



WELD TESTER

MM-380A

OPERATION MANUAL



Thank you for your purchase of the Miyachi Weld Tester MM-380A.
Please read this manual carefully to ensure correct use. Keep the manual handy after reading for future reference.

K05M0811E-02

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1. Special Notes

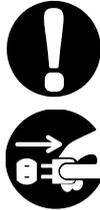
(1) Safety Precautions

Before using the weld checker, please read through the Safety Precautions carefully to ensure proper use.

The precautions listed here are designed to ensure safe use and proactively prevent risks and damage to the user and other people.

All precautions are critical for safety. Please read them all.

The hazard signs have the following meanings:

 DANGER	<p>Mishandling may cause imminent risk of death or serious injury.</p>
 ATTENTION	<p>Mishandling may cause risk of death or serious injury.</p>
 CAUTION	<p>Mishandling may cause risk of injury and physical damage.</p>
	<p>These signs represent "DON'Ts." They warn of actions not covered by the product warranty" in the previous document.</p>
	<p>These signs represent "DOs" which must be observed by the product user.</p>
	<p>A sign within a triangular border indicates that a hazard (danger, warning or caution) is present.</p>

**DANGER****NEVER ATTEMPT to disassemble, repair or modify the instrument.**

Do not touch any parts inside the instrument. Failure to observe this may result in an electric shock or fire.

For battery replacement, inspection or repair, please contact your dealer or Miyachi Corporation.

**ATTENTION****DO NOT place your hands between the electrodes.**

When welding, be extremely careful not to get your fingers or hand caught in the electrodes.

**During or immediately after welding, DO NOT touch the welded areas or electrode.**

The welded areas of the workpiece, the electrodes and the welding machine's arm are extremely hot. To prevent burns, do not touch these areas.

**ALWAYS use the specified power supply.**

Failure to use the power supply specified in the Instruction Manual may result in a fire or electric shock.

**Use the specified cables and connect them securely.**

Failure to do so or improper connection may result in a fire or electric shock.

**Keep the power and connection cables free of damage.**

Do not walk on, twist or tug the cables.

Damaged cable may result in an electric shock, short circuit, or fire.

For repair or replacement, contact your dealer or Miyachi Corporation.

**In the event of an anomaly, STOP the operation.**

Continuing the operation with anomalies such as a the generation of fumes, a burning odor, strange noise, or overheating unattended may result in an electric shock or fire. In the event of the above or other anomaly, immediately contact your dealer or Miyachi Corporation.

**STAY AWAY from the instrument if you have a pace maker.**

If you have a pacemaker, do not approach a welding machine in operation or the immediate area unless your doctor has given consent.

Welding machines generate a magnetic field which interferes with the operation of a pacemaker.

**ALWAYS wear appropriate work clothing.**

Wear protective gear such as gloves, a long-sleeved top and leather apron. Surface flash and expulsion can cause burns if it contacts the skin.

**ALWAYS wear protective goggles.**

Directly looking at surface flash and expulsion during welding can temporary impair vision. Welding spatter can cause permanent eye damage, including blindness.



DO NOT splash water.

Electrical parts may cause an electric shock or short circuit if they become wet.



Keep the area clear of flammable objects.

Surface flash and expulsion generated during welding may ignite flammable objects, resulting in a fire. If work involves use of flammable items, place a non-flammable cover over such items.



DO NOT cover the instrument with a blanket or cloth.

During operation, do not cover the instrument with a blanket or cloth. This may lead to the instrument overheating and catching fire.



Wipe off dust from the power plug and securely insert it all the way.

Dust or improper insertion may lead to the plug heat up and catch fire.



Hold the power plug when removing or inserting it.

Removing the power plug by pulling on the cable may damage the power cable, resulting in an electric shock or causing the cable to catch fire.



If you do not use the instrument for extended periods, remove the power plug from the outlet.

Failure to do so may deteriorate the insulation, resulting in an electric shock, current leakage or fire.



Provide fire extinguishers.

Provide fire extinguishers at the welding site as a precautionary measure.



Perform maintenance and inspection on a regular basis.

Perform maintenance and inspection regularly and repair damaged areas and parts before using the instrument.



Wear soundproof earmuffs.

Loud noise may impair hearing.

(2) Handling Precautions**Avoid the following locations when installing the instrument:**

- Humid location (humidity of 90% or more)
- Extremely hot (45°C or more) or cold (0°C or less) locations
- Near a radio frequency noise source
- Location where chemical substances, etc. are handled
- Location where condensation occurs
- Dusty location
- Location exposed to direct sunlight
- Location that is inclined, insecure, unstable, or weak

Check the voltage and power frequency before installation.**Keep the exterior clean with a soft cloth or cloth lightly dampened with water.**

For stains, clean them off using a diluted neutral detergent or alcohol.

Do not use thinner or benzene as they may cause discoloration or deformation.

To prevent malfunction, do not allow any foreign objects such as screws or coins to enter the instrument.**Operate the instrument according to the procedure described in the Operation Manual.****Operate the switches and buttons with care. Rough operation or the use of a tool or pen tip may result in damage or malfunction.**

2. Features

Miyachi Corporation Weld Tester **MM-380A** is a hand-held measuring instrument designed for resistance welding machines.

The instrument can measure the current, voltage, current flow time, force^{*1}, and external input voltage (max. $\pm 10\text{ V}$)^{*1} and display their waveforms.

(*1: You can select to measure force or external input voltage in measurement section on the STATUS screen.)

The LCD screen ensures clear viewing of the welding current and force waveforms for optimal welding quality control. Further, it is equipped with a printer, allowing to print measurement values and waveforms without having to attach an external printer.

The **MM-380A** offers the following features:

Easy to use with an encoder

You can scroll through the screens by simply turning the encoder and select items by moving the cursor. Pressing the encoder confirms the item selected by moving the cursor.

Easy-to-view operation screens

The LCD offers approximately four-fold improvement in resolution over our conventional products, and provides an accurate and clear display of the current and force waveforms.

Extensive display capability capabilities, obviating the need for an oscilloscope

Incorporates a zoom display function, which permits the user to change the spacings of the X-axis (time) and Y-axis (force/current) freely, and a cursor measurement function, a function for measuring the width and time difference between parts of the waveforms by moving the vertical and horizontal cursors.

Optimal waveform redisplay (FIT) capability

If the waveform is moved or zoomed off the screen, the instrument can resize the waveform to its optimal size and redisplay it on screen.

Simultaneous measurement of force and welding current during current flow

You can measure the force and welding current during current flow simultaneously using the optional current/force sensor (**MA-770A/MA-771A**).

Storing measured values and waveforms

You can store measured values and waveforms in the built-in flash memory.

Managing measurement data with PC

You can transmit measurement data to your PC through the RS-232C interface.

Supports a wide range of welding machines

The instrument supports single-phase AC, DC inverter, AC inverter, and transistor welding machines.

Supports multiple languages

Languages available are Japanese, English, Chinese, German, French, and Spanish.

3. Packing List

Check the contents of the package. In the case of damaged or missing items, please contact Miyachi Corporation.

(1) Accessories

Item	Item code	Qty
Strap	PC021923	1
Operation manual	EV000886	1
Stereo Plug	PA022402	1

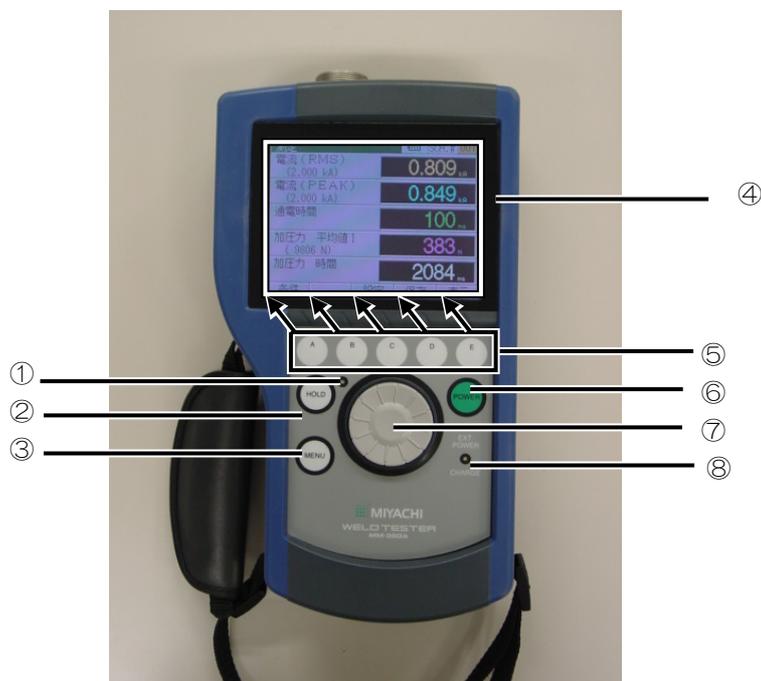
(2) Options

Item	Model	Item code
MM-380A AC adapter	BLM-110W	PA021243
AC cable for the MM-380A AC adapter	ACS-100J (Japan)	PA021247
	ACS-100U (US)	PA021244
	ACS-100G (Europe)	PA021245
	ACS-100E (UK)	PA021246
Toroidal coil	MB-800K (approx. 250mm in dia.)	EI000006
Toroidal coil	MB-400K (approx. 120mm in dia.)	EI000001
Toroidal coil	MB-45F (45mm in inner dia.)	EI000010
Voltage detection cord	A-06591-001 (for multi-connector)	EK000356
Current/force sensor	MA-770A (4903N (500kgf) max.)	EG000118
Current/force sensor	MA-771A (9806N (1,000kgf) max.)	EG000117
Voltage detection cord	42665 (for attaching current/force sensor)	EK000017
Force sensor	MA-520 (98.06N (10kgf) max.)	EG000112
Force sensor	MA-521 (980.6N (100kgf) max.)	EG000113
Force sensor	MA-522 (9806N (1,000kgf) max.)	EG000114
Force sensor conversion connector	A-03581-001	EK000275
Multiconnector (For External $\pm 10V$ voltage)	SRCN6A21-16P	PA001844
RS-232C communication cable	1.5m, 9-pin female-female	PA008130
Lithium-ion battery (optional addition)	UR-121	PA010658
Printer	BL-58R11	PA008257
Printer cable	1.5m, 25-pin male-male	PA009842
Printer AC adapter	BL-100W	PA008233
AC cable for printer AC adapter	AC-100J (Japan)	PA008934
	AC-100U (US)	PA008935
	AC-100G (Europe)	PA008936
Printer thermal paper	TPW058-25A 58 x 25	PA003088
Carry bag	MM-380A soft case	PC021959

3. Packing List

4. Name and Function of Each Part

(1) Front



- ① HOLD lamp: Lit green when the HOLD button is ON. Unlit when the HOLD button is OFF.
- ② HOLD button: You can perform the following operations by turning this button ON/OFF. The HOLD button is OFF when the instrument is turned on.

	Data measurement	Screen operation
HOLD button ON (Hold mode)	No	Yes
HOLD button OFF (Hold mode canceled)	Yes	No

- ③ MENU button: Shows the menu list on the display.
- ④ Display: Shows measured values, waveforms and operation screens. Refer to Chapter 8, "Operation Screens" for details of the operation screens.
- ⑤ Operation buttons A, B, C, D and E: For performing the operations shown on the function keys at the bottom of the operation screens. The nature of the operation performed by pressing each button varies from one operation screen to another.
- ⑥ POWER button: Turns ON the power for the **MM-380A**.

- ⑦ Encoder: Used to select menus and parameters and confirm the selection. Refer to “(2) Using the Encoder” in Chapter 7 for basic use of the encoder.

- ⑧ EXT POWER/CHARGE lamp: Lit when the **MM-380A** is connected to an external power supply and blinked when charged.

(2) Top



- ① Toroidal coil connector: Plug a toroidal coil into this connector.
- ② Multiconnector^{*1}: Plug an optional displacement sensor (**MA-770A/MA-771A**) into this connector. To connect an optional force sensor (**MA520/MA-521/MA-522**), use the force sensor conversion cable.

(3) Right Side



- ① Printer connector: Connect the optional dedicated printer here with the dedicated cable.
- ② AC adapter jack: Connect the dedicated AC adapter here when charging the battery built into the **MM-380A** or using an external power supply.

CAUTION

Connect only the dedicated AC adapter to the AC adapter jack. Failure to do so may result in malfunction, fire, or electric shock.

(4) Left Side



- ① SOL signal (24V AC/DC) input connector: A connector for inputting a solenoid signal.

4. Name and Function of Each Part

- ② RS-232C connector: Connector to connect the instrument and PC with an optional RS-232C communication cable. Used to transfer measured values and waveform data to the PC.

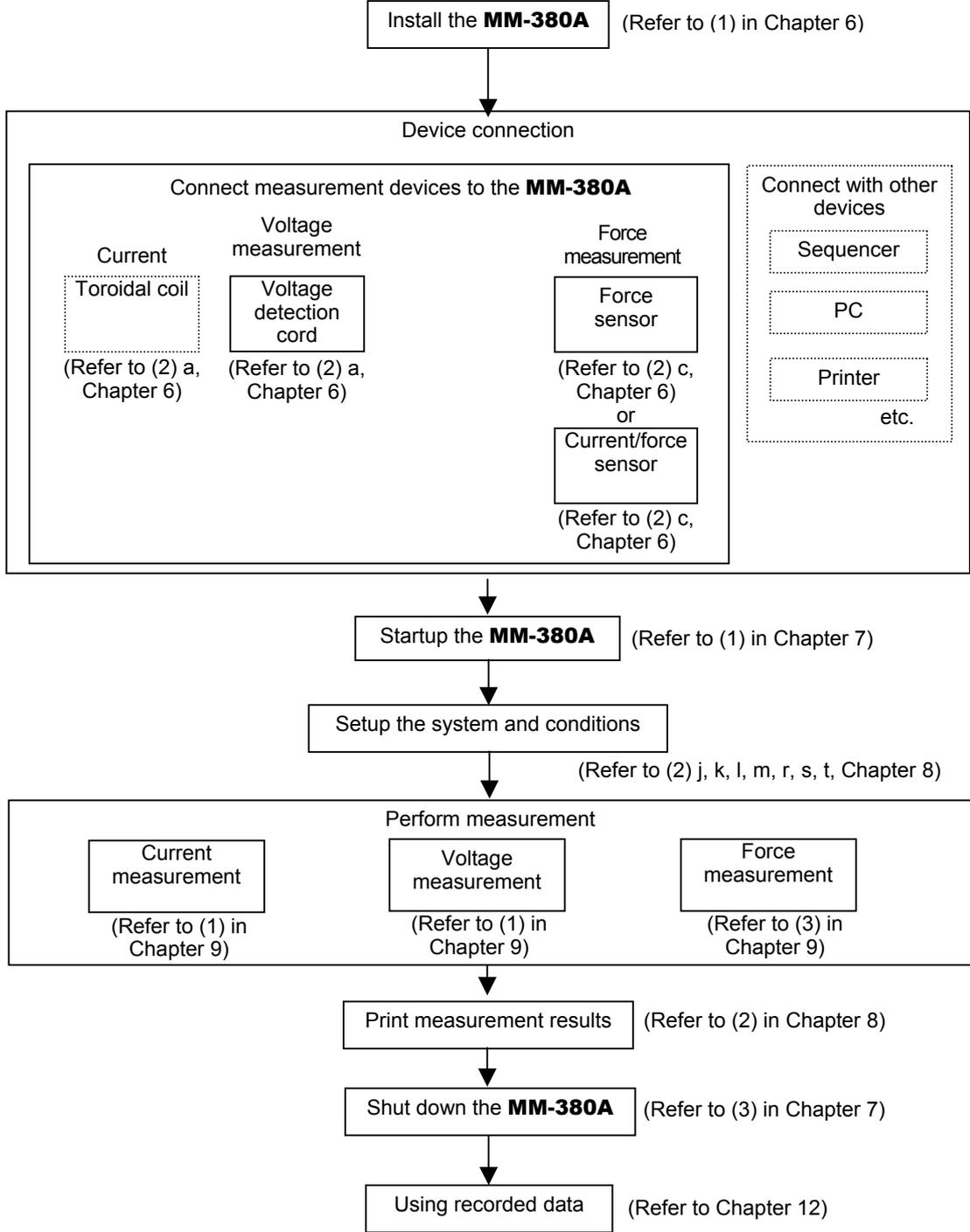
(5) Rear



- ① Battery cover: A cover to protect the battery. The rechargeable lithium battery is housed under a cover, in a holder.

5. Operation Flow

The operation flow is shown below.



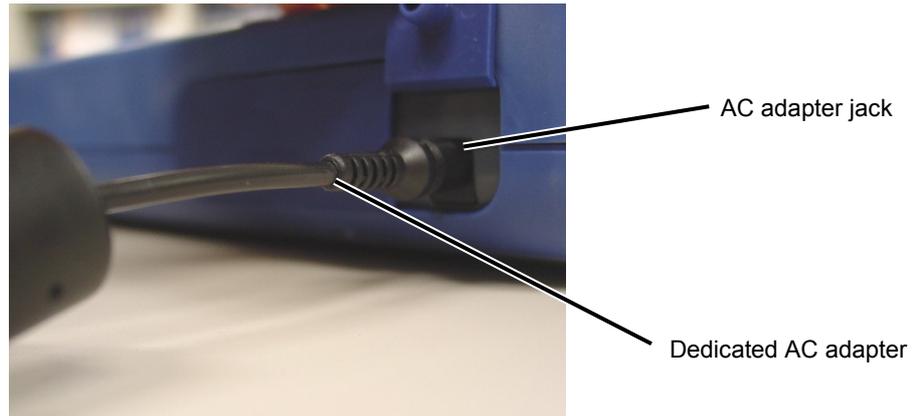
= option

6. Preparations and Connections

(1) Connecting the **MM-380A** and Power Supply

To charge the built-in battery (lithium battery) or use an external power supply, connect the power supply to the AC adapter jack on the right side of the **MM-380A** with the dedicated AC adapter.

- 1) Plug the dedicated AC adapter into the AC adapter jack on the right side of the **MM-380A**.



(2) Preparations for Measurement – Connection between the **MM-380A** and Measurement Devices

a. Connecting a toroidal coil

To measure current, plug a toroidal coil into the toroidal coil connector on the top of the of the **MM-380A**.



Toroidal coil connector

Toroidal coil

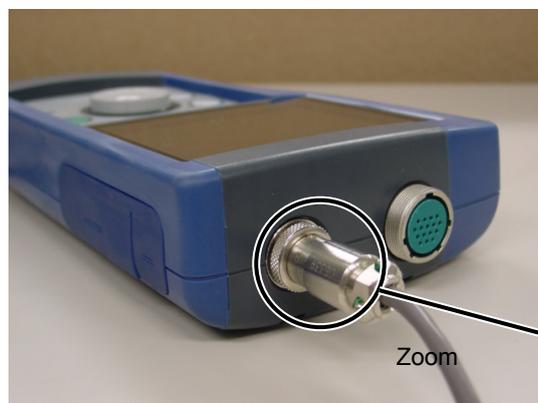
Connect a toroidal coil suited to your operating environment.

The toroidal coils of the following sizes can be used:

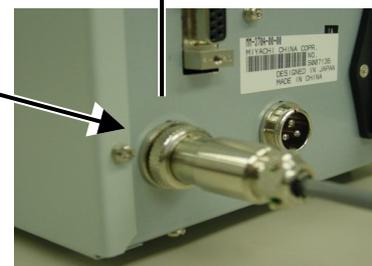
Toroidal coil model	Type
MB-800K	1× sensitivity coil (with 800mm bracket)
MB-400K	1× sensitivity coil (with 400mm bracket)
MB-45F	10× sensitivity coil (mold type)

Follow the steps described below to connect the toroidal coil and the voltage detection cord.

- 1) Plug the toroidal coil's connector into the toroidal coil connector on the rear panel of the **MM-380A**.



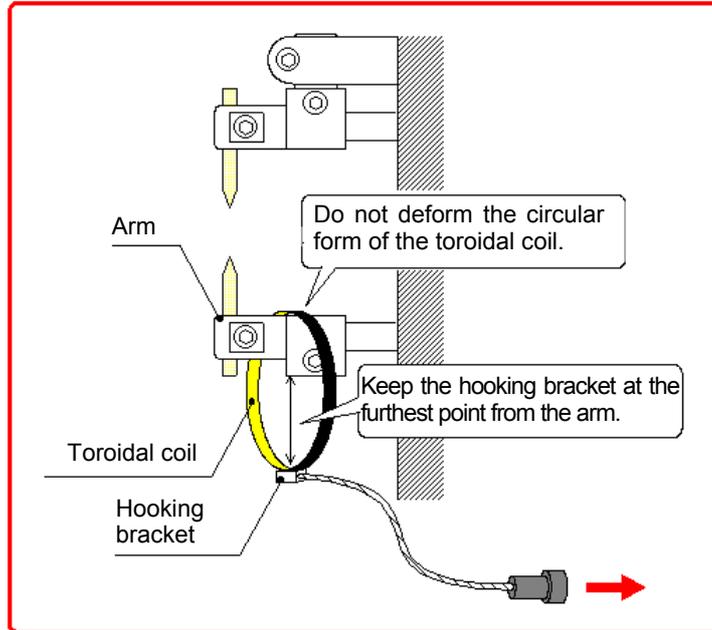
Toroidal coil connector



- 2) Fit the toroidal coil onto the welding machine's arm or secondary conductor.

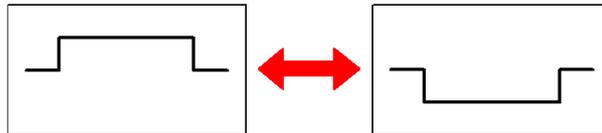
When fitting the coil, be careful with the following:

- Keep the toroidal coil's hooking bracket as far away from the welding machine's arm (secondary conductor) as possible.
- Do not deform the circular form of the toroidal coil when fitting it.



CAUTION

- If the toroidal coil is fitted in reverse orientation, the waveforms in the WAVEFORM screen and the analog output waveforms measured with the oscilloscope are also shown in reverse.



- For a band-type toroidal coil, do not deform it when fitting it. Repeated bending and extension may break internal wires.

b. Connecting the Force Sensor

The **MM-380A** can measure force when connected with force sensor **MA-520/MA-521/MA-522** or current/force sensor **MA-770A/MA-771A**.

Current/force sensor **MA-770A/MA-771A** incorporates a current sensor (toroidal coil), making it possible to measure force and current at the same time simply by applying a force and passing a current.



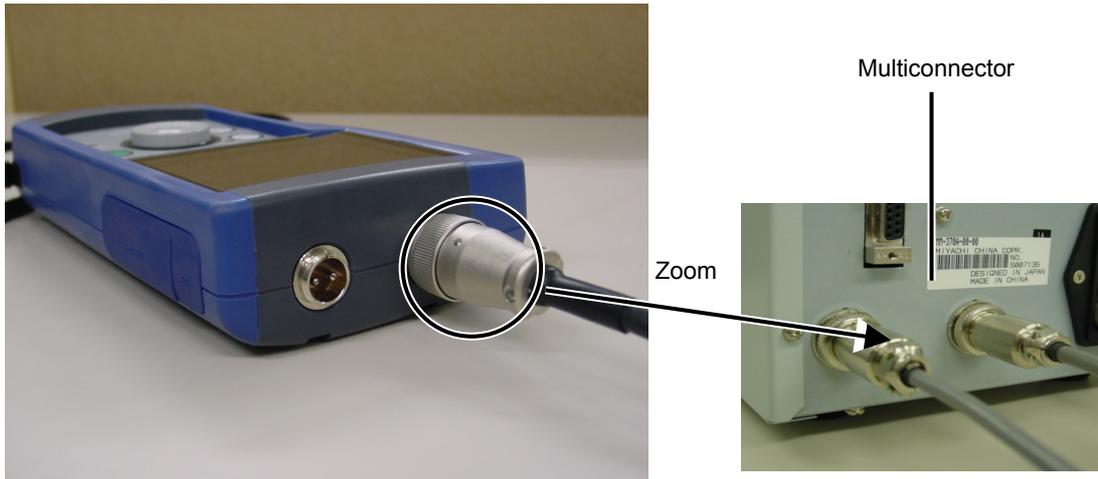
Current/force sensor

Follow the steps described below to connect the current/force sensor.

CAUTION

- When using a current/force sensor, do not connect any device to the toroidal coil connector.
- The **MM-380A** is calibrated one to one with the current/force sensor. Do not use any other sensors. If you purchase a current/force sensor later, the sensor and **MM-380A** must be adjusted as a set. In this case, please contact Miyachi Corporation. When you purchased the **MM-380A** and current/force sensor as a set, they have already been adjusted and can be used as is.
- Before measuring force, be sure to set the force sensor's offset to "0." Note that you must at this time make sure that no force is applied to the sensor. During HOLD OFF, the force sensor's offset will be automatically set to "0."

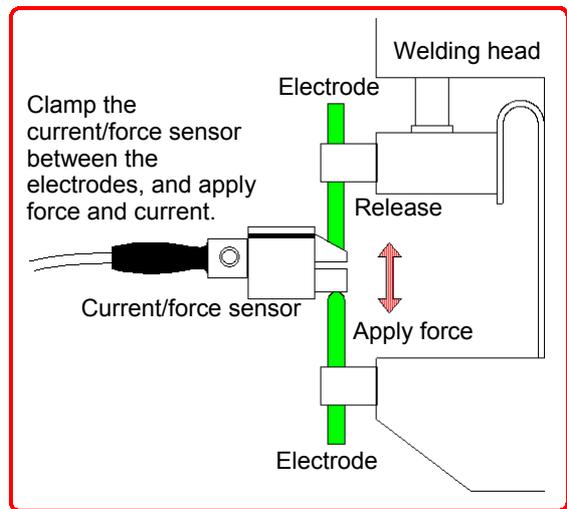
- 1) Plug the current/force sensor's connector into the toroidal coil connector on the top of the **MM-380A**.



2) Attach the current/force sensor to the welding machine's electrodes.

When attaching the sensor, be careful with the following:

- Be sure that the center of the sensor's detection area is aligned with the centers of the welding machine's electrodes.
- Be sure that the force is applied perpendicularly to the sensor.



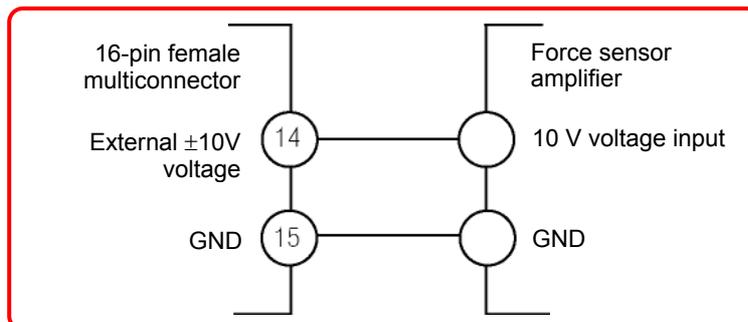
c. When using an external $\pm 10V$ voltage input

The **MM-380A**'s force/displacement-equipped specification allows for force measurement using a commercial force sensor and force sensor amplifier connected to the external $\pm 10 V$ voltage input.

(Have ready a force sensor and force sensor amplifier—purchased separately.)

Follow the steps described below to connect the external $\pm 10V$ voltage equipment.

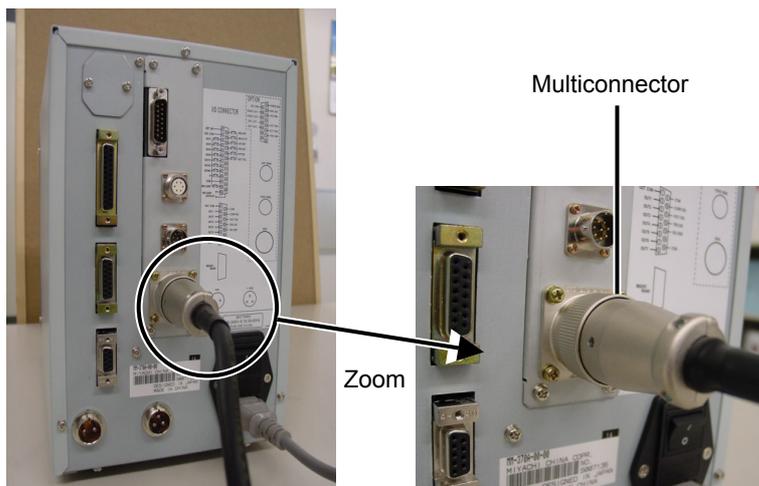
1) External $\pm 10V$ Voltage Input Connection Diagram



The 16-pin female multiconnector is optional.
(Multiconnector **SRCN6A21-16P**: Japan Aviation Electronics Industry)

6. Preparations and Connections

- 2) Plug the multiconnector into the multiconnector on the top panel of the **MM-380A**.



- 3) Connect the force sensor and the force sensor amplifier.

CAUTION

- Before measuring the force, be sure to set the force sensor's offset to "0." Note that you must at this time make sure that no force is applied to the sensor.

A force sensor with a voltage output in the ± 10 V range can be used. (The **LA-1022** from TOYO SOKKI, for example, can be used.)

7. Basic Operation

(1) Startup

- 1) To use an external power supply, connect the power supply to the AC adapter jack with the dedicated AC adapter. (Refer to Chapter 6(1).)
- 2) Press the POWER button.



An operation screen appears on the display after a while.

MEASUREMENT		SCH. # 001
CURRENT (RMS) (20.00 kA)	1.97	kA
CURRENT (PEAK) (20.00 kA)	2.51	kA
VOLTAGE (RMS) (20.0 V)	1.1	V
VOLTAGE (PEAK) (20.0 V)	3.8	V
WELD TIME	60	ms
SETUP	STATUS	SAVE VIEW

(2) Using the Encoder

This section describes how to use the **MM-380A**'s encoder.

You can perform the operations described in the table below by turning the encoder clockwise or counterclockwise.



Encoder

	CW	CCW
Selecting menus	Down	Up
Moving cursor	Right or Down	Left or Up
Changing parameter (value)	+ (Up)	- (Down)
Changing parameter (setting)	Next	Previous
Scrolling screen	Right or Down	Left or Down

You can confirm the selected menu or parameter by pressing the encoder.

a. Selecting Menus

- 1) Press the MENU button.

The menu list appears on the left side of the screen.

MEASUREMENT		SCH. # 001
MEASURE (S)	1.97	kA
WAVEFORM)		
ALL CYCLE (AK)	2.51	kA
FORCE TIME)		
SETUP (S)	1.1	u
PRINT)		
COMM (AK)	3.8	u
HISTORY)		
STATUS)	60	ms
SETUP	STATUS	SAVE VIEW

- 2) Turning the encoder clockwise or counterclockwise, move to the desired menu.
- 3) Press the encoder to confirm the menu selection.

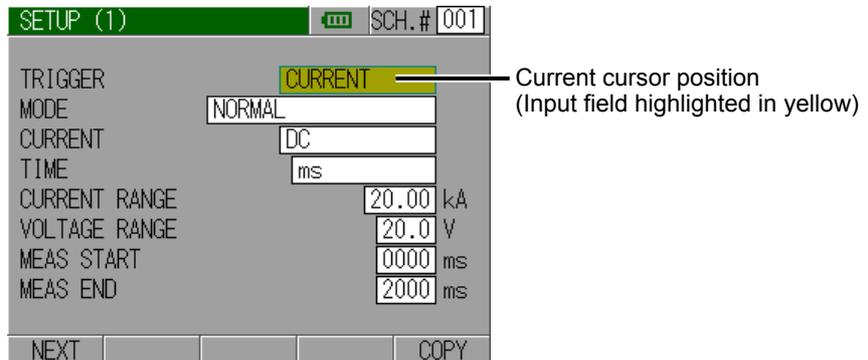
The operation screen for the selected menu appears.

Refer to Chapter 8 "Operation Screens" for operations in the operation screens.

b. Moving the Cursor and Changing Parameters

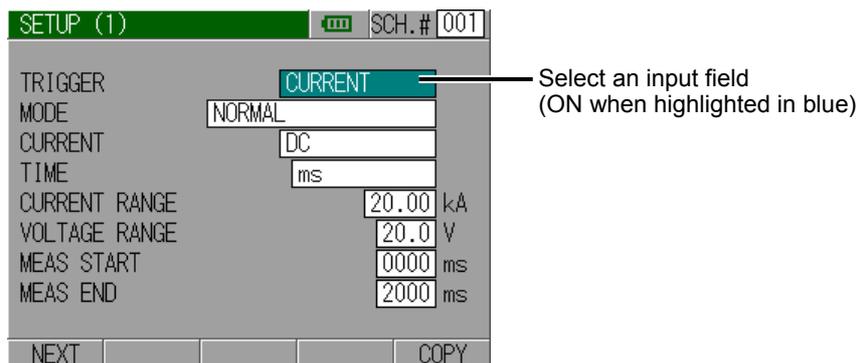
- Turning the encoder clockwise or counterclockwise, move to the input field of the desired parameter. You can move the cursor to the right or down by turning the encoder clockwise and to the left or up by turning it counterclockwise.

In this screen example, the cursor is at the TRIGGER input field. The cursor moves to the input fields of MODE, CURRENT and so on as you turn the encoder clockwise.

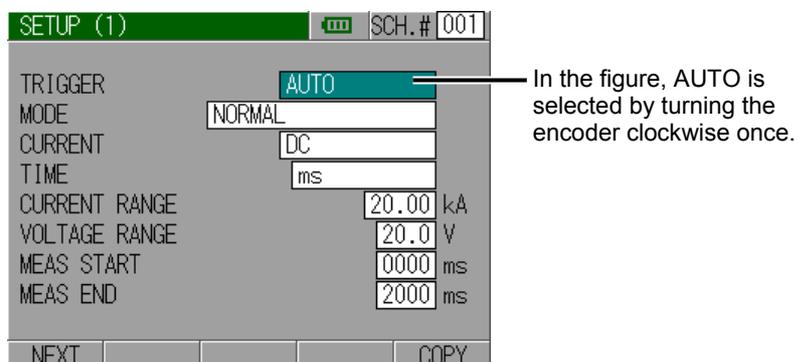


- Press the encoder to select an input field and make it ready for entry.

The parameter input field is selected, turning its background blue.



- Turning the encoder clockwise or counterclockwise, show the desired value. When the parameter is numerical, the value increases as you turn the encoder clockwise and decreases as you turn it counterclockwise. When the parameter is an option (item), the next item appears as you turn the encoder clockwise, and the previous item appears as you turn it counterclockwise.



- Press the encoder.

This sets the selected value for the parameter, turning the input field background back to yellow.

7. Basic Operation

c. Scrolling a Screen

If the scroll (SCRL) key appears among the function keys at the bottom of the operation screen, you can scroll the screen using the encoder.

- 1) Press the operation button (one of A to E) below the SCRL key.
In this screen example (ALL CYCLE screen (FORCE)), press operation button C.



Scrolling becomes enabled, turning the SCRL key background to yellow.

- 2) Turn the encoder clockwise or counterclockwise.
The screen scrolls down as you turn it clockwise, and up as you turn it counterclockwise.
- 3) When you are finished scrolling, press the operation button (one of A to E) below the SCRL key.
In this screen example (ALL CYCLE screen (FORCE)), press operation button C.
Scrolling becomes disabled, turning the SCRL key background back to gray.

(3) Shutdown

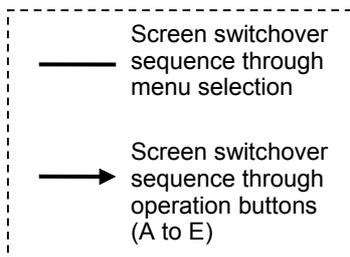
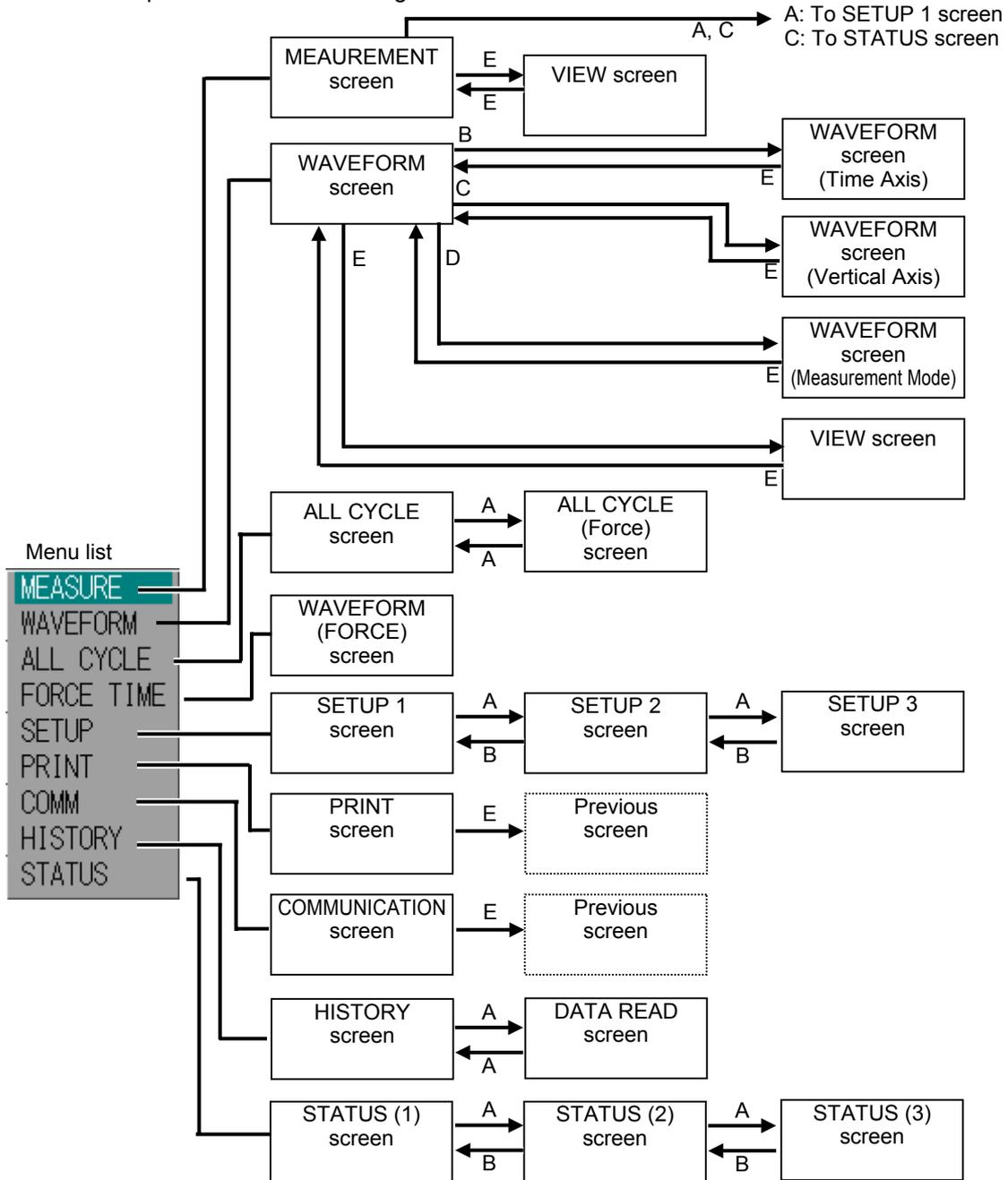
- 1) Press the POWER button.



8. Operation Screens

(1) Operation Screen Organization

Press the MENU button to display the menu list, and select a menu using the encoder. At this time, the operation screen for the selected menu appears. The **MM-380A**'s operation screens are organized as shown below.



- Making Measurement while Displaying Data on Screen

You can measure current, force and others in the MEASUREMENT, WAVEFORM and ALL CYCLE screens.

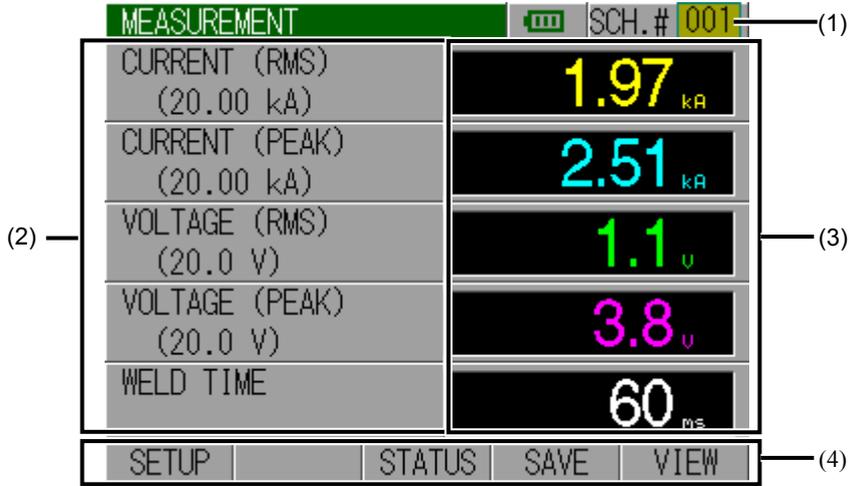
The MEASUREMENT screen accepts next measurement even while the screen is being updated following a measurement.

In contrast, the WAVEFORM and ALL CYCLE screens accept next measurement only after the screen is updated.

If you perform the operation to cancel the hold with data shown in a screen other than the Measurement, WAVEFORM and ALL CYCLE screens, the display returns to the MEASUREMENT screen to cancel the hold, after which next measurement starts.

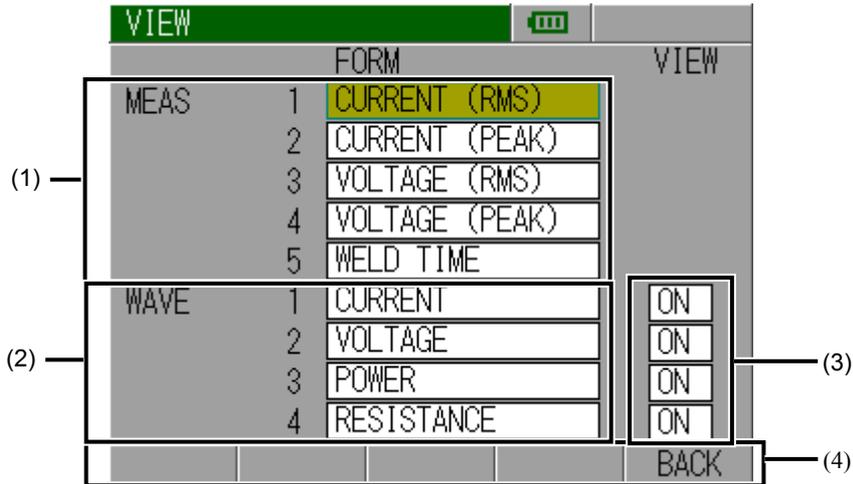
(2) Description of the Operation Screens

a. MEASUREMENT Screen



No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	Measurement item	Top: Shows five measurement items. Measurement items can be selected in the VIEW screen. Bottom: Shows the measurement range for each measurement item in brackets.	
(3)	Measured values (M-VALUE)	Shows the measurement value of the each item.	
(4)	Function keys	Conditions (SETUP)	Pressing operation button A displays the SETUP (1) screen.
		Setting (STATUS)	Pressing operation button C displays the STATUS (1) screen.
		Save (SAVE)	Pressing operation button D saves the measured values, all cycle, and waveforms to flash memory in the MM-380A . The MM-380A operates in the same manner as when saving the HISTORY screen. For more information, refer to the description of the HISTORY screen.
		Display (VIEW)	Pressing operation button E displays the VIEW screen.

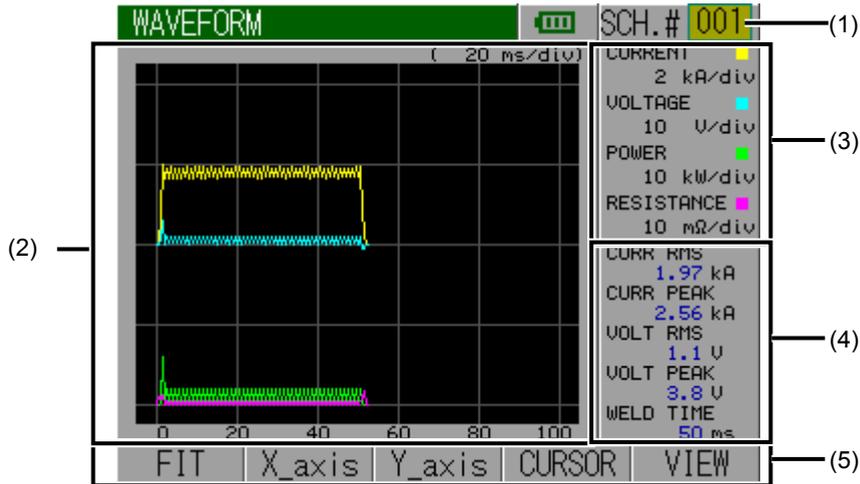
b. VIEW screen



No.	Item	Description
(1)	Measurement (MEAS) 1 to 5	<p>Select five measurement items from the following:</p> <p>CURRENT (RMS) Shows the arithmetic mean RMS current over the measurement interval in arithmetic mean mode.</p> <p>CURRENT (PEAK) Shows the peak current during current flow.</p> <p>VOLTAGE (RMS) Shows the arithmetic mean RMS current over the measurement interval in arithmetic mean mode.</p> <p>VOLTAGE (PEAK) Shows the peak current during current flow.</p> <p>WELD TIME Shows the time from the detection of a current trigger to when the current flow is determined to be terminated.</p> <p>CONDUCTION ANGLE Shows the maximum conduction angle within the current flow time.</p> <p>POWER Shows the mean power over the measurement interval.</p> <p>RESISTANCE Shows the mean resistance over the measurement interval.</p> <p>COUNT Shows the counter that indicates the number of measurements. It counts up irrespective of OK/NG judgment against upper and lower limits.</p> <p>FORCE AVERAGE 1 FORCE AVERAGE 2 Shows the mean force over the force measurement interval. You can specify two measurement ranges for a single force application.</p> <p>FORCE PEAK Shows the peak force.</p>
	(Continued to next page)	

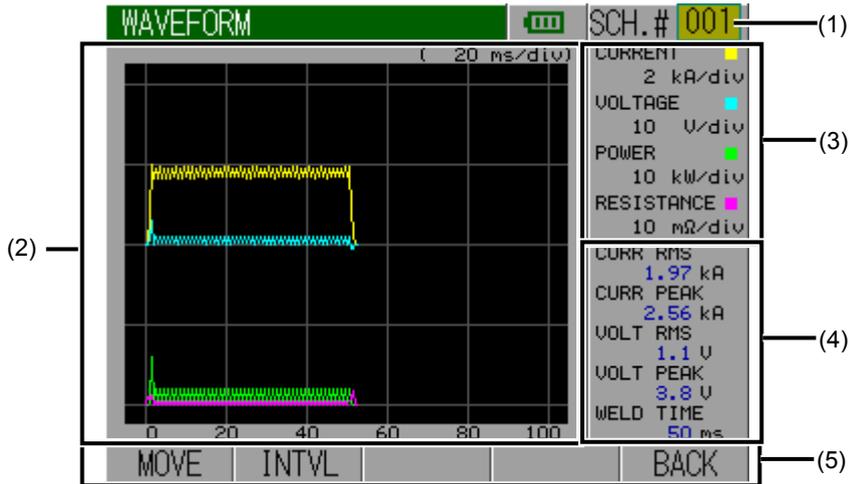
No.	Item	Description	
(1)	Measurement (MEAS) 1 to 5 (Continued from previous page)	<p>REAL TIME FORCE The MM-380A constantly measures the force while the hold is canceled. The MM-380A stops measurement when put in hold mode. Measurement is made at intervals of twice a second. Here, if you wish to select REAL TIME FORCE for measurement, select FORCE for TRIGGER and REAL TIME for MODE in the SETUP (1) screen.</p> <p>FORCE TIME Shows the time from when the force signal exceeds the force start level to when the signal falls below the force end level.</p> <p>EXTERNAL PEAK Shows the mean external input voltage converted at the preset conversion factor.</p> <p>PEAK EXTERNAL VOLTAGE (P-EXT) Shows the peak external input voltage converted at the preset conversion factor.</p> <p>REAL TIME EXT (R-EXT) *1 The MM-380A constantly measures the external ± 10 voltage while the hold is canceled. The MM-380A stops measurement when put in hold mode. Measurement is made at intervals of twice a second. Here, if you wish to select R-EXT for measurement, select EXTERNAL for TRIGGER and CONSTANT for MODE in the SETUP (1) screen.</p> <p>EXTERNAL TIME Shows the time from the start to the end of external voltage input.</p>	
(2)	Waveforms (WAVE)1 to 4	<p>Select four items to display in the WAVEFORM screen from the following: CURR, VOLT, POWER, RESIST, FORCE, EXTERNAL</p>	
(3)	Display ON/OFF	<p>Select whether to show the waveforms by selecting ON/OFF.</p>	
(4)	Function keys	Return (BACK)	Pressing operation button E returns the display to the previous screen (MEASUREMENT or WAVEFORM screen).

c. WAVEFORM screen



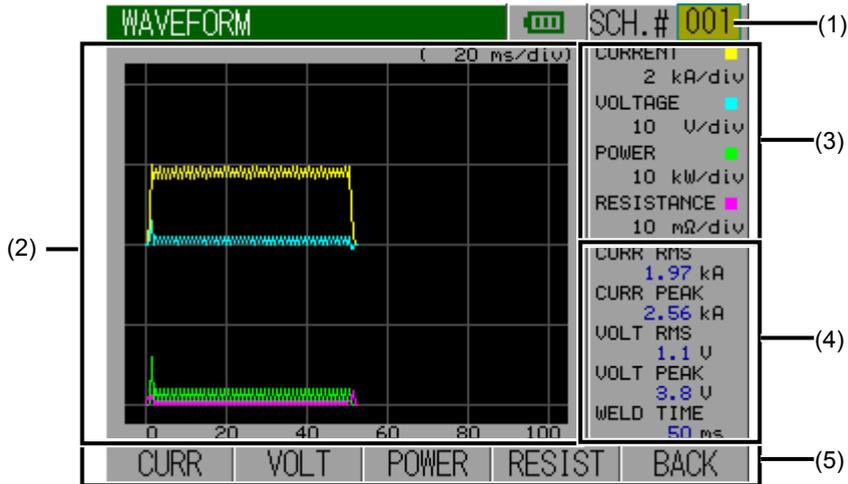
No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	Waveform	Shows the waveforms of four items on the grid. Waveform display items can be selected in the VIEW screen.	
(3)	Grid spacing	Shows the grid spacings for the four waveforms shown on the grid.	
(4)	Measured values (M-VALUE)	Shows the measured values of five (5) items. Measurement items can be selected in the VIEW screen.	
(5)	Function keys	FIT	Pressing operation button A redisplay the waveforms by automatically resizing them to fit into the screen by the FIT feature.
		Time Axis (X_axis)	Pressing operation button B displays the WAVEFORM screen (time axis).
		Vertical Axis (Y_axis)	Pressing operation button C displays the WAVEFORM screen (vertical axis).
		Measure (CURSOR)	Pressing operation button D displays the WAVEFORM screen (measurement), switching the instrument to measurement mode.
		Display (VIEW)	Pressing operation button E displays the VIEW screen.

d. WAVEFORM Screen (Time Axis)



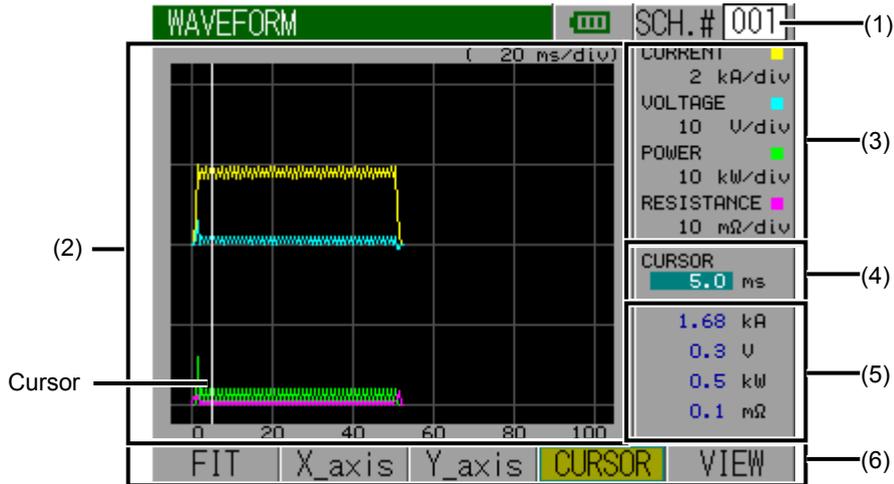
No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	Waveform	Shows the waveforms of four items on the grid. Waveform display items can be selected in the VIEW screen.	
(3)	Grid spacing	Shows the grid spacings for the four waveforms shown on the grid.	
(4)	Measured values (M-VALUE)	Shows the measured values of five (5) items. Measurement items can be selected in the VIEW screen.	
(5)	Function keys	Position (MOVE)	Pressing operation button A makes it possible to move the waveforms. In this condition, turn the encoder clockwise or counterclockwise. This moves the waveforms to the right or left. Pressing operation button A again locks the waveforms.
		Spacing (INTVL)	Pressing operation button B makes it possible to adjust the grid spacing on the waveforms. In this condition, turn the encoder clockwise or counterclockwise. This increases or decreases the grid spacing of the waveform's time axis (X axis). Pressing operation button B again locks the grid spacing on the waveforms.
		Return (BACK)	Pressing operation button E returns the display to the WAVEFORM screen.

e. WAVEFORM Screen (Vertical Axis)



No.	Item	Description
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.
(2)	Waveform	Shows the waveforms of four items on the grid. Waveform display items can be selected in the VIEW screen.
(3)	Grid spacing	Shows the grid spacings for the four waveforms shown on the grid.
(4)	Measured values (M-VALUE)	Shows the measured values of five (5) items. Measurement items can be selected in the VIEW screen.
(5)	Function keys	<p>The function keys above operation buttons A to D show the item names for the displayed waveforms. The displayed item names vary depending on the selection of waveform display items.</p> <p>(In the above screen example, current (CURR), voltage (VOLT), power (POWER) and resistance (RESIST) are selected as waveform display items. Thus, these four items are shown on the function keys.)</p> <p>Pressing one of operation buttons A to D makes it possible to adjust the grid spacing for the vertical axis (Y axis) of the corresponding item. In this condition, turn the encoder clockwise or counterclockwise. This increases or decreases the grid spacing of the waveform's vertical axis (Y axis). Pressing that operation button (A to D) again locks the grid spacing for the waveform's vertical axis (Y axis).</p>
	Return (BACK)	Pressing operation button E returns the display to the WAVEFORM screen.

f. WAVEFORM Screen (Measurement Mode)



No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	Waveform	Shows the waveforms of four items on the grid. Waveform display items can be selected in the VIEW screen.	
(3)	Grid spacing	Shows the grid spacings for the four waveforms shown on the grid.	
(4)	Cursor position information	Shows the current position information of the cursor. You can move the white line (cursor) on the grid by turning the encoder clockwise or counterclockwise.	
(5)	Measured values (M-VALUE)	Shows the measured values of the waveforms at the point in time indicated by the cursor.	
(6)	Function keys	FIT	Pressing operation button A redisplay the waveforms by automatically resizing them to fit into the screen by the FIT feature.
		Time Axis (X_axis)	Pressing operation button B displays the WAVEFORM screen (time axis).
		Vertical Axis (Y_axis)	Pressing operation button C displays the WAVEFORM screen (vertical axis).
		Measure (CURSOR)	Pressing operation button D terminates the measurement mode.
		Display (VIEW)	Pressing operation button E displays the VIEW screen.

g. ALL CYCLE screen



No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	RMS per cycle ^{*2}	Shows the RMS current, voltage and conduction angle ^{*1} every half cycle in AC mode and every 1 ms in DC mode. The area with values shown in blue represents the calculation interval.	
(3)	Measured values (M-VALUE)	Shows the measured values of five (5) items. Measurement items can be selected in the VIEW screen.	
(4)	Function keys	Force (FORCE)	Pressing operation button A displays the ALL CYCLE screen (Force).
		Recalculate (RECALC)	Pressing operation button B recalculates the measured current and voltage. Use this function to redo the calculation of the arithmetic mean over a new calculation interval after changing the start and end cycle (MEAS START, MEAS END) settings in the SETUP (1) screen.
		Scroll (SCROLL)	Pressing operation button C and turning the encoder clockwise or counterclockwise scrolls the screen down or up.

*1: Conduction angle appears only when AC is selected for CURR and CYC-50/60 Hz, CYC-*** Hz or CYC-LONG is selected for TIME in the SETUP (1) screen.
 *2: RMS per cycle does not appear if ms-SHORT is selected for TIME in the SETUP (1) screen. RMS per cycle does not also appear if current is not measured.

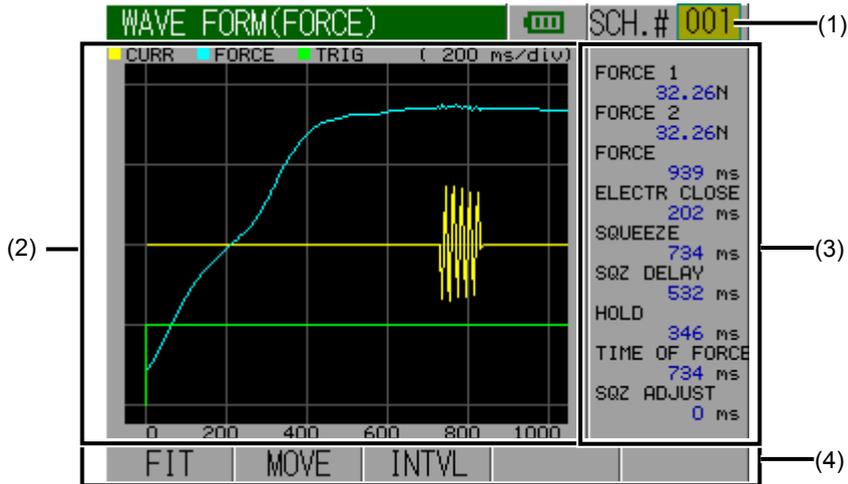
h. ALL CYCLE (Force) Screen



No.	Item	Description	
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.	
(2)	RMS per cycle	Shows the RMS FORCE every 10 ms. The area with values shown in blue represents the calculation interval.	
(3)	Measured value ^{*1}	Shows the measured values of five (5) items. Measurement items can be selected in the VIEW screen.	
(4)	Function keys	Force (CURR)	Pressing operation button A displays the ALL CYCLE screen.
		Recalculate (RECALC)	Pressing operation button B recalculates the measured force. Use this function to redo the calculation of the mean over a new calculation interval after changing the start and end cycle (FORCE TIME, FORCE TIMR END) settings in the SETUP (3) screen.
		Scroll (SCROLL)	Pressing operation button C and turning the encoder clockwise or counterclockwise scrolls the screen down or up.

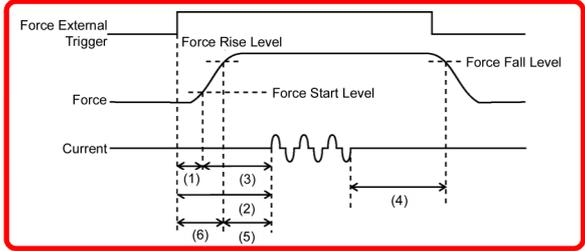
*1: Not shown if force is not measured.

i. WAVEFORM (FORCE) screen



No.	Item	Description
(1)	SCH.#	Shows the measurement condition number used (1 to 127). On the other hand, you can change conditions by selecting this field with the encoder and turning the encoder clockwise or counterclockwise. The details of the conditions can be set using the SETUP (1) to (3) screens.
(2)	Waveform display ^{*1}	Shows the force, current and trigger waveforms.
(3)	Force time ^{*1}	Shows the following items: ((1) to (6) correspond to the numbers in the figure on the next page.) Force 1 (FORCE1) ^{*2} : Mean force over force calculation interval 1 Force 2 (FORCE2) ^{*2} : Mean force over force calculation interval 2 Force Time (FORCE) ^{*2} : Time from when the force signal exceeds the force start level to when the signal reaches the force end level Force Start Time (ELECTR CLOSE) (1): Time from the force external trigger input to when the force signal exceeds the force start level Squeeze Time (SQUEEZE) (2): Time from the force external trigger input to the start of current flow Force Stabilization Time (SQZ DELAY) (3): Time from when the force signal exceeds the force start level to the start of current flow Hold Time (HOLD) (4): Time from the end of current flow to when the force signal falls below the fall level Current Start Time (TIME OF FORCE) (5): Time from when the force signal exceeds the rise level to the start of current flow Force Completion Time (SQZ ADJUST) (6): Time from the force external trigger input to when the force signal exceeds the rise level

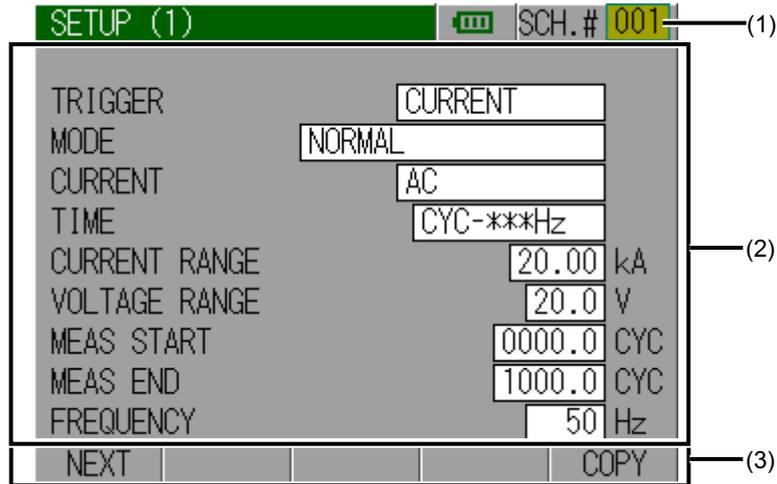
(Continued to next page)

No.	Item	Description	
(3)	Force time (Continued from previous page)		
(4)	Function keys	FIT	Pressing operation button A redisplay the waveforms by automatically resizing them to fit into the screen by the FIT feature.
		Position (MOVE)	Pressing operation button B makes it possible to move the waveforms. In this condition, turn the encoder clockwise or counterclockwise. This moves the waveforms to the right or left. Pressing operation button B again locks the waveforms.
		Spacing (INTVL)	Pressing operation button C makes it possible to adjust the grid spacing on the waveforms. In this condition, turn the encoder clockwise or counterclockwise. This increases or decreases the grid spacing of the waveform's time axis (X axis). Pressing operation button C again locks the grid spacing on the waveforms.

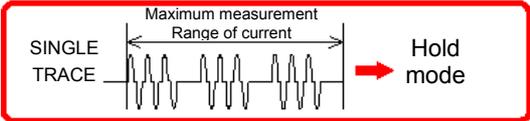
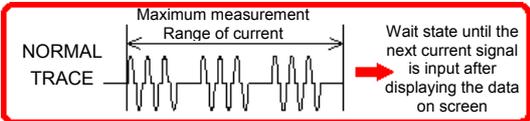
*1: Shown when force or current is measured using the force external trigger.

*2: Not shown if FORCE or FORCE TIME is not selected in the VIEW screen.

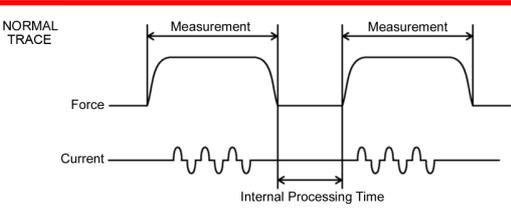
j. SETUP (1) Screen



No.	Item	Description
(1)	SCH.#	Select a measurement condition number (1 to 127) to set in the SETUP (1) to (3) screens. You can change condition numbers by selecting this field with the encoder and turning the encoder clockwise or counterclockwise.
(2)	Parameter setting	<p>TRIGGER /MODE</p> <p>Select a measurement trigger from among the following options of trigger and mode combinations:</p> <p><When TRIGGER: Current (CURRENT) is selected></p> <p>When TRIGGER: Current (CURRENT) is selected, force and external $\pm 10V$ voltage input are not measured.</p> <p>MODE: NORMAL</p> <p>Current normal mode</p> <p>The instrument performs measurement each time a current signal is input, showing the measured values and waveforms.</p> <p>To pass multiple current pulses, refer to the PULSE MODE settings in the SETUP (2) screen.</p> <div style="border: 2px solid red; padding: 5px; margin-top: 10px;"> <p>The diagram shows a series of current pulses. Two measurement windows are indicated by double-headed arrows labeled 'Measurement'. Between the measurement windows, there is a period labeled 'Internal Processing Time'.</p> </div> <p>(Continued to next page)</p> <p>The internal processing time varies depending on the force and current flow time. As a result, the internal processing may not be complete before next measurement.</p>

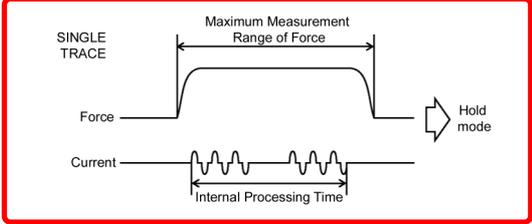
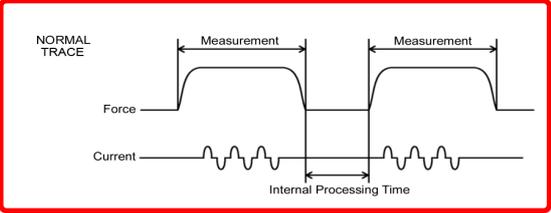
No.	Item	Description													
(2)	Parameter setting	TRIGGER /MODE (Continued from previous page)	<p>MODE: SINGLE TRACE Current single-trace mode The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters hold mode. The instrument shows “-” in the measured value field without showing the measured value and making any OK/NG judgment on the value.</p>  <p>MODE: NORMAL TRACE Current normal trace mode The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters hold mode. After displaying the data on screen, the instrument goes into wait state until the next current signal is input. The instrument shows “-” in the measured value field without showing the measured value and making any OK/NG judgment on the value.</p>  <p>The maximum current measurement range varies as follows depending on the TIME and Current (CURRENT) settings in the SETUP (1) screen:</p> <p>AC</p> <table border="0"> <tr> <td>CYC-50/60Hz, CY-***Hz:</td> <td>4000ms</td> </tr> <tr> <td>ms:</td> <td>2000ms</td> </tr> <tr> <td>CYC-LONG:</td> <td>10000ms</td> </tr> </table> <p>DC</p> <table border="0"> <tr> <td>CYC-50/60Hz:</td> <td>2000ms</td> </tr> <tr> <td>ms:</td> <td>2000ms</td> </tr> <tr> <td>ms-SHORT:</td> <td>100ms</td> </tr> </table>	CYC-50/60Hz, CY-***Hz:	4000ms	ms:	2000ms	CYC-LONG:	10000ms	CYC-50/60Hz:	2000ms	ms:	2000ms	ms-SHORT:	100ms
CYC-50/60Hz, CY-***Hz:	4000ms														
ms:	2000ms														
CYC-LONG:	10000ms														
CYC-50/60Hz:	2000ms														
ms:	2000ms														
ms-SHORT:	100ms														

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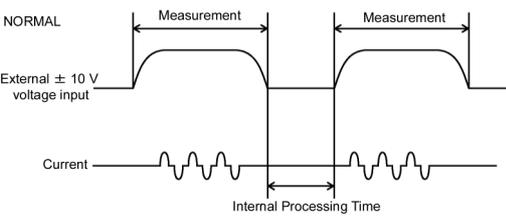
No.	Item	Description	
(2)	Parameter setting	TRIGGER /MODE (Continued from previous page)	<p><When TRIGGER: AUTO is selected > MODE: NORMAL Auto normal mode The first input among current, force (or external $\pm 10V$ voltage input)^{*1} and external force trigger triggers measurement.</p> <p>When current is a trigger The instrument operates in the same manner as in current or force in normal mode.</p> <p>When force (or external $\pm 10V$ voltage input)^{*1} is a trigger The instrument operates in the same manner as in force (or external $\pm 10V$ voltage input)^{*1} normal mode.</p> <p>When external force trigger is a trigger The instrument operates in the same manner as in force (or external $\pm 10V$ voltage input)^{*1} normal mode. Note, however, that in the case of external force trigger, the instrument starts measurement only upon input of current or force (or external $\pm 10V$ voltage input)^{*1}.</p> <p>When you have selected Auto for Trigger, attach the force sensor. The instrument performs a zero force adjustment when the hold mode is turned off.</p> <p><When TRIGGER: FORCE is selected ^{*2}> MODE: NORMAL Force normal mode The instrument performs measurement each time a current signal is input, showing the measured values and waveforms. To pass multiple current pulses, refer to the PULSE MODE settings in the SETUP (2) screen.</p> <div data-bbox="842 1413 1402 1724" style="border: 2px solid red; padding: 5px;">  <p>The internal processing time varies depending on the force and current flow time. As a result, the internal processing may not be complete before next measurement.</p> </div>

(Continued to next page)

- *1: Force when FORCE is selected, and external $\pm 10V$ voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

No.	Item	Description													
(2)	Parameter setting	TRIGGER /MODE (Continued from previous page)	<p>MODE: SINGLE TRACE Force single-trace mode The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters hold mode. The instrument shows “-” in the measured value field without showing the measured value and making any OK/NG judgment on the value.</p>  <p>MODE: NORMAL TRACE Force normal trace mode The instrument measures the maximum force measurement time upon input of a force signal. After displaying the data on screen, the instrument goes into wait state until the next force signal is input. The instrument shows “-” in the measured value field without showing the measured value and making any OK/NG judgment on the value.</p>  <p>The maximum current measurement range varies as follows depending on the TIME and CURRENT settings in the SETUP (1) screen:</p> <table border="0"> <tr> <td colspan="2">AC</td> </tr> <tr> <td>CYC-50/60Hz, CY-***Hz:</td> <td>4000ms</td> </tr> <tr> <td>ms:</td> <td>2000ms</td> </tr> <tr> <td colspan="2">DC</td> </tr> <tr> <td>CYC-50/60Hz:</td> <td>2000ms</td> </tr> <tr> <td>ms:</td> <td>2000ms</td> </tr> </table> <p>The maximum force measurement range is 6000ms.</p>	AC		CYC-50/60Hz, CY-***Hz:	4000ms	ms:	2000ms	DC		CYC-50/60Hz:	2000ms	ms:	2000ms
AC															
CYC-50/60Hz, CY-***Hz:	4000ms														
ms:	2000ms														
DC															
CYC-50/60Hz:	2000ms														
ms:	2000ms														

- *1: Force when FORCE is selected, and external ±10V voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

No.	Item	Description	
(2)	Parameter setting	TRIGGER /MODE (Continued from previous page)	<p>MODE: REAL TIME Force constant start mode Force is measured at intervals of half a second. In this trigger mode, the instrument measures only force. To use this trigger mode, select Constant Force (REAL TIME) in the VIEW screen. Press the HOLD button to put the instrument in hold mode and stop the measurement.</p> <p><When TRIGGER: External (EXTERNAL) is selected^{*3}></p> <p>MODE: NORMAL External ± 10 V voltage input normal mode The instrument starts measurement each time a force signal is input, making an OK/NG judgment and showing the measured value and waveform. To pass multiple current pulses, refer to the PULSE MODE settings in the SETUP (2) screen.</p> <div data-bbox="842 976 1399 1352" style="border: 2px solid red; padding: 5px;">  <p>The diagram shows two pulses of 'External ± 10 V voltage input'. Each pulse is followed by a 'Measurement' period. Below the voltage input, the 'Current' waveform shows small oscillations. A horizontal arrow labeled 'Internal Processing Time' spans the duration between the end of one measurement and the start of the next, indicating the time taken for the instrument to process the current data before the next measurement begins.</p> </div> <p>(Continued to next page)</p> <p>The internal processing time varies depending on the force and current flow time. As a result, the internal processing may not be complete before next measurement.</p>

- *1: Force when FORCE is selected, and external ±10V voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

No.	Item	Description	
(2)	Parameter setting	TRIGGER/ MODE (Continued from previous page)	<p>The maximum current measurement range varies as follows depending on the TIME and CURRENT settings in the SETUP (1) screen:</p> <p>AC CYC-50/60Hz, CY-***Hz: 4000ms ms: 2000ms</p> <p>DC CYC-50/60Hz: 2000ms ms: 2000ms</p> <p>The maximum external ± 10 V voltage input is 6000ms.</p> <p>MODE: REAL TIME External ± 10V voltage External ± 10V voltage is measured at intervals of half a second. In this trigger mode, the instrument measures only External ± 10V voltage. To use this trigger mode, select REAL TIME EXTERNAL (R-EXT) in the VIEW screen. Press the HOLD button to put the instrument in hold mode and stop the measurement.</p>
		(Continued to next page)	

- *1: Force when FORCE is selected, and external ± 10 V voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

No.	Item	Description	
(2)	Parameter setting	Time (Continued from previous page)	<p>In DC mode, select from the following: CYC-50/60Hz Select this option to measure DC output inverter welding current in units of cycle. Set the frequency of the current you wish to pass in FREQUENCY in the SETUP (1) screen. (50 Hz: 100 CYC, 60 Hz: 120 CYC)</p> <p>ms Select this option to measure DC output inverter welding current in units of ms. Measurement time: 2,000 ms max.</p> <p>ms-SHORT Select this option to measure transistor welding current. The current flow time is 1ms when ms is selected. In contrast, the current flow time is every 0.05ms when ms-SHORT is selected, thus allowing measurement at more frequent intervals. Measurement time: 100 ms max. When you have selected ms-SHORT, you cannot measure force, external $\pm 10V$ voltage input or displacement.</p>
		Current range (CURRENT RANGE)	<p>Select from the following five ranges: The current ranges change as follows depending on the COIL TYPE setting in the STATUS (1) screen:</p> <p>COIL GAIN 1 2.000kA / 6.00kA / 20.00kA / 60.0kA / 200.0kA</p> <p>COIL GAIN 10 0.200kA / 0.600kA / 2.000kA / 6.00kA / 20.00kA</p>
	(Continued to next page)	Voltage range (VOLTAGE RANGE)	Select from the following two ranges: 6.00 V / 20.0 V

- *1: Force when FORCE is selected, and external $\pm 10V$ voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.
- *3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

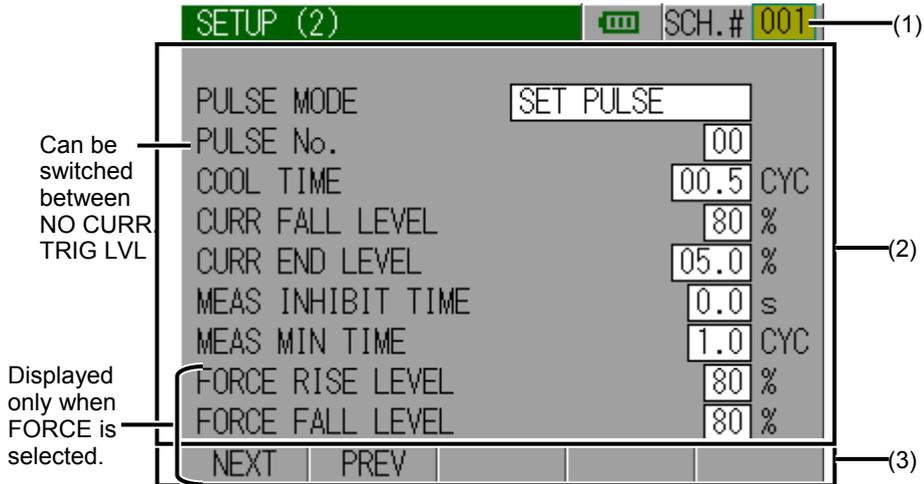
No.	Item	Description	
(2)	Parameter setting (Continued from previous page)	Start cycle (MEAS START) / END cycle (MEAS END)	<p>You can measure RMS current/voltage and mean power/resistance by specifying an arbitrary range. Set the interval from the start to end of the measurement as follows according to the CURRENT and TIME combination:</p> <p>CURRENT: AC, TIME: CYC-50/60 Hz 0.0 to 200.0 CYC (for FREQUENCY: 50 Hz) 0.0 to 240.0 CYC (for FREQUENCY: 60 Hz) (in units of 0.5 CYC for both)</p> <p>CURRENT: DC, TIME: CYC-50/60 Hz 0.0 to 100.0 CYC (for FREQUENCY: 50 Hz) 0.0 to 120.0 CYC (for FREQUENCY: 60 Hz) (in units of 0.5 CYC for both)</p> <p>CURRENT: AC, TIME: CYC-*** Hz 0.0 to 1,000.0 CYC (in units of 0.5 CYC)</p> <p>CURRENT: AC, TIME: CYC-LONG 0.0 to 500.0 CYC (for FREQUENCY: 50 Hz) 0.0 to 600.0 CYC (for FREQUENCY: 60 Hz) (in units of 0.5 CYC for both)</p> <p>CURRENT: DC, TIME: ms-SHORT 000.00 to 100.00 ms (in units of 0.05 ms)</p> <p>CURRENT: AC, TIME: ms or CURR: DC, TIME: ms 0000 to 2000 ms (in units of 1 ms)</p>
		Frequency	<p>CURRENT: AC, TIME: CYC-*** Hz Set the frequency of the current to be measured as follows according to the CURRENT and TIME combination:</p> <p>M050, M053, M056, M059, M063, M067, M071, M077, M083, M091, M100, M111, M125, M143, M167, M200, M250, 050 to 250Hz (in units of 1 Hz)</p> <p>Set the M*** frequency when using a Miyachi AC inverter welding power supply.</p>
(3)	Function keys	Next (NEXT)	Pressing operation button A displays the SETUP (2) screen.
		COPY	<p>Pressing operation button E copies the settings made under the condition number 001 (all the settings made in the SETUP (1) to (3) screens) to all the condition numbers 002 to 127.</p> <p>Pressing operation button E displays CANCEL above operation button C and START (execute) above operation button D. Press operation button D to copy conditions, and operation button C to cancel the copying.</p>

*1: Force when FORCE is selected, and external $\pm 10V$ voltage input when External (EXTERNAL) is selected, for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

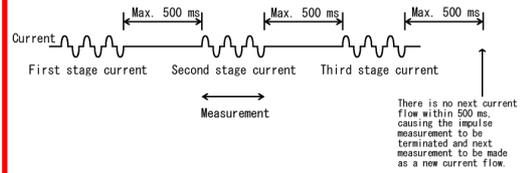
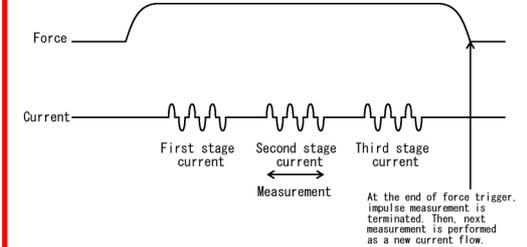
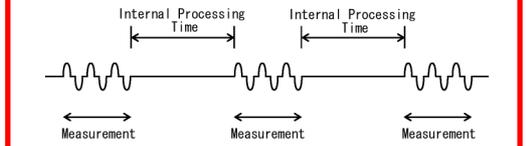
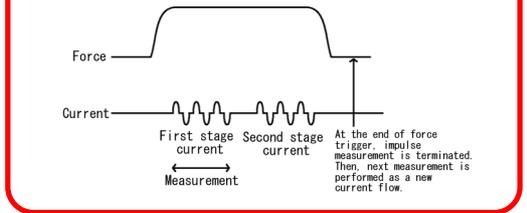
*2: Only when FORCE is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

*3: Only when External (EXTERNAL) is selected for Measurement Selection (SELECT MEAS) in the STATUS (1) screen.

k. SETUP (2) Screen

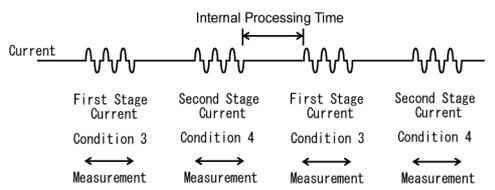
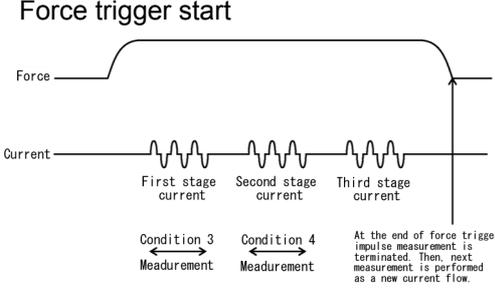
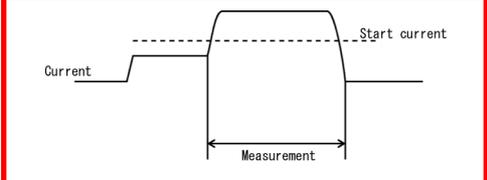


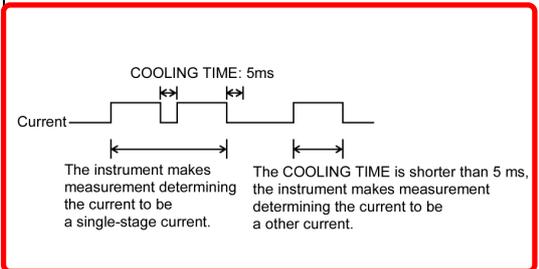
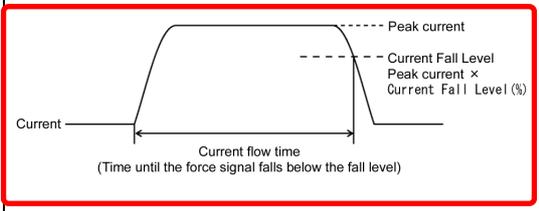
No.	Item	Description	
(1)	SCH.#	Select a measurement condition number (1 to 127) to set in the SETUP (1) to (3) screens. You can change condition numbers by selecting this field with the encoder and turning the encoder clockwise or counterclockwise.	
(2)	Parameter setting	PULSE MODE (Continued to next page)	Current may be passed several times in a single welding sequence. Use the impulse settings to measure such a current. The impulse settings are designed for current measurement. Select SET PULSE to measure an arbitrary stage, ALL PULSE to measure all stages, and NO COOL to measure the 2 nd stage with no cooling time. (If you do not wish to specify any stage number, select SET PULSE for PULSE MODE, and "0" for PULSE No.)

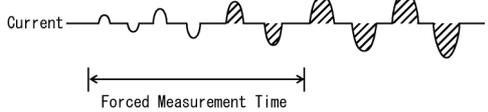
No.	Item	Description
(2)	Parameter setting	<p>PULSE MODE (Continued from previous page)</p> <p>Specified Pulse (SET PULSE) When you have selected any of 1 to 20 for PULSE No, the specified stage will be measured. When you have selected "2" for PULSE No, the second stage current will be measured.</p> <div data-bbox="869 454 1396 1167" style="border: 2px solid red; padding: 5px;"> <p>Current trigger start</p>  <p>Set the current flow interval to 500ms or less.</p> <p>Force trigger start</p>  <p>When external $\pm 10V$ voltage input and displacement are measured, the instrument operates in the same manner as in the force trigger start.</p> </div> <p>When "0" is selected for PULSE No, the instrument makes all measurement at measurable intervals. (When force, external $\pm 10V$ voltage input or displacement is measured, the instrument makes measurements in the same manner as when "1" is selected for PULSE No.)</p> <div data-bbox="869 1417 1396 1899" style="border: 2px solid red; padding: 5px;"> <p>Current trigger start</p>  <p>Force trigger start</p>  </div> <p>(Continued to next page)</p>

No.	Item	Description	
(2)	Parameter setting	PULSE MODE (Continued from previous page)	<p>All Pulses (ALL PULSE) Measures the current in the number of stages (1 to 20) specified by PULSE No. As for measurement condition, the condition number selected for measurement start is used. The judgment conditions are used successively. Ex.: In the case of three-stage current flow with conditions 5, conditions 5 are used as measurement conditions whereas conditions 5, 6 and 7 are used as judgment conditions respectively for the first, second and third stages. When you have selected "0" for PULSE No, the instrument operates in the same manner as when "1" is selected.</p> <p>In All Pulses measurement, multiple-stage current exceeding maximum current measurement time cannot be measured. When CYC is selected for TIME, at least 1.0CYC of the current flow interval (time that current does not flow) is required. When ms is selected for TIME, at least 2ms of the interval is required. If the number of measurement stages are less than the number of stages specified by PULSE No, the instrument makes measurement for the maximum current measurement time and the pulsation error occurs. When the number of measurement stages reaches the number of stages specified by PULSE No, the measurement ends. Set all measurement conditions to use in All Pulses measurement. For example, when you have selected "3" for PULSE No and started measurement with conditions 3, set measurement conditions 3 to 5. The following settings are also needed to be the same in conditions 3 to 5: TRIGGER, MODE, CURRENT, TIME, CURRENT RANGE, VOLTAGE RANGE in the SETUP (1) screen, PULSE MODE, PULSE No, COOL TIME, CURR FALL LEVEL, CURR END LEVEL, MEAS INHIBIT TIME, and MEAS MIN TIME in the SETUP (2) screen.</p> <p>When "2" is selected for PULSE No, the instrument measures the current at the first and second stages, and if conditions 3 are used for measurement start, conditions 3 are used as measurement conditions, and conditions 3 and 4 are used as judgment conditions respectively for the first and second stages.</p>

(Continued to next page)

No.	Item	Description	
(2)	Parameter setting	<p>PULSE MODE (Continued from previous page)</p>	<div style="border: 2px solid red; padding: 10px;"> <p>Current trigger start</p>  <p>Force trigger start</p>  <p>When external $\pm 10V$ voltage input and displacement are measured, the instrument operates in the same manner as in the force trigger start.</p> </div> <p>No Cooling (NO COOL) (2nd stage measurement) Set a measurement start current in NO COOL TRIG LVL. The instrument starts measurement determining the point in time where the start current is exceeded as the measurement start point. Measurement is possible only if the current at the second stage is larger than that at the first stage.</p> <div style="border: 2px solid red; padding: 10px; margin-top: 10px;">  </div>
	(Continued to next page)	PULSE No / NO COOL TRIG LVL	<p>When SET PULSE or ALL PULSE is selected for PULSE MODE, set the number of stages (0 to 20) in PULSE No.</p> <p>When NO COOL is selected for PULSE MODE, set a measurement start timing current for NO COOL TRIG LVL. For NO COOL TRIG LVL, set a value within the specified measurement range.</p>

No.	Item	Description	
(2)	Parameter setting	COOL TIME	<p>If, during current measurement, the COOL TIME is shorter than the value specified here, the instrument makes measurement determining the current to be a single-stage current. Set the COOL TIME in the following ranges:</p> <p>When CYC-50/60Hz, CYC-LONG or CYC-***Hz is selected for TIME 0.0-99.5CYC</p> <p>When ms is selected for TIME 0-99ms</p> <p>When ms-SHORT is selected for TIME 0.0-9.9ms</p> <div data-bbox="863 689 1402 958" style="border: 2px solid red; padding: 5px;">  </div>
	Current Fall Level (CURR FALL LEVEL)	<p>When DC is selected for CURRENT, you can measure the current flow time till the Current Fall Level setting is reached. Set the Current Fall Level as the ratio to the peak (10 to 90%).</p> <div data-bbox="863 1189 1402 1400" style="border: 2px solid red; padding: 5px;">  </div>	
	(Continued to next page)	Current End Level (CURR END LEVEL)	Set a CURR END LEVEL (1.5 to 15.0%).

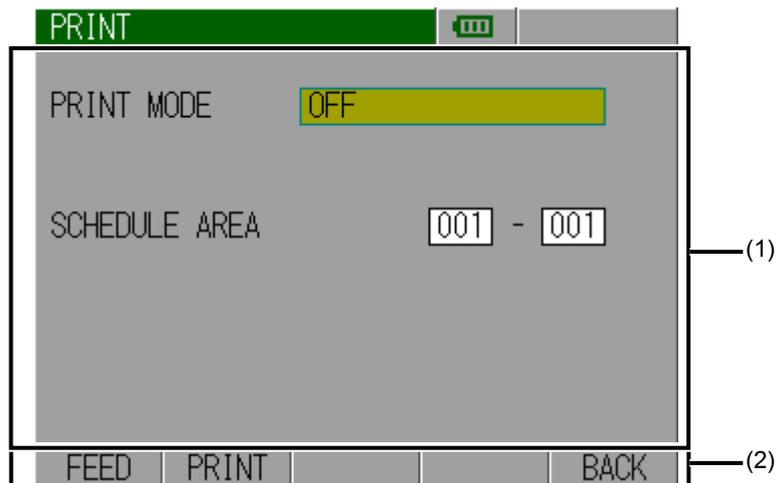
No.	Item	Description	
(2)	Parameter setting (Continued from previous page)	Measurement Pause Time (MEAS INHIBIT TIME)	Set a measurement prohibition time (0.0 to 9.9 sec) following a measurement.
		Forced Measurement Time (MEAS MIN TIME)	<p>In the early stages of current flow, the instrument may fail to measure the current if the current is excessively low. (This likely occurs if the upslope is used.)</p> <p>In such a case, set a Forced Measurement Time.</p> <p>Set a forced measurement time in the following ranges:</p> <p>When CYC-50/60Hz, CYC-LONG or CYC-***Hz is selected for TIME 0.5-9.5CYC</p> <p>When ms is selected for TIME 1-99ms</p> <p>When ms-SHORT is selected for TIME 0.0-9.9ms</p> <div data-bbox="868 958 1401 1205" style="border: 2px solid red; padding: 5px;">  <p>Set a time so that currents of measurable magnitude (shaded areas in the figure) are included.</p> </div>
		FORCE RISE LEVEL/ FORCE FALL LEVEL	When FORCE is selected for SELECT MEAS in the STATUS (1) screen, set FORCE RISE LEVEL and FORCE FALL LEVEL as the ratio to the peak (10 to 90%). This setting applies to the time measurements in the WAVEFORM (FORCE) screen.
(3)	Function keys	Next (NEXT)	Pressing operation button A displays the SETUP (3) screen.
		Back (PREV)	Pressing operation button B displays the SETUP (1) screen.

I. SETUP (3) Screen



No.	Item	Description	
(1)	SCH.#	Select a measurement condition number (1 to 127) to set in the SETUP (1) to (3) screens. You can change condition numbers by selecting this field with the encoder and turning the encoder clockwise or counterclockwise.	
(2)	Parameter setting	FORCE START TIME / FORCE END TIME / EXT START TIME / EXT END TIME	By specifying an arbitrary range, you can measure mean force and external $\pm 10V$ voltage input. When FORCE is selected for SELECT MEAS in the STATUS (1) screen, set FORCE START TIME and FORCE END TIME in the range from 0 to 6,000 ms (in units of 10 ms). As for force, there are two input fields for each item because you can specify two ranges for a single measurement and measure the force at two locations. When EXT (EXTERNAL) is selected for SELECT MEAS in the STATUS (1) screen, set the EXT START TIME and EXT END TIME in the range from 0 to 6,000 ms (in units of 10 ms).
(3)	Function keys	Back (PREV)	Pressing operation button B displays the SETUP (2) screen.
		Zero point adjustment (0 ADJ)	The instrument starts Zero point adjustment.

m. PRINT screen



No.	Item	Description	
(1)	Parameter setting	Print Setting (PRINT MODE)	Select an item to print from the following. To print, first select an item, then press the print button (button B).
		OFF	No printing
		Setting	Prints the measured values of the five (5) items selected in the VIEW screen.
		Waveform Data (WAVEFORM)	Prints the waveforms of the five (4) items selected in the VIEW screen. The vertical and horizontal scales applied to the printed waveforms are those set in the WAVEFORM screen. You can select the waveforms to print with waveform ON/OFF in the VIEW screen.
		Measured Value History (HISTORY)	Prints measured value history.
(Continued to next page)	Error History (HISTORY OUT OF LIM)	Prints measured value history with Overrange error or Pulsation error.	

No.	Item	Description	
(1)	Parameter setting	Print Setting (PRINT MODE)	Prints condition data whose range is set in Condition Data Range (SCHEDULE AREA).
		(Continued from previous page)	Screen Copy (DISPLAY)
			Current All Cycles (CURR ALL CYCLE)
			Force All Cycles (FORCE ALL CYCLE)
		Condition Data Range (SCHEDULE AREA)	Set the range of condition numbers to print condition data from 001 to 127. The setting of condition data range is valid only when condition data is printed.
(2)	Function keys	Feed (FEED)	Pressing operation button A feeds paper.
		Print (PRINT)	Pressing operation button B prints the item selected with the print setting. To pause printing, press the encoder long. The printer has a data storage space. Printing will stop after the data is all output from the printer.
		Return (BACK)	Pressing operation button E returns the display to the previous screen.

COPY DISPLAY 2000/01/14 14:57

MEASUREMENT		SCH.#	OUT
CURRENT (RMS) (20.00 kA)	3.06		kA
CURRENT (PEAK) (20.00 kA)	4.88		kA
VOLTAGE (RMS) (20.0 V)	0.9		V
VOLTAGE (PEAK) (20.0 V)	1.8		V
WELD TIME	10.0		CYC
SETUP	STATUS	SAVE	VIEW

Print example of COPY

SCHEDULE 2000/01/10 15:43

sch	001	
TRIGGER	CURRENT	
MODE	NORMAL	
CURRENT	AC	
TIME	CYC-50/60Hz	
CURRENT RANGE	20.00 kA	
VOLTAGE RANGE	20.0 V	
MEAS START	000.0 CYC	
MEAS END	200.0 CYC	

Print example of SCHEDULE

HISTORY OUT OF LIM 2000/01/10 15:53

SCH.	DATE	CURR RMS	CURR PEAK	VOLT RMS	VOLT PEAK	WELD TIME
001	01/10 15:52:48	-kA	-kA	-V		
		-V	-CYC			
001	01/10 15:52:40	-kA	-kA	-V		
		-V	-CYC			

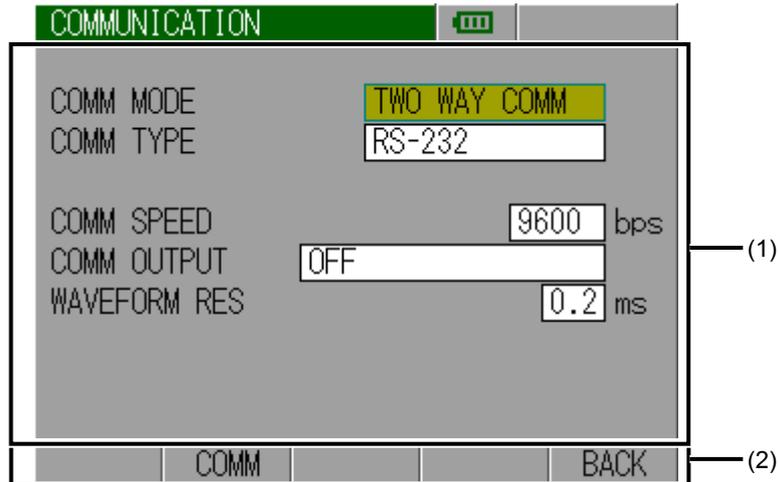
Print example of HISTORY

HISTORY OUT OF LIM 2000/01/10 15:53

SCH.	DATE	CURR RMS	CURR PEAK	VOLT RMS	VOLT PEAK	WELD TIME
001	01/10 15:52:48	-kA	-kA	-V		
		-V	-CYC			
001	01/10 15:52:40	-kA	-kA	-V		
		-V	-CYC			

Print example of HISTORY

n. COMMUNICATION screen



No.	Item	Description	
(1)	Parameter setting	Communication System (COMM MODE)	Specify unidirectional or bidirectional communication system. Do not select bidirectional as it is a reserve setting feature. Do not specify.
		Communication Type (COMM TYPE)	Set the communication type. It is fixed to RS-232C.
		Communication Speed (COMM SPEED)	Select from 9,600 bps, 19,200 bps and 38,400 bps.
		Communication setting (COMM OUTPUT)	Select an item to output from the following. To output, first select an item, then press the communication button (button B). Refer to Chapter 12 Data Communication for details of communication telegram.
		(Continued to next page)	OFF
		Measured values (MEASUREMENT)	Outputs the measured values of the five (5) items selected in the VIEW screen.

No.	Item	Description		
(1)	Parameter setting	Communication setting (Continued from previous page)	Waveform Data (WAVEFORM)	Outputs the waveforms of the five (4) items selected in the VIEW screen. You can set waveform decimation for output interval of the waveform sample value. Note that if you set an interval smaller than the data sampling interval stored in the instrument, the data will be output at the internally stored interval. You can select the waveforms to output with waveform ON/OFF in the VIEW screen. Outputs after the end of measurement.
			Measured Value History (HISTORY)	Outputs measured value history.
			Error History (HISTORY OUT OF LIM)	Outputs measured value history with Overrange error or Pulsation error.
			Current All Cycles (CURR ALL CYCLE)	Outputs current all cycles.
			Force All Cycles (FORCE ALL CYCLE)	Outputs force all cycles.
		Waveform Decimation (WAVEFORM RES)	Set a waveform decimation. You can select from among 0.2ms, 0.5ms, 1ms, 2ms, 5ms and 10ms. If you set a decimation smaller than the data sampling interval stored in the instrument, the data will be output at the internally stored interval. The setting of waveform decimation is valid only when WAVEFORM is selected for COMM OUTPUT.	
(2)	Function keys	Communication (COMM)	Pressing operation button B prints the item selected with the communication setting. To pause communicating, press the encoder long.	
		Return (BACK)	Pressing operation button E returns the display to the previous screen.	

o. HISTORY screen

HISTORY			
DATE	TIME	SCH	CURRENT (RMS)
~ 11/21	13:19:33	001	0.940 kA
~ 11/21	13:19:29	001	0.943 kA
~ 11/21	13:19:25	001	0.943 kA
~ 11/21	13:19:21	001	0.944 kA
~ 11/21	13:19:17	001	0.943 kA
~ 11/21	13:19:13	001	0.943 kA
~ 11/21	13:19:09	001	0.943 kA
~ 11/21	13:19:05	001	0.942 kA
~ 11/21	13:19:01	001	0.942 kA

(1) points to the current values in the table.

Can be switched between SAVE

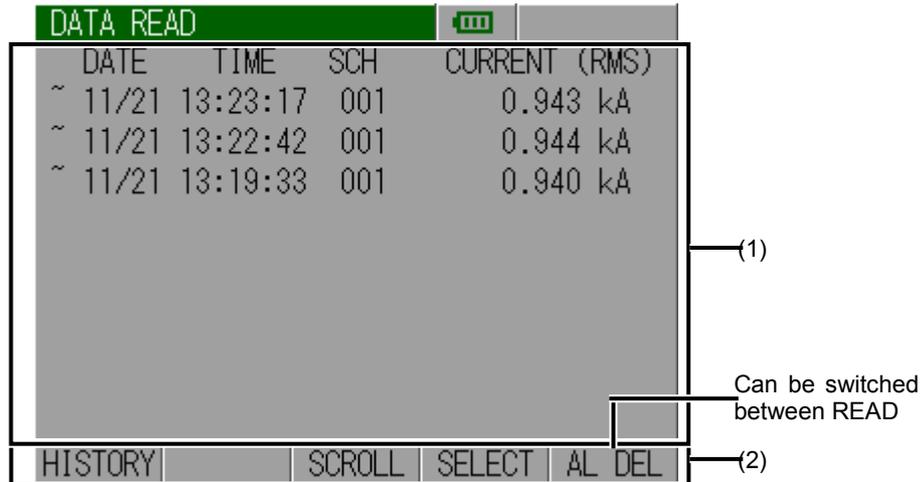
(2) points to the bottom control bar:

DATA	CHANGE	SCROLL	SELECT	AL DEL
------	--------	--------	--------	--------

No.	Item	Description
(1)	History display	<p>The HISTORY screen shows a list of measured values (presence/absence of waveforms, date, time, condition No.) obtained until now. This screen allows you to load past measured values and save new ones to the built-in flash memory. You can save measured values both to the built-in memory and flash memory.</p> <p>Amount of history data storable in the built-in memory</p> <p>The built-in memory is battery-backed-up RAM. It can store measured values (5 selected measured values), all cycles and waveforms (4 selected waveforms). Refer to the following for the amount of storable data:</p> <p>When you have selected WAVE MEMORY for SAVE SELECT in the STATUS (3) screen, the MM-380A is in mode to save measured values, all cycles and waveforms.</p> <p>Measured value data (5 selected measured values): 100 Older data is deleted as the number of measured values exceeds 100.</p> <p>All cycles and waveform data (4 selected waveforms): 20 (The number of storable pieces of data varies depending on the waveform measurement time.) Older data is deleted as the number of pieces of data exceeds 20 or as the maximum measurement time is surpassed.</p> <p>When you have selected MEAS. MEMORY for SAVE SELECT in the STATUS (3) screen, the MM-380A is in mode to save measured values.</p> <p>Measured value data (5 selected measured values): 3000 Older data is deleted as the number of measured values exceeds 3000.</p> <p>All cycles and waveform data (4 selected waveforms): 1 The final data remains stored.</p> <p>(Continued to next page)</p>

No.	Item	Description	
(1)	History display (Continued from previous page)	<p>Amount of history data savable in the built-in flash memory</p> <p>The built-in flash memory is flash ROM.</p> <p>It can store measured values (5 selected measured values), all cycles and waveforms (4 selected waveforms).</p> <p>Fifty (50) sets of measured values, all cycles and waveforms can be saved.</p> <p>The built-in flash memory has a write limit. An error message (system error) appears if the write limit is exceeded. The write limit is 100000.</p>	
(2)	Function keys	DATA	Pressing operation button A displays the DATA READ screen. Allows you to load the measured values stored in the built-in flash memory.
		Switch (CHANGE)	Pressing operation button B switches between measured values of five measurement items. You can switch the display to show five (5) measurement items by turning the encoder clockwise or counterclockwise.
		Scroll (SCROLL)	Pressing operation button C and turning the encoder clockwise or counterclockwise scrolls the screen down or up.
		Select (SELECT)	<p>Pressing operation button D makes it possible to select measured values, showing the cursor that encloses the on-screen history line by line. You can move the cursor by turning the encoder clockwise or counterclockwise.</p> <p>To save measured values, all cycles and waveforms to the flash memory built into the MM-380A, move the cursor to a desired measured value and press operation button E (SAVE). At this time, SELECT does not scroll the screen.</p> <p>Therefore, scroll the screen first, and then make a selection.</p> <p>Pressing operation button D again makes it possible to select measured values, thus allowing you to load stored measured values, all cycles and waveforms and view past measured values in the Measurement, WAVEFORM and ALL CYCLE screens.</p>
Save/Delete All (SAVE/AL DEL)	<p>When measured value selection is made possible by operation button D, SAVE appears. In this condition, move the cursor to a desired measured value using the encoder and press operation button E. This saves the selected measured value to the flash memory built into the MM-380A.</p> <p>If no measured value is selected, AI DEL appears. In this condition, press operation button E. This displays DELETE in operation button D, and CANCEL in operation button E.</p> <p>Selecting DELETE clears all history data from the built-in flash memory; selecting CANCEL leaves the data uncleared.</p>		

p. DATA READ screen



No.	Item	Description	
(1)	Loaded data display	Shows the list of measured values stored in the built-in flash memory. This screen allows you to load the measured values stored in the built-in flash memory.	
(2)	Function keys	History (HISTORY)	Pressing operation button A displays the HISTORY screen.
		Scroll (SCROLL)	Pressing operation button C and turning the encoder clockwise or counterclockwise scrolls the screen down or up.
		Select (SELECT)	Pressing operation button D makes it possible to select data, showing the cursor that encloses the on-screen history line by line. You can move the cursor by turning the encoder clockwise or counterclockwise. To load measured values, all cycles and waveforms from the flash memory built into the MM-380A , move the cursor to a desired measured value and press operation button E (READ). At this time, SELECT does not scroll the screen. Therefore, scroll the screen first, and then make a selection. Pressing operation button D again cancels SLCT.
		Load/Delete All (READ/AL DEL)	When data selection is made possible by operation button D, READ appears. In this condition, select desired data using the encoder and press operation button E. This loads the selected data from flash memory. Note that this operation will clear the history data. If no measured value is selected, AL DEL appears. In this condition, press operation button E. This displays DELETE in operation button D, and CANCEL in operation button E. Selecting DELETE clears all measured values from the built-in flash memory; selecting CANCEL leaves the measured values uncleared.

q. STATUS (1) Screen

Can be switched between External Trigger Level

Displayed only when FORCE is selected

Displayed only when rated setting is selected. Can be switched between External Rating and External Decimal Point.

Displayed only when FORCE is selected

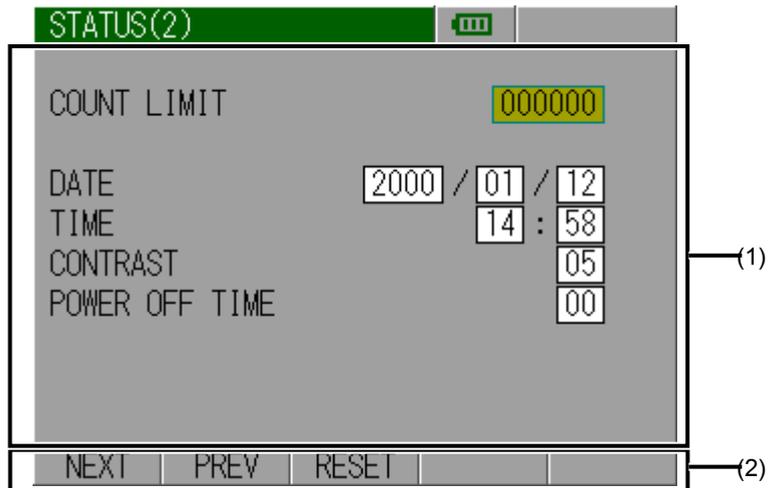
(1)

(2)

No.	Item	Description	
(1)	Parameter setting	COIL TYPE	Set as follows depending on the type of toroidal coil connected: When 1× sensitivity coil is used: 1 When 10× sensitivity coil is used: 10
		Current Trigger Sensitivity (CURR TRIGGER)	The sensitivity increases as you increase the value. Excessively increasing the sensitivity may cause malfunction.
		Measurement Selection (SELECT MEAS)	To measure force, select FORCE. To measure external input voltage, select EXTERNAL.
		Force Trigger Level (FORCE TRIGGER LEVEL) /External Trigger Level (EXT TRIGGER LEVEL)	Set a triggering level as the percentage of full scale. When you have selected FORCE for SELECT MEAS, select a force trigger level (2.0 to 99.9%). When you have selected EXTERNAL for SELECT MEAS, select an external trigger level (2.0 to 99.9%).
		FORCE UNIT	When you have selected FORCE for SELECT MEAS, select the force unit used for settings and display related to force from N, kgf, and lbf.
		FORCE SENSOR	When you have selected FORCE for SELECT MEAS, select the connected force sensor from the following: MA-520, MA-521, MA-522, MA-710A, MA-711A, MA-770A, MA-771A, MANUAL SET
	(Continued to next page)		

No.	Item	Description	
(1)	Parameter setting (Continued from previous page)	Force Rating (FORCE MAX) /External Rating (EXT MAX)	When you have selected rated setting (RTD) for FORCE SENSOR, set a force or external rating as follows: <When FORCE is selected for SELECT MEAS> FORCE UNIT: N Force rating: 490 to 9806 FORCE UNIT: kgf Force rating: 50 to 1000 FORCE UNIT: lbf Force rating: 110 to 2205 <When EXTERNAL is selected for SELECT MEAS> Force rating: 100 to 999
		Force Decimal Point (FORCE DECIMAL)/ External Decimal Point (EXT DECIMAL)	When you have selected rated setting (MANUAL SET) for FORCE SENSOR, set a force or external decimal point as follows: <When FORCE is selected for SELECT MEAS> Force decimal point: **.**, **.*, **** <When EXTERNAL is selected for SELECT MEAS> External decimal point: *.* , **.* , ***
		FORCE SPAN	When you have selected FORCE for SELECT MEAS, select a force trigger level (500 to 1500).
(2)	Function keys	NEXT	Pressing operation button A displays the STATUS (2) screen.
		Return (BACK)	Pressing operation button E returns the display to the previous screen.

r. STATUS (2) Screen



No.	Item	Description	
(1)	Parameter setting	Preset Counter (COUNT LIMIT)	The counter counts up by 1 for each measurement. When the counter reaches the preset counter value, the COUNT UP signal is output. Set a preset value (0 to 999,999).
		DATE	Set the date in the format: year (2000 to 2099), month (1 to 12) and day (1 to 31).
		TIME	Set the time in the format: hour (0 to 23) and minutes (0 to 59).
		CONTRAST	Set a display contrast (1 to 10).
		POWER OFF TIME	Set the time (00 to 30) after which the power automatically turns OFF. If you set this to "00", the power will not turn OFF automatically.
(2)	Function keys	NEXT	Pressing operation button A displays the STATUS (3) screen.
		Return (PREV)	Pressing operation button A displays the STATUS (1) screen.
		RESET	Pressing operation button C resets the preset counter value.

s. STATUS (3) Screen



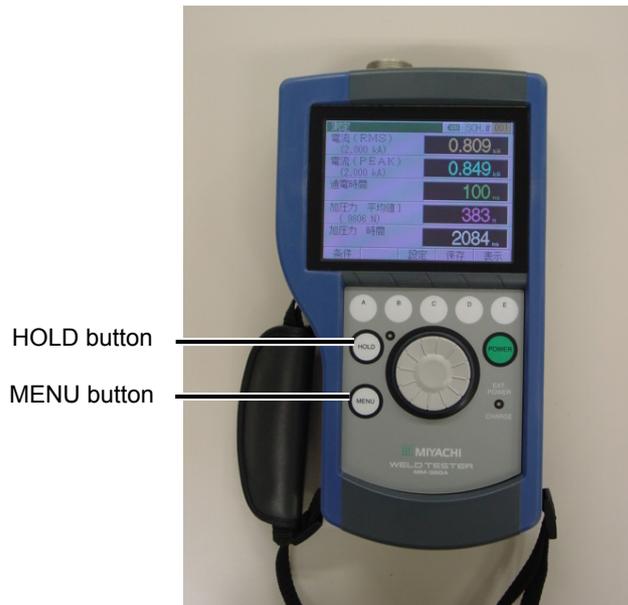
No.	Item	Description	
(1)	Parameter setting	Language (LANGUAGE)	Select a language for on-screen display from among Japanese, English, Chinese, French, German and Spanish.
		Save Selection (SAVE FORMAT)	Set the save mode to the waveform or measured value save mode. Waveform save mode (WAVE MEMORY) This mode saves the measured values and waveforms. The instrument stores the measured values and OK/NG judgment results of the five measurement items for up to the last 100 points and the waveforms of the four waveform display items. Older data is deleted when the measured values exceed 100 points. Older waveform is deleted as the number of pieces of data exceeds 20 or as the maximum measurement time is surpassed. On the other hand, you can check waveform data on the screen display or printout. Measured value save mode (MEAS. MEMORY) Stores the measured values and OK/NG judgment results of the five measurement items for the latest 3,000 points.
		Memory Battery (MEMORY BATTERY)	Shows the backup battery voltage of the MM-380A . Shows an error if the battery power is low.
		Main Battery (MAIN BATTERY)	Shows the lithium-ion battery voltage of the MM-380A . If two batteries are installed, the higher voltage is shown. The approximate remaining battery charge is shown at the top of the screen. An error appears if the battery charge is low.
	(Continued to next page)		

No.	Item	Description	
(1)	Parameter setting	Force Meter Information (FORCE INFO)	Shows the force meter model.
		Serial No. (SERIAL NO)	Shows the serial number of the force meter.
(2)	Function keys	Return (PREV)	Pressing operation button B displays the STATUS (2) screen.

9. Measurement

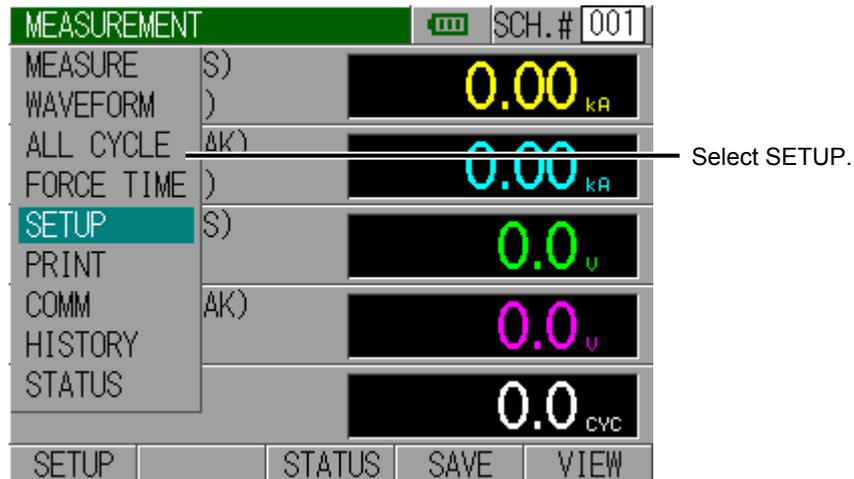
(1) Measuring Current (Current Flow Time)/Voltage

- 1) Connect the **MM-380A** to a power supply, and plug the toroidal coil to the **MM-380A**. (For more information, refer to (1) (2)a in Chapter 6.)
- 2) Start the **MM-380A**. (For more information, refer to (1) in Chapter 7.)
- 3) Press the HOLD button.



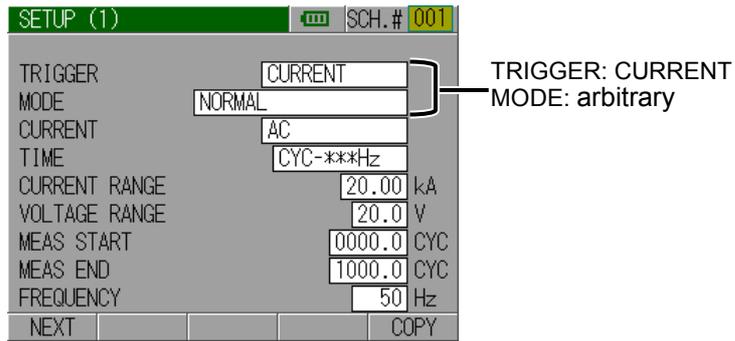
The **MM-380A** enters hold mode, allowing you to manipulate the screens.

- 4) Press the MENU button.
The menu list appears.
- 5) Using the encoder, select SETUP from the menu list.



The SETUP (1) screen appears.

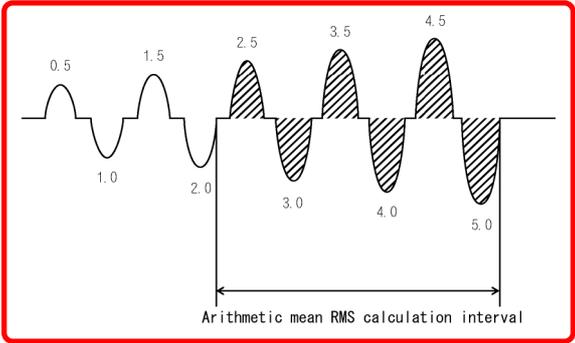
- 6) Select CURRENT for TRIGGER in the SETUP (1) screen, and select an arbitrary mode selectable for that trigger. (For more information, refer to (2) j in Chapter 8.)



- 7) Set up the **MM-380A** as follows according to the type of welding power supply used:

Single-phase AC welding power supply

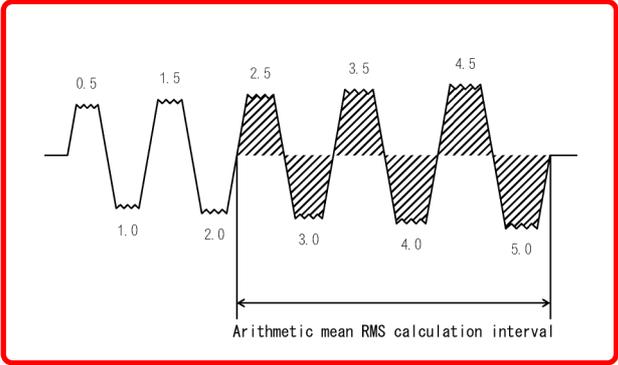
- (1) Set the following items in the SETUP (1) screen. (For more information, refer to (2) j in Chapter 8.)

Item	Setting
Current	AC
Time	CYC-50/60 Hz
Start Cycle (S-CYCLE)/ End Cycle (E-CYCLE)	Referring to the figure shown below, set the current calculation interval. 

AC inverter welding power supply

- (1) Set the following items in the SETUP (1) screen. (For more information, refer to (2) j in Chapter 8.)

Item	Setting
Current	AC
Time	When making measurement by setting a frequency: CYC-***Hz When measuring current flow time in units of ms: ms

Item	Setting
Start Cycle (S-CYCLE)/ End Cycle (E-CYCLE)	Referring to the figure shown below, set the current calculation interval. <div style="border: 2px solid red; padding: 10px; margin: 10px 0;">  </div>
Frequency	Set the frequency of the current to be measured. When using a Miyachi AC inverter welding power supply, set the frequency referring to the table shown below (Correlation between Frequencies of the Welding Power Supply and the MM-380A).

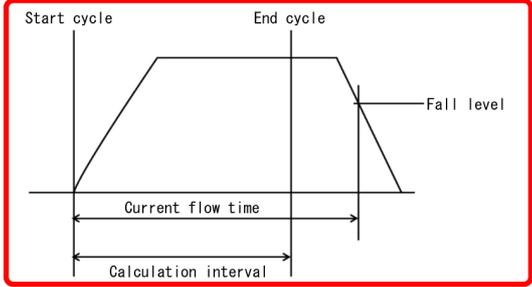
Correlation between Frequencies of the Welding Power Supply and the **MM-380A**

Welding power supply frequency setting	MM-380A frequency setting	Welding power supply frequency setting	MM-380A frequency setting
50 Hz	M050	91 Hz	M091
53 Hz	M053	100 Hz	M100
56 Hz	M056	111 Hz	M111
59 Hz	M059	125 Hz	M125
63 Hz	M063	143 Hz	M143
67 Hz	M067	167 Hz	M167
71 Hz	M071	200 Hz	M200
77 Hz	M077	250 Hz	M250
83 Hz	M083		

AC inverter welding power supply

- (1) Set the following items in the SETUP (1) screen.
(For more information, refer to (2) j in Chapter 8.)

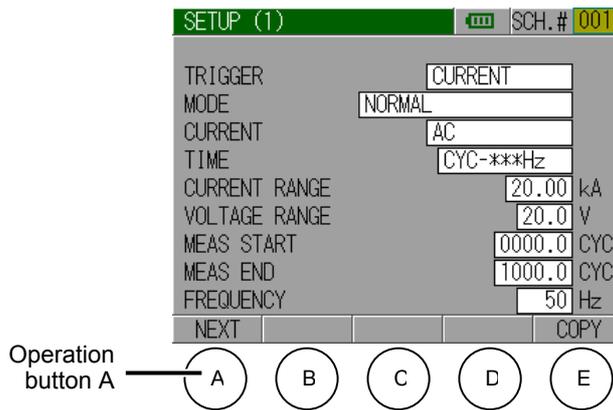
Item	Setting
Current	DC
time	When making measurement in units of cycle: CYC-50/60Hz When measuring current flow time in units of ms: ms
Start Cycle	Referring to the figure shown below, set the current calculation interval.

Item	Setting
(S-CYCLE)/ End Cycle (E-CYCLE)	 <p data-bbox="774 539 1361 633">If you set the current calculation interval by setting the CURR FALL LEVEL in the SETUP (2) screen, set the E-CYCLE to "0."^{*1}</p>

*1: You can set the current calculation end time also by CURR FALL LEVEL (an item that sets the percentage relative to the current peak to stop the calculation) in the SETUP (2) screen.

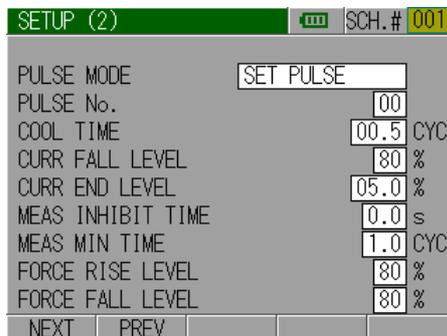
To set the CURR FALL LEVEL, proceed with Steps (2) and (3).

(2) Press operation button A.



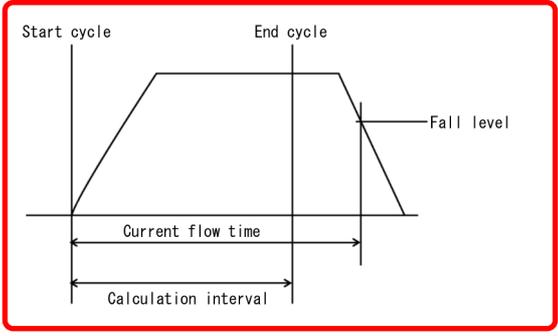
The SETUP (2) screen appears.

(3) Set the following items in the SETUP (1) screen.
(For more information, refer to (2) k in Chapter 8.)



Transistor welding power supply

- (1) Set the following items in the SETUP (1) screen. (For more information, refer to (2) j in Chapter 8.)

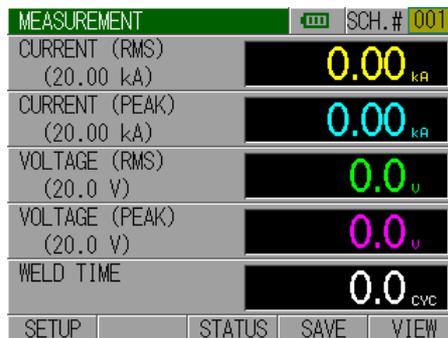
Item	Setting
Current	DC
Time	ms-SHORT
Start Cycle (S-CYCLE)/ End Cycle (E-CYCLE)	Set a calculation interval. 

- 8) Press the MENU button, and using the encoder, select MEASURE from the menu list.



The MEASUREMENT screen appears.

- 9) Press operation button E.



The VIEW screen appears.

- 10) According to the desired measurement item, set the following in one of Measure 1 to 5:
(For information on measurement items other than the below, refer to (2) b in Chapter 8.)

VIEW		FORM	VIEW
MEAS	1	CURRENT (RMS)	
	2	CURRENT (PEAK)	
	3	VOLTAGE (RMS)	
	4	VOLTAGE (PEAK)	
	5	WELD TIME	
WAVE	1	CURRENT	ON
	2	VOLTAGE	ON
	3	POWER	ON
	4	RESISTANCE	ON
			BACK

To measure RMS current: CURR (RMS)
 To measure peak current during current flow: CURR (PEAK)
 To measure RMS voltage: VOLT (RMS)
 To measure peak voltage during current flow: VOLT (PEAK)
 To measure current flow time: :CURR TIME
 To measure maximum conduction angle during current flow time: COND ANGLE

- 11) To display the waveforms of the measured items, set those items in Waveforms 1 to 4. (For more information, refer to (2) b in Chapter 8.)
- 12) As necessary, switch to the SETUP and STATUS screens and set other items. (For more information, refer to (2) j, k, l, m, r, s and t in Chapter 8.)
- 13) Press the HOLD button.
 The hold mode is canceled, putting the **MM-380A** into wait state until measurement starts (the signal selected as trigger is input).
- 14) When the trigger signal is input to the **MM-380A**, measurement starts. Confirm the measurement results on the MEASUREMENT and WAVEFORM screens. You can also print measured values and waveforms from the PRINT screen, as necessary. (For more information, refer to (1) and (2) in Chapter 8.)

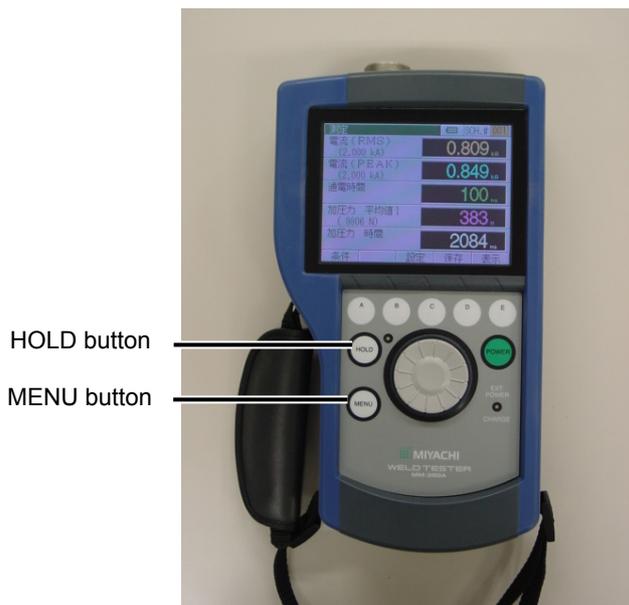
(2) Measuring Force (Option)

CAUTION

- Before using the force sensor, be sure to turn off the power of the welding machine and confirm that no welding current is flowing.
- Select an appropriate force sensor according to the force range you wish to measure.
- Before measuring force, be sure to set the force sensor's offset to "0." Note that you must at this time make sure that no force is applied to the sensor. During hold off, the force sensor's offset will be automatically set to "0."

- 1) Connect the **MM-380A** to a power supply, and plug the force or current/force sensor to the **MM-380A**. If you wish to measure the current and voltage as well as the force at the same time, plug the current/force sensor. (For more information, refer to (1) and (2) in Chapter 6.)

- 2) Start the **MM-380A**. (For more information, refer to (1) in Chapter 7.)
- 3) Press the HOLD button.



The **MM-380A** enters hold mode, allowing you to manipulate the screens.

- 4) Press the MENU button.
The menu list appears.
- 5) Using the encoder, select STATUS from the menu list.



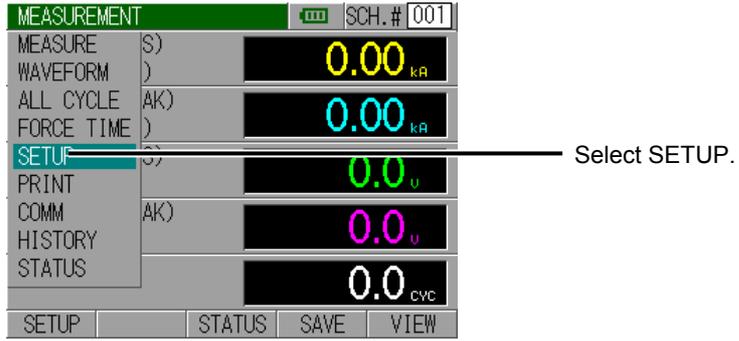
The STATUS (1) screen appears.

- 6) Set the following items in the STATUS (1) screen.
(For more information, refer to (2) r in Chapter 8.)

Item	Setting
Measurement Selection (SELECT MEAS)	Force
Force Trigger Level (FORCE TRIGGER LVL)	2.0 to 99.9%
FORCE UNIT	N, kgf, lbf
FORCE SENSOR	Select the force sensor connected.

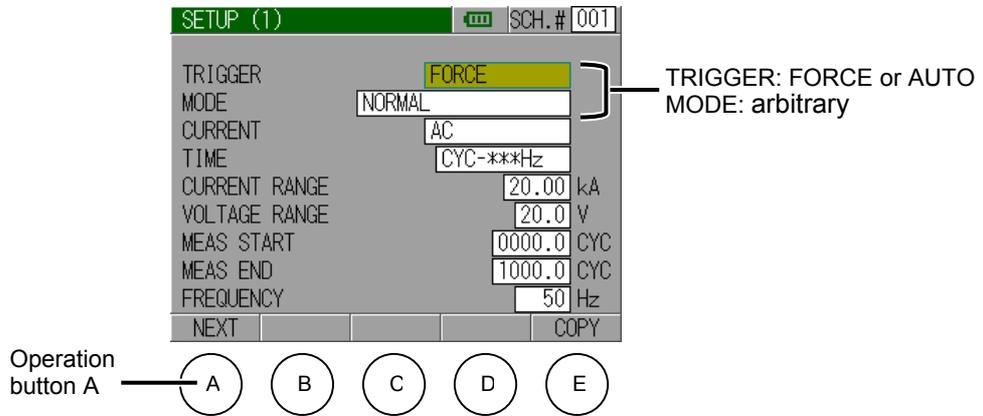
- 7) Press the MENU button.
The menu list appears.

- 8) Using the encoder, select SETUP from the menu list.



The SETUP (1) screen appears.

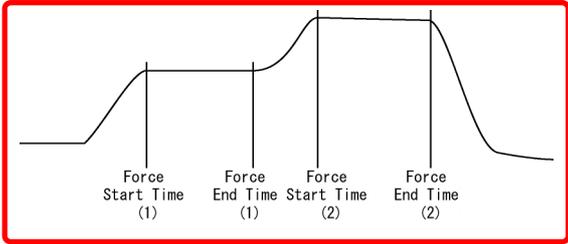
- 9) Select FORCE or AUTO for TRIGGER in the SETUP (1) screen, and select an arbitrary mode selectable for that trigger. (For more information, refer to (2) j in Chapter 8.)



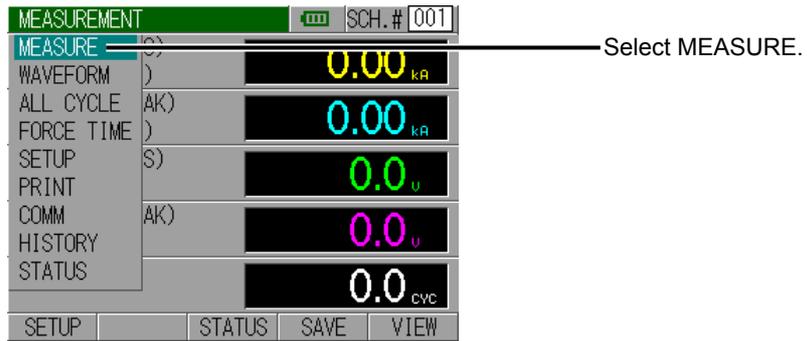
- 10) Press operation button A twice.

The SETUP (3) screen appears.

- 11) Set the following items in the SETUP (3) screen.

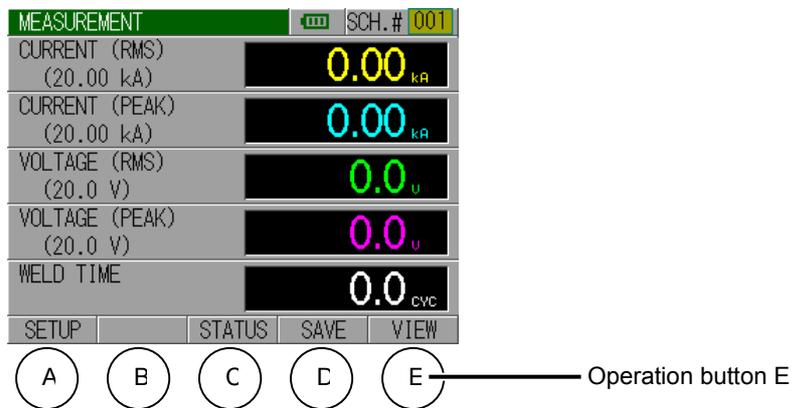
Item	Setting
FORCE START TIME 1 to 2 FORCE END TIME 1 to 2	Referring to the figure shown below, set a force calculation interval by the FORCE START TIME and FORCE END TIME. 

- 12) Press the MENU button, and using the encoder, select MEASURE from the menu list.



The MEASUREMENT screen appears.

- 13) Press operation button E.

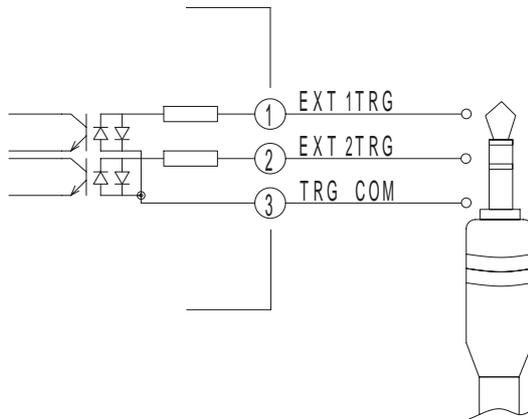


The VIEW screen appears.

- 14) According to the desired measurement item, set the following in one of Measure 1 to 5: (For information on measurement items other than the below, refer to (2) b in Chapter 8.)
- To measure mean force: Mean Force (M-FORCE) 1, Mean Force (M-FORCE) 2
 - To measure peak force: Peak Force (P-FORCE)
 - To measure the time from when the force signal exceeds the force start level to when the signal falls below the force end level: FORCE TIME
- 15) To display the waveforms of the measured items, set those items in Waveforms 1 to 4. (For more information, refer to (2) b in Chapter 8.)
- 16) As necessary, switch to the SETUP and STATUS screens and set other items. (For more information, refer to (2) j, k, l, m, r, s and t in Chapter 8.)
- 17) Press the HOLD button.
- The hold mode is canceled, putting the **MM-380A** into wait state until measurement starts (the signal selected as trigger is input).
- 18) When the trigger signal is input to the **MM-380A**, measurement starts. Confirm the measurement results on the MEASUREMENT and WAVEFORM screens. You can also print measured values and waveforms from the PRINT screen, as necessary. (For more information, refer to (1) and (2) in Chapter 8.)

10. Interface

Description of the SOL signal (24V AC/DC) input Connector.



Pin No.	Name	Function
1	EXT TRG1	Force trigger signal input terminal. Connect a force signal (solenoid valve signal) to measure the force and current timings. Supply a 24 V DC voltage input signal. For more information, refer to the description of the WAVEFORM (FORCE) screen.
2	EXT TRG1	Optional input. Unused.
3	TRG COM	COM terminal for trigger input.

11. Maintenance

(1) Charging the Battery

The battery is not charged at the time of factory shipment. When using the **MM-380A** for the first time, charge the battery. The battery can be charged by connecting the power supply to the AC adapter jack with the dedicated AC adapter. (Refer to Chapter 6(1) “Connecting the **MM-380A** and Power Supply”.)

CAUTION

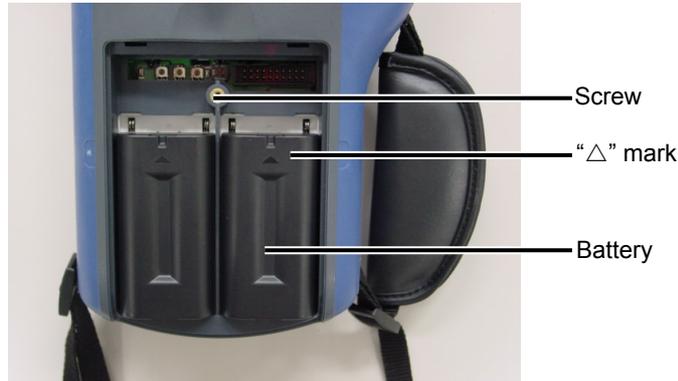
- When charging the battery, always connect the **MM-380A**'s AC adapter jack and the power supply with the dedicated AC adapter. Connecting the power supply with an AC adapter of another product, such as a printer, may result in malfunction.
- If you do not intend to use the **MM-380A** for extended periods, remove the battery or charge it once every two months.

(2) Battery Specification

Operation time	Approx. 2 hrs (with 1 battery) Approx. 4 hrs (with 2 batteries)	
Recharge warning display	Charge immediately in the event of the memory battery error.	
Charge method	Connect the 100 to 240 V AC power supply to the adapter jack on the MM-380A AC with the dedicated AC adapter.	
Charge time	Approx. 3 hrs (if charged with the MM-380A powered-off)	
Battery life (at recommended temp. 0 to 40°C)	A lithium-ion battery is used. The lifetime of the battery is approximately 500 full discharges and charges, depending on use. If the battery is at the end of its life, the operation time of the MM-380A becomes shorter. In this case, replace the battery.	
	Battery capacity guidance	
	Charge/discharge count	Battery capacity
	100 times	90%
	200 times	85%
300 times	80%	

(3) Replacing the Lithium-Ion Battery

- 1) Remove the screw from the battery cover on the rear of the **MM-380A** to detach the cover.
- 2) To attach the battery holder, slide it in the direction shown by the arrow with the “△” mark on the battery holder facing up
To detach the battery holder, slide it in the direction opposite to that of the arrow in the figure.

**(4) Replacing the Lithium Battery**

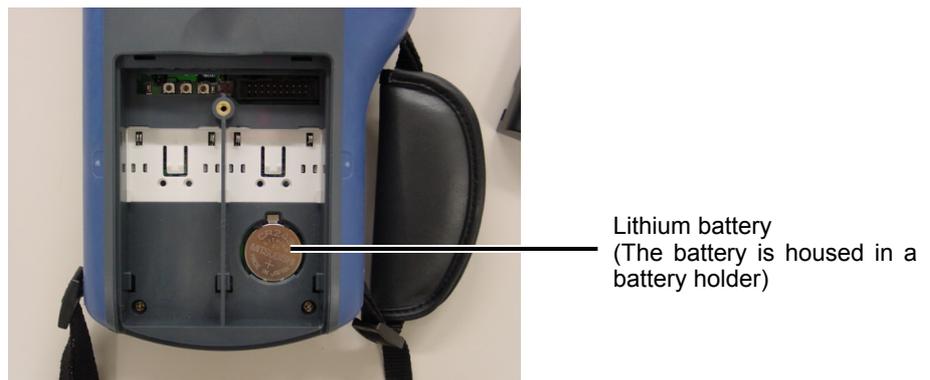
The service life of the built-in lithium battery is approximately five years.

Follow the steps below to replace the battery.

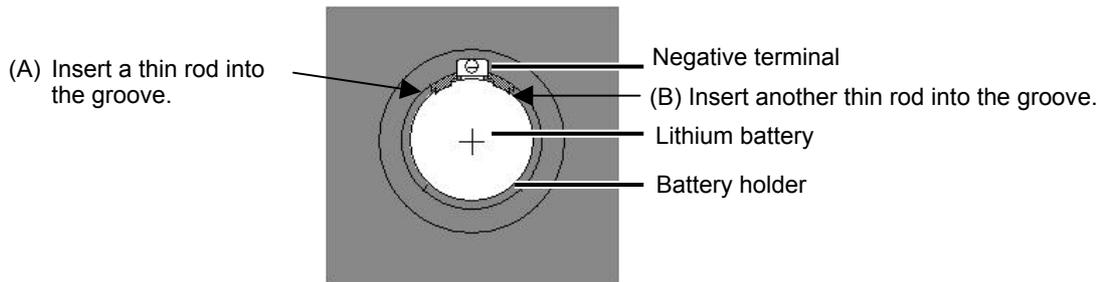
CAUTION

- When replacing the battery, leave the **MM-380A** connected to the power supply using the AC adapter. Removing the battery with the MM-380A unconnected to power will cause loss of the stored data.
- To remove the battery, use a non-conductive tool. Using a conductor may lead to short-circuit, resulting in damage.

- 1) Confirm that the power for the **MM-380A** is turned OFF.
- 2) Remove the screw from the battery cover on the rear to detach the cover.
(Refer to (3) Replacing the Lithium-Ion Battery.)
- 3) Remove the battery.
(Refer to (3) Replacing the Lithium-Ion Battery.)



- 4) Insert one thin non-conductive rod into the groove (position (A) in the figure) between the battery and the holder.



- 5) Insert another thin insulator rod into the groove (point(B) in the figure) and use both to lever the battery out completely.
- 6) Making sure that the battery's positive side faces up, firmly push the new battery into the battery holder.
- 7) Confirm that the battery is properly fitted in the holder.
- 8) Reattach the battery cover.
- 9) Fasten the battery cover with the screw.

ATTENTION

Lithium batteries contain hazardous substances. At the time of disposal, observe the local laws and regulations.

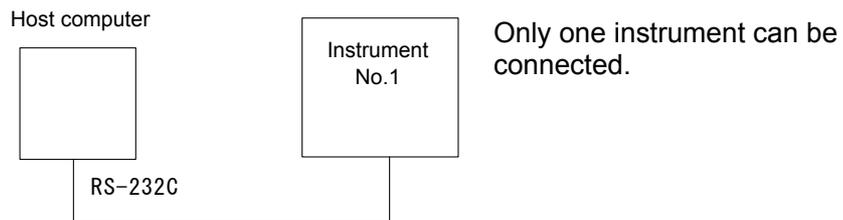
12. Data Communication

Monitoring data can be loaded from the **MM-380A** into the external PC.

(1) Data Transfer

Item	Description
System	RS-232C
Transfer rate	Select one option in the COMMUNICATION screen. 9600, 19200, 38400 bps
Data format	1 start bit, 8 data bits 1 stop bit, even parity
Character code	ASCII
Checksum data	None
Connector	D-sub 9-pin connector Pin layout: 2: RXD, 3: TXD, 5: SG

(2) Configuration



(3) Protocol

a. Unidirectional communication mode (unidirectional in the COMMUNICATION screen)

1) Measured values (M-VALUE)

Data string:

!01,0001:
 A B } Header

001,11/14 18:41:55,
 C D
00,.,1.86kA,
 E F G
01,.,3.63kA,
 H I J
04,.,10.0CYC,
 K L M
11,.,0N,
 N O P
13,.,0ms[CR]
 Q R S
[LF] } Data

Note: [] (shaded) area represents a space.

When multiple measured values are transmitted, the data is arranged as follows:

Ex.) Transmitting 5 measured values

!01,0005: 001,...[CR]
Header Data 1 Data 2 Data 3 Data 4
..... [LF]
Data 5 End

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific ID
B	Measured value count	4 fixed digits from 0001 to 0020	Number of measured values transmitted
C	Condition No.	3 fixed digits from 001 to 120	Condition No. used for measurement
D	Date	14 fixed digit	Measured date

	Item	Length	Description
E	Measurement item 1	2 fixed digits from 00 to 18 (refer to the Measurement Item No Table)	Measured value type ^{*1}
F	Judgment 1	1 fixed digit (refer to the Judgment Table)	Judgment result ^{*1}
G	Measured value 1	Varies depending on measurement item	Value obtained from measurement ^{*1}
H	Measurement item 2	2 fixed digits from 00 to 18 (refer to the Measurement Item No Table)	Measured value type ^{*1}
I	Judgment 2	1 fixed digit (refer to the Judgment Table)	Judgment result ^{*1}
J	Measured value 2	Varies depending on measurement item	Value obtained from measurement ^{*1}
K	Measurement item 3	2 fixed digits from 00 to 18 (refer to the Measurement Item No Table)	Measured value type ^{*1}
L	Judgment 3	1 fixed digit (refer to the Judgment Table)	Judgment result ^{*1}
M	Measured value 3	Varies depending on measurement item	Value obtained from measurement ^{*1}
N	Measurement item 4	2 fixed digits from 00 to 18 (refer to the Measurement Item No Table)	Measured value type ^{*1}
O	Judgment 4	1 fixed digit (refer to the Judgment Table)	Judgment result ^{*1}
P	Measured value 4	Varies depending on measurement item	Value obtained from measurement ^{*1}
Q	Measurement item 5	2 fixed digits from 00 to 18 (refer to the Measurement Item No Table)	Measured value type ^{*1}
R	Judgment 5	1 fixed digit (refer to the Judgment Table)	Judgment result ^{*1}
S	Measured value 5	Varies depending on measurement item	Value obtained from measurement ^{*1}

*1 Measurement items vary depending on the settings selected for Measurement (MEAS) 1-5 in the VIEW screen.

Measurement Item No Table

Code	Item
00	Current (RMS)
01	Current (PEAK)
02	Voltage (RMS)
03	Voltage (PEAK)
04	Current Flow Time
05	Conduction Angle
06	Power (POWER)
07	Resistance
08	Counter

Code	Item
09	Mean Force 1
10	Mean Force 2
11	Peak Force
12	-
13	Force Time
14	Mean External Voltage
15	Peak External Voltage
16	-
17	External Time
18	-
19	-

Judgment Table

Code	Judgment
(Space)	No judgment (20H)
O	Overrange error
I	Pulsation error

2) Waveform

Data string:

I01,00056:001,11/14 18:41:55,00,,1.86kA,01,,3.63kA,04,,10.0CYC,
 A B C

11,,0N,13,,0ms[CR][LF]

0,0,2,4,[CR][LF],
 D E F G

0000.0,-0.02kA,,0.0V,,0.00kW,0.00N[CR][LF]
 H I J K L

0000.5,-0.02kA,,0.0V,,0.00kW,0.00N[CR][LF]
 0001.0,-0.02kA,-0.1V,,0.00kW,0.00N[CR][LF]
 0001.5,0.00kA,-0.1V,,0.00kW,0.00N[CR][LF]
 ...

No output is produced if waveform display is OFF in the VIEW screen.
 The data is as follows if the 4th item is OFF:

I01,00056:001,11/14 18:41:55,00,,1.86kA,01,,3.63kA,04,,10.0CYC,
 11,,0N,13,,0ms[CR][LF]
 0,1,2,[CR][LF]
 0000.0,-0.02kA,,0.0V,,0.00kW[CR][LF]
 0000.5,-0.02kA,,0.0V,,0.00kW[CR][LF]
 0001.0,-0.02kA,-0.1V,,0.00kW[CR][LF]
 0001.5,0.00kA,-0.1V,,0.00kW[CR][LF]
 ...

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific

12. Data Communication

			ID
B	Sampling count	5 fixed digit	Number of samplings transmitted
C	Refer to "1) Measured values."		
D	Waveform item 1	1 fixed digit from 0 to 6 (refer to the Waveform Item Table)	Measured waveform type ^{*1}
E	Waveform item 2	1 fixed digit from 0 to 6 (refer to the Waveform Item Table)	Measured waveform type ^{*1}
F	Waveform item 3	1 fixed digit from 0 to 6 (refer to the Waveform Item Table)	Measured waveform type ^{*1}
G	Waveform item 4	1 fixed digit from 0 to 6 (refer to the Waveform Item Table)	Measured waveform type ^{*1}
H	Sampling time	6 fixed digit	Sampling time ^{*2} (unit: ms)
I	Waveform 1	Varies depending on measurement item	Measured value in each sampling time ^{*1}
J	Waveform 2	Varies depending on measurement item	Measured value in each sampling time ^{*1}
K	Waveform 3	Varies depending on measurement item	Measured value in each sampling time ^{*1}
L	Waveform 4	Varies depending on measurement item	Measured value in each sampling time ^{*1}

*1 Measurement items and presence/absence of output vary depending on the settings selected for Waveforms (WAVE) 1-4 in the VIEW screen.

*2 May differ from the Waveform Decimation setting in the COMMUNICATION screen depending on the stored waveform data.

Waveform Item Table

Code	Item
0	Current
1	Voltage
2	Power
3	Resistance
4	Force
5	External

3) Current All Cycles

Data string:

|01,0020:001,11/14 19:24:55,00,1.97kA,01,3.78kA,04,10.0CYC,
 A B C

11,0N,13,0ms[CR][LF]

0.5CYC,1.68kA,0.3V,86DEG[CR][LF]
 D E F G H

1.0CYC,*2.04kA,0.4V,91DEG[CR][LF]
 1.5CYC,*2.02kA,5.0V,91DEG[CR][LF]

...

The data is as follows if no conduction angle is output:

|01,0020:001,11/14 19:24:55,00,1.97kA,01,3.78kA,04,10.0CYC,
 11,0N,13,0ms[CR][LF]

0.5CYC,1.68kA,0.3V[CR][LF]
 1.0CYC,*2.04kA,0.4V[CR][LF]
 1.5CYC,*2.02kA,5.0V[CR][LF]

...

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific ID
B	All cycles count	4 fixed digit	Number of all cycles transmitted
C	Refer to "1) Measured values."		
D	Cycle time	Varies depending on measurement time setting	Cycle time of all cycles (CYC or ms)
E	Measurement range	1 fixed digit	*: Within the range (space): Outside the range
F	Current	1 fixed digit (refer to the Judgment Table)	Current in each cycle
G	Voltage	Varies depending on measurement range setting	Voltage in each cycle
H	Conduction Angle	Varies depending on measurement range setting	Conduction angle in each cycle

4) Force All Cycles

Data string:

|01,0012:001,11/14 19:29:51,00,0kA,01,0kA,04,0CYC,11,
 A B C

58.53N,13,115ms[CR][LF]

10ms,13.61N[CR][LF]
 D E F

20ms,*23.88N[CR][LF]
 30ms,*35.50N[CR][LF]

...

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific ID
B	All cycles count	4 fixed digit	Number of all cycles transmitted
C	Refer to "1) Measured values."		
D	Cycle time	Varies depending on measurement time setting	Cycle time of all cycles (CYC or ms)
E	Measurement range	1 fixed digit	*: Within the range (space): Outside the range
F	Force	5 fixed digit	Force in each cycle

5) History

Data string:

!01,0003:001,11/14 19:24:55,00,,1.97kA,01,,3.78kA,04,,10.0CYC,
A B C

11,,0N,13,,0ms[CR][LF]

001,11/14 19:24:54,00,,1.97kA,01,,3.78kA,04,,10.0CYC,11,,0N,
13,,0ms[CR][LF]

001,11/14 19:22:24,00,,0kA,01,,0kA,04,,0CYC,11,,58.53N,
13,,115ms[CR][LF]

...

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific ID
B	History count	4 fixed digit	Number of histories transmitted
C	Refer to "1) Measured values."		

6) Error History

Data string:

!01,0003:001,11/14 19:24:55,00,0,-kA,01,0,-kA,04,N,10.0CYC,
A B C

11,,0N,13,,0ms[CR][LF]

001,11/14 19:24:54,00,,1.97kA,01,,3.78kA,04,0,-CYC,11,,0N,
13,,0ms[CR][LF]

001,11/14 19:22:24,00,I,-kA,01,I,-kA,04,I,-CYC,11,I,-N,
13,I,-ms[CR][LF]

	Item	Length	Description
A	Instrument No.	2 fixed digits from 00 to 31	Instrument-specific ID
B	Error history count	4 fixed digit	Number of error histories transmitted
C	Refer to "1) Measured values."		

13. Error List

The **MM-380A** informs of an error occurrence by showing the error number.

Error code	Description	Cause	Remedy
E01	System error	Problem detected in MM-380A's control system	Turn off the power and on again. If "E01" (system error) appears again, the MM-380A needs repair. Please contact Miyachi Corporation.
E02	Condition memory error	Condition data in memory is damaged	<p>Check all the settings.</p> <p>If the data in memory is damaged, the following are possible causes:</p> <ul style="list-style-type: none"> Generation of powerful power supply or electrostatic noise Abnormal supply voltage resulting, for example, from lightening or induced lightening Flash memory's rewrite limit exceeded <p>It would be useful to record the settings in preparation for data damage. To print the settings, refer to "n. PRINT Screen" in Chapter 8 Operation Screens.</p> <p>When you switch ON the power switch while holding down the MENU key, a message "Initializing --- Please wait a moment." appears, after which the memory is initialized, resetting all settings back to factory settings. Set the data you recorded again. The memory will be initialized in approximately 10 seconds. Do not turn OFF the power during the initialization.</p> <p>If "E02" (condition memory error) appears again, the MM-380A needs repair. Please contact Miyachi Corporation.</p>
E03	Measured value memory error	Measured value data in memory is corrupt.	<p>Measured value data in memory is corrupt. If the data in memory is corrupt, the following are possible causes:</p> <ul style="list-style-type: none"> Generation of power supply noise, or electrostatic noise Abnormal supply voltage resulting, for example, from lightening or induced lightening Low memory battery voltage <p>It is advisable to back-up measured value data onto other media often, as a precaution against possible data corruption.</p> <p>If "E03" (Measured value memory error) appears again, the MM-380A needs repair. Please contact Miyachi Corporation.</p>
E04	Memory battery low error	The backup battery voltage is 2.2V or less.	Replace the batteries.

Error code	Description	Cause	Remedy
E05	Clock error	Loss of the hour due to low voltage of the backup current	Set the clock.
E06	Force sensor error	Unable to set the force offset to 0. After measurement, the force and external $\pm 10V$ voltage input signals remain above the trigger levels.	If no force sensor is connected, connect a force sensor or select a setting other than AUTO, FORCE and EXT for TRIGGER in the SETUP (1) screen. If, after measurement, force continues to be applied or external $\pm 10V$ voltage input continues to be supplied, bring the force or voltage input down below the trigger level after measurement. If "E06" (force sensor error) appears again, the MM-380A needs repair. Please contact Miyachi Corporation.
E07	Startup sensitivity level error	A problem was detected in the current detection circuit.	Turn off the power and on again. If "E07" (startup sensitivity level error) appears again, the MM-380A needs repair. Please contact Miyachi Corporation.
E08	Main battery low voltage error	The main battery voltage is low.	Recharge the lithium-ion battery. The power automatically shuts off in the event of this error.
E09	Printer error	A problem was detected in the printer.	Check the printer for paper. If the printer is out of paper, load new paper. If the printer paper cover is open, close the cover.

Error display		Description
MEASUREMENT screen	HISTORY screen	
OVER	O	Measured value is outside the measurable range. Check the range for each item. Check also whether the welding power supply is operating properly.
INPLUS	I	Current flow stopped before the set number of stages was reached during impulse measurement. Check the impulse settings. Check also whether the welding power supply is operating properly.
COUNT	None	Count exceeds the preset value. Check the preset counter or reset the count.

14. Specification

(1) Measurement Specification

Target	Specification	
Current	Measurement range	0.200kA range: 0.010 to 0.200kA 2.000kA range: 0.100 to 2.000kA 6.00kA range: 0.30 to 6.00kA 20.00kA range: 1.00 to 20.00kA 60.0kA range: 3.0 to 60.0kA 200.0kA range: 10.0 to 200.0kA
	Measurement time	<ul style="list-style-type: none"> • Current: AC, Time: CYC-50/60Hz, CYC-***Hz 0.5 to 200.0CYC (50Hz), 0.5 to 240.0CYC (60Hz), 0.5 to 1000.0CYC (250Hz) • Current: AC, Time: ms 1 to 2000ms • Current: AC, Time: CYC-LONG 0.5 to 500.0CYC (50Hz), 0.5 to 600.0CYC (60Hz) • Current: DC, Time: CYC-50/60Hz 0.5 to 100.0CYC (50Hz), 0.5 to 120.0CYC (60Hz) • Current: DC, Time: ms 1 to 2000ms • Current: DC, Time: ms-SHORT 0.50 to 100.00ms (0.05-ms increment)
	Measurement item	Arithmetic mean RMS/maximum (peak)

Target	Specification		
Current	Measurement accuracy	Current: RMS <2.000kA, 20.00kA or 200.0kA range> Single-phase AC welding power supply, transistor welding power supply $\pm (1\%rdg+9dgt)$ AC inverter welding power supply, DC inverter welding power supply $\pm (1\%rdg+15dgt)$ <6.00kA or 60.0kA range> Single-phase AC welding power supply, transistor welding power supply $\pm (1\%rdg+3dgt)$ AC inverter welding power supply, DC inverter welding power supply $\pm (1\%rdg+5dgt)$ Peak value <2.000kA, 20.00kA or 200.0kA range> Single-phase AC welding power supply, transistor welding power supply $\pm (1\%rdg+9dgt)$ AC inverter welding power supply, DC inverter welding power supply $\pm (1\%rdg+20dgt)$ <6.00kA or 60.0kA range> Single-phase AC welding power supply, transistor welding power supply $\pm (1\%rdg+3dgt)$ AC inverter welding power supply, DC inverter welding power supply $\pm (1\%rdg+7dgt)$	
	Detection method	Toroidal coil (Recommended: MB-800K, MB-400K, MB-45F)	
Voltage	Measurement range	6.00V range: 0.30 to 6.00V 20.0V range: 1.0 to 20.0V	
	Measurement item	Arithmetic mean RMS/maximum (peak)	
	Measurement accuracy	$\pm (1\%rdg+3dgt)$	
Force	Measurement range	MA-520	4.90 to 98.06N, 0.50 to 10.00kgf, 1.10 to 22.04lbf
		MA-521	49.0 to 980.6N, 5.0 to 100.0kgf, 11.0 to 220.4lbf
		MA-710A MA-770A	490 to 9806N, 50 to 1000kgf, 110 to 2204lbf
		MA-522 MA-711A MA-771A	245 to 4903N, 25 to 500kgf, 55 to 1102lbf
		Rated setting	5% to 100% of rated setting
	Measurement time	1 to 6000ms	
	Measurement accuracy	$\pm (\text{load cell F/S error}+2\%rdg+29dgt)$	

14. Specification

Target	Specification	
Force	Detection method	Force sensor: MA-520A/MA-521A/MA-522A Current/force sensor: MA-770A/MA-771A
External ±10V voltage input	Input voltage range	-10V to +10V
	Measurement range	5% to 100% of rated setting
	Measurement time	1 to 6000ms
	Measurement item	Mean value/maximum (peak)
	Measurement accuracy	± (2%rdg+15dgt)
Conduction Angle	Measurement range	0 to 180 degrees
	Measured values (M-VALUE)	Max. conduction angle over measurement interval
Measurement value display	Select five measurement values from the following to display: Current (RMS) Current (PEAK) Voltage(RMS) Voltage (PEAK) Conduction angle Power Resistance Weld time Force 1 (AVE) Force 2 (AVE) Force (PEAK) Force time External ±10V voltage input (AVE) External ±10V voltage input (PEAK) External ±10V voltage input time	
Waveform display	Select four waveforms from the following to display: Current waveform Voltage waveform Resistance waveform Power waveform Force waveform External ±10V voltage input waveform	
All cycle display	Current, voltage, conduction angle (Conduction angle appears only when AC is selected for CURR and CYC-50/60 Hz, CYC-*** Hz or CYC-LONG is selected for TIME in the SETUP (1) screen.) Displays data every half-cycle or 1 ms Force Displays data every 10ms.	

Target	Specification
Trigger method	Current normal mode Current single-trace mode Current normal trace mode Force normal mode Force single-trace mode Force normal trace mode External $\pm 10V$ voltage input normal mode External $\pm 10V$ voltage input single-trace mode External $\pm 10V$ voltage input normal trace mode Auto trigger Force constant start mode External $\pm 10V$ voltage input constant start mode
Pulsation	Specified pulse measurement All pulses measurement 20 pulses maximum No cooling, 2 nd stage measurement (Measurement is possible only if the current at the second stage is larger than that at the first stage.)

(2) Specification of the **MM-380A**

Item	Specifications
Display items	MEASUREMENT screen VIEW screen WAVEFORM screen ALL CYCLE screen WAVEFORM (FORCE) screen SETUP screens PRINT screen COMMUNICATION screen HISTORY screen DATA READ screen STATUS screens
External data output	RS-232C
Conditions	Number of conditions: 127
Power supply	Single-phase 100 to 200VAC±10% (50/60Hz)
Operating temperature	0°C to 45°C (Upon charging: 0°C to 35°C)
Outer dimensions	252mm (H) x 140mm (W) x 56mm (D) (excluding protrusions)
Mass	900g
Power consumption	Approx. 20W

15. Calibration

Regular calibration is required to maintain the **MM-380A** performance.

Calibration is conducted at our facility.

For calibration, please send your toroidal coil and force sensor together with the **MM-380A**.

Depending on the operating environment, the extent of deterioration varies from one

MM-380A to another. Therefore, the **MM-380A** must be calibrated together with the toroidal coil and the force sensor as a set.

For more information about calibration, contact Miyachi Corporation.

16. Appearance

(Unit: mm)

