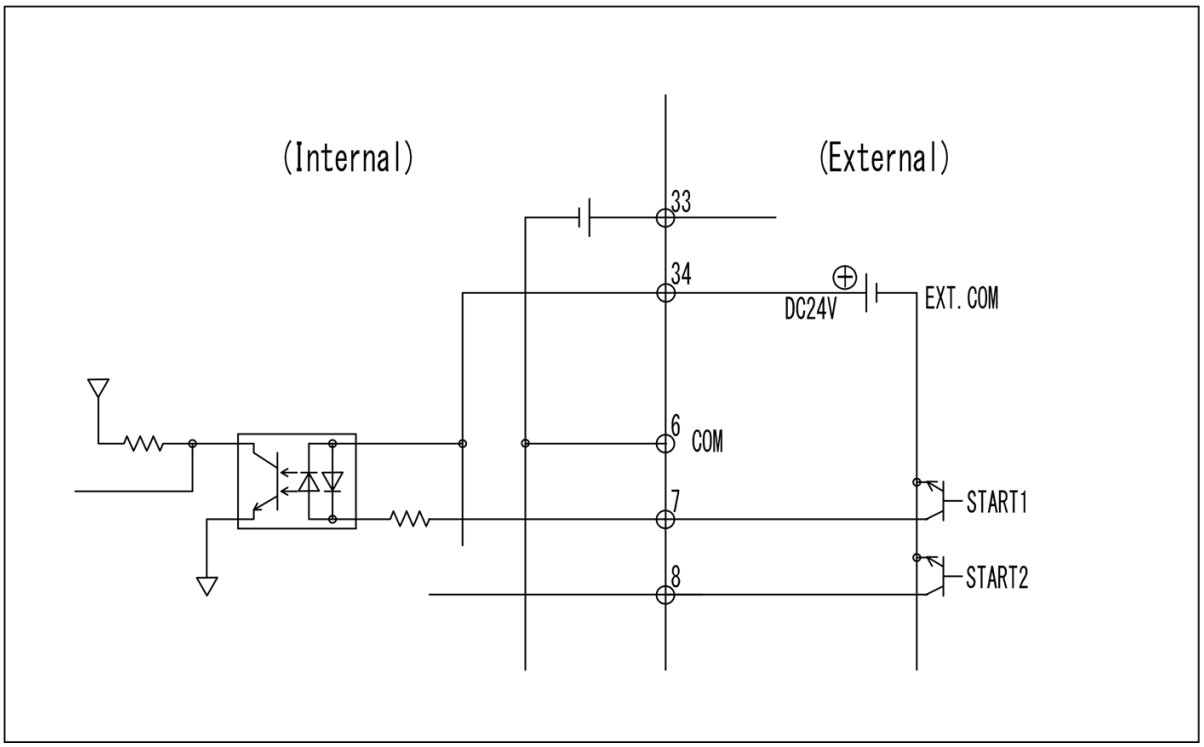
②When connecting to a device with NPN open collector output (when using an internal power supply), short terminals 33 and 34 and connect the emitter side of the PLC to the common terminal.



③When connecting to a PNP current output type device (when using an external power supply)
Connect the 0V side of the external power supply DC24V to terminal 34.

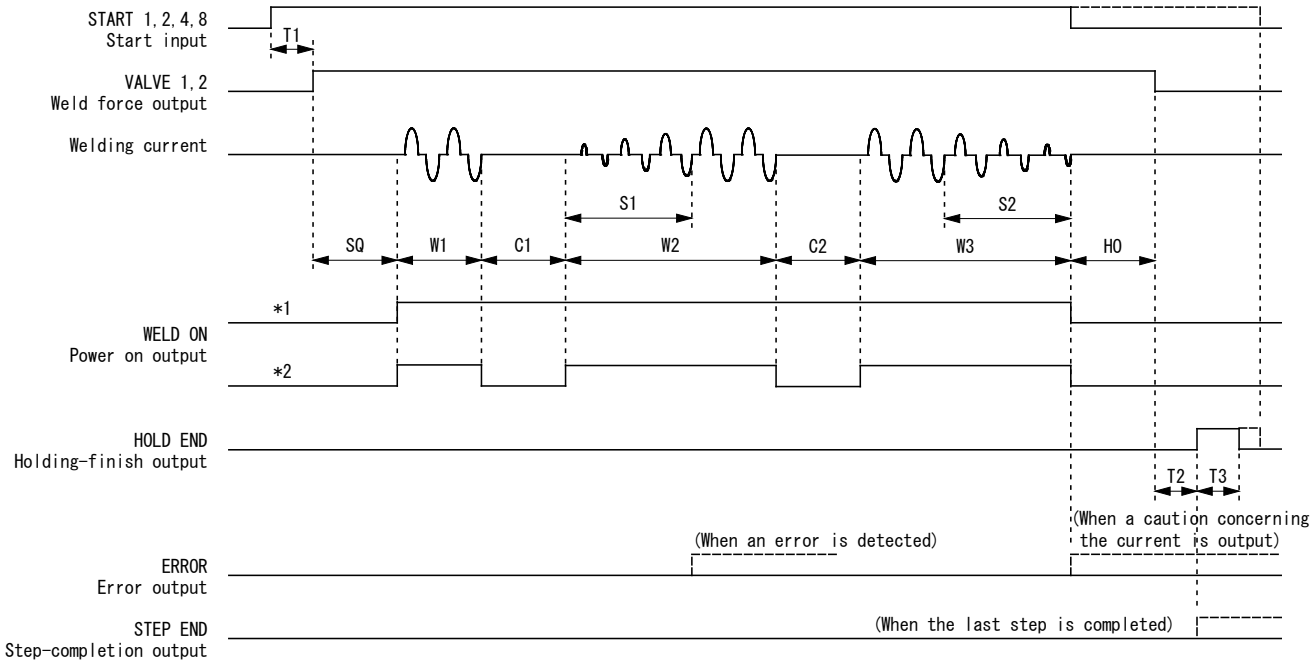


④When connecting to a device with NPN open collector output (when using an external power supply)
Input the + side of the external power supply DC24V to terminal 34.



(2) Timing Chart

1) Timing chart of basic operation



*1. When DSW1-(3) is off: Power-on timing output
*2. When DSW1-(3) is on: Flicker output

SQ:	Squeeze	S1:	Slope I (Up)	W3:	Weld III
W1:	Weld I	W2:	Weld II	S2:	Slope II (Down)
C1:	Cool I	C2:	Cool II	HO:	Hold

T1: Time from when the start signal [START1,2,4,8] is turned on (rising edge of the first input signal) until the valve signal [VALVE1,2] is turned on (60 ms max.)

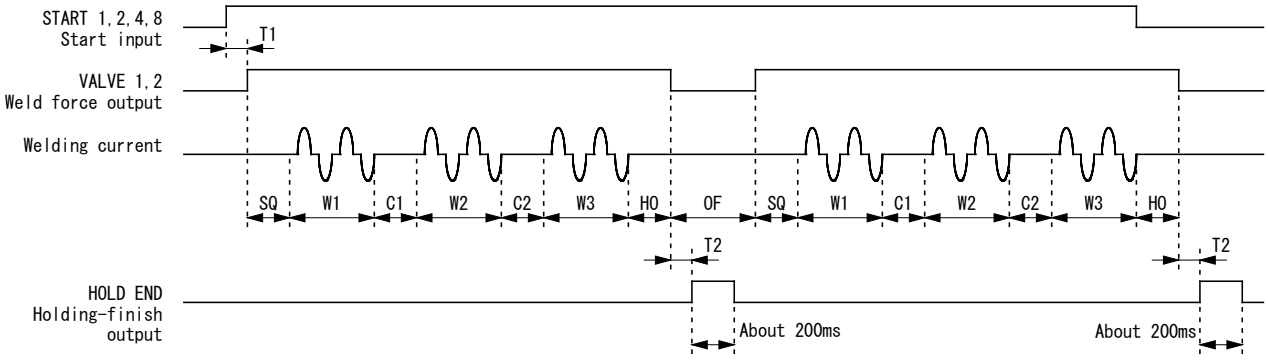
T2: Time from the Hold is finished until the holding finish signal [HOLD END] is turned on is 20 ms max.

T3: When DSW1-(7) is set to OFF (level output):
The ON time of the holding finish signal [HOLD END] is about 200 ms if the start signal [START1,2,4,8] is turned off before the Hold starts, or if it is turned off within about 200 ms after the Hold is finished.
Also, if the start signal [START1,2,4,8] is still on about 200 ms after the Hold is finished, the holding finish signal [HOLD END] is kept turned on until the start signal [START1,2,4,8] is turned off.

When DSW1-(7) is set to ON (pulse output):
The ON time of the holding finish signal [HOLD END] is about 200 ms.

If pulsation is set to 2 or higher, Cool II and Weld III are repeated the set number of pulsations (when DSW2-(1) is set to OFF).

2) Timing chart of repeating function operation (when DSW2-(1) is set to ON)



OF: Off

T1: Time from when the start signal [START1,2,4,8] is turned on (rising edge of the first input signal) until the valve signal [VALVE1,2] is turned on (60 ms max.)

T2: Time from the Hold is finished until the holding finish signal [HOLD END] is turned on is 20 ms max.

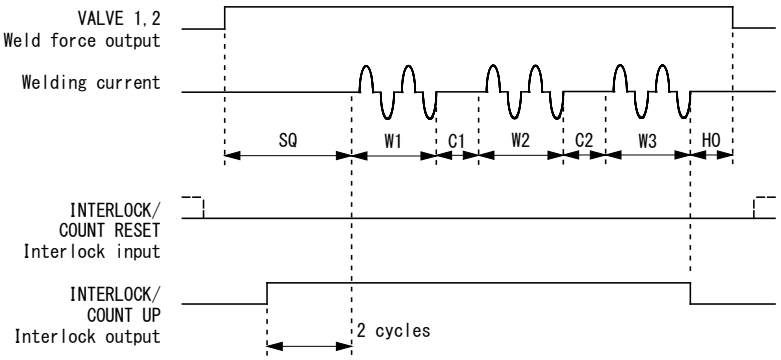
While the start signal [START1,2,4,8] is turned on, operation between Squeeze and Hold is repeated, being paused for the time set in OF.

If the total time between Squeeze and Off is shorter than the output time of the holding finish signal [HOLD END] (about 200 ms), the holding finish signal is output continuously.

3) Timing chart of interlock function operation (when DSW2-(2) is set to OFF)

When the welding is performed at the same timing, the voltage of the welding power supply decreases and the welding current fluctuates. In such a case, this function keeps the welding from being performed while the interlock input signal [**INTERLOCK**/COUNT RESET] is turned on.

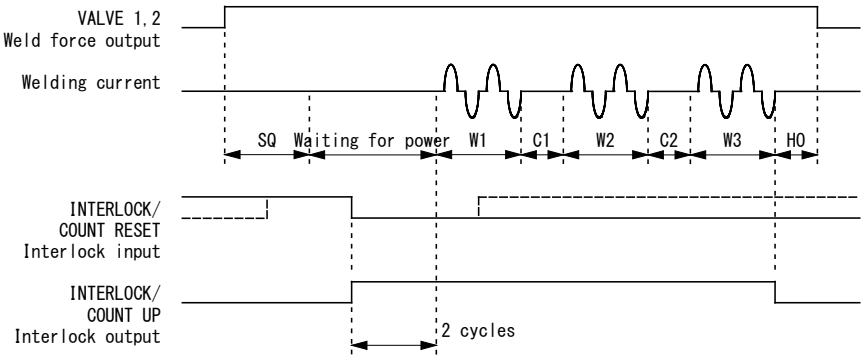
① When the interlock input signal [**INTERLOCK**/COUNT RESET] is turned off during Squeeze



a. The interlock output signal [**INTERLOCK**/COUNT UP] is turned on two cycles before the power is turned on.

b. If Squeeze is set to 0 cycles, the interlock input signal [**INTERLOCK**/COUNT RESET] is turned on when the power is turned on. If Squeeze is set to below 2 cycles, the interlock output signal [**INTERLOCK**/COUNT UP] is turned on from Squeeze starts.

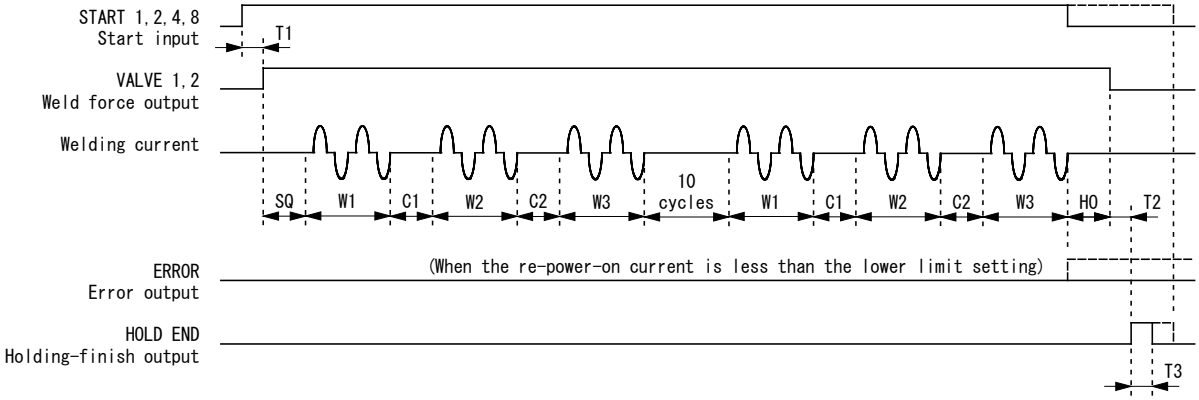
② When the interlock input signal [**INTERLOCK**/COUNT RESET] is turned on during Squeeze



a. The operation stops during the wait for power in the squeeze state. The system waits, indicating the squeeze operation, until the interlock input signal [**INTERLOCK**/COUNT RESET] is turned off.

b. If the interlock is turned off while the system is waiting for power, the interlock output signal [**INTERLOCK**/COUNT UP] is turned on, followed by the power.

4) Timing chart of re-power-on function operation (when DSW1-(6) is set to ON)



T1: Time from when the start signal [START1,2,4,8] is turned on (rising edge of the first input signal) until the valve signal [VALVE1,2] is turned on (60 ms max.)

T2: Time from the Hold is finished until the holding finish signal [HOLD END] is turned on is 20 ms max.

T3: When DSW1-(7) is set to OFF (level output):
The ON time of the holding finish signal [HOLD END] is about 200 ms if the start signal [START1,2,4,8] is turned off before the Hold starts, or if it is turned off within about 200 ms after the Hold is finished.
Also, if the start signal [START1,2,4,8] is still on about 200 ms after the Hold is finished, the holding finish signal [HOLD END] is kept turned on until the start signal [START1,2,4,8] is turned off.

When DSW1-(7) is set to ON (pulse output):
The ON time of the holding finish signal [HOLD END] is about 200 ms.

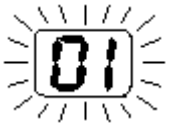
a. The power is turned on again when the welding current is less than the lower limit setting, or when no power is supplied.

b. The re-power-on current is 5% higher than the set current. If the welding current is outside the upper and lower limits when the power is turned on again, a caution concerning the current is output.

6. Operation Method

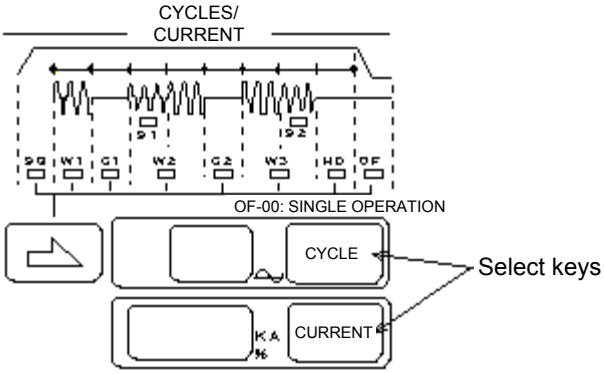
(1) Basic Operation

1) Turn on the control power switch.



If the control power switch [POWER] on the front is turned on, control power is supplied to the machine.
When it is turned on, all LEDs light up for 2-3 seconds while self-diagnosis is performed.
If the result is normal, the LEDs indicate the set values. If the result is an error, error code [01] blinks in the data indicator to indicate an alarm.

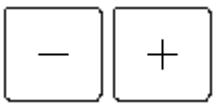
2) Input the data for each set item.



① The select keys are located to the right of the indicator. Press the select key for an item to be set; the settable digit blinks. If two digits are settable, they blink alternately each time the select key is pressed.

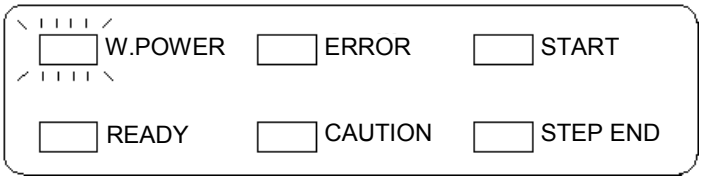
② Input the data using the [+] / [-] keys.
If either is pressed and held,
the data increases (+) or decreases (-) continuously.

+/- keys



3) Supply the welding power.

If the welding power is supplied, the red [W.POWER] LED lights up.



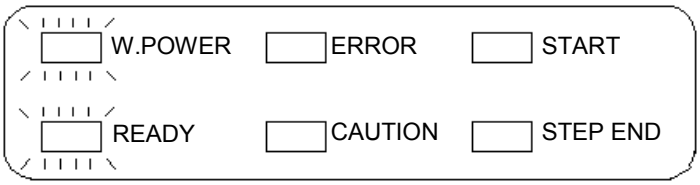
4) Press the [WELD] key to start welding.

ON/OFF

WELD

If the weld ON/OFF key [WELD] at the lower right is pressed to start welding, the green LED to the upper left of the key lights up.

The green [READY] LED lights up (when the weld ON/OFF signal [WELD ON/OFF] is turned on).



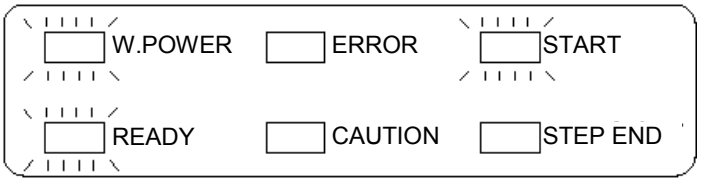
When turning off welding, press and hold the weld ON/OFF key [WELD] until the LED to the upper left of this key and the [READY] LED turn off.

CAUTION

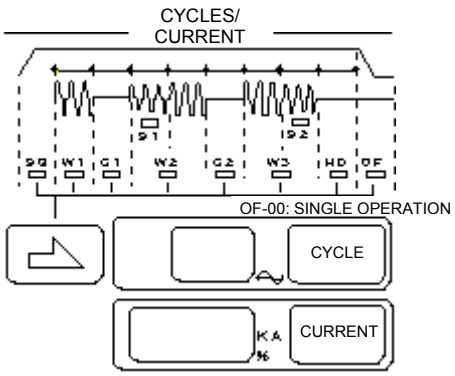
Do not turn on the control power switch [POWER] while pressing the weld ON/OFF key [WELD] on the front panel. In addition, do not turn on the weld ON/OFF key [WELD] within two seconds after the control power supply is turned on. If these procedures are not followed, all weld schedule data is initialized.

5) Input the start signal to start welding.

① If the start signal is input, the red [START] LED lights up.



②



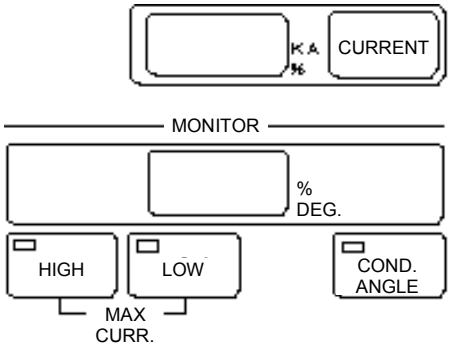
All indications go off, and the LED for the item being executed lights up. The weld sequence is indicated clearly.

Note: Only previously set cycle items are indicated. Slope I and Slope II are not indicated for execution, as they are included in Weld II and Weld III, respectively.

6) Upon completion of welding, the measured value is indicated.

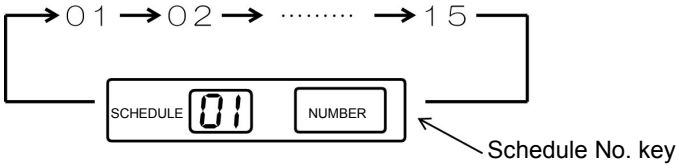
① The green [MONITOR DISPLAY] LED lights up, and the measured value that is the welding result is indicated.

The measured value of the item, the green LED of which is lit, is shown on the indicator

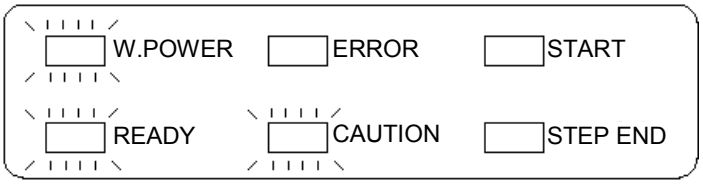


② Press the select key of a measured value to be checked, and then press the Monitor display key; the measured value is indicated.

③ When the [MONITOR DISPLAY] LED lights up, if the SCHEDULE [NUMBER] key is pressed, the measured value of that schedule No. is indicated. Each time the SCHEDULE [NUMBER] key is pressed, the schedule No. increases by 1. If the schedule No. reaches 15, it returns to 1.



7) If a monitor error is detected, the red [CAUTION] LED lights up.
At this time, an error signal [ERROR] is output.



Press the [RESET] key outside the main section to reset or turn on an external reset signal [ERROR RESET].

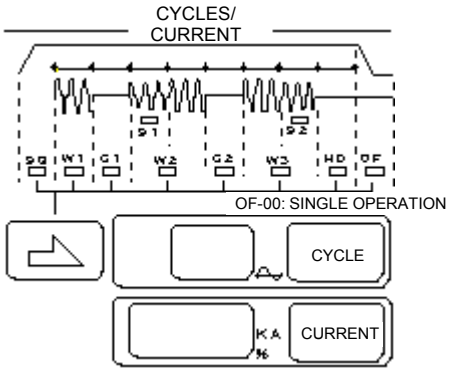
(2) Setting of Schedule Data

1) Setting of schedule No.

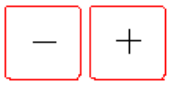
Press the SCHEDULE [NUMBER] key and select a schedule No.

Schedule No. key

2) Setting of timer



① Press the -> key to select an item to be set. Press the [CYCLE] key, and the settable digit blinks. If two digits are settable, they blink alternately each time the [CYCLE] key is pressed.



② Set the number of cycles using the [+] / [-] keys.

	Item	Setting range	Remarks
SQ	Squeeze	00 - 99 cycles	
W1	Weld I	0 - 99 cycles	
C1	Cool I	0 - 99 cycles	
S1 w2	Slope I (upslope) Weld II	0 - 9 cycles 00 - 99 cycles	Slope I is included in Weld II.
C2	Cool II	00 - 99 cycles	
W3 S2	Weld III Slope II (downslope)	00 - 99 cycles 00 - 99 cycles	Slope II is included in Weld III.
HO	Hold	00 - 99 cycles	
OF	OFF *1	00 - 99 cycles	Select either.
	Pulsation *2	0 - 9 times	

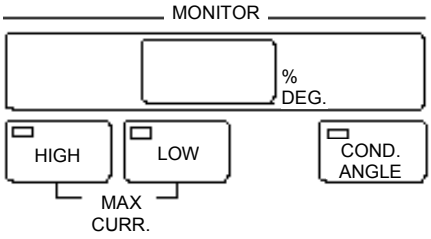
Up to 15 schedules can be set. When recording the set values, use "9. Schedule Data Table."

*1. If OFF (Repeating function) is selected (DSW2-(1) is set to OFF) and the start signal [START 1,2,4,8] is input, the welding sequence is repeated continuously.

*2. If the pulsation function is selected (DSW2-(1) is set to ON), Cool II and Weld III are repeated the set number of times.

Squeeze → Weld I → Cool I → Weld II →
→ Cool II → Weld III → → Hold
Repeated the set number of times

3) Setting of the maximum current



① Press the [HIGH] and [LOW] keys at the same time, then input the maximum welding current (maximum secondary current) using the [+] / [-] keys.

Setting range of max. current:
5 - 80 kA

Set the maximum short-circuit current of the welder to be used.

[Caution]

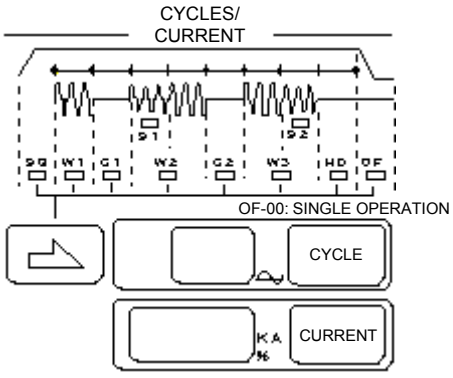
(1) Even if the primary current-feedback constant-current control method is selected, set the maximum secondary current. Set the maximum current so that it becomes within 50-1500 A converted to the primary current. If a value outside the range is set and the power is supplied, an error signal is output (Error code [03]).

Example) If the maximum current is 40 kA and the turn ratio of the transformer is 32, the primary current is as follows:
40 kA/32 = 1250 A --- In the range, thus settable

If the maximum current is 40 kA and the turn ratio of the transformer is 25, the primary current is as follows:
40 kA/25 = 1600 A --- Out of the range, thus unsettable

(2) Even if measuring the current using a toroidal coil or CT coil in the source-voltage fluctuation compensation control, set the maximum secondary current.

4) Setting of the welding current



① Select Weld 1 (W1), Weld 2 (W2), or Weld 3 (W3) using the -> key.

② Press the [CURRENT] key, then input the welding current using the [+] / [-] keys. The welding current is limited as follows, however, depending on the control method.

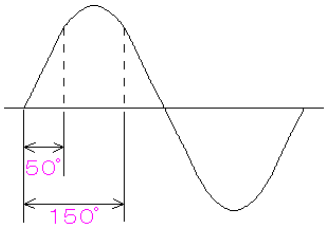
a. When the constant-current control method is used

Example)

Maximum current	Setting range
10 kA	2.0 kA - 10.0 kA
40 kA	8.0 kA - 40.0 kA
80 kA	16.0 kA - 80.0 kA

Set the welding current in the range of 20% to 100% of the maximum current.
If the welding current is set out of the above range, it cannot be kept constant.

b. When the source-voltage fluctuation compensation control is used

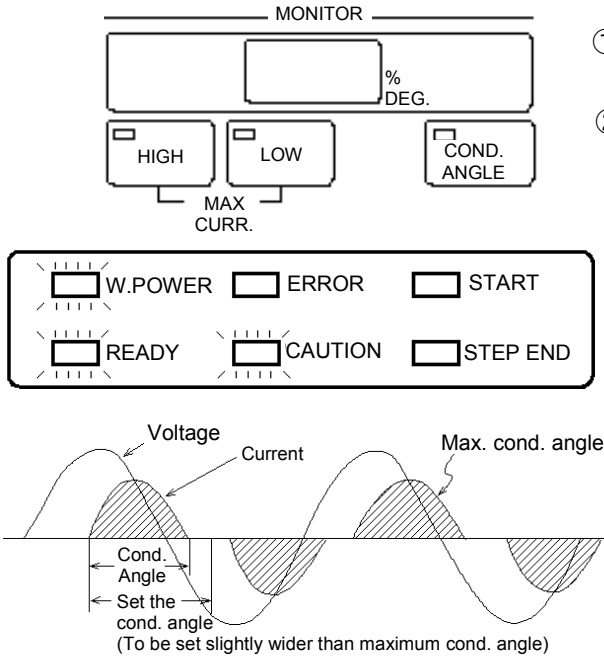


When the current is set to 99.9%, such a current as flows in a reference 50° welding machine having a 50° power factor angle at a 50° thyristor firing angle will flow; when the current is set to 00.0%, the equivalent thyristor firing angle is 150°. The current setting is expressed as a percentage with one decimal place, from 00.0% to 99.9%. The current depends on the specifications of the welder.

Firing angle	Setting
50°	99.9%
150°	00.0%

(3) Setting of the Monitor

1) Setting of the conduction-angle monitor



① Press the [COND. ANGLE] key to enter the setting mode.

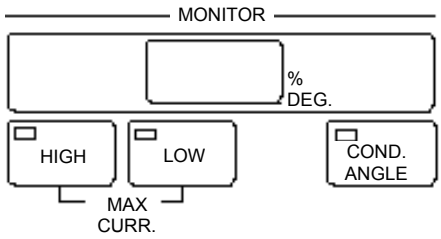
② Set the conduction angle (1 - 180°) using the [+] / [-] keys. Set it slightly wider than the maximum weld conduction angle. If the actual weld conduction angle exceeds the set conduction angle, a conduction-angle error occurs, an error signal [ERROR] is output and the red [CAUTION] LED lights up. If the conduction angle is set to "000", it will not be monitored.

[Caution]

① If the source-voltage fluctuation compensation control method is used, the conduction angle cannot be monitored.

② If this control is used with a welder of the single-phase rectifier type, the conduction angle cannot be monitored. In such a case, set the conduction angle to "000".

2) Setting of the current monitor (Effective only in constant-current control mode)



① Press the [HIGH] key to enter the setting mode.
② Set the upper limit of the current monitor using the [+] / [-] keys (setting range: 0 - 49%).
③ Similarly, press the [LOW] key, then set the lower limit of the current monitor using the [+] / [-] keys (setting range: 0 - 49%).

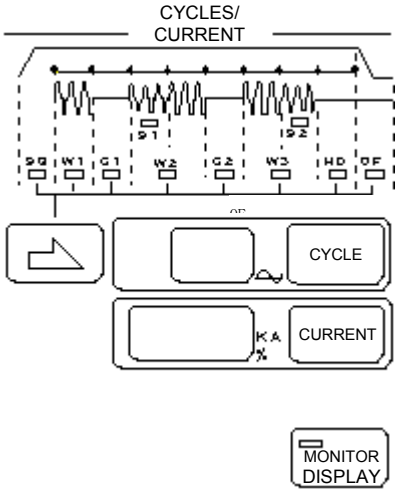
Example) If [Weld 2] is 10 kA, the High setting is 20%, and the Low setting is 10%, the setting range of the current monitor is between 9 kA and 12 kA.

The current monitor confirms that the average of the effective current values, excluding the first three cycles and slopes (I: Upslope; II: Downslope), is between the upper and lower limits. If the average effective current is out of the setting range of the current monitor (exceeds either limit), an error signal [ERROR] is output and the red [CAUTION] LED lights up.

[Caution]

If the source-voltage fluctuation compensation control method is used, the upper and lower limits of the current monitor cannot be set.

3) Indication of the measured welding current

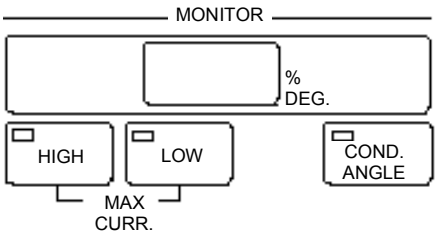


Upon completion of welding, the measured current is displayed on the welding-current setter/monitor display indicator. It indicates the measured value of the Weld current (W1, W2, or W3), the green LED for which is lit.

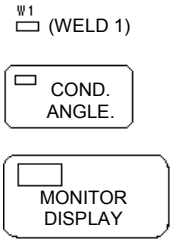
When checking the measured value of another current, press the -> key, then press the [MONITOR DISPLAY] key. The indicated value is the average of the effective values of the currents, excluding the first three cycles and slopes.

If the number of welding cycles is three or less, or shorter than slopes + 3 cycles (I: upslope, II: downslope), the effective current in the last cycle is indicated.

4) Indication of the conduction angle and monitored current

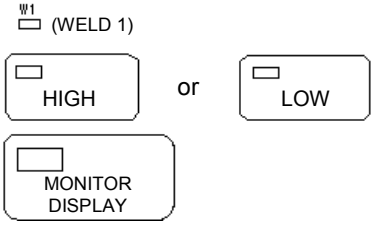


Upon completion of the weld cycle, the monitor indicates the conduction angle and monitored current.



① Indication of the conduction angle of Weld 1
Press the select key for Weld 1 and the [COND. ANGLE] key, then press the [MONITOR DISPLAY] key. The measured values of the conduction angles of Weld 2 and Weld 3 can be indicated similarly.

W2 (Weld 2) · W3 (Weld 3)



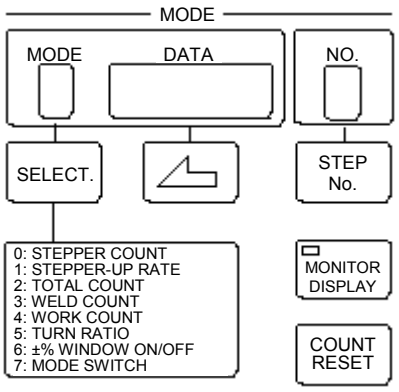
② Indication of the monitored value of Weld 1
Press the select key for Weld 1 and the [HIGH] or [LOW] key, then press the [MONITOR DISPLAY] key. If the current of Weld 1 is larger than the set value and the [HIGH] key is pressed, the deviation from the set value is indicated as a percent.
If the current of Weld 1 is less than the set value and the [LOW] key is pressed, the deviation from the set value is indicated as a percent. Weld 2 and Weld 3 are indicated similarly.

[Caution]

To display the measured value of welding current of the source-voltage fluctuation compensation control method is used, a toroidal coil or CT coil for current detection needs to be connected.

(4) Setting by Mode No.

The setter/indicator of the data/counter are explained below.

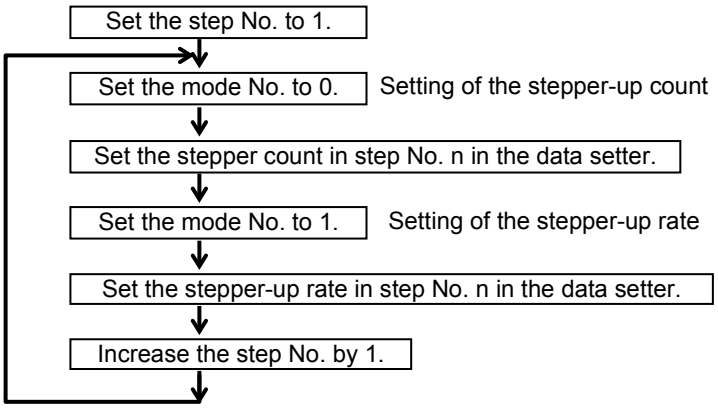


① Press the [SELECT] key, and select the mode (0 - 7) using the [+] / [-] keys.
Note: If DSW2- (7) is set to ON, select the mode from 0 to 9.

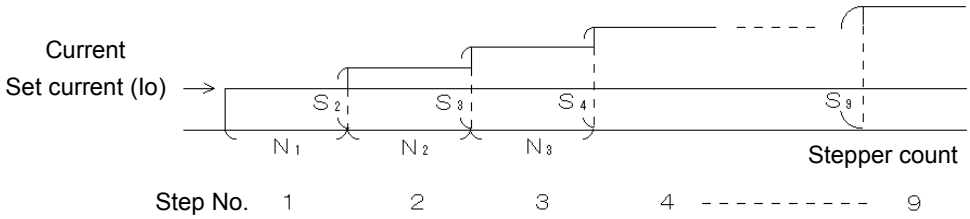
② Select the digit of the data to be input using the <- key. Input the value using the [+] / [-] keys.

(1) Mode 0, 1: STEPPER up [0: STEPPER COUNT / 1: STEPPER UP RATE]

① Set method (n = Step No.)



Note: The stepper-up rate of Step 1 is fixed at 100%. The stepper-up rate is based on the current in Step 1. For example, if the stepper-up rate is set to 120%, the welding current is increased by 20%.



Ni: Stepper count (0 - 9999)
Si: Stepper-up rate (50 - 200%)

For example, if the set current is 8.0 kA, step No. is 3, and the stepper-up rate of step No. 3 is 105%, the welding current is as follows:

$$\text{Welding current} = \text{Set current (8.0 kA)} \times \frac{\text{Stepper up rate of step No. 3 (105)}}{100} = 8.4 \text{ kA}$$

② Operation

If the number of weld counts for each step No. reaches the set value, the step No. is increased by 1 and the current is increased by the set stepper-up rate. Upon completion of the last step, the red [STEP END] LED lights up and the step-end signal [STEP END] is turned on. If the power is kept turned on, the power is supplied according to the schedule of the last step No.

③ Reset method

If a step reset signal [STEP RESET] is turned on from outside, the system returns to Step No. 1 and the step end signal [STEP END] is turned off. If the [STEP] key is pressed and the step No. is decreased using the [+] / [-] keys, the step starts from the decreased step No. with the current setting for the step No., and the stepper counter starts from zero.

[Caution]

1) If the step No. is set to 0, it is not increased. When using the step-up function, be sure to set the step No. to 1 or higher.
2) While using the step-up function, take care when setting the current step-up ratio.
3) If the current multiplied by the current stepper-up rate exceeds the set maximum value, a current-stepper-up-rate error signal is output.

(2) Mode 2: Total counter [2: TOTAL COUNT] (1 schedule)

① Setting method for preset value

Set the mode No. to 2. (Setting of the total counter)

↓

Set the preset value of the total counter in the data setter.

② Operation

If the total number of weld counts reaches the preset value, the monitor counter in the data indication area of the panel blinks, the buzzer sounds, and an error signal [ERROR] is output until the counter is reset.

Note: If the preset value is 0, the counter does not count.

③ Reset method

1) When the interlock function is turned on (DSW2-(2): ON)
   a. Press the [SELECT] key, and set the mode to "2" using the [+] / [-] keys.
   b. Press the [COUNT RESET] key; the total counter is reset.

2) When the interlock function is turned off (DSW2-(2): OFF)
   a. Press the [SELECT] key, and set the mode to "2" using the [+] / [-] keys.
   b. Press the [COUNT RESET] key or turn on the count reset signal [INTERLOCK/**COUNT RESET**] from outside.

(3) Mode 3: Weld counter [3: WELD COUNT] (1 schedule)

① Setting method for preset value

Set the mode No. to 3. (Setting of the weld counter)

↓

Set the preset value of the weld counter in the data setter.

② Operation

If the number of weld counts reaches the preset value, the buzzer sounds for 1 second. The counter is automatically reset. If the [COUNT] LED at the bottom of the panel is lit, counting is done. If it is not lit, counting is stopped.

③ Reset method

1) When the interlock function is turned on (DSW2-(2): ON)

a. If the weld counter reaches its maximum, it is automatically reset.

b. When resetting the weld counter while it is counting, press the [SELECT] key and set the mode to "3" using the [+] / [-] keys.

c. Press the [COUNT RESET] key; the weld counter is reset.

2) When the interlock function is turned off (DSW2-(2): OFF)

a. If the weld counter reaches its maximum, it is automatically reset.

b. When resetting the weld counter while it is counting, press the [SELECT] key and set the mode to "3" using the [+] / [-] keys.

c. Press the [COUNT RESET] key or the count reset signal [INTERLOCK/**COUNT RESET**] from outside.

(4) Mode 4: Work counter [4: WORK COUNT] (1 schedule)

① Setting method for preset value

Set the mode No. to 4. (Setting of the work counter)

↓

Set the preset value of the Work counter in the data setter.

↓

Set the mode No. to 3. (Setting of the weld counter)

↓

Set the preset value of the weld counter in the data setter.

② Operation

If the weld count reaches the preset value, the Work counter is increased by 1. If the Work count reaches the preset value, the monitor count blinks and the buzzer sounds intermittently. If the interlock function is turned off, a count-up signal [INTERLOCK/**COUNT UP**] is output. If the number of the weld counts for one workpiece is set as the preset value of “Mode 3: Weld counter”, the value shown on the Work counter indicates the quantity of production.

If the [COUNT] LED at the bottom of the panel is lit, counting is done. If it is not lit, counting is stopped.

③ Reset method

1) Reset of the work count. When the interlock function is turned on (DSW2-(2): ON)

a. Press the [SELECT] key and set the mode to "4" using the [+] / [-] keys.

b. Press the [COUNT RESET] key; the Work counter is reset.

2) Reset of the work count. When the interlock function is turned off (DSW2-(2): OFF)

a. Press the [SELECT] key and set the mode to "4" using the [+] / [-] keys.

b. Press the [COUNT RESET] key or the count reset signal [INTERLOCK/**COUNT RESET**] from outside.

3) Reset of the weld count. When the interlock function is turned on (DSW2-(2): ON)

a. Press the [SELECT] key and set the mode to "3" using the [+] / [-] keys.

b. Press the [COUNT RESET] key; the Work counter is reset.

4) Reset of the weld count. When the interlock function is turned off (DSW2-(2): OFF)

a. Press the [SELECT] key and set the mode to "3" using the [+] / [-] keys.

b. Press the [COUNT RESET] key or the count reset signal [INTERLOCK/**COUNT RESET**] from outside.

(5) Mode 5: Setting the turn ratio of the transformer [5: TURN RATIO]

When the primary constant-current control is selected, set the turn ratio of the transformer to be used.

Set the mode No. to 5. (Setting the turn ratio of the transformer)

↓

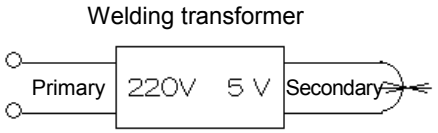
Set the turn ratio of the transformer in the data setter.

[Caution]

The turn ratio of the transformer is closely related to the setting of the maximum current. Set them in the following range:
50 ≤ Maximum current/Turn ratio of the transformer ≤ 1500
If these factors are set out of this range and the power is turned on, an error signal (Error code [03]) is output.

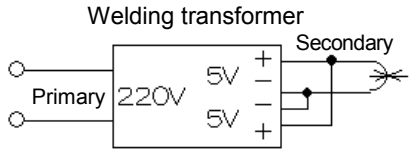
Examples of the turn ratio of the transformer

- **When only one secondary output is provided:**



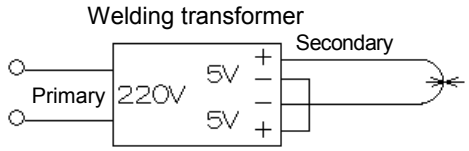
$$\text{Turn ratio} = \frac{\text{Primary input voltage}}{\text{Secondary output voltage}} = \frac{220}{5} = 44$$

- **When two secondary outputs are connected in parallel:**



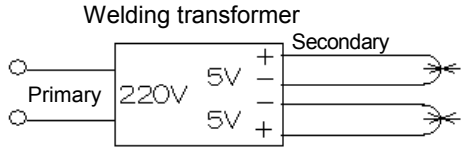
$$\text{Turn ratio} = \frac{\text{Primary input voltage}}{\text{Secondary output voltage}} = \frac{220}{5} = 44$$

- **When two secondary outputs are connected in series:**



$$\text{Turn ratio} = \frac{\text{Primary input voltage}}{\text{Secondary output voltage}} = \frac{220}{10} = 22$$

- **When two secondary outputs are used independently:**



$$\text{Turn ratio} = \frac{\text{Primary input voltage}}{\text{Secondary output voltage}} \times \frac{1}{\text{Number of secondary circuits}}$$

When two outputs are used simultaneously

$$\text{Turn ratio} = \frac{220}{5} \times \frac{1}{2} = 22$$

When only one output is used

$$\text{Turn ratio} = \frac{220}{5} \times \frac{1}{1} = 44$$

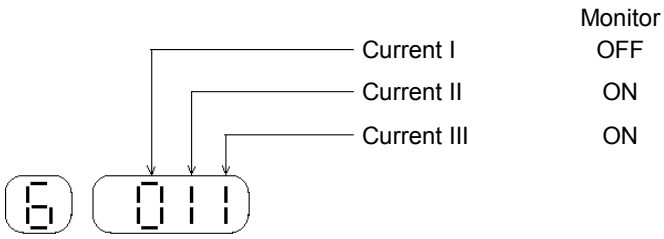
(6) Mode 6: Setting of: ±% WINDOW ON/OFF [6: ±% WINDOW ON/OFF]

Determine whether the upper and lower limits of the current monitor for Current I, Current II, and Current III should be judged.

Set the mode No. to 6. (Setting of ±% WINDOW ON/OFF)

↓

Set ±% WINDOW ON/OFF in the data setter. (0: OFF; 1: ON)



- When the monitor is on --- If a current exceeds the High or Low set value, the red [CAUTION] LED lights up and an error signal [ERROR] is output.
- When the monitor is off --- Even if a current exceeds the High or Low set value, it is not judged.

(7) Mode 7: Setting of the mode switch [7: MODE SWITCH]
Set the welding mode.

Set the mode No. to 7. (Setting of mode switch)

↓

Set the welding mode in the data setter.

Data: 0 Normal welding mode

The rise of current is the same as that of the conventional **CT-110E**.

The control method of Weld I to III (the constant-current control and the source-voltage fluctuation compensation control) depends on the setting of DSW1-(1).

Use this mode normally.

Data: 1 Welding mode for high-tension material (only when DSW1-(1) is set to OFF)

This is the mode for the quick rise of current applied to the high-tensile steel plate with a high initial resistance.

The control method of Weld I to III is the constant-current control.

This mode is suitable for welding of the high-tensile steel plate.

Data: 2 Welding mode in combination of the source-voltage fluctuation compensation control and the constant-current control (only when DSW1-(1) is set to OFF)

This is the mode for the quick rise of current applied to the high-tensile steel plate with a high initial resistance.

The control method of Weld I is the source-voltage fluctuation compensation control, and those of Weld I to III are the constant-current control.

This mode is suitable for welding of the color steel plate which is hard to flow the current at the beginning of the welding. The occurrence of the no-power-supply error can be minimized even if the current is hard to flow.

(8) Mode 8: Setting of the constant-current correction value for Interval G1 (only when DSW2-(7) is set to ON)

Adjust the constant-current correction value when the control is connected to a welder of the single-phase rectifier type and the welding current rises abnormally and overshoots or does not rise quickly enough. See page 4-9.

① Setting method for correction value

Set the mode No. to 8. (Setting of the constant-current correction value for interval G1)
↓
Set the correction value in the data setter.

② Correction value

Set the correction value to 50 normally; reduce it if the welding current rises abnormally and overshoots, and increase it if the welding current does not rise quickly enough.

(9) Mode 9: Setting of the constant-current correction value for Interval G2 (only when DSW2-(7) is set to ON)

Like Mode 8, Mode 9 sets the constant-current correction value for Interval G2. For details, see page 4-9.

(5) Setting of the Maximum Current

Set the maximum current of the welder to be used. If it is unknown, set it in accordance with the following procedure.

① Maximum current: 10.0 kA
② Weld I, II: 0 ∿
③ Weld III: 1 ∿
④ Current III: Desired current (10.0 kA maximum)

Turn on the power. If the monitored value of Current III is below the desired current, reduce the maximum current setting; if the former is larger than the latter, increase the maximum current setting.
Repeat the above procedure until the monitored value of Current III is slightly lower than the preselected value of Current III.

(6) Current Calibration Method

Though the **CT-110E** is properly factory-adjusted, the control current may vary over time. The control-current value may also change due to a current sensor and its installation. In such a case, the difference between controls used and the control current values can be adjusted using the properly calibrated Weld Checker, according to the following procedures.

1) In secondary constant-current control mode

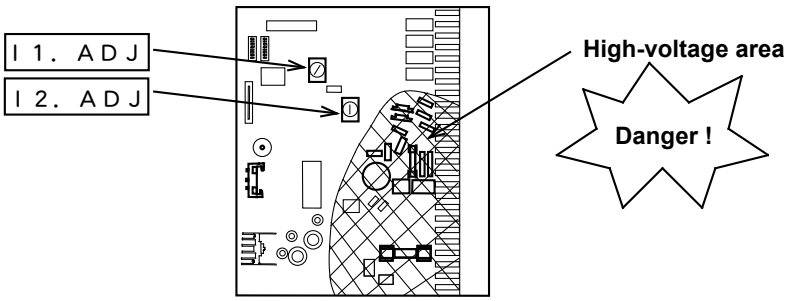
Adjust the I2.ADJ (VR2) knob on the controller so that the current set on the panel will be the same as the secondary current of the Weld Checker.

2) In primary constant-current control mode

Input the turn ratio of the transformer to be used (see Setting by mode No. (5)). Turn on the power and change the turn ratio of the transformer so that the current setting on the panel will be the same as the actual secondary current of the Weld Checker.
If the secondary current of the welder is greater than the current setting on the panel, set the turn ratio of the transformer higher.
If the current cannot be calibrated by adjusting the turn ratio of the transformer, calibrate it using the I1.ADJ (VR4) knob on the control.

[Danger]

When calibrating the current, do not touch any part other than the adjustment knob. As the welding power and control power are turned on, take care not to touch the high-voltage area.



7. Maintenance

(1) Replacement of Fuses

The printed circuit board in this device has two fuses to protect the device. If one is blown, check for the cause, and replace it in accordance with the following procedures.

(Note) Both fuses use the same fuse, which is different from CT-110D and earlier.

Fuse	Model
φ5.2 500VAC 1A	0477001.MXP

[Warning]

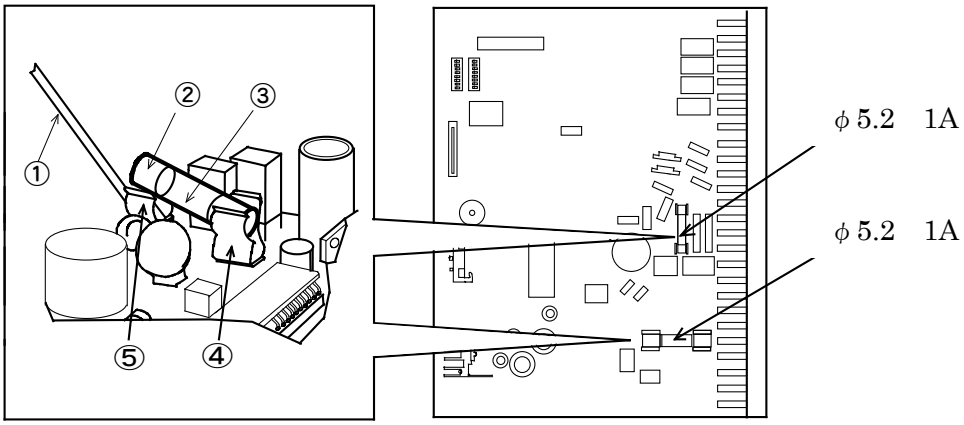
When replacing the fuses, be sure to turn off both the 240-V control power source and the 240-V or 480-V welding power source, in order to prevent electrical shock.

Replacement procedure for fuses

(1) Insert a narrow screwdriver on the rear fuse holder (5) side, and pry it up by using the screwdriver as a lever. Only touch the metallic part of the fuse with the screwdriver, so that the glass part (3) will not be broken.

(2) Place the metallic parts of a new fuse on the front (4) and rear (5) of the fuse holder, and firmly push in the glass part with your thumb.

(3) Confirm that the fuse is properly set in the fuse holder.



① Screwdriver
Use a narrow type.

② Fuse ..... Metallic part

③ Fuse ..... Glass part

④ Fuse holder ..... Front side

⑤ Fuse holder ..... Rear side

8. Specifications

(1) Standard Specifications

(1) Welding power source: The voltage depends on the specification. See (2) Specification Chart.
220V/230V/240V/380V AC -25% +10%, 50/60 Hz
400V/415V/440V/460V/480V AC -25% +10%, 50/60 Hz
(Voltage set at time of shipment)

(2) Control power source: The voltage depends on the specification. See (2) Specification Chart.
100V/120V/220V/230V/240V AC
±20%, 50/60 Hz (Voltage set at time of shipment)

(3) Control method: Primary- or secondary-current feedback constant-current control by phase control using a thyristor, or source-voltage fluctuation compensation control method

(4) Constant-current control
- ① Control speed: Half-cycle (secondary constant-current control), 1 cycle (primary constant-current control)
- ② Initial response speed: 2 cycles max. (in secondary constant-current control mode)
  Time from when the power is turned on until the current reaches the set current ±10%
- ③ Current accuracy (error in full scale)
  - a. Welding power-source voltage fluctuation: ±2% for +10%/-15%
  - b. Resistance load fluctuation: ±2% for ±15%
  - c. Inductive load fluctuation: ±2% for ±15%

(5) Source-voltage fluctuation compensation control
- ① Control Speed: 1 cycle
- ② Current accuracy: (error in full scale)
  ±3% for fluctuation of ±10% in welding power-source voltage

(6) Number of schedules: 15

(7) Valve output:
- ① System: 2 (Schedules 1-7: Valve 1 Schedules 8-15: Valve 2)
- ② Output voltage: Control voltage (1 A max.) or 24 V DC (0.6 A max.); The voltage depends on the specification. See (2) Specification Chart.

(8) Setting of timers
- ① Squeeze (SQ) time: 00 - 99 cycles, 15 schedules
- ② Weld I (W1) time: 00 - 99 cycles, 15 schedules
- ③ Cool I (C1) time: 00 - 99 cycles, 15 schedules
- ④ Slope I (S1) time (Upslope included in time of Weld 2):
  0 - 9 cycles, 15 schedules

⑤ Weld II (W2) time: 00 - 99 cycles, 15 schedules

⑥ Cool II (C2) time: 00 - 99 cycles, 15 schedules

⑦ Weld III (W3) time: 00 - 99 cycles, 15 schedules

⑧ Slope II (S2) time (Downslope included in time of Weld 3):
00 - 99 cycles, 15 schedules

⑨ Hold (HO) time: 00 - 99 cycles, 15 schedules

⑩ OFF (OF) time in Repeating function:
00 - 99 cycles, 15 schedules

⑪ Pulsation: 0 - 9 times, 15 schedules
Either (10) or (11) is selected in accordance with the selected function.

(9) Maximum current setting range:
1 schedule
Set to the maximum secondary current of the welder
Setting range: 5 - 80 kA

(10) Current setting range: 15 schedules

① Constant-current control mode
Current I, II, III: 20% - 100% of max. current setting

② Source-voltage fluctuation compensation control mode
Current I, II, III: 00.0 - 99.9%

(11) Primary-current control range: 50 - 1500 A

(12) Current monitor

① Current-monitor setting range (effective only in constant-current control mode)

Setting of upper limit: 0% - 49%, 15 schedules
Setting of lower limit: 0% - 49%, 15 schedules
(If set to 0%, the monitor is turned off.)

② Monitored value: Average effective value of currents, excluding first three cycles and slopes I and II

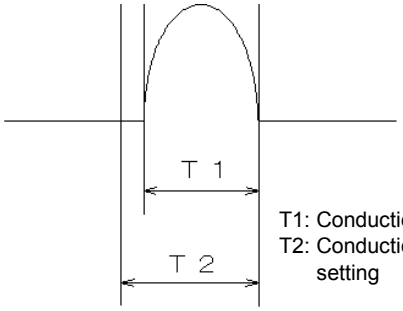
③ Judgment output: If the monitored current is out of the set range, the [CAUTION] LED lights up and an error signal [ERROR] is output.

④ In-source voltage fluctuation compensation control mode

When a current-detecting coil or a CT is used, if full waves are detected for four cycles or longer, the [CAUTION] LED lights up and an error signal [ERROR] is output.

(13) Setting range of the maximum-conduction-angle monitor

1 - 180 degrees (if set to 0, the monitor is turned off), 15 schedules



T1: Conduction angle
T2: Conduction-angle setting

If the monitored conduction angle exceeds the set angle, an error signal [ERROR] is output.
If the weld conduction angle is set to “000", the monitor does not check the conduction angle.
Note: The conduction-angle monitor does not work in the source-voltage fluctuation compensation control mode.
Note: This monitor cannot be used when the control is used for a welder of the single-phase rectifier type.

(14) Setting range of the transformer turn ratio: 1.0 to 199.9

(15) Current stepper-up

① Preset
   a. Step No.: 1 - 9
   b. Step count: 0 - 9999, 1 schedule
   c. Stepper-up rate: 50 - 200%, 1 schedule

② Operation
If the number of weld counts for each step No. reaches the set value, the step No. is increased by 1. Upon completion of the last step, the step end signal [STEP END] is turned on. The power is then supplied in accordance with the schedule of the last step No.

③ Reset
Turn on the step reset signal [STEP RESET] from outside, or decrease the step No. from the last step No. shown on the panel.

(16) Total counter

① Preset: 0 - 9999, 1 schedule

② Operation
If the total number of weld counts reaches the preset value, the monitor counter on the panel blinks, the buzzer sounds until the counter is reset, and the error signal [ERROR] is output.

③ Reset
If the interlock function is turned on, set the mode No. on the panel to "2" and press the [COUNT RESET] key. If the interlock function is turned off, set the mode No. on the panel to "2", and press the [COUNT RESET] key or turn on the count reset signal [INTERLOCK/**COUNT RESET**].

(17) Weld counter

① Preset: 0 - 99, 1 schedule

② Operation
If the number of weld counts reaches the preset value, the buzzer sounds for 1 second and the counter is automatically reset. If the [COUNT] key on the panel is turned off, counting is stopped.

③ Reset
If reset does not occur automatically and the interlock function is turned on, set the mode No. on the panel to "3" and press the [COUNT RESET] key. If the interlock function is turned off, set the mode No. to "3", and press the [COUNT RESET] key or turn on the count reset signal [INTERLOCK/**COUNT RESET**].

(18) Work counter

① Preset: 0 - 9999, 1 schedule

② Operation
If the weld count reaches the preset value, the Work counter is increased by 1. If the Work count reaches the preset value, the monitor count blinks and the buzzer sounds intermittently. If the interlock function is turned off, an count-up signal [INTERLOCK/**COUNT UP**] is turned on.

③ Reset
If the interlock function is turned on, set the mode No. on the panel to "4" and press the [COUNT RESET] key. If the function is turned off, set the mode No. to "4", and press the [COUNT RESET] key or turn on the count reset signal [INTERLOCK/**COUNT RESET**].

(19)Error outputs

To output an error signal [ERROR] when an error is detected or the "Check current" signal is indicated

No.	Contents	Detection period	Operation		Reset		Holding-finish output		Alarm output	Indication on panel	Remarks
1	Self-diagnosis error	When the power is turned on	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 01 ON	
2	Start input error	When a start signal is input	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 02 ON	During parity check only
3	Current-setting error	When a start signal is input	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 03 ON	During constant-current control only
4	Current step-up-ratio setting error	When a start signal is input	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 04 ON	During stepper-up operation only
5	Thermostat error	When a start signal is not input	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 05 ON	
6	Thyristor short-circuit error	During SQ, C1, C2, and H0	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 06 ON	With a toroidal or CT coil connected only in source-voltage fluctuation compensation control mode
7	No-power supply error	During W1, W2, and W3	Cannot start		Reset error		Not turned on		ERROR	[ERROR] LED and error code 07 ON	• During constant-current control only • With 4 or more cycles set for welding current only
8	Current upper-and-lower-limit error	When W3 ends	Can start	Cannot start	Reset error or restart	Reset error	Turned on	Not turned on	ERROR	[CAUTION] LED lights up	Only in constant-current control mode
9	Cond. angle error	When W3 ends	Can start	Cannot start	Reset error or restart	Reset error	Turned on	Not turned on	ERROR	[CAUTION] LED lights up	Only in constant-current control mode
10	Full-wave error	When W3 ends	Can start	Cannot start	Reset error or restart	Reset error	Turned on	Not turned on	ERROR	[CAUTION] LED lights up	Only in source-voltage fluctuation compensation control mode
11	Total counter up	Upon completion of welding	Can start		Reset count		Turned on		ERROR	Monitored count blinks	
12	—	—	—		—		—		—	—	—
13	Step-up completion	Upon completion of welding	Can start		Reset step		Turned on		STEP END	[STEP END] LED lights up	

Note: Shaded items apply only when DSW1-(8) is set to ON.

(**CT-110E** error detection list)

(20) External input signals

① PROGRAM.LOCK: If a closed-contact signal is input, programming is locked.

② START 1,2,4,8,P: Five types of start signals - START 1, 2, 4, 8, and P (parity) - are available. A 4-bit input terminal is installed. Fifteen schedules can be selected using binary signals. In 15-schedule mode, parity check is available. Only odd parity can be checked, however. When using four schedules, use Schedules 1, 2, 4, and 8.

③ WELD ON/OFF: If a closed-contact signal is input, welding can start; if the contact is open, only sequential operation is executed.

④ THERMOSTAT: Connect to thyristor thermostat

⑤ STEP RESET: If a closed-contact signal is input, the step No. is returned to first step No.

⑥ ERROR RESET: If a closed-contact signal is input, the error alarm is reset. The contact outputs and LED turned on when an error occurs are turned off.

⑦ INTERLOCK/COUNT RESET (dip-switch-selectable):
If a closed-contact signal is input, the system waits for the power to be turned on or the count to be reset.

(21) External output signals

① HOLD END: Output for approximately 200 ms or until the start signal is turned off after the holding period (contact capacity: 110 V AC, 0.5 A)

a. If internal dip switch DSW1-(8) is set to ON, and the start signal is turned off within 200 ms after the holding period or operation is repeated, this contact is closed for 0.2 seconds.
b. This contact signal is also output when welding is stopped.

② ERROR: Output when an error occurs
(contact capacity: 110 V AC, 0.5 A)

③ STEP END: Output when the last step is finished in step-up operation mode (contact capacity: 110 V AC, 0.5 A)

④ VALVE 1: Outputs the control power-source voltage, 24 V DC, during the weld cycle

⑤ VALVE 2: Outputs the control power-source voltage, 24 V DC, during the weld cycle

⑥ WELD ON: Outputs during Weld I, II, and III

⑦ INTERLOCK/COUNT UP (dip-switch-selectable):
Outputs from 2 cycles from when the power is turned on until the power is turned off, or outputs when the counter expires (contact capacity: 110 V AC, 0.5 A)

(22) Operating ambient temperature: 0 - 45°C

(23) Power consumption: Control power --- 10 W max. (excluding valve output)

(24) Dimensions and mass

355 mm (H) x 110 mm (W) x 250 mm (D) (excluding fittings), 4.5 kg

(25) Accessories

① Fuse (spare): 2 pc.

② Fittings: 1 set

(2) Specification Chart

Model No. CT-110E-	Control power source	Welding power source		Valve output	Data out function	Toroidal coil
00-00	100V	220V	440V	100V	Available	MB-400L or standard x1 coil
00-01	120V	240V	480V	24V DC	Available	
00-03	220V	220V	380V	220V	Available	
00-08	230V	230V	400V	24V DC	Available	

(3) Data Out Function (Option)

Data out function (option) is for outputting the monitor data via RS-485. As to whether the function is equipped on your device or not, see (2) Specification Chart.

(1) Data out

Data is output when dip switch DSW2-(5) on the control is ON and DSW2-(1) is OFF (Pulsation).

① Data transmission

Method:	Conforms to RS-485, asynchronous, no set procedure	
Data transmission rate:	9600 bps	
Data format:	Start bit	1
	Data bit	8
	Stop bit	1
	Parity bit	Even

② Connector

CT-110E side: NJC2012-RM (Nanaboshi Electric Mfg. Co., Ltd.)
Attached plug: NJC2012-PF (Nanaboshi Electric Mfg. Co., Ltd.)

Pin No.	Name of signal
1-4	Not connected
5	DATA (+)
6	DATA (-)
7-12	Not connected

Note: The model numbers of connectors are subject to change without notice. Depending on the part to be changed, the mounting screw shape may change and a necessary tool may be different. For the latest parts information, contact a nearest sales office.

③ Data structure

ASCII-code character strings

a. Monitor data

M : □ □ ___
Fixed ①

□ □ . □ ___ □ □ □ ___ ± □ □ ___
②　　③　　④

□ □ . □ ___ □ □ □ ___ ± □ □ ___
⑤　　⑥　　⑦

□ □ . □ ___ □ □ □ ___ ± □ □ ___
⑧　　⑨　　⑩

□ □ . □ ___ □ □ □ ___ ± □ □ 「CR」
⑧　　⑨　　⑩

Starts with the character "M". Space code "20H" between each piece of data. Ends with CR code "0DH".

①: Start No.
②: Monitor the current value of WELD 1.
③: Monitor the conduction angle of WELD 1.
④: Deviation of the WELD 1 current. If the current is larger than the current setting, “+” is shown; if it is smaller, “-” is shown.
⑤: Monitor the current value of WELD 2.
⑥: Monitor the conduction angle of WELD 2.
⑦: Deviation of the WELD 2 current. If the current is larger than the current setting, “+” is shown; if it is smaller, “-” is shown.
⑧: Monitor the current value of WELD 3.
⑨: Monitor the conduction angle of WELD 3.
⑩: Deviation of the WELD 3 current. If the current is larger than current setting, “+” is shown; if it is smaller, “-” is shown.

Note: In pulsation mode, data on WELD 3 indicates the number of pulsations.

b. Error data

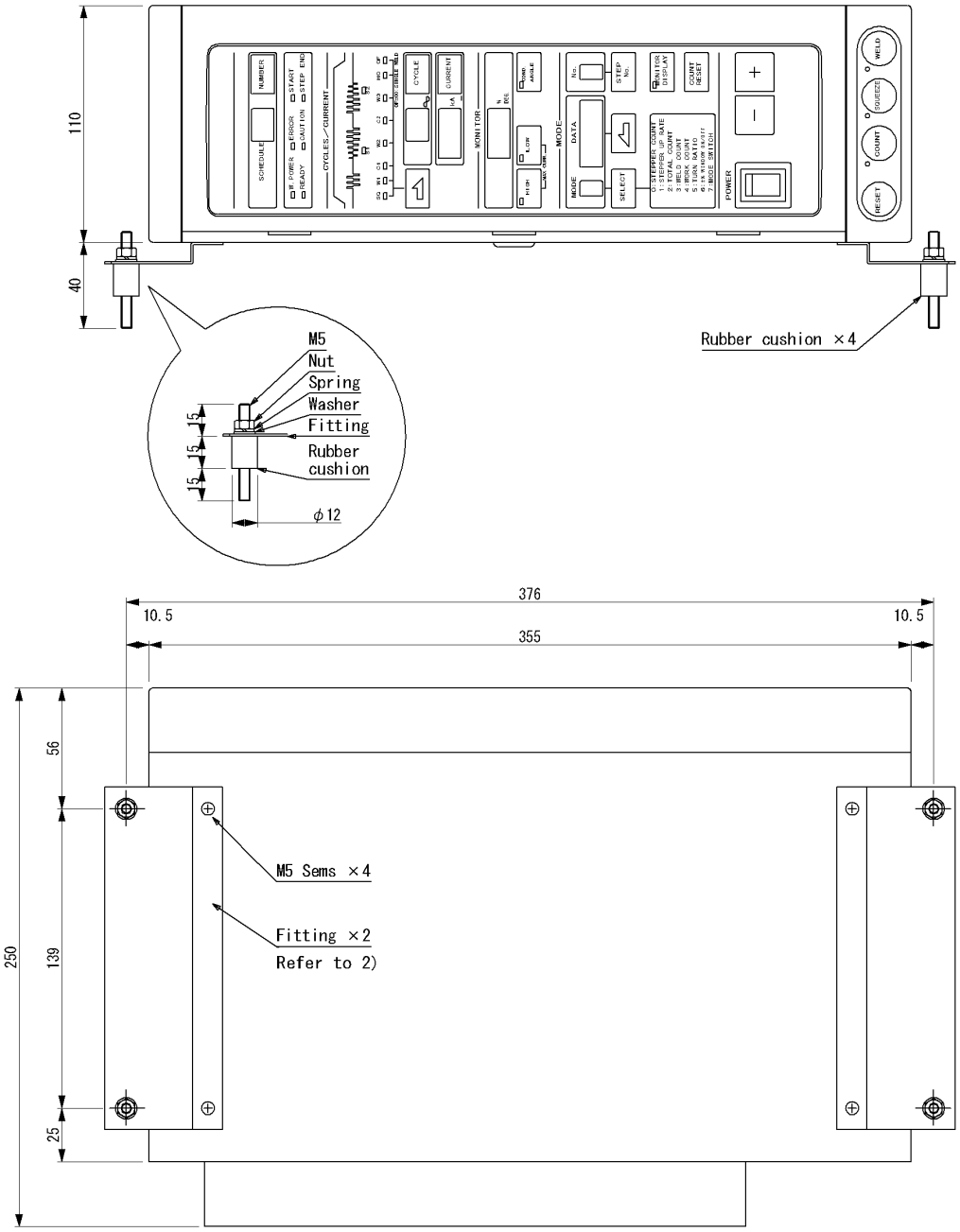
E : □ □ _ □ □ 「CR」
Fixed

Starts with "E:". The error code is 2 fixed digits, and a space code is inserted between two or more error codes. Ends with CR code "0DH".

Code	Contents	Code	Contents
01	Self-diagnosis error	07	No power supply error
02	Start-input error	08	Upper/lower-current-limit error
03	Current-setting error	09	Conduction-angle error
04	Current stepper-up rate setting error	10	Full-wave error
05	Thermostat error	11	Total count up
06	Thyristor short-circuit error	13	Stepper-up completion

(4) Outline Drawing

1) CT-110E

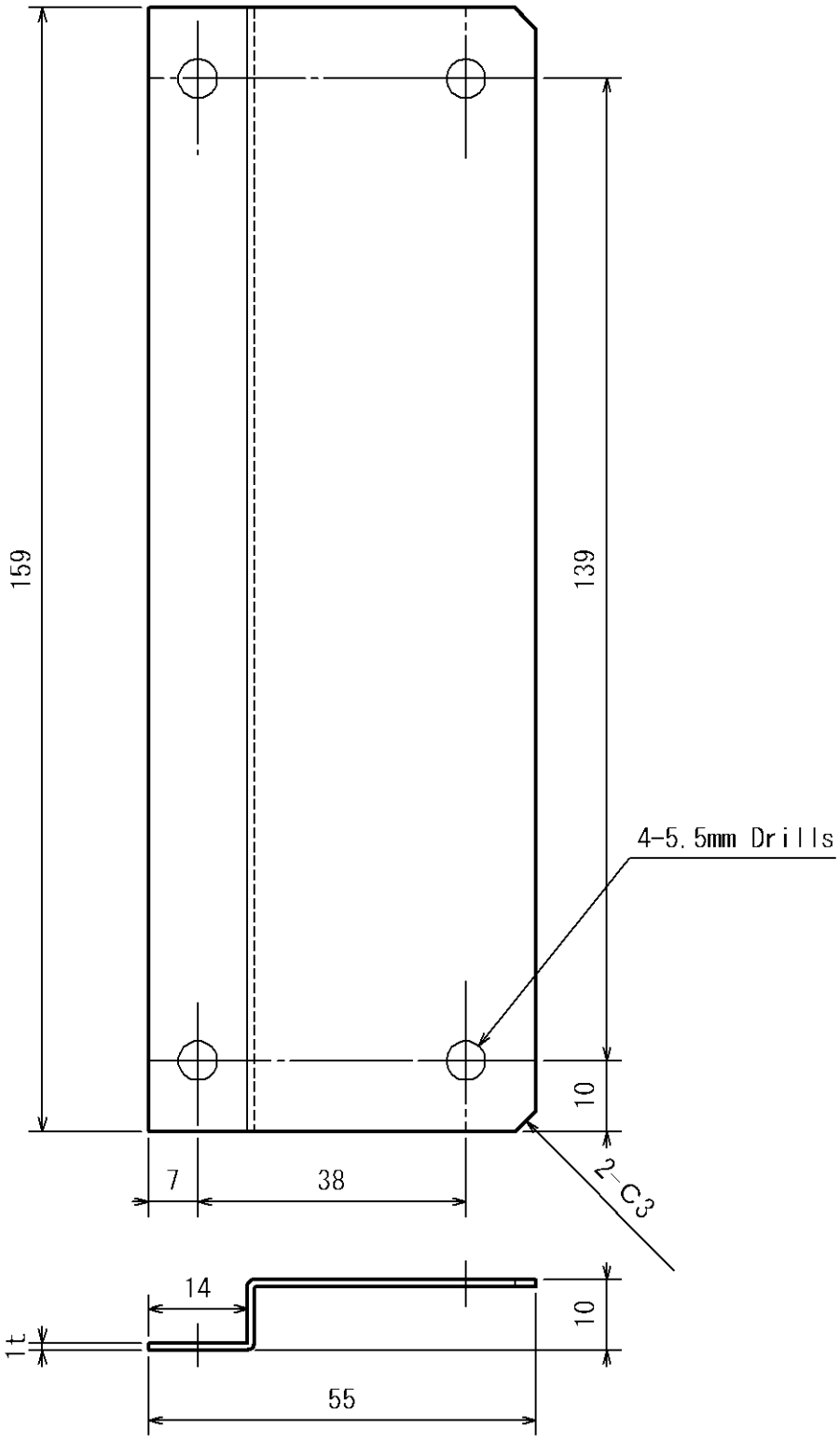


(Unit: mm)

Fittings set

M5 Rubber cushion:	4 pcs.	M5 Sems, 5 x 12:	4 pcs.
M5 Washer:	8 pcs.	M5 Nut:	8 pcs.
M5 Spring:	8 pcs.	Fittings (Upper and lower):	2 pcs.

2) Detail Drawing of Fitting



9. Schedule Data Table

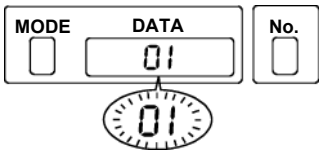
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Squeeze (SQ)															
Weld I (W1)															
Cool I (C1)															
Slope I (Up) (S1)															
Weld II (W2)															
Cool II (C2)															
Weld III (W3)															
Slope II (Down) (S2)															
Hold (HO)															
Pulsation/OFF (OF)															
Current I															
Current II															
Current III															
Cond. angle monitor setting															
+% monitor setting (High)															
-% monitor setting (Low)															

Current monitor 0: OFF; 1: ON	Weld I (W1)	Weld II (W2)	Weld III (W3)

Max. current																		
Turn ratio of transformer																		
Step 1	**Count**																	
Step 2	**Count**																	
	Stepper-up rate																	
Step 3	**Count**																	
	Stepper-up rate																	
Step 4	**Count**																	
	Stepper-up rate																	
Step 5	**Count**																	
	Stepper-up rate																	
Step 6	**Count**																	
	Stepper-up rate																	
Step 7	**Count**																	
	Stepper-up rate																	
Step 8	**Count**																	
	Stepper-up rate																	
Step 9	**Count**																	
	Stepper-up rate																	

Total counter	
Weld counter	
Mode switch	

10. Error Indication and Countermeasures



Each error code blinks in the "DATA" area on the panel.

Error Code	Contents	Countermeasures
01	Self-diagnosis error	Schedule data is different from the time of programming. Check all settings. If it appears again after initialization, repair is required. Please contact us.
02	Start input error	A parity check error of the start input was detected. Check the external programmable controller, start-input cable, etc.
03	Current-setting error	The current setting exceeds the maximum current setting. Lower the former below the latter. If the primary constant-current control is selected, confirm the following relationship: $\frac{\text{Max. current setting}}{\text{Turn ratio of transformer}} \leq 1500\ \text{A}$
04	Current stepper-up-rate setting error	For the stepper tip, confirm the following relationship: Max. current setting $\geq$ current setting x ($\frac{\text{Stepper - up rate}}{100}$)
05	Thermostat error	The thermostat signal [THERMOSTAT] is turned off. Check the thermostat and cooling-water temperature of the contactor.
06	Thyristor shot-circuit error	Thyristor is shorted. Check it.
07	No-power supply error	Current is not detected. Check the following: ① Determine whether enough force is applied to the electrode. ② Check the current-detecting coil (toroidal coil or CT) for breakage. ③ Check whether the current-detecting-coil connector is disconnected. ④ Confirm that the squeeze is set sufficiently long. (Set it longer than the stroke time of the electrode.) ⑤ Confirm that the maximum current is not set too high. ⑥ Check to confirm that the connections to 01 and (02) or 02 are proper. This error is not detected if the welding current is set at 3 cycles or less. Check the above points once again if no current flows with the welding current set at 3 cycles or less.