
INSTRUCTION MANUAL

Welding Current Meter

Weld Scope WS-80

MODEL: WS-80.rev2

Original instructions

.....
The instruction manual must be carefully
read for proper machine operation.
.....

.....
No person is allowed to install, conduct test run of, operate, maintain, repair the
machine or do similar works, without having well understood what the manual
refers to.
.....

.....
The improper operation with inadequate knowledge may cause serious accident.
Incidentally, the manual must be kept at a place accessible to any of the person
concerned.
.....

.....
Please inquire an uncertain point of our Sales Department/each office.
.....



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NOTICE

1. Please do not reprint contents of this instruction partially without permission.
2. The content of Instruction manuals might change without notifying beforehand.
3. Please contact us when there are any suggestions like an uncertain by any chance point, mistake, and description leakage, etc.

Revision history

5	Revised F.S. description	2020/ 11/13	M.Arima		
4	Changed company name, Text error correction	2017/ 12/24	Nozaki	Fukuta	Omori
3	Change to WS-80.rev2 model. (for improvement.), Add calibration clause, etc.	2012/ 03/08	Nozaki	Fukuta 2012.3.13	Komachi 2012.3.13
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Contents

1. SAFETY INSTRUCTIONS AND CONSIDERATIONS.....	1
1 - 1. Product safety labels and symbols	1
1 - 2. Application of the equipment and safety	2
1 - 3. Safety considerations	2
1 - 4. Safety during operation.....	2
1 - 5. Electrical safety	3
1 - 6. Safety items on maintenance work	4
1 - 7. Accident prevention	5
2. WARRANTY and REPAIR-AVAILABLE PERIOD	8
2 - 1. Warranty.....	8
2 - 2. Repair-Available period.....	9
3. Overview	10
4. Specifications	10
5. Connection.....	13
5 - 1. Mounting the Toroidal Coil	13
5 - 2. Connecting Toroidal Coil, Power Supply, and Ground.....	14
6. Operation	15
6 - 1. Panel Switches	16
6 - 2. Panel Lamps	16
6 - 3. Setting Items	17
6 - 4. Operation	19
7. Screens.....	21
7 - 1. Numeric screen (numeric mode).....	21
7 - 2. Graphic screen	22
7 - 3. History screen.....	24
7 - 4. System screen	25
8. Error Items.....	25
8 - 1. Error contents.....	25
9. Measured Welders	26
9 - 1. Single-phase AC Welder	26
9 - 2. Pulsation Welder (AC Welder).....	27
9 - 3. Seam Welder (AC).....	29
9 - 4. Single-phase/Three-phase Rectification and Inverter Welders	29
9 - 5. Capacitor Welder	30
9 - 6. Measuring Continuous Current Conduction for More than 200 Cycles	30
10. External Signals.....	31
10 - 1. Connecting Input-Output Terminal Block	31

11. Communication	32
11 - 1. Communication format	32
11 - 2. Print data	32
11 - 3. Timing Chart	33
11 - 4. Data Transfer Specifications	33
12. Tip Voltage	34
13. Maintenance	35
13 - 1. Precautions concerning maintenance	35
13 - 2. Parts replacement	35
13 - 3. CALIBRATION	36
14. Troubleshooting	37

EC DECLARATION OF CONFORMITY

In accordance with BS EN ISO/IEC 17050-1:2010

We **DENGENSHA TOA CO., LTD.**
1-23-1, Masugata, Tama-ku, Kawasaki-shi
Kanagawa 214-8588, JAPAN



declare that:

Current measuring device
Model: WS-80

In accordance with the following Directives:

2006/95/EC conforms with the essential electrical equipment requirements of the Low Voltage Directive and its amending directives.

2004/108/EC conforms with the essential protection requirements of the Electromagnetic Compatibility Directive and its amending directives.

has been designed and manufactured to the following specifications:

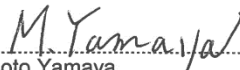
EN 61010-1:2010

EN 61000-6-4:2007+A1:2010

I hereby declare that the equipment listed above has been tested and found to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives.

December 15, 2017

Signature


.....
Makoto Yamaya
General Manager
Quality assurance Dept.

Our authorized representative in Europe

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DENGENSHA TOA CO., LTD.

1. SAFETY INSTRUCTIONS AND CONSIDERATIONS

IT IS **IMPERATIVE** THAT :

Any person involved with the installation, functional testing, operation, maintenance and repair of this machine must start the work with complete understanding of the machine after reading this INSTRUCTION MANUAL carefully, to help prevent personal injury or damage to the equipment.

DENGENSHA TOA equipment has been designed and produced with due consideration to safety. Be sure to observe the instructions in this instruction manual. Failure to comply with these instructions may cause personal injury.

1 - 1. Product safety labels and symbols

In this manual and the machine, the following labels or symbols are used.

(1) General warning sign

	This is the general warning sign. It is used to alert the user to potential hazards. All safety messages that follow this sign shall be obeyed to avoid possible harm.
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(2) Hazard severity panels

	DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
	WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
	CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

(3) Prohibition sign

	A black graphical symbol inside a red circular band with a red diagonal bar defines a safety sign that indicates that an action shall not be taken or shall be stopped.
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(4) Mandatory action

	A white graphical symbol inside a blue circle defines a safety sign that indicates that an action shall be taken to avoid a hazard.
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1 - 2. Application of the equipment and safety

1 - 3. Safety considerations

We emphasize that DENGENSHA TOA Co., Ltd. disclaims all liability for damage and malfunctions resulting from non-compliance with the following instructions in particular:

- (a) The instruction manual must be read and strictly understood. If there are any questions, contact our business department and/or each office.
- (b) Unauthorized conversion and/or modification affecting the safety of the equipment are not allowed.
- (c) The equipment may not be equipped or operated with products of other manufacturers whose use is not expressly permitted in the associated manuals.
- (d) For the items(b)and(c), consult with our business department/each office on safety.

1 - 4. Safety during operation



CAUTION

(1) Injury prevention from electrode or clamping force

Resistance welding machine generally uses electrode pressurizing force or clamping force of several thousands Newtons or more.

Since this large force is dangerous, do not put hands, fingers, or any part of the body between the electrodes, and between the clamps. Failure to observe this warning can cause serious injury. The same warning applies to the electrodes when opening.

A guard is provided to protect against a pinch point when the upper electrode opens.

Do not put hands, fingers or any part of the body between the upper electrode and the cylinder body. Operation should not occur unless the guard is in place.



CAUTION

(2) Wearing safety gear

Spark or spatter that is produced during welding operation may cause eye injury.

Since it is difficult to eliminate spark or spatter completely, it is necessary to put on protective glasses, helmet, gloves and non-combustible working clothes to safeguard against splash and spatter.

**CAUTION****(3) Prevention from burns or fire**

Spark or spatter produced during welding operation or hot parts just after being welded cause burns. Observe the following precautions and install fire extinguishers close to the weld working area in case of an emergency.

- (a) Remove flammable substances so that Spark or spatter do not fall on them or drape them with a non-combustible cover.
- (b) Do not perform welding work near the flammable gas.
- (c) Do not bring hot parts immediately after being welded, close to the flammable materials.
- (d) Do not touch the parts just after being welded with bare hands. Even if they are not red, the temperature may be very high, causing a burn.
- (e) Keep any personnel other than workers away from a place where spark or spatter is produced.

(4) Noise protection

Measure noise level of this equipment and its surroundings area. If the level is in excess of 85db, use appropriate hearing protection.

1 - 5. Electrical safety**DANGER****(1) In order to avoid electrical shock**

In order to avoid electrical shock, be sure to observe the following items :

- (a) Do not touch the parts bearing electrical charges other than secondary conductor.
Failure to observe this may result in a fatal electrical shock or severe burns.
- (b) Do not touch both ends of secondary conductor simultaneously. Failure to observe this may result in a slight electrical shock.

(2) Connection to the power supply

The equipment should be connected properly to the power supply as per the instruction manual. The power supply work should be carried out according to local laws and your in-house standards.

(3) Qualifications for electrical work

Voltage of approx. 440V is supplied to the equipment according to the specification (Higher voltage may be used depending on models. Refer to the specification).

Educated, trained and qualified personnel¹⁾ with regard to the potential hazards arising from these dangerous voltages should be assigned, especially, to electrical work for installation, maintenance and repair works.

Note : 1) For example, personnel who possess qualifications for electrical work or authorized customer employee.

(4) Grounding work

An earth terminal is provided with the equipment for safety.

A person qualified for conducting the electrical work should carry out the grounding work according to the local laws and in house standards.

(5) Provision of properly sized conductors

The customer is responsible to provide properly sized conductors for the incoming power feed to the welder. Do not use wire of insufficient capacity or damaged/exposed wires. Failure to observe this may cause fire due to overheated electrical wire and electrical shock or current leakage.

(6) Electric wire connection

The connection terminal of the electrical wire should firmly be tightened and insulated. In case of loose connection, the connection may become overheated and cause fire, and insufficient insulation may cause electrical shock or current leakage.

1 - 6. Safety items on maintenance work

 DANGER
(1) Promotion of safe system start-up and shut-down There is a possibility of causing extremely dangerous condition when the sources of power supply, pneumatic and water are turned on without warning to a worker during maintenance/repair work. Systems that promote safe system start-up and shutdown should be provided for personnel safety.

(2) Before performing maintenance work

 DANGER
Before performing any maintenance and/or repair work, including cleaning, it must be ensured that : (a) The equipment has been disconnected, using a lock-out/tag-out procedure, from all power supplies for welding, control and power. (b) Perform plant lock-out/tag-out procedures on power sources of the equipment.

 CAUTION
(c) All sources of pneumatic pressure and cooling water have been locked-out/tagged-out. (d) Residual pressure of all pneumatic circuits and cooling water circuits have been relieved.

(3) Perform maintenance work

Installation, maintenance/inspection, repair work should be performed by trained qualified personnel²⁾ according to the instruction manual for safety reasons.

Note : 2) Qualified personnel, authorized by the customer, who have received manufacturer's or customer's in-house training and have clear understanding of the equipment in question.

(4) Perform periodic maintenance

It is necessary to perform periodic maintenance and inspection of the equipment as described in the manual.

(5) Water or pneumatic hoses

When the customer prepares to install water, or pneumatic hoses to the welder, make sure they will sufficiently bear the pressure.

Possibilities of danger occur when these hoses have insufficient resistance to pressure or are deteriorated or damaged, periodically perform maintenance and inspection and repair the deteriorated or damaged parts before using the equipment.

(a) When hoses bursts or disconnected, the hose may act violently or the equipment may operate unexpectedly.

(b) When a water hose bursts developing a leak, there is a possibility of deteriorated insulation of the electrical circuit or deterioration of the control equipment and/or current leakage.

1 - 7. Accident prevention

(1) Cooling water used for welding machine

Be sure to observe the following items for safe operation, to prevent accident and maintain proper functioning of the equipment.

(a) Use water of the following quality or equivalent :

- i) Rate of electric resistance : More than $5,000\Omega \cdot \text{cm}$ for thyristor cooling water.
- ii) Less deposit in water.
- iii) Ammonium ion content must be less than 1ppm.

Smaller resistance of water may cause current leakage. The cooling water with large deposits may clog a circuit to degrade the circuit function, lowering the cooling capacity and causing the circuit to malfunction or fail.

Cooling water containing a large amount of ammonium ions may have the possibilities of corroding copper or copper alloy components on the cooling circuit and create water leaks, leading to current leakage and electrical shock or electrical breakdown of welding transformer that can causes a fire on the equipment.

(b) When the cooling water is turned off, be sure to turn off the welding power supply.
Leakage current flowing for a long time may heat and damage thyristors, depending on quality of cooling water.

(c) Amount of cooling water prescribed in the specification of the equipment should be provided in the following manner. It is also important to keep water temperature prescribed in the specification in order to maintain the cooling capacity as well as water quantity :

- i) Maintain a given water pressure prescribed in the specification.
- ii) Check the water flow periodically to prevent clogging & overheation conditions.
- iii) Perform maintenance of cooling water circuit as prescribed in the specification.

When cooling capacity is deteriorated, the equipment may generate faults or a fire may generate due to overheated components such as welding transformers, conductors, electrodes, thyristors.

**CAUTION****(2) Upper electrode falls when air supply is stopped**

In general, when air supply for welding machine is stopped, the upper electrode falls spontaneously due to deadweight. Though its falling speed is not high, there is a possibility of occurring problems : injury may occur if hands, fingers, a part of body are caught, or work piece be deformed if it is between the electrodes.

(3) Proper pressurizing force must be established

Proper pressurizing force must be established before passing welding current through the electrodes. If current is passed through the electrodes when the pressurizing force is too low, a dangerous explosion of sparks and splatter will occur, causing serious injury or burns.

EXAMPLES:

- (a) When pressure of 0.1Mpa or less has been established causing uncontrolled drifting down of the electrode.
- (b) When the squeeze time is set too short and the electrode completes the weld circuit under load.

(4) Magnetic field effect

The resistance welding machine generates high magnetic field around the secondary circuit when energized. This magnetic field has an influence on operation of certain type of sensors, watch, and magnetic cards. For the same reason, a person who uses a heart pace maker is prohibited from coming up to the resistance welding machine during operation.

(5) Equipment fall down prevention

Equipment may fall down depending on models when an earthquake occurred. Perform installation work of the equipment according to the instruction manual.

(6) Safety information of peripheral devices

Information about possibilities of danger of peripheral devices of this equipment such as conveyors, feeders, robots should also be provided to workers.

(7) To use within maximum input and allowable duty factor

The welding transformer has rated input, maximum input, allowable duty factor, and so forth. This is the heat capacity of welding transformer prescribed under the cooling conditions (temperature and quantity of water). This specification indicates the upper limit of operation of the welding transformer. In excess of this limit, the welding transformer may be overheated or burnt in some cases. Since the heat capacity of welding transformer is based predicated on being cooled, the welding transformer may be overheated under normal operation or burnt in some cases if the cooling condition is insufficient.

The welding machine and welding transformer should be used within prescribed maximum input and allowable duty factor without fail. (For details, refer to the REFERENCE "Maximum Input of Welding Transformer, allowable duty factor".)

◎ Reference 1: Maximum input and allowable duty factor of welding transformers

Rated input P_{50} , maximum input $P_{\max}$, allowable duty factor $\alpha_{\max}$, etc. are prescribed for welding transformers.

Rated input P_{50} indicates the input kVA of the welding machine when the duty factor is assumed to be 50%.

The heat capacity of a welding transformer can be indicated with the following formula, using the input and duty factor.

$$\text{Heat capacity} = P_{50} \times (0.5)^{1/2}$$

The heat capacity is constant, regardless of how the transformer is to be used. Since the heat capacity will be the same even when the transformer is used with maximum input $P_{\max}$, it follows that the duty factor will be restricted by a certain value, and this value will be called the "allowable duty factor" $\alpha_{\max}$. That is, they will have the following relationship.

$$P_{50} \times (0.5)^{1/2} = P_{\max} \times (\alpha_{\max})^{1/2}$$

In other words, the duty factor will have to be reduced when the welding machine or welding transformer is to be used with a large input kVA, and when using it with the duty factor increased, it will exceed the heat capacity of the welding transformer unless the input kVA is lowered. This can easily be examined, if you apply values to above-mentioned formula.

◎ Reference 2: Equivalent continuous current (continuous secondary current) of welding machines

Welding current and duty factor are prescribed for welding transformers. Calculating the following formula with these values will give you the equivalent continuous current (continuous secondary current).

$$I_{2p} = \text{Equivalent continuous current} = \text{Welding current} \times \sqrt{\text{duty factor}} \text{ (A)}$$

This is the maximum continuous current that this transformer can allow to flow.

Example 1 : calculation formula of the equivalent continuous current that uses the specification

When the welding current is 11,000 A, and the duty factor is 10% :

$$\text{Equivalent continuous current} = 11,000 \times \sqrt{0.1} = 3,470 \text{ A}$$

Example 2 : calculation formula of the equivalent continuous current from the welding condition

In the case of applying electrical current three times :

$$I_{2p} = \sqrt{\frac{I_1^2 \times WT_1 + I_2^2 \times WT_2 + I_3^2 \times WT_3}{\text{Production Cycle time (sec.)} \times \text{frequency (Hz)}}} \text{ (A)}$$

If a transformer is to be used in excess of this equivalent continuous current, generation of heat by this transformer will cause damages and other accidents.

I_1 : First current to be applied (A)

I_2 : Second current to be applied (A)

I_3 : Third current to be applied (A)

WT_1 : Period of time of the first current to be applied (cycle)

WT_2 : Period of time of the second current to be applied (cycle)

WT_3 : Period of time of the third current to be applied (cycle)

2. WARRANTY and REPAIR-AVAILABLE PERIOD

2 - 1. Warranty

(1) Warranty Period

① Product for Japanese market

The warranty period shall be one (1) year from the date of the acceptance inspection of the Product or within 2,000 hours after commencement of operation of the Product, whichever comes first.

② Export Product

In the case where a specification sheet have an agreement on the warranty period, that period shall be applied. In the case where a specification sheet have no agreement on the warranty period, the period shall be one (1) year after the acceptance inspection of the Product, or within 2,000 hours after the commencement of operation, or for a period of fifteen months as from the date of the last shipment of the Product, whichever comes first.

In addition, for a repaired part of the Product, warranty services shall be available for six (6) months since the implementation of such repair, however, the warranty period or the repair-available period for the entire Product shall not be extended.

(2) Warranty Conditions (applied to Product for Japanese market, Export Product)

In the event of any failure that is obviously attributed to the Company during proper operation of the Product as provided in the instruction manual during the warranty period as specified above, the Company shall repair the Product at no cost. Provided that, even within the warranty period, this warranty shall not apply in cases such as the ones specified below:

- ① Any defect or damage due to improper handling, operating, storing, and environment in your premises;
- ② In the cases where the Product has been disassembled, modified, repaired by any company other than the Company or those designated by the Company;
- ③ Any defect due to use of parts other than genuine parts of the Company;
- ④ In the case where the Customer failed to do maintenance as provided in the instruction manual and replace consumable parts;
- ⑤ Any failure or damage caused by dropping, etc. at the time of installation or transfer;
- ⑥ Any failure or damage caused by natural disasters (fire, lightning, earthquake, flood or the like) and abnormal voltage.
- ⑦ Any damage or loss caused by a failure of the Product;
- ⑧ In the case where the person requesting the repair is not the first end-user;
- ⑨ The following consumable parts,

The consumable parts mean those which shall have been worn out and not worked properly by using the Product. Those parts need to be changed periodically.

(For example: Electrode tip, Wheel electrode, guide pin, shunts, Bite cutter, Vinyl tube, Capacitor bank) Including consumable parts listed in Parts list of Instruction manual.

2 - 2. Repair-Available period

- (1) Repair-available period shall mean a period during which the Product can be repaired by using spare parts even after expiration of the warranty period. The period shall be ten (10) years from the acceptance inspection as a standard, but the actual period might vary slightly.
- (2) In the case where the repair period has expired, the request of repair might not be acceptable.
- (3) In the case where a person requesting the repair is not the first end-user and the distribution channel could not be identified, repair service might not be acceptable.
- (4) In the case where the spare parts are out of inventory, the repair period might be longer due to taking time to obtain the repair parts.
- (5) In the case where the spare parts are unavailable, the Product might be repaired by the replacement parts having performance equivalent to the original ones. In such case, the repair period might be longer due to the performance evaluation of the replacement parts and other such procedures. Please note that we would not be able to provide repair services in the case where there are no replacement parts.

3. Overview

The Weld Scope WS-80 (Model: WS-80.rev2) measures the welding current and the welding cycle of resistance welders.

This device displays and prints the measured results on a fluorescent display respectively on a printer in numerically and in waveform format. Data can be output to a personal computer through a data transfer cable. The internal memory stores up to 4000 data items that were measured earlier. To match varying welding conditions, 15 types of monitor conditions can be set. Measured results that exceed the range are reported by alarm indication, buzzer sound, and relay output.

- The following items are included with the WS-80 unit:

① Toroidal coil (model: 1B8L5, lead wire 5m):	1
② Power cord (5m):	1
③ Recording paper (including inside body):	1
④ Instruction manual (this manual):	1

4. Specifications

(1) Model

- Name: Weld Scope WS-80
- Model: WS-80.rev2

(2) Measured devices

- Single-phase AC welders
- Single-phase rectification welders
- Three-phase rectification welders
- Capacitor welders (peak current value)
- Inverter welders
- Seam welders
- Pulsation welders

(3) Detection method for welding current

- A detection sensor is used to detect the welding current on the secondary line of a welder.
- Detection sensor: Toroidal coil model 1B8L5 (accessory)
Toroidal coils with a sensitivity of 0.5, 1, 5, and 10 can be used.

(4) Detection method for Electrode tip voltage

- A detection line (optional) is used for detecting the tip voltage on the electrode rod.

(5) Contents of measurement and measurement range

- Welding time: 0.5-99.0 [cycles] (in 0.5 cycle units)
- Welding current: unit: kA

Range	Toroidal coil sensitivity scale factor			
	1/2	1 (accessory)	5	10
5: 5kA	1.00 - 10.0	0.50 - 5.00	0.10 - 1.00	0.05 - 0.50
20: 20kA	4.00 - 40.0	2.00 - 20.0	0.40 - 4.00	0.20 - 2.00
50: 50kA	10.0 - 100	5.00 - 50.0	1.00 - 10.0	0.50 - 5.00
100: 100kA	20.0 - 200	10.0 - 100	2.00 - 20.0	1.00 - 10.0

- Tip voltage: 0.5-9.99 [V]
- Conduction angle: 30-180 [°]

(6) Measurement accuracy

- Welding time: Cycle ±0 cycle
ms ±1%
- Welding current: Single-phase AC ±2% (for full scale)
Other ±5% (for full scale)
- Tip voltage: ±5%
- Conduction angle: ±3%

(Notice : 1)

Setting range Welder type	5kA	20kA	50kA	100 k A
A Single-phase alternating current (AC)	±0.1kA	±0.4kA	±1.0kA	±2.0kA
MFDC(DC) Capacitor Discharge (CAP)	±0.25kA	±1.0kA	±2.5kA	±5.0kA

(7) Display

- Fluorescent display tube (256 × 64 dots)

(8) Printer

- Thermal printer (432 dots/line)
- Paper width 60 mm

(9) External input

- Pressure signal (3): No-voltage contact, 100 VAC, or 24VDC
- Measurement ON/OFF (1): No-voltage contact or open collector
- Condition switching (4): No-voltage contact or open collector
- Tip voltage (1): Voltage detection line
- Current detection (1): Toroidal coil

(10) External output

- Welding start (Weld): Contact output (1a)
- Abnormal signal (No Good): Contact output (1a)
- Normal signal (Good): Contact output (1a)
- Welding current waveform: Voltage output (± 10 V)
- Tip voltage waveform: Voltage output (± 10 V)
- Welding data communication: RS-232C

(11) Power supply

- 100 - 120VAC 50/60 Hz (changeable by setting)
- Power consumption: About 15 VA
About 50 VA (when the printer operates)

(12) Outline

- Dimensions: 240 × 290.5 × 178 (w × h × d) [mm]
- Mass: Approx. 6.1 [kg]

(13) Ambient conditions

- Temperature: 0 to +40°C (No condensation)
0 to +104 deg F
- Humidity: Up to 90%
- Altitude: Up to 1000 m above sea level
- Storage temperature: -25 to +55°C
-13 to +131 deg F

5. Connection

5 - 1. Mounting the Toroidal Coil

Insert the Toroidal coil into the side-connector, then wind the coil around the secondary circuit of the welder. As shown in Figure 1, mount the Toroidal coil so that the coil mounting screw is placed on the opposite side of the central part of the welder so as to ensure detection at the center of the coil. If the sensitivity in the area where the coil mounting screw is placed is too low, the measured values might contain errors.

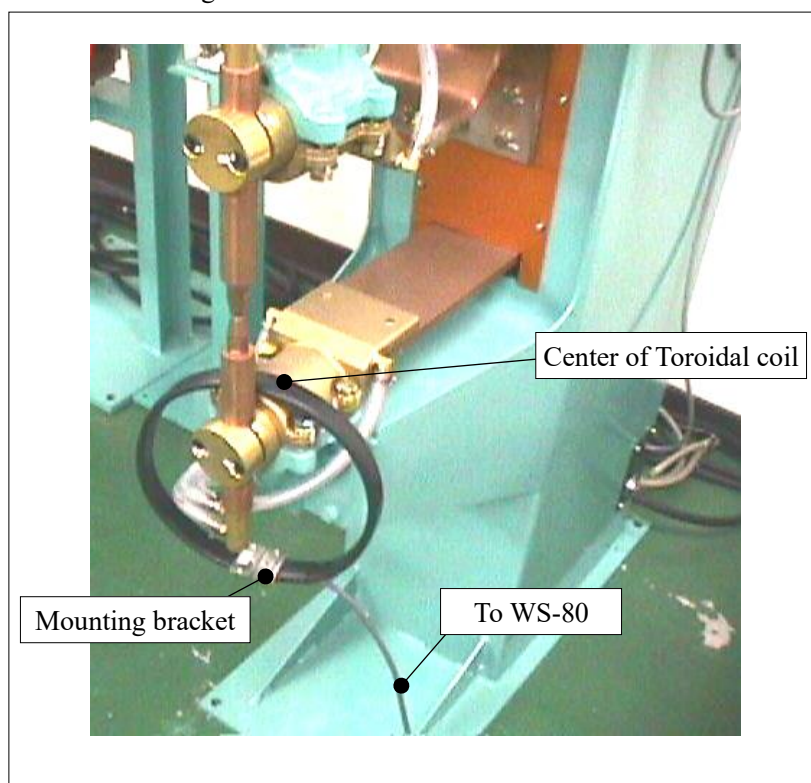


Figure 1 Mounting of the Toroidal coil



CAUTION

- (1) Read instruction manual for individual welding machine, and then operate carefully.
- (2) When attached toroidal coil to welding machine, confirm safety before beginning operation to prevent injury or electric shock by power supplies for welding turned off.

5 - 2. Connecting Toroidal Coil, Power Supply, and Ground

The connectors are mounted at locations to the right side of the panel, as shown in Figure 2.

(a) Toroidal coil

Connect the Toroidal coil to the Toroidal coil connector and secure it with the connector screw.

(b) Power supply

Connect the power cord to the power connector.

The power switch is located above the connector.

- Input power supply: 100 - 120VAC 50/60 Hz
Be sure to use only the included power cord.

(c) Ground

Connect the ground terminal to the ground.

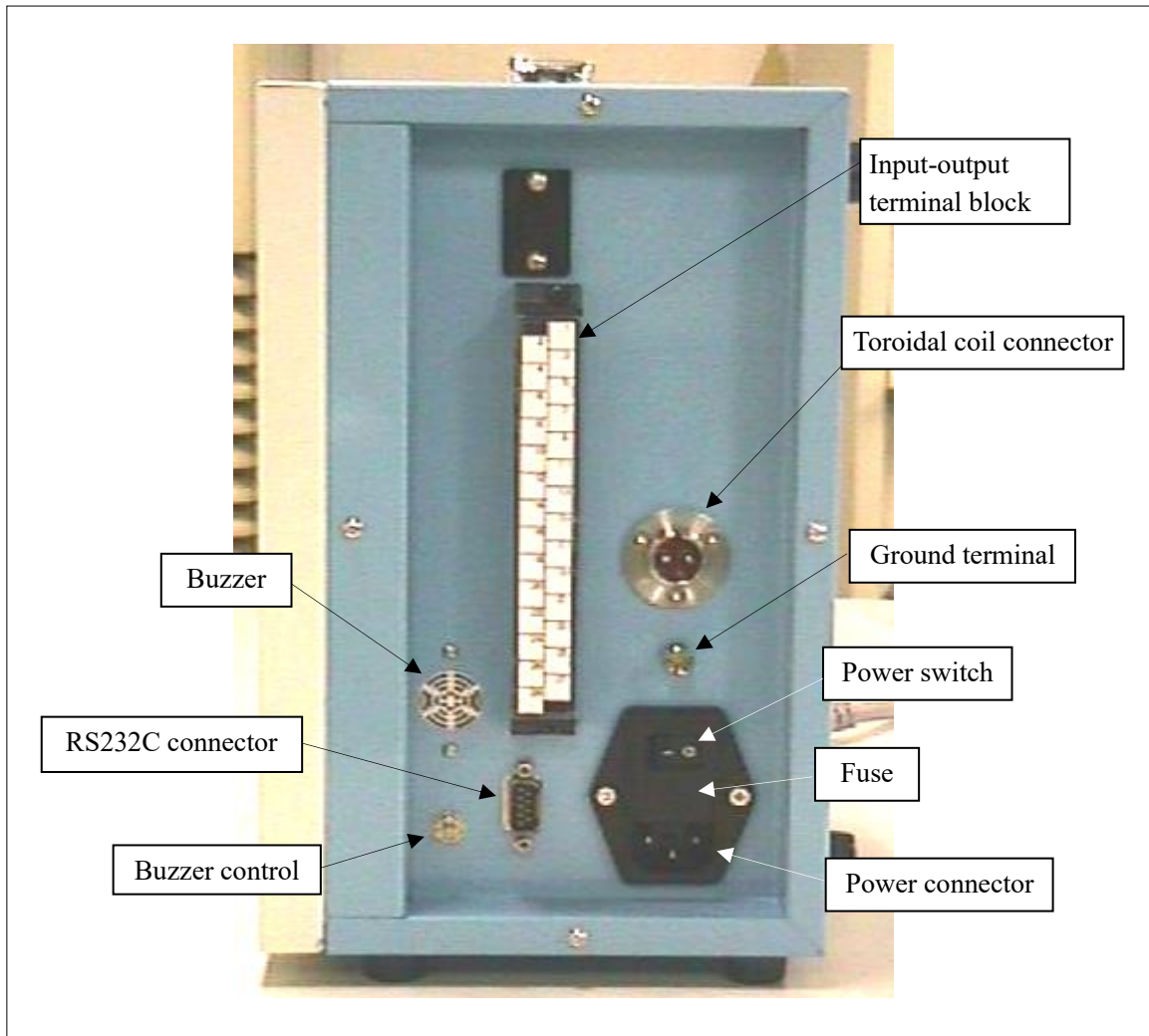


Figure 2 Connector layout

6. Operation

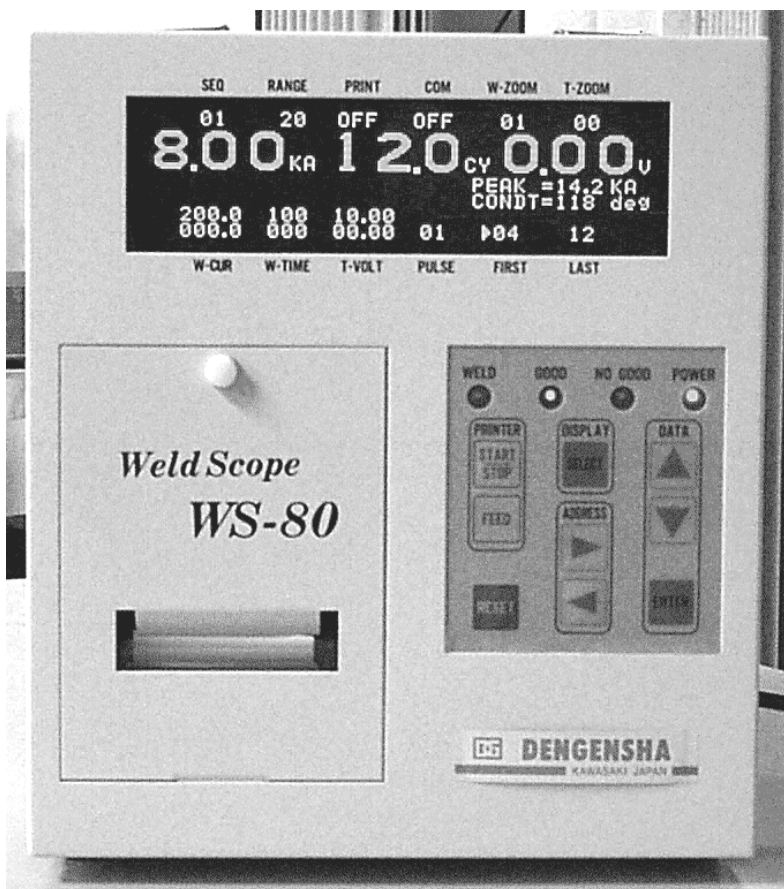


Figure 3 Front panel

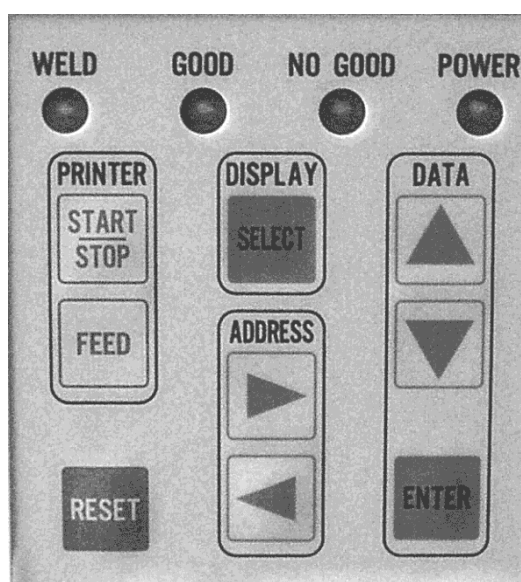


Figure 4 Switches and panel

6 - 1. Panel Switches

- ① ADDRESS: Address key
Moves the cursor to the item that is to be set.
The right direction key moves items from the upper left to the lower right.
The left direction key moves items in reverse order as for the right direction key.
- ② DATA: Data key
Changes data on items that were selected by the address key.
The upward key increases a numeric value.
The downward key decreases a numeric value.
- ③ ENTER: Write key
Stores the set data in the memory.
- ④ SELECT: Select key
Selects the contents that is to be displayed on the fluorescent display tube from among four types.
The screen changes each time this key is pressed: The display changes repeatedly in the sequence numeric screen to graphic screen to history screen to system screen to numeric screen.
- ⑤ START/STOP: Print/Print stop key
Prints out data that conforms to the contents displayed on the selected screen.
Pressing this key again during print operation stops the printing process.
Note: When the system screen is selected, no data is printed out.
While data is printed out, the current is not measured.
- ⑥ FEED: Paper feed key
Feeds paper to the printer.
As long as this button is pressed, paper continues to be fed.
- ⑦ RESET: Reset key
Resets the error display.

6 - 2. Panel Lamps

- ① WELD lamp
The LED is on during measurement.
- ② GOOD lamp
The LED is on when the measured current value, welding cycle, and tip voltage are within the range of upper and lower limits.
The LED is off when the reset key is pressed or the next measurement starts.
- ③ NO GOOD lamp
The LED is on when the measured current value, welding cycle, and tip voltage exceed the upper and lower limits.
The LED is off when the reset key is pressed or the next measurement starts.
- ④ POWER lamp
The LED is on when power is turned on.
The power switch is located above the power connector on the right side of the panel.

6 - 3. Setting Items

① SEQ

Sets the sequence number (1 to 15).

- Set a condition for SEQ number 1 when the condition change signal of the external input terminal is not used. Measurement is performed under the condition recorded for SEQ number 1.
- The sequence number for which a measurement has been performed is not displayed. It can be checked from the data on the history screen.

② RANGE

Sets the current measurement range (5kA, 20kA, 50kA, 100kA).

- The range is set for each of the sequence numbers separately.

③ PRINT

Sets a condition for which results are automatically printed out at the end of the measurement.

- The same setting will be used for all sequence numbers.
- Data that conforms to the contents displayed on the selected screen is printed out. See the example in “Screens” clause.
- When the system screen was selected, no data is printed out.
- While data is printed out, the current is not measured.

OFF: No data is printed out.

ON: Data is printed out after every measurement.

1 to 99: Number of printout intervals
e.g.) When 10 is set, data is printed out every 10 units of the welding count.

ERR: Data is printed out when an error occurs.

MONITOR: The monitor results are printed out after every measurement.
The monitor results are printed out regardless of the selected screen, even if the system screen was selected.

④ COM

Sets a condition for which the results are output during data transfer at the end of the measurement.

- This setting is used for all sequence numbers.
- Data that conforms to the contents displayed on the selected screen is output. See the example of communicated data in Section 5, “Screens.”
- When the graphic screen or system screen was selected, no data is output.
- While data is output, the current is not measured.

OFF: No data is output.

ON: Data is output after every measurement.

1 to 99: Number of output intervals
e.g.) When 10 is set, data is output every 10 units of the welding count.

ERR: Data is output when an error occurs

MONITOR: The monitor results are output after every measurement.
The monitor results are printed out regardless of the selected screen, even if the graphic screen or system screen were selected.

⑤ W-ZOOM

Sets the height of the current waveform that is being displayed (1 to 10).

- This setting is used for all sequence numbers.
- When the height is set to 0, the current waveform is not displayed.

⑥ T-ZOOM

Sets the height of the tip voltage waveform that is being displayed (0 to 10).

- This setting is used for all sequence numbers.
- When the height is set to 0, the tip voltage waveform is not measured.
The waveform and the display become 0 displays. (Even if the height is not set to 0, the tip voltage waveform will not be displayed if the time base is contracted.)

⑦ W-CUR

Sets the upper and lower limits of monitoring the current (0.0 to 200.0 kA).

- This item is set for each sequence number separately.
- This item can be set when the numeric screen or system screen is selected. The upper row displays the upper limit and the lower row displays the lower limit.
- When the monitor value is larger than the upper limit or smaller than the lower limit, an error occurs. The upper limit or lower limit themselves are also within the range.
- To disable the upper- and lower-limit monitor function, set the upper limit to 200.0 kA and the lower limit to 0.0 kA.

⑧ W-TIME

Sets the upper and lower limits of monitoring the welding cycle (0 to 200 cycles).

- This item is set for each sequence number separately.
- This item can be set when the numeric screen or system screen is selected. The upper row displays the upper limit and the lower row displays the lower limit.
- When the monitor value is larger than the upper limit or smaller than the lower limit, an error occurs. The upper limit or lower limit themselves are also within the range.
- To disable the upper- and lower-limit monitor function, set the upper limit to 100.0 cycles and the lower limit to 0 cycle.

⑨ T-VOLT

Sets the upper and lower limits of monitoring the tip voltage (0.00 to 10.00 V).

- This item is set for each sequence number separately.
- This item can be set when the numeric screen or system screen is selected. The upper row displays the upper limit and the lower row displays the lower limit.
- When the monitor value is greater than the upper limit or smaller than the lower limit, an error occurs. The upper limit or lower limit themselves are also within the range.
- To disable the upper- or lower-limit monitor function, set the upper limit to 10.00 V and the lower limit to 0.00 V.

⑩ PULSE

Sets the impulse that is to be displayed (1 to 50/CONT/SEAM/MULT).

- This item is set for each sequence number separately.

1 to 50: Number of impulses to be set

CONT: Continuous current conduction of 99 cycles or more

SEAM: Seam welder

MULT: The section specified in FIRST-LAST is measured regardless of the number of impulses.

⑪ FIRST

Specifies the beginning of the section for which the stored data is displayed and monitored (1 to 200 cycles).

- This item is set for each sequence number separately.

⑫ LAST

Specifies the end of the section for which the stored data is displayed and monitored (1 to 200 cycles).

- This item is set for each sequence number separately.

6 - 4. Operation

(1) Power on

(a) Turn the POWER switch on the right side of the panel to ON.

(b) The POWER lamp lights up and the fluorescent display tube displays the numeric screen.

(2) System settings

(a) Use the SELECT key to enter the system screen.

(b) Repeat the following steps to set each of the necessary items:

Use the ADDRESS key to move the cursor to a settings item.

Use the DATA key to change the value of the setting and use the ENTER key to write it.

(3) System items

- See Figure 18, "System Screen" in (4) of Section 5 for details about the actual screen.

① FRE: Sets the power frequency (50/60 Hz).

② TOR: Sets the scale factor of the Toroidal coil (1/2, 1, 5, 10) (initial value is 1).

③ COL: Sets the cooling time at the end of the measurement (10 – 100 cycles) (initial value is 30).

- For impulse current conduction, this time is set to be longer than the cooling time for the welding condition. After the specified cooling time has passed, current conduction for the next welding process is measured.

④ HOUR: Hour

⑤ MIN: Minute

⑥ SEC: Second

- Clock for time stamp

- ⑦ WELDER: Sets the type of the welder.
 - AC: Single-phase AC welder or seam welder
 - DC: Single-phase/three-phase rectification welder, three-phase low-frequency welder, or inverter welder
 - CAP: Capacitor welder
- ⑧ COUNTER: Erases monitor data (0/present measurement count).
 - The present measurement count is displayed. The stored monitor data is erased by selecting and writing 0.
- ⑨ VERSION: Displays the version (This is not an item of the settings).

(4) Setting of monitor conditions

- (a) Use the SELECT key to enter the numeric screen.
- (b) Repeat the following steps to set each of the necessary items:
 - Use the ADDRESS key to move the cursor to a settings item.
 - Use the DATA key to change the value of the setting and use the ENTER key to write it.
 - See “Setting Items” clause for details on the setting items.

The preparations for measurement are now completed.

7. Screens

7 - 1. Numeric screen (numeric mode)

- (1) Displayed: The monitor results are displayed in the form of numerical values.
 (2) Printed: Monitor results, bar graph, and data for every half cycle
 (3) Transferred: Monitor results and data in every half cycle

SEQ	RANGE	PRINT	COM	W-ZOOM	T-ZOOM
01	20	OFF	OFF	01	01
O. OOKA000. OCYO. OOV					
PEAK = 0.00 KA					
CONDT = 000 deg					
200.0	100	10.00			
000.0	000	00.00	1	004	099
W-CUR	W-TIME	T-VOLT	PULSE	FIRST	LAST

Figure 5 Numeric screen

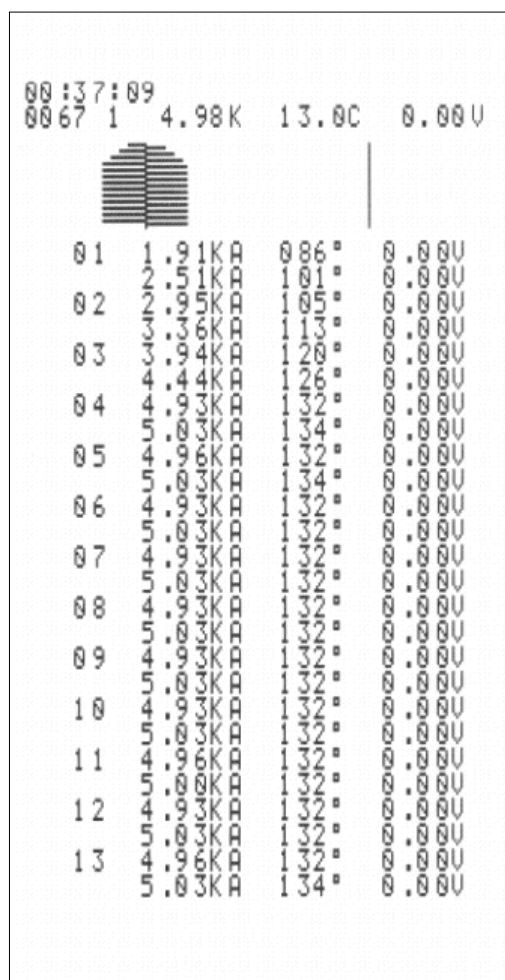


Figure 6 Example of numeric screen

067	1	4.98K	13.0C	0.00V	00:37:09	· 6
01	1.91KA	086D	0.00V	· F		
	2.51KA	101D	0.00V	· v		
02	2.95KA	105D	0.00V	· H		
	3.36KA	113D	0.00V	· o		
03	3.94KA	120D	0.00V	· J		
	4.44KA	126D	0.00V	· k		
04	4.93KA	132D	0.00V	· F		
	5.03KA	134D	0.00V	· p		
05	4.96KA	132D	0.00V	· B		
	5.03KA	134D	0.00V	· p		
06	4.93KA	132D	0.00V	· D		
	5.03KA	132D	0.00V	· r		
07	4.93KA	132D	0.00V	· C		
	5.03KA	132D	0.00V	· r		
08	4.93KA	132D	0.00V	· B		
	5.03KA	132D	0.00V	· r		
09	4.93KA	132D	0.00V	· A		
	5.03KA	132D	0.00V	· r		
10	4.93KA	132D	0.00V	· I		
	5.03KA	132D	0.00V	· r		
11	4.96KA	132D	0.00V	· E		
	5.00KA	132D	0.00V	· u		
12	4.93KA	132D	0.00V	· G		
	5.03KA	132D	0.00V	· r		
13	4.96KA	132D	0.00V	· C		
	5.03KA	134D	0.00V	· p		

Figure 7 Example of transferred data (numeric screen)

7 - 2. Graphic screen

- (1) Displayed: Measured data is displayed in the form of graphs.
- (2) Printed: Monitored results and graph of the waveform
- (3) Transferred: No data is output.
- If the section (display section) as set by FIRST and LAST is very short, the display of the waveform is enlarged.

SEQ	RANGE	PRINT	COM	W-ZOOM	T-ZOOM
01	20	OFF	OFF	01	01
O. OOKA000. OCYO. OOV					
				PEAK = 0.00 KA	
				CONDT = 000 deg	
200.0	100	10.00			
000.0	000	00.00	1	004	099
W-CUR	W-TIME	T-VOLT	PULSE	FIRST	LAST

Figure 8 Graphic screen (maximum display)

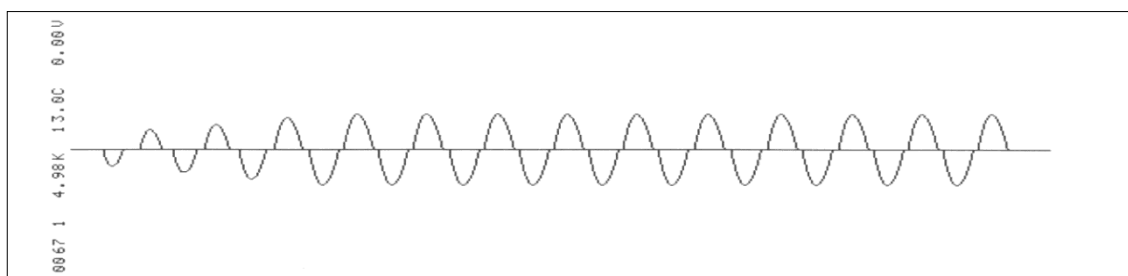


Figure 9 Example of graphic screen in maximum display

- If the section (display range) as set in FIRST and LAST is very long, the display of the waveform is made smaller.

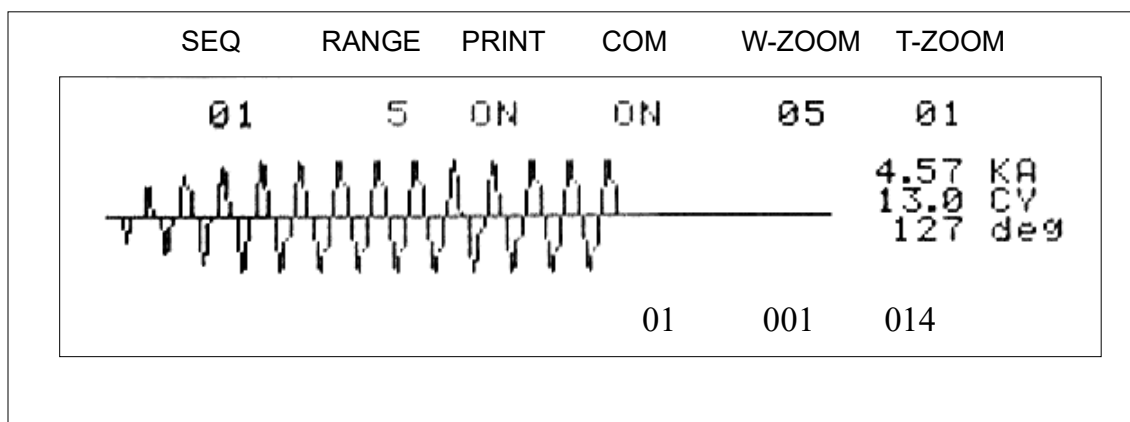


Figure 10 Graphic screen (reduced display)

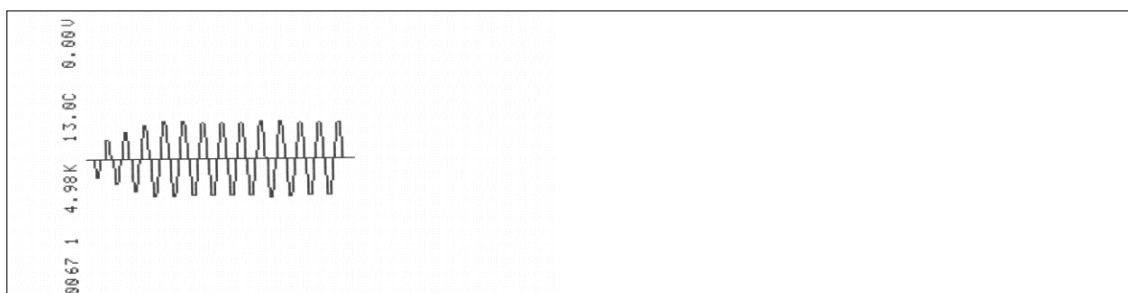


Figure 11 Example of graphic screen in minimum display

- When W-ZOOM is changed, the height of the waveform changes while the display range remains unchanged.

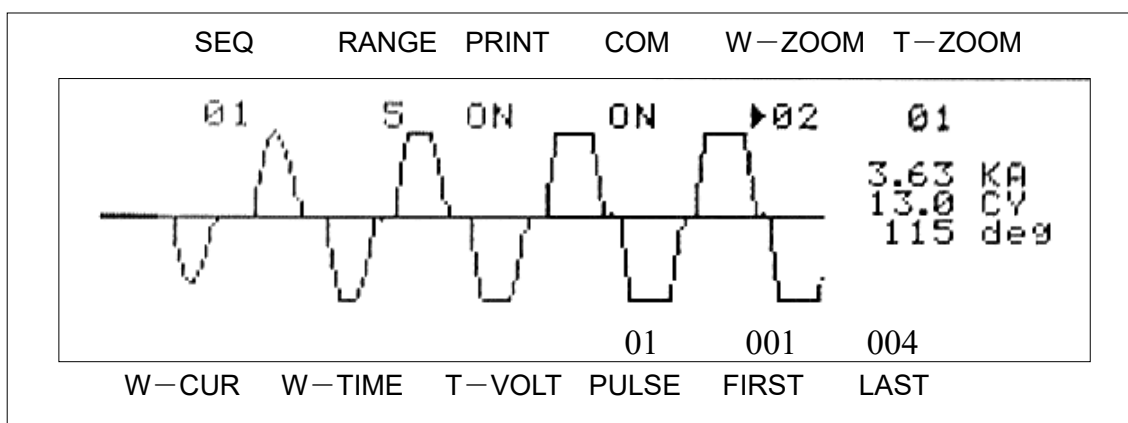


Figure 12 Graphic screen (zoom-in)

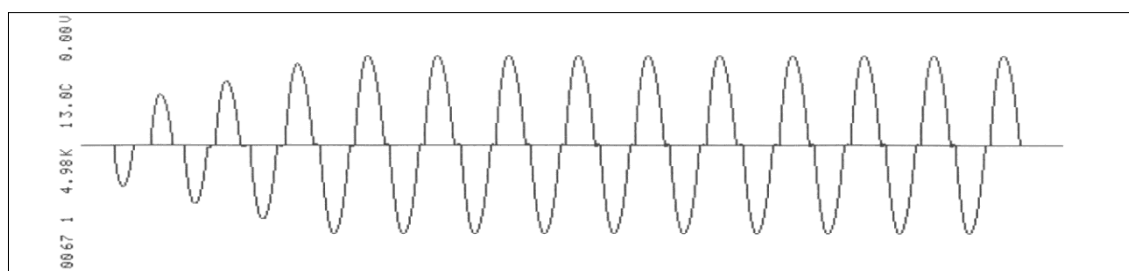


Figure 13 Example (graphic screen in zoom-in)

7 - 3. History screen

- (1) Displayed: Up to 4000 monitor results that were recorded earlier are displayed in the format of a table.
- (2) Printed: Monitor results
In manual printout mode, the displayed data is printed.
- (3) Transferred: Monitor results

- The screen can be scrolled by pressing the DATA key.

SEQ	RANGE	PRINT	COM	W-ZOOM	T-ZOOM
0155	01	7.85	12.0	0.00	09:26
0156	01	7.79	12.0	0.00	09:26
0157	01	7.80	12.0	0.00	09:26
0158	01	8.04	12.0	0.00	09:26
0159	01	7.99	12.0	0.00	09:26
0160	01	8.00	12.0	0.00	09:26

W-CUR W-TIME T-VOLT PULSE FIRST LAST

Figure 14 History screen

Figure 15 Ex. history screen in automatic mode

• 0163 1 2.96K 12.0C 0.00V 10:50:19 • k

Figure 16 Ex. of transferred data (history screen)

[illegible]

Figure 1

7 - 4. System screen

- (1) Displayed: Screen of system settings
- (2) Printed: No data is output.
- (3) Transferred: No data is output.

- All setting items are displayed.

SEQ	RANGE	PRINT	COM	W-ZOOM	T-ZOOM
▶01	20	OFF	OFF	01	00
FRE= 50 HOUR=09 WELDER =AC TOR= 1 MIN.= 34 COUNTER=0160 COL=030 SEC.= 40 VERSION:1.00					
200.0	100	10	01	001	004
000.0	000	00	01	001	04
W-CUR	W-TIME	T-VOLT	PULSE	FIRST	LAST

Figure 18 System screen

8. Error Items

8 - 1. Error contents

If an error occurs, a message is displayed that explains the contents of the error. The NO GOOD lamp on the panel also lights up.

Error contents	Message that is displayed on the screen	Code of monitor results
No current conduction	NO CURR	N precedes the current value.
Over current	OVER CURR	H precedes the current value.
Undercurrent	UNDER CURR	L precedes the current value.
Over welding time	OVER CYC	H precedes the welding time.
Under welding time	UNDER CYC	L precedes the welding time.
Range of the over current	OVER RANGE	(The monitor results are not kept)

- The message is erased and the lamp is turned off when the reset key is pressed or at the start of the next measurement.
- About the repetition abnormality display by the error history screen.
 e.g.) 0001 1 H5.17KL013.0C 0.08V
 Error repetition display of OVER CURR and UNDER CYC

9. Measured Welders

9 - 1. Single-phase AC Welder

- ① In this example, the current is measured for the following settings:

Up slope:	2 cycles
Current conduction time:	8 cycles
Current setting:	8.00 kA
Upper limit of current monitor:	8.8 kA
Lower limit of current monitor:	7.2 kA
Upper limit of welding cycle monitor:	11 cycles
Lower limit of welding cycle monitor:	10 cycles
Power frequency:	50 Hz

A standard Toroidal coil is used.

- ② Enter the setting values for all required items. For details about the operation, refer to “Operation” clause.

- (1) Enter the system screen and set the following items:

FRE:	50	Set this item to 50 Hz.
TOR:	1	Standard Toroidal coil
COL:	030	This initial value was chosen since there is only a single current impulse (for impulse current conduction, set the value to be longer than the cooling time that was specified in the welding conditions.)
WELDER:	AC	Alternating current

- (2) Enter the numeric screen and set the following items:

SEQ:	01	Set the conditions for sequence number 1 (this is the setting for the case that the condition change signal of an external input terminal is not used).
RANGE:	20	Set the range of current measurement to 1.00-20.00 kA.
PRINT:	OFF	(This is the setting when automatic printout is not used.)
COM:	OFF	(This is the setting when data transfer is not used.)
W-ZOOM:	01	(Change this item as required while viewing the graph.)
T-ZOOM:	01	(Change this item as required while viewing the graph.)
W-CUR:	008.8	A value higher than 8.8 kA is defined to be an error.
	007.2	A value lower than 7.2 kA is defined to be an error.
W-TIME:	011	A value higher than 11 cycles is defined to be an error.
	010	The value that is lower than 10 cycles is defined to be an error.
T-VOLT:	10.00	Set the maximum value (this is the setting when the tip voltage is not measured or the upper limit does not have to be determined).
	00.00	Set the minimum value (this is the setting when the tip voltage is not measured or the lower limit does not have to be determined).
PULSE:	01	A single current impulse
FIRST:	003	Monitoring starts from the third cycle (the measured data is retrieved from the first cycle).
LAST:	008	The section that is to be monitored ranges up to the eighth cycle (measured data is retrieved till the end of the current impulse).

- ③ With the above settings, measured results for the shaded area in the following chart are displayed:

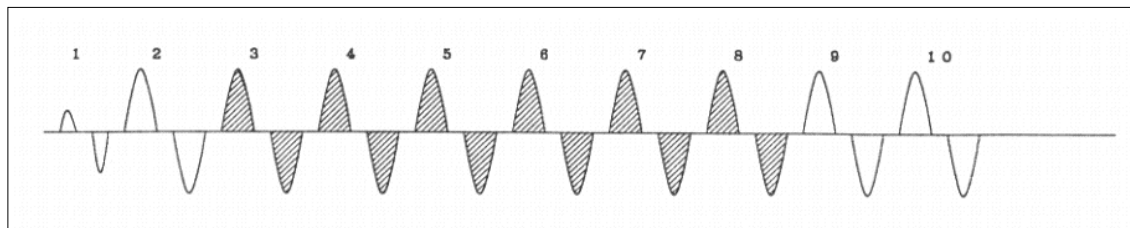


Figure 19 Monitor section

- The effective values for any section can be measured by changing the settings for FIRST and LAST.
- The measured data is stored from the start to the end cycle of current conduction in a memory area for all sections. Even if the settings for FIRST and LAST are changed after the end of the measurement, the effective values for any section can be retrieved.
- Even if the setting for LAST exceeds the welding cycle, measurement is performed normally. In this case, the measurement section ranges from the specified FIRST cycle to the last cycle of current conduction.

9 - 2. Pulsation Welder (AC Welder)

(1) Monitoring the specified impulse

- ① This example shows the settings of the monitor section for the case of pulsation welding that has a current conduction time of five cycles.
- ② With the settings of this example, the effective values for the shaded area in the following chart are displayed. In the display for the current conduction time, the specified impulse current conduction time is displayed.

WELDER:	AC	Alternating current
PULSE:	02	The second impulse is specified for monitoring purposes.
FIRST:	001	Monitoring starts from the first cycle of the specified impulse (measured data for all cycles is retrieved).
LAST:	003	The monitoring section ranges up to the third cycle of the specified impulse (measured data for all cycles is retrieved).

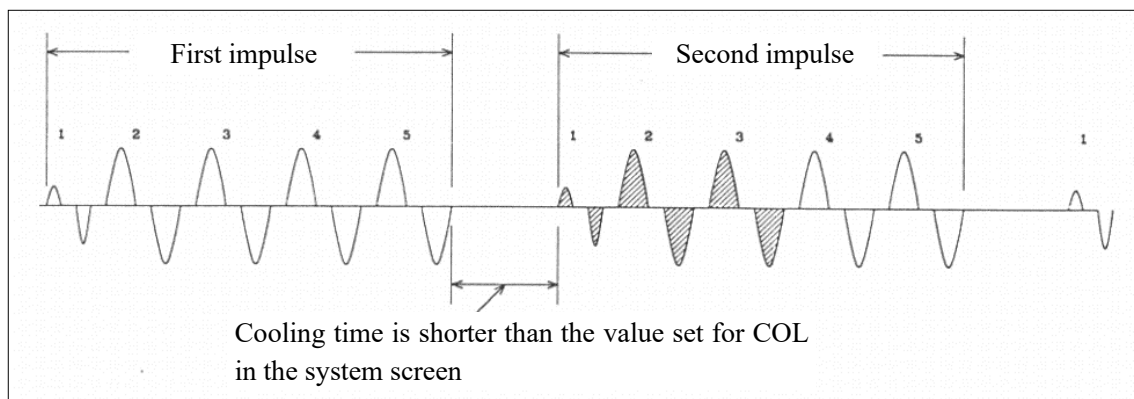


Figure 20 Monitor section (pulsation)

- If the cooling time between the first impulse and the second impulse is longer than the time set for COL in the system screen, measurement is not possible. The second impulse is measured as the next welding instance.

(2) Continuous monitoring of multiple impulses

- ① This example uses a setting of the monitoring section for pulsation welding that has a current conduction time of five cycles.
- ② With the settings of this example, the effective values for the following chart are displayed. In the display for the current conduction time, the total current conduction time is displayed.

WELDER:	AC	Alternating current
PULSE:	MULT	Impulse is measured continuously.
FIRST:	001	Monitoring starts with the first cycle of current conduction (measured data for all cycles is retrieved).
LAST:	012	The monitoring section ranges up to the 12th cycle of current conduction (measured data is fetched from all cycles).

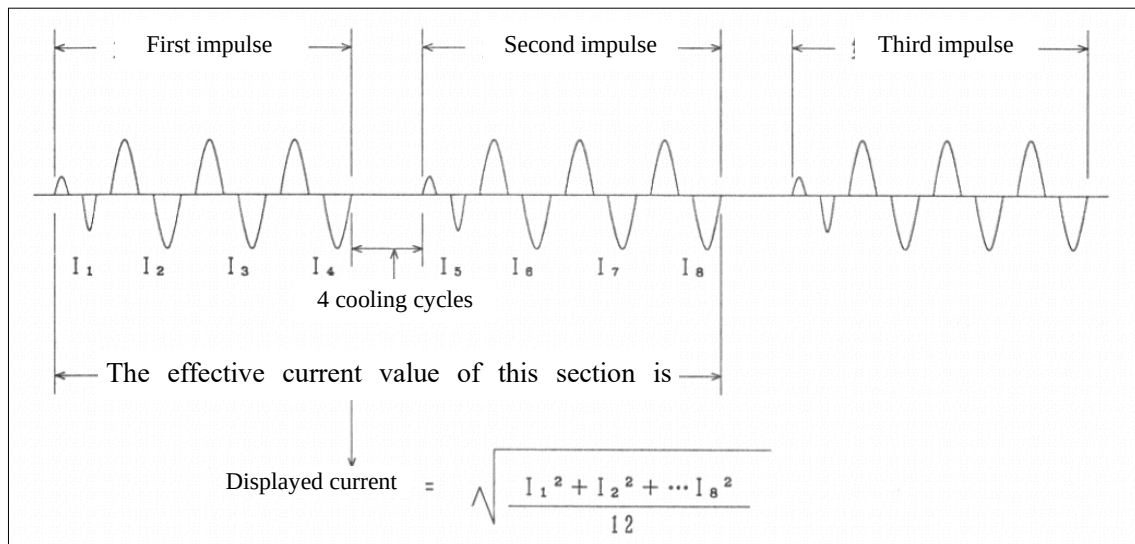


Figure 21 Monitoring section (MULT)

- The cooling time must be within the time that was set for COL in the system screen.

9 - 3. Seam Welder (AC)

- ① Set PULSE to SEAM on the numeric screen. FIRST and LAST do not have to be set.
The set data is ignored.

WELDER: AC
PULSE: SEAM

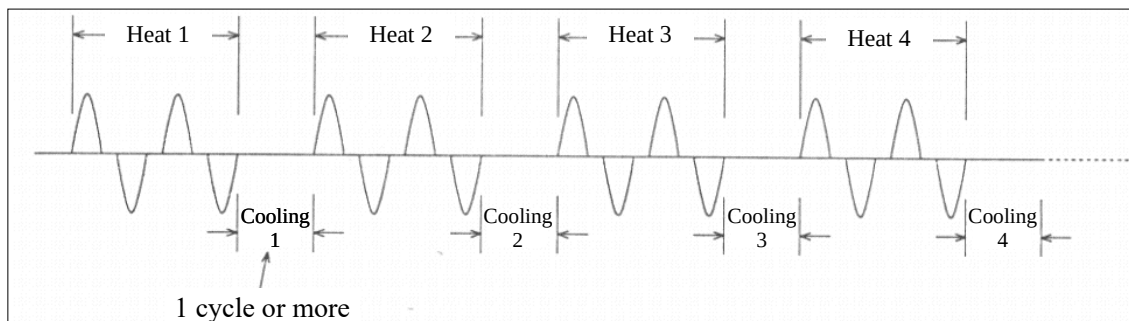


Figure 22 Seam welder

- “Detection → monitor” is repeated in an infinite loop for all heats. All current conduction pulses are monitored but only the monitoring results that are to be displayed are extracted. The extraction interval depends on the length of heat and cooling time.
- During measurement in seam mode, waveform display, automatic printout, and data transfer output are not available. During measurement, only monitoring takes place. By selecting the history screen after measurement is finished, all stored data and the error occurrence status can be checked. The data can also be printed out manually.

9 - 4. Single-phase/Three-phase Rectification and Inverter Welders

- ① Set WELDER in the system screen to DE and PULSE in the numeric screen to 01. An example in which the monitor section was set to FIRST: 02 and LAST: 04 is shown below.

WELDER: DC
PULSE: 01
FIRST: 002
LAST: 004

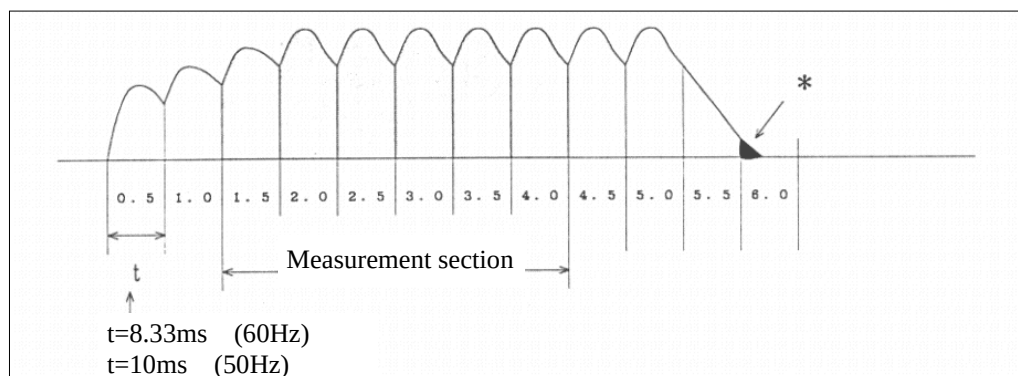


Figure 23 Rectification welding

- The effective value and cycle for the current rectification value are calculated for every half cycle, as shown above.
*: When the shaded area is smaller than the detection threshold value, the welding cycle is displayed as 5.5 cycles.

9 - 5. Capacitor Welder

- ① Set WELDER on the system screen to CAP and PULSE on the numeric screen to 01.
FIRST and LAST do not have to be set. The set data is ignored.

WELDER: CAP

PULSE: 01

For example: In capacitor mode, the peak current value and the time required for reaching the peak are displayed as follows:

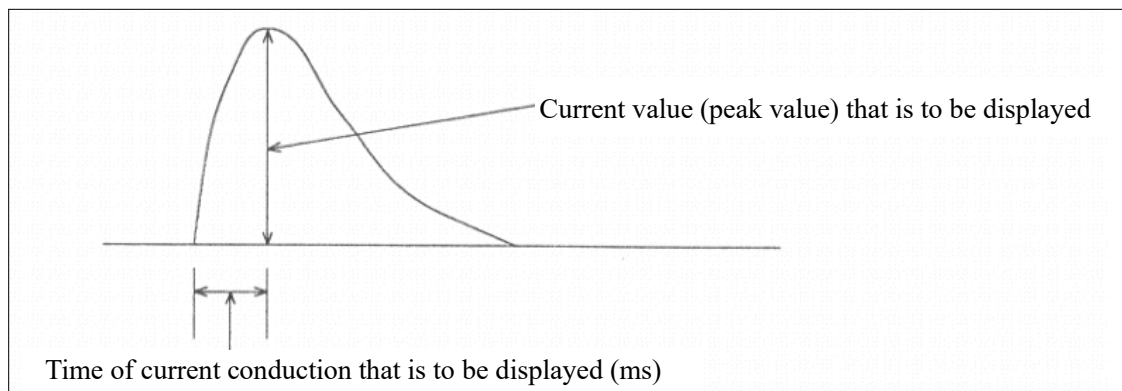


Figure 24 Capacitor mode

- In capacitor mode, the peak current is displayed as the current value. The time from when current conduction starts till the peak current is reached is displayed as current conduction time in milliseconds.

9 - 6. Measuring Continuous Current Conduction for More than 200 Cycles

- ① Set WELDER on the system screen to AC and PULSE on the numeric screen to CONT.
Set FIRST and LAST appropriately for specifying the monitoring section.

WELDER: AC

PULSE: CONT

For example: In CONT mode, measurement and display are performed as follows.

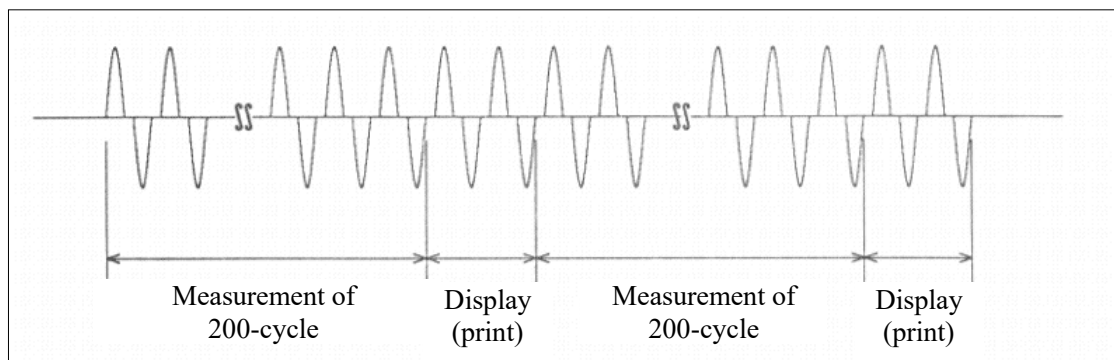


Figure 25 CONT mode

- When continuous current conduction is measured for more than 200 cycles, the steps measurement of 200 cycles → display (print) → measurement of 200 cycles → display (print) are repeated according to the settings of CONT in PULSE.

10. External Signals

10 - 1. Connecting Input-Output Terminal Block

Connect these boards as required.

The terminal board numbers stand for the following contents:

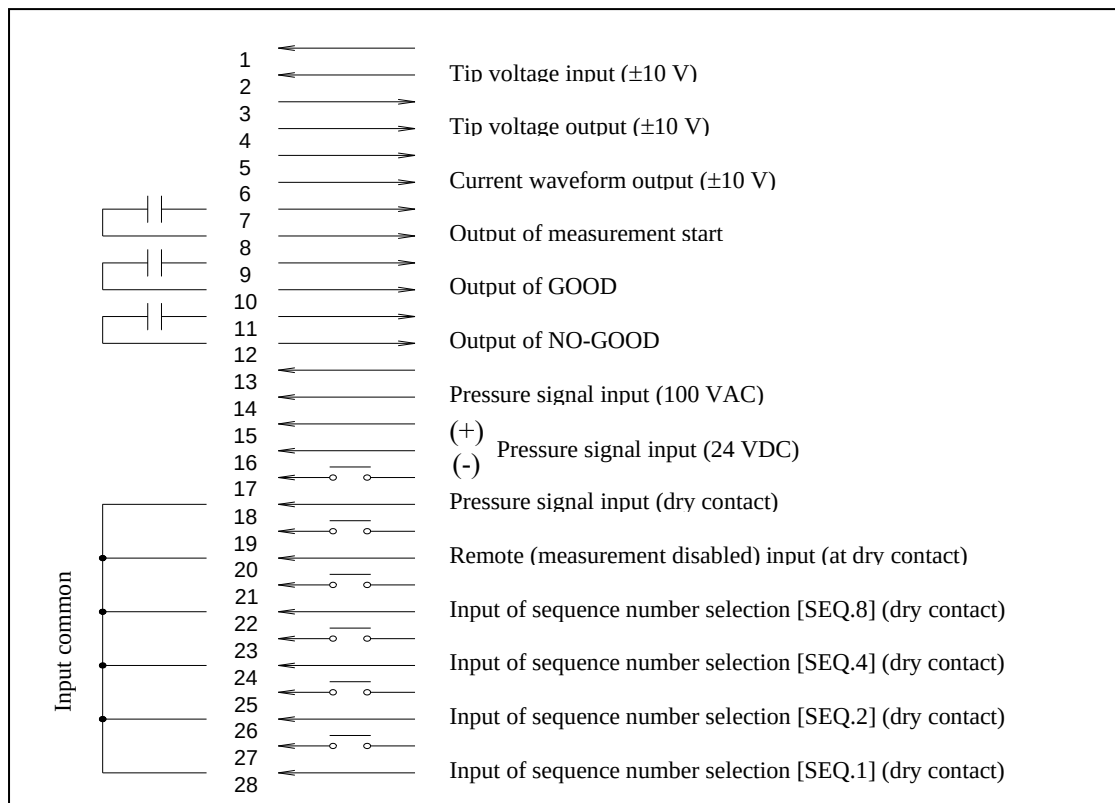


Figure 26 External terminal block layout

Notice:

- To use pressure signal input, select only one of three input signals.
- In the case of remote (measurement disabled) input, measurement is not possible.
- Use binary code to input a sequence number selection.

For example: To select the sequence number 7, input to terminal board numbers 23, 25, and 27.

 CAUTION
(1) When measuring drive signal for AC-valve. Be careful to prevent electric shock. AC100V applied on Terminal blocks (2) Be careful not to make an improper connection it bring about troubles.

11. Communication

11 - 1. Communication format

Communication data	Data contents	Notice
Start code (STX)	0F0h	
Print data	7bits ASCII 36 bytes	
End code (ETX)	0FEh	
Checksum	Tow's complement of sum of the 8-bit data from STX to ETX	
CR+LF		

11 - 2. Print data

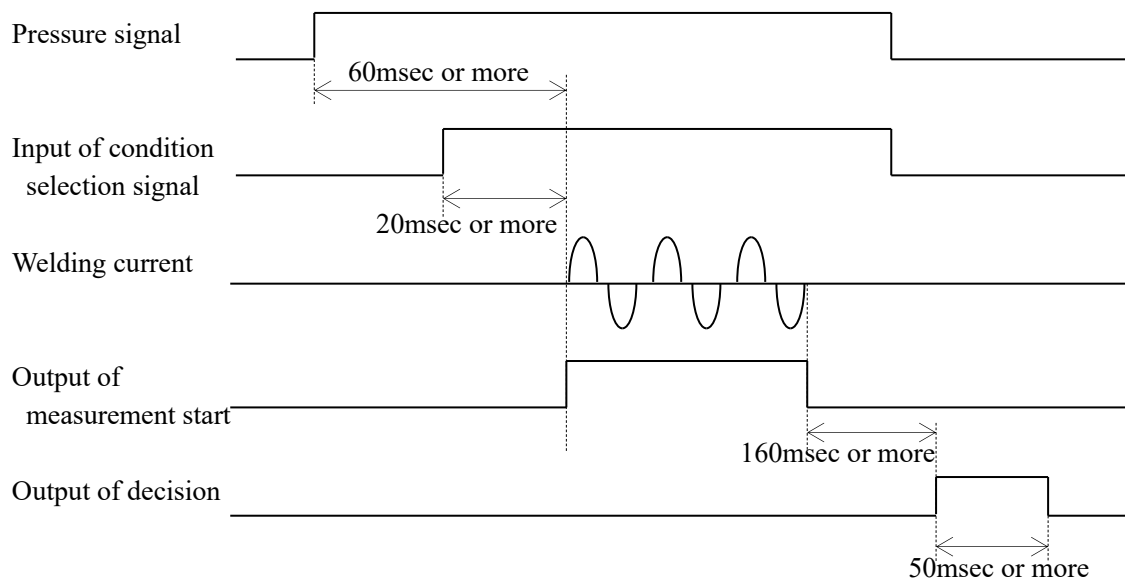
e.g.)

0163 1 — 2.96K — 12.0C — 0.00V 10:59:19 k
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Print data

- ① number of measurements
- ② number of sequence
- ③ H : Error upper limit
L : Error lower limit
- ④ Current rms value
- ⑤ H : Error upper limit
L : Error lower limit
- ⑥ Cycle of current condition
- ⑦ H : Error upper limit
L : Error lower limit
- ⑧ Tip voltage
- ⑨ Time
- ⑩ Checksum

11 - 3. Timing Chart



11 - 4. Data Transfer Specifications

(1) Data transfer settings

Bit/second	9600
Data bit	8
Parity	None
Stop bit	2
Flow control	Hardware

(2) Connection

RS232C connector of WS-80		Serial port for DOS/V personal computer
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9		9

12. Tip Voltage

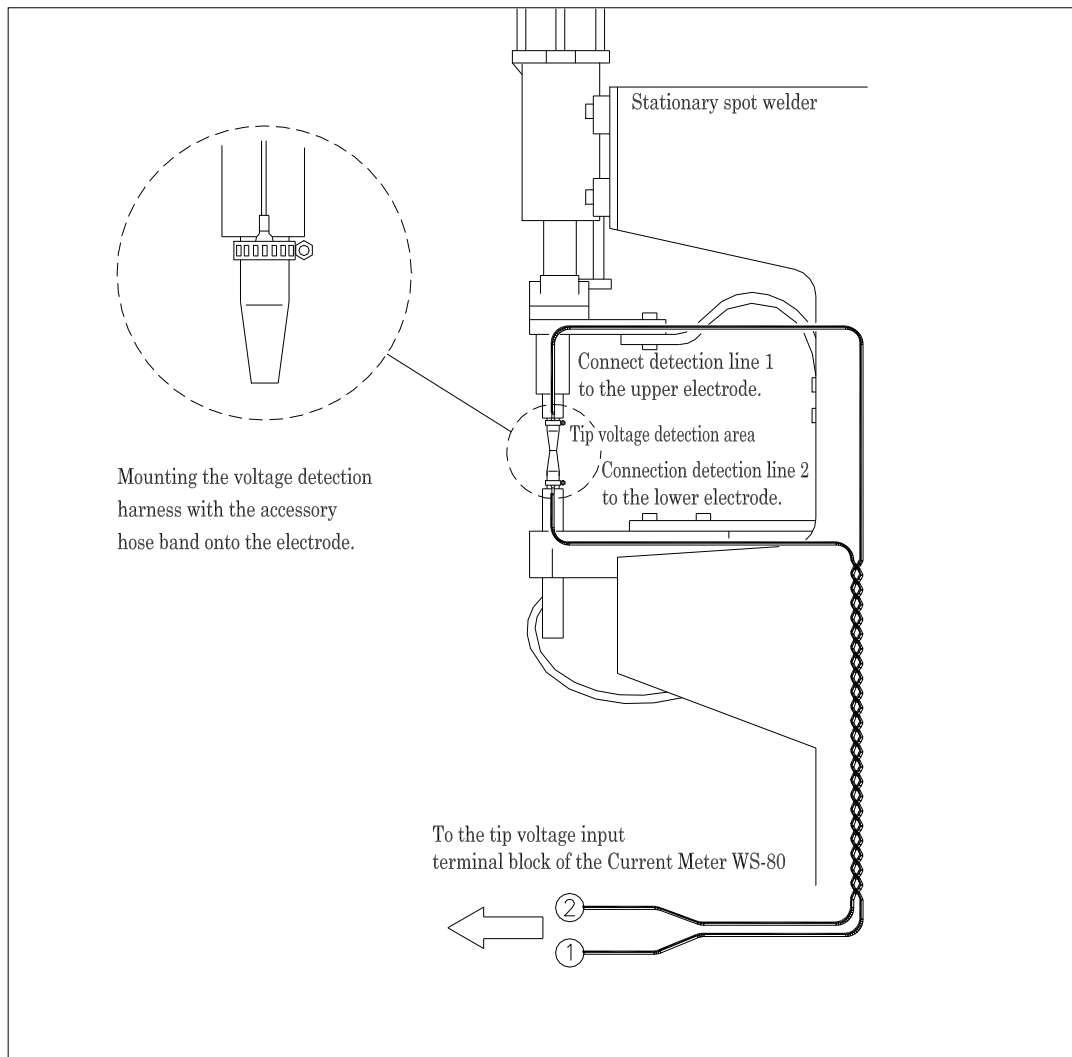


Figure 27 Connect of Tip voltage

- The peak value of tip voltage is measured for every half cycle. The average of these values is monitored and displayed.
- To display the tip voltage graphically, set the monitor section (FIRST to LAST) to four cycles or less and maximize the waveform display. Set T-ZOOM to 1 or more.
- The cable is provided as an option.

WARNING

- (1) Read instruction manual for individual welding machine, and then operate carefully.
- (2) When attached detection lead to welding machine, confirm safety before beginning operation to prevent injury or electric shock by power supplies for welding turned off.

13. Maintenance

13 - 1. Precautions concerning maintenance

- Be sure to check if the welding power has been cut off.
- Use only specified replacement parts.

13 - 2. Parts replacement

(1) Fuse

FU1: 3A glass tube, Slow blow type ($\phi 5 \times 20$ mm)

■ Method of replacement

- ① Turned the Power switch off and then remove AC-cable.
- ② Open the cover of fuse holder.
- ③ Pick out the fuse carriage.



WARNING

Replace fuse with same type and rating.



CAUTION

To prevent breakage the cover, remove AC-power cable before opening a cover of fuse holder.

(2) Toroidal coil

A deformed or damaged Toroidal coil might cause inaccurate measurement. Replace deformed or damaged Toroidal coils.

1B8L5 (accessory)

DENGENSHA TOA

(Sensitivity: 1 , lead wire: 5m)

Example for unique specification)

10B8L10 (sensitivity: 10 , lead wire: 10m)

①B8L②

①: Sensitivity

②: lead wire

(3) Power cord

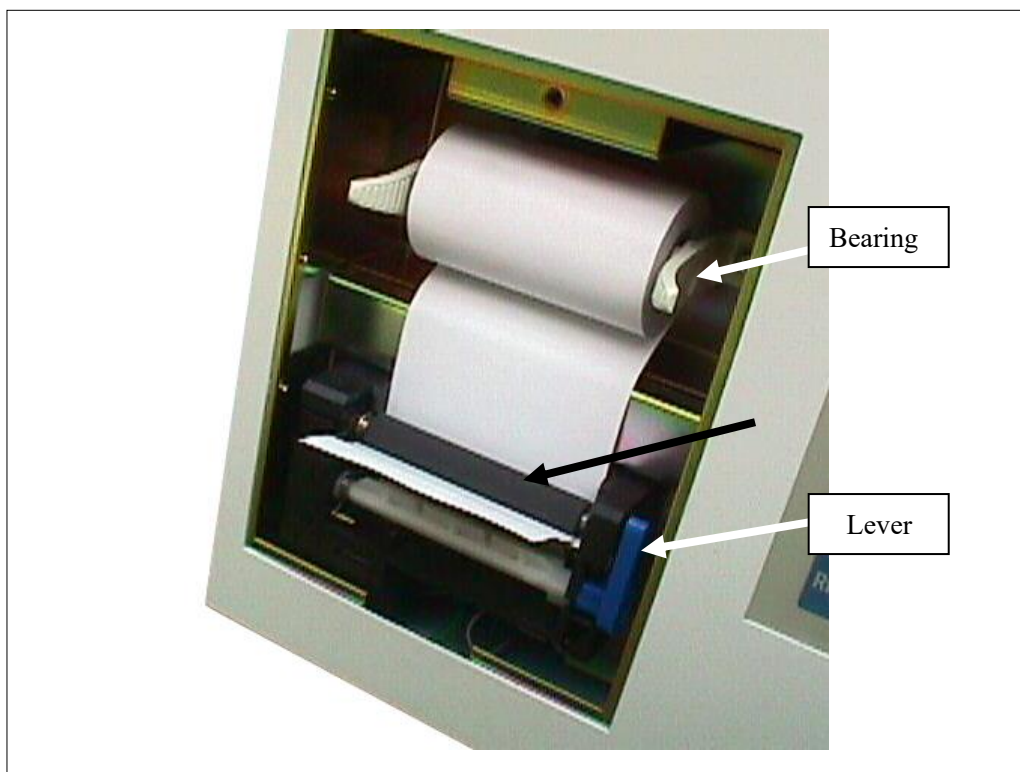
Plug	KP-30B (13A125V)
Cord	SJT3#16AWG (5m)
Receptacle	KS-32 (13A125V)
Adapter	KPR-25

KAWASAKI ELECTRIC WIRE CO., LTD
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(4) Recording Paper
Recording paper

TPW060-30

NAKAGAWA MFG. CO., LTD.



(Old model TP50KS-4F is out of production.)

Figure 28 Setting recording paper

- ① Remove the mounting screw, then remove the printer cover.
- ② Set the new recording paper onto the bearing.
- ③ Insert the tip of the recording paper into the printer slot, and then press the FEED key to feed the paper in by about 5 cm.
 - The power must be on.
 - Keep the lever down.
- ④ Put the paper through the printer cover hole, and then mount the cover.
 - Do not pull the set paper out on the printer forcibly. This might cause a printer head failure.



CAUTION

- (1) Be careful not to injure your finger, hand against a edge of paper cutter attached in printer cover.
- (2) Be careful not to drop a screw or any other substance, inside box.

13 - 3. CALIBRATION

Weld current mater WS-80 (model: WS-80.rev2) is required periodical calibration to keep its measuring accuracy. (Recommended period is one year)

Please send both Weld current mater WS-80 and sensor (troidal coil) to DENGENSHA TOA for calibration.

Please inform DENGENSHA TOA consulting staff calibration detail.

14. Troubleshooting

- (a) The power lamp does not work.
 - Is the fuse (FU1) blown?
 - Is the connector of the power cord connected correctly?
 - Is the power cord disconnected?

- (b) Measurement is not possible (the WELD lamp does not work).
 - Does the WELD lamp on the front panel light up during current conduction?
 - If the WELD lamp does not light up in this case, decrease the RANGE setting.
 - If the problem remains after the setting for RANGE was decreased, remove the Toroidal coil, then measure the coil resistance with the tester.
Normal value: 30 to 40 ohm

- (c) The WELD lamp is lighted but measurement is not possible.
 - Is the setting for PULSE correct?
 - If PULSE is set to 2 or more for single current conduction welding, the measured value becomes 0. In this case, set PULSE to 1.
 - Does the setting of FIRST exceed the welding cycle?
 - In this case, the cycle of current conduction is displayed normally. Decrease the setting for FIRST to ensure so that it is within the welding cycle.
 - Is the setting of LAST smaller than the setting of FIRST?
 - In this case, the cycle of current conduction is displayed correctly. Increase the setting of LAST so that it becomes larger than the setting of FIRST.

- (d) Printing is not possible.
 - Was recording paper set?
 - Is the printer lever depressed?
 - If the lever is raised, printing is not possible. The printer cover will not close in that case.
 - Is the printer jammed with recording paper?
 - Remove the printer cover, then set the recording paper correctly.
 - Is PRINT set to OFF, ERR, or a large numeric value?
 - If PRINT is set to OFF is set, automatic printing is not performed. If PRINT is set to ERR, printing is performed only when an error occurs. If PRINT is set to a large numeric value, printing is performed only every welding count that is specified by the value.

- (e) Correct measurement is not possible.
 - The Toroidal coil is defective.
 - Replace the Toroidal coil.
 - The PC board in the ammeter is defective.
 - Please contact to DENGENSHA TOA.



Memo







Memo



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