SK-54

Operation Manual Ver. 5421AC

FORWEL

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I. Outline and Features

1. Outline

- SK-54 is a constant-alternating current resistance weld control which has easy setting function, operation and which controlled with F.D.S.P (Full Digital Set-up Parameter) by micro-computer.

- Has 3-stage power-on by 15 schedules. With the plating layer treatment by the pre-stage current, heat treatment by the post-stage current, etc., splashing is prevented and the welding tip is protected from overheating and an ideal welding current can be set.

- SK-54 can be applied to the all kinds of spot welding machines by selecting the secondary current feed-back constant current control method.

- The required items can be set very simply and easily.

2. Features

- Indicates the schedule set No., set time, welding current, current monitor, etc., with 7-segment LED.

- Can store up to 15 schedules according to the materials and thickness of the workpieces to be welded.

- Equipped with the 3-stage power-on system which has functions to monitor the current and conduction angle, and up-slope and down-slope functions.

- Supplies a stable welding current by the secondary constant current control method compensation method.

- Has four counters to indicate the quantity of products and others.

- Don't need to have back-up battery because SK-54 stores all data to EEPROM.

- Has 7 functions by the pressure valve1, valve2.

- The function of self-adjustment for maximum current.
  ※ What is this function?
  Maximum current is adjusted automatically by considering the existing status of the weld power, weld transformer and secondary circuit. (Please refer to "page 28" for the procedure.)

- Printout functions
  1) Printout of welding schedules
  2) Real-time printout of welding current1,2 and 3
  3) Printout in case of welding current1,2 and 3 errors

- RS485 Network (Option)
  1) By using Welding data logger(Fcom_V2.3) software, Welding data can be collected from each SK54 controller at real time and the collected data can be stored by excel file at computer.
  2) One PC can be linked to maximum 32 units of SK54.
  3) Weld current data and schedule data can be requested to each of SK54, then the data can be seen and printed.
  4) Weld schedule can be changed by PC.
  5) When welding defects is occurred, event monitoring is available and time and weld current data can be checked easily at real time.
  6) Opto-Isolated RS485 converter(Option) is installed insode of SK54.
  7) PC and SK54 is connected by 2 electric wires and the length is maximum 1.2 Km.

II. Specifications

1. Specifications

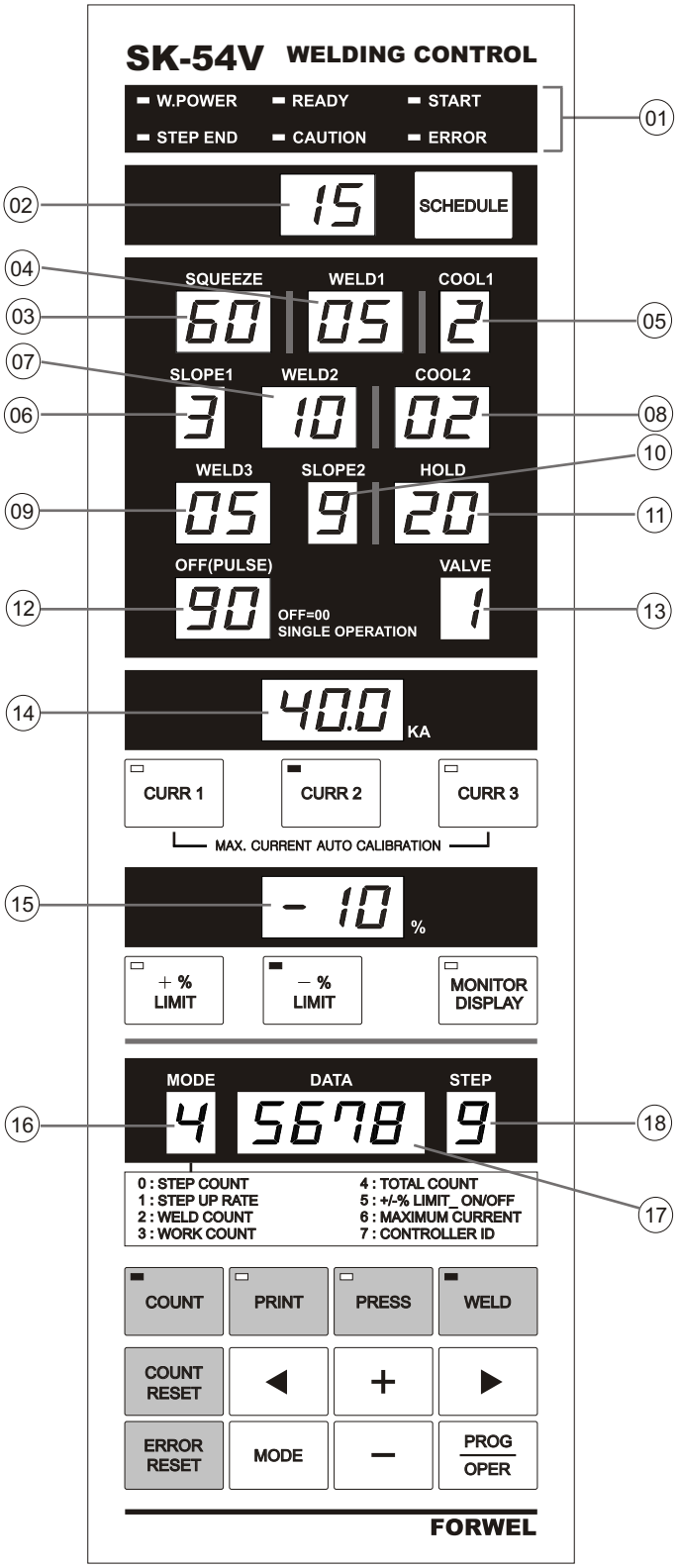
<table>
<tr><th colspan="2">MODEL</th><th>SK-54V</th><th>SK-54H</th></tr>
<tr><td colspan="2">Welding Power Source</td><td colspan="2">200~240VAC and 380~480VAC</td></tr>
<tr><td colspan="2">Control Power Source</td><td colspan="2">100~240VAC</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="2">50/60Hz</td></tr>
<tr><td colspan="2">Control Method</td><td colspan="2">Secondary feed-back constant current control
by phase control with thyristor</td></tr>
<tr><td colspan="2">Control Speed</td><td colspan="2">1/2 cycle</td></tr>
<tr><td colspan="2">Current Accuracy</td><td colspan="2">±2%</td></tr>
<tr><td colspan="2">Indication</td><td colspan="2">7-segment LED</td></tr>
<tr><td rowspan="11">Setting of
Timers</td><td>Schedule</td><td colspan="2">15 schedules</td></tr>
<tr><td>Squeeze Time</td><td colspan="2" rowspan="2">0..99 cycles</td></tr>
<tr><td>Weld 1 Time</td></tr>
<tr><td>Cool 1 Time</td><td colspan="2" rowspan="2">0..9 cycles</td></tr>
<tr><td>Up Slope Time</td></tr>
<tr><td>Weld 2 Time</td><td colspan="2">0..99 cycles</td></tr>
<tr><td>Cool 2 Time</td><td colspan="2">0..99 cycles or 0..99 half cycles(DSW1-1 ON)</td></tr>
<tr><td>Weld 3 Time</td><td colspan="2">0..99 cycles</td></tr>
<tr><td>Down Slope Time</td><td colspan="2">0..9 cycles</td></tr>
<tr><td>Hold Time</td><td colspan="2">0..99 cycles</td></tr>
<tr><td>Off Time / Pulsation</td><td colspan="2">0..99 cycles / 0..9 times</td></tr>
<tr><td>Valve</td><td colspan="2">7 operations</td></tr>
<tr><td colspan="2">Maximum Current Setting Range</td><td colspan="2">3.0KA to 80.0KA</td></tr>
<tr><td colspan="2">Current Setting Range</td><td colspan="2">15 schedules
Constant-current control mode, (0.3KA to 80.0KA)
Current1,2,3 : 10% to 100% of maximum current setting</td></tr>
<tr><td rowspan="2">Current
Monitor</td><td>Setting of Upper Limit</td><td colspan="2" rowspan="2">15 schedules, ±0 to 49%</td></tr>
<tr><td>Setting of Lower Limit</td></tr>
</table>

Pressure Valve	System	Valve No.1 or 2 can be selected for 15 schedules 7 operations
	Output	Valve 1, Valve 2 Control Voltage Output
Stepper up of Current	Step No.	0..9
	Step Count	0..9999
	Step Up Rate	50 to 200%
Counter	Weld Count	0..99
	Work Count	0..9999
	Total Count	0..9999
External Input (Dry contact or open collector)		Program Lock Switch
		Start 1,2,4,8 Switch
		Weld ON/OFF Switch
		Thermo Switch
		Step Reset Switch
		Error Reset Switch
		Interlock / Weld No. Switch
External Contact Output (250V 1A Max.)		Hold End Output
		Error Output
		Step End Output
		Interlock / Weld No. Error Output
Serial Output (Options)		RS232 / RS485 Interface
Memory Retention		10 years
Ambient Temperature		-10 to 55℃ (at non-freezing status)
Storage Temperature		-25 to 65℃ (at non-freezing status)
Ambient Humidity		35 to 85% RH
Dimensions	SK-54V	85mm(W) x 260mm(H) x 207mm(D), 3.3"(W) x 10.2"(H) x 8.1"(D)
	SK-54H	260mm(W) x 85mm(H) x 207mm(D), 10.2"(W) x 3.3"(H) x 8.1"(D)
Toroidal Coil		TC-450L, TC-600L (Option)

III. Name and Function of each section

1. Front panel

1) SK-54V _ Descriptions of display value

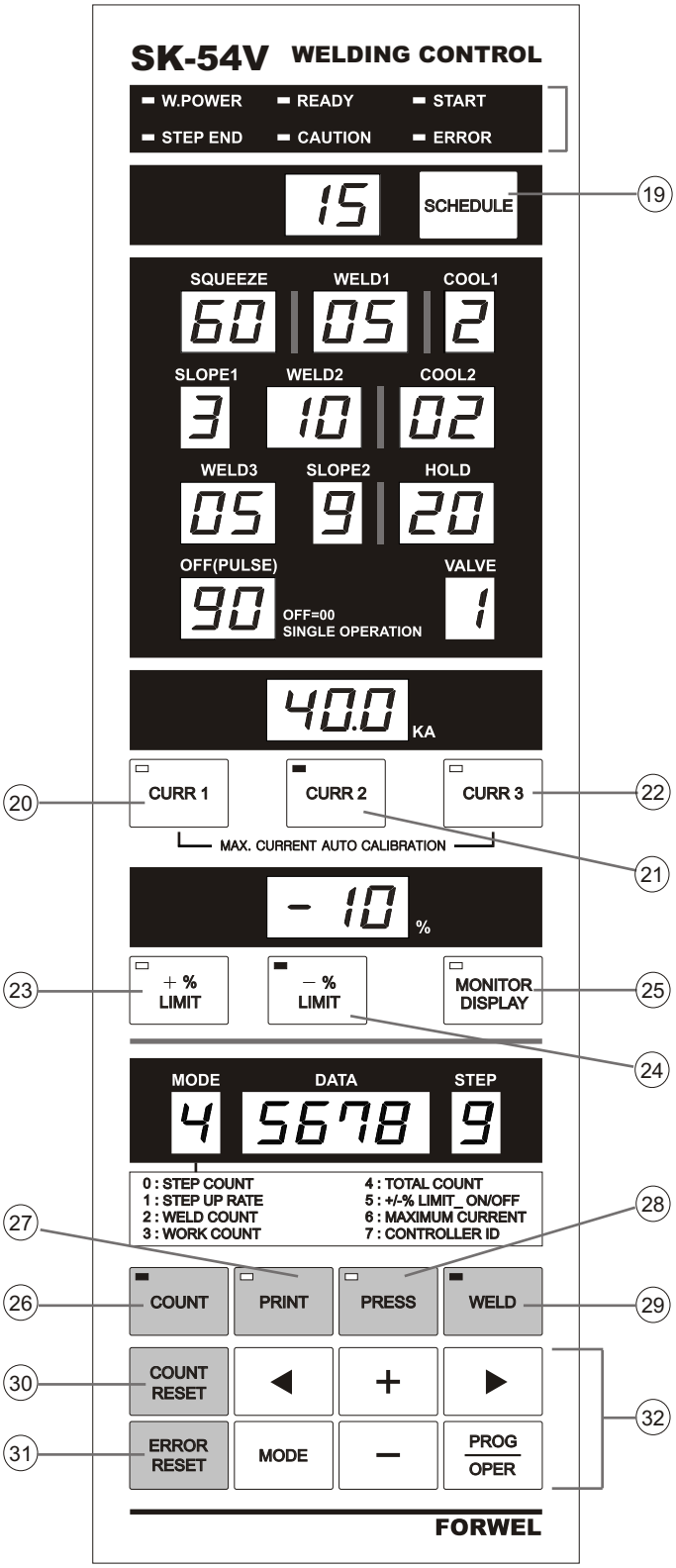


01) Indication of status
[W.POWER] LED
: Illumination for weld power ON.
[READY] LED
: Possible welding conditions are as belows ;
- [W.POWER] LED ON
- [WELD] LED ON
- External WELD ON (Pins12 and 13 in the terminal block) short
[START] LED
: Illumination when start switch1,2,4,8 operated.
[STEP END] LED
: Blinking when step completed.
[CAUTION] LED
: Illumination when out of limits ±%.
[ERROR] LED
: Illumination when error occurred.

02) SCHEDULE Indication
03) SQUEEZE Indication
04) WELD1 Indication
05) COOL1 Indication
06) SLOPE1 (UP SLOPE) Indication
07) WELD2 Indication
08) COOL2 Indication
09) WELD3 Indication
10) SLOPE2 (DOWN SLOPE) Indication
11) HOLD Indication
12) OFF Indication
PULSATION Indication
13) VALVE Indication

14) Indication and Monitor of CURR1,2,3
15) ±% Indication and Monitor of CURR1,2,3
16) MODE No. Indication
17) MODE and STEP Data Indication
18) STEP No. Indication

2) SK-54V _ Descriptions of preset value



19) SCHEDULE button
: Press to increase the schedule No. by 1.
20) CURR1 button
: Illumination when set curr1.
21) CURR2 button
: Illumination when set curr2.
22) CURR3 button
: Illumination when set curr3.
23) +% LIMIT button
: Illumination when set +%.
24) -% LIMIT button
: Illumination when set -%.
25) MONITOR DISPLAY button
: Illumination when display the measured current and ±%.

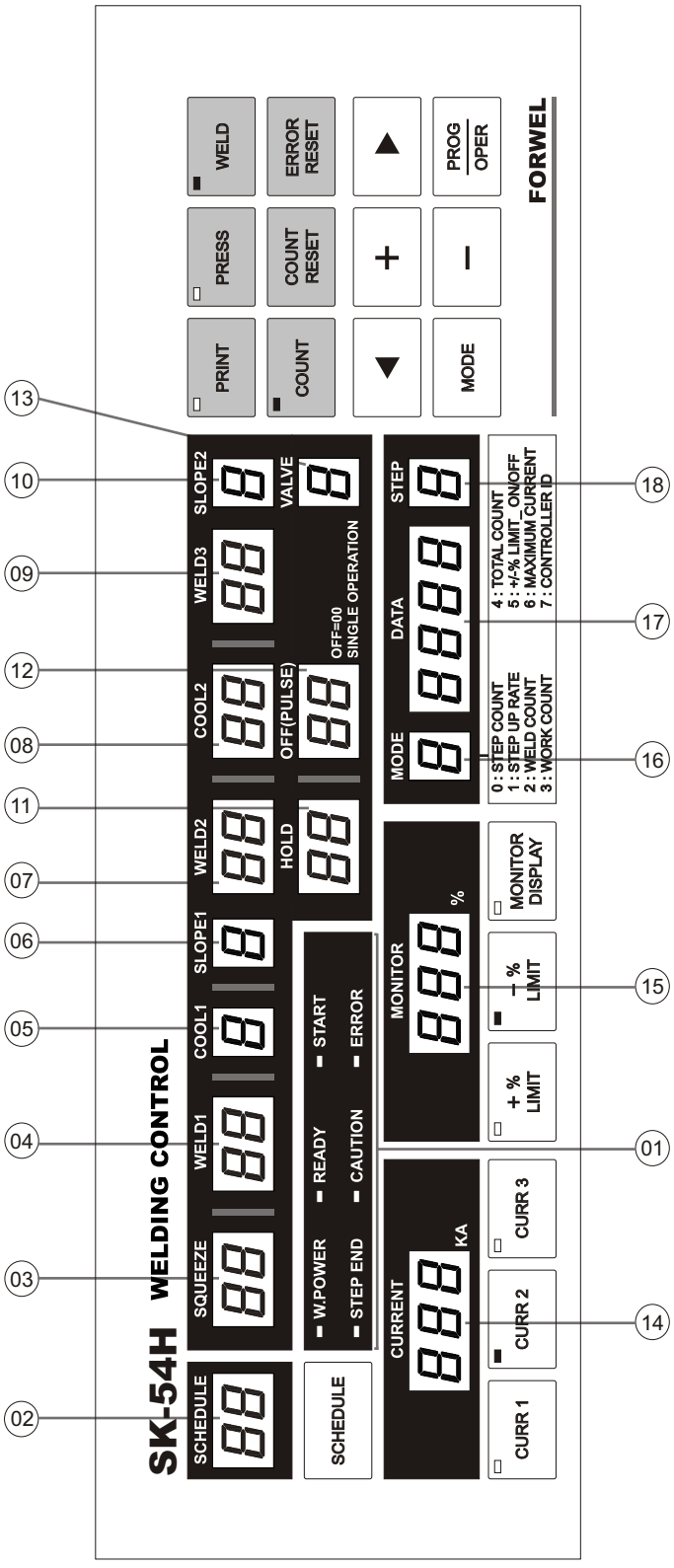
26) COUNT button
: Illumination when count function ON.
27) PRINT button (Printer option)
: Weld schedule print.

28) PRESS button
: Illumination when the press mode selected.
29) WELD button
: LED ON = WELD / LED OFF = TEST

30) COUNT RESET button
: Use to delete the mode2,3,4 on operation mode.
31) ERROR RESET button
: For reset the error.

32) Setter button explanation
[PROG/OPER] button
: To select the program and operation mode.
[MODE] button
: Press to increase the mode No. 1.
[◀] Button : Preset position to left.
[▶] Button : Preset position to right.
[+] Button : Data increase
[–] Button : Data decrease

3) SK-54H _ Descriptions of display value



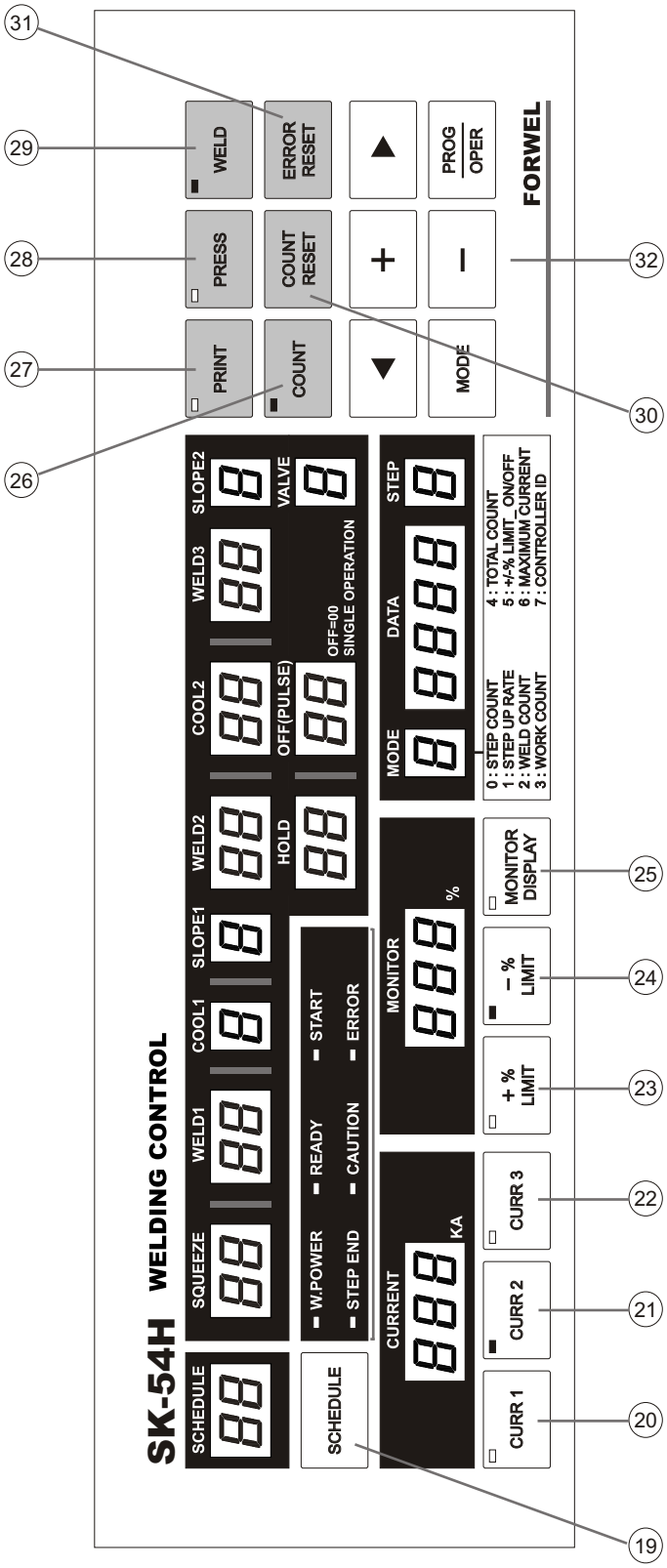
01) Indication of status
[W.POWER] LED
: Illumination for weld power ON.
[READY] LED
: Possible welding conditions are as belows ;
- [W.POWER] LED ON
- [WELD] LED ON
- External WELD ON (Pins12 and 13 in the terminal block) short.

[START] LED
: Illumination when start switch1,2,4,8 operated.
[STEP END] LED
: Blinking when step completed.
[CAUTION] LED
: Illumination when out of limits ±%.
[ERROR] LED
: Illumination when error occurred.

02) SCHEDULE Indication
03) SQUEEZE Indication
04) WELD1 Indication
05) COOL1 Indication
06) SLOPE1 (UP SLOPE) Indication
07) WELD2 Indication
08) COOL2 Indication
09) WELD3 Indication
10) SLOPE2 (DOWN SLOPE) Indication
11) HOLD Indication
12) OFF Indication
PULSATION Indication
13) VALVE Indication

14) Indication and Monitor of CURR1,2,3
15) ±% Indication and Monitor of CURR1,2,3
16) MODE No. Indication
17) MODE and STEP Data Indication
18) STEP No. Indication

4) SK-54H _ Descriptions of preset value



19) SCHEDULE button
: Press to increase the schedule No. by 1.

20) CURR1 button
: Illumination when set curr1.

21) CURR2 button
: Illumination when set curr2.

22) CURR3 button
: Illumination when set curr3.

23) +% LIMIT button
: Illumination when set +%.

24) -% LIMIT button
: Illumination when set -%.

25) MONITOR DISPLAY button
: Illumination when display the measured current and ±%.

26) COUNT button
: Illumination when count function ON.

27) PRINT button (Printer option)
: Weld schedule print.

28) PRESS button
: Illumination when the press mode selected.

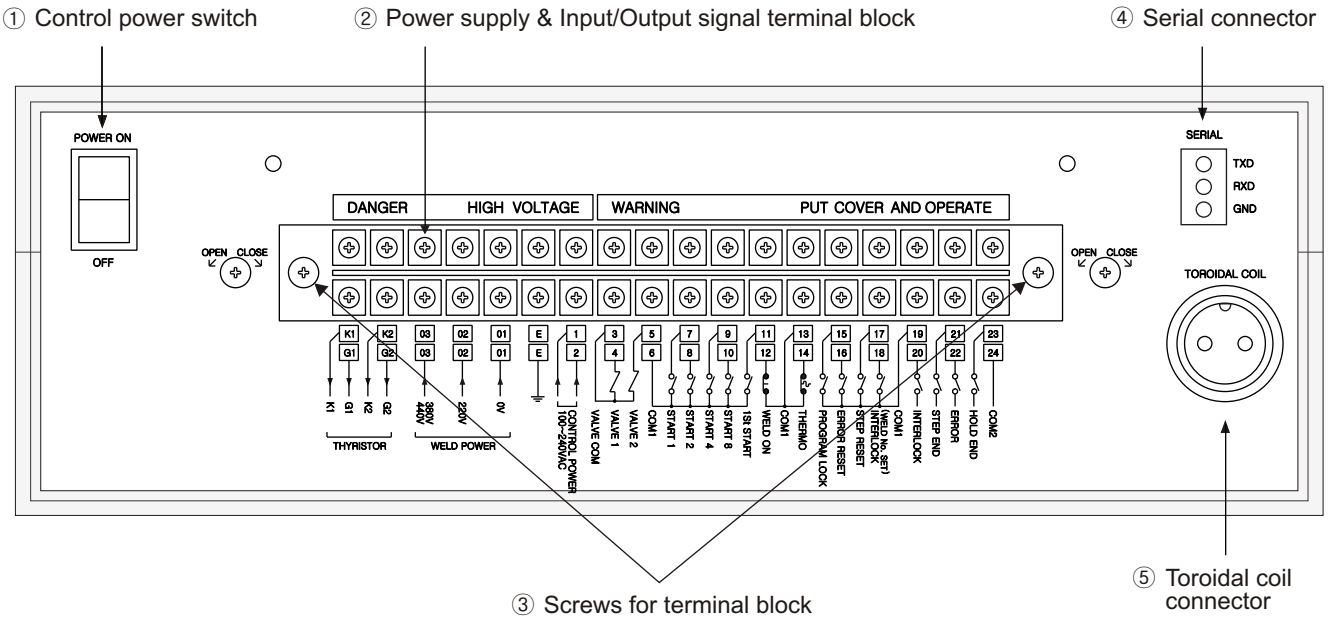
29) WELD btton
: LED ON = WELD / LED OFF = TEST

30) COUNT RESET button
: Use to delete the mode2,3,4 on operation mode.

31) ERROR RESET button
: For reset the error.

32) Setter button explanation
[PROG/OPER] button
: To select the program and operation mode.
[MODE] button
: Press to increase the mode No. 1.
[◀] Button : Preset position to left.
[▶] Button : Preset position to right.
[+] Button : Data increase
[–] Button : Data decrease

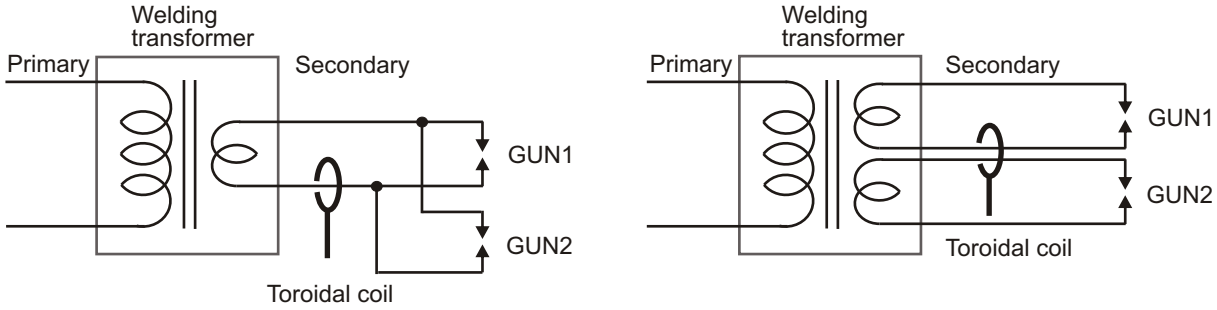
2. Rear panel(Separable terminal block)



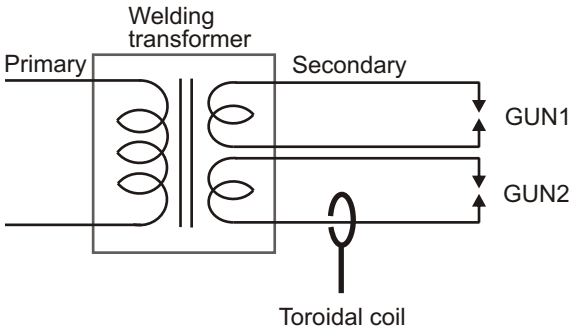
3. Installation method for Toroidal coil

1) Install the toroidal coil to the secondary of the welding transformer. If two or more welding guns are used, install the toroidal coil as shown below :

① When only one gun welds at a time



② When two or more guns weld at a time

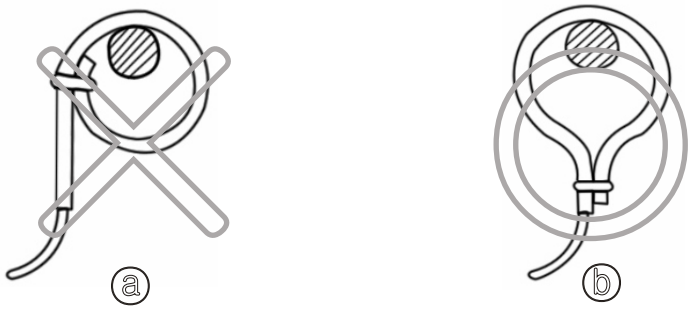


Current of only one circuit is kept constant in this case.

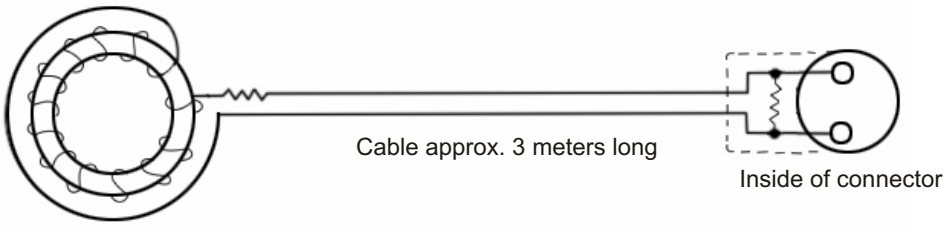
2) Precautions for installation of Toroidal coil

If the toroidal coil is broken in the constant current control mode, an error signal is output and the operation stops. Accordingly, select a proper installing position of the toroidal coil so that it will not be broken by the temperature rise of the conductor, mechanism motion, contact with a workpiece, etc.
In addition, secure the toroidal coil to the conductor.

① If the toroidal coil is wound onto the conductor as shown in Fig.ⓐ, an error is made. Accordingly, wind it as shown in Fig.ⓑ.

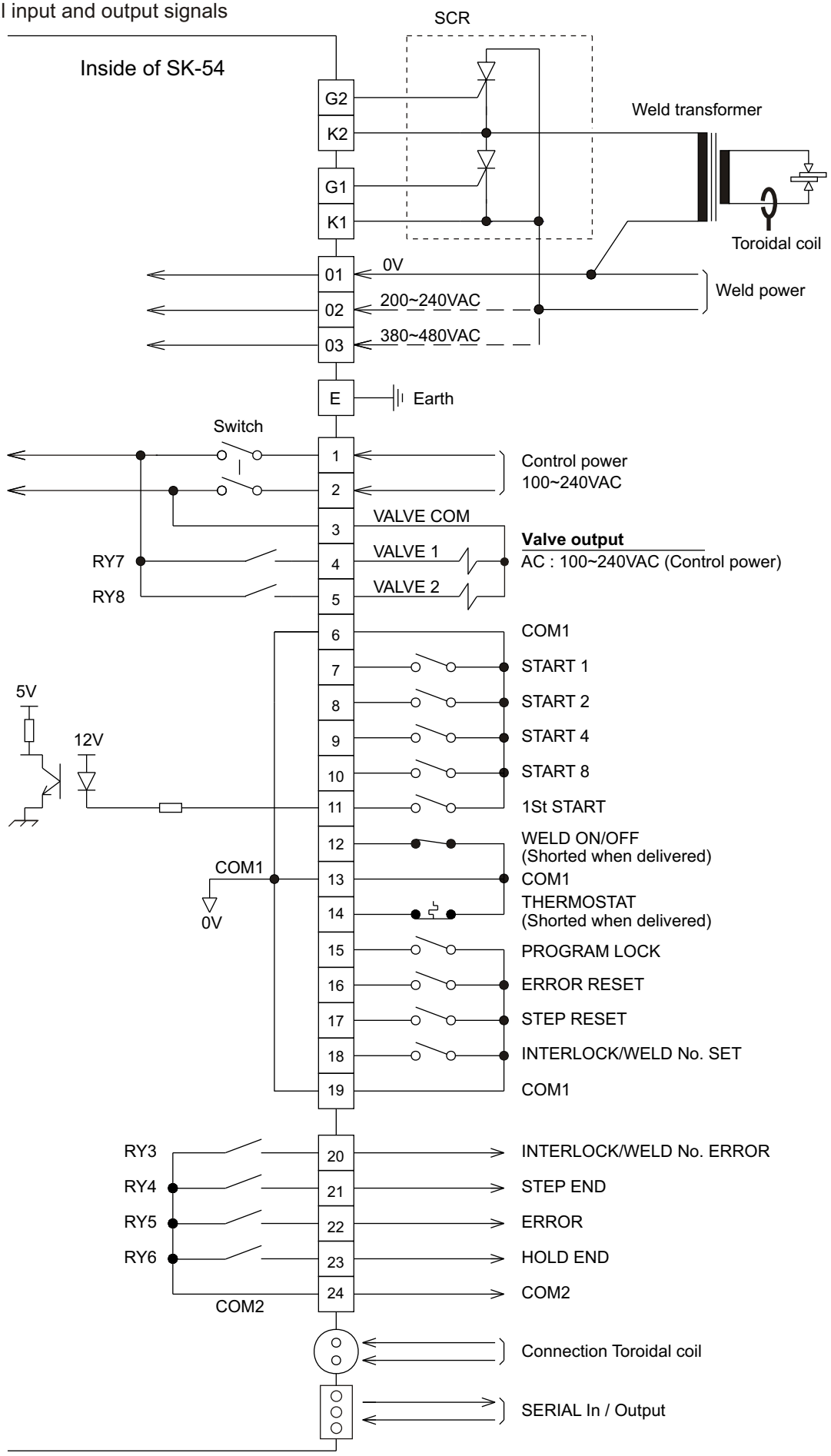


② The sensitivity of each toroidal coil is adjusted so that it will detect the current accurately. If its cable is cut halfway and extended or if the connector is disassembled, the current cannot be kept constant.



4. Connections

1) External input and output signals



2) Explanation of External Input and Output Signals

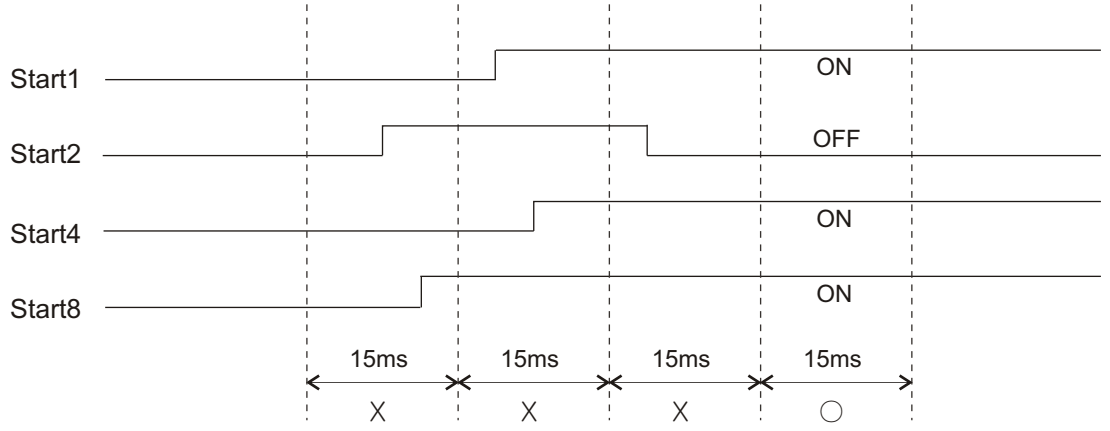
1	Pins 1 and 2	Terminals to input control power source.
2	Pin 3	Common terminal for VALVE output.
3	Pin 4	Output terminal for VALVE1
4	Pin 5	Output terminal for VALVE2
5	Pin 6	Common terminal for START input.
6	Pins 7~10	Input terminals for START1, START2, START4 and START8. 7_START1, 8_START2, 9_START4, 10_START8
7	Pin 11	1St START Input terminal. (It is available when DSW2-(7) is ON only)
8	Pins 12 and 13	WELD ON/OFF input terminals. If these are closed, weld is enabled, and if open, the weld is disabled.
9	Pins 13 and 14	THERMOSTAT input terminals. Connect to the thermostat in transformer. If it is open, the thermostat error signal is output.
10	Pin 15	Terminal to input PROGRAM LOCK signal. If this is open, a weld schedule can be changed, and if closed, the schedule cannot be changed.
11	Pin 16	ERROR RESET input terminal. If this is turned on, the error output is reset.
12	Pin 17	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.
13	Pin 18	INTERLOCK / WELD No. SET input terminal. Input the interlock signal to this terminal when the interlock function is selected. Input a workpiece-confirming signal, which is on if the workpiece is set and off if removed, when the weld count monitor function is selected.
14	Pin 19	Common terminal for Pins 15, 16, 17 and 18.
15	Pin 20	Terminals to output INTERLOCK / WELD No. ERROR signals. When the interlock function is selected, the interlock signal (contact to be closed) is output. When the weld count monitor function is selected, the weld count error signal (contact to be closed) is output.
16	Pin 21	Terminals to output the SETP END signal. The contact closed upon completion of the last step is output.
17	Pin 22	Terminals to output ERROR signals. The contact closed when an error is made is output.
18	Pin 23	Terminal to output the HOLD END signals. The contact closed upon completion of the hold time is output.
19	Pin 24	Common terminal for Pins 20, 21, 22 and 23.

5. Inputting method for start signals

1) Select up to 15 schedules by inputting the four signals of Start1, Start2, Start4 and Start 8 in binary format.

Schedule	START1	START2	START4	START8
1	●			
2		●		
3	●	●		
4			●	
5	●		●	
6		●	●	
7	●	●	●	
8				●
9	●			●
10		●		●
11	●	●		●
12			●	●
13	●		●	●
14		●	●	●
15	●	●	●	●

● ····· ON
Blank ····· OFF



Schedule will be decided when same status of starts is maintained over 15ms.

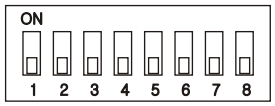
① 15 Schedules (DSW2-(4) OFF) : Schedule will be 13.

② 4 Schedules (DSW2-(4) ON) : Schedule will be 1. The first No. of stay "ON" will be the schedule.

6. Setting of dip switches

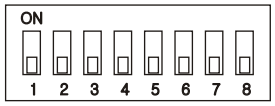
When setting the dip switches on the board, please check that Welding power and control power is off, and then remove the cover and proceed the setting by safety situation.

1) Setting status(Factory settings)



DSW2

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



DSW1

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

Note : Please do not set dip switch during power "ON". Dip switch should be set during power "OFF".

2) Functions set with dip switches

DSW		ON	OFF
DSW1	1	COOL 2 TIME Half cycle	COOL 2 TIME Full cycle
	2	RS485_Network & Remote Control (Option)	RS232_Print Output (Option)
	3	Serial Output _38400bps	Serial Output _57600bps
	4	Linear Stepper function	9 Stepper function
	5	Step count enable	Step count disable
	6	Re-power-on enable	Re-power-on disable
	7	Output of holding finish signal level	Output of holding finish signal pulse
	8	When current monitor has trouble, holding finish signal is not output and welding cannot be started again.	When current monitor has trouble, holding finish signal is output and welding can be started again.
DSW2	1	Pulsation function	Repeating function
	2	Weld count monitor function	Interlock function
	3	Start with schedule No. on panel	Start with external schedule No.
	4	4 schedule start	15 schedule start
	5	Seam & Roll Spot operation	Spot & Pulsation operation
	6	Self-holding of start signal at squeeze	Self-holding of start signal at weld start
	7	1St Start Input enable	1St Start Input disable
	8		Kept turned off.

3) Explanation of Functions of Dip Switch1

1. DSW1-(1) : Select the COOL 2TIME
   OFF : COOL 2 TIME Full cycle
   ON : COOL 2 TIME Half cycle
2. DSW1-(2) : Select serial communication method. (Option)
   OFF : RS232 _Print Output
   ON : RS485_Network & Remote Control
3. DSW1-(3) : Select the speed of data transmission of serial communication.
   OFF : 57600 bps
   ON : 38400 bps
4. DSW1-(4) : Select stepper function.
   OFF : Function of 9 Stepper
   ON : Function of Linear Stepper
   If this dip switch is turned off, step No. 0~9 is worked.
   If it is turned on, step No. will be “0” , and No. 1~9 can not be set.
5. DSW1-(5) : Select the use/no use the Stepper function.
   OFF : Step Count Disable (OFF)
   ON : Step Count Enable (ON)
6. DSW1-(6) : Select the power to be supplied again or not, when the lower current limit is detected or no current flows.
   OFF : Re-power-on Disable
   ON : Re-power-on Enable
7. DSW1-(7) : Select the length of time to output the holding finish signal.
   OFF : Output of holding finish signal pulse
   ON : Output of holding finish signal level
   When OFF, Output will be for 0.2 seconds.
   When ON, Output for 2 seconds or until the finish of off time.
8. DSW1-(8) : Select the action against a current monitor error.
   OFF : When current monitor has trouble, holding finish signal is output and welding can be started again.
   ON : When current monitor has trouble, holding finish signal is not output and welding cannot be started again.

4) Explanation of Functions of Dip Switch2

1. DSW2-(1) : Select the pulsation function or repeating function.

   OFF : Repeating function

   ON : Pulsation function (COOL2 and WELD3)

   If this dip switch is turned off, the repeating function will be selected and it will be OFF time.

   If the dip switch is turned on, the pulsation function will be selected and OFF time will be the set number of pulsation.

2. DSW2-(2) : Select the interlock function or weld count monitor function.

   OFF : Interlock function

   ON : Weld count monitor function

   If this dip switch is turned off, the interlock function is selected. In this case, Pins18 and 19 in the terminal block on the rear side is used to input the interlock signals and Pins20 and 24 are used to output the interlock signals.

   If the dip switch is turned on, the weld count monitor function is selected. In this case, Pins18 and 19 in the terminal block on the rear side is used to input the set weld count and Pins20 and 24 are used to output the weld count error signals.

3. DSW2-(3) : Select a schedule No.

   OFF : Start with external schedule No.

   ON : Start with schedule No. on panel

   If this dip switch is turned off, a schedule No. is selected and the operation starts upon receiving start signal 1, 2, 4 and 8 are received from outside.

   If the dip switch is turned on, the operation starts upon receiving a start signal No. selected with the panel. The schedule can be changed by pressing the schedule input button.

4. DSW2-(4) : Select start with 4-schedule start mode or 15-schedule start mode upon receiving an external start signal.

   OFF : 15-schedule start mode

   ON : 4-schedule start mode

   If this dip switch is turned off, 15-schedule made by combining start signals 1, 2, 4 and 8 are selected.

   If the dip switch is turned on, the start signal of the least No. of 1, 2, 4 and 8 which are on 15ms after the first start signal is turned on is selected.

5. DSW2-(5) : Select the operation “Spot” or “Seam”.

   OFF : Spot & Pulsation operation

   ON : Seam & Roll Spot operation

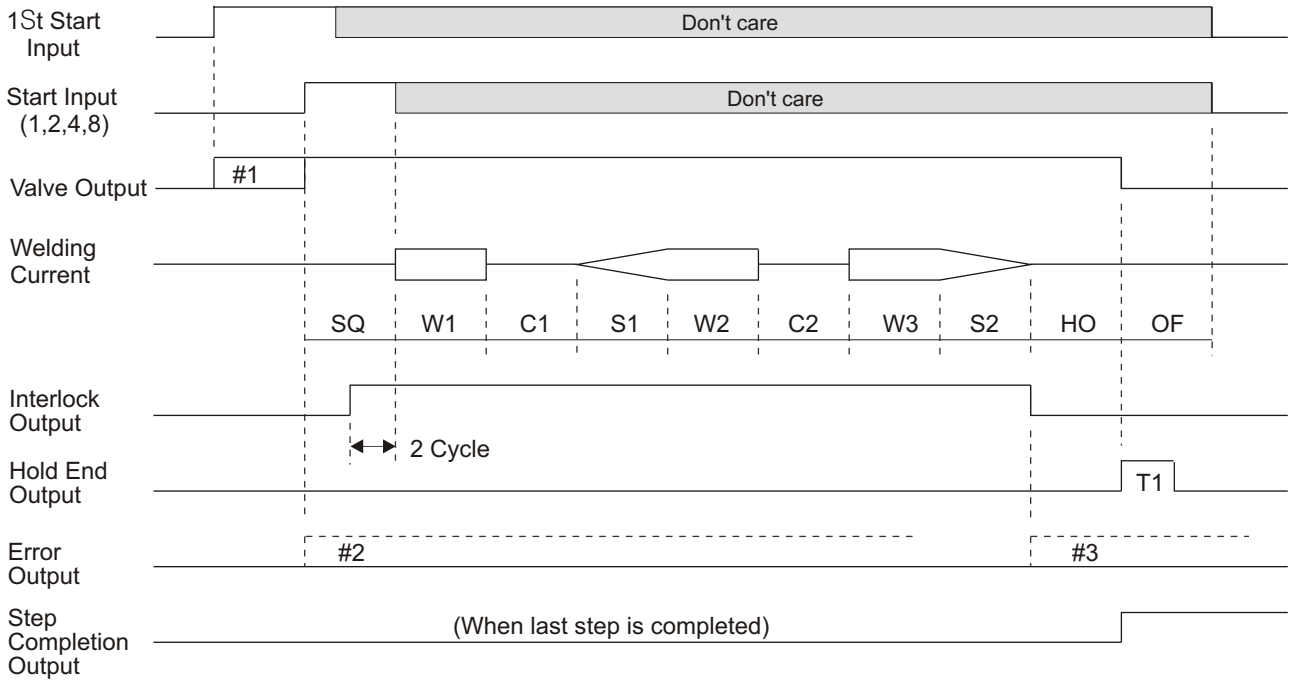
6. DSW2-(6) Select the self-holding timing for the start signal.

   OFF : Self-holding of start signal at weld(WELD 1) start

   ON : Self-holding of start signal at squeeze

7. Time Chart

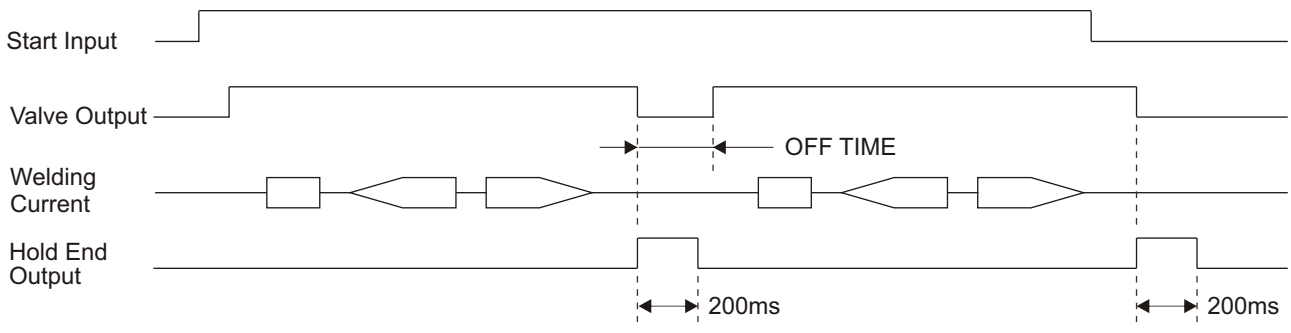
1) Time chart of basic operation



- #1 : This functions is available only when DSW2-(7) is ON.
  If DSW2-(7) is OFF, 1St Start Input is invalid.
- #2 : When an error is detected
- #3 : When caution for current is output
- T1 : This is set to 200ms if the start input signal is turned off before the hold starts or if it is turned off 200ms after the hold is finished.
- If pulsation is set to 1 or higher, cool2 and weld3 are repeated by the set number of pulsations.

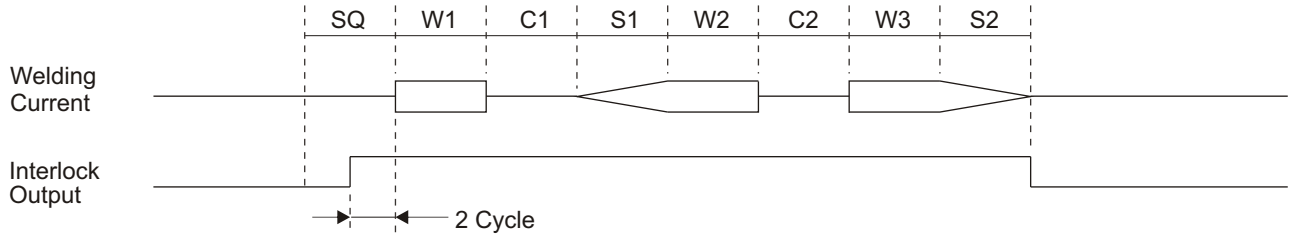
SQ	: SQUEEZE	C2	: COOL2
W1	: WELD1	W3	: WELD3
C1	: COOL1	S2	: SLOPE2 (DOWN SLOPE)
S1	: SLOPE1 (UP SLOPE)	HO	: HOLD
W2	: WELD2	OF	: OFF

2) Time chart of repeating operation (When DSW2-(1) is turned off)



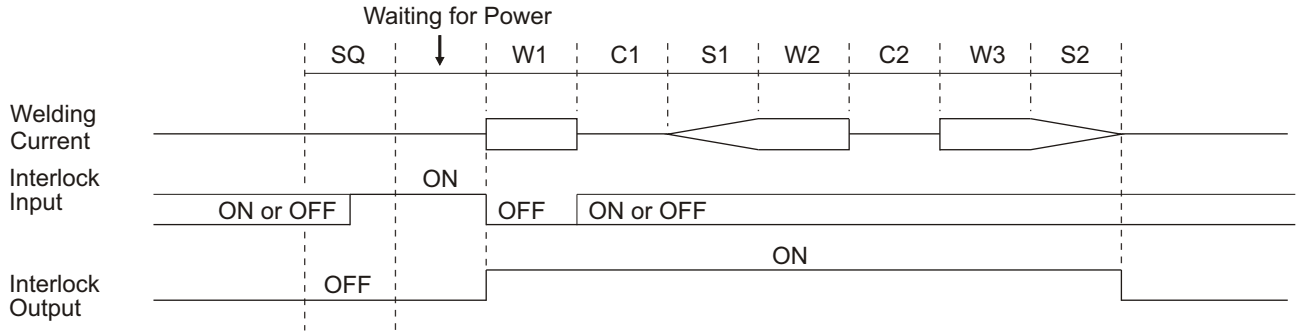
3) Time chart of interlock operation (When DSW2-(2) is turned off)

① When the interlock signal is not input



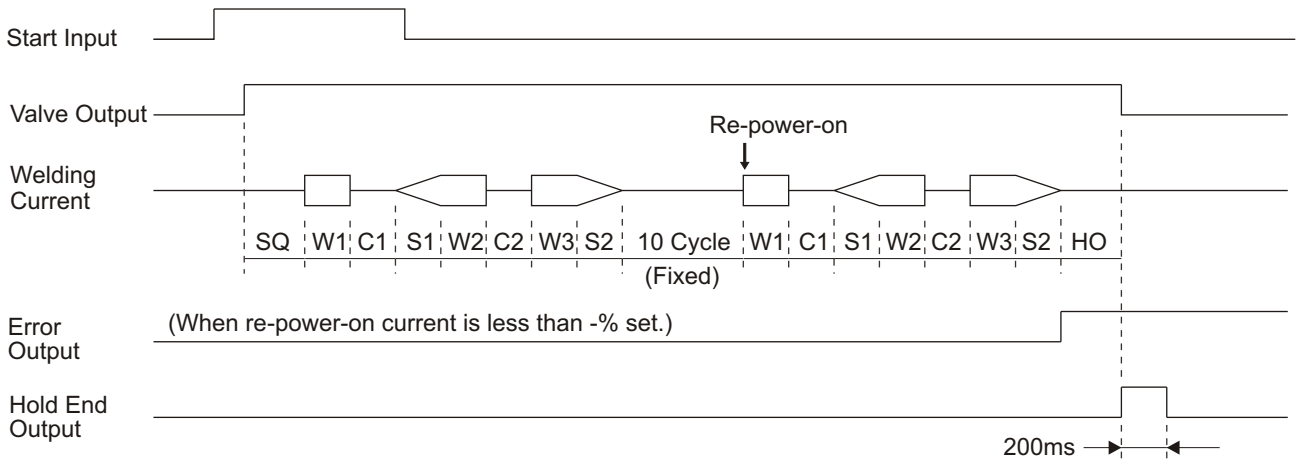
- The interlock output is turned on two cycles before the power is turned on.
- If Squeeze is set to 0 cycle, the interlock output is turned on when the powr is turned on.

② When the interlock signal is input



- The operation stops during the period to wait for the power in the squeeze state. The system waits, indicating the set squeeze time, until the interlock input is turned off.
- If the interlock input is truned off while the system is waiting for the power, the interlock output is turned on, then the power is turned on.

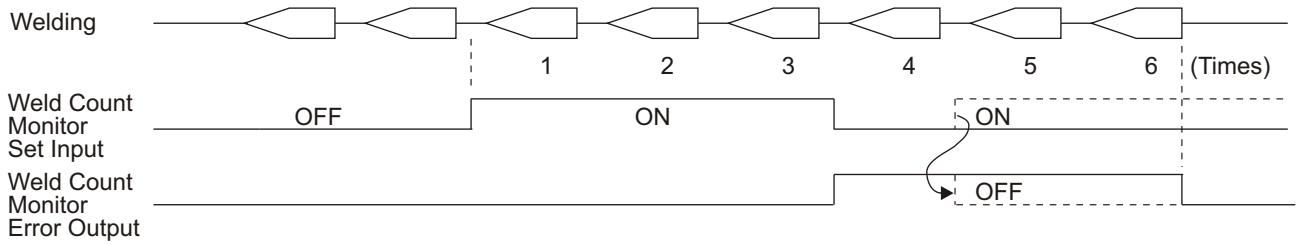
4) Time chart of re-power-on operation (When DSW1-(6) is turned on)



- The power is turned on again when the welding current is less than -% set or no power is turned on.

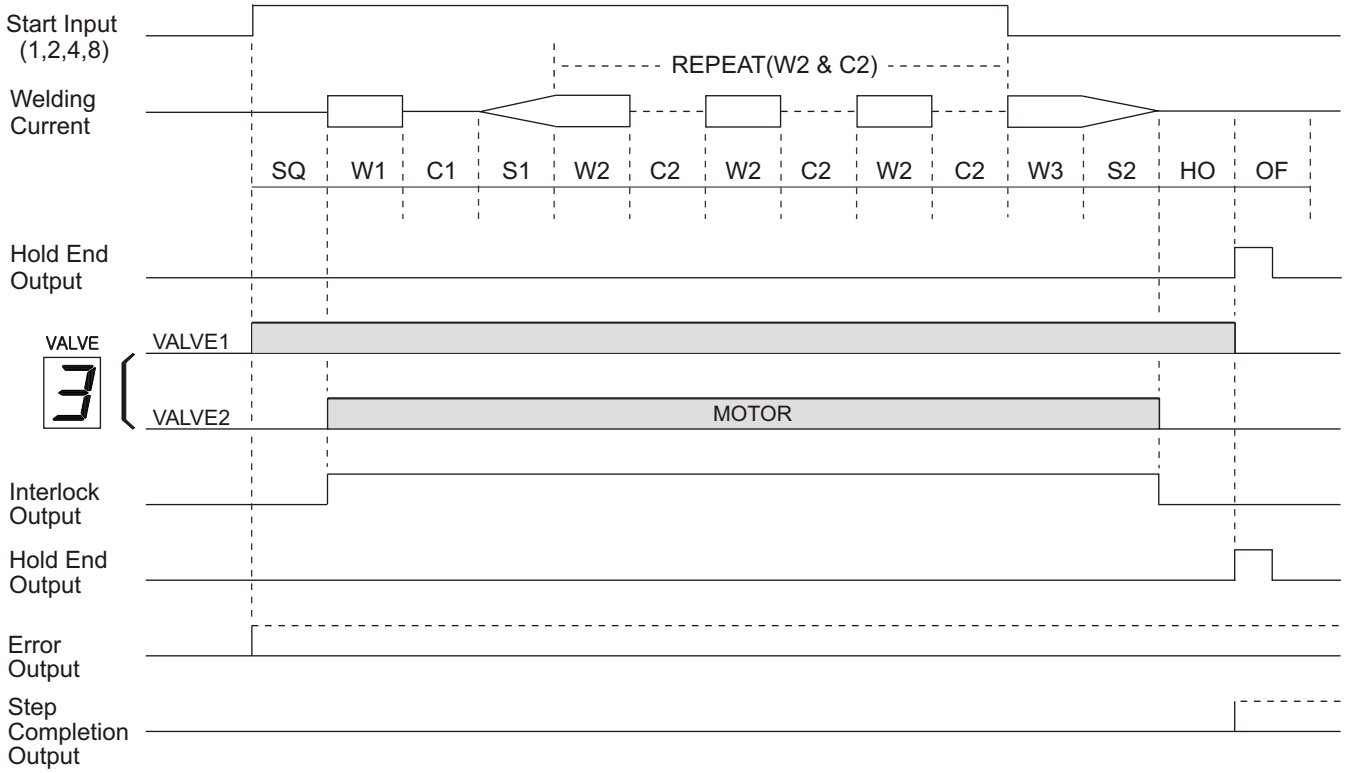
5) Time chart of weld count monitor (When DSW2-(2) is turned on)

(Example of counting of 6)

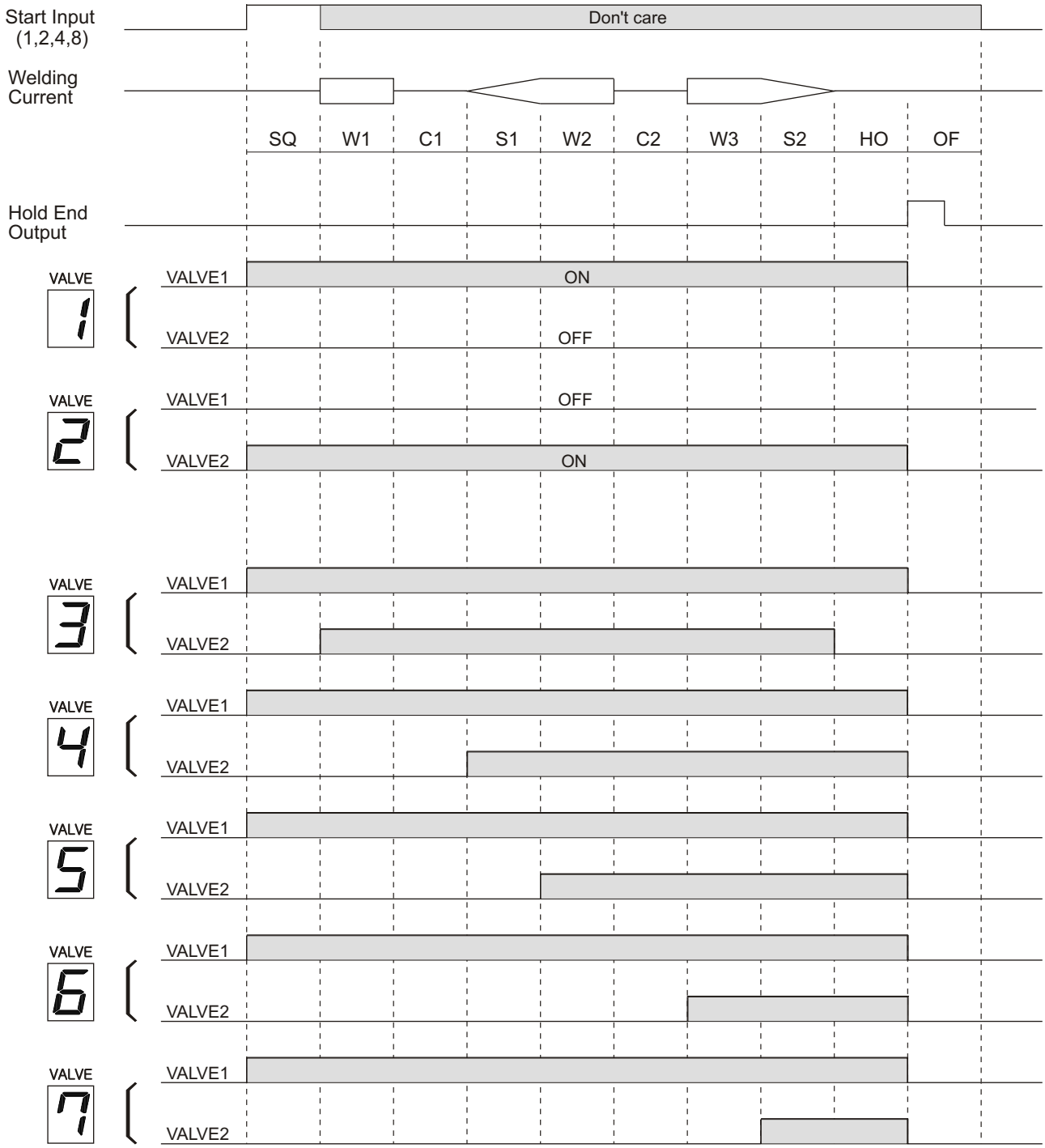


- The numer of welds is counted while the weld count monitor set input is turned on.
- When the weld count monitor set input is turned off, the number counted is compared whith the number set. If the former is less than the latter, a weld count monitor error is output.
- The weld count monitor error output is rreset in the following cases.
  - When insufficiency of the number of weld shots are performed.
  - When the weld count set input is turned on again.

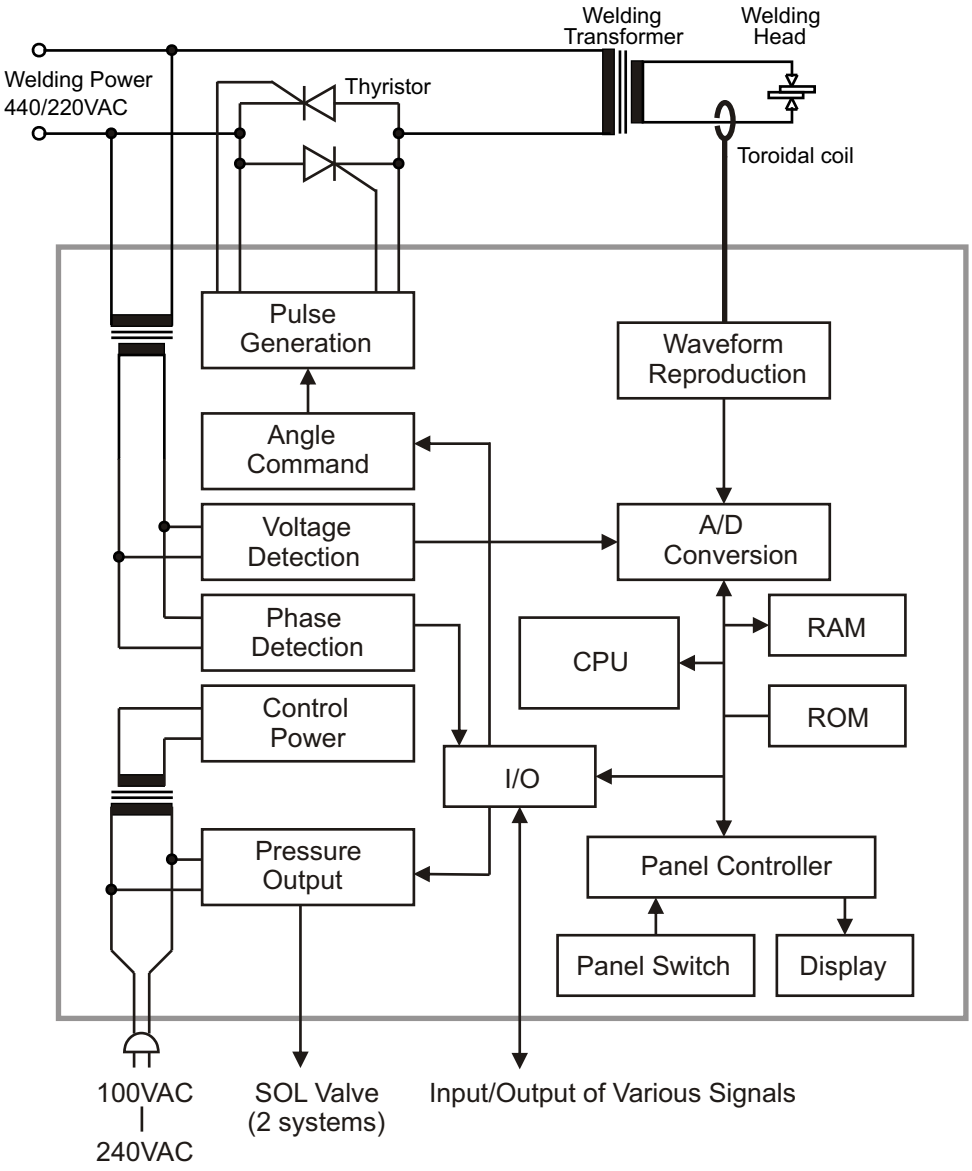
6) Time chart of seam welding operation (When DSW2-(5) is turned on)



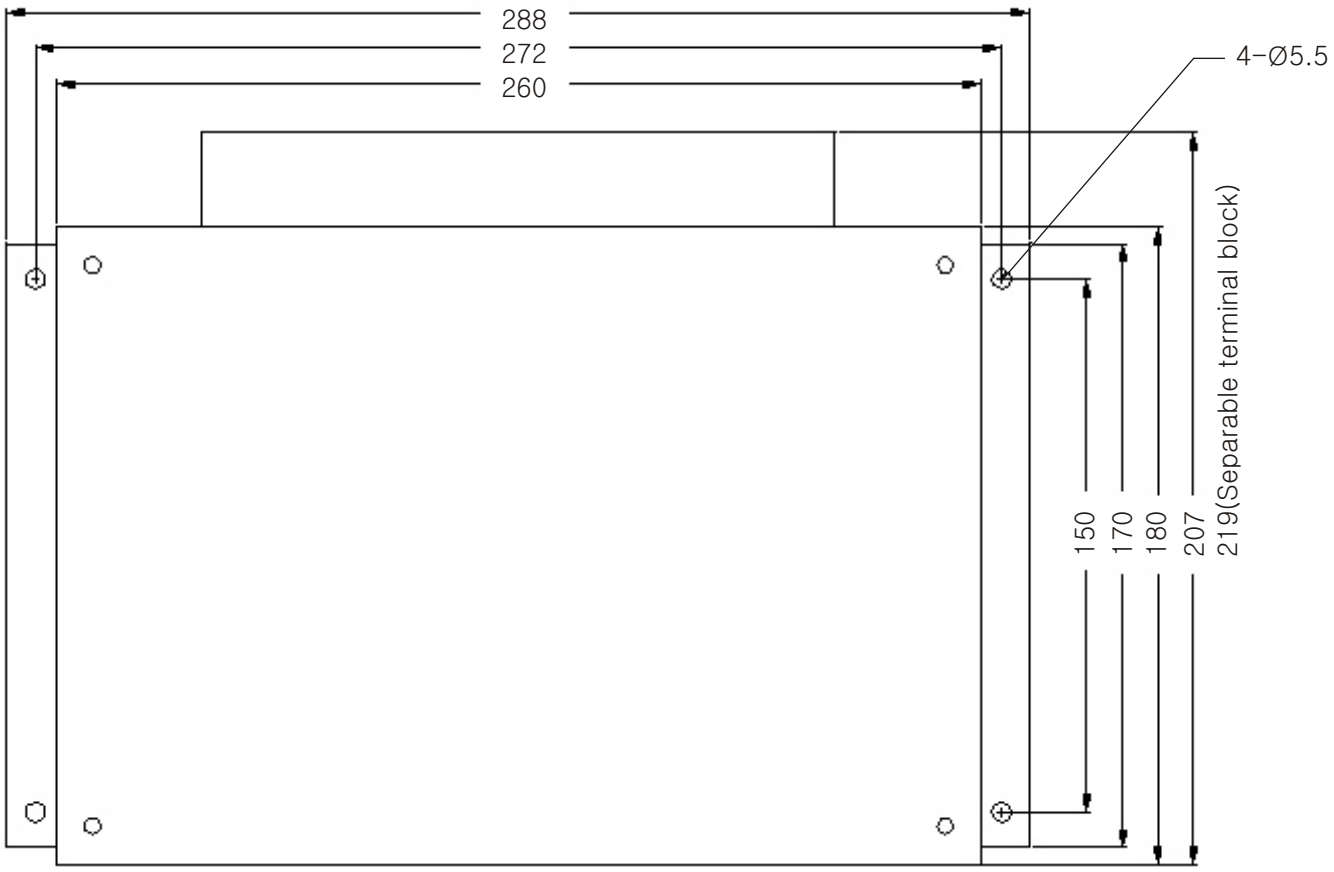
7) Time chart of 4-Schedule & 15-Schedule valve operation

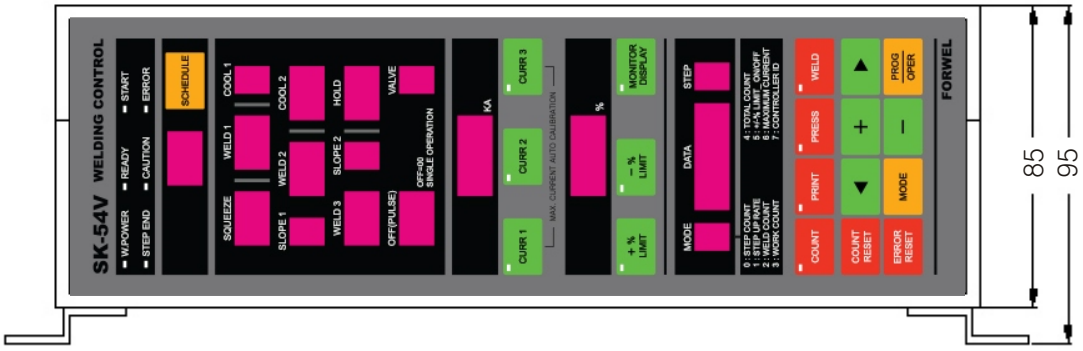


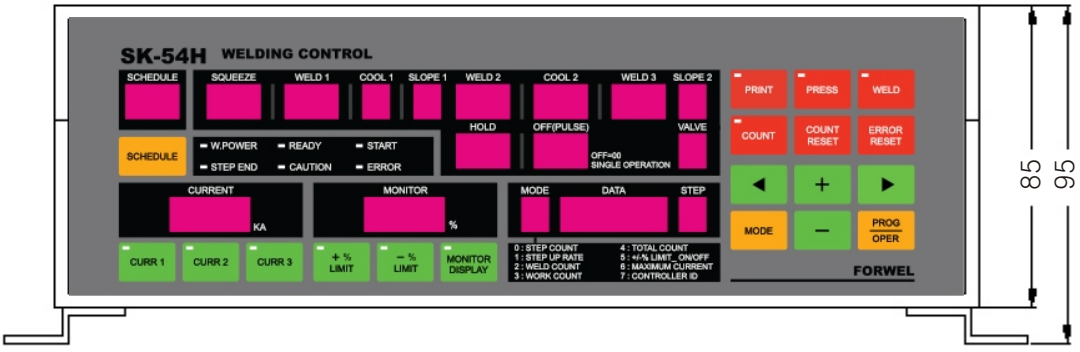
8. Internal block diagram



9. Dimensions (Unit : mm)

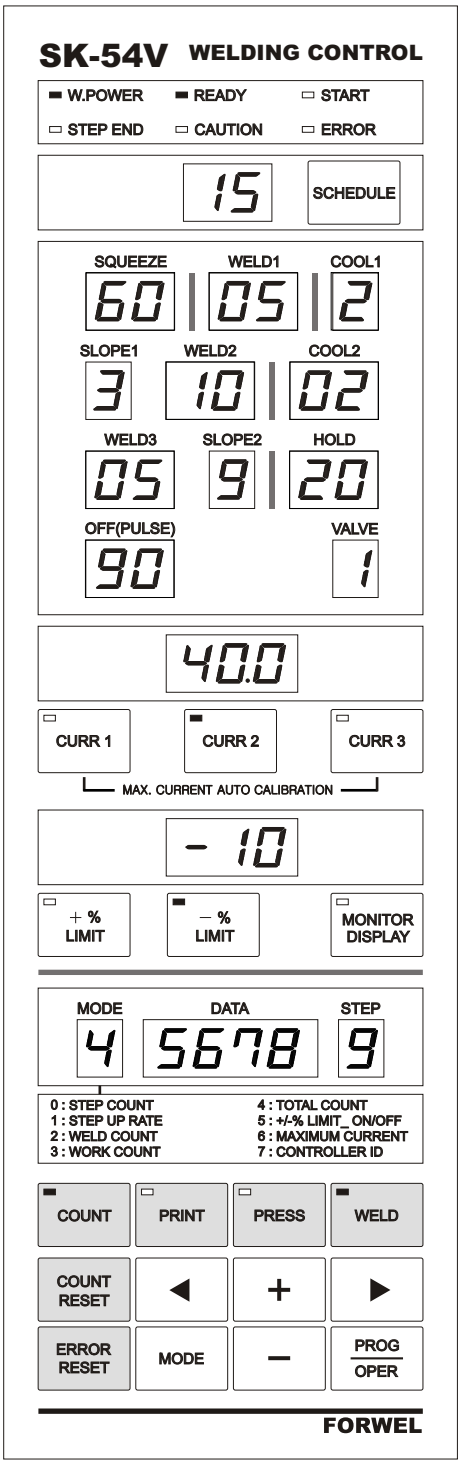






IV. Operation Method

1. Basic operation



1) Turn on the control power switch.
   If the control power switch on the rear side is turned on, the control power is supplied to the machine.

2) Input the data to each set item.

3) Supply the welding power. (220VAC/440VAC)
   If the welding power is supplied, the [W.POWER] LED ON.

4) Press the [WELD] button.
   When press [WELD] button, LED [WELD] & [READY] is illuminated during [W.POWER] ON and Pins12 and 13 in the terminal block shortened.
   When press [WELD] button once more, LED [WELD], [READY] will be OFF.

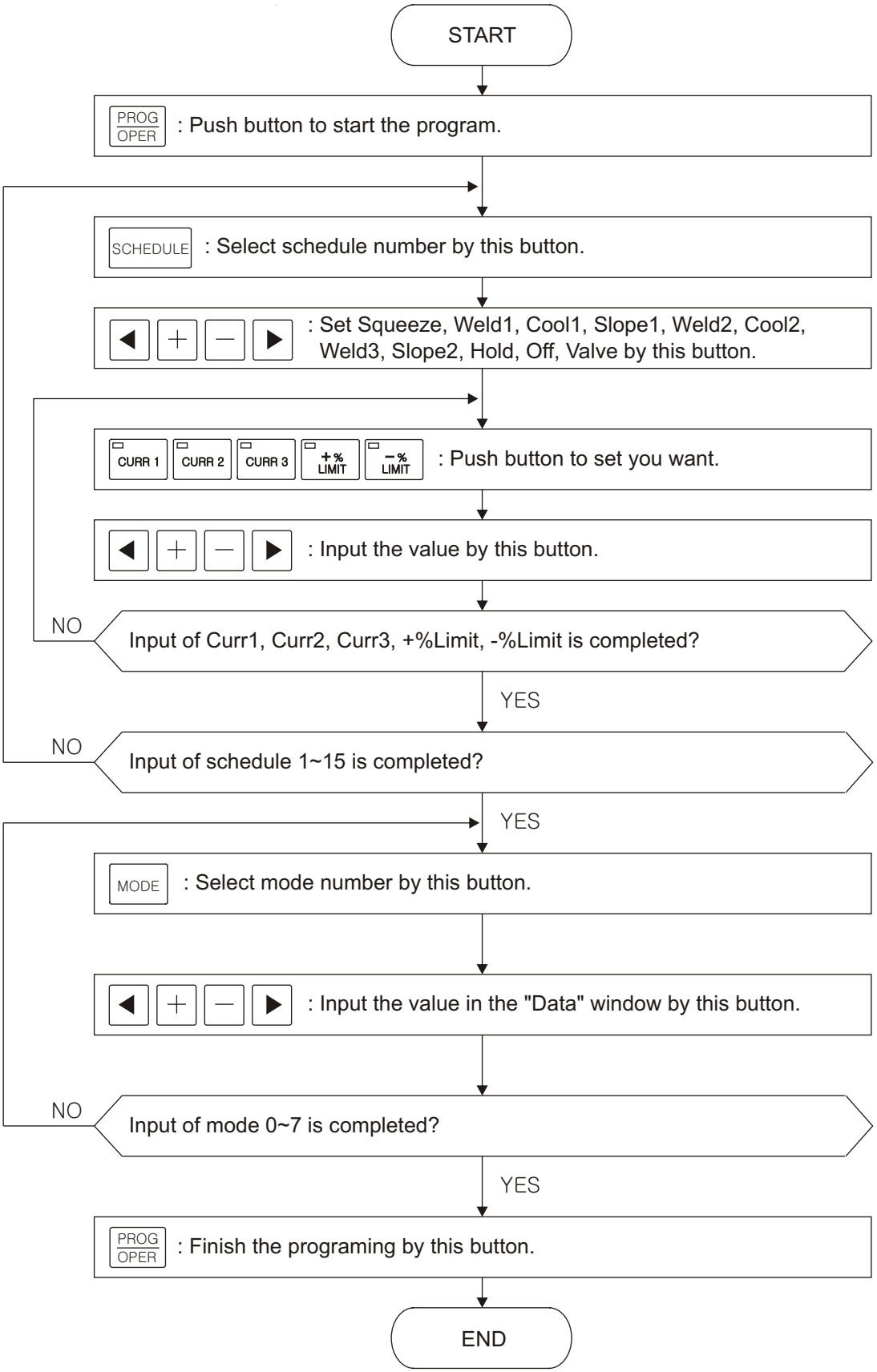
5) Input the start signal(Start1,2,4,8) to start welding.
   ① If the start signal is input, the [START] LED ON.
   ② Cycle indication is disappeared and display the operating condition.

6) After welding is finished, the measure current and ±% is indicated.
   Among Curr1,2,3, it displays the measured data and ±%, of the items illuminated.
   Press [MONITOR DISPLAY] not to display the measured data.

7) If a monitor error is detected, the [CAUTION] LED ON.
   At this time, an error signal is output.
   Press the [ERROR RESET] button out of the frame to reset or input an external reset signal to error reset.

2. Setting of Schedule Data

1) Setting of schedule data



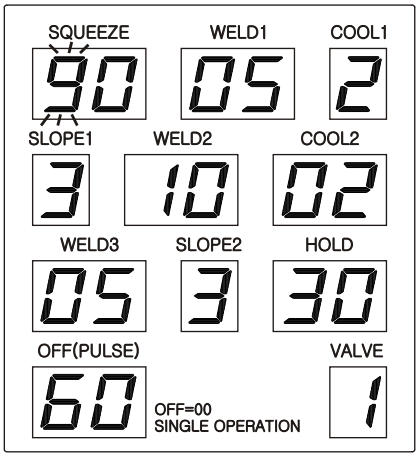
2) Setting of schedule No. (15 schedules available)

Press the [SCHEDULE] button so that a schedule No. can be input.

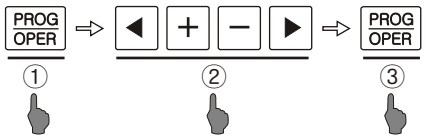
Each time the [SCHEDULE] button is pressed, the schedule No. increases by 1. If the schedule No. reaches 15, it returns to 1.

→ 01 → 02 → 03 → 04 → 05 - - - - - - - - - → 15 →

3) Setting of Timer



Set the cycle numbers by below buttton.



① The indicator is blinked when press the button, [PROG OPER]

② Change the value for setting by using the button, [◀] [+] [−] [▶]

③ Complete the setting pressing the button, [PROG OPER]

Item	Setting range	Remarks
SQUEEZE	0..99 cycles	
WELD1		
COOL1	0..9 cycles	
SLOPE1 (UP SLOPE)		
WELD2	0..99 cycles	
COOL2	0..99 cycles or 0..99 half cycle	
WELD3	0..99 cycles	
SLOPE2 (DOWN SLOPE)	0..9 cycles	
HOLD	0..99 cycles	
OFF (*1)	0..99 cycles	Repeating function (DSW2-(1) OFF)
PULSATION (*2)	0..9 times	Pulsation function (DSW2-(1) ON)
VALVE	1 to 7 modes	

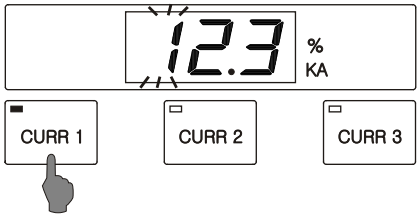
(*1) If OFF (Repeating function) is selected (DSW2-(1) is turned off) and the start signal is input, the welding sequence is repeated continuously.

(*2) If the pulsation function is selected (DSW2-(1) is turned on), Cool2 and Weld3 are repeated by the set number of times.

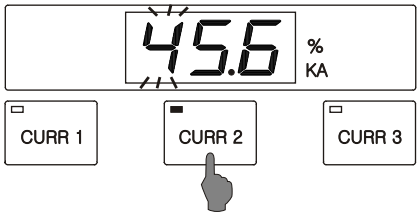
SQUEEZE → WELD1 → COOL1 → SLOPE1 → WELD2 →
→ COOL2 → WELD3 → → SLOPE2 → HOLD → OFF

Repeated by set number of times

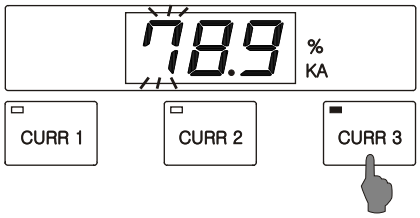
4) Setting of welding current



① Setting method of CURR1



② Setting method of CURR2



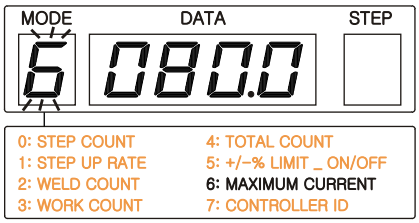
③ Setting method of CURR3

Set the welding current in the range of 20%~100% of the maximum current.

Example)

Maximum Current	Setting Range
10.0 kA	2.0 to 10.0 kA
40.0 kA	8.0 to 40.0 kA
80.0 kA	16.0 to 80.0 kA

3. Setting of Maximum current (Setting range : 3.0~80.0kA)



• Setting mode : Input the value of maximum current to be used at the welder.

① Set the Mode "6".

② Set maximum current "80.0" in the data window..

[Note]

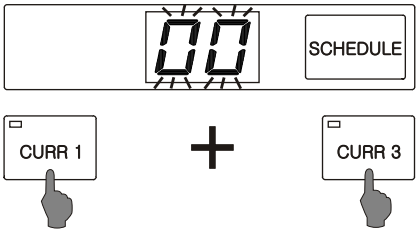
If you cannot know the exact value of the maximum current value of the welder please use the "Maximum current self-adjustment" feature.

This function will set the exact amount of "Maximum current self-adjustment".

Seguence of maximum current self-adjustment

① Check "Ready" LED is ON.
If not, not available check below to continue.

- [W.POWER] LED ON
- [WELD LED] ON
- External WELD ON (Pins12 and 13 in the terminal block) shorten.



② When push CURR1 and CURR3 at the same time,

schedule No. will be "00", and the blinking.

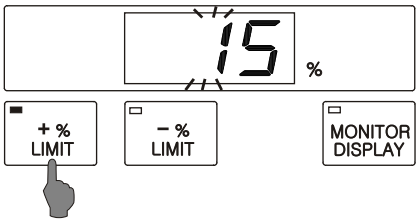
③ Make one of start switch1, 2 to be ON.
Start switch1 operates valve1, and start switch2 operates valve2.

Welding and Hold is repeated, and auto self-adjustment is started, which takes maximum 10 seconds.

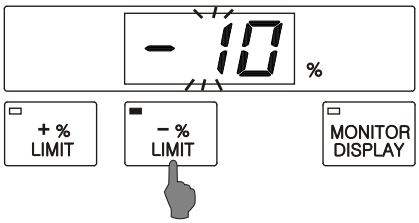
④ Schedule No. will be "01" and completed.

4. Setting of Monitor

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



① Set the upper limit (+%) of the current monitor.
(Setting range : 0~49%)



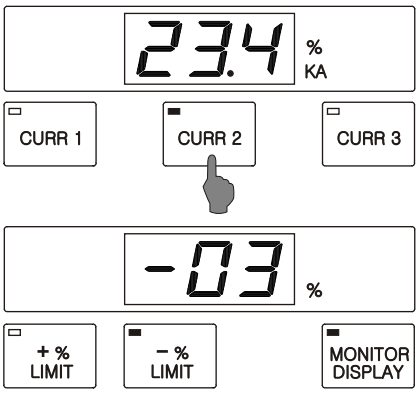
② Set the lower limit (+%) of the current monitor.
(Setting range : 0~ -49%)

• Example)
If Current2 is 10kA, High setting is 20% and Low setting is 10%, the setting range of the current monitor is between 9kA and 12kA.

• The current monitor confirms that the average of the effective values of current, excluding the first three cycles is between the upper and lower limits.

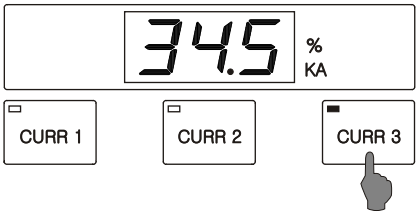
• If the average effective current is out of the setting range of the current monitor (exceeds either limit), the error signal is output and the [CAUTION] LED ON.

2) Indication of measured welding current and monitored current (Effective only in constant-current control mode)

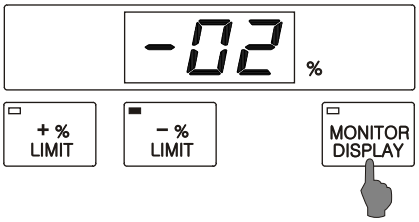


After welding, the measured current and ±% is displayed.
When push a selection button (among Curr1, 2, 3) during monitor display LED is illuminated, the selected "Current" is illuminated and display the measured welding current.

The indicated valve is the average of the effective values of currents, excluding the first three cycles and slopes. If the number of welding cycles is three or less, the effective current in the last half cycle is indicated.



To display the other's measured current when "Monitor Display" LED is off, push the button (Curr1, 2, 3) you want to see and then push [Monitor Display] button.

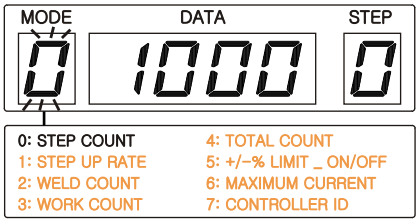


Not to display the measured current, make the "Monitor Display" LED OFF.

5. Setting of Mode No.

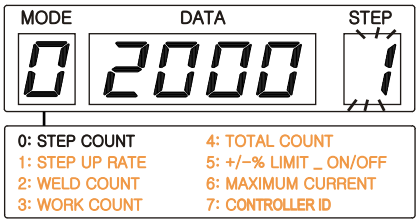
The setter/Step count/Step up rate/Weld count/Work Count/Total count/ +/-% limit ON/OFF are explained below.

1) STEP COUNT (Setting range : 0~9999)



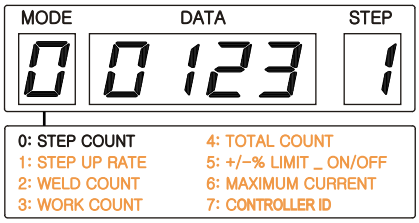
• Setting mode : Input the preset step count by the buttons.

① Set the Mode "0".
② Set the Step No. "0".
③ Set the Step Count in data window.



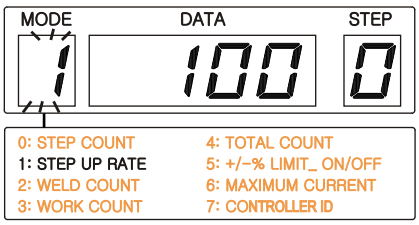
④ Set the Step No. "1".
⑤ Set the Step Count in data window.

Input the step count by repeating above ②~⑤.



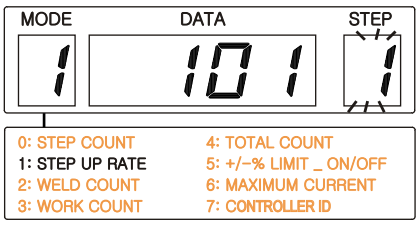
• Operating mode : It display the working step count.

2) STEP UP RATE (Setting range : 50~200%)



• Setting mode : Input the step up rate by the buttons.

① Set the Mode "1".
② Set the Step No. "0".
③ Set the Step Up Rate in data window.

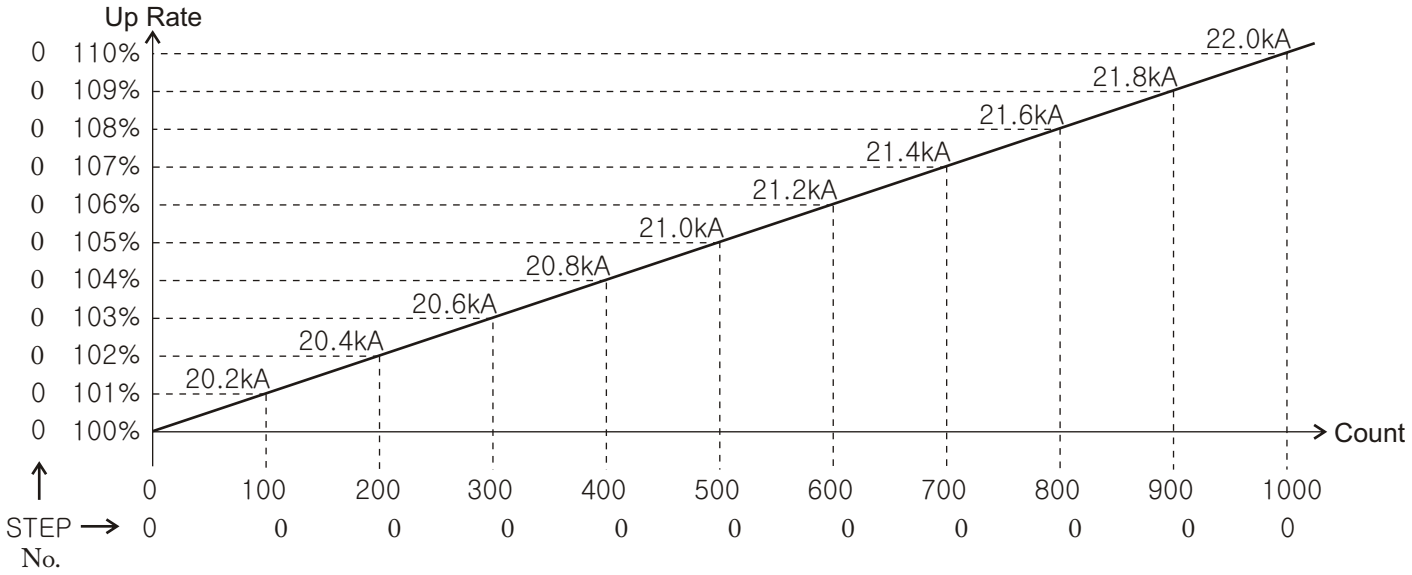


④ Set the Step No. "1".
⑤ Set the Step Up Rate in data window.

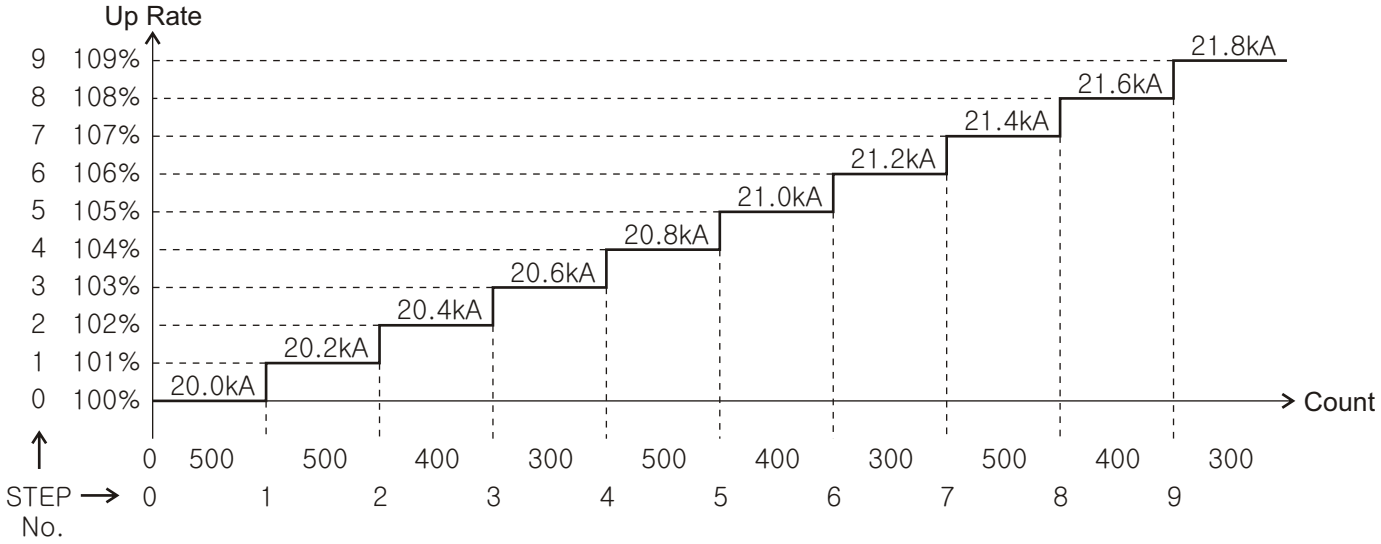
Input the step up rate by repeating above ②~⑤.

50 ~ 99% : It will be step down.
101 ~ 200% : It will be step up.

• Linear stepper (When DSW1-(4) is turned on)_It is working as step No. "0", and not available to set the step No. 1~9.



• 9 stepper (When DSW1-(4) is turned off)_It is working as step No. 0~9.



$$\text{Welding current} = \text{Set current (20.0kA)} \times \frac{\text{STEP UP RATE (STEP No.2 (109\%))}}{100} = 21.8\text{kA}$$

• Operation

If the last step is finished, the LED of step end lights up and the step end output is turned on.
If the power is kept turned on, the power is supplied according to the schedule of the last step No.

• Reset method

a) If a step reset signal is input from outside, the system returns to Step No. , Step count "0" and the step end signal is truned off.

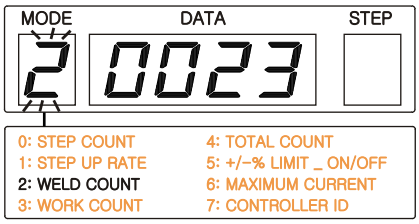
b) It works as the condition of the changed step No. after increasing or decreasing step No. Step count will be maintained.

[Caution]

• While using the step-up function, take care of setting of the current step-up ratio.

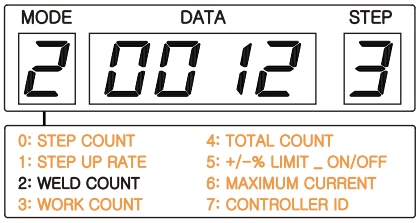
• If the current multiplied by the current stepper up rate exceeds the set maximum value, the current stepper up rate error signal is output.

3) WELD COUNT (Setting range : 0~99) _ Preset is not available when "0" set.



• Setting mode : Input the preset weld count by the buttons.

① Set the Mode "2".
② Set the weld count "23" in data window.

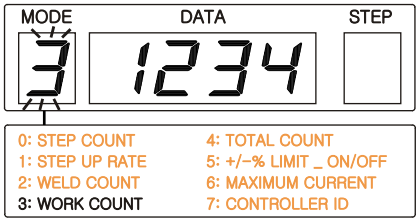


• Operating mode : It display the weld count on working.

• Operation of weld count
The weld shots are counted while an external WELD No. SET input is turned on (i.e., a workpiece is set). When the WELD No. SET input is turned off (i.e., a workpiece is removed), if the number of the weld counts is less than the preset value, the weld count error signal is output. This counter is used to check for insufficiency of the number of weld shots.

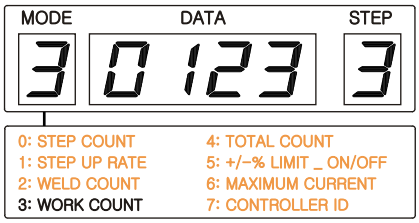
• Reset of weld count
a. Weld by the deficiency of the weld shots, then the weld count error signal is turned off.
b. Turn on the WELD No. SET input again.

4) WORK COUNT (Setting range : 0~9999) _ Preset is not available when "0" set.



• Setting mode : Input the preset work count by the buttons.

① Set the Mode "3".
② Set the work count "1234" in data window.

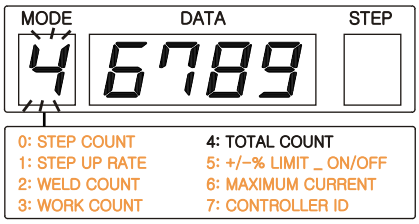


• Operating mode : It display the work count on working.

• Operation of work count
If [WELD COUNT ≥ PRESET WELD COUNT] condition is acceptable, work count will be +1.
If [WELD COUNT ≥ PRESET WELD COUNT] condition is occurred, the monitor value in data window will be disappeared and then output the fault signal.

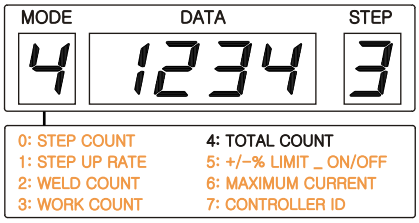
• Reset of work count
In the operating mode, set the [MODE] as "3", and then the work count will be reset, if [COUNT RESET] pushed.

5) TOTAL COUNT (Setting range : 0~9999) _ Preset is not available when "0" set.



• Setting mode : Input the preset total count by the buttons.

① Set the Mode "4".
② Set the total count "6789" in data window.

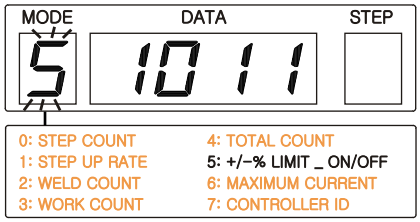


• Operating mode : It display the total count on working.

• Operation of total count
Total count is increased by "1" by one welding.
If [TOTAL COUNT ≥ PRESET TOTAL COUNT] condition is occurred, the value of monitor count is disappeared and then output the fault signal.

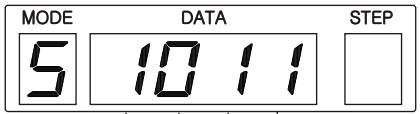
• Reset of total count
In the operating mode, set the [MODE] as "4", and then the total count will be reset if [COUNT RESET] pushed.

6) Setting of ±% WINDOW ON/OFF (Setting range : 0000 or 2111)



• Use to determine if the upper and lower limits of the current monitor for current1, current2 and current3 should be judged, and also determine to input the print function.

① Set the Mode "5".
② Set the monitoring data as "1011".



Current 3 : Monitor "ON"
Current 2 : Monitor "ON"
Current 1 : Monitor "OFF"
0 : No print
1 : Print when caution of current
2 : Print always

• When the monitor is ON - - - If a current exceeds the High or Low set valve, the [CAUTION] LED ON and an error signal is output.

• When the monitor is OFF - - - Even if a current exceeds the High or Low set valve, it is not judged.

7) Printout function

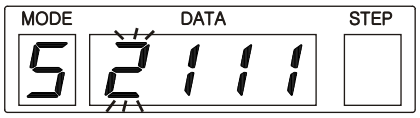
```
SCHEDULE_01 ----------------------------
SQ_60  W1_05  C1_03  S1_05
W2_10  C2_00  W3_05  S2_05
HO_30  OF_60         VALVE_1

CURR1       : 40.0 KA  05 CY
CURR2       : 50.0 KA  10 CY
CURR3       : 30.0 KA  05 CY
HIGH LIMIT  :  +01 %
LOW LIMIT   :  -01 %

MODE 0,1_STEPPER ----------------------
No.  COUNT  UP RATE  CURRENT_KA
-------------------------------------------------
0    0500     100 %    CURR2_ 50.0
1    0490     122 %    CURR2_?61.0
2    0480     104 %    CURR2_ 52.0
3    0470     106 %    CURR2_ 53.0
4    0460     108 %    CURR2_ 54.0
5    0450     110 %    CURR2_ 55.0
6    0440     102 %    CURR2_ 51.0
7    0430     144 %    CURR2_?72.0
8    0420     116 %    CURR2_ 58.0
9    9999     118 %    CURR2_ 59.0

MODE 2_PRESET WELD COUNT     : 0000
MODE 3_PRESET WORK COUNT     : 0000
MODE 4_PRESET TOTAL COUNT    : 0000
MODE 5_+/-% LIMIT ON/OFF     : 2111
MODE 6_MAXIMUM CURRENT(KA) : 60.0

DIP SWITCH 1 : 00000000
DIP SWITCH 2 : 00000000
-------------------------------------------------
```

PRINT : If this button pushed, all of data on working among schedule 1~15 will be printed.

If the calculated value of step up rate by the highest value among Curr1, 2, 3 exceeds the maximum current, "?" is printed.

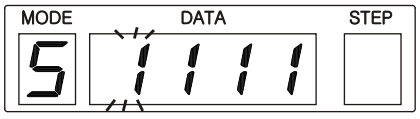
If the calculated value of step up rate exceeds the maximum current, it is wrong set of step up rate.

```
-------------------------------------------------
COUNT  SCH  CURR1  CURR2  CURR3
-------------------------------------------------
0001    01   39.9   50.0   29.9
0002    01   40.1   50.0   30.0
0003    01   40.0   50.0   30.0
0004    01   40.0   50.0   30.0
0005    01   40.0   50.0   30.0
0006    01   39.9   50.0   30.0
0007    01   40.0   50.0   29.9
0008    01   40.0   50.0   30.0
0009    01   40.0   50.0   30.0
0010    01   39.9   50.0   30.0
```



Weld current is printed at real time.
Count is the total count value which works now.

```
-------------------------------------------------
COUNT  SCH  CURR1  CURR2  CURR3
-------------------------------------------------
0056    01  ?40.8   50.0   30.0
1300    01   40.1  ?51.2   30.0
1512    01   40.0   50.0  ?30.7
1753    01   40.0  ?48.9   30.0
2800    01   40.0   50.0  ?29.3
3125    01  ?39.1   50.0   30.0
4300    01   40.0   50.0  ?31.0
4895    01  ?39.0  ?48.8   30.0
5230    01   40.0   50.0  ?30.8
6812    01  ?38.8  ?48.7  ?29.2
```



After completion of welding, it is printed if one of weld current1, 2, 3 exceed the ±% value of set.
Count is the total count value which works now.

V. Considerations for Use

1. Precautions on operating environment

The SK-54 should not be used in the following environments :

1) In atmosphere of high temperature and high humidity
2) Environment affected by vibration or impact
3) In chemical atmosphere or in areas directly affected by chemicals
4) Near a high-frequency noise-generating source.

2. Precautions for installation

1) Confirm that the control are installed (fixed) securely to the specified places.
2) Do not apply a source voltage higher than the rated value.
3) Ground the machine securely.

3. Other precautions

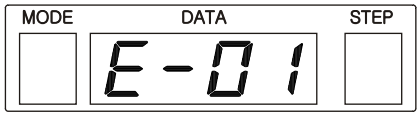
1) Wipe off dirt from the controller exterior with a dry cloth.
   Do not wipe controller with a wet towel. It may cause malfunction.
2) Do not push the touch keys on the front panel with a pointed instrument such as a screwdriver.
3) Do not disassemble or modify the controller.
   We are not responsible for any trouble caused by disassembly or modification.

4. Accessiories

1) Toroidal Coil (TC450L) : 1 piece
2) Operation manual : 1 copy

VI. Error Indications and Countermeasures

1. Fault singal and Trouble shooting



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

Error Code	Contents	Countermeasures ◑Fault ●Trouble shooting
E-01	Self-diagnosis error	◑The program data are error. ●Input the schedules again.
E-12	Maximum current setting error	◑3.0kA > MAX CURR > 80.0kA ●Set the maximum current as 3.0~80.0kA.
E-13	Current setting error	◑CURR1,2,3 ≥ MAX CURR In case of setting current is exceeded the maximum current. ●Set the current 1, 2, 3 to be lower than maximum current.
E-14		◑CURR1,2,3 ≤ 10% of MAX CURR When setting current is below the 10% of maximum current ●Set the current to be over than 10% of the maximum current.
E-15	Current stepper up rate setting error	◑When the calculated value of the step up rate is exceeded the maximum current Max. current ≤ Current setting X $\left(\frac{\text{STEP UP RATE}}{100}\right)$ ●Set the calculated value of step up rate to be lower than maximum current.
E-16		◑When the calculated value of the step up rate is below 10% of the maximum current 10% of Max. current ≥ Current setting X $\left(\frac{\text{STEP UP RATE}}{100}\right)$ ●Set the calculated value of the step up rate to be over 10% of the maximum current.
E-20	Thermostat error	◑The external thermostat input is open. ●Check the thermostat and cooling water temperature for the contactor.
E-21	No current or toroidal coil breakage	◑Current is not detected. ❶Check the supply of weld power source. ❷Check if the external Weld ON (Pins11 and 12 in the terminal block) is ON. ❸See if enough force is applied to the electrode. ❹Confirm that the squeeze is set long sufficiently. Set it longer than the stroke time of the electrode. ❺Check the Toroidal coil connector for disconnection.

E-22	Thyristor short-circuit error	◑Thyristor is shorted. ●Check it.
E-30	Frequency error	◑Control power and constant frequency is over ±10% of 50Hz/60Hz ●Check the constant frequency.
E-41	Auto calibration error	◑Current is not detected. ❶Check the supply of weld power source. ❷Check if the external Weld ON (Pins11 and 12 in the terminal block) is ON. ❸See if enough force is applied to the electrode. ❹Check the Toroidal coil connector for disconnection.

VII. Schedule Data Table

1.Schedule Data Table

SCHEDULE No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SQUEEZE															
WELD1															
COOL1															
SLOPE1 (UP)															
WELD2															
COOL2															
WELD3															
SLOPE2 (DOWN)															
HOLD															
OFF(PULSE)															
VALVE															
CURR1															
CURR2															
CURR3															
+% LIMIT															
-% LIMIT															

±% WINDOW ON/OFF 0 : OFF 1: ON	WELD1	WELD2	WELD3

Step data table					
MODE 0	DATA	STEP	MODE 1	DATA	STEP
Step Counter		0	Step Up Rate (%)		0
		1			1
		2			2
		3			3
		4			4
		5			5
		6			6
		7			7
		8			8
		9			9

Step data table (Factory Output)					
MODE 0	DATA	STEP	MODE 1	DATA	STEP
Step Counter	9000	0	Step Up Rate (%)	100	0
	9001	1		100	1
	9002	2		100	2
	9003	3		100	3
	9004	4		100	4
	9005	5		100	5
	9006	6		100	6
	9007	7		100	7
	9008	8		100	8
	9009	9		100	9

Max. Current	
WELD Count	
WORK Count	
TOTAL Count	