Original instructions

WELD TESTER

MM-410B EU

OPERATION MANUAL

AMADA

AA11OM1213245-01

Thank you for your purchase of our Weld Tester **MM-410B**.
Please read this manual carefully to ensure correct use. Keep the manual handy after reading for future reference.

Contents

1. Special Precautions

(1) Safety Precautions

Before using the weld tester, 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	Mishandling may cause imminent risk of death or serious injury.
WARNING	Mishandling may cause risk of death or serious injury.
CAUTION	Mishandling may cause risk of injury and physical damage.
	These signs represent “DON’Ts.” They warn of actions not covered by the product warranty” in the previous document.
	These signs represent “DOs" which must be observed by the product user.
	A sign within a triangular border indicates that a hazard (danger, warning or caution) is present.

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 us.

NEVER burn, destroy, cut, crush or chemically decompose the instrument.

This product incorporates parts containing gallium arsenide (GaAs).

ALWAYS use the specified battery.

Failure to use the battery specified in the Instruction Manual may result in a fire.

WARNING

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 us.

In the event of an anomaly, STOP the operation.

Continuing the operation with anomalies such as a 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 us.

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.

CAUTION

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.

Do not sit on or place objects on the instrument.

Failure to observe this precaution may lead to malfunction.

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) Precautions for Handling

- Avoid the following locations when installing the instrument:
  - Humid (above 90%) locations
  - Extremely hot (above 45°C) or cold (below 0°C) locations
  - Near a high 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.

- If you do not intend to use the **MM-410B** for extended periods, remove the battery or charge it once every two months.

- Dropping the **MM-410B** may result in damage or malfunction. Use the attached strap.

(3) On Disposal

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

2. Features

The Weld Tester **MM-410B** is a hand-held measuring instrument designed for resistance welding machines.
The instrument can measure the current, voltage, current flow time, force, external voltage input (max. ±10 V)[*1] and external current input (4 to 20 mA)[*1] and display their waveforms.
(*1: You can select to measure external voltage input or external input current by setting.)

The LCD screen ensures clear viewing of the welding current and force waveforms for optimal welding quality control.

The **MM-410B** offers the following features:

- **Easy to use with a touch panel**

  Easy setting through the menu selection system on the 5.7-inch color touch panel.

- **ISO17657-compliant measurement**

  In addition to the arithmetic mean RMS which is a conventional calculation system, the RMS in a whole current flow time which is the ISO17657-compliant calculation system can be selected. For the ISO17657-compliant measurement, the dedicated ISO-compliant toroidal coil is required.

- **Extensive waveform display capabilities**

  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 values between parts of the waveforms by moving the horizontal cursor.

- **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/771A**), as conventionally.

- **Storing measured values and waveforms**

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

- **Managing measurement data with PC**

  You can transmit measurement data to your PC through the Ethernet or USB communication.

- **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, Korean, German, French, and Spanish.

- **Measurement with seam current**

  Measures current/voltage in AC welding or voltage in DC welding with a max. 5-minute moving measurement.

3. Packaging

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

(1) Accessories

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

Item	Model	Q'ty
Strap	Z-05266-001	1
Operation manual	AS1213243(OM1213244,OM1213245)	1

(2) Options

Item	Model
AC adapter[*1]	UNI324-0926-JTKG-0099 (Power cord 125 V AC) (AC cord length 1.8 m, DC cord length 0.3 m)
	PK-1201955 (Power cord 250 V AC) (AC cord length 1.8 m, DC cord length 0.3 m)
ISO toroidal coil[*3]	**MB-400P-00** (approx. 120 mm in dia.) 1x sensitivity coil (with 400 mm bracket) (cable length of 3 m)
	MB-800P-00 (approx. 250 mm in dia.) 1x sensitivity coil (with 800 mm bracket) (cable length 3 m)
ISO toroidal coil extension cable[*2]	SK-1211386 (cable length of 2 m)
	SK-1211387 (cable length of 5 m)
	SK-1211388 (cable length of 10 m)
	SK-1211389 (cable length of 20 m)
Toroidal coil[*3*7]	**MB-45G-00** (45 mm in inner dia.) 10x sensitivity coil (mold type) (cable length of 3 m)
Voltage detection cable	SK-1193301 (cable length of 3 m)
Voltage detection conversion cable[*4]	SK-1193599 (cable length of 0.1 m)

Item	Model
Current/force sensor (put between electrodes for measurement)	MA-770A-01 (4903 N (500 kgf))
	MA-771A-01 (9806 N (1,000 kgf))
Replacement plate*5	Z-04715-002 (with groove)
	Z-04715-003 (flat)
Current/force sensor cable	SK1213253 (cable length of 0.15 m)
Force sensor connecting cable*6	SK1200686 (cable length of 0.15 m)
Force sensor (put between electrodes for measurement)	MA-520B-00 (98.06 N (10 kgf) max.)
	MA-521B-00 (980.6 N (100 kgf) max.)
	MA-522B-00 (9806 N (1,000 kgf) max.)
Multiconnector (for external ±10 V voltage/ 4 to 20 mA current)	HR10A-7P-6P(73)
USB cable	U2C-BF30BK(TYPE A -TYPE B) (cable length of 3 m)
LAN cable	KB-FL6A-03BL(TYPE A -TYPE B) (cable length of 3 m)
Lithium battery	AS1211535
Soft case	PC1203993

*1: Exclusively for the **MM-410B**. Do not use for other devices.

*2: For extending the **MB-400P/800P** and **MB-45G-00**.

*3: Do not use a toroidal coil that is not set as an option.

*4: The conversion cable is required for connecting an old type voltage detection cable (42265).

*5: Used with the current/force sensor.

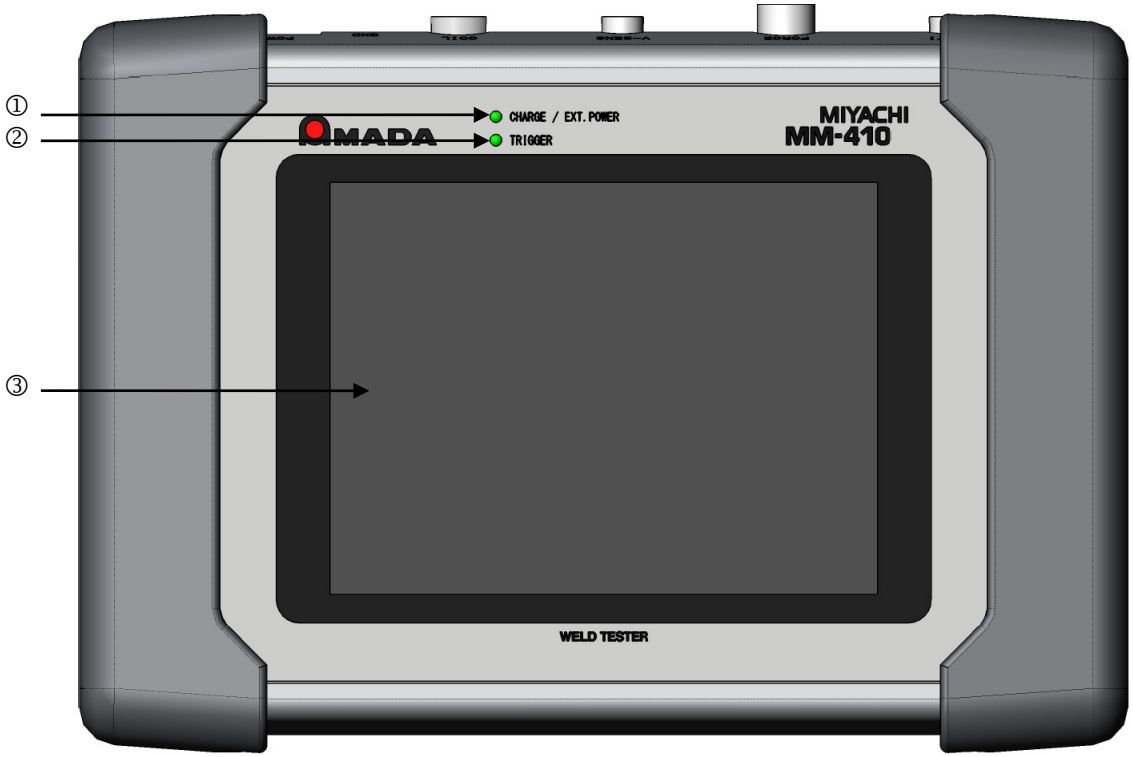
*6: The conversion cable is required for connecting an old type force sensor (**MA-520-01/521-01/522-01**).

*7: The MB-45G has a measurement range of up to 1kA, Do not use for over 1kA, because of failure cause **MM-410B** & **MB-45G**.

4. Name and Functions of Each Section

(1) Front

CAUTION
When using the instrument by placing on a table, face the front upward.

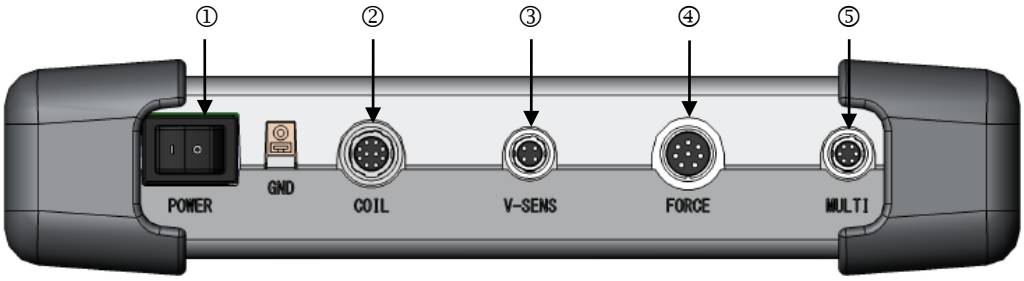


① [CHARGE / EXT.POWER] lamp:
Blinked when the built-in battery is being charged and lit when charging is completed.

② [TRIGGER] lamp:
Lit during the measurement operation.

③ Touch panel:
Shows measured values, waveforms and operation screens. Refer to Chapter 8, “Operation Screens” for details of the operation screens.

(2) Top



① Main power switch:
Switch for the main power. Set this to the ON position (– side) to start the **MM-410B**.

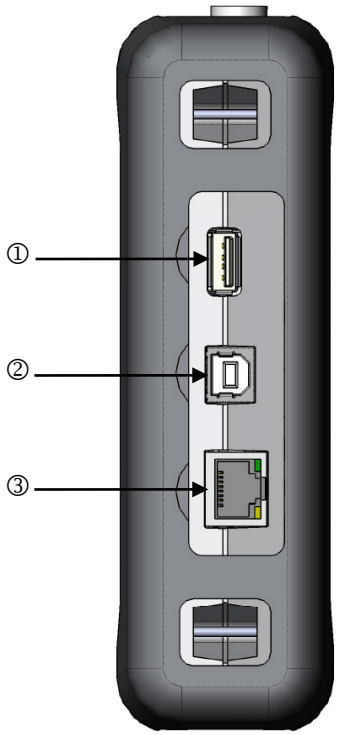
② Toroidal coil connector:
Plug a toroidal coil into this connector.

③ Voltage detection cable connector:
Plug the voltage detection cable into this connector.

④ Force sensor connector:
Plug an optional force sensor (**MA-520B/521B/522B**) into this connector.

⑤ Multiconnector:
A connector for inputting a signal from a peripheral device. Also used to plug an external voltage/current input.

(3) Right Side

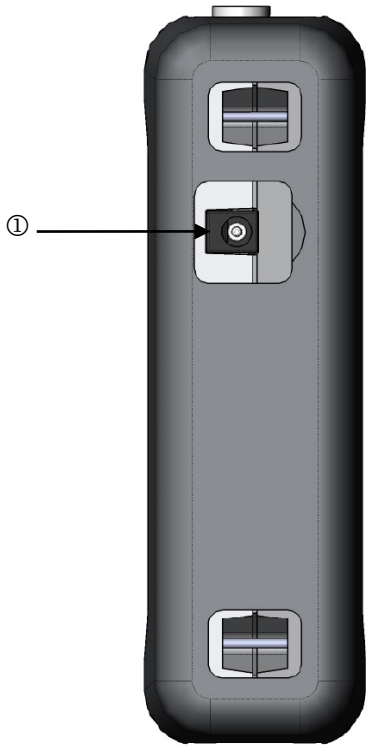


① USB memory connector:
Plug the USB memory into this connector.

② USB communication connector:
Plug the USB cable into this connector.

③ LAN cable connector:
Plug the LAN cable for Ethernet into this connector.
The orange LED is lit when it can be connected and is blinked when the data is being sent or received. The green LED is not lit when operated at 10 MB/s and is lit when operated at 100 MB/s.

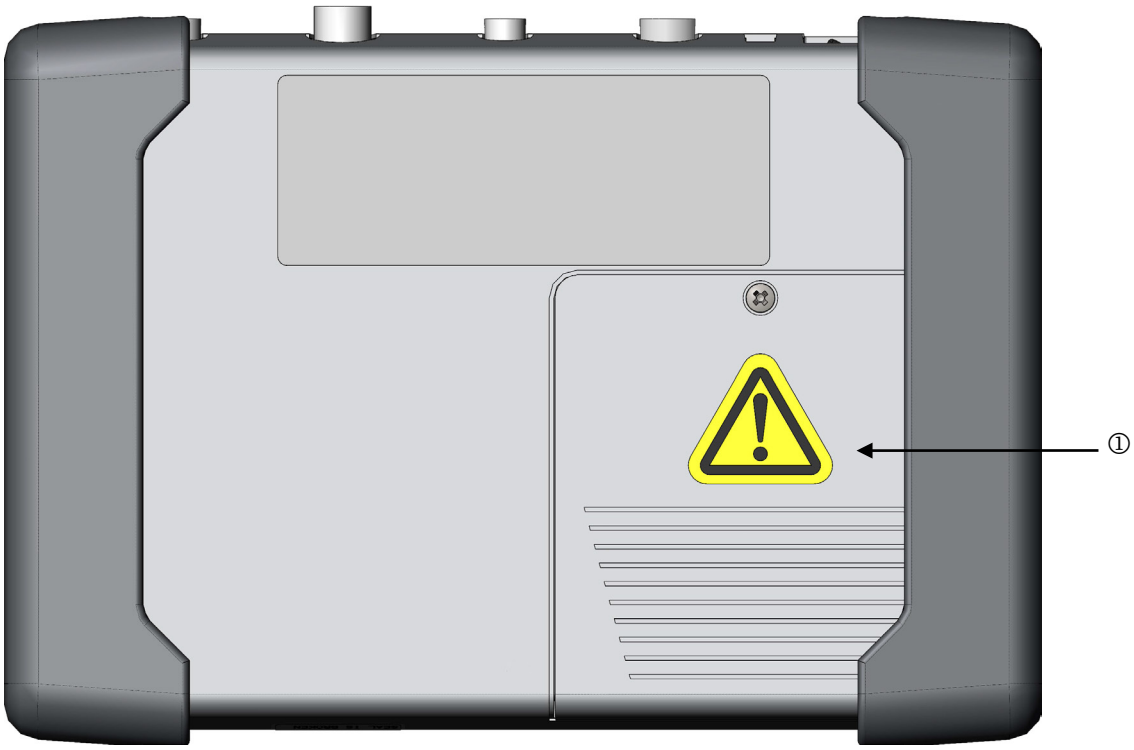
(4) Left Side



① AC adapter jack:
Connect the dedicated AC adapter here when charging the battery built into the **MM-410B** 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.

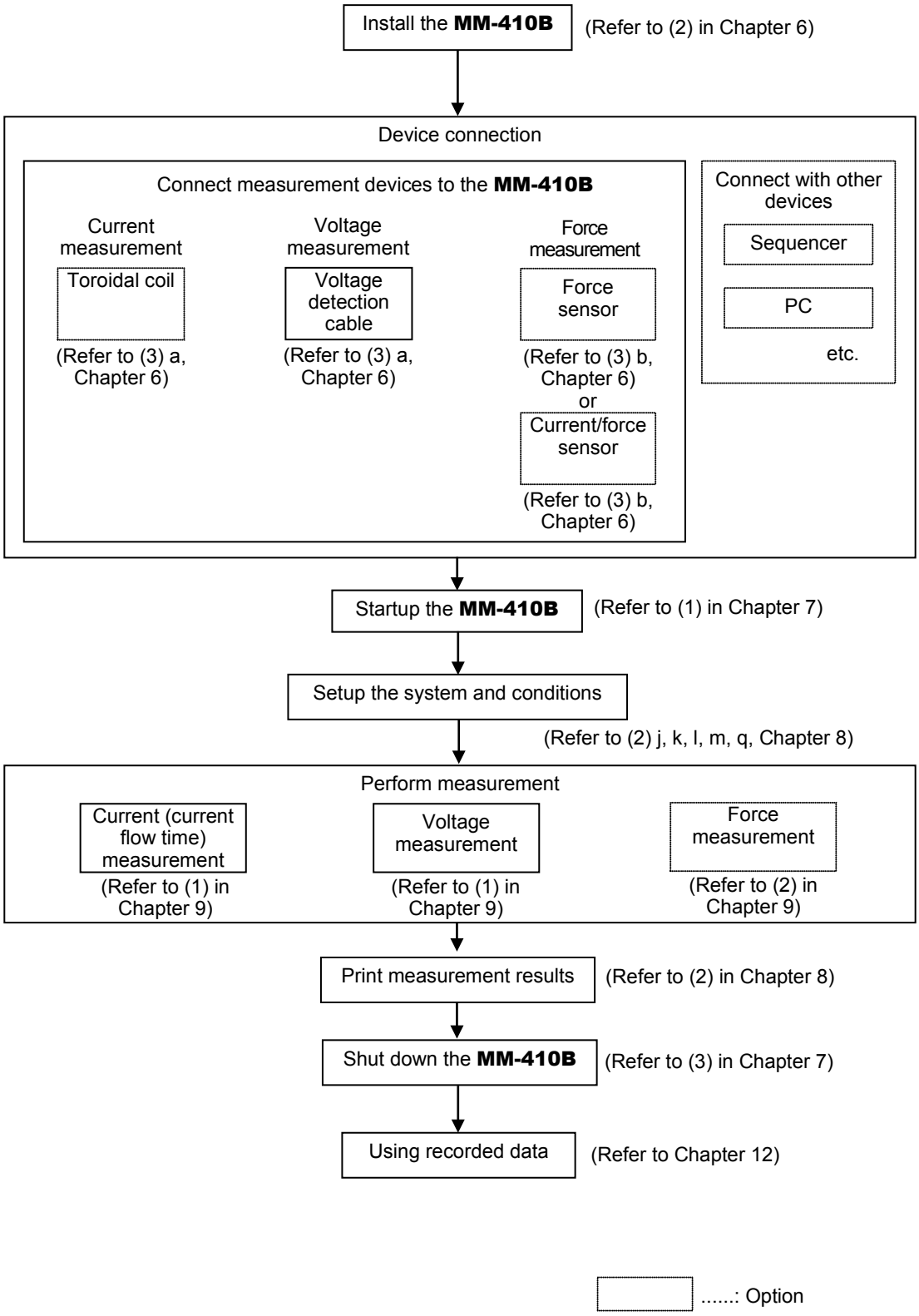
(5) Rear



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

5. Operation Flow

The operation flow is shown below.

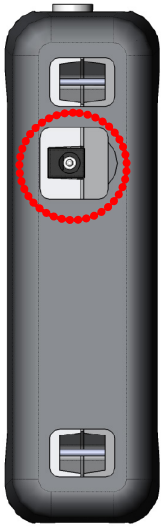


6. Preparations and Connections

(1) Connecting the MM-410B 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 left side of the **MM-410B** with the dedicated AC adapter.

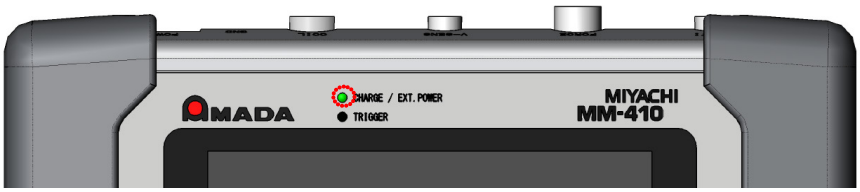
1) Plug the dedicated AC adapter into the AC adapter jack on the left side of the **MM-410B**.



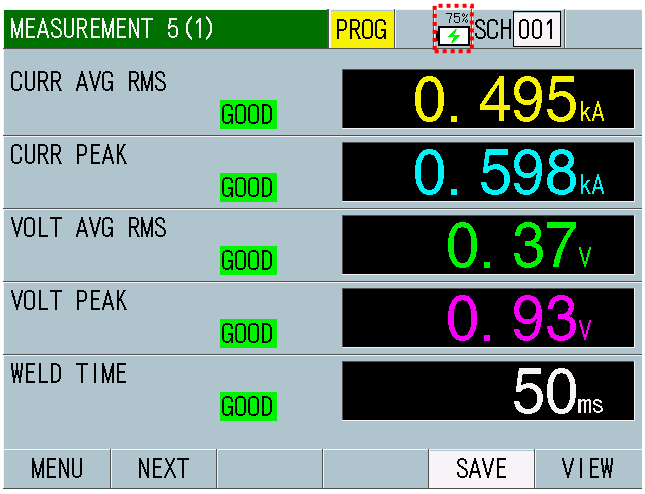
CAUTION

- Do not perform measurement during the battery charging. Performing measurement during charging may cause the delay of completion of the battery charging.
- Connect only the dedicated AC adapter to the AC adapter jack. Failure to do so may result in malfunction, fire, or electric shock.
- Except when charging the battery, close the cover connecting to the AC adapter jack. If using the **MM-410B** with the cover opened, it may result in malfunction.

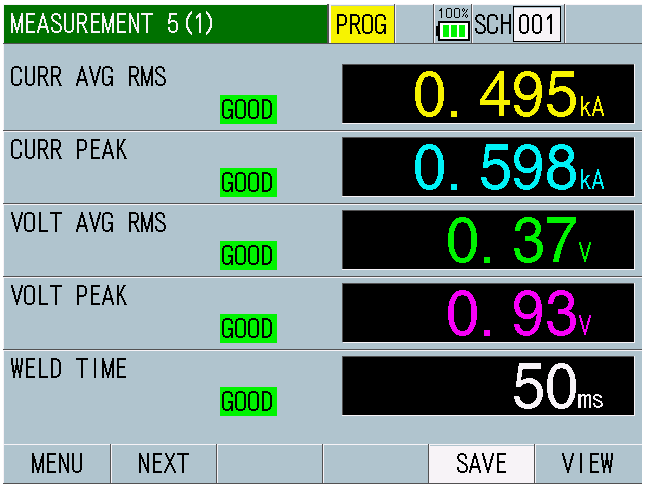
2) When charging is started, the [CHARGE / EXT.POWER] lamp on the front of the **MM-410B** blinks.



When the **MM-410B** is started, the battery display on the upper portion of the screen of the **MM-410B** is switched.



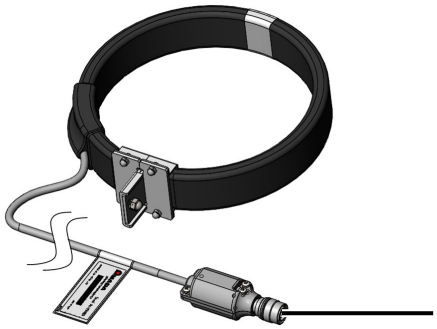
3) When charging is completed, the [CHARGE / EXT.POWER] lamp on the front of the **MM-410B** lights up and the battery display on the upper portion of the screen returns to the original state.



(2) Preparations for Measurement – Connection between the MM-410B and Measurement Devices

a. Connecting the Toroidal Coil and the Voltage Detection Cable

To measure the current or voltage, connect the toroidal coil and the voltage detection cable to the top of the **MM-410B**.



Toroidal coil (e.g., **MB-400P**)

Connect a toroidal coil suited to your operating environment.

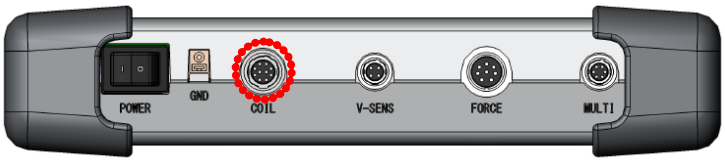
The toroidal coils of the following sizes can be used:

Toroidal coil model	Type
MB-400P	1x sensitivity coil (with 400 mm bracket), ISO17657-compliant type
MB-800P	1x sensitivity coil (with 800 mm bracket), ISO17657-compliant type
MB-45G	10x sensitivity coil (mold type), Max measurement range:1kA Do not use for over 1kA, because of failure cause **MM-410B** & **MB-45G**

(Note) The above toroidal coil can be used. Do not use other toroidal coils.

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

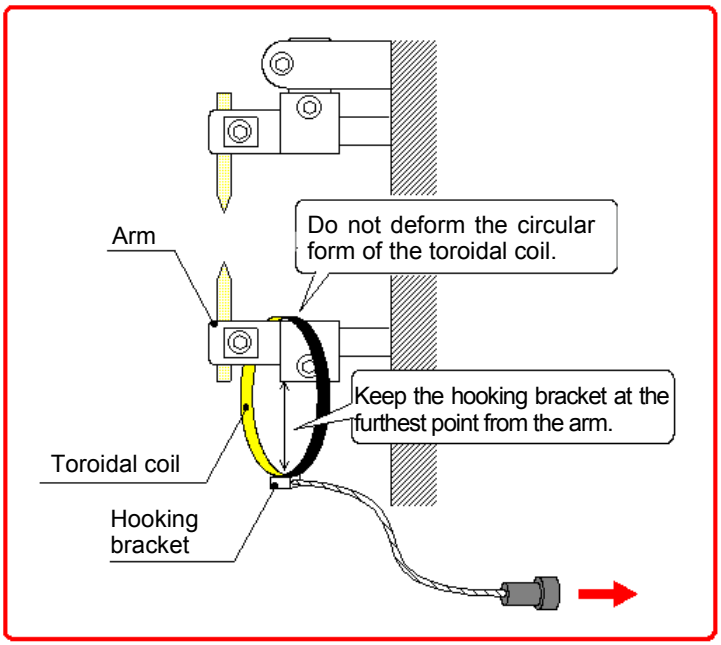
1) Plug the toroidal coil's connector into the toroidal coil connector [COIL] on the top of the **MM-410B**.



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

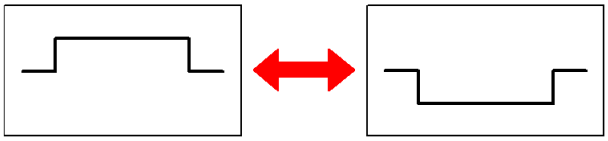
When fitting the coil, be careful with the following:

- 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.



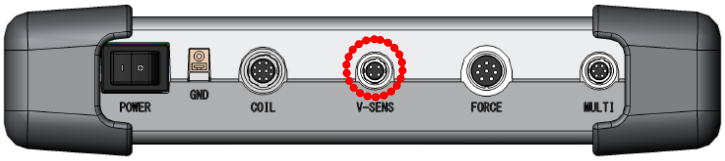
CAUTION

- 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. The analog output (current and voltage) is output in reverse side of the waveforms in the WAVEFORM screen.



- For a band-type toroidal coil, do not deform it when fitting it. Repeated bending and extension may break internal wires.
- The ISO toroidal coil (**MB-400P/800P**) has an arrow. For DC measurement, match the direction of an arrow and a current.

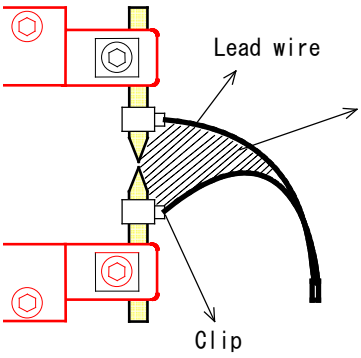
3) Plug the voltage detection cable connector into the voltage detection cable connector [V-SENS] on the top of the **MM-410B**.



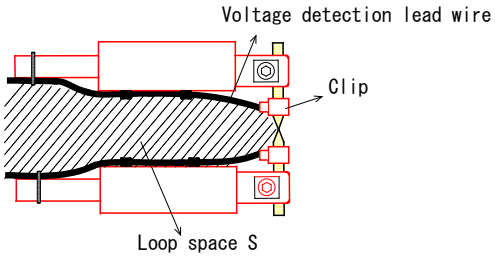
4) Connect the voltage measurement cables to the electrodes (positive/negative).

(Note) To properly perform a voltage detection

The voltage detection cable picks up voltage induced by the welding current. To measure the voltage between the tips, connect the cable as shown below.



Make the distance between clips as small as possible, and twist the lead wires together so that induction voltage is reduced and the voltage between tips can be measured accurately.



When the voltage detection cable wires are placed as shown to the left, voltage induced by the welding current is added to the voltage between tips. When monitoring voltage, fasten the lead wires so that the loop space S does not change and induction voltage does not fluctuate.

b. Connecting the Force Sensor

The **MM-410B** can measure force when connected with force sensor **MA-520B/521B/522B** or current/force sensor **MA-770A/771A**.

Current/force sensor **MA-770A/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.

Force sensor

Current/force sensor

Follow the steps described below to connect the force sensor.

① For force sensor **MA-520B/521B/522B**

1) Plug the force sensor connector into the force sensor connector [FORCE] on the top of the **MM-410B**.

2) Perform a reset (ON setting) without applying loads to the force sensor.

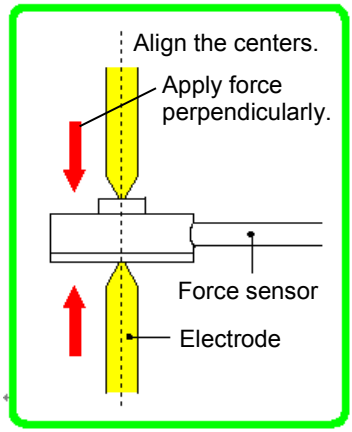
CAUTION

Be sure to set the force sensor's offset to "0" before measuring force. You can set the offset to "0" by touching the FORCE 0 key on the SYSTEM SETUP (2) screen. At this time make sure that no force is applied to the sensor. For resetting a force, refer to Chapter 8, "I-2. SYSTEM SETUP (2) Screen."

3) Attach the force sensor to the welding machine's electrodes.

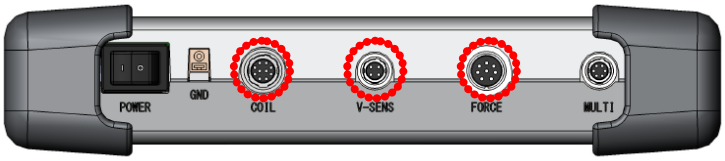
When attaching the sensor, be careful with the following:

- 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 force sensor.



② For current/force sensor **MA-770A/771A**

1) Plug the dedicated cables into the toroidal coil connector [COIL], the voltage detection cable connector [V-SENS] and the force sensor connector [FORCE] on the top of the **MM-410B**.



2) Perform a reset (ON setting) without applying loads to the current/force sensor.

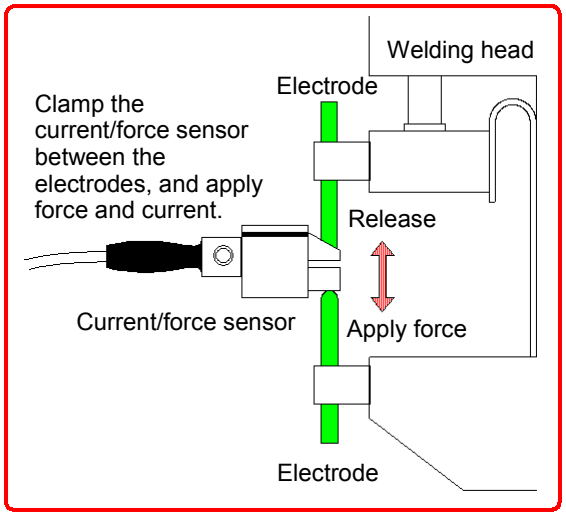
CAUTION

Be sure to set the force sensor's offset to "0" before measuring force. You can set the offset to "0" by touching the FORCE 0 key on the SYSTEM SETUP (2) screen. At this time make sure that no force is applied to the sensor. For resetting a force, refer to Chapter 8, "I-2. SYSTEM SETUP (2) Screen."

3) 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.

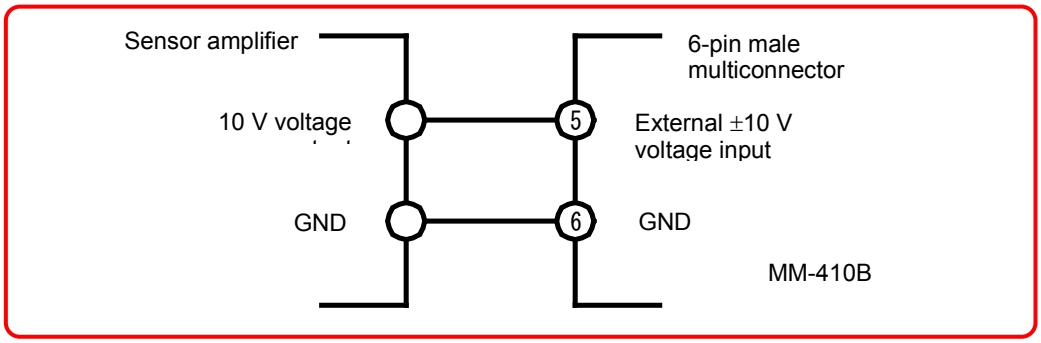


c. When Using an External ±10 V Voltage Input

1) The **MM-410B** allows for displaying the measured voltage signal using a commercial sensor and amplifier connected to the external ±10 V voltage input.

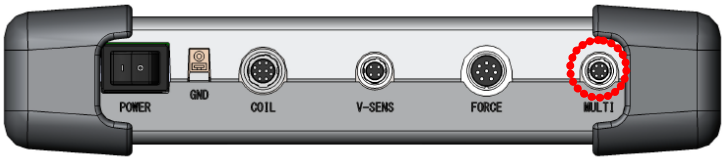
Follow the steps described below to connect the external ±10 V voltage.

External ±10 V Voltage Input Connection Diagram



The 6-pin male multiconnector is optional.
(Multiconnector HR10A-7P-6S(73): HIROSE ELECTRIC CO., LTD.)

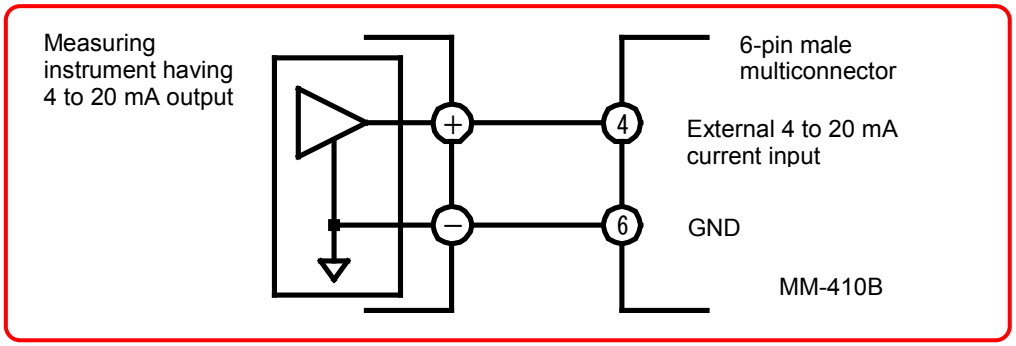
2) Plug the multiconnector into the multiconnector [MULTI] on the top of the **MM-410B**.



d. When Using an External 4 to 20 mA Current Input

1) The **MM-410B** allows for measurement connecting a commercial 4 to 20 mA output sensor connected to the external current input. Input it in a range of 4 to 20 mA.

External 4 to 20 mA Current Input Connection Diagram



The 6-pin male multiconnector is optional.
(Multiconnector HR10A-7P-6S(73): HIROSE ELECTRIC CO., LTD.)

(3) Attaching the Strap

Attaching example of the attached strap (Z-05266-001) is shown below.

1) Remove buckles from the belt.

2) Pass the belt on the cushion side through the pin at the upper part on the left side of the **MM-410B**.

3) Fix the belt to the hook and loop fastener of the cushion.

4) Close the cushion.

5) Pass a buckle through.

6) Pass the belt through the pin at the lower part on the left side of the **MM-410B**.

7) Pass the belt through a buckle.

8) Pass another buckle through.

9) Pass the belt through the pin at the lower part on the right side of the **MM-410B**.

10) Pass the belt through a buckle.

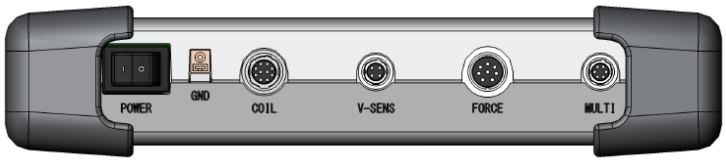
Now attaching the strap is completed.

When the strap attached

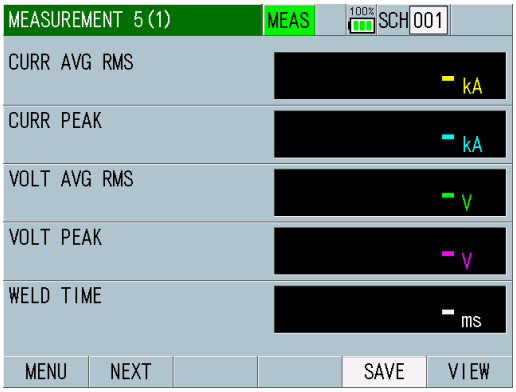
7. Basic Operation

(1) Startup

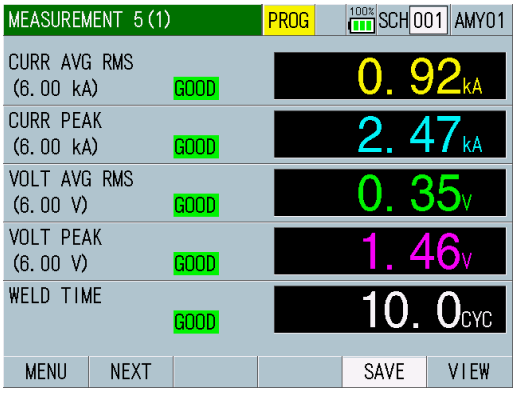
1) Set the main power switch on the top to the ON position (– side).



The MEASUREMENT 5(1) or MEASUREMENT 10 screen appears on the display after a while. (The MEASUREMENT 5(1) screen appears first used after shipment.)



To display a waveform or change or check the setting, touch MEAS to change it to PROG. (Alternately switched by touching.)



(2) Changing the Display Language

1) Touch the MENU key on the lower-left portion of the screen.
The MENU screen appears.

2) Select SYSTEM SETUP.
The SYSTEM SETUP (1) screen appears.

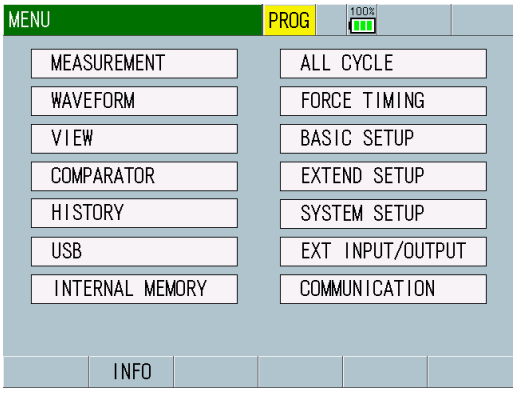
The display language can be changed by the LANGUAGE setting. Select a language to display.

For operation, refer to "(3) Basic Usage of the MM-410B" and Chapter 8, "I-1. SYSTEM SETUP (1) Screen."

(3) Basic Usage of the MM-410B

This section describes the basic usage of the **MM-410B**.

1) Touch the MENU key on the lower-left portion of the screen.
The MENU screen appears.



2) Touch the desired menu on the MENU screen.
For operations on each screen, refer to Chapter 8, "Operation Screen."

IMPORTANT

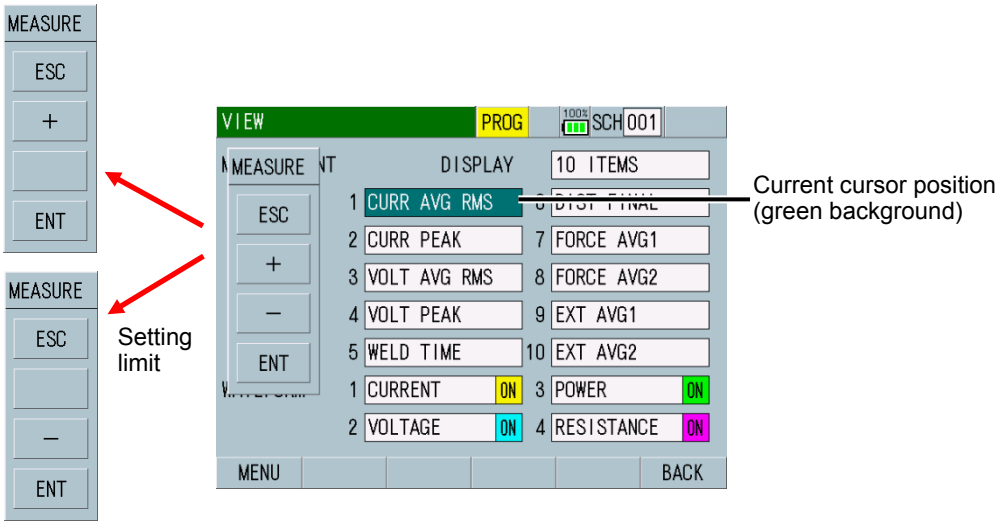
- Press switches and touch panel display carefully by hand. Handling them roughly (using a screwdriver or the tip of pen) may result in a malfunction or failure.
- Press switches and touch panel display one at a time. Pressing more than one switch at a time may result in a malfunction or failure.

3) When you touch a desired item on each screen, a ten-key for the item appears. Items that can be operated are restricted by the setting of password to be selectively used for the supervisor and the operator.

For the password setting, refer to Chapter 8, "I-3. PASSWORD Screen."

- Selecting an item in the VIEW screen

In this screen example, the cursor is positioned at the DISPLAY selection field. The settable item is switched by “+” and “-.” Since the setting items do not loop, only “+” or “-” appears when the setting limit is reached. After selection, touch ENT to determine. To exit a ten-key display without determining setting, touch ESC.

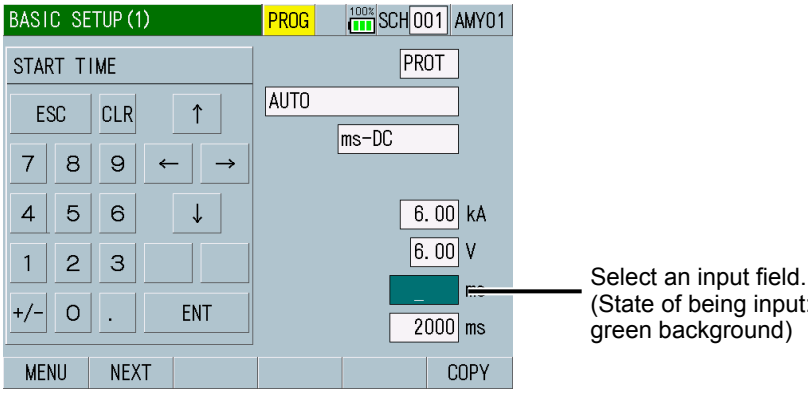


- Inputting a value

In this screen example, the cursor is positioned at the START TIME setting field. Set a value using numbers and decimal point, and touch ENT to determine. To exit a ten-key display without determining setting, touch ESC.

Touching ↑ ↓ moves the input field up and down. Touching ← → moves the digit of the input number right and left. Touching CLR deletes the input letters and numbers one by one.

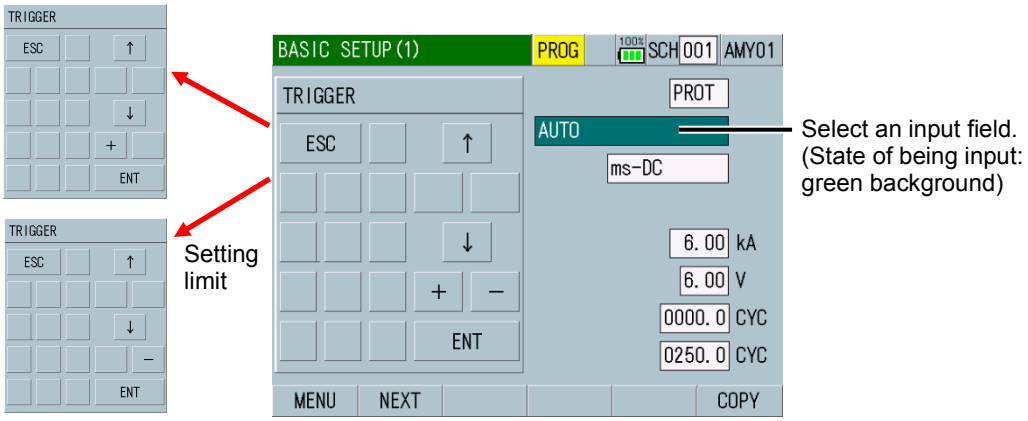
When an unsettable value is input and determined, it returns to the original setting value.



- Selecting a mode

In this screen example, the cursor is positioned at the TRIGGER selection field. The settable item is switched by "+" and "-." Since the setting items do not loop, only "+" or "-" appears when the setting limit is reached. After selection, touch ENT to determine. To exit a ten-key display without determining setting, touch ESC.

Touching ↑ ↓ moves the input field up and down.



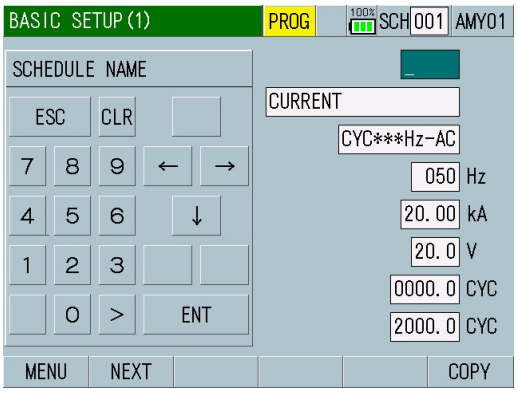
- Setting the SCHEDULE NAME

For SCHEDULE NAME in the BASIC SETUP (1) screen, select up to five letters among numbers of 0 to 9 and alphabetical characters of A to Z using five kinds of ten-keys. After selection, touch ENT to determine. To exit a ten-key display without determining setting, touch ESC.

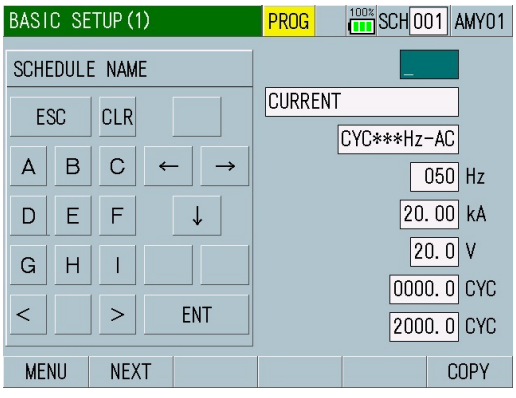
Touching ↑ ↓ moves the input field up and down. Touching ← → moves the digit of the input number right and left. Touching CLR deletes the input letters and numbers one by one.

Touching < > moves between ten-keys (i) to (iv).

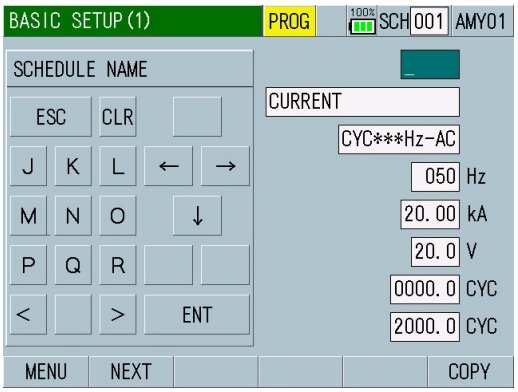
(i) Numbers (0 to 9)
Move to the next ten-key (ii) by >.



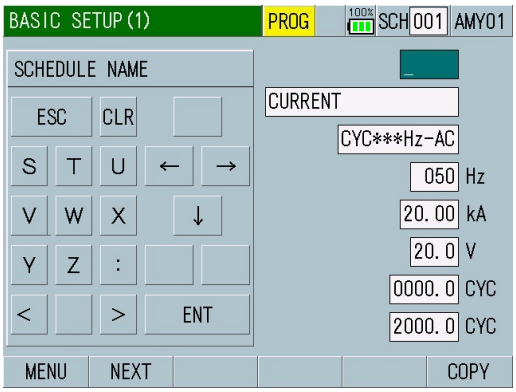
(ii) Alphabetical characters (A to I)
Move to (iii) by > and (i) by <.



(iii) Alphabetical characters (J to R)
Move to (iv) by > and (ii) by <.

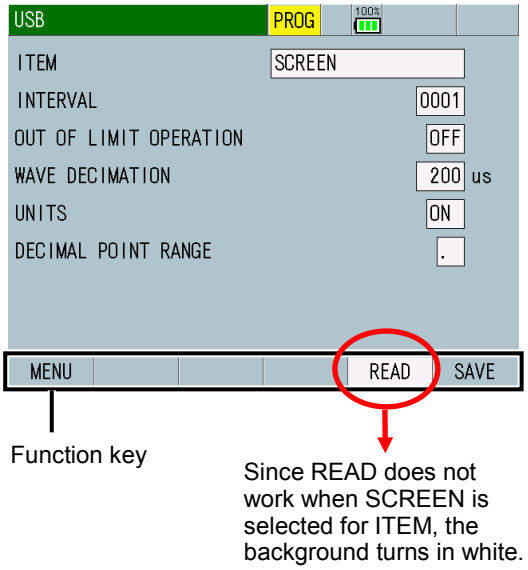


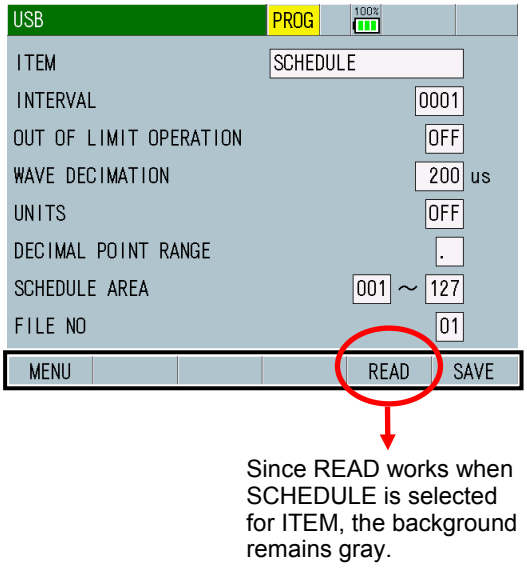
(iv) Alphabetical characters (S to Z)
Move to (iii) by <.



4) Enable the function keys.
Touching the function keys at the lower portion of the screen loads screens or enables various functions.

When the function keys do not work, the background turns in white.

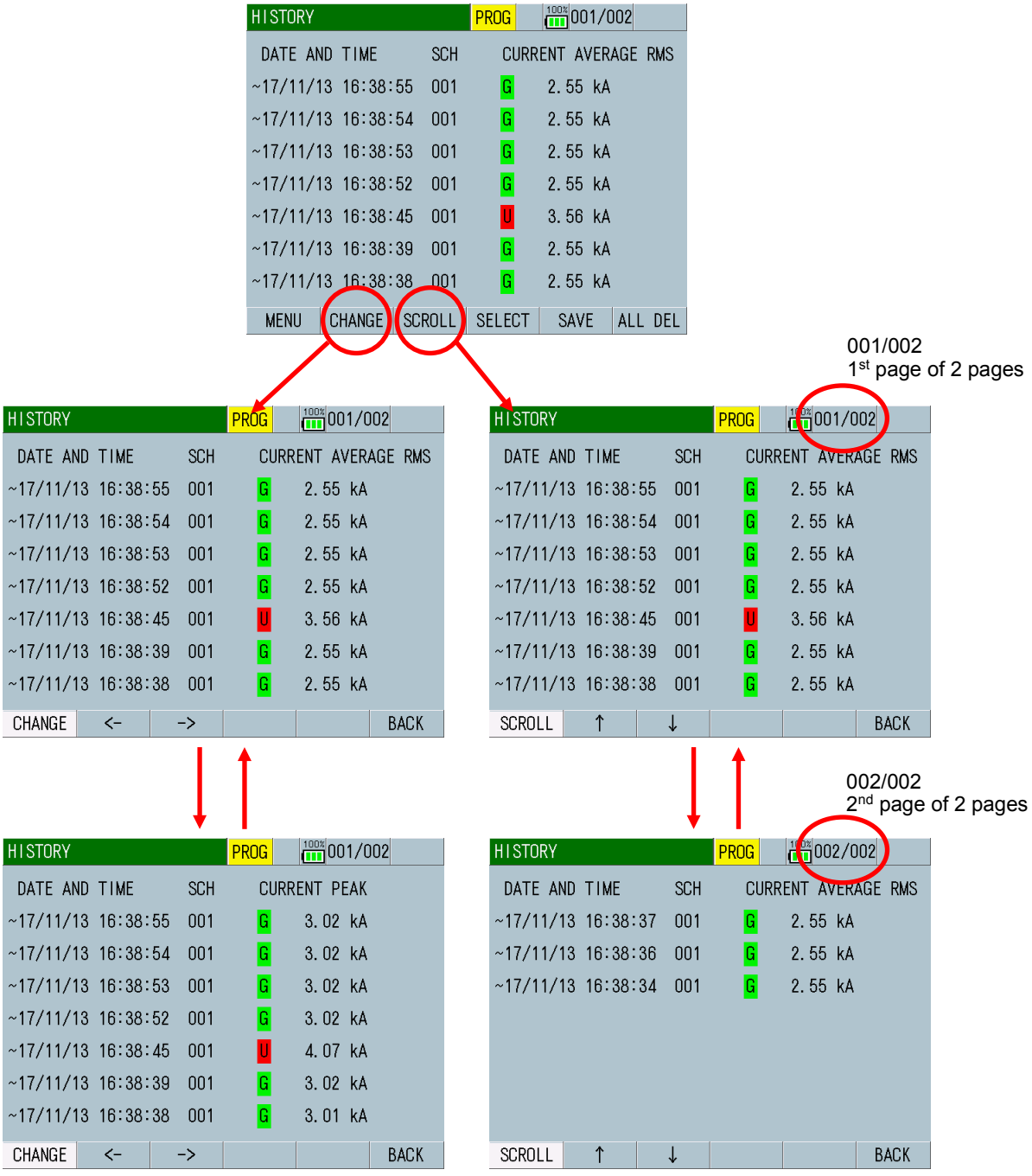




- Scrolling the HISTORY screen.

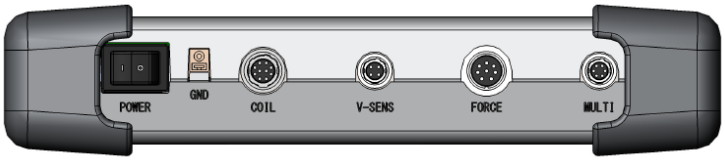
Touching the CHANGE key on the at the lower portion of the HISTORY screen displays ← → to switch ten measurement items selected in the VIEW screen. Touching the SCROLL key displays ↑ ↓ to scroll the screen by seven points.

The page number is shown at the upper-right portion on the screen.



(4) Shutdown

1) Set the main power switch on the top to the OFF position (O side).



8. Operation Screens

(1) Operation Screen Organization

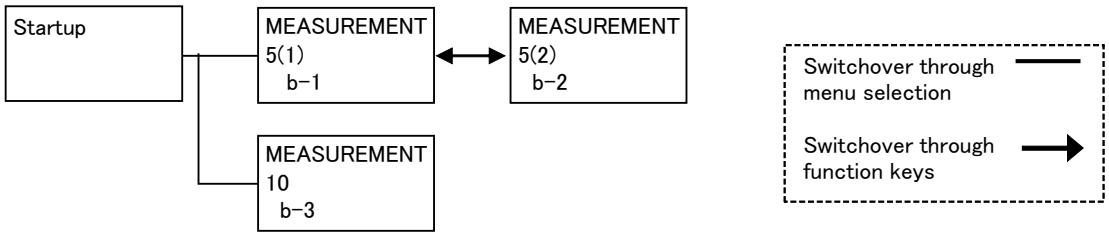
Turn on the power supply and switch the measurement mode “MEAS” and the program mode “PROG” on the MEASUREMENT screen. Touch the MENU key to display the MENU screen, and select each screen.

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

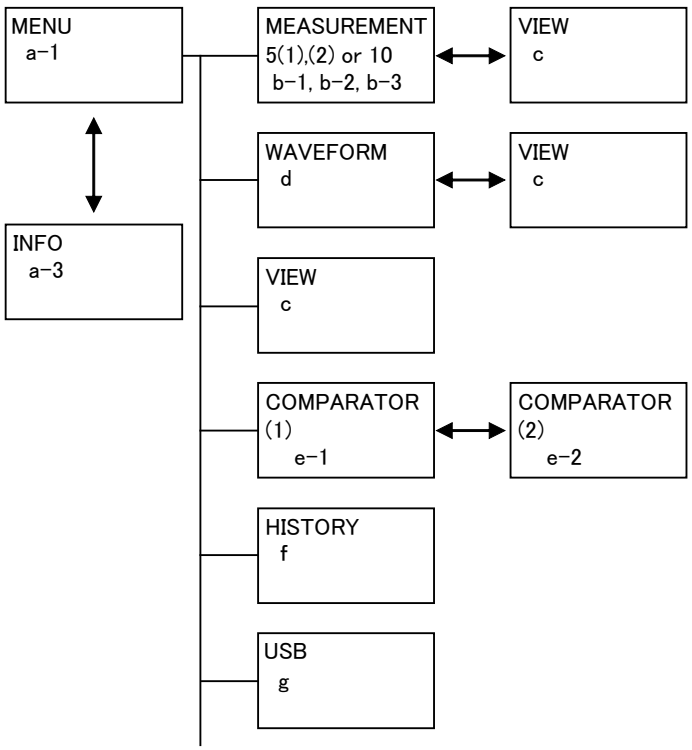
The MEASUREMENT screen accepts next measurement even while the screen is being updated following a measurement.
In contrast, the WAVEFORM and ALL CYCLE screens accept next measurement only after the screen is updated.

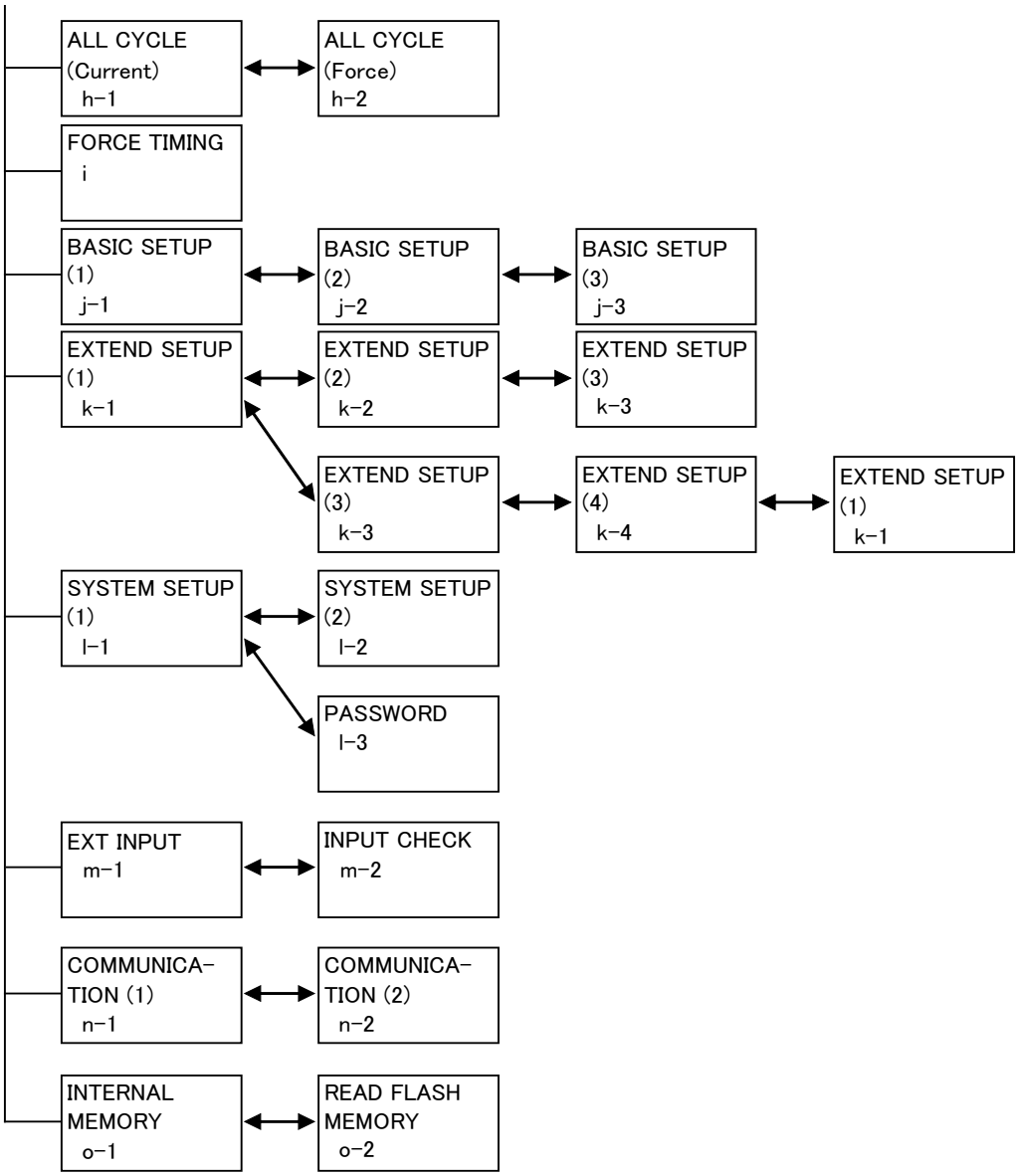
If you switch to the measurement mode with data shown in a screen other than the MEASUREMENT, WAVEFORM and ALL CYCLE screens, the display returns to the MEASUREMENT screen to move to the measurement mode, after which next measurement starts.

The **MM-410B**’s operation screens (normal screen) are organized as shown below.

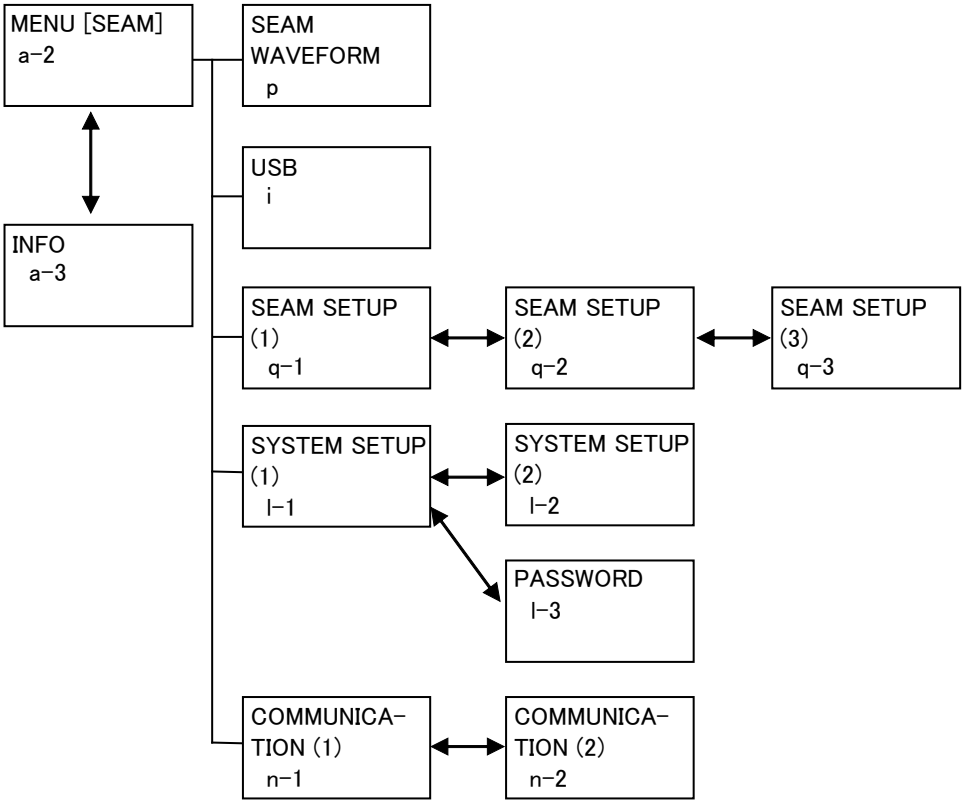


The followings are set after the measurement mode (MEAS) is changed to the program mode (PROG).




ALL CYCLE
(Current)
h-1
ALL CYCLE
(Force)
h-2
FORCE TIMING
i
BASIC SETUP
(1)
j-1
BASIC SETUP
(2)
j-2
BASIC SETUP
(3)
j-3
EXTEND SETUP
(1)
k-1
EXTEND SETUP
(2)
k-2
EXTEND SETUP
(3)
k-3
EXTEND SETUP
(3)
k-3
EXTEND SETUP
(4)
k-4
EXTEND SETUP
(1)
k-1
SYSTEM SETUP
(1)
l-1
SYSTEM SETUP
(2)
l-2
PASSWORD
l-3
EXT INPUT
m-1
INPUT CHECK
m-2
COMMUNICA-
TION (1)
n-1
COMMUNICA-
TION (2)
n-2
INTERNAL
MEMORY
o-1
READ FLASH
MEMORY
o-2

The **MM-410B**'s operation screens (seam measurement) are organized as shown below.

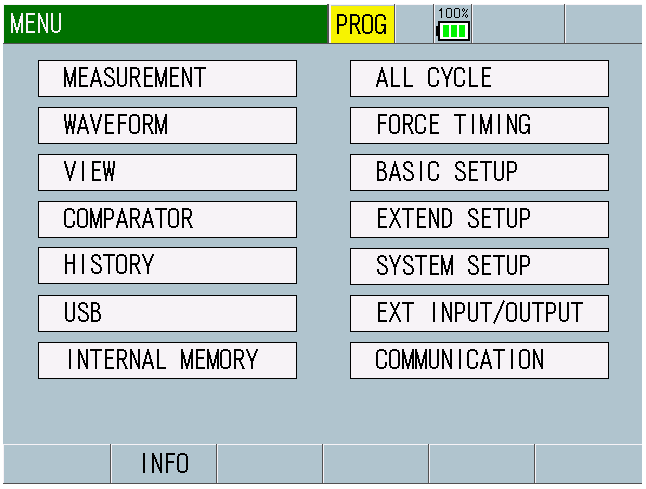


(2) Description of the Operation Screens

a. MENU Screen

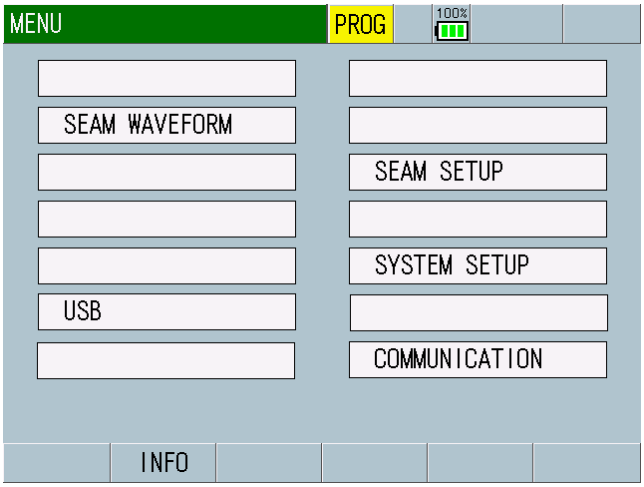
Touching each item moves each screens. The screen varies according to the product specifications and mode settings.

a-1. Normal



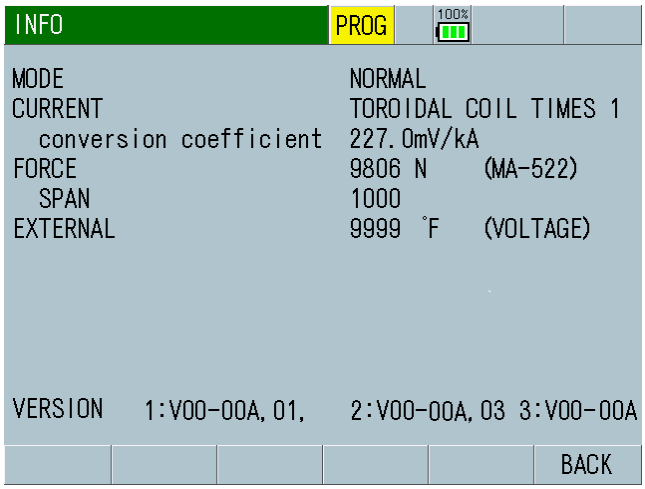
a-2. Seam Mode

To change to the seam mode, touch SYSTEM SETUP in the MENU screen and set MODE to SEAM in the SYSTEM SETUP (1) screen.



a-3. INFO Screen

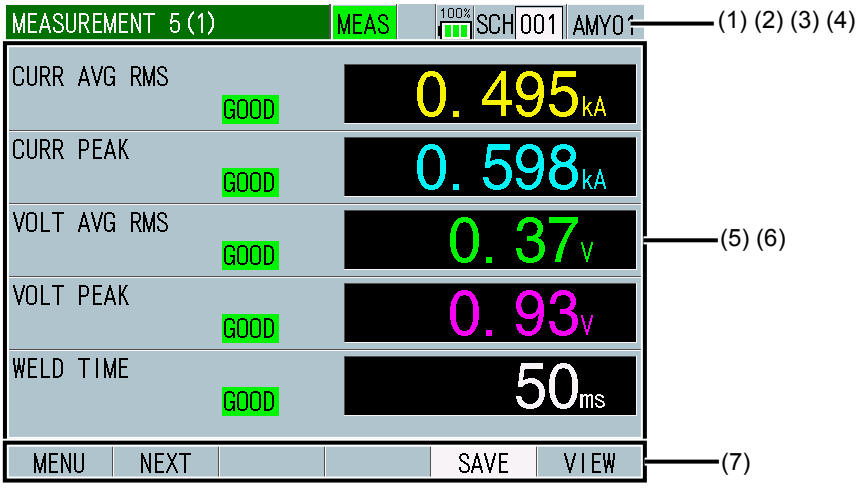
Touching the INFO key in the MENU screen displays various settings and software versions. Touching the BACK key returns to the MENU screen.



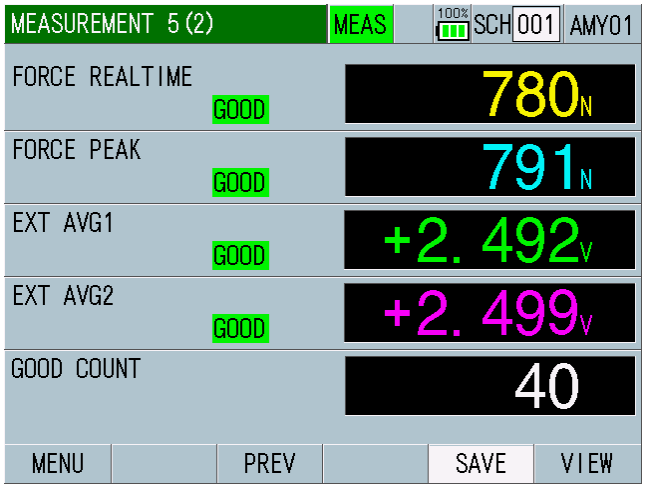
b. MEASUREMENT Screen

The **MM-410B** can display up to 10 measured values simultaneously. There are two modes for the MEASUREMENT screen, a mode to display 5 items in two screens (b-1, b-2) and a mode to display 10 items in a screen (b-3). The display mode is selected in the VIEW screen.

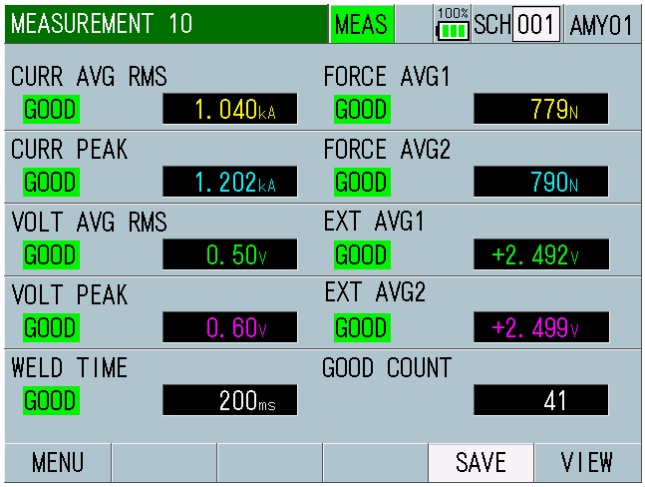
b-1. MEASUREMENT 5(1) Screen



b-2. MEASUREMENT 5(2) Screen



b-3. MEASUREMENT 10 Screen



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) MEAS (MEASUREMENT) / PROG (PROGRAM)

Switches the measurement mode (MEAS) and the program mode (PROG). When the power is turned on, the measurement mode is selected.

MEAS: Measurement enabled and screen operation disabled
PROG: Measurement disabled and screen operation enabled

(4) Battery display

Shows a residual quantity of the lithium battery of the **MM-410B**.

The display changes when charging. (Refer to Chapter 6, (2) “Connecting the MM-410B and Power Supply.”)

(5) Measurement item

Shows items selected in the VIEW screen. Shows the measurement range for each measurement item in brackets in the 5-item display screens (MEASUREMENT 5(1) and MEASUREMENT 5(2)).

Also shows the result by GOOD, NG UPPER or NG LOWER when making a judgment. For details, refer to Judgment display in Chapter 13, (1) “Troubleshooting.”

(6) Measured values

Shows the measured value of the each item.

(7) Function keys

MENU: Touching this displays the MENU screen.

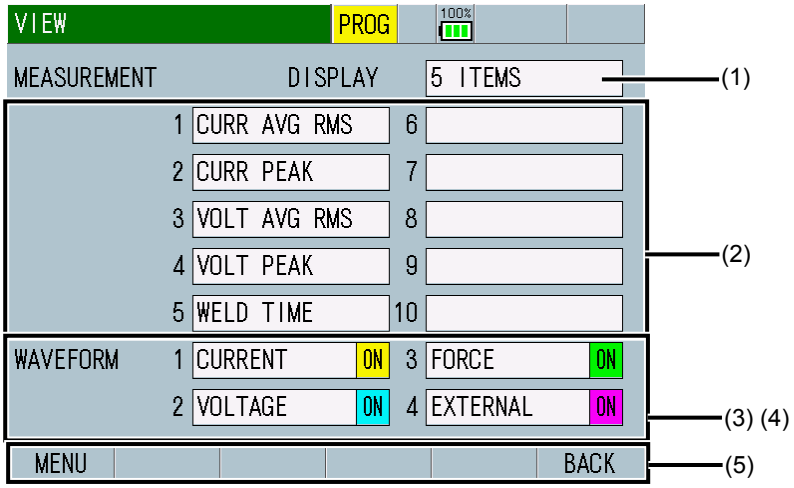
NEXT: Touching this displays the MEASUREMENT 5(1) screen. (5-item display only)

PREV: Touching this displays the MEASUREMENT 5(2) screen. (5-item display only)

SAVE: Touching this saves the measured values, all cycle, and waveforms to flash memory in the **MM-410B**. The **MM-410B** operates in the same manner as when saving the HISTORY screen. For more information, refer to “f. HISTORY Screen.” It is necessary to set items to save on the INTERNAL MEMORY screen in advance. If not, the SAVE key remains white and does not function.

VIEW: Touching this displays the VIEW screen.

c. VIEW Screen



(1) DISPLAY

Select 5 items or 10 items.

(2) MEASUREMENT 1 to 10

Select ten measurement items from the following thirty-four items.
When the measurement item is changed, upper and lower limits for the changed measurement item may be initialized. Set upper and lower limits again on the COMPARATOR screen. (Refer to “e. COMPARATOR Screen.”)

(Note) Do not make MEASUREMENT 1 to 10 the same setting.

- CURR PEAK
  Shows the peak current during current flow including the outside of the measurement interval.
- CURR RMS
  For ISO17657-compliant measurement. Calculates and shows the arithmetic RMS current over the measurement interval.
  Available only when you have selected ISO17657 for CALCULATION in the BASIC SETUP (3) screen. (Refer to Note 1.)
- CURR AVG RMS
  Original measurement mode. Calculates and shows the arithmetic mean RMS current over the measurement interval.
  Available only when you have selected ORIGINAL for CALCULATION in the BASIC SETUP (3) screen. (Refer to Note 1.)
- VOLT PEAK
  Shows the peak current during current flow including the outside of the measurement interval.
- VOLT RMS
  For ISO17657-compliant measurement. Calculates and shows the arithmetic RMS voltage over the measurement interval.
  Available only when you have selected ISO17657 for CALCULATION in the BASIC SETUP (3) screen. (Refer to Note 1.)
- VOLT AVG RMS
  Original measurement mode. Calculates and shows the arithmetic mean RMS current over the measurement interval in arithmetic mean mode.
  Available only when you have selected ORIGINAL for CALCULATION in the BASIC SETUP (3) screen. (Refer to Note 1.)
- CONDUCTION ANGLE
  Shows the maximum conduction angle within the current flow time including the outside of the measurement interval. Used for the single-phase AC welding machines.

- POWER
  Shows the mean power over the measurement interval.
- RESISTANCE
  Shows the mean resistance over the measurement interval.
- WELD TIME
  Shows the time from the detection of a current trigger to when the current flow is determined to be terminated.
- WELD TIME TP
  Used when measuring the capacitor-type welding current. Shows the time from when the welding current begins to flow to when it reaches the maximum value.
- WELD TIME TH
  Used when measuring the capacitor-type welding current. Shows the time from the welding current exceeds the maximum value to when it falls to half the maximum value.
  (Note) In WELD TIME TP and WELD TIME TH, measurement is made when the time setting is SHORT ms-DC. Also, make measurement with the setting of SET PULSE for MODE and 00 for PULSE No.
- FLOW TIME
  Applied for DC only. Shows the time from the detection of a current trigger to when the current flows is decreased to the 10% level of the measured welding current. Note that the meaning of 10% differs depending on the CALCULATION setting in the BASIC SETUP (3) screen. (Refer to Note 2.)
  ORIGINAL: 10% of welding current peak value
  ISO17657: 10% of welding current RMS
- FORCE PEAK
  Shows the peak force including the outside of the measurement range.
- FORCE AVG1
  You can specify two measurement ranges for a single force application. Shows the mean force over the force measurement interval 1. (START TIME 1 and END TIME 1 in the EXTEND SETUP (1) screen)
- FORCE AVG2
  You can specify two measurement ranges for a single force application. Shows the mean force over the force measurement interval 2. (START TIME 2 and END TIME 2 in the EXTEND SETUP (1) screen)
- FORCE INITIAL
  Measures and shows the force before welding.
- FORCE FINAL
  Measures and shows the force after the end of current flow (between the final current flow and the end of final delay time).
- FORCE REAL TIME
  The **MM-410B** constantly measures and displays the force while MEAS is selected. The **MM-410B** stops measurement when PROG is selected. Measurement is made at intervals of twice a second. If you wish to select FORCE REAL TIME for measurement, select REAL TIME for TRIGGER the BASIC SETUP (1) screen.
- FORCE TIME
  Shows the time from when the force signal exceeds TRIGGER LEVEL to when the signal falls below TRIGGER LEVEL.
- EXT PEAK
  Shows the peak external input voltage or current (±10 V voltage or 4 to 20 mA current) converted at the preset conversion factor.
- EXT AVG1
  Shows the mean external input voltage or current (±10 V voltage or 4 to 20 mA current) converted at the preset conversion factor.

- EXT AVG2
  Shows the mean external input voltage or current (±10 V voltage or 4 to 20 mA current) converted at the preset conversion factor.
- EXT INITIAL
  Shows the measured external input voltage or current (±10 V voltage or 4 to 20 mA current) before welding converted at the preset conversion factor.
- EXT FINAL
  Shows the measured external input voltage or current (±10 V voltage or 4 to 20 mA current) after the end of current flow converted at the preset conversion factor.
- EXT REAL TIME
  The **MM-410B** constantly measures the external input (±10 V voltage or 4 to 20 mA current) while MEAS is selected. The **MM-410B** stops measurement when PROG is selected. Measurement is made at intervals of twice a second. If you wish to select EXT REAL TIME for measurement, select REAL TIME for TRIGGER in the BASIC SETUP (1) screen.
- EXT TIME
  Shows the time from the start to the end of external input (±10 V voltage or 4 to 20 mA current).
- WELD COUNT*1
  Shows the counter that indicates the number of measurements. It counts up irrespective of OK/NG judgment against upper and lower limits.
- GOOD COUNT*1
  Shows the good counter within upper and lower limits.
- No selection

(3) WAVEFORM 1 to 4

Select four items to display in the WAVEFORM screen from the following: CURRENT, VOLTAGE, POWER, RESIST, FORCE, EXTERNAL, no selection

(Note) Do not make WAVEFORM 1 to 4 the same setting.

(4) Display ON/OFF

Select whether to show the waveforms by selecting ON/OFF. The waveforms with OFF are not shown even when selected.

(5) Function keys

MENU: Touching this displays the MENU screen.

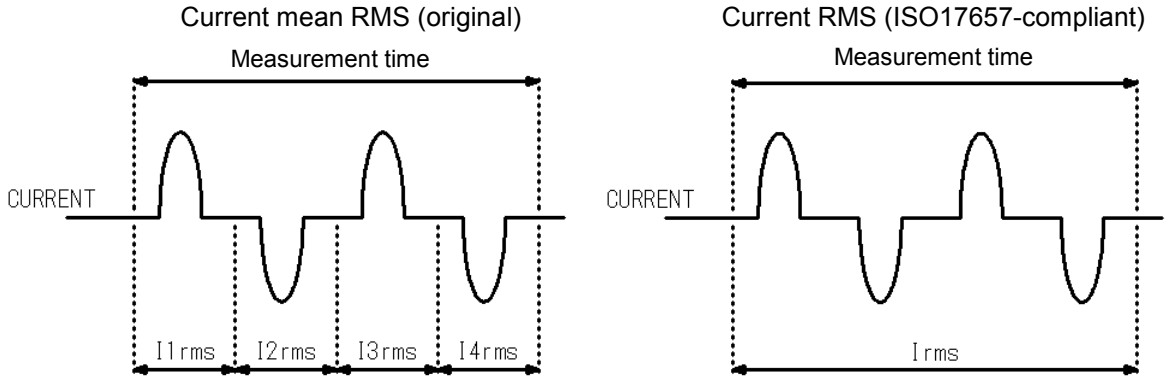
BACK: Touching this returns the display to the previous screen (MEASUREMENT or WAVEFORM screen). When the WAVEFORM screen is selected from the MENU screen, this does not function.

*1: The display of WELD COUNT and GOOD COUNT may change in the measurement mode (MEAS) and in the program mode (PROG).

Measurement mode (MEAS): Displays the current counter. When the CT RESET key is touched, the value becomes 0.

Program mode (PROG): Also displays the past counter. When the past measured value is displayed from the history, the value is different from the current count value. Even when the CT RESET key is touched, the value does not become 0.

(Note 1) Difference between the original measurement mode and the ISO17657-compliant measurement mode in RMS calculation



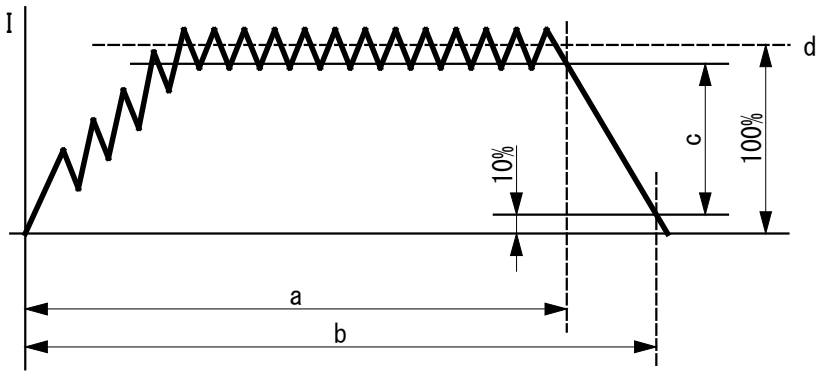
Arithmetic mean RMS current in the measurement interval

$$\text{Arithmetic mean RMS} = \frac{I1rms + I2rms + I3rms + I4rms}{4}$$

RMS current in all measurement intervals

RMS = Irms

(Note 2) Difference between current flow time of the original measurement mode and that of the ISO17657-compliant measurement mode (DC measurement only)



a: Current flow time b: Flow time c: Fall level 10 to 90% d: RMS

- Original measurement mode
  - a: Time till the welding current reaches FALL LEVEL (10 to 90% of **peak value**)
  - b: Time till the welding current reaches 10% of **peak value**

- ISO17657-compliant measurement mode
  - a: Time till the welding current reaches FALL LEVEL (10 to 90% of **RMS**)
  - b: Time till the welding current reaches 10% of **RMS**

(Note) FALL LEVEL is set in the BASIC SETUP (2) screen.

d. WAVEFORM Screen

(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

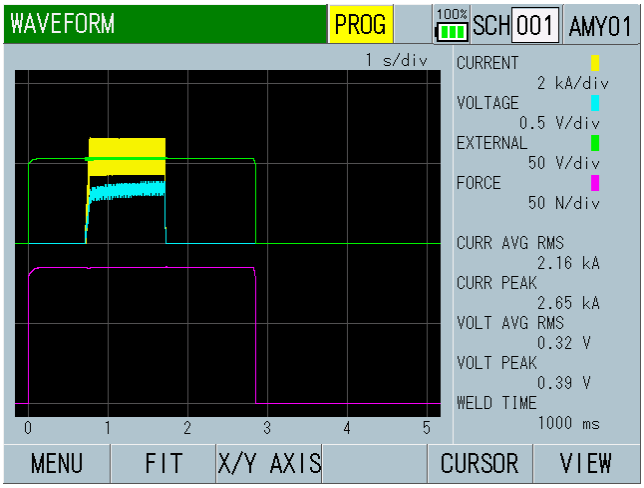
Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) Waveform

Shows the waveforms of four items on the grid. Waveform display items can be selected in the VIEW screen.

(Note) When EXTERNAL is selected for waveform display item, you need to select VOLTAGE or CURRENT for INPUT in the EXTEND SETUP (4) screen.

① Waveform example when the external input is voltage (WAVEFORM 3)



Displays ON (+0 V) to 500 N (+10 V) with a load cell amplifier prepared separately.

② Waveform example when the external input is current (WAVEFORM 3)

Displays 140°C (4 mA) to 2000°C (20 mA) with a radiation thermometer. Less than 140°C is not displayed.

(4) Grid spacing

Shows the grid spacings for the four waveforms shown on the grid.

(5) Measured values

Shows the measured values of five items. Measurement items can be selected in the VIEW screen.

(6) Function keys

MENU: Touching this displays the MENU screen.

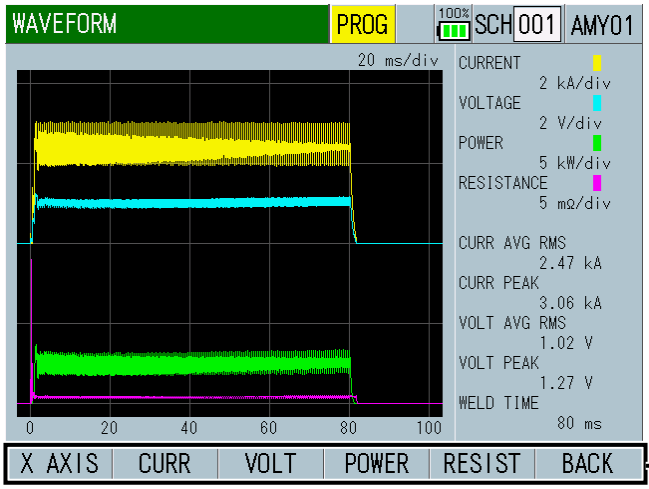
FIT: Touching this redisplays the waveforms by automatically resizing them to fit into the screen.

X/Y AXIS: Touching this displays XY-axis scale command at the function key. (Refer to (6)-1.)

CURSOR: Touching this displays the vertical axis and cursor command at the function key. (Refer to (6)-2.)

VIEW: Touching this displays the VIEW screen.

(6)-1 XY-axis scale command



X AXIS: Touching this enlarges/reduces the time axis of waveform and makes it possible to move the waveforms. In this condition, touch the arrow key (<- ->). This moves the waveforms to the right or left. Touch + (plus) to enlarge the time axis of waveform or - (minus) to reduce it.

X AXIS	<-	->	+	-	BACK

CURR: Touching this makes it possible to adjust the scale of the vertical axis for the current waveform. In this condition, touch + (plus) to enlarge a scale of the vertical axis for the current waveform or - (minus) to reduce it.

CURR	+	-			BACK

VOLT: Touching this makes it possible to adjust the scale of the vertical axis for the voltage waveform.

VOLT	+	-			BACK

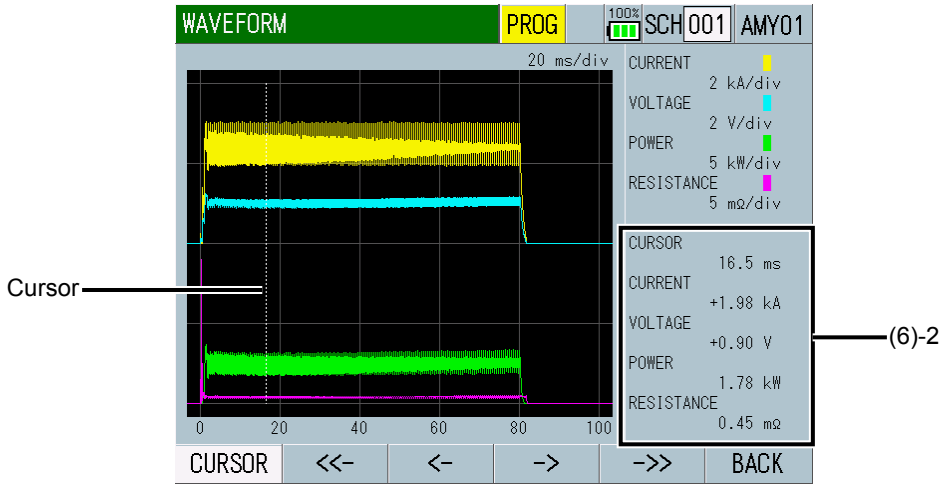
POWER: Touching this makes it possible to adjust the scale of the vertical axis for the power waveform.

POWER	+	-			BACK

RESIST: Touching this makes it possible to adjust the scale of the vertical axis for the resistance waveform.

RESIST	+	-			BACK

(6)-2 Cursor command



Shows the current time axis information of the cursor and the measured values of the waveforms at the point in time indicated by the cursor.

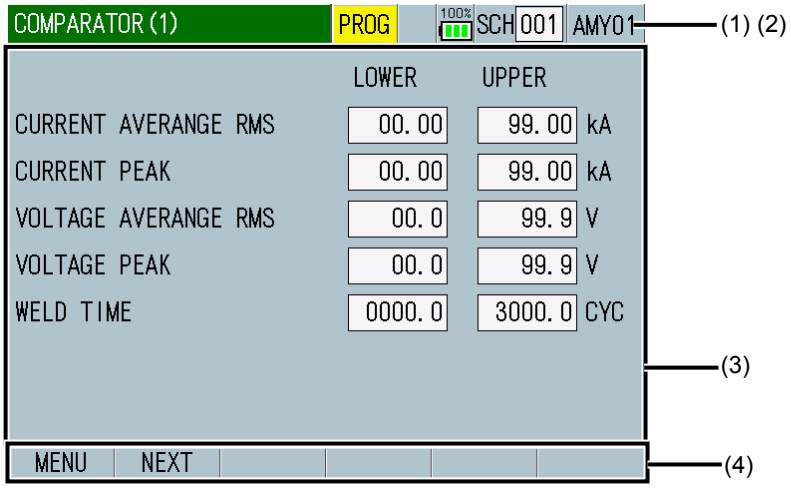
You can move the white line (cursor) on the grid right and left by touching the function keys.

<- ->: Touching this moves the cursor right and left by 1 dot. The cursor moves only while the key is touched.

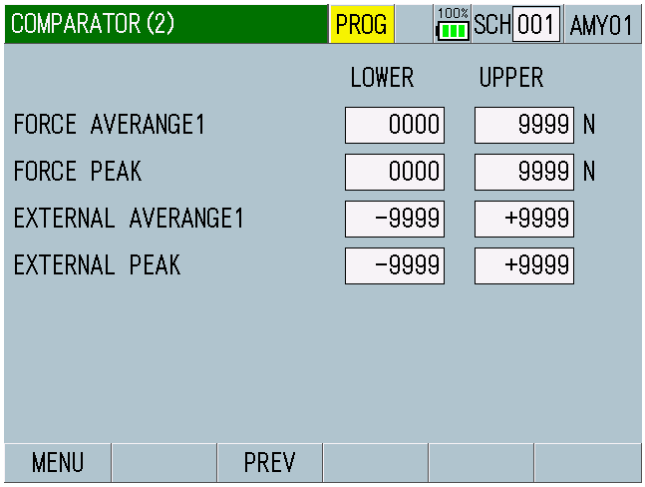
<<- ->>: Touching this moves the cursor right and left by 50 dots.

e. COMPARATOR Screen

e-1. COMPARATOR (1) Screen



e-2. COMPARATOR (2) Screen



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) Parameter setting

Set upper and lower limits for the measurement items selected in the VIEW screen as follows. Items 1 to 5 are on the COMPARATOR (1) screen and items 6 to 10 are on the COMPARATOR (2) screen.

When the measurement item is changed, upper and lower limits for the changed measurement item may be initialized. (Refer to "c. VIEW Screen.")

When the TRIGGER and TIME settings are changed, upper and lower limits for measurement items WELD TIME and FLOW TIME may be initialized. Set upper and lower limits again. (Refer to "j-1. BASIC SETUP (1) Screen.")

- CURRENT (PEAK, RMS, AVERAGE RMS)
  Set upper and lower limits in the following ranges depending on the type of toroidal coil connected and according to the CURR RANGE setting in the BASIC SETUP (1) screen:

When 1x sensitivity coil is used:
2.000 kA range: 0.000 to 9.999 kA
6.00 kA range: 00.00 to 99.99 kA
20.00 kA range: 00.00 to 99.99 kA
60.0 kA range: 000.0 to 999.9 kA
200.0 kA range: 000.0 to 999.9 kA

When 10x sensitivity coil is used:
0.200 kA range: 0.000 to 9.999 kA
0.600 kA range: 0.000 to 9.999 kA
2.000 kA range: 0.000 to 9.999 kA
6.00 kA range: 00.00 to 99.99 kA
20.00 kA range: 00.00 to 99.99 kA

- VOLTAGE (PEAK, RMS, AVERAGE)
  Set upper and lower limits in the following ranges according to the VOLTAGE RANGE setting in the BASIC SETUP (1) screen:

6.00 V range: 0.00 to 9.99 V
20.0 V range: 0.0 to 99.9 V

- WELD TIME
  Set upper and lower limits in the following ranges according to the TIME setting in the BASIC SETUP (1) screen:

CYC-AC, CYC***Hz-AC, CYC-DC, LONG CYC-AC: 0.0 to 3000.0 CYC
ms-DC, ms-AC: 0 to 30000 ms
SHORT ms-DC: 0.00 to 300.00 ms

- POWER AVERAGE
  0.0 to 300.00 kW
- RESISTANCE AVERAGE
  0.0 to 300.00 mΩ
- FORCE (AVERAGE 1, AVERAGE 2, PEAK, INITIAL, FINAL)
  Set upper and lower limits in the following ranges according to the SENSOR and UNITS settings in the EXTEND SETUP (2) screen:

MA-520: 0.00 to 99.99 N / 0.00 to 99.99 kgf / 0.00 to 99.99 lbf
MA-521: 0.0 to 999.9 N / 0.0 to 999.9 kgf / 0.0 to 999.9 lbf
MA-522, **MA-770A**, **MA-771A**: 0 to 9999 N / 0 to 9999 kgf / 0 to 9999 lbf

- EXTERNAL (AVERAGE 1, AVERAGE 2, PEAK, INITIAL, FINAL)
  Set upper and lower limits in the following ranges according to the DECIMAL RANGE setting in the EXTEND SETUP (4) screen:

*.***: -9.999 to +9.999
.: -99.99 to +99.99
***.*: -999.9 to +999.9
****: -9999 to +9999

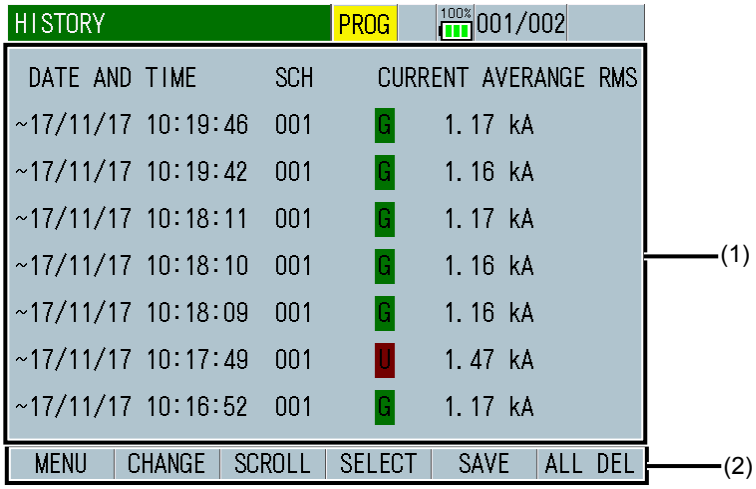
(4) Function keys

MENU: Touching this displays the MENU screen.

PREV: Touching this displays the COMPARATOR (1) screen.

NEXT: Touching this displays the COMPARATOR (2) screen.

f. HISTORY Screen



(1) History display

The HISTORY screen shows a list of measured values (presence/absence of waveforms, date, time, schedule No., judgment result, and measured value) obtained until now. This screen allows you to load past measured values and save new ones to the built-in flash memory.

"~" on the left side of the screen indicates the save state of waveforms. When you load the history of the item with "~", waveforms can be displayed on the WAVEFORM screen.

The **MM-410B** has three types of built-in memory.

- Built-in memory 1: The backup power supply holds data when the power is turned off.
- Built-in memory 2: When the power supply is turned off without performing backup, data is cleared.
- Built-in flash memory: Holds data even when the power is turned off. It has a write limit (100,000).

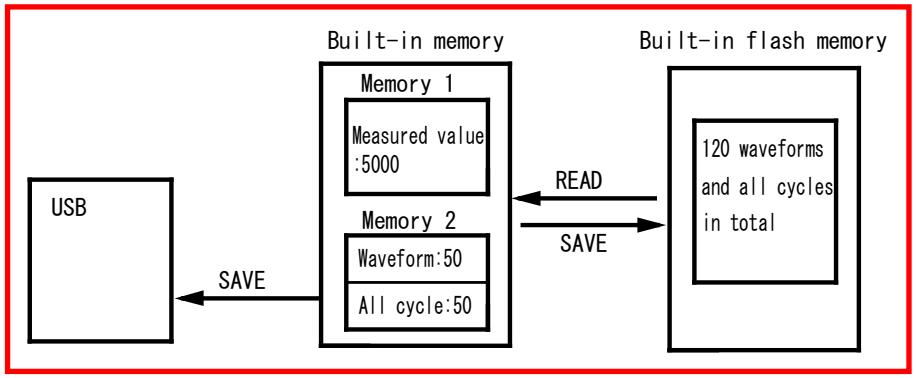
The measured value (10 selected items in the VIEW screen) data uses the built-in memory 1. The number of storable pieces of data is 5,000 and older data is deleted as it exceeds 5,000 and overwrites new data. Data is held even when the power is turned off.

All cycles and waveforms (4 selected waveforms in the VIEW screen) uses the built-in memory 2. The maximum number of storable pieces of data is **50** for all cycles and waveforms **respectively**. (The number of storable pieces of data varies depending on the waveform measurement time. 50 is just a guide.) Older data is deleted as the number of pieces of data is exceeded and overwrites new data. When the power supply is turned off, data is cleared.

For measured value, all cycles and waveforms, older data is deleted as the number of pieces of data is exceeded. Take out data via USB or communication accordingly.

The built-in flash memory (internal memory) can be used as backup of the built-in memory. (Refer to “o. INTERNAL MEMORY Screen.”) The standard number of storable pieces of data is **120** for all cycles and waveforms **in total**. (The number of storable pieces of data varies depending on the waveform measurement time. 120 is just a guide.) An error message “E15: INTERNAL MEMORY ERROR” appears if the write limit is exceeded. If an error occurs, save the internal memory data into the USB, and then touch ALL DEL key on the READ FLASH MEMORY screen to clear the built-in flash memory data. Even if you save data in a state that an error is occurring, new data is not written. Data is held even when the power is turned off.

When reading the built-in flash memory (internal memory), the history of measured value, waveforms and all cycles is deleted. Take out data via USB or communication accordingly before reading.



(2) Function keys

MENU: Touching this displays the MENU screen.

CHANGE: Touching this displays the arrow key (← →). Touching the arrow key switches between measured values of ten measurement items.

SCROLL: Touching this displays the arrow key (↑↓). Touching the arrow key moves a page of the screen.

SELECT: First select an item to load, and then touch this.

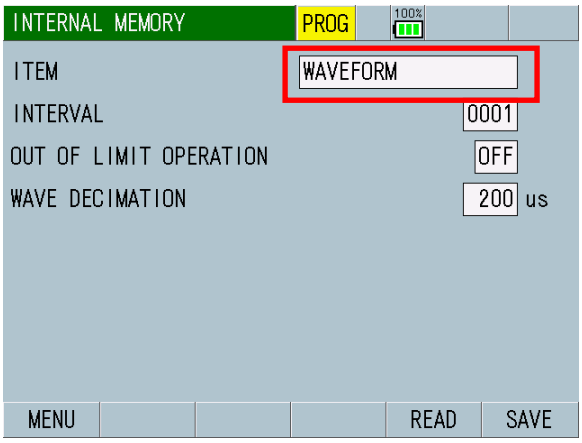
SAVE: Directly touching the displayed history displays a line-based cursor. In this condition, touch the SAVE key in the built-in flash memory to save current, force all cycle or waveform in the built-in flash memory. However, you need to select an item to save in the INTERNAL MEMORY screen in advance. Touching SELECT again deselects measured values.

ALL DEL: Clears all history data from the built-in flash memory.

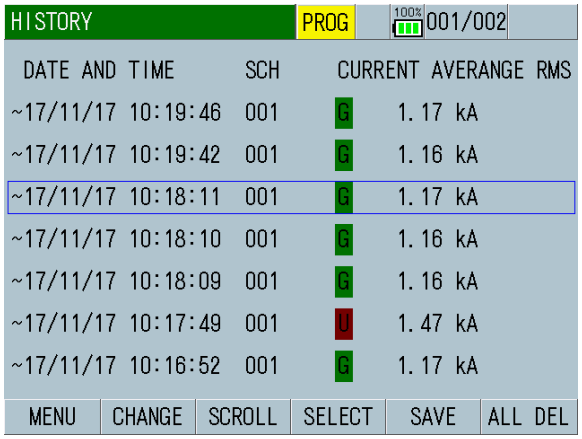
[How to load data saved earlier than data in the HISTORY screen (waveform, all cycle)]

1) Select an item (WAVEFORM, CURRENT ALL CYCLE and FORCE ALL CYCLE) to load in the INTERNAL MEMORY screen in advance.

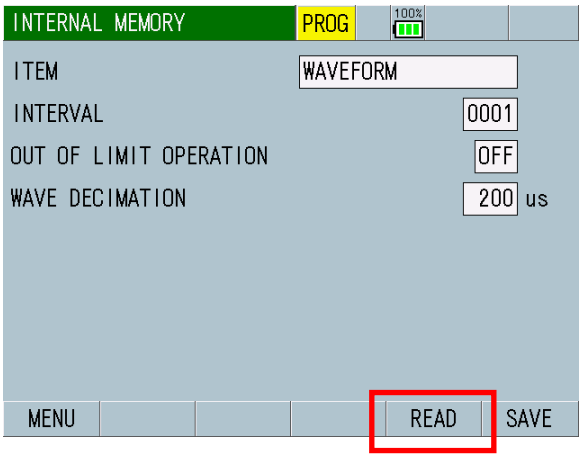
(Note) WAVEFORM, CURRENT ALL CYCLE and FORCE ALL CYCLE cannot be loaded simultaneously from a history data.



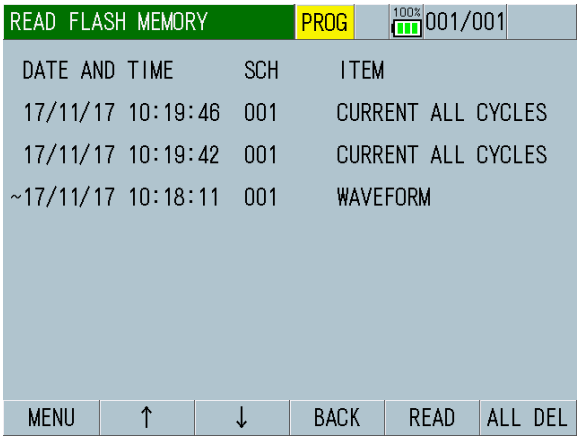
2) Select one to load among data with "~" on the left side of the HISTORY screen. The selected data is surrounded with a blue frame. Touch the SAVE key to save it in the internal memory.



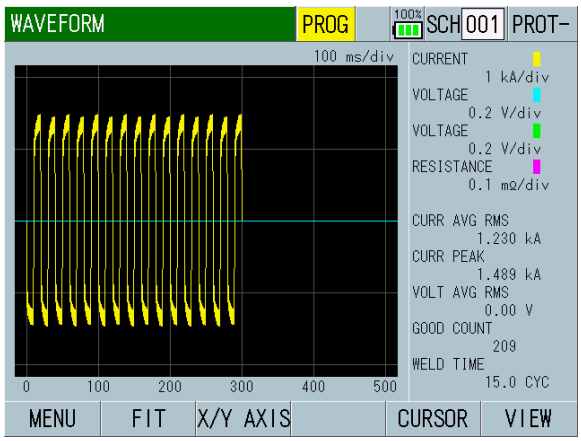
3) Move to the INTERNAL MEMORY screen and touch the READ key, the READ FLASH MEMORY screen (saved data list) is displayed.
Return to 2) to load other history data or return to 1) to change the item and set WAVEFORM, CURRENT ALL CYCLE or FORCE ALL CYCLE again.



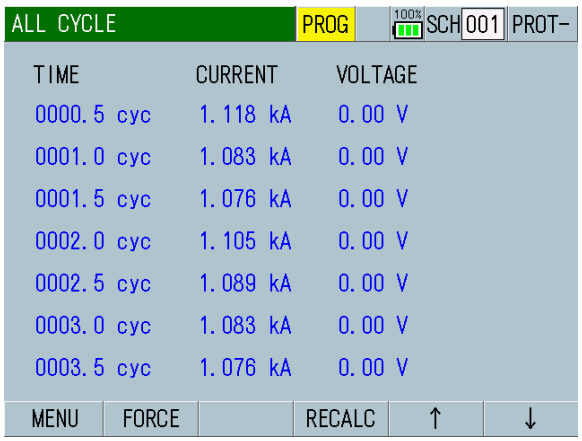
4) Select data by touching directly on the list and touch the READ key. Once the READ key is touched, other history data are all deleted.



5) Move to the screen of the loaded item (WAVEFORM or ALL CYCLE screen) to check data.



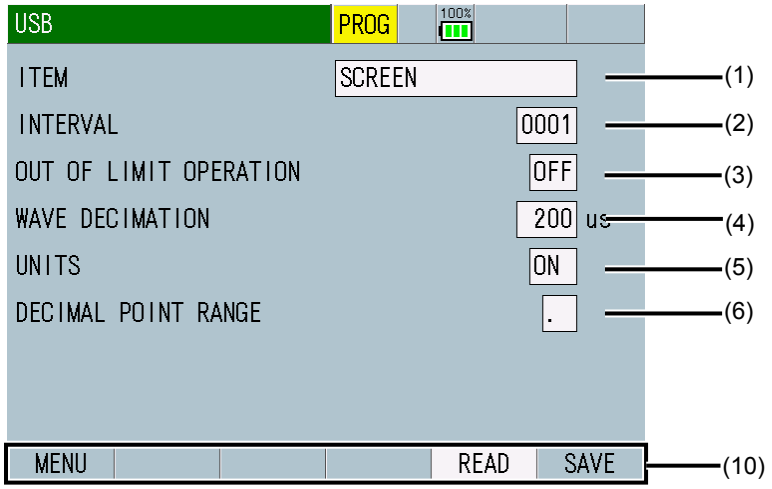
Waveform data loaded by 17/11/17 10:18:11



All cycle data loaded by 17/11/17 10:18:11

(Caution) Items to load cannot be checked simultaneously. For example, even when you move to the ALL CYCLE screen after loading the waveform, data is not shown. Select CURRENT or FORCE ALL CYCLE in step 1) again and perform steps 2) to 5).

g. USB Screen



(1) ITEM

Select the data to read from or write in the USB memory from the following:

- OFF
  No writing and reading in/from the USB memory.
- MEASUREMENT
  Writes the measured values of ten items selected in the VIEW screen in the USB memory.
  The filenames are “measure-0.CSV” to “measure-1000.CSV.” After 1000, the filename returns to 0. The file is overwritten. A thousand of measured values are written in a file.
  In saving by the SAVE key, a measured value is written and “¥measure_MM410” folder is created.
  In automatic saving for every interval, up to 1000 measured values are written in a file and “¥measure_in_meas_MM410” folder is created.
  When **MM-410B** is powered off, USB memory is removed, or “E14: USB ERROR” occurs, the measured value is written with a new filename.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.
- WAVEFORM
  Writes the waveforms of four items selected in the VIEW screen in the USB memory.
  The filenames are “wav-0.csv” to “wav-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥wav_MM410” folder is created by the SAVE key and “¥wav_in_meas_MM410” folder is created by automatic saving for every interval.
  Waveforms are not saved in the seam measurement.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.
- CURR ALL CYCLE
  Writes current all cycles in the USB memory.
  The filenames are “curr_allcycle-0.csv” to “curr_allcycle-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥curr_allcycle_MM410” folder is created by the SAVE key and “¥cur_allcycle_in_meas_MM410” folder is created by automatic saving for every interval.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen or ISO17657 is selected for CALCULATION in the BASIC SETUP (3) screen, no writing in the USB memory is made.

- FORCE ALL CYCLE
  Writes force all cycles in the USB memory.
  The filenames are “force_allcycle-0.csv” to “force_allcycle-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥force_allcycle_MM410” folder is created by the SAVE key and “¥force_allcycle_in_meas_MM410” folder is created by automatic saving for every interval.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.
- HISTORY
  Saves history selected in HISTORY AREA (20**/**/** to 20**/**/**) among measured values saved in the HISTORY screen in the USB memory. To save, first select this item, and then touch SAVE.
  The filenames are “hist_measure-0.csv” to “hist_measure-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥hist_measure_MM410” folder is created.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.
- HISTORY OUT OF LIM
  Saves history selected in HISTORY AREA (20**/**/** to 20**/**/**) among measured values with Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error saved in the HISTORY screen in the USB memory. To save, first select this item and touch SAVE.
  The filenames are “hist_error-0.csv” to “hist_error-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥hist_error_MM410” folder is created.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.
- SCHEDULE
  Writes/Reads the schedule data in/from the USB memory. At writing, the information selected among schedules 1 to 127 is written. At reading, only the selected schedule is read. Also, set the file number (01 to 10) to read from or write in the schedule data. The schedule data can be backed up and copied to other **MM-410B**.
  “¥sch_set_MM410” folder is created, and “¥FileNo_01” to “¥FileNo_10” folders are created in a lower hierarchy for each file number.

  (Note) Before reading the schedule data, change the decimal point setting to the same setting as that set when saved it. (Refer to “(6) DECIMAL POINT RANGE.”) When the decimal point has not been changed from the initial setting, it can be read with the present setting. The initial setting of decimal point is “.”.
- SCREEN
  Writes screen image prior to the USB screen in the USB memory. To write in the USB memory, first display the screen to write. Then, return to the USB screen by MENU and touch SAVE.
  The data format is BITMAP. The filenames are “screen_bmp-0.bmp” to “screen_bmp-1000.bmp.” After 1000, the filename returns to 0. The file is overwritten.
  “¥screen_bmp_MM410” folder is created.
- WAVEFORM2
  Writes the 10 measured values and 4 waveforms selected on the display setting screen to the USB memory.
  The filenames are “wav2-0.csv” to “wav2-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥wav2_MM410” folder is created by the SAVE key and “¥wav2_in_meas_MM410” folder is created by automatic saving for every interval.
  Waveforms are not saved in the seam measurement.

When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.

- CURR ALL CYCLE2
  The measured values of 10 items selected on the display setting screen and current all cycles are written to the USB memory.
  The filenames are “curr_allcycle2-0.csv” to “curr_allcycle2-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥curr_allcycle2_MM410” folder is created by the SAVE key and “¥cur_allcycle2_in_meas_MM410” folder is created by automatic saving for every interval.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen or ISO17657 is selected for CALCULATION in the BASIC SETUP (3) screen, no writing in the USB memory is made.
- FORCE ALL CYCLE2
  Writes force all cycles in the USB memory.
  The filenames are “force_allcycle2-0.csv” to “force_allcycle2-1000.csv.” After 1000, the filename returns to 0. The file is overwritten.
  “¥force_allcycle2_MM410” folder is created by the SAVE key and “¥force_allcycle2_in_meas_MM410” folder is created by automatic saving for every interval.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no writing in the USB memory is made.

(2) INTERVAL (*)

You can set an interval (1 to 1,000) to save each measurement data automatically in the USB. Saves irrespective of a save interval in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error. The setting of interval is valid only when MEASUREMENT, WAVEFORM, CURR ALL CYCLE, or FORCE ALL CYCLE is selected for ITEM. When OUT OF LIMIT OPERATION is set to ON, an interval does not work.

(*) About interval

The interval corresponds to the number of weldings. Since it depends on the number from the last save, the number of saves changes depending on the OUT OF LIMIT OPERATION setting.

INTERVAL setting		1	1	3	3
OUT OF LIMIT OPERATION setting		ON	OFF	ON	OFF
1st welding	OK	-	Save	-	-
2nd welding	OK	-	Save	-	-
3rd welding	OK	-	Save	Save	Save
4th welding	OK	-	Save	-	-
5th welding	NG	Save	Save	Save	-
6th welding	OK	-	Save	-	Save
7th welding	OK	-	Save	-	-
8th welding	OK	-	Save	Save	-

(3) OUT OF LIMIT OPERATION

Select ON/OFF to specify whether to save only in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error.

ON: If there is an error, They will be saved regardless of the interval.
OFF: Saves irrespective of errors. They are saved every interval regardless of normal/abnormal.

Saves at intervals set for INTERVAL when normal. Saves at the time of an error occurrence when abnormal. The settings for saving in the event of an error are valid only when you select an item for MEASUREMENT, WAVEFORM, CURR ALL CYCLE, or FORCE ALL CYCLE.

(4) WAVE DECIMATION

Set a waveform decimation. You can select from among 20 us, 50 us, 100 us, 200 us, 500 us, and 1000 us. 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 ITEM.

WAVE DECIMATION is reflected when the followings are satisfied.

CURRENT SAMPLING INTERVAL	FORCE SAMPLING INTERVAL	Current measure-ment	Force/ external measurement	TIME	WAVE DECIMATION
20us	100us 200us 500us	Yes	No	SHORT ms-DC	20us, 100us, 200us, 500us, and 1000us are the same as setting. 50us becomes 20us.
20us[*1]	100us 200us 500us			All settings	50us, 100us, 200us, 500us, and 1000us are the same as setting. 20us becomes 50us.
50us					
100us					100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.
200us[*1]	100us 200us 500us	Yes	No	All settings	200us, 500us and 1000us are the same as setting. 20us, 50us and 100us become 200us.
20us[*1] 50us[*1] 100us	100us		Yes		100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.
	200us				100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.
	500us				100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.
200us[*1]	100us[*1]				100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.
	200us				
	500us				100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.

CURRENT SAMPLING INTERVAL	FORCE SAMPLING INTERVAL	Current measure-ment	Force/ external measurement	TIME	WAVE DECIMATION
20us*1 50us*1 100us	100us	No		-	100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.
	200us				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.
200us*1	100us*1				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	200us				
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.

*1: Also refer to CURRENT SAMPLING INTERVAL and FORCE/ EXTERNAL SAMPLING INTERVAL in Chapter 8, “I-2. SYSTEM SETUP (2) Screen.”

(5) UNITS

Select whether to add a unit to the save data or not.

OFF: Not added
ON: Added

(6) DECIMAL POINT RANGE

"." (period) or "," (comma) for DECIMAL POINT RANGE is switched, the measurement data saved in the CSV file changes as shown below.

- Example of "." (period) (partly omitted measurement data)
  (snip)01.00kA,00,G,01.10kA,05,G,02(snip)[CR][LF]
- Example of "," (comma) (partly omitted measurement data)
  (snip)01,00kA;00;G;01,10kA;05;G;02(snip)[CR][LF]

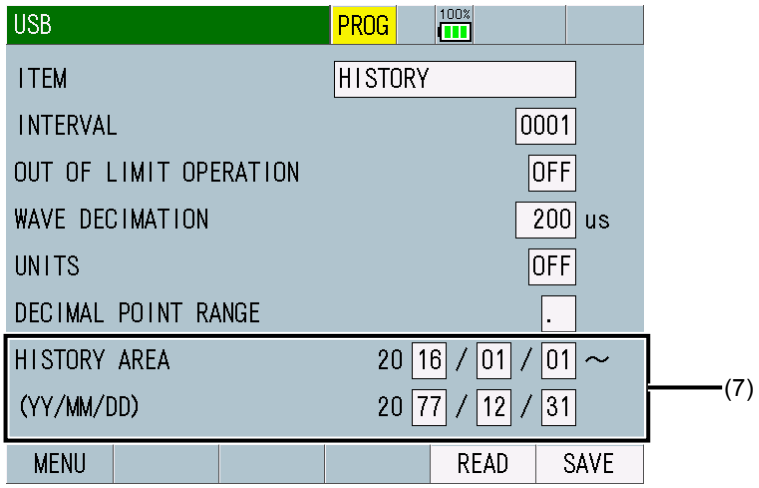
In the "." (period) setting, period is used for decimal point and comma is used for delimiter. On the other hand, in the "," (comma) setting, comma is used for decimal point and semicolon is used for delimiter.

When the language setting of Excel is Japanese, select "." (period) for DECIMAL POINT RANGE. When European language such as German is set, select "," (comma).

(7) HISTORY AREA

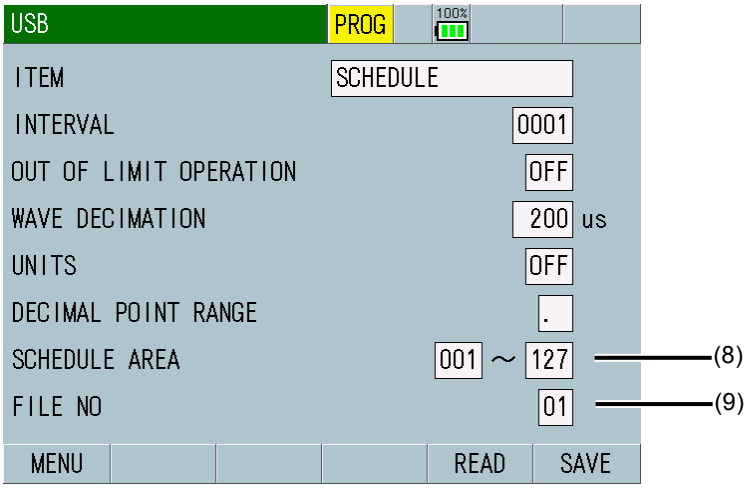
Shown when you have selected HISTORY or HISTORY OUT OF LIM for ITEM. Set a save range with year, month and day.

(Note) The start date should be before the end date.



(8) SCHEDULE AREA

Shown when you have selected SCHEDULE for ITEM. Set the range of schedule numbers to save schedule data from 001 to 127. The setting of schedule data range is valid only when schedule data is saved.



(9) FILE NO

When you have selected SCHEDULE for ITEM, FILE NO is displayed.

Set the file number (01 to 10) to read from or write in the schedule data.

"¥sch_set_MM410" folder is created, and "¥FileNo_01" to "¥FileNo_10" folders are created in a lower hierarchy for each file number. Further, the following files are created in a lower hierarchy for each screen.

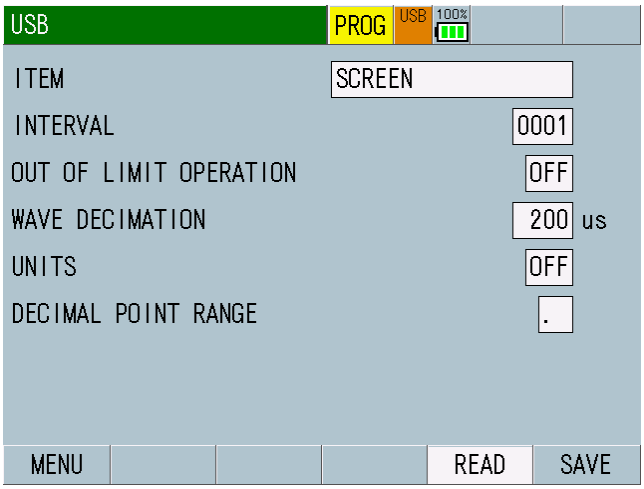
Screen	Filename
VIEW screen	View.csv
COMPARATOR screen	HiLoComp.csv
USB screen	Usb.csv
BASIC SETUP (1), (2) screens	Base12.csv
BASIC SETUP (3) screen	Base3.csv
EXTEND SETUP (1), (3) screens	Extend146.csv
EXTEND SETUP (2), (4) screens	Extend2357.csv
SYSTEM SETUP (1), (2) screens	System.csv
EXT INPUT screen	ExtIO.csv
COMMUNICATION (1), (2) screens	Comm.csv
INTERNAL MEMORY screen	InternalMem.csv
SEAM SETUP (1), (2) screens	Seam12.csv
SEAM SETUP (3) screen	Seam3.csv

(10) Function keys

MENU: Touching this displays the MENU screen.

READ: Touching this performs reading schedule setting data from the USB memory. Valid when SCHEDULE is selected for ITEM.

SAVE: Touching this performs writing the item selected for ITEM in the USB memory. When the USB memory works, “USB” is shown in orange.



CAUTION

Do not turn off the power supply while reading from or writing in the USB. If not, it results in malfunction.

(Note 1) Contents of USB data

- The data contents of measured value “measure-*.csv” (* indicates 0 to 1000), measured value history “hist_measure-*.csv” (* indicates 0 to 1000), and error history “hist_error-*.csv” (* indicates 0 to 1000) are as follows. For item code table, refer to “Chapter 12, (5) Code Table of Communication and USB Data.”

Column	Item	Display/contents
A	Schedule number	1 to 127
B	Year / month / day hour : minute: second	
C	Measurement item code 1	Refer to the Measurement code table.
D	Judgment item code 1	Refer to the Judgment code table.
E	Measured value 1	
F	Measurement item code 2	Refer to the Measurement code table.
G	Judgment item code 2	Refer to the Judgment code table.
H	Measured value 2	
I	Measurement item code 3	Refer to the Measurement code table.
J	Judgment item code 3	Refer to the Judgment code table.
K	Measured value 3	
L	Measurement item code 4	Refer to the Measurement code table.
M	Judgment item code 4	Refer to the Judgment code table.
N	Measured value 4	
O	Measurement item code 5	Refer to the Measurement code table.
P	Judgment item code 5	Refer to the Judgment code table.
Q	Measured value 5	
R	Measurement item code 6	Refer to the Measurement code table.
S	Judgment item code 6	Refer to the Judgment code table.
T	Measured value 6	
U	Measurement item code 7	Refer to the Measurement code table.
V	Judgment item code 7	Refer to the Judgment code table.
W	Measured value 7	
X	Measurement item code 8	Refer to the Measurement code table.
Y	Judgment item code 8	Refer to the Judgment code table.
Z	Measured value 8	
AA	Measurement item code 9	Refer to the Measurement code table.
AB	Judgment item code 9	Refer to the Judgment code table.
AC	Measured value 9	
AD	Measurement item code 10	Refer to the Measurement code table.
AE	Judgment item code 10	Refer to the Judgment code table.
AF	Measured value 10	

- The data contents of CURRENT ALL CYCLE “curr_allcycle_*.csv” (* indicates 0 to 1000) are as follows.

Column/Cell	Item	Display/range
A	Current flow time	In unit(s) of 1 ms or 0.5 CYC
B	Measurement range	Shows * for measurement range and space for non-measurement range.
C	Current value	Shows current value for every current flow time.
D	Voltage value	Shows voltage value for every current flow time.
E	conduction angle	Shows Displays the conduction angle for each weld time.

- The data contents of FORCE ALL CYCLE “force_allcycle_*.csv” (* indicates 0 to 1000) are as follows.

Column/Cell	Item	Display/range
A	Current flow time	In units of 10 ms
B	Measurement range	Shows * for force measurement range and space for non-measurement range.
C	Force value	Shows force value for every 10 ms.
D	Measurement range	Shows * for external output measurement range and space for non-measurement range.
E	External output value	Shows external output value for every 10 ms.

- The data contents of WAVEFORM “wav_*.csv” (* indicates 0 to 1000) are as follows.

Column/Cell	Item	Display/range
A	Current flow time	In unit of sampling interval
B	Waveform 1	WAVEFORM 1 in the VIEW screen
C	Waveform 2	WAVEFORM 2 in the VIEW screen
D	Waveform 3	WAVEFORM 3 in the VIEW screen
E	Waveform 4	WAVEFORM 4 in the VIEW screen

- The data contents of the saved CURRENT ALL CYCLE2 "curr_allcycle2_*.csv" (* indicates 0 to 1000) are the measured value "measure-*.csv" and the current all cycle "curr_allcycle_*.csv". Data is saved in the order of measured value and current all cycles.

- The data contents of the saved FORCE ALL CYCLE2 "force_allcycle2_*.csv" (* indicates 0 to 1000) are the measured value "measure-*.csv" and the current all cycle "force_allcycle_*.csv". Data is saved in the order of measured value and force all cycles.

- The data contents of saved WAVEFORM2 "wav2_*.csv" (* indicates 0 to 1000) are measured value "measure-*.csv" and waveform "wav_*.csv". Data is saved in the order of measured values and waveforms.

(Note 2) About the USB memory

USB memories formatted as FAT16 or FAT32 are supported. Those formatted as exFAT or NTFS are not supported. (*)

We have confirmed the operations of the following USB memories (as of August 2017).

Manufacturer	Model	Capacity
ELECOM	MF-SU308GSV	8 GB
	MF-KSU2A16GSV	16 GB
	MF-PSU316G* *1	16 GB
	MF-KSU2A32GSV	32 GB
	MF-MSU3A04G* *1	4 GB
I/O DATA	U3-CPSL8G/* *1	8 GB
BUFFALO	RUF3-K8GA-* *1	8 GB
	RUF3-PS8G-* *1	8 GB
	RUF3-SMA8G-* *1	8 GB
	RUF3-SMA32G-* *1	32 GB
SONY	USM8GR* *1	8 GB
SanDisk	SDCZ33-016G-J57	16 GB
Transcend	TS16GJF700PE	16 GB

1: "" indicates color.

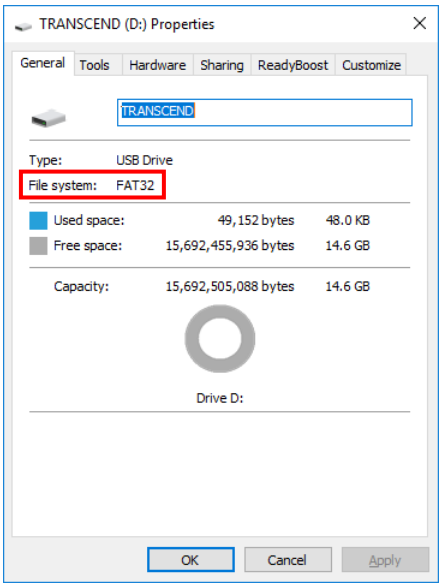
The operations of USB memories were confirmed by us and are not guaranteed. Please note that we do not take responsibility for any damage caused by using them.

Due to the circumstances of manufactures, specifications of USB memories may be changed. Please note that USB memories may not work normally depending on the changes.

(*) About the USB memory format (FAT16, FAT32, NTFS, and exFAT)

- FAT16: A format used in MS-DOS or later, and it can't be over 4 GB.
- FAT32: A format used in Windows 98 and later, and it can't be over 32 GB.
- NTFS: A format used as system drive such as HDD and SSD to install Windows NT and later, and it supports up to 256 TB almost limitlessly.
- exFAT: A format used in a large capacity SD memory card (SDXC etc.) mainly used in digital camera and digital video camera, and it supports up to 256 TB almost limitlessly.

In advance, point a mouse cursor to the USB drive in the Explorer on a Windows computer etc. and right-click [Properties (R)] to check the USB in use by the file system.



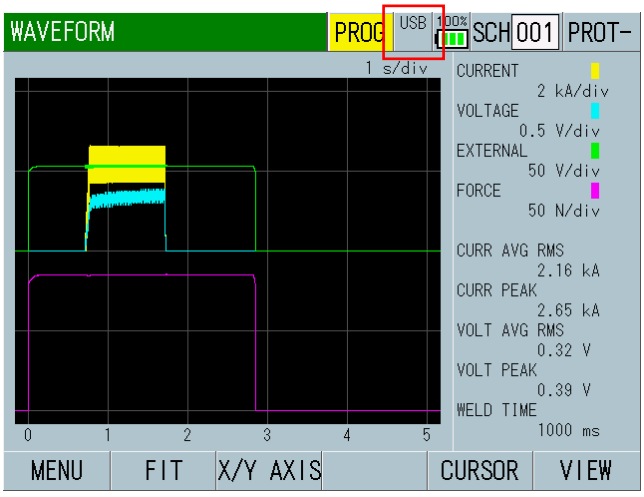
(Note 3) About using a brand-new USB memory

Before using a brand-new or freshly-formatted USB memory on the **MM-410B**, create a file in advance on a Windows computer, etc. and save it in USB.

If there is not file to save, an empty text file doesn't matter. It can be created by right-clicking in the Explorer to execute "New" – "Text Document." Create a text file and change the filename.

(Note 4) About the display of USB memory

When a usable USB is inserted in the **MM-410B**, "USB" is shown at the upper portion of the screen. To save data, be sure to confirm this display.



(Note 5) About the use of USB memory

Store data saved in the USB memory into a computer periodically without leaving the saved data. When deleting all files after storing data, perform (Note 3).

Also, the USB memory has a write-in life, so when it takes time to write-in longer than before or garbled character is generated in the written file, replace it.

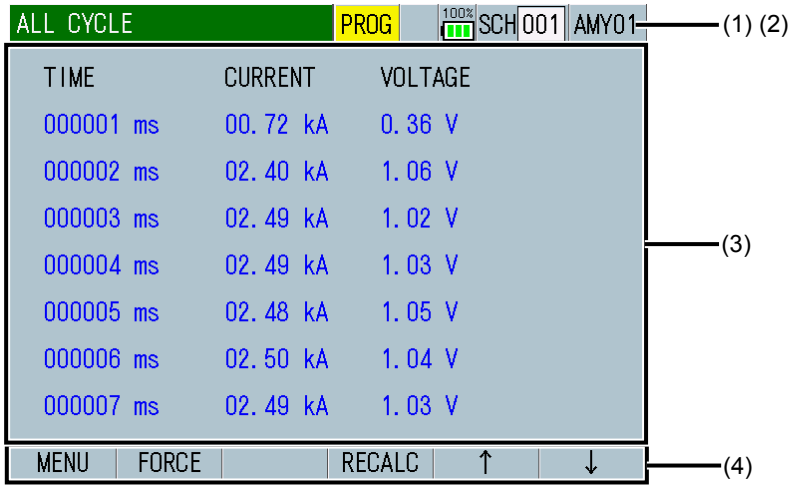
The life of the USB memory can be extended by moving data at short intervals without leaving the saved data and using it with large free space.

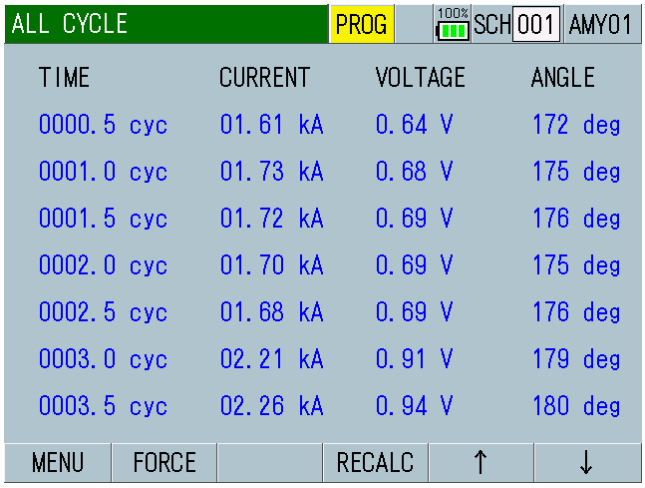
h. ALL CYCLE Screen

Can not be used in the ISO17657 mode, but in the original mode.

With this function, current flow result after measurement every half cycle or 1 ms and measurement result of force/external input every 10 ms can be analyzed in detail.

h-1. ALL CYCLE Screen (Current)





(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) 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.

(4) Function keys

MENU: Touching this displays the MENU screen.

FORCE: Touching this displays the ALL CYCLE screen (Force).

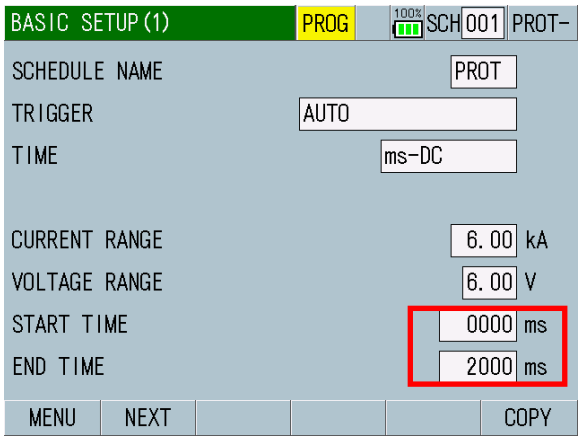
RECALC: Touching this recalculates the measured current and voltage. Use this function to redo the calculation of the arithmetic mean over a new calculation interval after changing the start and end cycle (MEAS START, MEAS END) settings in the BASIC SETUP (1) screen.

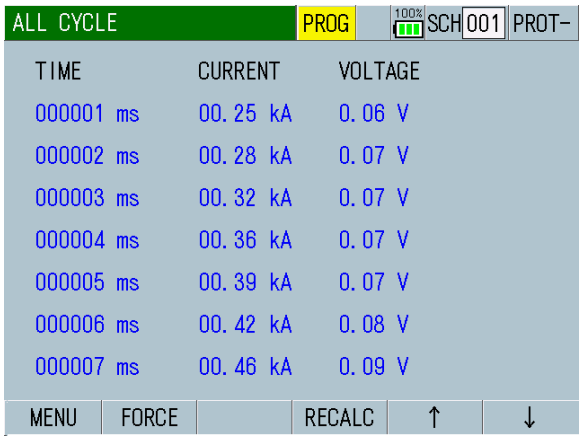
↑↓: Touching this moves a page of the screen.

*1: Conduction angle appears only when CYC-AC, CYC***Hz-AC or LONG CYC-AC is selected for TIME in the BASIC SETUP (1) screen.
*2: The measured value does not appear in the ALL CYCLE screen if SHORT ms-DC is selected for TIME in the BASIC SETUP (1) screen.

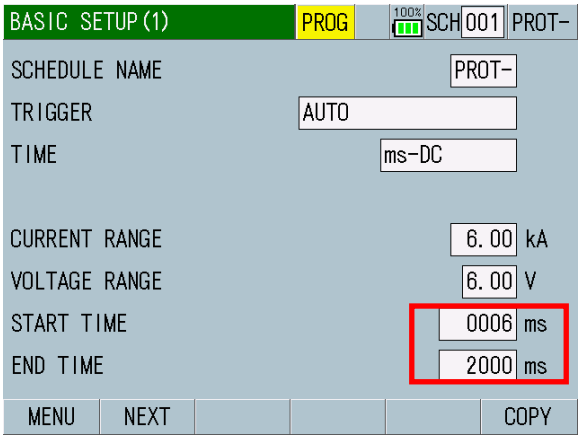
(*) How to execute RECALC of current, voltage and conduction angle

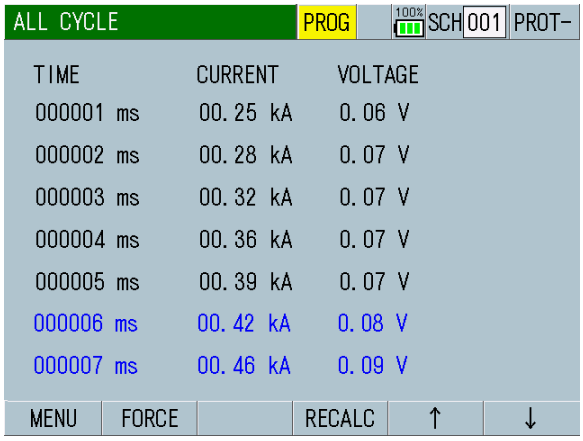
1) Before executing RECALC: Measurement range 0 to 2000 ms





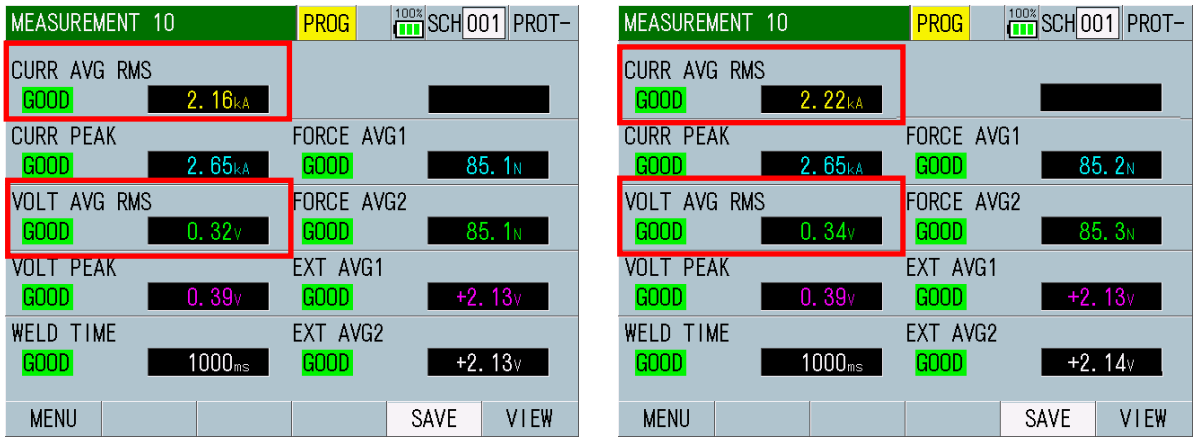
2) Change the measurement start to 6 ms and touch the RECALC key. The color of range omitted from calculation (1 to 5 ms) changes from blue to black.



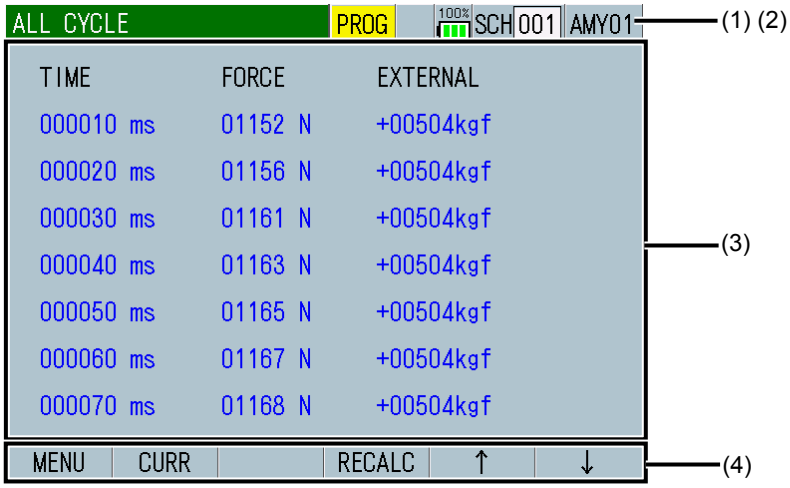


3) Left: Measured value before recalculation Right: After recalculation

Since the RMS calculation starts from 6 ms, the rising part is omitted from the measured value.



h-2. ALL CYCLE Screen (Force)



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) RMS per cycle

Shows the RMS FORCE and EXTERNAL every 10 ms. The area with values shown in blue represents the calculation interval.

(4) Function keys

MENU: Touching this displays the MENU screen.

CURR: Touching this displays the ALL CYCLE screen (Current).

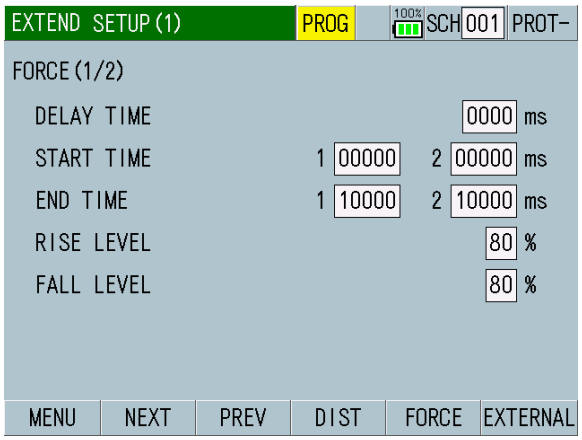
RECALC: Touching this recalculates the measured force and external input. Use this function to redo the calculation of the mean over a new calculation interval after changing the force start and end cycle (START TIME, END TIME) settings in the EXTEND SETUP (1) screen and changing the external input start and end cycle (START TIME, END TIME) settings in the EXTEND SETUP (3) screen.

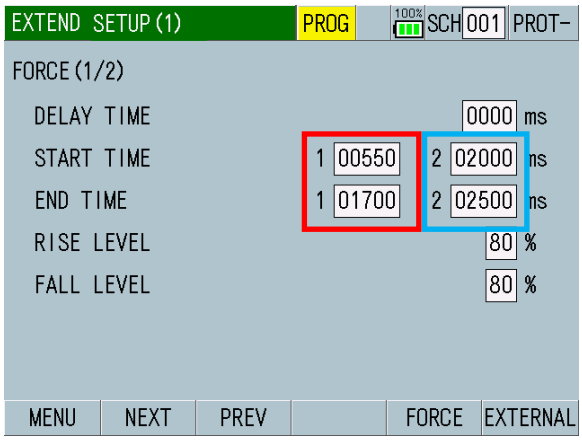
↑↓: Touching this moves a page of the screen.

(*) How to execute RECALC of force and external

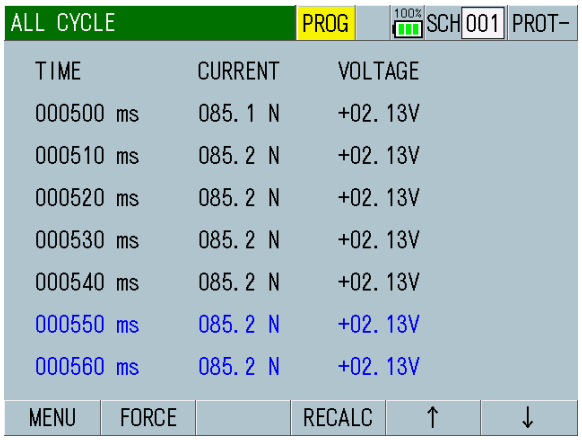
1) Just like RECALC of current/voltage/conduction angle, change start time and end time of force to recalculate after measurement. The external input is are also similar.

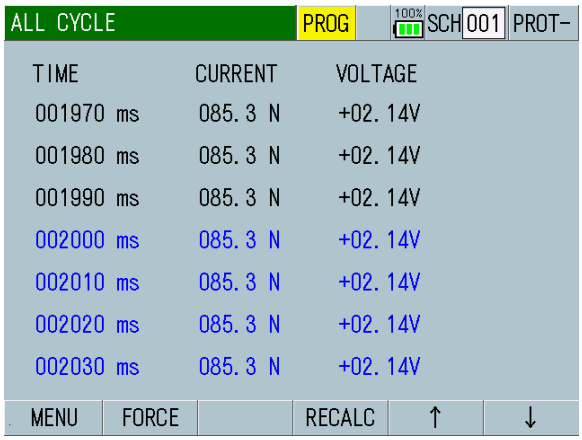
Left: Schedule of measurement before recalculation Right: Schedule of recalculation



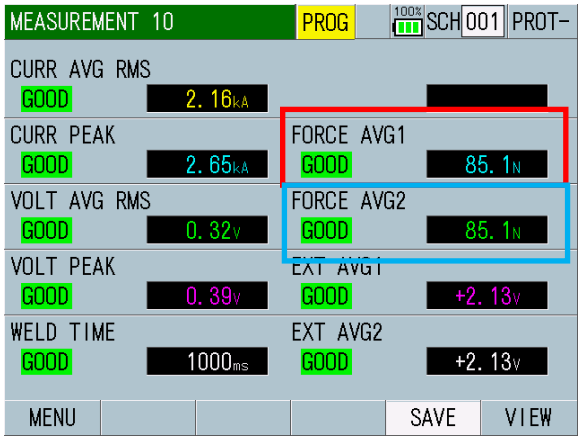


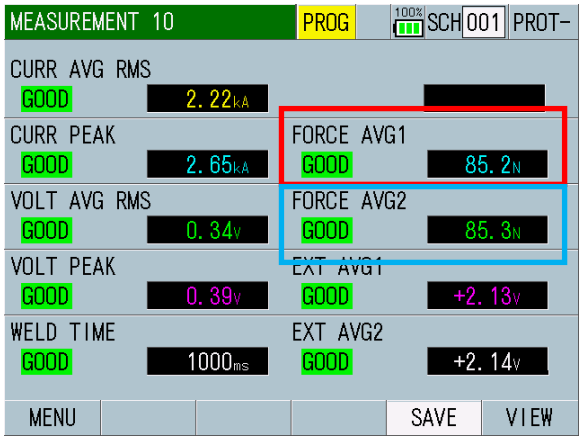
2) Touching the RECALC key changes the color of range omitted from calculation from blue to black. Left: Force average 1 Right: Force average 2





3) Left: Measured value before recalculation Right: After recalculation



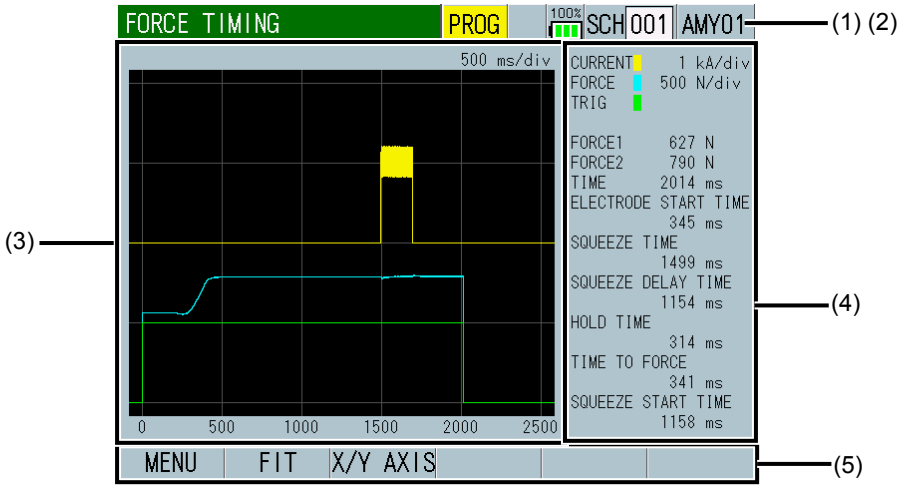


i. FORCE TIMING Screen

The FORCE TIMING screen is for checking the timing from when the force starts, the current flows, until when the force ends. Displays waveforms and measured values.

Note1: Set the followings in advance.
Set TRIGGER to FORCE in the BASIC SETUP (1) screen and MODE to NORMAL in the SYSTEM SETUP (1) screen.
Also, the force waveform can be displayed when the force reaches the preset force trigger level and the current reaches the current trigger level, and then both force and current are measured.

Note2: This screen is shown only when the FORCE TIMING screen is selected from the MENU screen. To display the next force timing, go to the MEASUREMENT, WAVEFORM or ALL CYCLE screen and display the FORCE TIMING screen after measurement.



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) Waveform display

Shows the current[*2], force[*2] and force external trigger[*1] waveforms.

(4) Force time

Shows the following items: ((1) to (6) correspond to the numbers in the figure on the next page.)

Force 1 (FORCE 1)[*3]: Mean force over force calculation interval 1

Force 2 (FORCE 2)[*3]: Mean force over force calculation interval 2

Force Time (TIME)[*3]: Time from when the force signal exceeds the force trigger level to when the signal reaches the force end level

Force Start Time (ELECTRODE START TIME)[*1] (1): Time from the external input signal “FORCE TRIGGER” input to when the force signal exceeds TRIGGER LEVEL

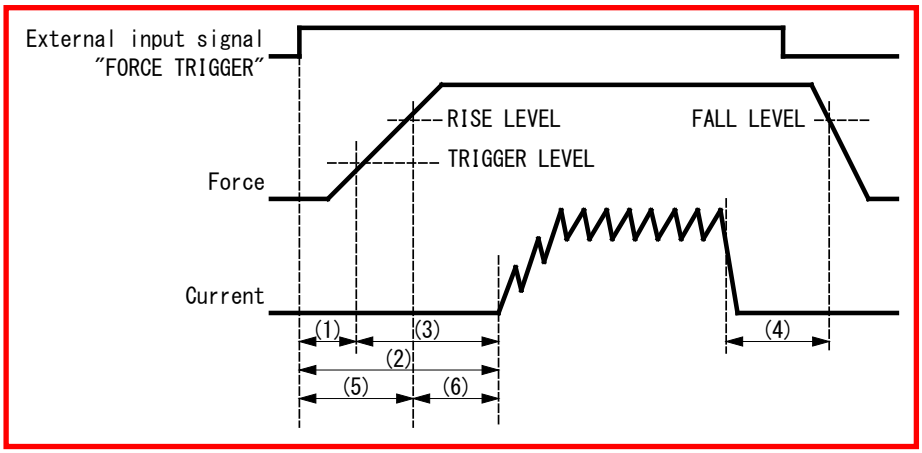
Squeeze Time (SQUEEZE TIME)[*1] (2): Time from the external input signal “FORCE TRIGGER” input to the start of current flow

Force Stabilization Time (SQZ DELAY TIME)[*2] (3): Time from when the force signal exceeds TRIGGER LEVEL to the start of current flow

Hold Time (HOLD TIME)*2 (4): Time from the end of current flow to when the force signal falls below FALL LEVEL

Force Completion Time (TIME TO FORCE)*1 (5): Time from the external input signal “FORCE TRIGGER” input to when the force signal becomes RISE LEVEL

Current Start Time (SQUEEZE START TIME)*2 (6): Time from when the force signal exceeds RISE LEVEL to the start of current flow



(5) Function keys

MENU: Touching this displays the MENU screen.

FIT: Touching this redisplays the waveforms by automatically resizing them to fit into the screen.

X/Y AXIS: Touching this displays the scale command of XY axis at the function key. For the scale command of XY axis, refer to (2) d (7) in Chapter 8.

*1: Shown when force and current are measured using the external input signal “FORCE TRIGGER.”
*2: Shown when force and current are measured.
*3: Not shown if FORCE1, FORCE2 or FORCE TIME is not selected in the VIEW screen.

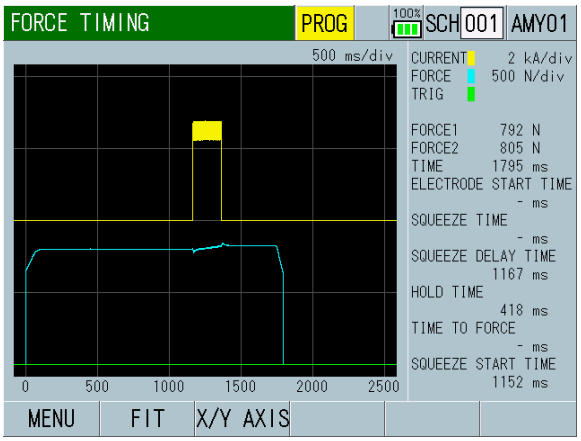
[Force measurement start timing]

There are two ways for measurement, a way to start when the weld force reaches the preset TRIGGER LEVEL without using the external input signal “FORCE TRIGGER” and a way to start measurement using the external input signal “FORCE TRIGGER” (force valve driving signal) together.

In the first case, Force start time, Squeeze time and Force completion time cannot be measured, but in the latter case, all items can be measured by inputting the external input signal “FORCE TRIGGER.”

- Way to start when the weld force reaches the preset TRIGGER LEVEL

The timing from when the welding head starts applying force, the welding current flows, until when the force ends is measured. When the weld force exceeds TRIGGER LEVEL, the measurement starts. For the force trigger level, refer to “k-2. EXTEND SETUP (2) Screen.” Taking the force start point as the reference point of time axis (horizontal axis), force and current waveforms are displayed and each timing can be observed. The unit of horizontal axis is ms. Force 1, Force 2, Force time, Current stabilization time, Hold time, and Current start time are displayed in the area of displaying measured values.

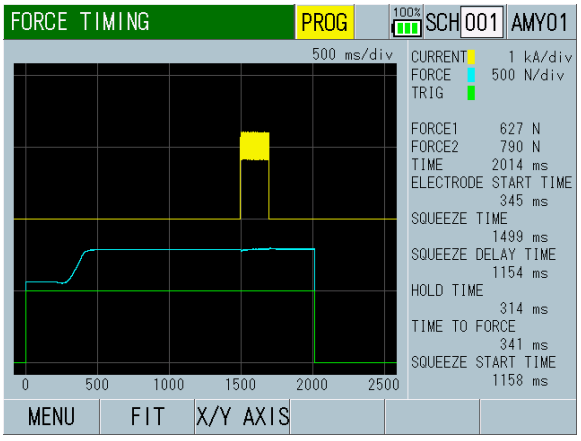


- Way to start measurement using the external input signal “FORCE TRIGGER” (force valve driving signal) together

The timing from when the force valve driving signal of the welding head is input, the welding head starts applying force, the welding current flows, the force valve driving signal is turned off, until when the force ends is measured.

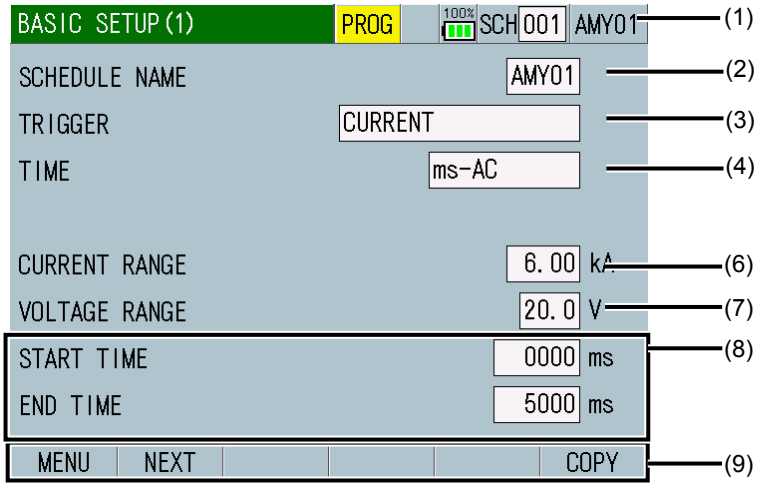
Turn off 24V DC by inputting the external input signal “FORCE TRIGGER” simultaneously with the force valve driving signal of the welding head. When the force valve uses the welding head with 24V DC specification, you can divide the force valve driving signal to input. The input terminal of the external input signal “FORCE TRIGGER” does not have polarity.

Taking the timing of the external input signal “FORCE TRIGGER” input as the reference point of time axis (horizontal axis), force external trigger, force and current waveforms are displayed on the screen and each timing can be observed. The unit of horizontal axis is ms. Since the screen is for measuring the timing, the vertical axis has no unit. Force 1, Force 2, Force time, Force start time, Squeeze time, Force stabilization time, Hold time, Force completion time, and Current start time are displayed in the area of displaying measured values.



j. BASIC SETUP Screen

j-1. BASIC SETUP (1) Screen



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) SCHEDULE NAME

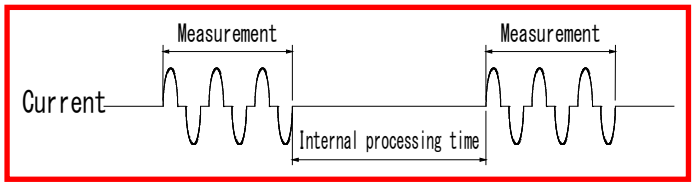
Inputs the name for the set schedule. Up to five alphanumeric characters can be input.

(3) TRIGGER

Select an input signal required to start measurement.

When the TRIGGER setting is changed, upper and lower limits for measurement items WELD TIME and FLOW TIME and TIME, START TIME, END TIME, COOL TIME, and MEASUREMENT MIN TIME on the BASIC SETUP screens may be initialized. Set upper and lower limits and TIME, START TIME, END TIME, COOL TIME, and MEASUREMENT MIN TIME on the BASIC SETUP screens again. (Refer to "e. COMPARATOR Screen" and "j-2. BASIC SETUP (2) Screen.")

- CURRENT
  Force and external voltage/current input are not measured.
  The instrument performs measurement each time a current signal is input, showing the measured values, waveforms and all cycles. The internal processing time varies depending on the current flow time. As a result, the internal processing may not be complete before next measurement. To pass multiple current pulses, refer to PULSE MODE in the BASIC SETUP (2) screen.



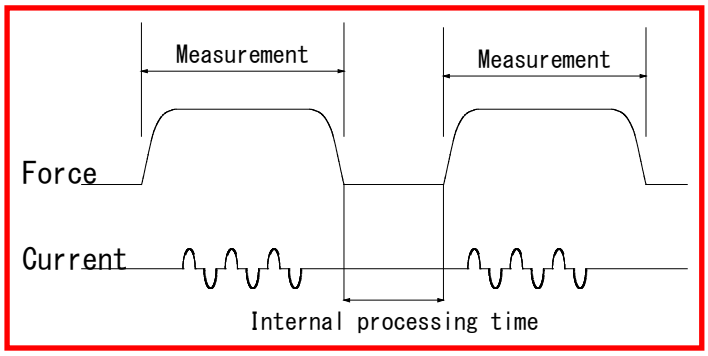
- AUTO
  The first input among 1) current, 2) force or external input (±10 V voltage or 4 to 20 mA current), and 3) force trigger or external force trigger triggers measurement.

1) When current is a trigger, the instrument operates in the same manner as in the CURRENT setting for TRIGGER.

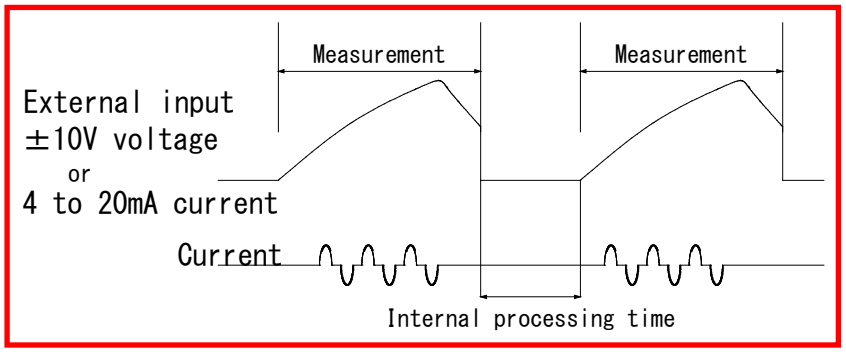
2) When force or external input is a trigger, the instrument operates in the same manner as in the FORCE or EXTERNAL setting for TRIGGER.

3) When force trigger or external trigger is a trigger, the instrument operates in the same manner as in the FORCE (EXT) or EXTERNAL (EXT) setting for TRIGGER. Note, however, that the instrument starts measurement only upon input of current or force (or external input).

- FORCE
  The instrument performs measurement each time a force signal is input, showing the measured values and waveforms.
  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. To pass multiple current pulses, refer to PULSE MODE in the BASIC SETUP (2) screen.

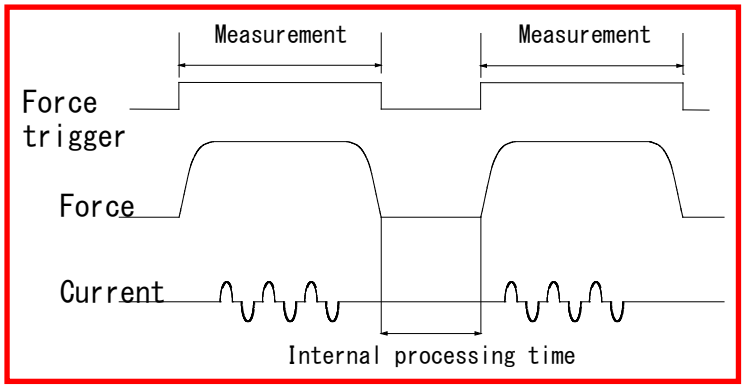


- EXTERNAL
  The instrument starts measurement each time an external input voltage (±10 V) or external input current (4 to 20 mA) is input, making an OK/NG judgment and showing the measured value and waveform.
  The internal processing time varies depending on the external input and current flow time. As a result, the internal processing may not be complete before next measurement. To pass multiple current pulses, refer to PULSE MODE in the BASIC SETUP (2) screen.

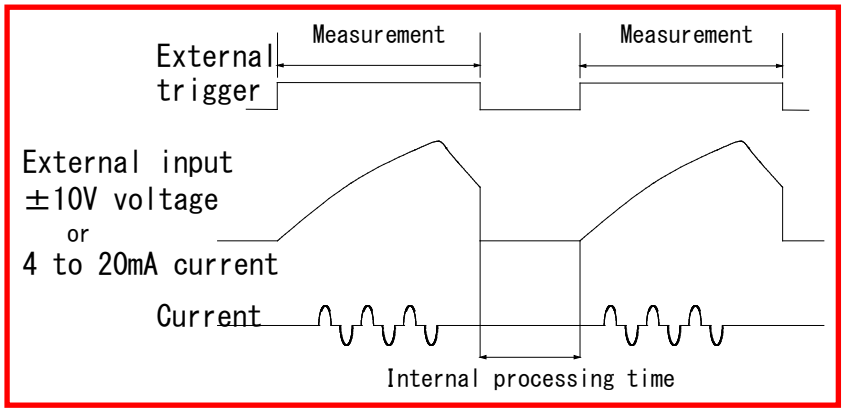


- REAL TIME
  The instrument makes measurement constantly. Force or external input is measured at intervals of half a second. To perform measurement, select FORCE REAL TIME or EXT REAL TIME in the VIEW screen. Measurement stops when MEAS is changed to PROG.

- FORCE (EXT)
  The instrument measures force each time a force trigger of the external input signal is input. The internal processing time varies depending on the current flow and force measurement time. As a result, the internal processing may not be complete before next measurement. To pass multiple current pulses, refer to PULSE MODE in the BASIC SETUP (2) screen.



- EXTERNAL (EXT)
  The instrument measures external input voltage (±10 V) or external input current (4 to 20 mA) each time an external trigger of the external input signal is input. The internal processing time varies depending on the current flow and external input measurement time. As a result, the internal processing may not be complete before next measurement. To pass multiple current pulses, refer to PULSE MODE in the BASIC SETUP (2) screen.



(Reference) TRIGGER setting and measurement

Measurement start item varies depending on the TRIGGER setting.

TRIGGER setting and measurement start item

		Measurement start item					
		CURRENT *1	VOLTAGE	FORCE *1	EXTERNAL *1	FORCE *2 (EXTERNAL INPUT)	EXTERNAL *2 (EXTERNAL INPUT)
TRIGGER setting	CURRENT	○	×	×	×	×	×
	AUTO	○	×	○	○	○	○
	FORCE	×	×	○	×	×	×
	EXTERNAL	×	×	×	○	×	×
	FORCE (EXT)	×	×	×	×	○	×
	EXTERNAL (EXT)	×	×	×	×	×	○

*1: Measurement starts when the set threshold is exceeded.
*2: Measurement starts when IN1 (force) / IN2 (external) of the external input is closed.

TRIGGER setting and measurement item

		Measurement item					
		CURRENT	VOLTAGE	POWER	RESIST	FORCE	EXTERNAL
TRIGGER setting	CURRENT *3	○	○	○	○	×	×
	AUTO *4 *5	○	○	○	○	○	○
	FORCE *6	○	○	○	○	○	○
	EXTERNAL *7	○	○	○	○	○	○
	FORCE (EXT) *8	○	○	○	○	○	○
	EXTERNAL (EXT) *9	○	○	○	○	○	○

*3: Measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.
*4: Measurement of CURRENT/VOLTAGE/POWER/RESIST/FORCE/EXTERNAL is performed when current measurement starts.
*5: Measurement of FORCE/EXTERNAL is performed when any measurement of FORCE/EXTERNAL/FORCE (EXTERNAL INPUT)/EXTERNAL (EXTERNAL INPUT) starts, and then measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.
*6: Measurement of FORCE/EXTERNAL is performed when force measurement starts, and then measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.

*7: Measurement of FORCE/EXTERNAL is performed when external measurement starts, and then measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.
*8: Measurement of FORCE/EXTERNAL is performed when force (external input) measurement starts, and then measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.
*9: Measurement of FORCE/EXTERNAL is performed when external (external input) measurement starts, and then measurement of CURRENT/VOLTAGE/POWER/RESIST is performed when current measurement starts.

Since MEASUREMENT and WAVEFORM set in the VIEW screen are measured, it is necessary to set above TRIGGER setting and measurement item in the VIEW screen.

FORCE (EXT) and EXTERNAL (EXT) operate by the input trigger signal of interface.

Ex.)

- When measuring current:
  Select CURRENT for TRIGGER.
- When measuring current/force with a current/force sensor (**MA-770A/771A**):
  Select FORCE for TRIGGER.

* The same settings applied when measuring current.

- When measuring force with a force sensor (**MA-520B/521B/522B**):
  Select FORCE for TRIGGER.
- When switching measurement of current/voltage with a toroidal coil and measurement of current/voltage/force with a force sensor (**MA-520B/521B/522B**):
  Select AUTO for TRIGGER.
- When measuring force/external (external sensor measurement) according to the current measurement start:
  Select AUTO for TRIGGER.

* Set the trigger level of force/external to the maximum value.

- When measuring an external (external sensor measurement):
  Select EXTERNAL (EXT) or EXTERNAL for TRIGGER.

* The same setting is applied when measuring current.

* When the trigger level setting is difficult because difference between the times when measurement is performed and when not performed is small, it is recommended to use the external input trigger.

(4) TIME

To measure a current accurately, be sure to select “-DC” for DC measurement and “-AC” for AC measurement.

When the TIME setting is changed, upper and lower limits for measurement items WELD TIME and FLOW TIME and TIME, START TIME, END TIME, COOL TIME, and MEASUREMENT MIN TIME on the BASIC SETUP screens may be initialized. Set upper and lower limits and TIME, START TIME, END TIME, COOL TIME, and MEASUREMENT MIN TIME on the BASIC SETUP screens again. (Refer to "e. COMPARATOR Screen" and "j-2. BASIC SETUP (2) Screen.")

When the TRIGGER setting is changed, TIME may be initialized. Set TIME again.

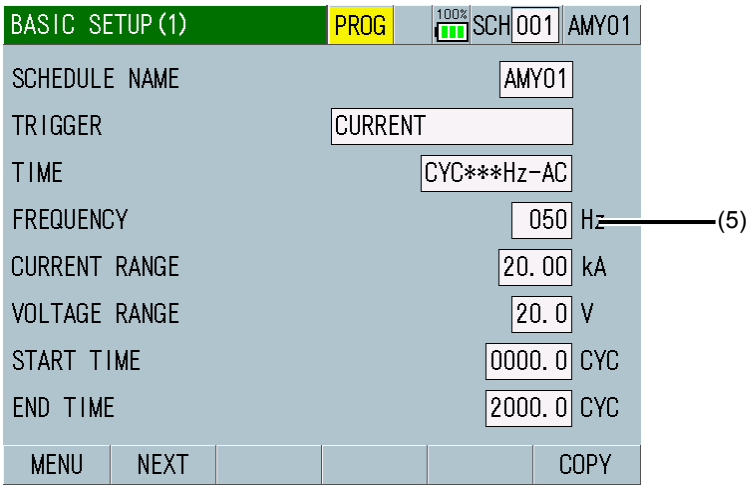
- CYC-AC
  Select this option to measure single-phase AC welding current.
  Frequency: Automatically detected from the **MM-410B**'s power supply
  Measurable time: 5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
- ms-DC
  Select this option to measure DC output inverter welding current in units of ms.
  Measurable time: 2,000 ms max.
- CYC***Hz-AC
  Select this option to measure AC output inverter welding current in units of cycle. Set the frequency of the current you wish to pass in FREQUENCY in the BASIC SETUP (1) screen.
  Measurable time: 4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz): 50 CYC, ... M500 (500 Hz): 2000 CYC)
- CYC-DC
  Select this option to measure DC output inverter welding current in units of cycle.
  Frequency: Automatically detected from the **MM-410B**'s power supply
  Measurable time: 2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
- ms-AC
  Select this option to measure AC output inverter welding current in units of ms.
  Measurable time is 5,000 ms max.
- SHORT ms-DC
  Select this option to measure transistor welding current. The current flow time is 1 ms when ms-DC is selected. In contrast, the current flow time is every 0.05 ms when SHORT ms-DC is selected, thus allowing measurement at more frequent intervals.
  When you have selected SHORT ms-DC, you cannot measure force and external input (±10 V voltage or 4 to 20 mA current).
  To measure the current flow time every 0.05 ms, you need to set CURRENT SAMPLING INTERVAL to 50us. For the CURRENT SAMPLING INTERVAL setting, refer to Chapter 8, "I-2. SYSTEM SETUP (2) Screen."
  Measurable time: 300 ms max.
- LONG CYC-AC
  Select this option to measure single-phase AC welding current for a long period. When you have selected LONG CYC-AC, you cannot measure force and external input (±10 V voltage or 4 to 20 mA current).
  Frequency: Automatically detected from the **MM-410B**'s power supply
  Measurable time: 10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC)

(5) FREQUENCY

When you have selected CYC***Hz-AC for TIME, set the frequency of the current to be measured as follows: M050, M053, M056, M059, M063, M067, M071, M077, M083, M091, M100, M111, M125, M143, M167, M200, M250, M294, M417, M500, 050 to 250 Hz (in unit of 1 Hz).

Set the M*** frequency when using our AC inverter welding power supply.

When you have selected CYC-AC, CYC-DC or LONG CYC-AC for TIME, set the frequency of the current to be measured to 050Hz or 060Hz.



(6) CURRENT RANGE

Select from the following five ranges. Select one which is larger than the maximum current of welding current actually measured and close to the measured current.

Set upper and lower limits in the following ranges depending on the type of toroidal coil connected and according to the TOROIDAL COIL setting in the BASIC SETUP (3) screen:

- When 1x sensitivity coil is used: 2.000 kA range, 6.00 kA range, 20.00 kA range, 60.0 kA range, 200.0 kA range
- When 10x sensitivity coil is used: 0.200 kA range, 0.600 kA range, 2.000 kA range, 6.00 kA range, 20.00 kA range

(7) VOLTAGE RANGE

Select from the following two ranges, Select one which is larger than the maximum voltage of welding current actually measured and close to the measured voltage.

6.00 V: 6.00 V range
20.0 V: 20.0 V range

(8) START TIME / END TIME

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 TIME. However, this is not the measurable time. For the measurable time, refer to TIME.

When the TRIGGER and TIME settings are changed, START TIME and END TIME may be initialized. Set START TIME and END TIME again.

- When TIME is CYC-AC: 000.0 to 300.0 CYC (in units of 0.5 CYC)
- When TIME is ms-DC: 0000 to 2000 ms (in unit of 1 ms)
- When TIME is CYC***Hz-AC: 0000.0 to 2,000.0 CYC (in units of 0.5 CYC)
- When TIME is CYC-DC: 000.0 to 120.0 CYC (in units of 0.5 CYC)
- When TIME is SHORT ms-DC: 000.00 to 300.00 ms (in units of 0.01 ms)
- When TIME is ms-AC: 0000 to 5000 ms (in unit of 1 ms)
- When TIME is LONG CYC-AC: 0.0 to 600.0 CYC (in units of 0.5 CYC)

(9) Function keys

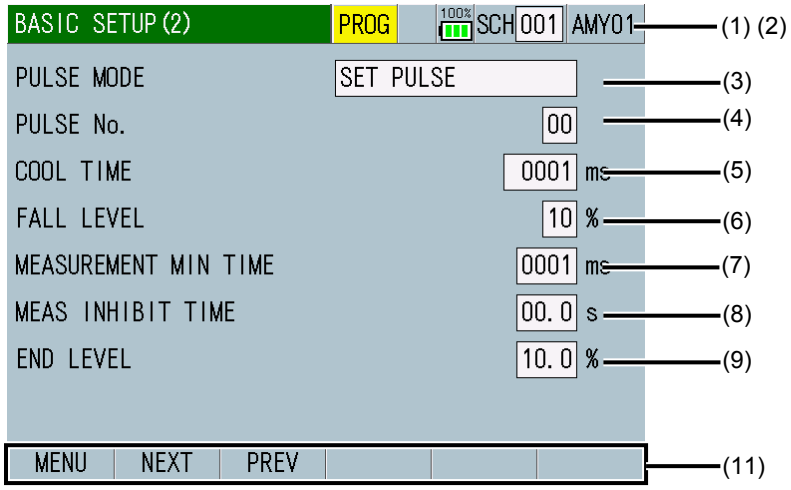
MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the BASIC SETUP (2) screen.

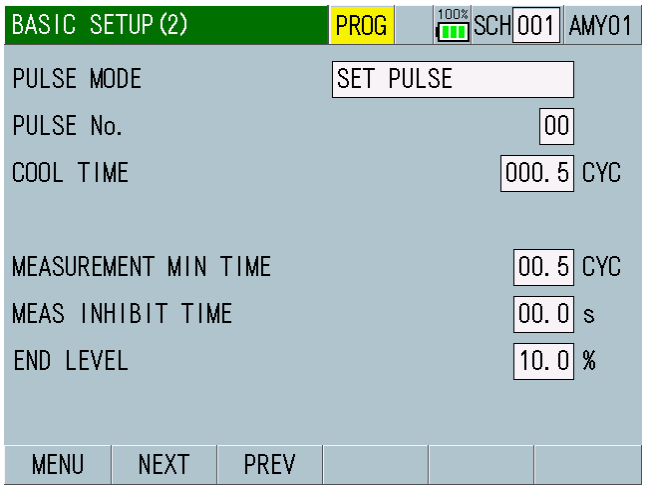
COPY: Touching this copies the settings made under the schedule number 001 (all the settings made in the COMPARATOR, BASIC SETUP, and EXTEND SETUP screens) to all the schedule numbers 002 to 127.

j-2. BASIC SETUP (2) Screen

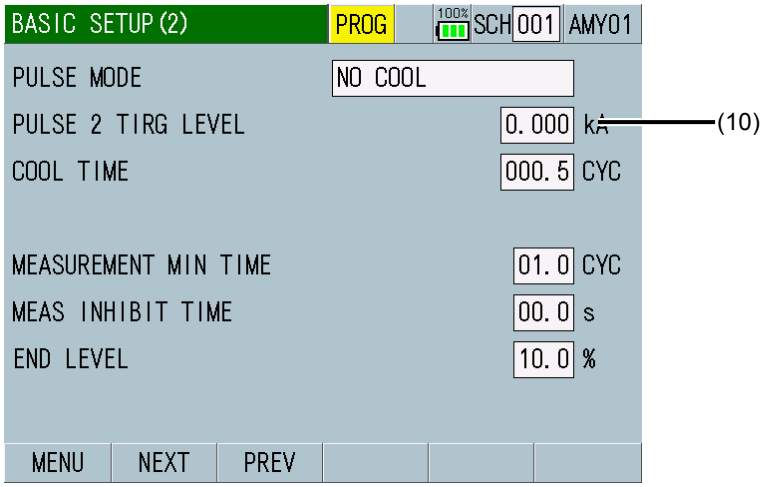
When TIME is DC



When TIME is AC



When PULSE MODE is NO COOL



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

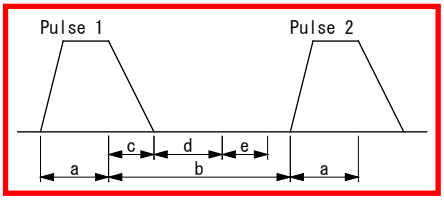
(3) PULSE MODE

For a standard single pulse spot welding, select SET PULSE for PULSE MODE, and “00” for PULSE No.

Current may be passed several times in a single welding sequence. Use the impulse settings to measure an arbitrary step, all steps, and the second step in the 2-step welding with no cooling time. Waveforms of all numbers of measured times are displayed.

(Note) Current flow interval

The cooling time of the welding power supply should be longer than the following current flow interval (time that current does not flow). If the time is shorter, the impulse measurement cannot be performed. The current flow interval should be longer than c + d + e shown below.
For COOL TIME of **MM-410B**, set the time shorter than that of the welding power supply. (Use the initial setting of 0.5 CYC or 1 ms.)
Also, when COOL TIME of **MM-410B** is longer than that of the welding power supply, the measurement is performed as the same pulse.



a: WELD (weld time of the welding power supply)
b: COOL (downtime of the welding power supply)
c: Time until current falls below the END LEVEL setting
d: Time set in COOL TIME
e: 1 CYC when TIME is CYC, 2 ms when TIME is ms

For TIME, refer to Chapter 8, “I-1. BASIC SETUP (1) Screen.”

Even if the impulse settings are used, a welding longer than the following measurable time cannot be measured. The cooling time is included.

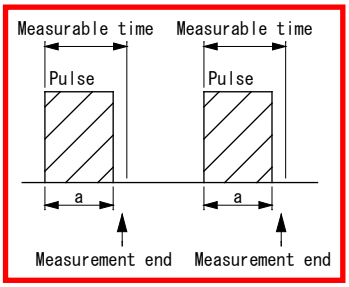
Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

- SET PULSE
  Used when performing the 1-step welding (current is not passed several times) in a single welding sequence or when performing the multi-step welding in a single welding sequence and measuring the specified step

1) 1-step welding (current is not passed several times) in a single welding sequence

Set PULSE No. to “00” (no impulse measurement is performed).



a: WELD

The next measurement is made after a measurement ends.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

2) When performing the multi-step welding in a single welding sequence and measuring the specified step

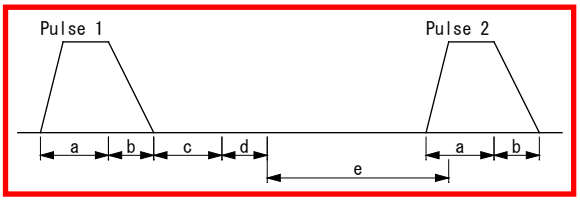
Set an arbitrary step number to measure to PULSE No.

01: Measures the first step, 02: Measures the second step, 20: Measures the twentieth step

When the interval of the several current flows is less than 500 ms, a measurement is made as a single sequence. When 500 ms elapses, a measurement is made as another sequence.

(Note) Current flow waiting time of 500 ms

The current flow waiting time of 500 ms used for impulse measurement is the time after b + c + d.
When the current flow interval is longer than the time of b + c + d + e, a measurement is made as another sequence.

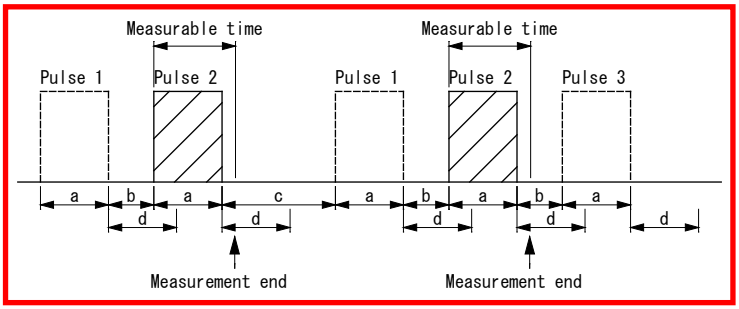


a: WELD (weld time of the welding power supply)
b: Time until the current falls below the END LEVEL setting
c: Time set in COOL TIME
d: 0.5 CYC when TIME is CYC, 1 ms when TIME is ms
e: Current flow waiting time of 500 ms

3-1) When current is first measured, and force or external input is NOT measured

The step set in PULSE No. is measured.

When the interval of the several current flows is less than 500 ms, a measurement is made as a single sequence. When 500 ms elapses, a measurement is made as another sequence.



a: WELD b: COOL, less than 500 ms
c: Interval between welding sequences, more than 500 ms
d: Current flow waiting time of 500 ms

When PULSE No. is set to 2, the second step is measured. When 500 ms elapses, a measurement of a single sequence ends.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

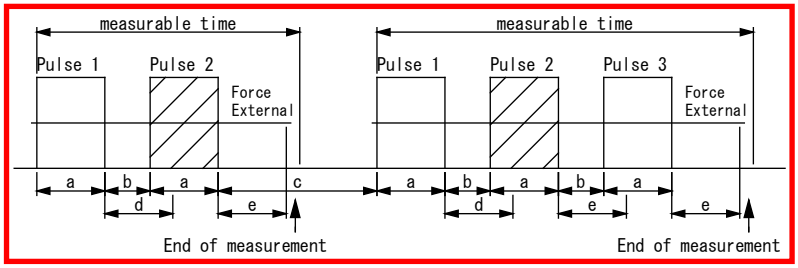
CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

2-2) When current is first measured, and force or external input is measured

The step set in PULSE No. is measured.

Before the specified step is measured, when the interval of the several current flows is less than 500 ms, a measurement is made as a single sequence. When 500 ms elapses, the impulse error occurs. After the specified step is measured, when the interval of the several current flows is shorter than the setting of DELAY TIME of FORCE, or DELAY TIME of EXTERNAL, a measurement is made as a single sequence. When the delay time elapses, a measurement is made as another sequence. A single welding sequence is measured as a single sequence. When the delay time elapses, a measurement is made as another sequence.

(Note) Set DELAY TIME of FORCE, and DELAY TIME of EXTERNAL longer than the cooling time setting of the welding power supply. Set the delay time of the item to measure.



a: WELD b: COOL, less than 500 ms or delay time
c: Interval between welding sequences, more than 500 ms or delay time
d: Current flow waiting time of 500 ms e: Delay time

When PULSE No. is set to 2, the second step and FORCE FINAL or EXT FINAL after the delay time are measured and then ended. When 500 ms elapses before the specified step is measured or when the delay time elapses after the specified step is measured, a measurement of a single sequence ends.

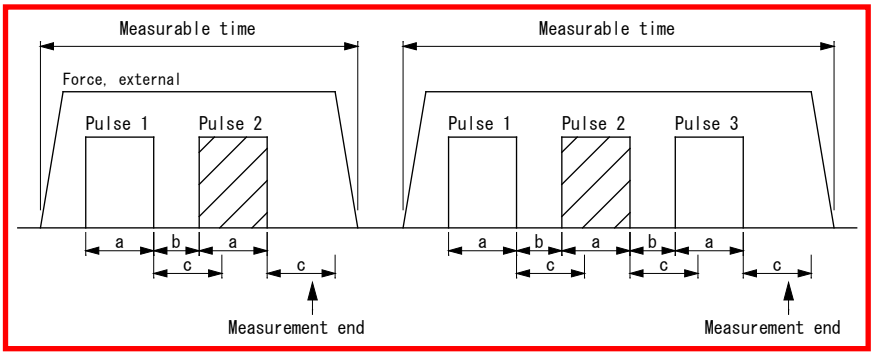
(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

3-3) When force or external is first measured

When the interval of the several current flows is less than 500 ms in the measurement interval of force or external, a measurement is made as a single sequence. When 500 ms elapses, the impulse error occurs.



a: WELD b: COOL c: Current flow waiting time of 500 ms

When PULSE No. is set to 2, the second step is measured. When 500 ms elapses, a measurement of a single sequence ends.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

For DELAY TIME of FORCE, refer to Chapter 8, “k-1. EXTEND SETUP (1) Screen.”

For DELAY TIME of EXTERNAL, refer to Chapter 8, “k-3. EXTEND SETUP (3) Screen.”

- ALL PULSE (SET)
  Used when current is passed several times in a single welding sequence and the number is decided.

The instrument makes measurement of a number of times specified in PULSE No. in a single welding sequence as a single sequence.

When the number of current flow times of PULSE No. has been measured, a current measurement ends regardless of the delay time setting of displacement, force and external.

If the number of current flow times is less than the times specified by PULSE No., the impulse error occurs in the time that current is not passed after the maximum current measurement time elapses.

(Note) In ALL PULSE (SET), set PULSE No. to the same value as the number of current flow times in a single welding sequence.

Measurement schedule and judgment schedule
You need to set measurement schedule and judgment schedule from SCH.# of the measurement start to SCH.# of the number of current flow times.

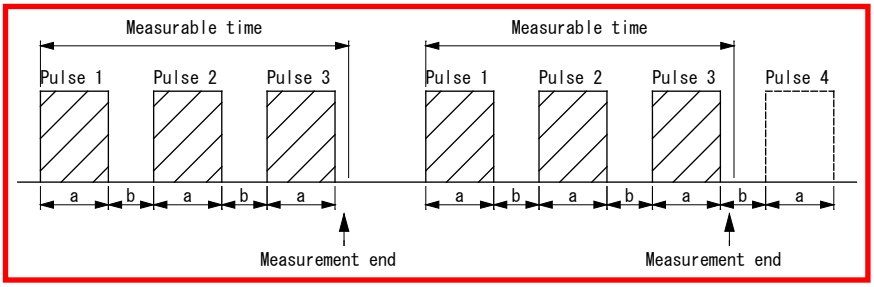
About measurement schedule
Make the SCH# to be used should be the same as the contents in the BASIC SETUP (1) and (2) screens and the EXTEND SETUP (1) and (3) screens

About judgment schedule
As for judgment schedule, the schedule numbers following the schedule number of measurement start are assigned for measurement schedule, for example, first step to the schedule number of measurement start, second step to the start schedule number +1...

Ex.: When making measurement schedules for SCH.#003 to 007 contents in the BASIC SETUP (1) and (2) screens and the EXTEND SETUP (1) and (3) screens the same and measuring the 3-step welding with SCH.#003

Input the judgment schedule of the first step to SCH.#003
Input the judgment schedule of the second step to SCH.#004
Input the judgment schedule of the third step to SCH.#005

1) When current is first measured, and displacement, force or external input is NOT measured

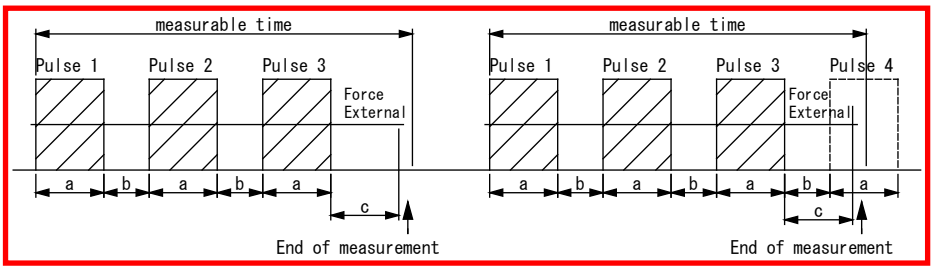


a: WELD b: COOL

When PULSE No. is set to 3, the first to third steps are measured and then ended. The fourth step is not measured.

(Note) For measurable time, refer to “Measurable time of all-pulse measurement for each mode.”

2) When current is first measured, and force or external input is measure



a: WELD b: COOL d: Delay time

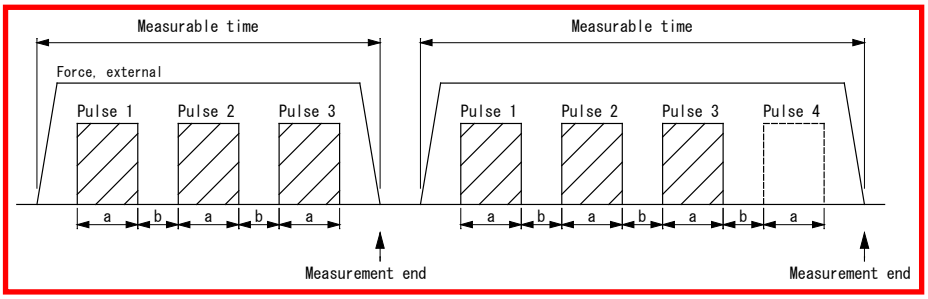
When PULSE No. is set to 3, the first to third steps and FORCE FINAL or EXT FINAL after the delay time are measured and then ended. The fourth step is not measured.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

3) When force or external is first measured



a: WELD b: COOL

When PULSE No. is set to 3, the first to third steps are measured and then ended. The fourth step is not measured.

(Note) For measurable time, refer to “Measurable time of all-pulse measurement for each mode.”

For DELAY TIME of FORCE, refer to Chapter 8, “k-1. EXTEND SETUP (1) Screen.”

For DELAY TIME of EXTERNAL, refer to Chapter 8, “k-3. EXTEND SETUP (3) Screen.”

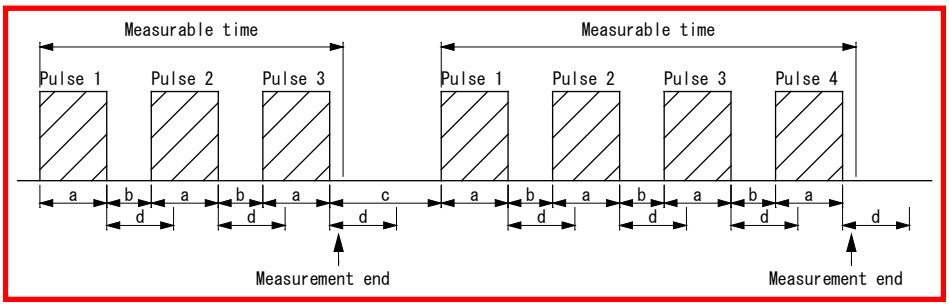
- ALL PULSE (NO SET)
  Used when current is passed several times in a single welding sequence, but the number is not decided.

PULSE No. is not used. When the interval of the several current flows is less than 500 ms, a measurement is made as a single sequence. When 500 ms elapses, a measurement is made as another sequence

The measurement schedule and judgment schedule are the same as those of ALL PULSE (SET). Set the maximum number of current flow times.

(Note) For the current flow waiting time of 500 ms, refer to "･SET PULSE, (Note) Current flow waiting time of 500 ms".

1) When current is first measured, and displacement, force or external input is NOT measured



a: WELD b: COOL, less than 500 ms
c: Interval between welding sequences, 500 ms or more
d: Current flow waiting time of 500 ms

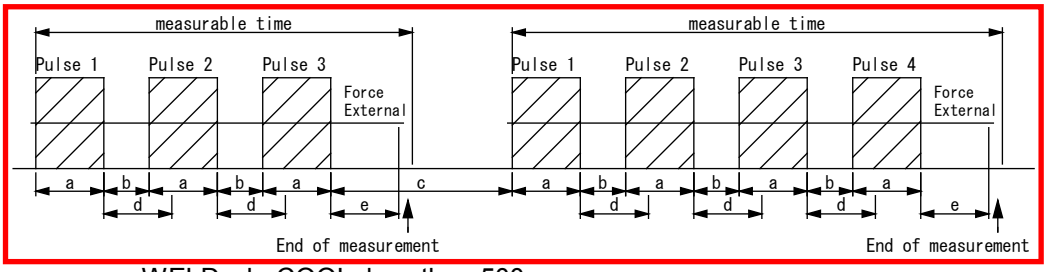
In the 3-step welding, the first to third steps are measured and then ended. In the 4-step welding, the first to fourth steps are measured and then ended. When 500 ms elapses, a measurement of a single sequence ends.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and "00" for PULSE No.

2) When current is first measured, and force or external input is measured



a: WELD b: COOL, less than 500 ms
c: Interval between welding sequences, 500 ms or more
d: Current flow waiting time of 500 ms e: Delay time

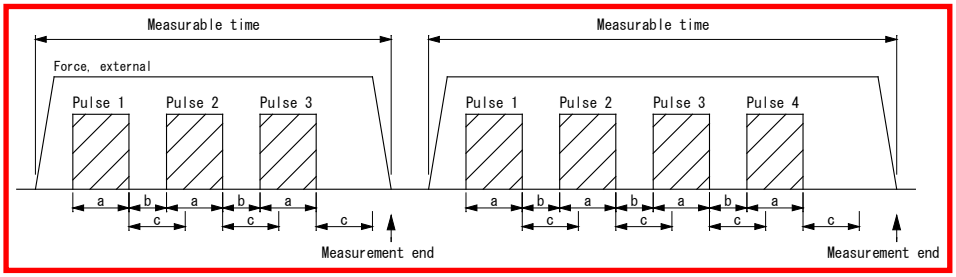
In the 3-step welding, the first to third steps and FORCE FINAL or EXT FINAL after the delay time are measured and then ended. In the 4-step welding, the first to fourth steps and FORCE FINAL or EXT FINAL after the delay time are measured and then ended. When 500 ms elapses, a measurement of a single sequence ends.

(Note) For measurable time,

Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

3) When force or external is first measured



a: WELD b: COOL c: Current flow waiting time of 500 ms

In the 3-step welding, the first to third steps are measured and then ended. In the 4-step welding, the first to fourth steps are measured and then ended. When 500 ms elapses, a measurement of a single sequence ends.

(Note) For measurable time,

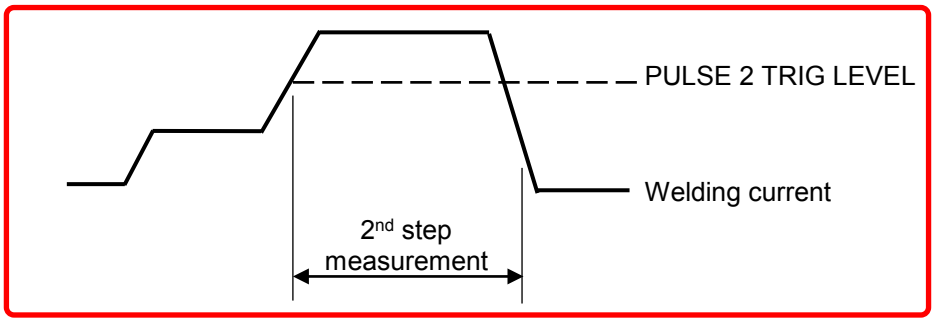
Measurable time of all-pulse measurement for each mode:

CYC-AC	5,000 ms max. (50 Hz: 250 CYC, 60 Hz: 300 CYC)
ms-DC	2,000 ms max.
CYC***Hz-AC	4,000 ms max. (M050 (50 Hz): 200 CYC, M063 (63 Hz), 250 CYC, ... M500 (500 Hz): 2,000 CYC)
CYC-DC	2,000 ms max. (50 Hz: 100 CYC, 60 Hz: 120 CYC)
ms-AC	5,000 ms max.
SHORT ms-DC	300 ms max.
LONG CYC-AC	10 s max. (50 Hz: 500 CYC, 60 Hz: 600 CYC) No impulse measurement is performed. Select SET PULSE for PULSE MODE, and “00” for PULSE No.

For DELAY TIME of FORCE, refer to Chapter 8, “k-1. EXTEND SETUP (1) Screen.”

For DELAY TIME of EXTERNAL, refer to Chapter 8, “k-3. EXTEND SETUP (3) Screen.

- NO COOL (2nd step measurement)
  Set a measurement start current in PULSE 2 TRIG LEVEL. 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 step is larger than that at the first step.



(4) PULSE No.

For a standard single pulse, set “00” for PULSE No.

When SET PULSE is selected for PULSE MODE, set the number of current flow times to measure. When ALL PULSE (SET) is selected, set the number of current flow times in a single welding sequence. When ALL PULSE (NO SET) is selected, any setting is good since PULSE No. is not used.

When NO COOL is selected for PULSE MODE, set a measurement start timing current for PULSE 2 TRIG LEVEL. For PULSE 2 TRIG LEVEL, set a value within the specified measurement range.

When LONG CYC-AC is selected for TIME, no impulse measurement is performed. To operate, select SET PULSE for PULSE MODE, and “00” for PULSE No.

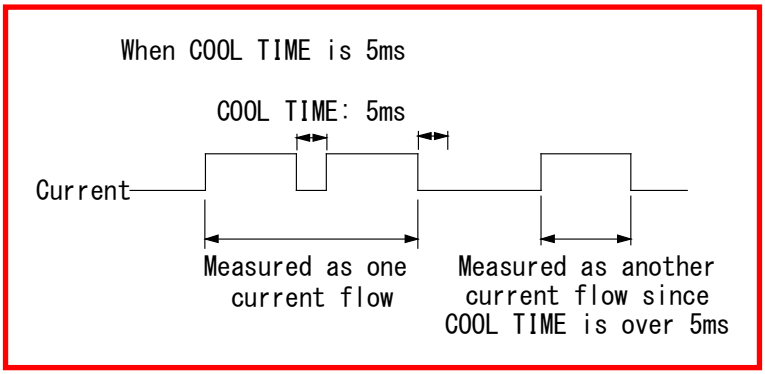
For TIME, refer to Chapter 8, “j-1. BASIC SETUP (1) Screen.”

(5) COOL TIME

If, during current measurement, the COOL TIME (time that current does not flow) is shorter than the value specified here, the instrument makes measurement determining the current to be a single current flow. Set the COOL TIME in the following ranges.

When the TRIGGER and TIME settings are changed, COOL TIME may be initialized. Set COOL TIME again. (Refer to "j-1. BASIC SETUP (1) Screen.")

- When CYC-AC, CYC-DC, LONG CYC-AC, or CYC***Hz-AC is selected for TIME: 000.5 to 100.0 CYC
- When ms-DC or ms-AC is selected for TIME: 0001 to 2,000 ms
- When SHORT ms-DC is selected for TIME: 000.1 to 200.0 ms



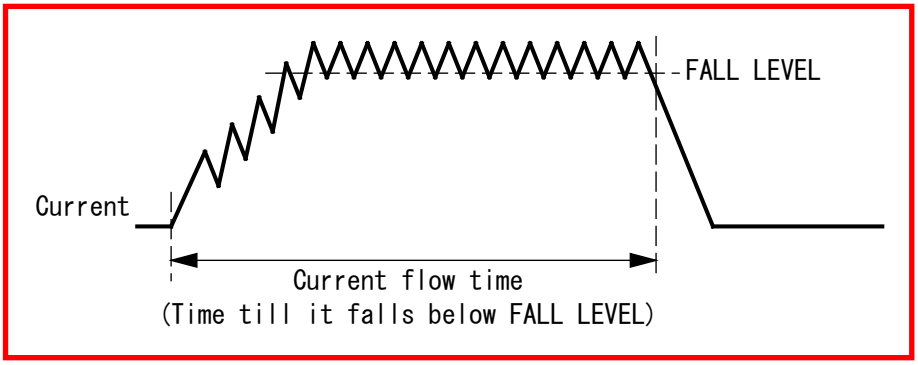
When measuring as a single current flow, set COOL TIME of **MM-410B** longer than the cooling time of the welding power supply.

When measuring as another current flow, set COOL TIME of **MM-410B** shorter than the cooling time of the welding power supply. (Use the initial setting of 0.5 CYC or 1 ms).

(6) FALL LEVEL

When ms-DC, CYC-DC or SHORT ms-DC is selected for TIME, you can measure the current flow time till the FALL LEVEL setting is reached. Set the FALL LEVEL as the ratio to the peak (10 to 90%).

Refer to (Note 1) Difference between the original measurement mode and the ISO17657-compliant measurement mode for RMS calculation in “c. VIEW Screen.”



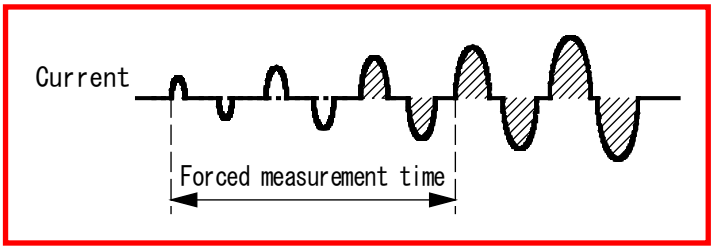
(7) MEASUREMENT MIN TIME

In the early steps 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.) In such a case, set a forced measurement time. Set a forced measurement time in the following ranges.

When the TRIGGER and TIME settings are changed, MEASUREMENT MIN TIME may be initialized. Set MEASUREMENT MIN TIME again. (Refer to "j-1. BASIC SETUP (1) Screen.")

- When CYC-AC, CYC-DC, LONG CYC-AC or CYC***Hz-AC is selected for TIME: 00.5 to 50.0 CYC
- When ms-DC or ms-AC is selected for TIME: 0001 to 1,000 ms
- When SHORT ms-DC is selected for TIME: 000.1 to 100.0 ms

Set a time so that currents of measurable magnitude (shaded areas in the figure) are included.



(8) MEAS INHIBIT TIME

Set a measurement prohibition time (0.0 to 10.0 sec). Select SET PULSE for PULSE MODE, and “00” for PULSE No.

By setting a measurement prohibition time, a non-measurement time following a measurement is provided not to measure a reset current following a welding current flow peculiar to a capacitor-type welding machine.

(9) END LEVEL

You can measure the current flow time till the Current End Level setting is reached. Set the Current End Level as the ratio to the used current range (1.5 to 15.0%).

Refer to (Note 1) Difference between the original measurement mode and the ISO17657-compliant measurement mode for RMS calculation in “c. VIEW Screen.”

(10) PULSE 2 TRIG LEVEL

When you have selected NO COOL for PULSE MODE, this can be set. 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.

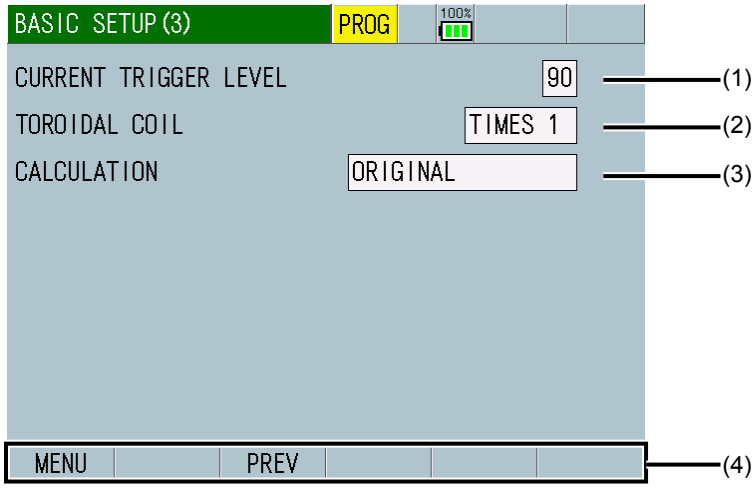
(11) Function keys

MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the BASIC SETUP (3) screen.

PREV: Touching this displays the BASIC SETUP (1) screen.

j-3. BASIC SETUP (3) Screen



(1) CURRENT TRIGGER LEVEL

The sensitivity increases as you increase the value. Excessively increasing the sensitivity may cause malfunction. If set to around 99, the current trigger may not be complete. At the time, decrease the value.

(2) TOROIDAL COIL

Set as follows depending on the type of toroidal coil connected:

When 1x sensitivity coil is used: 1
When 10x sensitivity coil is used: 10

(3) CALCULATION

Select original or ISO17657-compliant to set the calculation system of RMS.

Refer to (Note 1) Difference between the original measurement mode and the ISO17657-compliant measurement mode for RMS calculation in “c. VIEW Screen.”

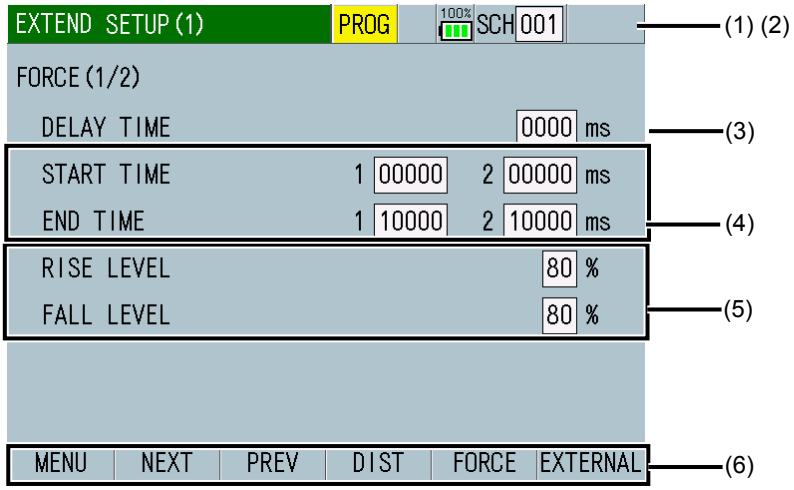
(4) Function keys

MENU: Touching this displays the MENU screen.

PREV: Touching this displays the BASIC SETUP (2) screen.

k. EXTEND SETUP Screen

k-1. EXTEND SETUP (1) Screen: FORCE (1/2)



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

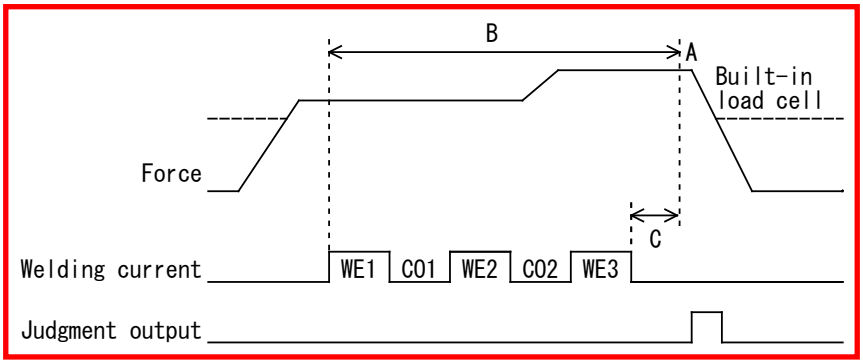
Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) DELAY TIME

Set a delay time from the end of current flow to when the force measurement interval or position is reached in the range from 0 to 1,000 ms.

Be sure that the total of the current flow time, the delay time (including the cooling time between current flows), cooling time, and time to judge the current flow end does not exceed the maximum current measurement range.

Make a measurement in a marginal range since the time to judge the current flow end changed depending on the magnitude of the current.



A: Measurement of “FORCE FINAL”
B: Measurement range of “FORCE PEAK”, “FORCE AVG1” and “FORCE AVG2”
C: Delay time

(4) START TIME / END TIME

By specifying an arbitrary range, you can measure mean force. Set START TIME and END TIME in the range from 0 to 10,000 ms. As for force, there are three input fields for each item because you can specify three ranges for a single measurement and measure the force at three locations.

(5) RISE LEVEL / FALL LEVEL

Set RISE LEVEL and FALL LEVEL as the ratio to the peak (10 to 90%). This setting applies to the time measurements in the FORCE TIMING screen.

(6) Function keys

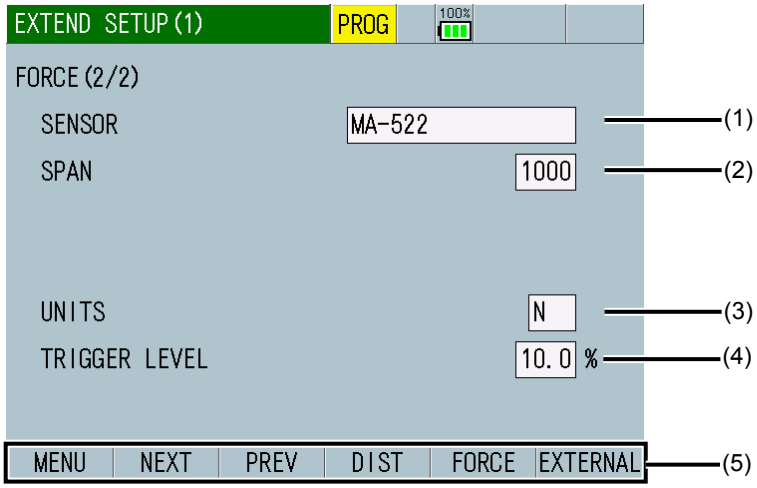
MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the EXTEND SETUP (2): FORCE (2/2) screen.

FORCE: Touching this displays the EXTEND SETUP (2): FORCE (2/2) screen.

EXTERNAL: Touching this displays the EXTEND SETUP (3): EXTERNAL (1/2) screen.

k-2. EXTEND SETUP (2) Screen: FORCE (2/2)



(1) SENSOR

Select the connected force sensor from the following.

Force sensor	SENSOR setting
MA-520-01, MA-520B-00	MA-520
MA-521-01, MA-521B-00	MA-521
MA-522-01, MA-522B-00	MA-522
MA-770A-00	MA-770
MA-771A-00	MA-771

(2) SPAN

Since the sensor have some variation in accuracy, value and force span to correct it are listed on the label of our force sensor and current/force sensor. Set the value of force span on the label to the SPAN (500 to 1,500).

(3) UNITS

Select the force unit used for settings and display related to force from N, kgf, and lbf.

(4) TRIGGER LEVEL

Set a trigger level (2.0 to 99.9%) as the percentage of full scale. A force is measured while it exceeds the trigger level.

Set it to 99.9% when performing measurement according to the current measurement start.

(5) Function keys

MENU: Touching this displays the MENU screen.

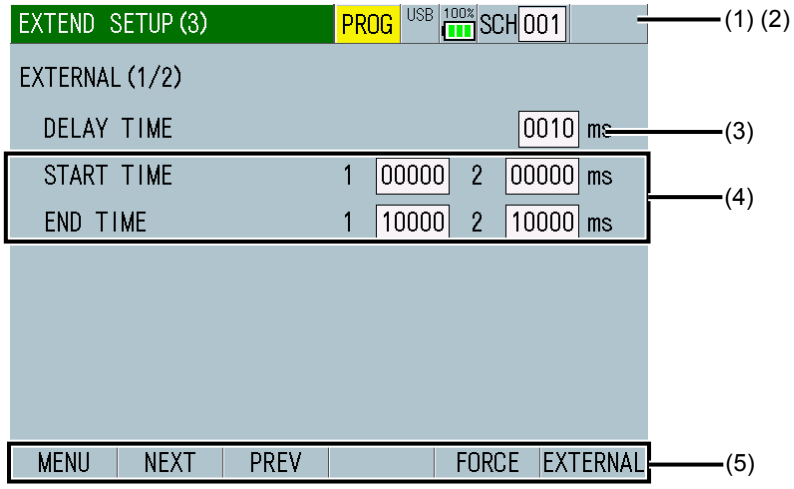
NEXT: Touching this displays the EXTEND SETUP (3): EXTERNAL (1/2) screen.

PREV: Touching this displays the EXTEND SETUP (1): FORCE (1/2) screen.

FORCE: Touching this displays the EXTEND SETUP (1): FORCE (1/2) screen.

EXTERNAL: Touching this displays the EXTEND SETUP (3): EXTERNAL (1/2) screen.

k-3. EXTEND SETUP (3) Screen: EXTERNAL (1/2)



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) DELAY TIME

Set a delay time (welding/external input signal stabilization time) from the end of current flow to when the external input measurement position is reached in the range from 0 to 1,000 ms. Be sure that the total of the current flow time, the delay time (including the cooling time between current flows), cooling time, and time to judge the current flow end does not exceed the maximum current measurement range. Make a measurement in a marginal range since the time to judge the current flow end changed depending on the magnitude of the current.

(4) START TIME / END TIME

By specifying an arbitrary range, you can measure mean external input (±10 V voltage or 4 to 20 mA current input). Set START TIME and END TIME in the range from 0 to 10,000 ms. There are three input fields for each item because you can specify three ranges for a single measurement and measure the external input at three locations.

(5) Function keys

MENU: Touching this displays the MENU screen.

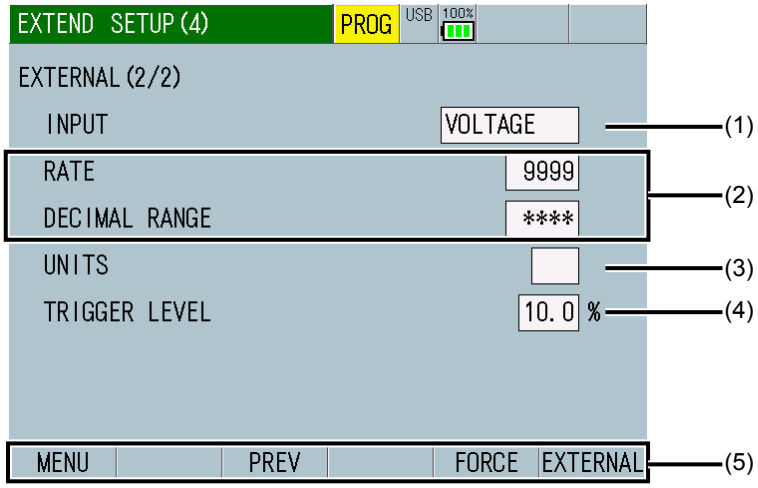
NEXT: Touching this displays the EXTEND SETUP (4): EXTERNAL (2/2) screen.

PREV: Touching this displays the EXTEND SETUP (2): FORCE (2/2) screen.

FORCE: Touching this displays the EXTEND SETUP (1): FORCE (1/2) screen.

EXTERNAL: Touching this displays the EXTEND SETUP (4): EXTERNAL (2/2) screen.

k-4. EXTEND SETUP (4) Screen: EXTERNAL (2/2)



(1) INPUT

Select voltage input (±10 V) or current input (4 to 20 mA).

(2) RATE / DECIMAL RANGE

You can change the setting range of RATE arbitrarily according to the DECIMAL RANGE setting.

DECIMAL RANGE	RATE
*.***	0.500 to 9.999
.	05.00 to 99.99
***.*	050.0 to 999.9
****	0500 to 9999

(3) UNITS

Select the unit used for settings and display of external input from the followings:

No unit / voltage V / force N, kgf, lbf / temperature °C, °F / air pressure Mpa, bar, psi

(4) TRIGGER LEVEL

Set a trigger level (2.0 to 99.9%) as the percentage of full scale. An external input is measured while it exceeds the trigger level.

Set it to 99.9% when performing measurement according to the current measurement start.

(5) Function keys

MENU: Touching this displays the MENU screen.

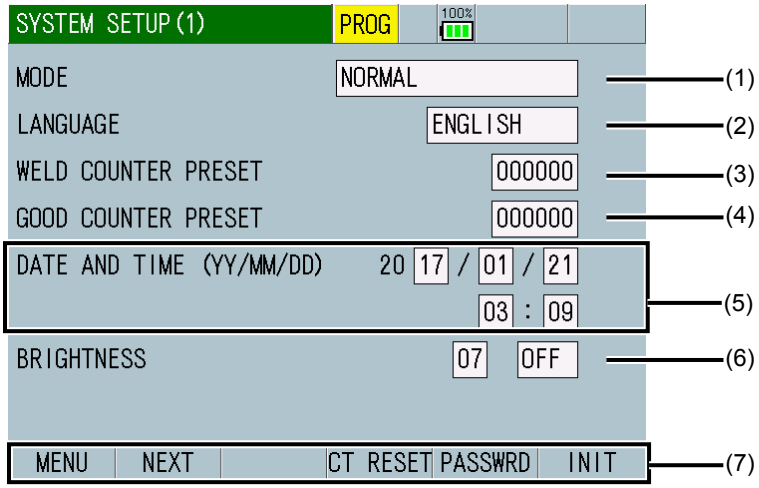
PREV: Touching this displays the EXTEND SETUP (3): EXTERNAL (1/2) screen.

FORCE: Touching this displays the EXTEND SETUP (1): FORCE (1/2) screen.

EXTERNAL: Touching this displays the EXTEND SETUP (3): EXTERNAL (1/2) screen.

I. SYSTEM SETUP Screen

I-1. SYSTEM SETUP (1) Screen



(1) MODE

Select NORMAL, SEAM, NORMAL TRACE, or SINGLE TRACE.

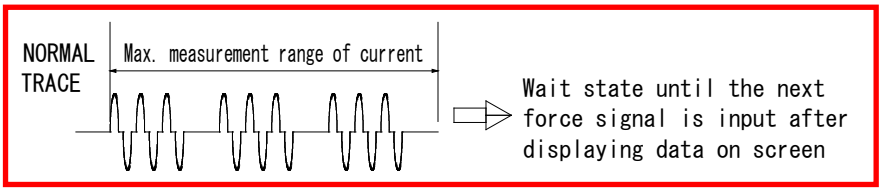
- NORMAL
  The instrument performs measurement each time a current signal is input, showing the measured values and waveforms.
- SEAM
  The instrument measures the seam current and voltage for five minutes maximum.
- NORMAL TRACE
  The instrument measures the maximum measurement range of current upon input of a current signal. 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.

1) Current normal trace mode

The instrument measures the maximum measurement range of current upon input of a current signal. 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. Only waveforms and all cycles are measured.

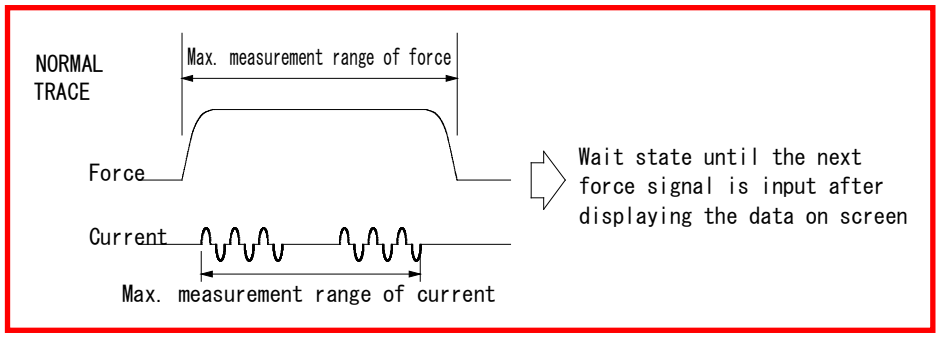
The maximum current measurement range varies as follows depending on the TIME setting in the BASIC SETUP (1) screen:

CYC-AC: 5,000 ms
CYC***Hz-AC: 4000 ms
ms-AC: 2000 ms
CYC-LONG: 1,000 ms (current only)
CYC-DC: 2,000 ms
ms-DC: 2,000 ms
SHORT ms-DC: 100 ms (current only)



2) Force normal trace mode

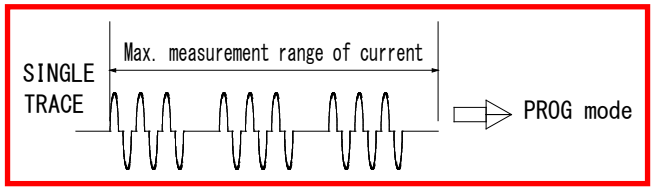
The instrument measures the maximum force measurement time upon input of a force signal. After displaying the data on screen, the instrument goes into wait state until the next force signal is input. The instrument shows "-" in the measured value field without showing the measured value and making any OK/NG judgment on the value. Only waveforms and all cycles are measured. The maximum force measurement range is 10000 ms.



- SINGLE TRACE
  The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters the program mode (PROG). The instrument shows "-" in the measured value field without showing the measured value and making any OK/NG judgment on the value.

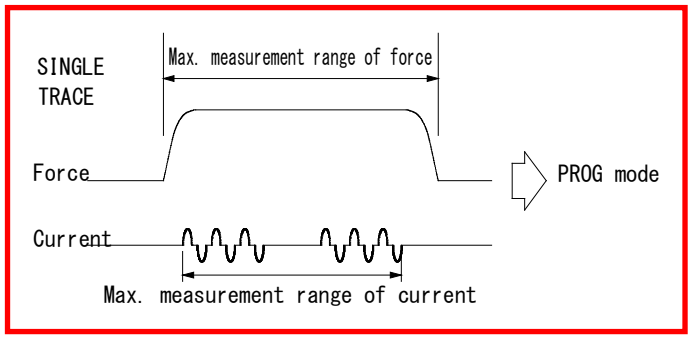
1) Current single-trace mode

The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters program mode (PROG). The instrument shows "-" in the measured value field without showing the measured value and making any OK/NG judgment on the value. Only waveforms and all cycles are measured. The maximum force measurement range is the same as that of normal trace mode.



2) Force single-trace mode

The instrument measures the maximum measurement range of current upon input of a current signal, after which it enters program mode (PROG). The maximum force measurement range is 10000 ms.



(2) LANGUAGE

Select a language for on-screen display from among Japanese, English, Chinese, Korean, French, German and Spanish.

(3) WELD COUNTER PRESET

Set a preset count value (0 to 999,999) of the weld counter. The weld counter counts up by 1 for each measurement whether the value is within upper and lower limits or not. When the counter reaches the preset count value, the COUNT UP signal is output. When “0” is set for the preset count value, the COUNT UP signal is not output.

(4) GOOD COUNTER PRESET

Set a preset count value (0 to 999,999) of the good counter. The good counter counts up by 1 for each measurement only when the value is within upper and lower limits. When the counter reaches the preset count value, the COUNT UP signal is output. When “0” is set for the preset count value, the COUNT UP signal is not output.

(5) DATE AND TIME

Set the date in the format: year (2016 to 2077), month (1 to 12) and day (1 to 31). Set the time in the format: hour (0 to 23) and minutes (0 to 59).

IMPORTANT

Be sure to disconnect the AC adapter before changing date and time. If changed while the AC adapter is inserted for charging, charging will not be performed normally.

(6) BRIGHTNESS

Set the brightness of a screen in the range of 01 to 10 (01: dark ... 10: bright).

When AUTO is set, the energy saving mode is started if no operation is performed within continuing three minutes, and the screen display disappears automatically. Touching the screen again redisplays the screen.

(7) Function keys

MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the SYSTEM SETUP (2) screen.

CT RESET: Touching this resets the counter value.

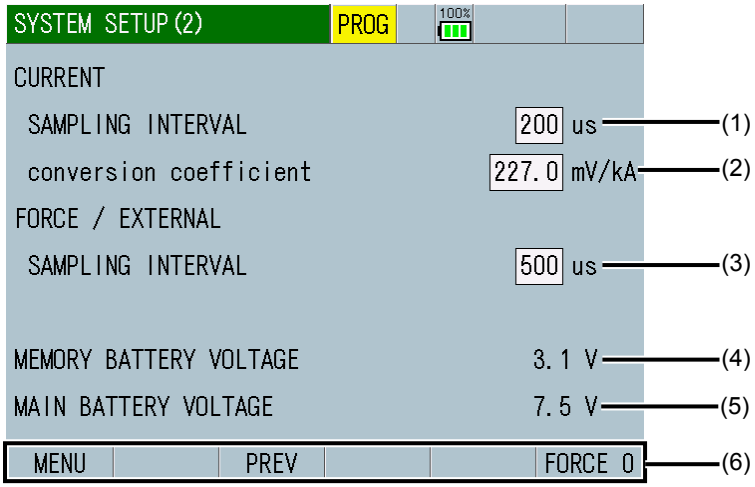
PASSWRD: Touching this displays the PASSWORD screen.

INIT: Touching this initializes all setting conditions. It takes about 60 seconds for initialization.

IMPORTANT

Do not turn off the power supply during initialization. If not, it results in malfunction.

I-2. SYSTEM SETUP (2) Screen



(1) CURRENT SAMPLING INTERVAL

Set the sampling interval of current, voltage, power, and resistance.

20us: Performs measurement (sampling) every 20 us, calculates and displays waveforms every 20 us, and outputs data*1 every 20 us. (Notes 1 and 2)

50us: Performs measurement (sampling) every 50 us, calculates and displays waveforms every 50 us, and outputs data*1 every 50 us. (Note 1)

100us: Performs measurement (sampling) every 100 us, calculates and displays waveforms every 100 us, and outputs data*1 every 100 us.

200us: Performs measurement (sampling) every 100 us, calculates every 100 us, displays waveforms every 200 us, and outputs data*1 every 100 us*2.

*1: Waveform output by communication and USB

*2: In a combination of force and external, data is output every 100 us. In a combination of current, voltage, power, and resistance, data is output every 200 us. When data is output every 100 us, measured values change every 0.2 ms.

100 us interval (calculation)		200 us interval (data output)		Remarks
Time [ms]	Current [kA]	Time [ms]	Current [kA]	
0.0	0.00	0.0	0.00	
0.1	0.50	0.1	0.00	Same as 0.0 ms
0.2	0.60	0.2	0.60	
0.3	0.70	0.3	0.60	Same as 0.2 ms

(Note 1) When 20 µs is selected for SAMPLING INTERVAL and the TIME setting in the BASIC SETUP (1) screen is a setting other than SHORT ms-DC, the sampling interval becomes 50 µs automatically.

(Note 2) When 20 µs or 50 µs is selected for SAMPLING INTERVAL and force or external input is measured, the sampling interval becomes 100 µs automatically.

(2) CURRENT CONVERSION COEFFICIENT

Set a conversion coefficient of toroidal coil. The setting is valid only when TIMES 1 is selected for TOROIDAL COIL. (Refer to (2) in "j-3. BASIC SETUP (3) Screen.") For our ISO toroidal coil (**MB-400P**/**800P**), the rated conversion coefficient is 227.0 mV/kA.

When using our toroidal coil, do not change the conversion coefficient.

(3) FORCE / EXTERNAL SAMPLING INTERVAL

Set the sampling interval of force and external input (voltage or current) measurement.

100us: Performs measurement (sampling) every 100 us, calculates and displays waveforms every 100 us, and outputs data*1 every 100 us. (Note 1)

200us: Performs measurement (sampling) every 200 us, calculates and displays waveforms every 200 us, and outputs data*1 every 200 us.

500us: Performs measurement (sampling) every 500 us, calculates and displays waveforms every 500 us, and outputs data*1 every 500 us.

*1: Waveform output by communication and USB

(Note 1) When 200 µs is selected for CURRENT SAMPLING INTERVAL, the sampling interval becomes 200 µs automatically.

(4) MEMORY BATTERY VOLTAGE

Shows the voltage of the backup battery of the **MM-410B**. When the residual capacity of a battery is small, an error occurs.

(5) MAIN BATTERY VOLTAGE

Shows the voltage of the lithium battery of the **MM-410B**. If two batteries are installed, the higher voltage is shown. The approximate remaining battery charge is shown at the top of all the screens. When the residual capacity of a battery is small, an error occurs.

(6) Function keys

MENU: Touching this displays the MENU screen.

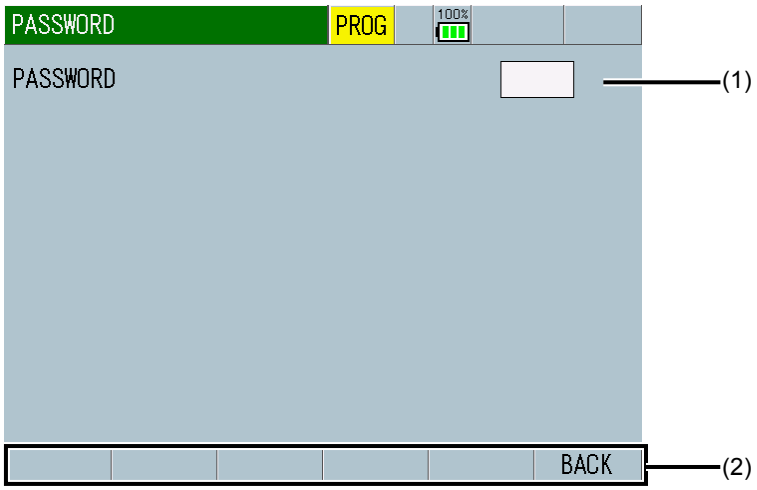
PREV: Touching this displays the SYSTEM SETUP (1) screen.

FORCE 0: Touching this resets the measured value of force at that time to 0. Perform a reset without applying loads to the force sensor.

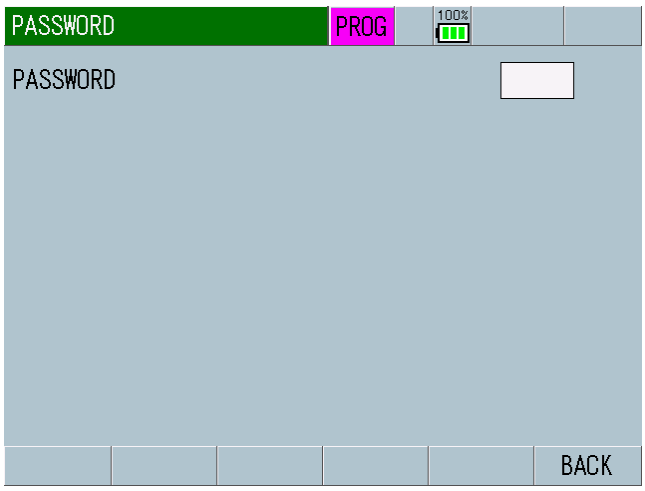
I-3. PASSWORD Screen

You can protect set values by setting the password. When the password is set and validated, schedule settings cannot be input from the panel.

Status in the supervisor mode



Status in the operator mode



(1) PASSWORD

Input a password (0000 to 9999). (Initial password: 0000)

The password is displayed as "*." When the input password coincides with the set password, the mode changes from the operator mode to the supervisor mode.

The supervisor mode is maintained while the power supply in turned on. To enter the operator mode, set the password the number other than 0000 and restart the power supply. For details, refer to **[How to change the password]**. If you forget the password, contact us.

Operation contents	Supervisor mode	Operator mode
Schedule setting in each screen	Can change	Cannot change
COPY in the BASIC SETUP (1) screen COPY in the SEAM SETUP (1) screen	Can operate	Cannot operate
CT RESET and INIT in the SYSTEM SETUP (1) screen FORCE 0 in the SYSTEM SETUP (2) screen	Can operate	Cannot operate
ALL DEL in the HISTORY screen READ and ALL DEL in the READ FLASH MEMORY screen	Can operate	Cannot operate
Schedule number in the PROG mode *1	Can change	Can change
Schedule number in the MEAS mode *1	Can change	Cannot change

*1: When you change the schedule number from 3 to 5 in the supervisor mode and switch the mode to MEAS, the schedule number changes to 5. When you change the schedule number from 3 to 5 in the operator mode and switch the mode to MEAS, the schedule number returns to 3. (You cannot change the schedule number for measurement in the operator mode.)

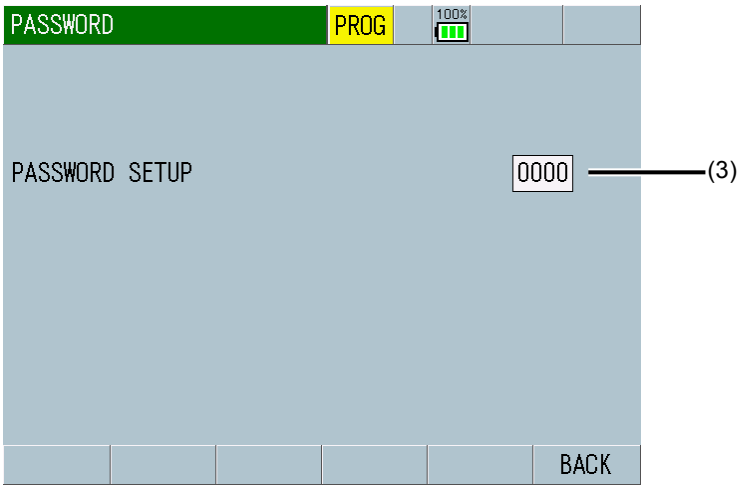
(2) Function keys

BACK: Touching this displays the SYSTEM SETUP (1) screen.

(3) PASSWORD SETUP

Changes a password (0000 to 9999) in the supervisor mode. Input a four-digit number.

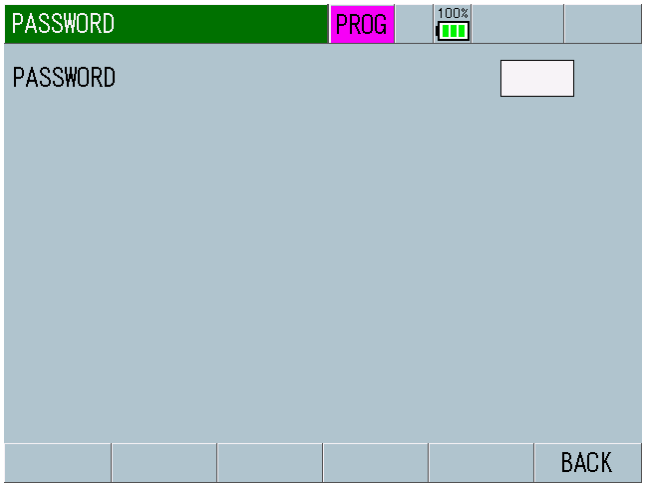
For details, refer to **[How to change the mode]**.



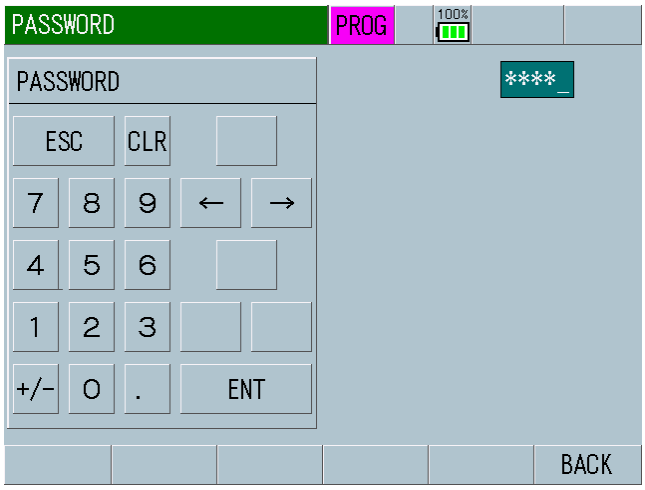
[How to change the mode]

As an example, how to change the mode from the operator mode to the supervisor mode with the password 1111 is explained below.

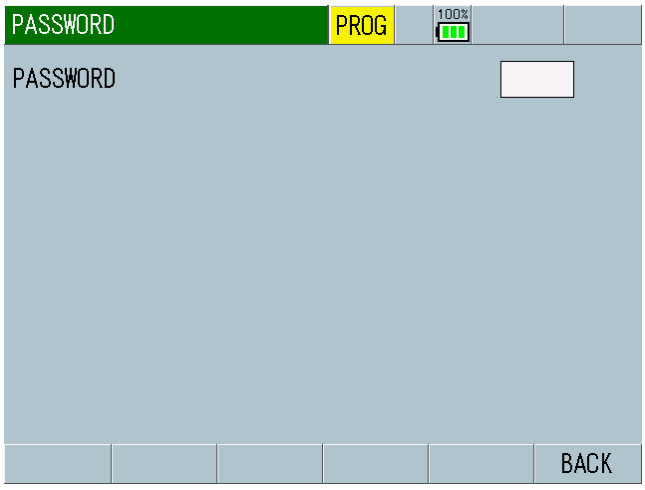
1) Move to the PASSWORD screen.



2) Touch the white frame and input a password 1111.



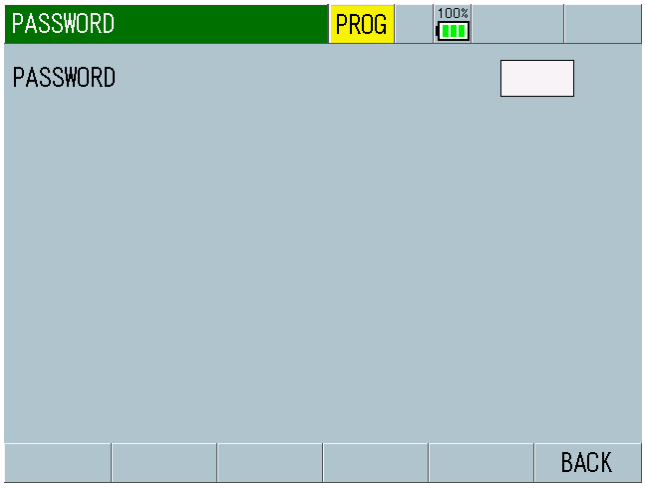
3) Touching ENT switches the mode to the supervisor mode. However, the password is wrong, the screen display does not change.



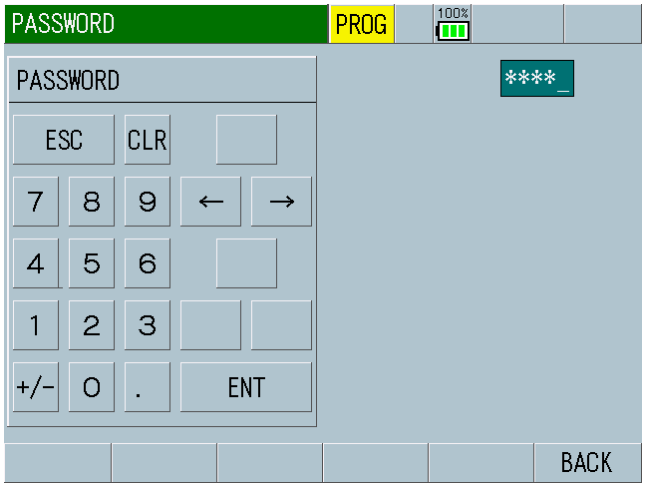
[How to change the password]

As an example, how to change the password from 0000 to 1111 is explained below. Before changing the password, change the mode from the operator mode to the supervisor mode.

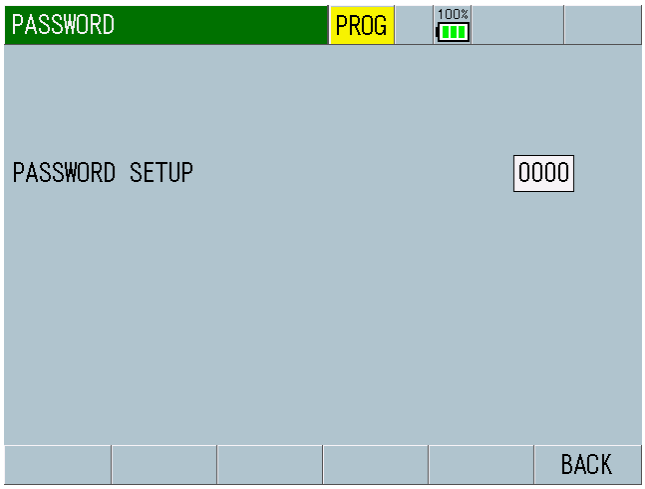
1) Move to the PASSWORD screen.



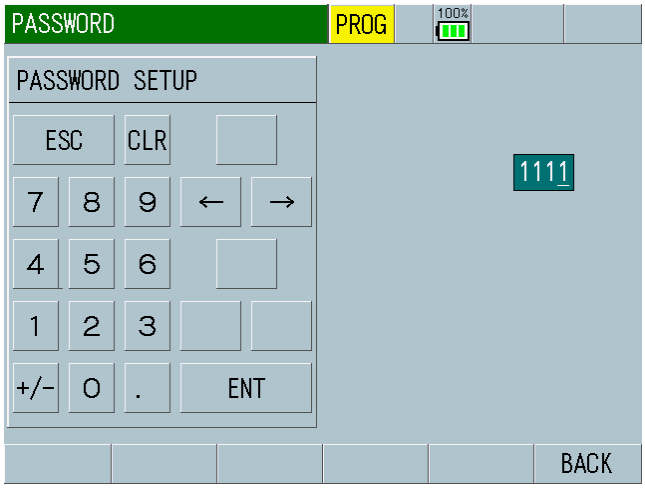
2) Touch the white frame and input a password 0000.



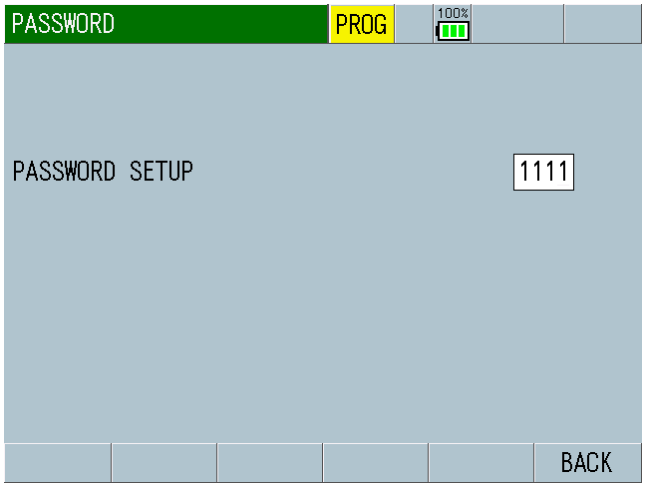
3) Touching ENT displays PASSWORD SETUP.



4) Touch the white frame and input a desired password 1111.

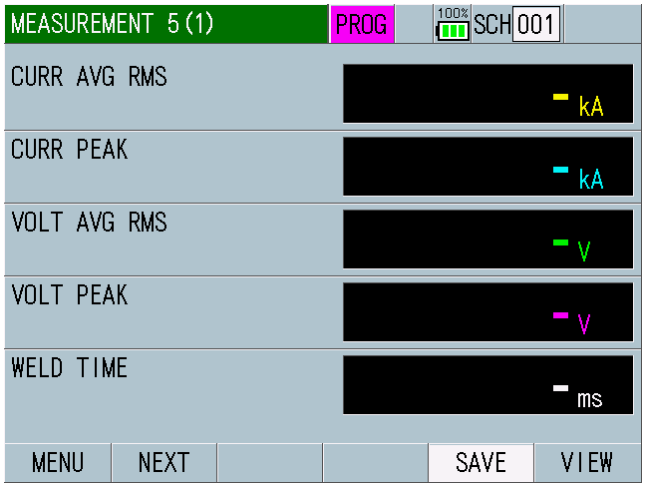


5) Touching ENT changes the number of PASSWORD SETUP.



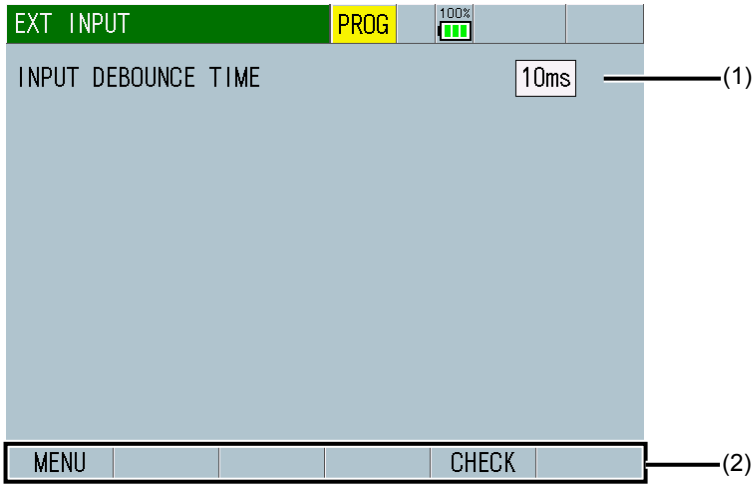
Password change is now complete. When you go to the other screen, perform the same procedures from 1).

6) When you touch MEAS in the MEASUREMENT screen after restarting the power supply, PROG is displayed in purple color indicating the operator mode.



m. EXT INPUT Screen

m-1. EXT INPUT Screen



(1) INPUT DEBOUNCE TIME

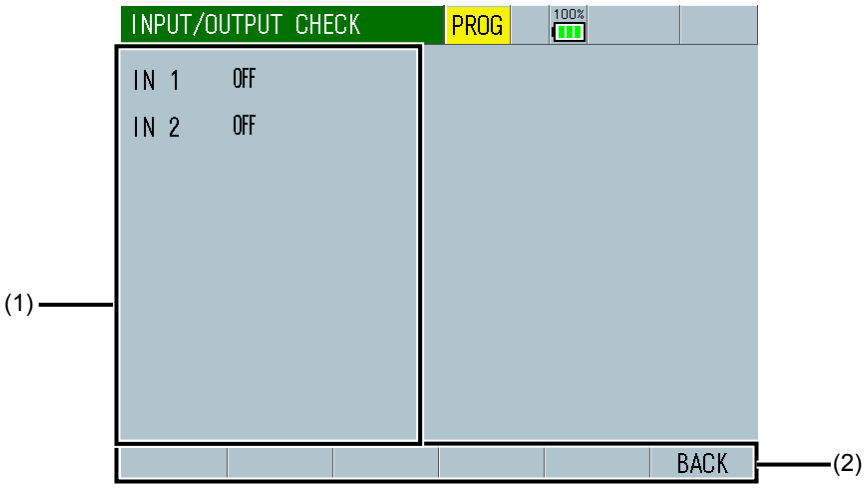
Set a delay time from the signal input to when the signal settles down. This setting makes it possible to eliminate input signal chatter.

(2) Function keys

MENU: Touching this displays the MENU screen.

CHECK: Touching this displays the INPUT CHECK screen.

m-2. INPUT CHECK Screen



(1) Input signal status

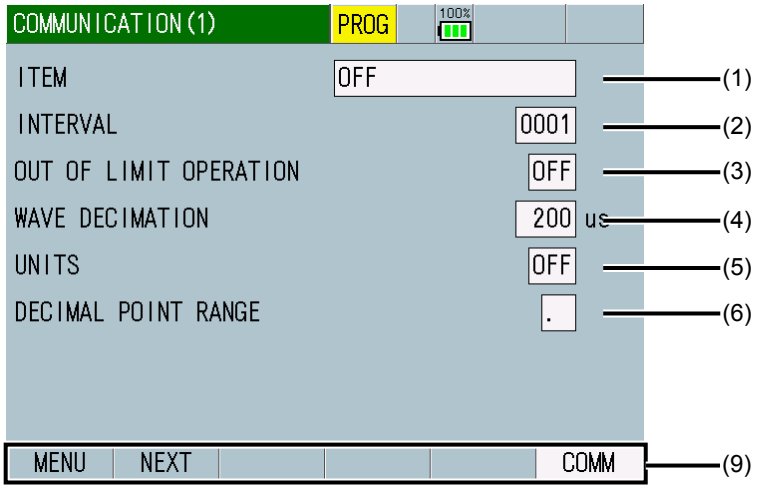
Shows ON/OFF of the corresponding input signal.

(2) Function keys

BACK: Touching this displays the EXT INPUT screen.

n. COMMUNICATION Screen

n-1. COMMUNICATION (1) Screen



(1) ITEM

Select an item to output from the following:

- OFF
  No communication
- MEASUREMENT
  Outputs the measured values of ten items selected in the VIEW screen. Outputs after the end of measurement or when COMM is touched.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no communication is made.
- WAVEFORM
  Outputs the waveforms of four 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 or when COMM is touched.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no communication is made.
- CURR ALL CYCLE
  Outputs current all cycles. Outputs after the end of measurement or when COMM is touched.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen or ISO17657 is selected for CALCULATION in the BASIC SETUP (3) screen, no communication is made.
- FORCE ALL CYCLE
  Outputs force all cycles. Outputs after the end of measurement or when COMM is touched. Available only for the force/displacement-equipped specification.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no communication is made.
- HISTORY
  Outputs history selected in HISTORY AREA (20**/**/** to 20**/**/**) among measured values saved in the HISTORY screen. To output, first select this item, and then touch COMM.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no communication is made.

- HISTORY OUT OF LIM
  Outputs history selected in HISTORY AREA (20**/**/** to 20**/**/**) among measured values with Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error saved in the HISTORY screen. To output, first select this item and touch COMM.
  When SEAM is selected for MODE in the SYSTEM SETUP (1) screen, no communication is made.
- SCHEDULE
  Outputs schedule data. To output, first select the schedule number, and then touch COMM.

(2) INTERVAL (*)

When you have selected ONE WAY with a setting other than OFF for MODE in the COMMUNICATION (2) screen, you can set a communication interval (1 to 1,000). Communicates irrespective of a communication interval in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error. The setting of communication interval is valid only when MEASUREMENT, WAVEFORM, CURR ALL CYCLE, or FORCE ALL CYCLE is selected for ITEM. When OUT OF LIMIT OPERATION is set to ON, a communication interval does not work.

(Note) During data communication, “SCI” is shown in orange at the upper part of a screen, and no measurement can be performed during that time.

(*) About interval

The interval corresponds to the number of weldings. Since it depends on the number from the last communication, the number of prints changes depending on the OUT OF LIMIT OPERATION setting.

INTERVAL setting		1	1	3	3
OUT OF LIMIT OPERATION setting		ON	OFF	ON	OFF
1st welding	OK	-	Commu-nicate	-	-
2nd welding	OK	-	Commu-nicate	-	-
3rd welding	OK	-	Commu-nicate	Commu-nicate	Commu-nicate
4th welding	OK	-	Commu-nicate	-	-
5th welding	NG	Commu-nicate	Commu-nicate	Commu-nicate	-
6th welding	OK	-	Commu-nicate	-	Commu-nicate
7th welding	OK	-	Commu-nicate	-	-
8th welding	OK	-	Commu-nicate	Commu-nicate	-

(3) OUT OF LIMIT OPERATION

Select ON/OFF to specify whether to communicate only in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error.

ON: Communicates in the event of an error.
OFF: Communicates irrespective of errors.

If it is normal, it communicates at the interval set in IINTERVAL.
In case of abnormality, communicate when it occurs.

The setting of error communication is valid only when MEASUREMENT, WAVEFORM, CURR ALL CYCLE, or FORCE ALL CYCLE is selected for ITEM.

(4) WAVE DECIMATION

Set a waveform decimation. You can select from among 20 us, 50 us, 100 us, 200 us, 500 us, and 1000 us. 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 ITEM.

WAVE DECIMATION is reflected when the followings are satisfied.

<table>
<tr><th>CURRENT SAMPLING INTERVAL</th><th>FORCE SAMPLING INTERVAL</th><th>Current measure-ment</th><th>Force/ external measurement</th><th>TIME</th><th>WAVE DECIMATION</th></tr>
<tr><td>20us</td><td>100us
200us
500us</td><td rowspan="8">Yes</td><td rowspan="6">No</td><td>SHORT
ms-DC</td><td>20us, 100us, 200us, 500us, and 1000us are the same as setting. 50us becomes 20us.</td></tr>
<tr><td>20us*1</td><td rowspan="3">100us
200us
500us</td><td rowspan="5">All settings</td><td rowspan="2">50us, 100us, 200us, 500us, and 1000us are the same as setting. 20us becomes 50us.</td></tr>
<tr><td>50us</td></tr>
<tr><td>100us</td><td>100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.</td></tr>
<tr><td>200us*1</td><td>200us, 500us and 1000us are the same as setting. 20us, 50us and 100us become 200us.</td></tr>
<tr><td rowspan="3">20us*1
50us*1
100us</td><td>100us</td><td rowspan="3">Yes</td><td>100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.</td></tr>
<tr><td>200us</td><td>100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.</td></tr>
<tr><td>500us</td><td>100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.</td></tr>
</table>

CURRENT SAMPLING INTERVAL	FORCE SAMPLING INTERVAL	Current measure-ment	Force/ external measurement	TIME	WAVE DECIMATION
200us*1	100us*1	Yes	Yes	All settings	100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.
	200us				
	500us				100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.
20us*1 50us*1 100us	100us	No		-	100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.
	200us				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.
200us*1	100us*1				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	200us				
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.

*1: Also refer to CURRENT SAMPLING INTERVAL and FORCE/ EXTERNAL SAMPLING INTERVAL in Chapter 8, “I-2. SYSTEM SETUP (2) Screen.”

(5) UNITS

Select whether to add a unit to the communication data or not.

OFF: Not added
ON: Added

(6) DECIMAL POINT RANGE

Select “.” (period) or “,” (comma) for a symbol for decimal point. The data is written in the selected decimal point.

• Example of "." (period) (some measurement data omitted)
(Omitted) 01.00kA, 00, G, 01.10kA, 05, G, 02 (Omitted) [CR] [LF]

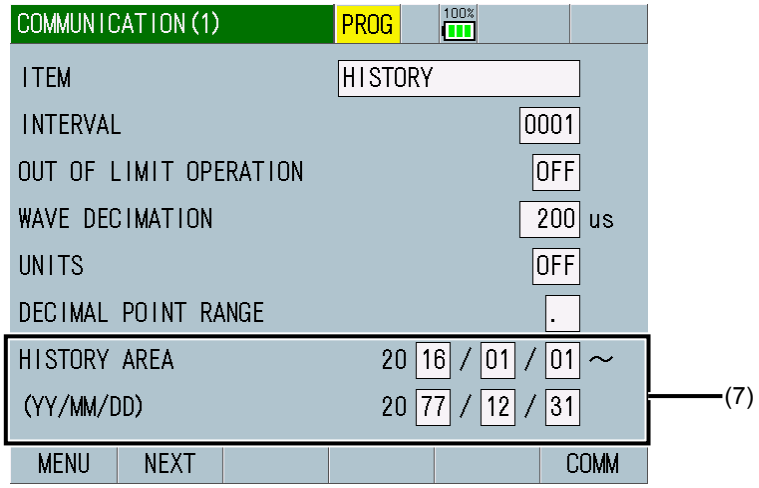
• Example of "," (comma) (some measurement data omitted) (Omitted)
01,00kA;00;G;01,10kA;05;G;02 (Omitted)[CR][LF]

A setting of '.' (period) uses a period as the decimal point. Comma is used to separate data. On the other hand, the "," (comma) setting uses a comma as the decimal point. Semicolon is used to separate data.

(7) HISTORY AREA

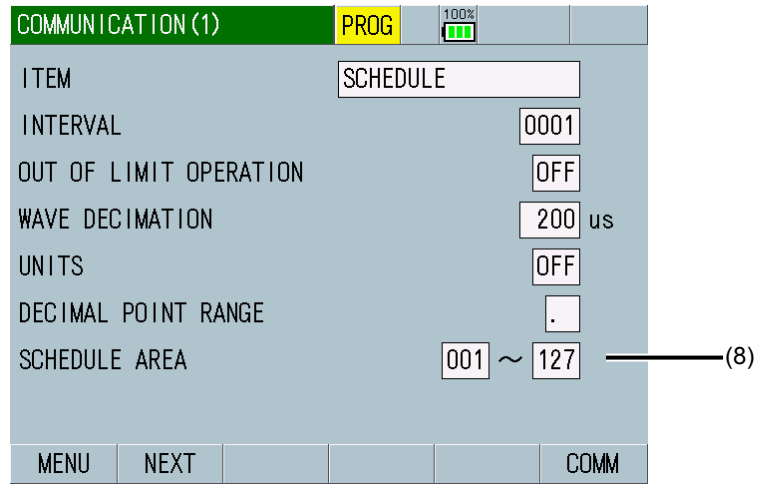
Shown when you have selected HISTORY or HISTORY OUT OF LIM for ITEM. Set a communication range with year, month and day.

(Note) The start date should be before the end date.



(8) SCHEDULE AREA

Shown when you have selected SCHEDULE for ITEM. Set the range of schedule numbers to communicate schedule data from 001 to 127. The setting of schedule data range is valid only when schedule data is communicated.



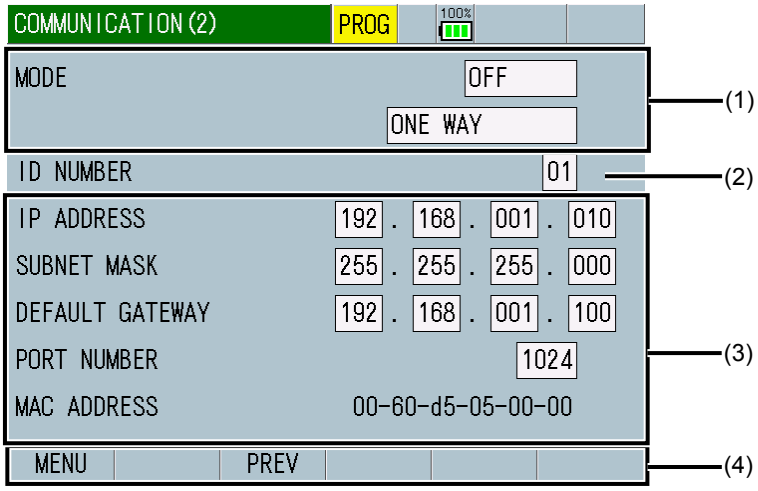
(9) Function keys

MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the COMMUNICATION (2) screen.

COMM: Touching this outputs items selected for ITEM.

n-2. COMMUNICATION (2) Screen



(1) MODE

Select whether to use OFF, USB or ETHERNET for communication. Specify unidirectional or bidirectional communication system.

(2) ID NUMBER

Set an instrument number (1 to 31).

(3) TCP/IP settings

When you have selected ETHERNET for MODE, set the following: IP address, subnet mask, default gateway, and port number

Also, device MAC address is displayed.

PORT NUMBER can be set between 1024 and 5000.

(4) Function keys

MENU: Touching this displays the MENU screen.

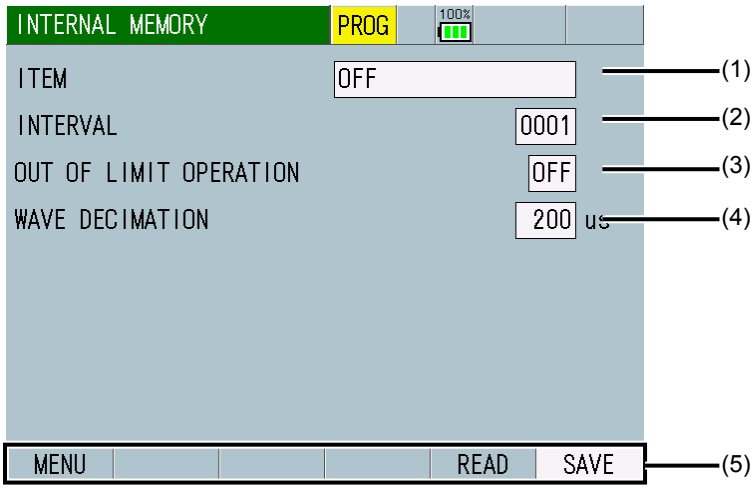
PREV: Touching this displays the COMMUNICATION (1) screen.

o. INTERNAL MEMORY Screen

o-1. INTERNAL MEMORY Screen

Waveforms and all cycle data are saved in the built-in flash memory.

Waveforms and all cycles are deleted when the power supply is turned off. Since 120 waveforms and all cycles in total (guide) can be saved in the built-in flash memory even after the power is turned off, you can load the saved data to check them.



(1) ITEM

Selects the data to save.

- OFF
  No data is saved.
- WAVEFORM
  Outputs the waveforms of four 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 save with waveform ON/OFF in the VIEW screen. Touching the SAVE key saves them in the internal memory.
- CURRENT ALL CYCLE
  Saves current all cycles by touching the SAVE key.
  When ISO17657 is selected for CALCULATION in the BASIC SETUP (3) screen, no data is saved
- FORCE ALL CYCLE
  Saves force all cycles by touching the SAVE key. Available only for the force/displacement-equipped specification.

(2) INTERVAL (*)

You can set an interval automatically saved in the built-in flash memory each measurement (1 to 1,000). Saves irrespective of a save interval in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error. When (3) OUT OF LIMIT OPERATION is set to ON, a save interval does not work in the event of above errors.

(Note) In writing, “MON” is shown in orange at the upper part of a screen, and no measurement can be performed during that time. The flash memory used in the internal memory has a write limit (100,000). An error message “E15: INTERNAL MEMORY ERROR” appears if the write limit is exceeded.

(*) About interval

The interval corresponds to the number of weldings. Since it depends on the number from the last save, the number of saves changes depending on the OUT OF LIMIT OPERATION setting.

INTERVAL setting		1	1	3	3
OUT OF LIMIT OPERATION setting		ON	OFF	ON	OFF
1st welding	OK	-	Save	-	-
2nd welding	OK	-	Save	-	-
3rd welding	OK	-	Save	Save	Save
4th welding	OK	-	Save	-	-
5th welding	NG	Save	Save	Save	-
6th welding	OK	-	Save	-	Save
7th welding	OK	-	Save	-	-
8th welding	OK	-	Save	Save	-

(3) OUT OF LIMIT OPERATION

Select ON/OFF to specify whether to save only in the event of Upper limit error, Lower limit error, Overrange error, Impulse error, or Parity error.

ON: Saves irrespective of interval in the event of an error.
OFF: Saves each interval irrespective of errors.

Saves at intervals set for INTERVAL when normal. Saves at the time of an error occurrence when abnormal.

(4) WAVE DECIMATION

Set a waveform decimation. You can select from among 20 us, 50 us, 100 us, 200 us, 500 us, and 1000 us. 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 ITEM.

WAVE DECIMATION is reflected when the followings are satisfied.

<table>
<tr><th>CURRENT SAMPLING INTERVAL</th><th>FORCE SAMPLING INTERVAL</th><th>Current measure-ment</th><th>Force/ external measurement</th><th>TIME</th><th>WAVE DECIMATION</th></tr>
<tr><td>20us</td><td>100us
200us
500us</td><td>Yes</td><td>No</td><td>SHORT
ms-DC</td><td>20us, 100us, 200us, 500us, and 1000us are the same as setting. 50us becomes 20us.</td></tr>
<tr><td>20us*1</td><td rowspan="3">100us
200us
500us</td><td rowspan="6"></td><td rowspan="4"></td><td rowspan="6">All settings</td><td rowspan="2">50us, 100us, 200us, 500us, and 1000us are the same as setting. 20us becomes 50us.</td></tr>
<tr><td>50us</td></tr>
<tr><td>100us</td><td>100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.</td></tr>
<tr><td>200us*1</td><td>200us, 500us and 1000us are the same as setting. 20us, 50us and 100us become 200us.</td></tr>
<tr><td rowspan="3">20us*1
50us*1
100us</td><td>100us</td><td rowspan="5">Yes</td><td>100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.</td></tr>
<tr><td>200us</td><td>100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.</td></tr>
<tr><td>500us</td><td>100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.</td></tr>
<tr><td rowspan="3">200us*1</td><td>100us*1</td><td rowspan="3">100us, 200us and 1000us are the same as setting. 20us, 50us and 500us become 100us.</td></tr>
<tr><td>200us</td></tr>
<tr><td>500us</td><td>100us, 500us and 1000us are the same as setting. 20us, 50us and 200us become 100us.</td></tr>
</table>

CURRENT SAMPLING INTERVAL	FORCE SAMPLING INTERVAL	Current measure-ment	Force/ external measurement	TIME	WAVE DECIMATION
20us*1 50us*1 100us	100us	No	Yes	-	100us, 200us, 500us, and 1000us are the same as setting. 20us and 50us become 100us.
	200us				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.
200us*1	100us*1				200us and 1000us are the same as setting. 20us, 50us, 100us, and 500us become 200us.
	200us				
	500us				500us and 1000us are the same as setting. 20us, 50us, 100us, and 200us become 500us.

*1: Also refer to CURRENT SAMPLING INTERVAL and FORCE/ EXTERNAL SAMPLING INTERVAL in Chapter 8, “I-2. SYSTEM SETUP (2) Screen.”

(5) Function keys

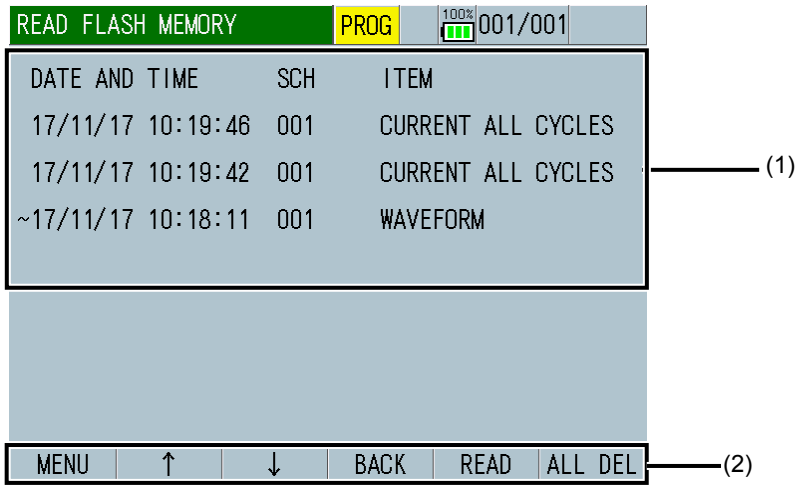
MENU: Touching this displays the MENU screen.

READ: Touching this displays the measurement data saved in the built-in flash memory. When you touch this data directly, it is selected by a line-based cursor. Touch the READ key again to read data. Note that only one selected among WAVEFORM, CURRENT ALL CYCLE and FORCE ALL CYCLE can be read.

SAVE: Touching this saves the contents selected for ITEM of the measurement data in the built-in flash memory.

o-2. READ FLASH MEMORY Screen

Histories of WAVEFORM, CURRENT ALL CYCLE and FORCE ALL CYCLE saved in the built-in flash memory are displayed.



(1) Loaded data display

Shows the measured values stored in the built-in flash memory.
When you touch this data directly, it is selected by a line-based cursor. Touch the READ key again to read data. Note that only one selected among WAVEFORM, CURRENT ALL CYCLE and FORCE ALL CYCLE can be read.

(2) Function keys

MENU: Touching this displays the MENU screen.

↑↓: Touching this moves a page of the screen.

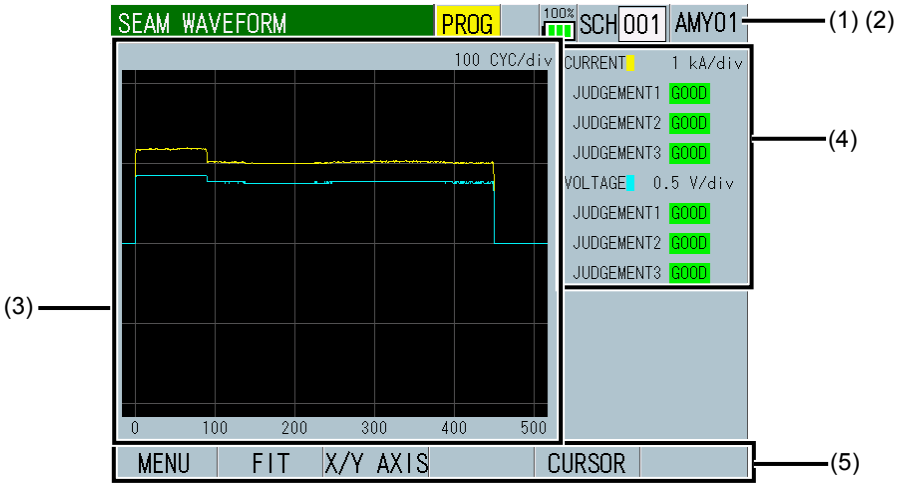
BACK: Touching this returns to the INTERNAL MEMORY screen.

READ: Touching this reads data selected with a blue cursor.

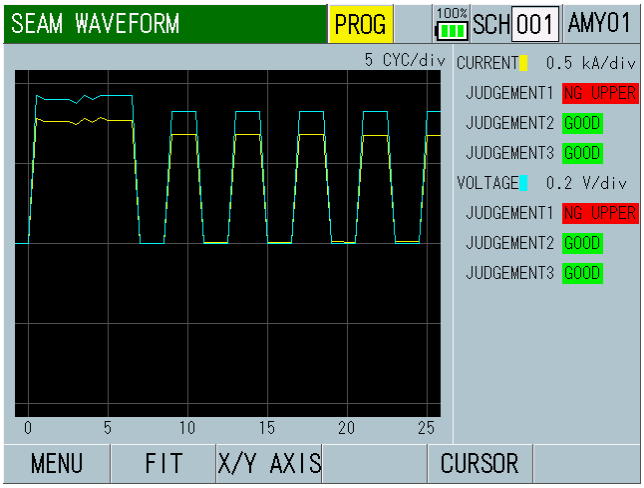
ALL DEL: Touching this clears all measured values from the built-in flash memory.

p. SEAM WAVEFORM Screen

Waveform of continuous seam current / voltage



Waveform of intermittent seam current / voltage



The **MM-410B** realizes seam welding by repeating measurement of the specified range. The measured value calculated with the measurement range and the measurement interval is displayed.

The waveform in the SEAM WAVEFORM screen displays the measured value resulting from calculation with the set contents. This method is different from the WAVEFORM screen displaying the instantaneous value in the normal measurement mode.

The judgment value can be set for three judgment periods (JUDGEMENT1 to 3), respectively.

In the AC measurement, current and voltage can be measured in a max. 5-minute current flow.

In the DC measurement, voltage can be measured in a max. 5-minute current flow.

(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) Waveform

Waveform display items can be selected in the VIEW screen.

(4) Judgment display

Shows the judgment results of CURRENT at the upper part and VOLTAGE at the lower part. Shows the judgment result of three range sections (JUDGEMENT1 to 3) for CURRENT and VOLTAGE respectively.

Shows GOOD when the waveform is within the range, NG UPPER when it exceeds the upper limit, and NG LOWER when it falls below the lower limit even if 1 section. When it is out of both upper and lower limits at the same time, NG LOWER is preferentially displayed. Also, when the measured value exceeds the measurable range, OVER is displayed.

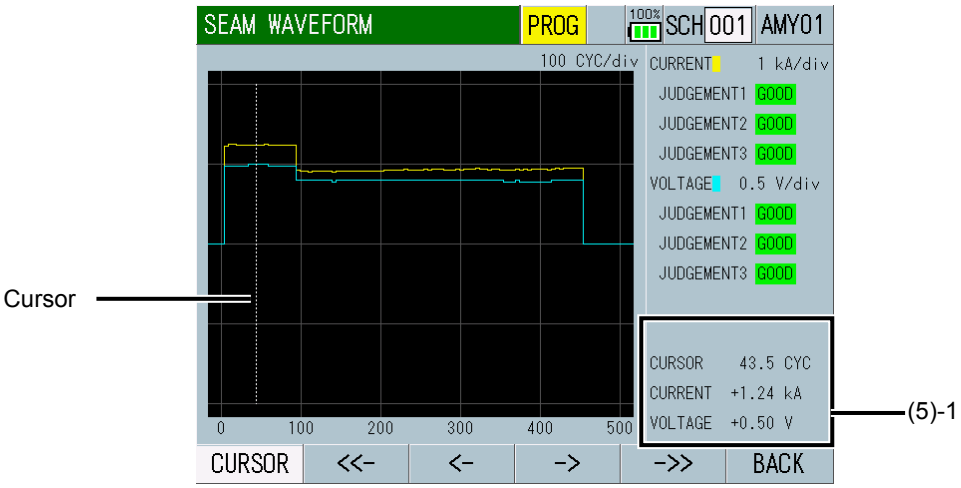
(5) Function keys

MENU: Touching this displays the MENU screen.

FIT and X/Y AXIS: Same as the function keys in the WAVEFORM screen. Refer to “d. WAVEFORM Screen.”

CURSOR: Touching this displays the cursor of the vertical axis and cursor command at the function key. (Refer to (5)-1.)

(5)-1 Cursor command



Shows the current time axis information of the cursor and the measured values of the waveforms at the point in time indicated by the cursor.

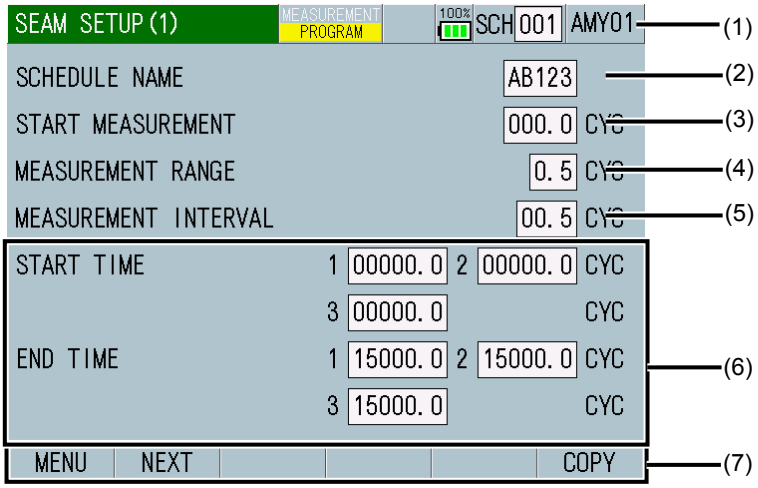
You can move the white line (cursor) on the grid right and left by touching the function keys.

<- ->: Touching this moves the cursor right and left by 1 dot. The cursor moves only while the key is touched.

<<- ->>: Touching this moves the cursor right and left by 50 dots.

q. SEAM SETUP Screen

q-1. SEAM SETUP (1) Screen



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) SCHEDULE NAME

Inputs the name for the set schedule. Up to five alphanumeric characters can be input.

(3) START MEASUREMENT

Set the time to start the seam welding in time or cycle from the welding start.

When the TRIGGER and TIME settings are changed, START MEASUREMENT may be initialized. Set START MEASUREMENT again. (Refer to "q-3. SEAM SETUP (3) Screen.")

CYC-AC, CYC-DC: 0.0 to 120.0 CYC
ms-DC, ms-AC: 10 to 2,000 ms (in units of 10 ms)
SHORT ms-DC: 1 to 200 ms

(4) MEASUREMENT RANGE

Calculates the measured value in this range to use it for judgment. When the cool time is included, the measured value falls correspondingly.

When the TRIGGER and TIME settings are changed, MEASUREMENT RANGE may be initialized. Set MEASUREMENT RANGE again. (Refer to "q-3. SEAM SETUP (3) Screen.")

CYC-AC, CYC-DC: 0.5 to 6.0 CYC
ms-DC, ms-AC: 10 to 100 ms (in units of 10 ms)
SHORT ms-DC: 1 to 10 ms

(5) MEASUREMENT INTERVAL

Shifts the measurement range at this interval. (The cool time is included.)

When the TRIGGER and TIME settings are changed, MEASUREMENT INTERVAL may be initialized. Set MEASUREMENT INTERVAL again. (Refer to "q-3. SEAM SETUP (3) Screen.")

CYC-AC, CYC-DC: 0.5 to 12.0 CYC
ms-DC, ms-AC: 10 to 200 ms (in units of 10 ms)
SHORT ms-DC: 1 to 20 ms

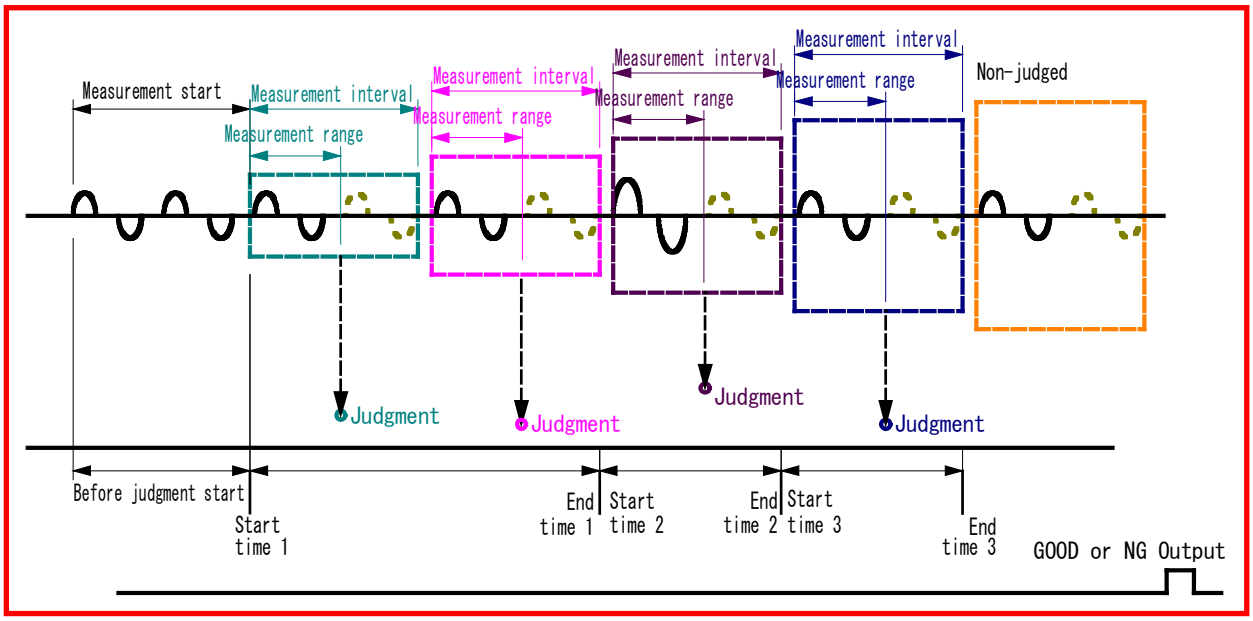
(Note) Use with measurement interval ≥ measurement range. In the intermittent current flow, set so that one cycle of WELD/COOL be the measurement interval and WELD time be the measurement range.

(6) START TIME / END TIME

Set the judgment start time and end time of the judgment periods1 to 3 in time or cycle from the welding start. In this judgment period, GOOD or NG judgment is made after each measurement range and output at the end of welding. When all judgments are within upper and lower limits, the judgment period is judged as GOOD.

When the TRIGGER and TIME settings are changed, START TIME and END TIME may be initialized. Set START TIME and END TIME again. (Refer to "q-3. SEAM SETUP (3) Screen.")

CYC-AC, CYC-DC: 0 to 18,000 CYC
ms-DC, ms-AC: 0 to 300,000 ms (in units of 10 ms)
SHORT ms-DC: 0 to 30,000 ms



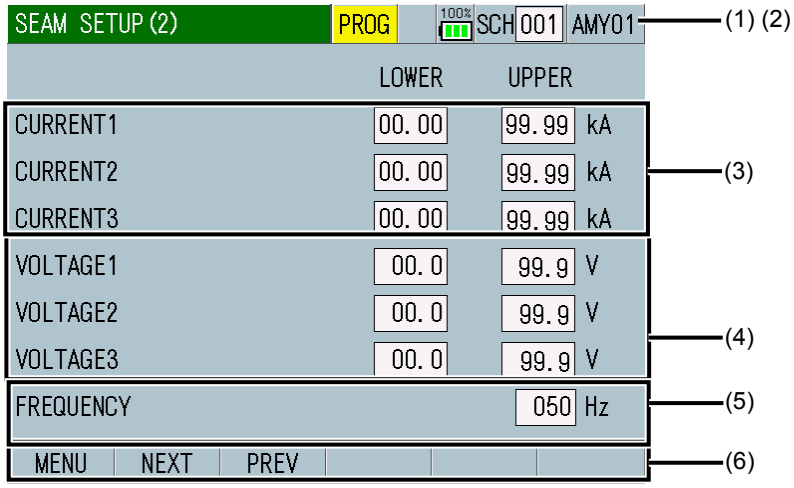
(7) Function keys

MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the SEAM SETUP (2) screen.

COPY: Touching this copies the settings made under the schedule number 001 (all the settings made in the COMPARATOR, BASIC SETUP, and EXTEND SETUP screens) to all the schedule numbers 002 to 127.

q-2. SEAM SETUP (2) Screen



(1) SCH

Shows the measurement schedule number used (1 to 127). On the other hand, you can change schedules by selecting this field and inputting a value.

(2) Schedule name

Shows the name of SCH. This can be set in the BASIC SETUP (1) screen.

(3) CURRENT 1 to 3

Set upper and lower limit values of the current in the judgment period 1 to 3.

(4) VOLTAGE 1 to 3

Set upper and lower limit values of the voltage in the judgment period 1 to 3

(5) FREQUENCY

Set the frequency of the current to be measured to 050Hz or 060Hz.

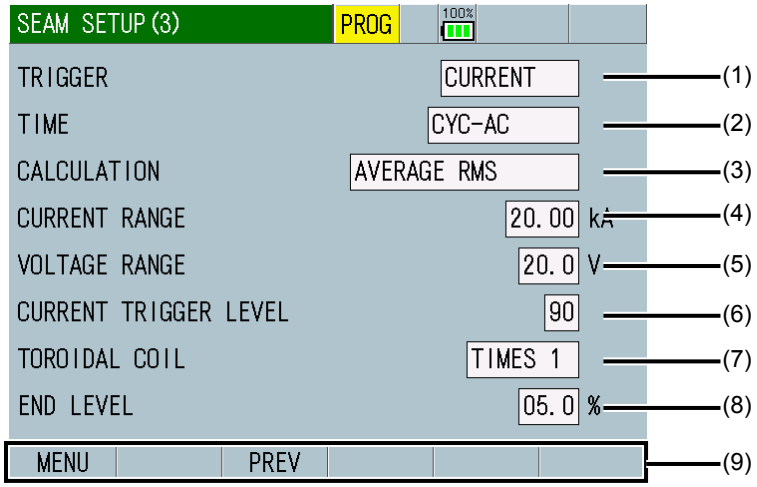
(6) Function keys

MENU: Touching this displays the MENU screen.

NEXT: Touching this displays the SEAM SETUP (3) screen.

PREV: Touching this displays the SEAM SETUP (1) screen.

q-3. SEAM SETUP (3) Screen



(1) TRIGGER

Select CURRENT or VOLTAGE.

When the TRIGGER setting is changed, START MEASUREMENT, MEASUREMENT RANGE, MEASUREMENT INTERVAL, START TIME, and END TIME may be initialized. Set START MEASUREMENT, MEASUREMENT RANGE, MEASUREMENT INTERVAL, START TIME, and END TIME again. (Refer to "q-1. SEAM SETUP (1) Screen.")

(2) TIME

Select from CYC-AC, ms-AC, CYC-DC, ms-DC, and SHORT ms-DC.

(Note) When CURRENT is selected for TRIGGER, CYC-AC or ms-AC can be selected for TIME. When VOLTAGE is for TRIGGER selected, ms-DC, CYC-DC, or SHORT ms-DC can be selected for TIME.

When the TIME setting is changed, START MEASUREMENT, MEASUREMENT RANGE, MEASUREMENT INTERVAL, START TIME, and END TIME may be initialized. Set START MEASUREMENT, MEASUREMENT RANGE, MEASUREMENT INTERVAL, START TIME, and END TIME again. (Refer to "q-1. SEAM SETUP (1) Screen.")

(3) CALCULATION

Select the calculation system.

RMS: Calculated the RMS in the whole measurement range.

AVERAGE RMS: Calculates the RMS every half cycle or 1 ms and calculates the arithmetic mean value within the measurement range.

Refer to (Note 1) Difference between the original measurement mode and the ISO17657-compliant measurement mode for RMS calculation in “c. VIEW Screen.”

(4) CURRENT RANGE

Select from the following five ranges. Select one which is larger than the maximum current of welding current actually measured and close to the measured current.

The current ranges change as follows depending on the TOROIDAL COIL setting in the BASIC SETUP (3) screen

- When the TOROIDAL COIL setting is 1: 2.000 kA range, 6.00 kA range, 20.00 kA range, 60.0 kA range, 200.0 kA range
- When the TOROIDAL COIL setting is 10: 0.200 kA range, 0.600 kA range, 2.000 kA range, 6.00 kA range, 20.00 kA range

(5) VOLTAGE RANGE

Select from the following two ranges. Select one which is larger than the maximum voltage of welding current actually measured and close to the measured voltage.

6.00 V: 6.00 V range
20.0 V: 20.0 V range

(6) CURRENT TRIGGER LEVEL

The sensitivity increases as you increase the value. Excessively increasing the sensitivity may cause malfunction. If set to around 99, the current trigger may not be complete. At the time, decrease the value.

(7) TOROIDAL COIL

Set as follows depending on the type of toroidal coil connected:

When 1x sensitivity coil is used: 1
When 10x sensitivity coil is used: 10

(8) END LEVEL

You can measure the current flow time till the End Level setting is reached. Set the End Level as the ratio to the used current range (1.5 to 15.0%).

(9) Function keys

MENU: Touching this displays the MENU screen.

PREV: Touching this displays the SEAM SETUP (2) screen.

9. Measurement

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

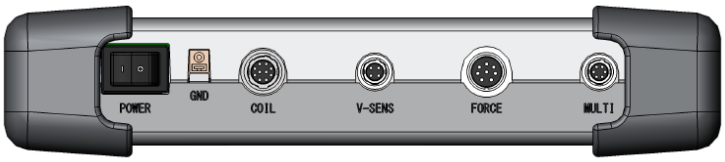
CAUTION

Do not perform measurement during the battery charging. Performing measurement during charging may cause the delay of completion of the battery charging.

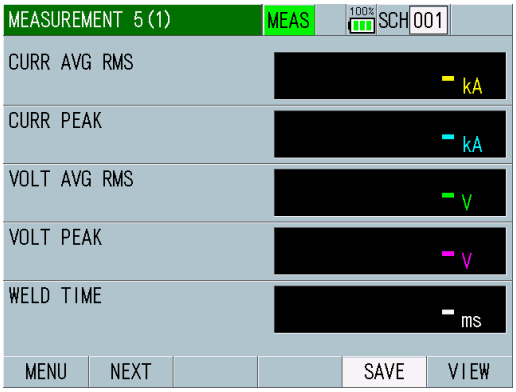
In "(4) Setting from welding schedule" described later, a setting example of MM-410B is explained from the welding schedule.

1) Connect the **MM-410B** to a power supply, and plug the toroidal coil and the voltage detection cable to the **MM-410B**. (For more information, refer to (3) a 1) and 2) in Chapter 6.)

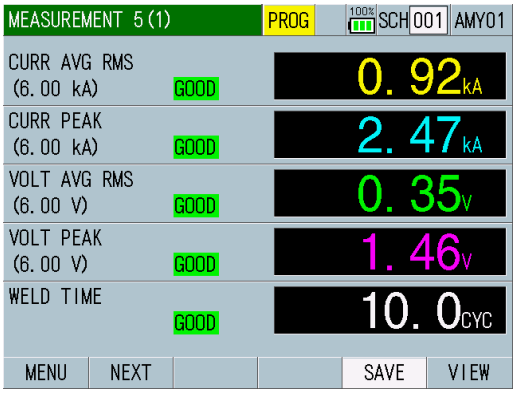
2) Set the main power switch on the top to the ON position (– side) to start the **MM-410B**.



3) The MEASUREMENT 5(1) or MEASUREMENT 10 screen appears on the display after a while.



To change or check the setting, touch MEAS to change it to PROG. (Alternately switched by touching.)

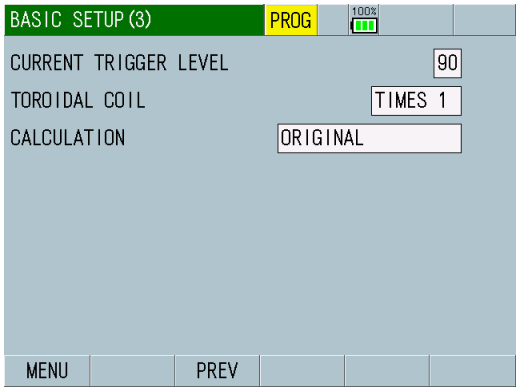


4) Touch the MENU key.

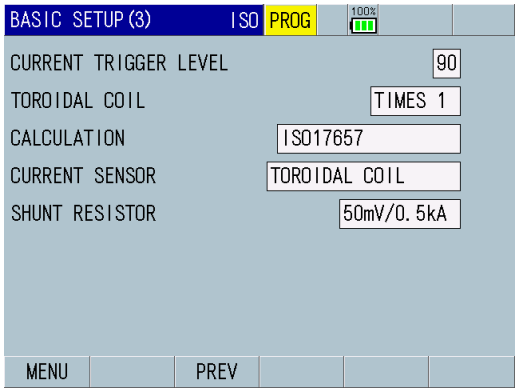
The MENU screen appears. Select BASIC SETUP.

5) For ISO17657-compliant calculation, change ORIGINAL to ISO17657 in the BASIC SETUP (3) screen.

When ISO17657 is selected, the upper-left portion of the screen changes from green to blue on all screens and “ISO” is displayed.

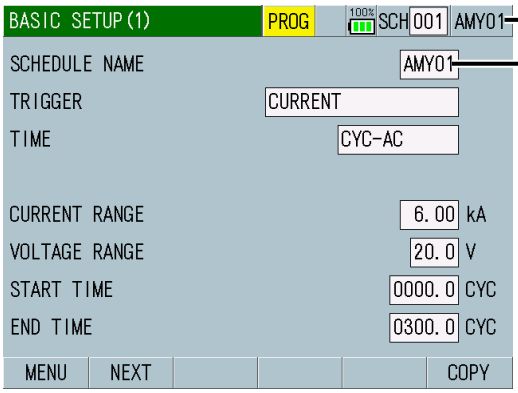


Original mode

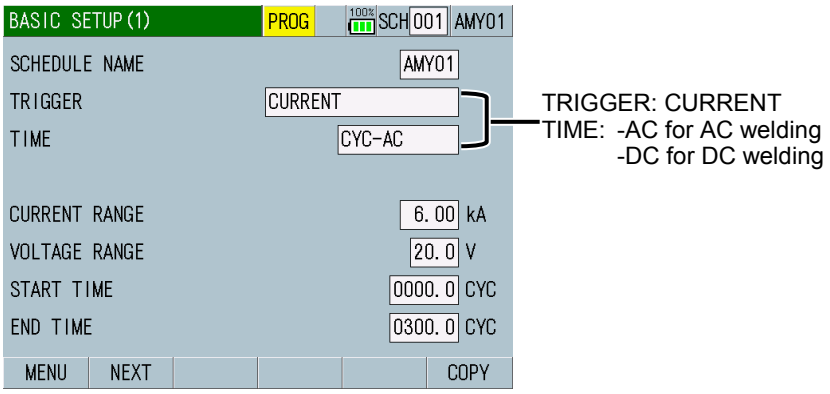


ISO17657 mode

6) The BASIC SETUP (1) screen appears. You can set the schedule name for a schedule.



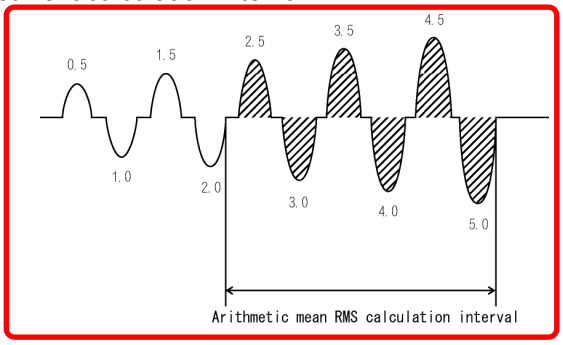
7) Select CURRENT for TRIGGER in the BASIC SETUP (1) screen, and select a type of welding current to measure and the measurement time unit. (For more information, refer to (2) j-1 in Chapter 8.)



8) Set up the **MM-410B** as follows according to the type of welding power supply used:

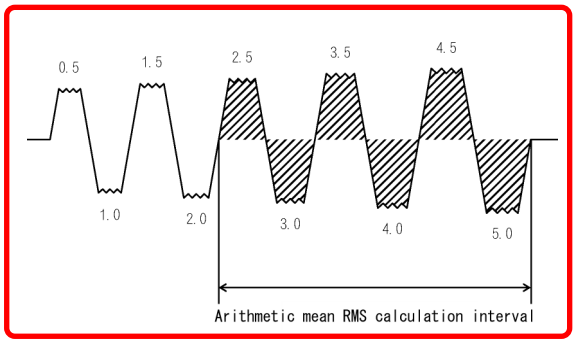
- Single-phase AC welding power supply

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

Item	Setting
TIME	CYC-AC
START TIME/ END TIME	Referring to the figure shown below, set the current calculation interval. 

- AC inverter welding power supply

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

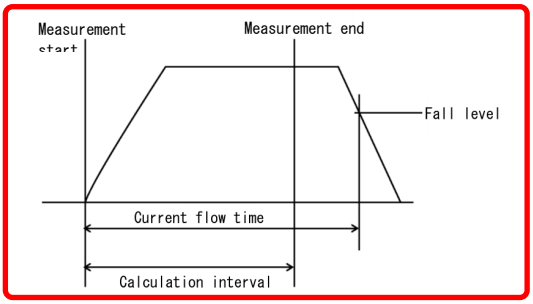
Item	Setting
TIME	When making measurement by setting a frequency: CYC***Hz-AC When measuring current flow time in units of ms: ms-AC
START TIME/ END TIME	Referring to the figure shown below, set the current calculation interval. 
FREQUENCY	Set the frequency of the current to be measured. When using our AC inverter welding power supply, set the frequency referring to the table shown below “Correlation between Frequencies of the AC Inverter Welding Power Supply and the **MM-410B**.”

Correlation between Frequencies of the AC Inverter Welding Power Supply and the **MM-410B**

Welding power supply frequency setting	MM-410B frequency setting	Welding power supply frequency setting	MM-410B frequency setting
50 Hz	M050	100 Hz	M100
53 Hz	M053	111 Hz	M111
56 Hz	M056	125 Hz	M125
59 Hz	M059	143 Hz	M143
63 Hz	M063	167 Hz	M167
67 Hz	M067	200 Hz	M200
71 Hz	M071	250 Hz	M250
77 Hz	M077	294 Hz	M294
83 Hz	M083	417 Hz	M417
91 Hz	M091	500 Hz	M500

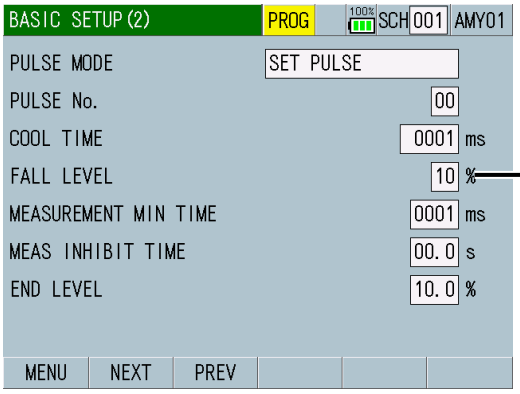
- DC inverter welding power supply

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

Item	Setting
TIME	When making measurement in units of cycle: CYC-DC When making measurement in units of ms: ms-DC
START TIME/ END TIME	Referring to the figure shown below, set the current calculation interval.  Set FALL LEVEL in the BASIC SETUP (2) screen for the current flow time. *1

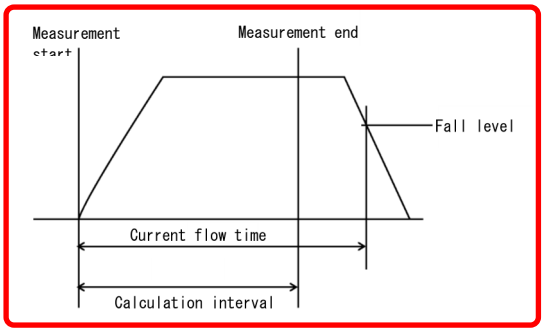
*1: The calculation end time becomes FALL LEVEL set in the BASIC SETUP (2) screen when END TIME is longer than the current flow time. FALL LEVEL is a peak value when ORIGINAL is selected for CALCULATION, and a ratio from the maximum RMS when ISO17657.

(2) Set FALL LEVEL in the BASIC SETUP (2) screen.



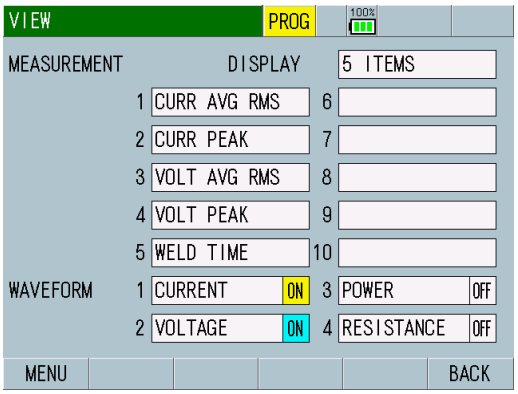
- Transistor welding power supply

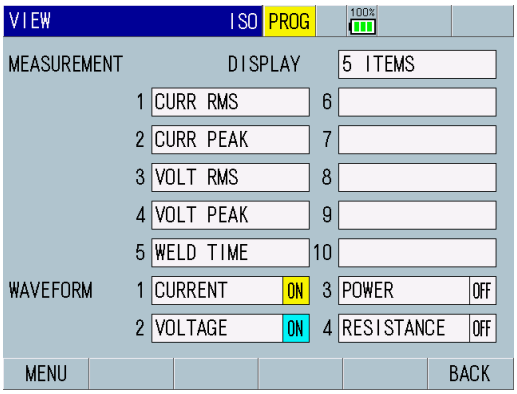
Set the following items in the BASIC SETUP (1) screen. (For more information, refer to (2) j-1 in Chapter 8.)

Item	Setting
TIME	SHORT ms-DC
START TIME/ END TIME	Set the current calculation interval. 

9) Touch the MENU key to select VIEW.

According to the desired measurement item, set the following in one of MEASUREMENT 1 to 5 or 1 to 10. The settable items are different between ORIGINAL and ISO17657: (For information on measurement items other than the following, refer to (2) c in Chapter 8.)





To measure RMS current (ISO17657 mode):	CURR RMS
To measure average RMS current (original mode):	CURR AVG RMS
To measure peak current during current flow:	CURR PEAK
To measure RMS voltage (ISO17657 mode):	VOLT RMS
To measure average RMS voltage (original mode):	VOLT AVG RMS
To measure peak voltage during current flow:	VOLT PEAK
To measure current flow time:	WELD TIME
To measure max. conduction angle during current flow time:	COND ANGLE

When the measurement item is changed, upper and lower limits for the changed measurement item are initialized. Set upper and lower limits again on the COMPARATOR screen. (Refer to (2) m in Chapter 8.)

10) To display the waveforms of the measured items, set those items in WAVEFORM 1 to 4. (For more information, refer to (2) c in Chapter 8.)

11) Touch the MENU key to select MEASUREMENT or WAVEFORM.

12) Select a schedule number to measure.

Set a schedule number to measure in “SCH.”

13) Touch PROG to change it to MEAS, putting the **MM-410B** into wait state until measurement starts (the signal selected as trigger is input).

14) When the trigger signal is input to the **MM-410B**, the [TRIGGER] lamp lights up and measurement starts. Confirm the measurement results on the MEASUREMENT and WAVEFORM screens.

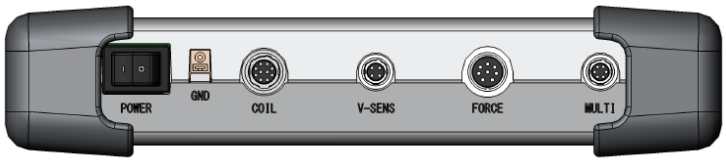
(2) Measuring Force

CAUTION

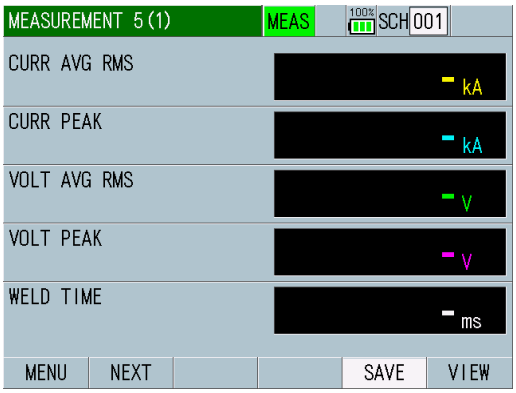
- Before using the force sensor **MA-520B/521B/522B**, be sure to turn off the power of the welding machine and confirm that no welding current is flowing.
- Select an appropriate force sensor according to the force range you wish to measure.
- Before measuring force, be sure to set the force sensor's offset to "0." You can set the offset to "0" by touching the FORCE 0 key on the SYSTEM SETUP (2) screen. At this time make sure that no force is applied to the sensor.
- Do not perform measurement during the battery charging. Performing measurement during charging may cause the delay of completion of the battery charging.

1) Connect the **MM-410B** to a power supply, and plug the force or current/force sensor to the **MM-410B**. 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 (3) b 1) and 2) in Chapter 6.)

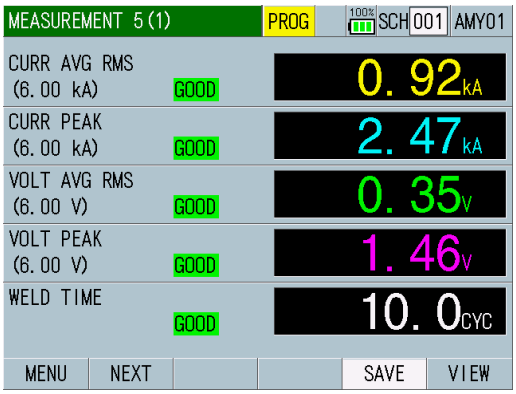
2) Set the main power switch on the top to the ON position (– side) to start the **MM-410B**.



3) The MEASUREMENT 5(1) or MEASUREMENT 10 screen appears on the display after a while.



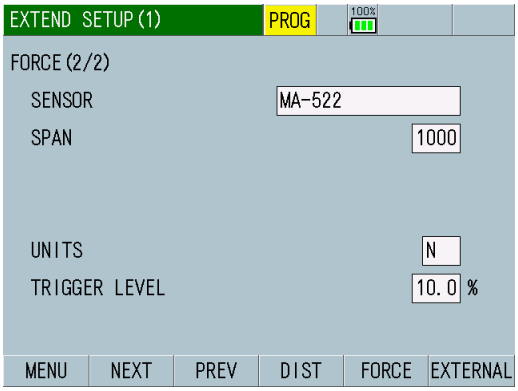
To change or check the setting, touch MEAS to change it to PROG. (Alternately switched by touching.)



4) Touch the MENU key.

The MENU screen appears. Select EXTEND SETUP.

5) Select the EXTEND SETUP (2) screen.



6) Set the following items. (For more information, refer to (2) k-2 in Chapter 8.)

Item	Setting
SENSOR	Select the force sensor connected.
SPAN*1	500 to 1500
UNITS	N, kgf, lbf
TRIGGER LEVEL	Measures while the trigger level is exceeded. Set in % from full scale: 2.0 to 99.9%

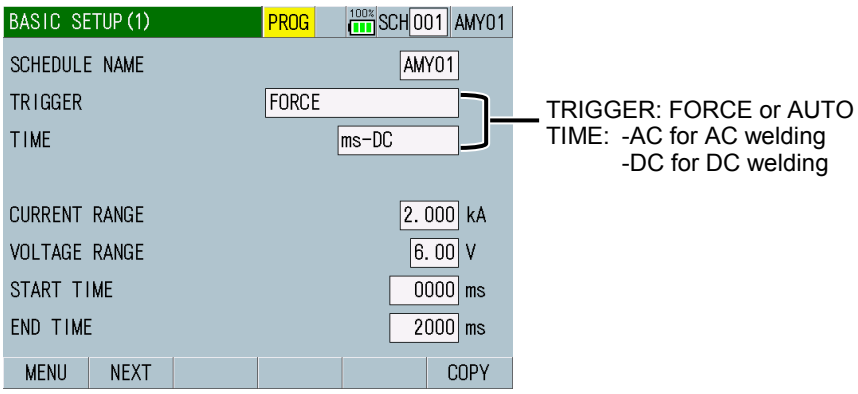
*1: Since the sensor have some variation in accuracy, value and force span to correct it are listed on the label of our force sensor and current/force sensor. Set the value of force span on the label to the SPAN.

7) Touch the MENU key.

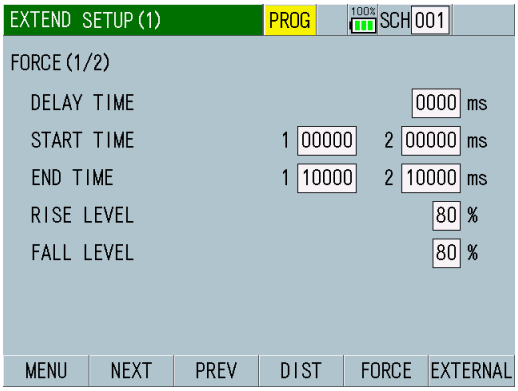
The MENU screen appears. Select BASIC SETUP.

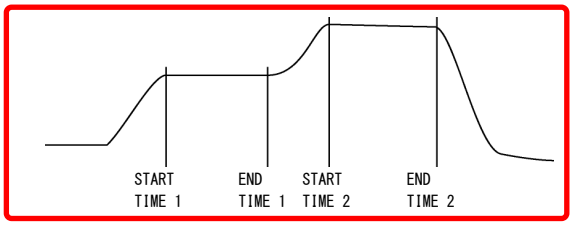
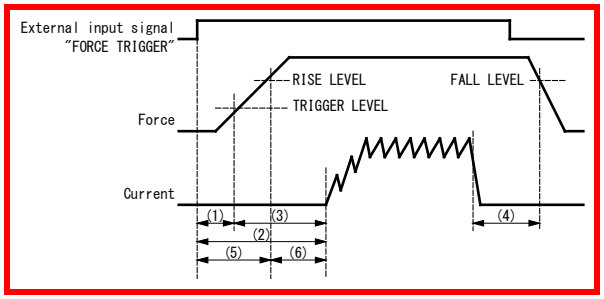
The BASIC SETUP (1) screen appears.

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



9) Set the following items in the EXTEND SETUP (1) screen.



Item	Setting
DELAY TIME	Measures force at the end of the delay time after the current flow end.
START TIME 1/2 END TIME 1/2	Referring to the figure shown below, set a force calculation interval by the START TIME and END TIME. 
RISE LEVEL FALL LEVEL	Set RISE LEVEL and FALL LEVEL as the ratio to the peak (10 to 90%). This setting applies to the time measurements in the FORCE TIMING screen. 

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

To measure mean force of measurement interval 1:	FORCE AVG1
To measure mean force of measurement interval 2:	FORCE AVG2
To measure peak force:	FORCE PEAK
To measure force before the start of current flow:	FORCE INITIAL
To measure force after the end of welding:	FORCE FINAL
To measure force constantly by the constant trigger:	FORCE REAL TIME

To measure the force time (from when the force signal exceeds the force start level to when the signal falls below the force end level): FORCE TIME

When the measurement item is changed, upper and lower limits for the changed measurement item are initialized. Set upper and lower limits again on the COMPARATOR screen. (Refer to (2) e in Chapter 8.)

11) To display the waveforms of the measured items, set those items in WAVEFORM 1 to 4.

12) Touch the MENU key to select MEASUREMENT or WAVEFORM.

13) Select a schedule number to measure.

Set a schedule number to measure in “SCH.”

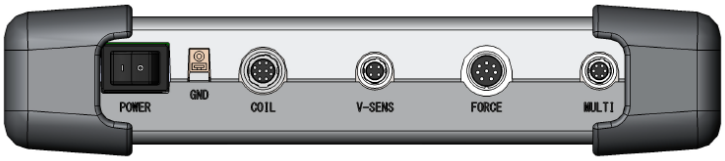
14) Touch PROG to change it to MEAS, putting the **MM-410B** into wait state until measurement starts (the signal selected as trigger is input).

15) When the trigger signal is input to the **MM-410B**, the [TRIGGER] lamp lights up and measurement starts. Confirm the measurement results on the MEASUREMENT and WAVEFORM screens.

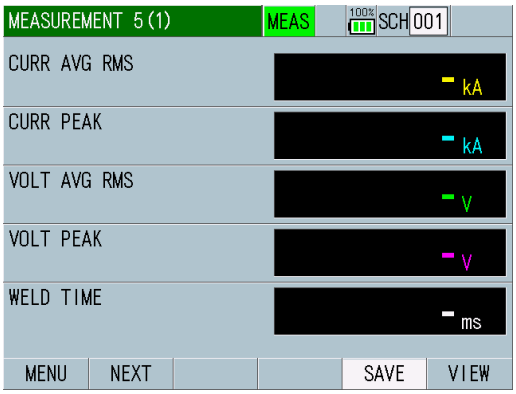
(3) Continuously Measuring Force and External Input

1) Plug any of the following sensors to measure to the **MM-410B**: the force sensor, external ±10 V voltage input, or external 4 to 20 mA current input. (For more information, refer to (2) b to d in Chapter 6.)

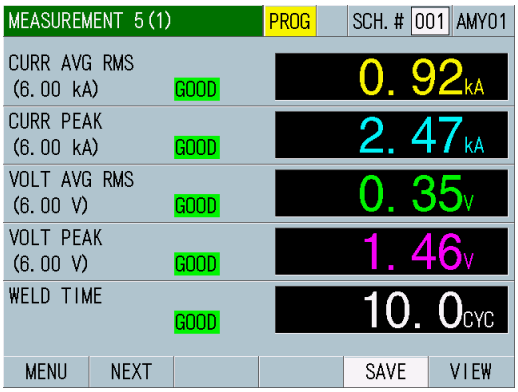
2) Set the main power switch on the top to the ON position (– side) to start the **MM-410B**.



3) The MEASUREMENT 5(1) or MEASUREMENT 10 screen appears on the display after a while.



To change or check the setting, touch MEAS to change it to PROG. (Alternately switched by touching.)

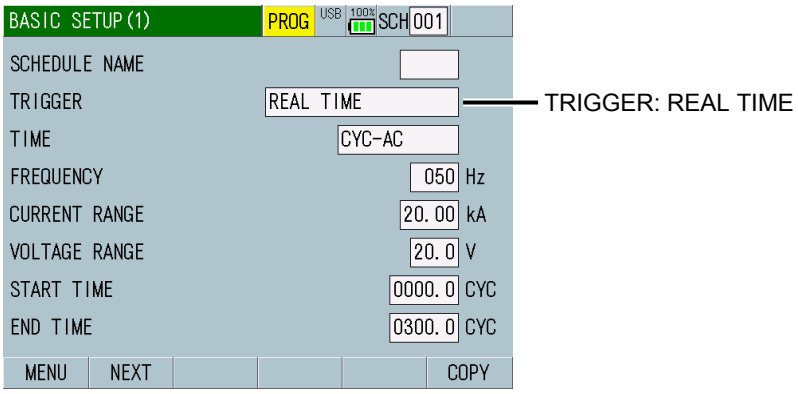


4) Touch the MENU key.

The MENU screen appears. Select BASIC SETUP.

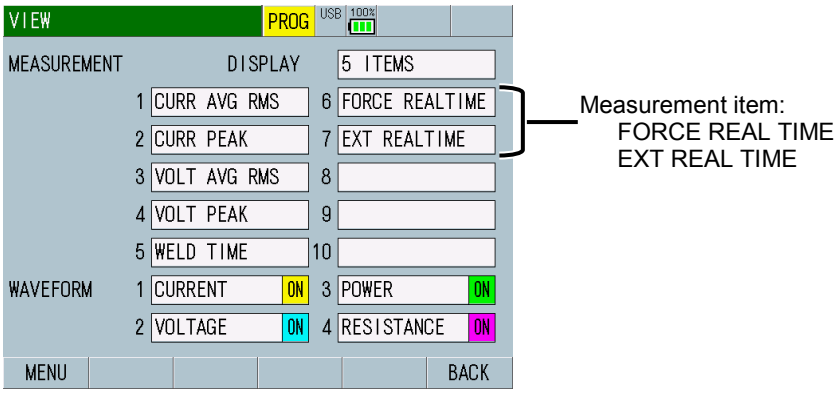
5) Select REAL TIME for TRIGGER in the BASIC SETUP (1) screen. (For more information, refer to (2) l-1 in Chapter 8.)

When the TRIGGER setting is changed if the TIME setting is SHORT ms-DC or LONG CYC-AC, upper and lower limits for measurement items WELD TIME and FLOW TIME and TIME, START TIME, END TIME, COOL TIME, and MEASUREMENT MIN TIME on the BASIC SETUP screens are initialized. Save settings in the USB memory as necessary so that you can restore the settings by reading them.
(For saving schedules and reading them, refer to (2) i in Chapter 8.)



6) Touch the MENU key to select VIEW.

Set items to measure to FORCE REAL TIME and EXT REAL TIME in any of MEASUREMENT 1 to 10 on the VIEW screen. (For more information, refer to (2) c in Chapter 8.)



7) Touch the MENU key to select MEASUREMENT.

8) Touch PROG to change it to MEAS. Measured values of the respective sensors are displayed in items of FORCE REAL TIME and EXT REAL TIME.

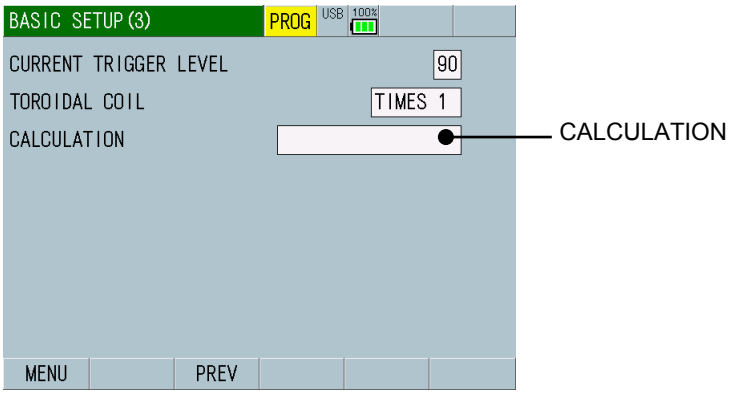
(4) Settings from welding schedule

Setting example of MM-410B is explained from the welding schedule.
The setting method from the initial setting state is shown. If you have changed the setting, initialize it before setting.
(refer to “I-1. SYSTEM SETUP (1) Screen” in Chapter 8, “Operation Screens”),

1) Selection of Calculation Method
Select the calculation method and perform settings according to the setting method.
If you perform the same operation as the **MM-370C**, select ① ORIGINAL.
If you perform the ISO17657-compliant operation, select ① ISO17657.

Calculation	Setting
Same operation as the **MM-370C**	① ORIGINAL setting
Compliant operation with ISO17657	② ISO17657 setting

Display the BASIC SETUP (3) screen.
(refer to “j-3. BASIC SETUP (3) Screen” in Chapter 8, “Operation Screens”)



① ORGINAL:
Set the “CALULATION” to “ORIGINAL”.
If you select Original, the upper left column is displayed in green on all screens

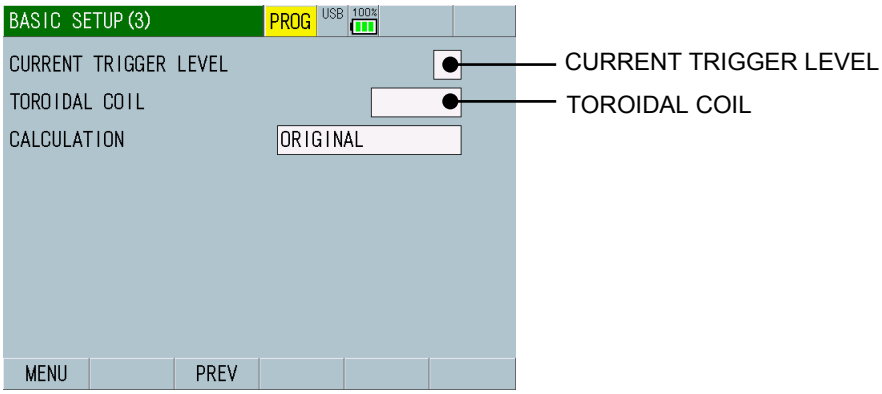
② ISO17657:
Set the “CALULATION” to “ISO17657”.
If you select ISO17657, the upper left column is displayed in blue on all screens and displays ISO.

The setting of [1) Selection of Calculation Method] is now complete. Go to [2) Selection of Toroidal Coil]

2) Selection of Toroidal Coil
Select the toroidal coil to and perform settings according to the setting method.

Toroidal coil	Setting
MB-400P/MB-800P [1x sensitivity coil]	① 1x sensitivity setting
MB-45G [10x sensitivity coil]	② 10x sensitivity setting

Display the BASIC SETUP (3) screen.
(refer to “j-3. BASIC SETUP (3) Screen” in Chapter 8, “Operation Screens”)



Usually,set “CURRENT TRIGGER LEVEL” to “90 (initial value)”.
If the measurement does not start when measuring a small welding current (the [TRIGGER] lamp does not light up), increase the value of “CURRENT TRIGGER LEVEL”.
If you start measurement without welding ([TRIGGER] lamp lights up), decrease the value of “CURRENT TRIGGER LEVEL”.

① 1x sensitivity setting:
Set the “TOROIDAL COIL” to “TIMES 1”.

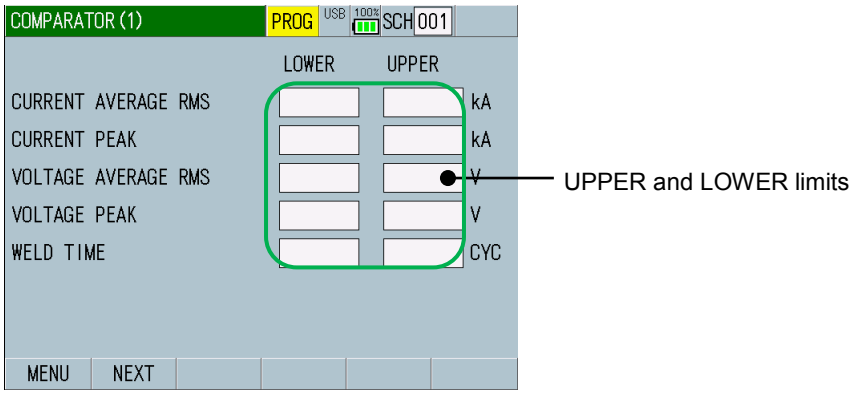
② 10x sensitivity setting:
Set the “TOROIDAL COIL” to “TIMES 10”.

The setting of [2)] Selection of Toroidal Coil] is now complete. Go to [3) Selection of Welding Power Supply to Measure]

3) Selection of Welding Power Supply to Measure
Select the type of your welding power supply and set according to the setting method.

Type of welding power supply	Setting
Single-phase AC type	① Single-phase AC setting
Single-phase rectifier type	② Single-phase rectifier setting
AC inverter type	③ AC inverter setting
DC inverter type	④ DC inverter setting
Transistor type	⑤ Transistor setting
Capacitor type	⑥ Capacitor setting

The method for setting the upper and lower limits is common.
Set it as necessary after “Selection of Welding Power Supply to Measure”.
(refer to “e. COMPARATOR Screen” in Chapter 8, “Operation Screens”)



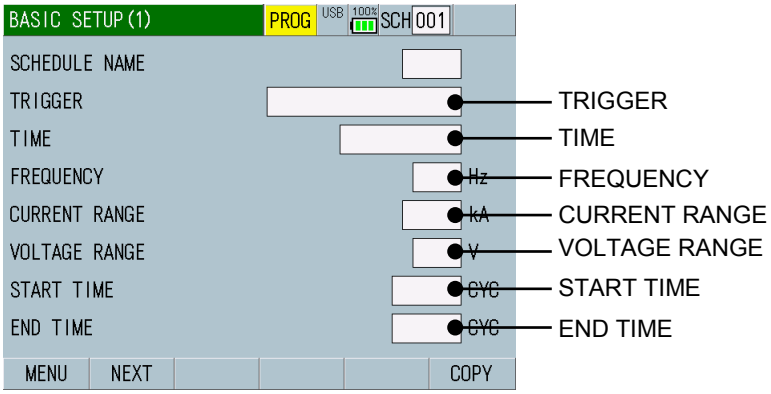
Judgment can be performed by setting upper and lower limits.
Set it as necessary.

It is possible to determine the quality of welding by verifying the measurement range in which the weld is acceptable and setting the lower and upper limits of that range.

If you do not want to set upper and lower limits, set “LOWER” to “Minimum value (initial value)” and “UPPER” to “Maximum value (initial value)”.

①Single-phase AC setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



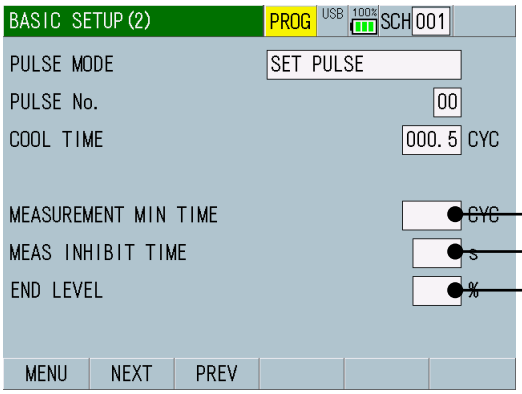
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “CYC-AC”.
Set the “FREQUENCY” to “50Hz or 60Hz”.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE" to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0.0CYC (initial value)” and “END TIME” to “300.0CYC (initial value)”.

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)

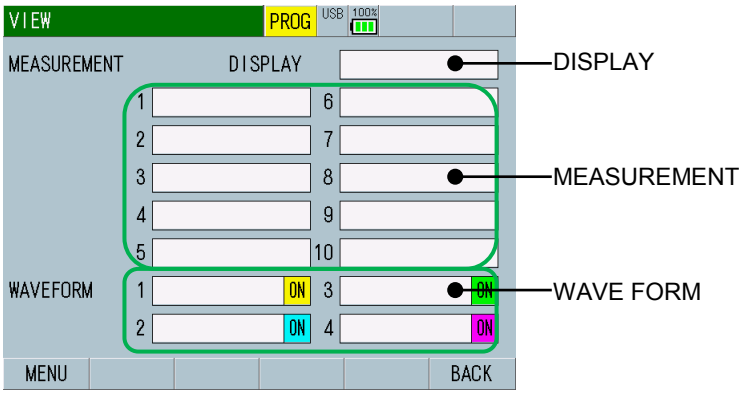


Normally, set the “MEASUREMENT MIN TIME” to “1.0CYC (initial value)”.
If the welding current flow is small (using upslope, etc.) and measurement cannot be performed, set the “MEASUREMENT MIN TIME” to the weld time or upslope time set in the welding power supply.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items” or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS*1 / CURR RMS*1	2	CURR PEAK
3	VOLT AVG RMS*1*2 / VOLT RMS*1*2	4	VOLT PEAK*2
5	WELD TIME	6	CONDUCTION ANGLE
7	POWER*2	8	RESISTANCE*2
9	WELD COUNT	10	GOOD COUNT

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

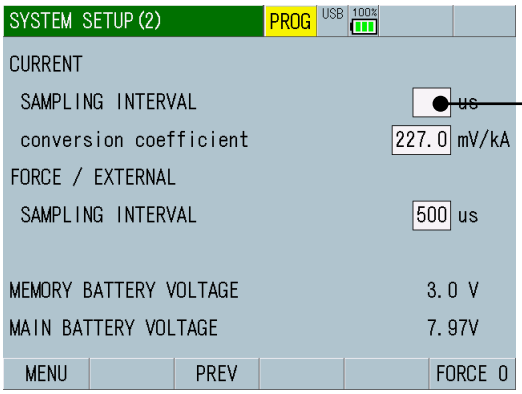
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE*1
3	POWER*1	4	RESISTANCE*1

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)

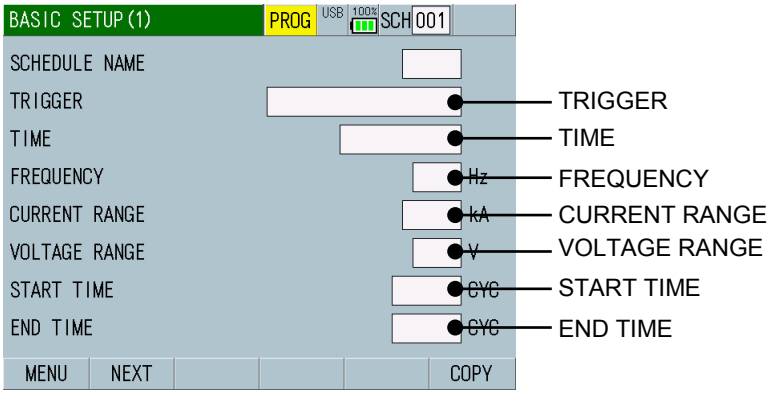


Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display. Also, “50us” cannot be used when measuring “FORCE” or “EXTERNAL”.

② Single-phase rectifier setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



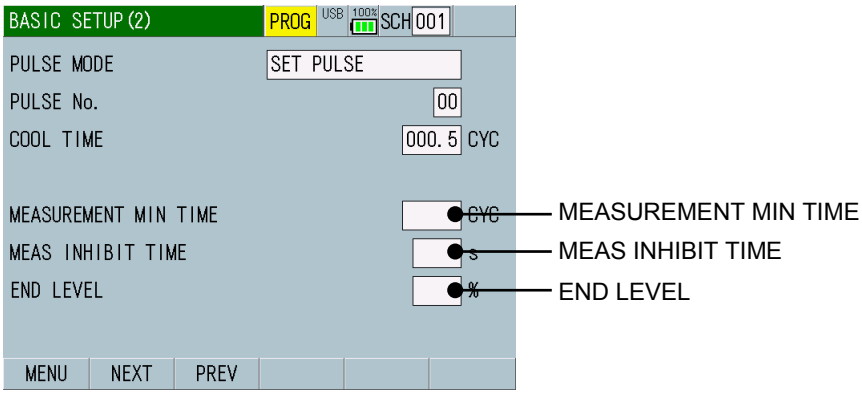
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “CYC-DC”.
Set the “FREQUENCY” to “50Hz or 60Hz”.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE” to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0.0CYC (initial value)” and “END TIME” to “300.0CYC (initial value)”.

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)

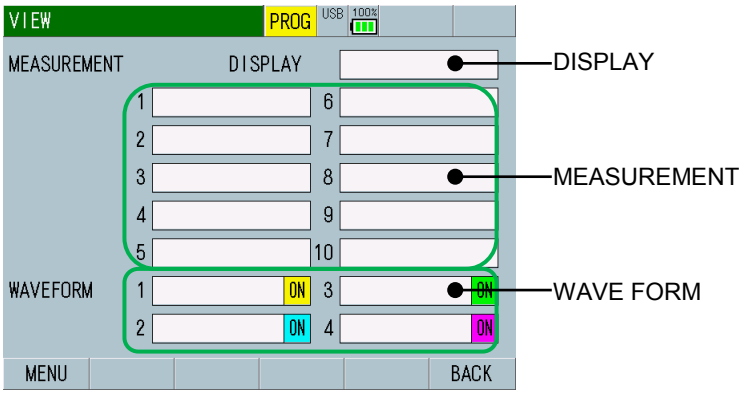


Normally, set the “MEASUREMENT MIN TIME” to “1.0CYC (initial value)”.
If the welding current flow is small (using upslope, etc.) and measurement cannot be performed, set the “MEASUREMENT MIN TIME” to the weld time or upslope time set in the welding power supply.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items” or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS[*1] / CURR RMS[*1]	2	CURR PEAK
3	VOLT AVG RMS[*1*2] / VOLT RMS[*1*2]	4	VOLT PEAK[*2]
5	WELD TIME	6	POWER[*2]
7	RESISTANCE[*2]	8	WELD COUNT
9	GOOD COUNT	10	

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

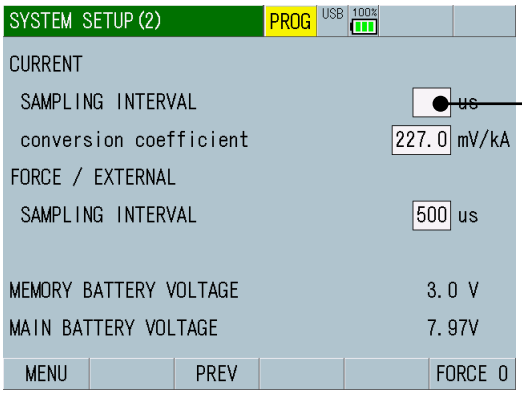
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE[*1]
3	POWER[*1]	4	RESISTANCE[*1]

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)

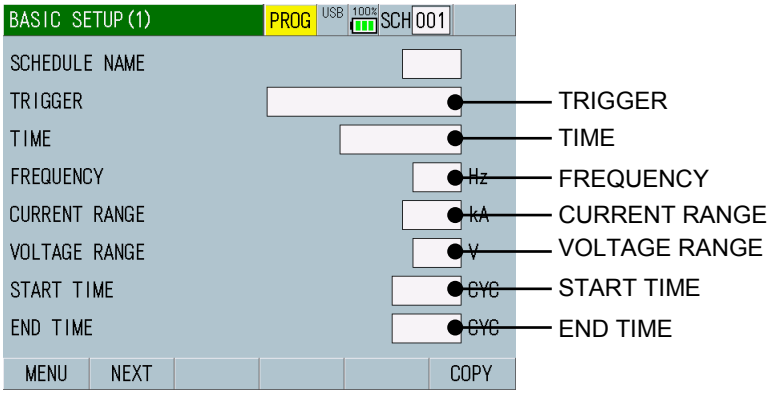


Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display. Also, “50us” cannot be used when measuring “FORCE” or “EXTERNAL”.

③ AC inverter setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



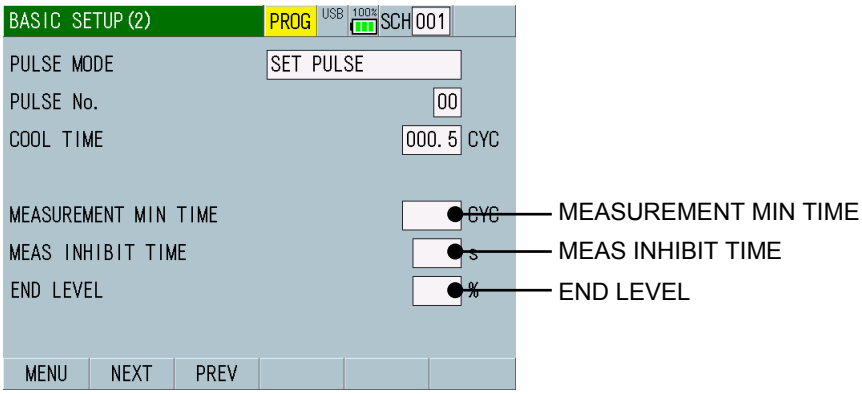
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “CYC***Hz-AC”.
Set the “FREQUENCY” to the welding frequency of the AC inverter type.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE" to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0.0CYC (initial value)” and “END TIME” to “2000.0CYC (initial value)”.

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)

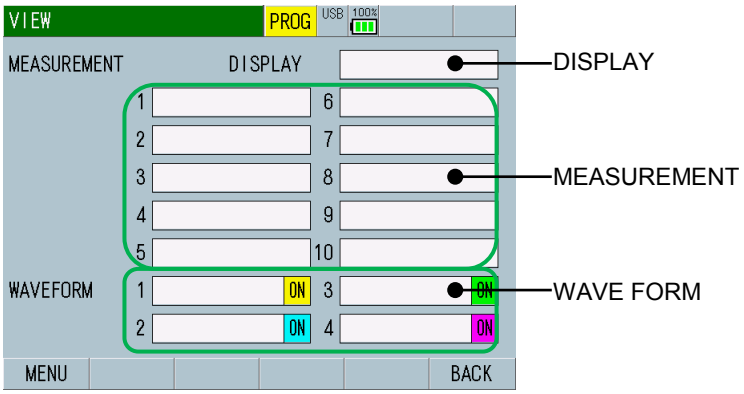


Normally, set the “MEASUREMENT MIN TIME” to “1.0CYC (initial value)”.
If the welding current flow is small (using upslope, etc.) and measurement cannot be performed, set the “MEASUREMENT MIN TIME” to the weld time or upslope time set in the welding power supply.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items” or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS[*1] / CURR RMS[*1]	2	CURR PEAK
3	VOLT AVG RMS[*1*2] / VOLT RMS[*1*2]	4	VOLT PEAK[*2]
5	WELD TIME	6	POWER[*2]
7	RESISTANCE[*2]	8	WELD COUNT
9	GOOD COUNT	10	

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

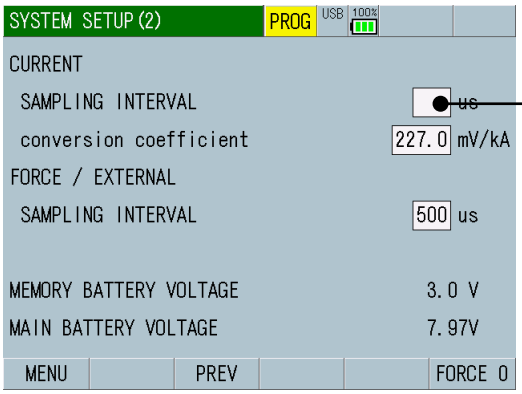
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE[*1]
3	POWER[*1]	4	RESISTANCE[*1]

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)

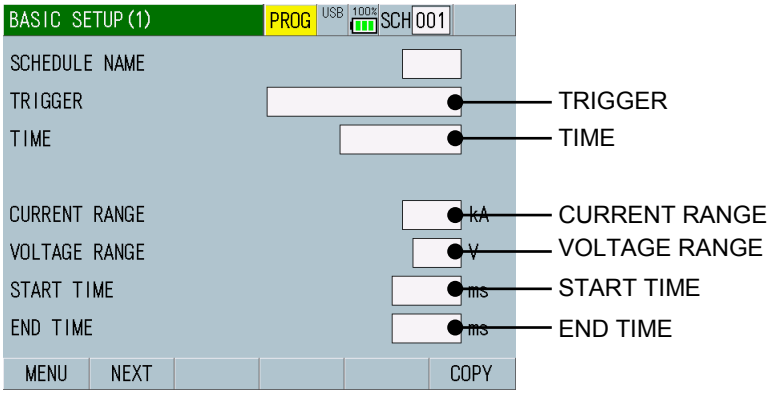


Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display. Also, “50us” cannot be used when measuring “FORCE” or “EXTERNAL”.

④ DC inverter setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



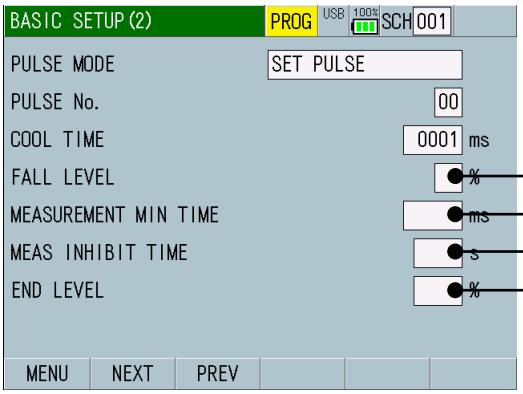
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “ms-DC”.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE" to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0ms (initial value)” and “END TIME” to “2000ms (initial value)”.

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)



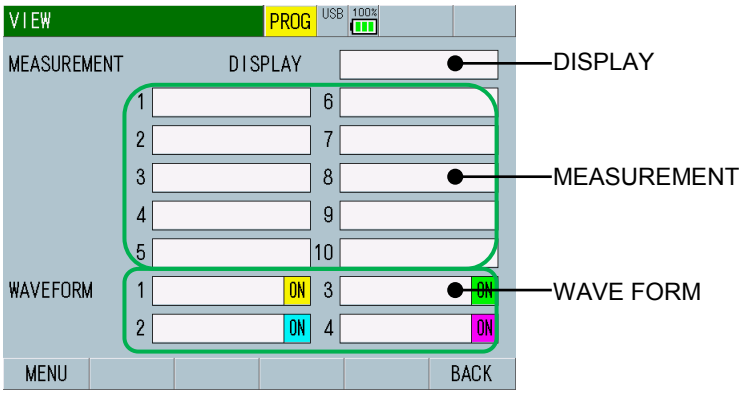
Normally, set the “FALL LEVEL” to “80% (initial value)”.
If you want to measure until the end of the welding current flow, or if the welding current overshoots and the measurement time is short, reduce the “FALL LEVEL”.

Normally, set the “MEASUREMENT MIN TIME” to “5ms (initial value)”.
If the welding current flow is small (using upslope, etc.) and measurement cannot be performed, set the “MEASUREMENT MIN TIME” to the weld time or upslope time set in the welding power supply.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items” or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS[*1] / CURR RMS[*1]	2	CURR PEAK
3	VOLT AVG RMS[*1*2] / VOLT RMS[*1*2]	4	VOLT PEAK[*2]
5	WELD TIME	6	POWER[*2]
7	RESISTANCE[*2]	8	WELD COUNT
9	GOOD COUNT	10	

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

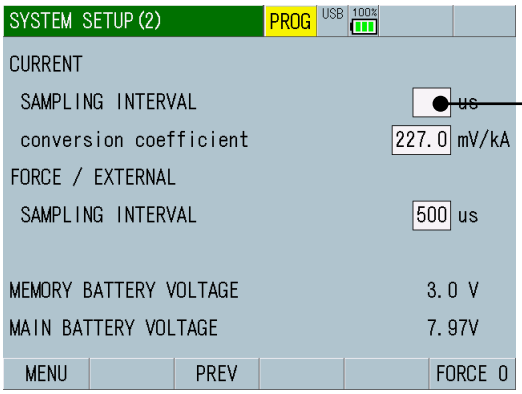
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE[*1]
3	POWER[*1]	4	RESISTANCE[*1]

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)

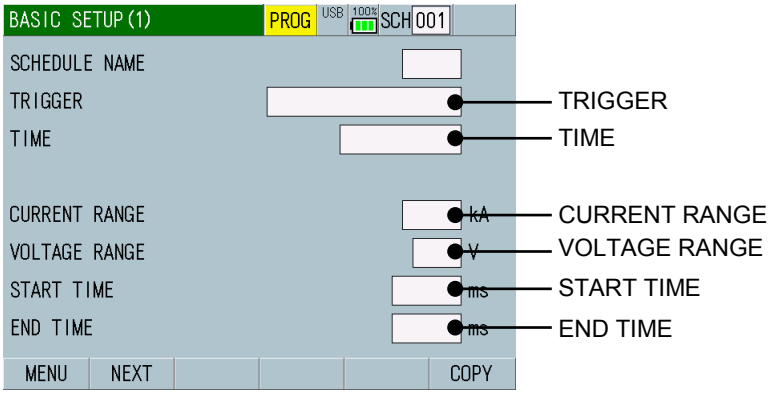


Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display. Also, “50us” cannot be used when measuring “FORCE” or “EXTERNAL”.

⑤ Transistor setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



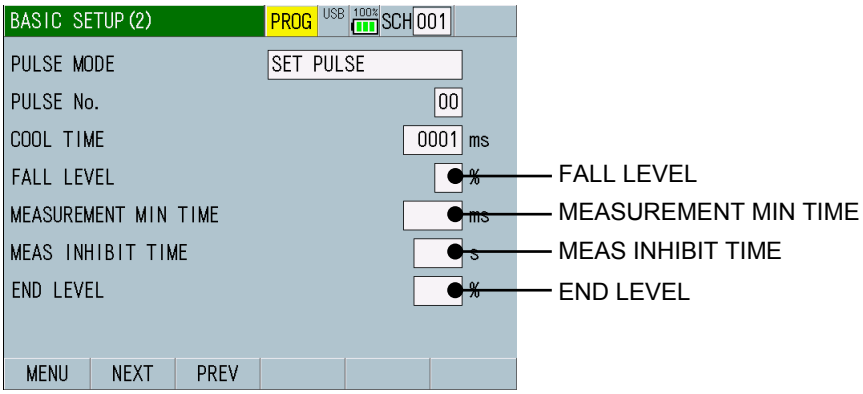
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “ms-DC”or “SHORT ms-DC”.
“ms-DC” enables measurement in units of 1ms, and “SHORT ms-DC” enables measurement of finer than 1ms.
“SHORT ms-DC” cannot be used when measuring “FORCE” or “EXTERNAL”.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE" to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0ms (initial value)” and “END TIME” to “2000ms (initial value)” (when “time” is “ms-DC”).
If you do not specify a range, set the “START TIME” to “0.00ms (initial value)” and “END TIME” to “300.00ms (initial value)” (when “time” is “SHORT ms-DC”).

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)



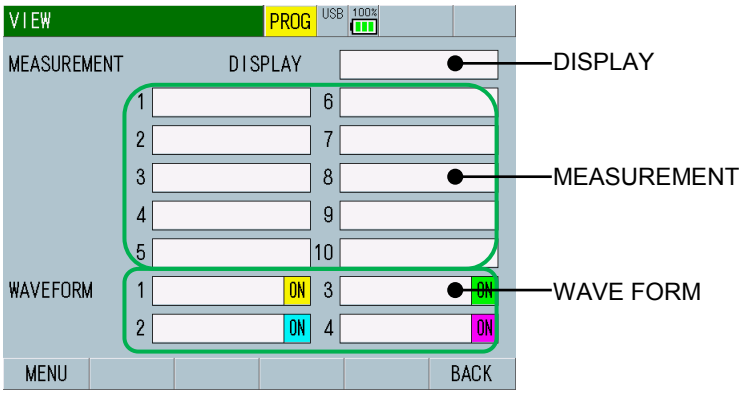
Normally, set the “FALL LEVEL” to “80% (initial value)”.
If you want to measure until the end of the welding current flow, or if the welding current overshoots and the measurement time is short, reduce the “FALL LEVEL”.

Normally, set the “MEASUREMENT MIN TIME” to “5ms (initial value)” (when “time” is “ms-DC”).
Also set the “MEASUREMENT MIN TIME” to “5.0ms (initial value)” (when “time” is “SHORT ms-DC”).
If the welding current flow is small (using upslope, etc.) and measurement cannot be performed, set the “MEASUREMENT MIN TIME” to the weld time or upslope time set in the welding power supply.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items” or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS*1 / CURR RMS*1	2	CURR PEAK
3	VOLT AVG RMS*1*2 / VOLT RMS*1*2	4	VOLT PEAK*2
5	WELD TIME	6	POWER*2
7	RESISTANCE*2	8	WELD COUNT
9	GOOD COUNT	10	

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

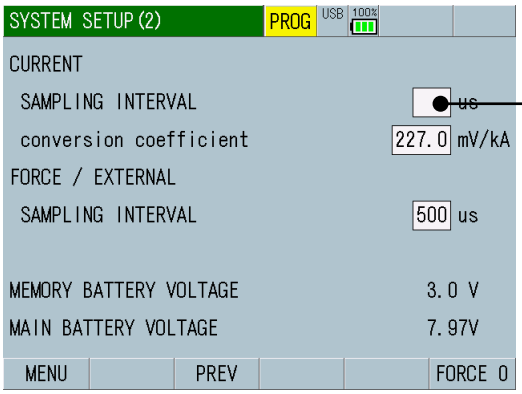
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE*1
3	POWER*1	4	RESISTANCE*1

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)

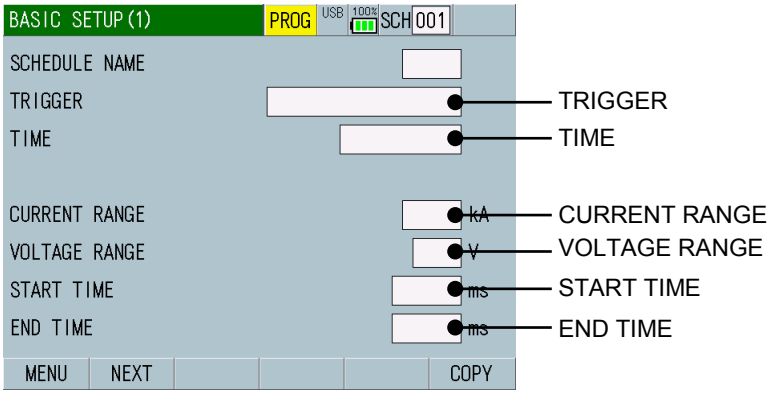


Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “20us”, “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display. “20us” cannot be used when “TIME” is set to “ms-DC”. Also, “50us” cannot be used when measuring “FORCE” or “EXTERNAL”.

⑥Capacitor setting

Display the BASIC SETUP (1) screen.
(refer to “j-1. BASIC SETUP (1) Screen” in Chapter 8, “Operation Screens”)



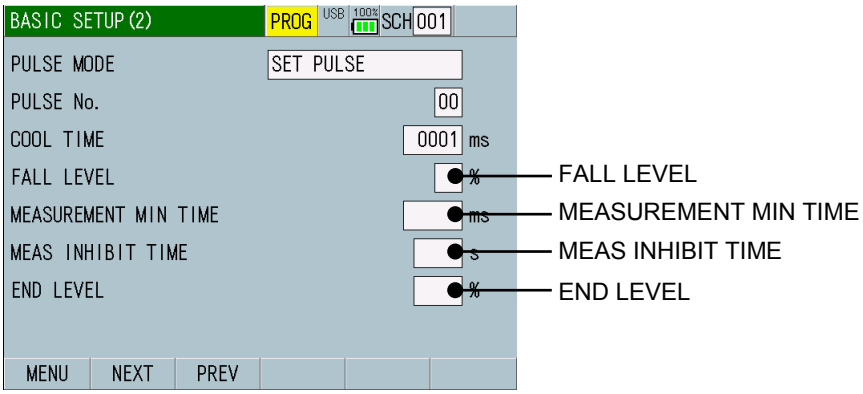
Set the “TRIGGER" to “CURRENT”.
Set the “TIME” to “SHORT ms-DC”.
“ms-DC” enables measurement in units of 1ms, and “SHORT ms-DC” enables measurement of finer than 1ms.
“SHORT ms-DC” cannot be used when measuring “FORCE” or “EXTERNAL”.

If you have set the current value of the welding power supply, select a current range that is about 1.2 times larger than the current value of the welding power supply you are setting.
If the current value of the welding power supply is not set, set the “CURRENT RANGE” to “20.00kA”.
At the time of measurement, if the measured current value is smaller than the current range one level below, decrease the “CURRENT RANGE”.
If the current value seems to be over, please increase the “CURRENT RANGE”.

Set the “VOLTAGE RANGE" to “20.0V”.
At the time of measurement, if the measured voltage value is smaller than the voltage range one level below, decrease the “VOLTAGE RANGE”.

“START TIME” setting and “END TIME” setting can be used to measure current/voltage RMS and average power/resistance values by specifying an arbitrary range.
If you want to measure a part of the section or measure the section excluding the upslope or downslope, set it as necessary.
If you do not specify a range, set the “START TIME” to “0.00ms (initial value)” and “END TIME” to “300.00ms (initial value)”.

Display the BASIC SETUP (2) screen.
(refer to “j-2. BASIC SETUP (2) Screen” in Chapter 8, “Operation Screens”)



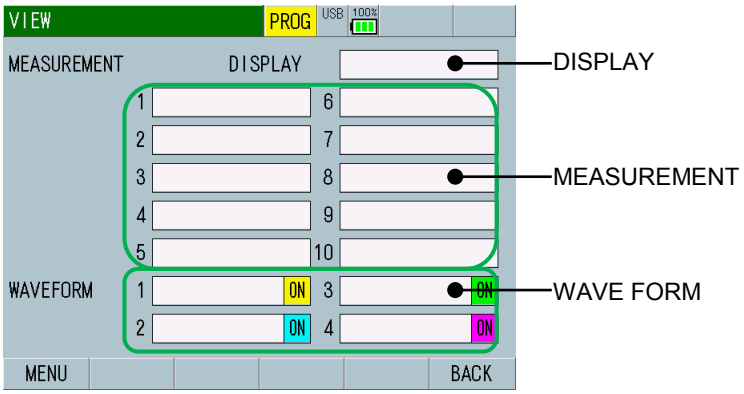
Normally, set the “FALL LEVEL” to “50%”.
The RMS value can be measured up to the “WELD TIME TH”.

Normally, set the “MEASUREMENT MIN TIME” to “5.0ms (initial value)”.
If the welding current flow is small and measurement cannot be performed, increase the “MEASUREMENT MIN TIME”.

Set the “MEAS INHIBIT TIME” to “0.0s (initial value)”.
So as not to measure the reset current after the welding current.
If you measure a current that does not need to be measured after measuring the welding current, set the “MEAS INHIBIT TIME”.

Normally, set the “END LEVEL” to “5.0% (initial value)”.
If the measurement does not end, increase the “END LEVEL”.

Display the VIEW screen.
(refer to “c. VIEW Screen” in Chapter 8, “Operation Screens”)



Set the “DISPLAY” to "5 items" or “10 items” according to the number of items to be measured.

Refer to the following and set the necessary items in “MEASUREMENT”.

1	CURR AVG RMS[*1] / CURR RMS[*1]	2	CURR PEAK
3	VOLT AVG RMS[*1*2] / VOLT RMS[*1*2]	4	VOLT PEAK[*2]
5	WELD TIME	6	WELD TIME TP
7	WELD TIME TH	8	WELD COUNT
9	GOOD COUNT	10	

*1: In [original mode], CURR/VOLT AVG RMS.
In [ISO17657 mode], CURR/VOLT RMS.

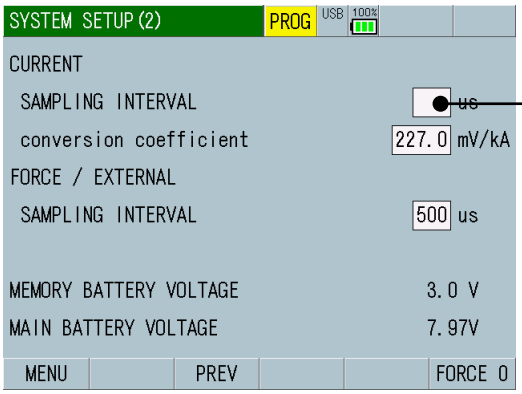
*2: When measuring voltage.

Refer to the following and set the necessary items in “WAVEFORM”

1	CURRENT	2	VOLTAGE[*1]
3	POWER[*1]	4	RESISTANCE[*1]

*1: When measuring voltage.

Display the SYSTEM SETUP (2) screen.
(refer to “I-2. SYSTEM SETUP (2) Screen” in Chapter 8, “Operation Screens”)



Normally, set the “CURRENT SAMPLING INTERVAL” to “200us (initial value)”. If you want to measure welding in more detail or check the welding waveform in more detail, set “20us”, “50us”or “100us” as necessary.

(Note) Please note that changing this setting will increase the processing time related to waveforms such as waveform display.

10. Interface

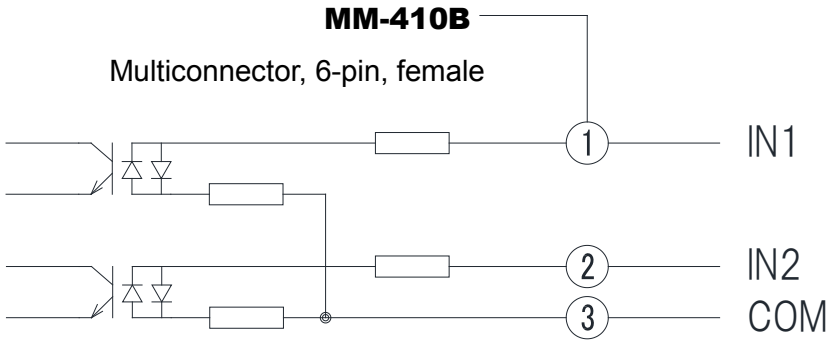
This chapter explains about the pins of the input connectors.

(1) Connection and Description of the External Input Signals

a. Input Connector

[Refer to (2) Top ⑤ in Chapter 4 “Name and Functions of Each Section.”]

The input signals are 24 V AC/DC.
The SOL signals of 24 V AC/DC can be directly connected.



Pin No.	Name	Function
1	IN1	Terminal for starting the force measurement externally.
2	IN2	Terminal for starting the external voltage/current input measurement externally.
3	COM	COM terminal for the external input signal.

(2) Interface of Other Connectors

a. Force sensor connector

[Refer to (2) Top ④ in Chapter 4 “Name and Functions of Each Section.”]

A NC

B NC

C NC

D FORCE IN1(+)

E FORCE IN2(-)

F 0V

G FG

H +5V

b. Multiconnector

[Refer to (2) Top ⑤ in Chapter 4 “Name and Functions of Each Section.”]

10	IN1	(External input signal “FORCE TRIGGER”)
11	IN2	(External input signal “EXTERNAL TRIGGER”)
12	COM	(External input signal)
13	EXT IN [CURRENT]	(EXTERNAL)
14	EXT IN [VOLT]	(EXTERNAL)
15	EXT COM	(EXTERNAL)

11. Timing Chart

(1) Time to Start Communication

*1: Internal processing time
Time for end judgment and calculation

*2: End judgment time
Time set for COOL TIME (Refer to Chapter 8, “j-2. BASIC SETUP (2) Screen.”)

*3: Calculation time
30 ms

*4: Communication time
When MEASUREMENT is selected for ITEM (Refer to Chapter 8, “n-1. Communication (1) Screen.”)

MODE	Communication time
ETHERNET	50 ms
USB	51 ms

(Refer to Chapter 8, “c. VIEW Screen” for MEASUREMENT in the VIEW screen and “n-2. Communication (2) Screen” for MODE.)

12. Data Communication

Monitoring data can be loaded from the **MM-410B** into the external PC. Also, schedule settings can be written from the external PC into the **MM-410B**.

(1) Data Transfer

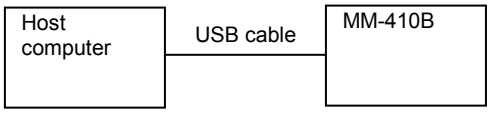
Item	Description
System	Select one option in the COMMUNICATION screen. (1) USB2.0 Hi-SPEED (Compatible operating systems are Windows 10 and Windows 7.) (2) Ethernet IEEE 802.3-compliant (10BASE-T/100BASE-TX protocol TCP/IP)
Character code	ASCII
Checksum data	None
Connector	(1) USB: USB B connector (2) Ethernet: RJ45 connector

CAUTION

To perform a setting by connecting a network, ask a network manager.

(2) Configuration

a. USB



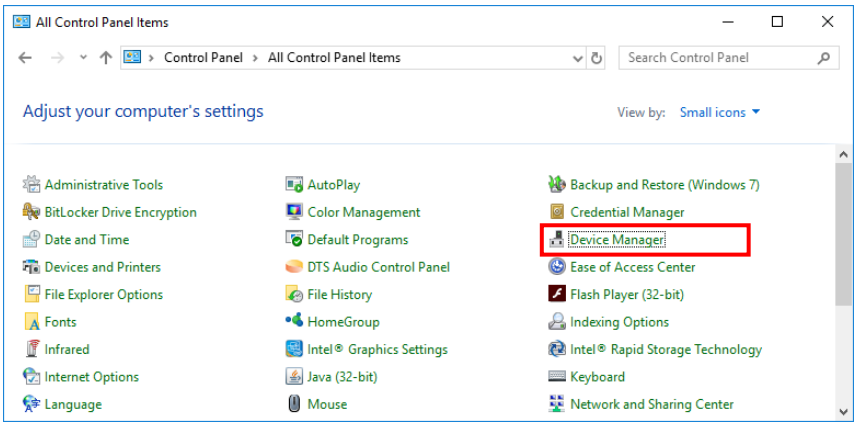
* The USB cable is optional.

[USB communication setting]

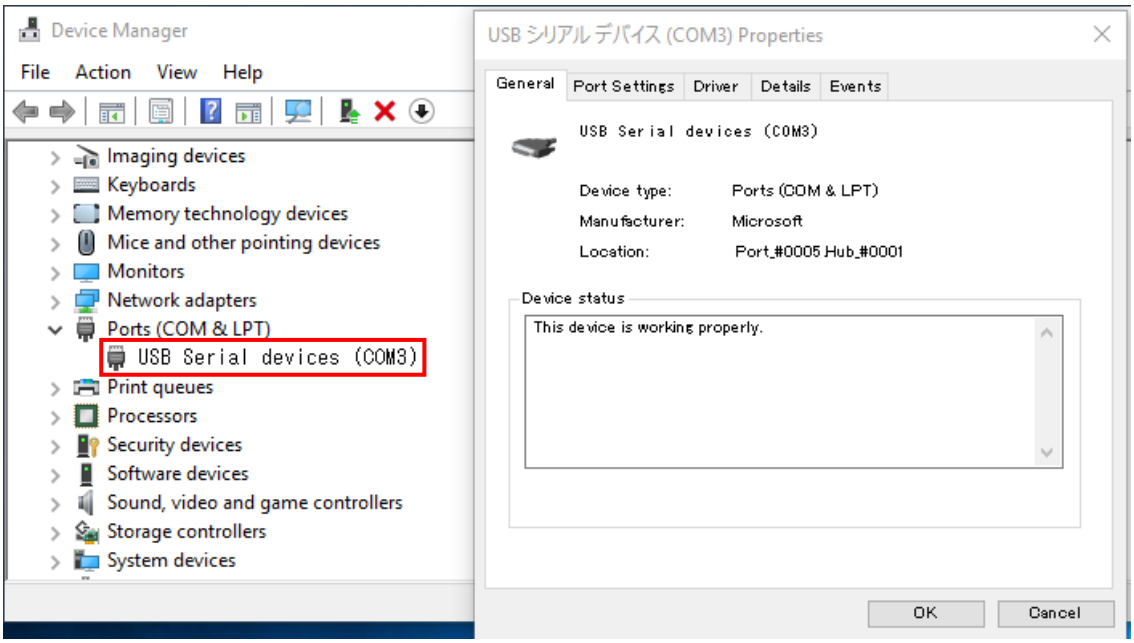
Setting procedure (for Windows 10)
* For Windows 7, contact us.

1) Connect between the **MM-410B** and a personal computer.

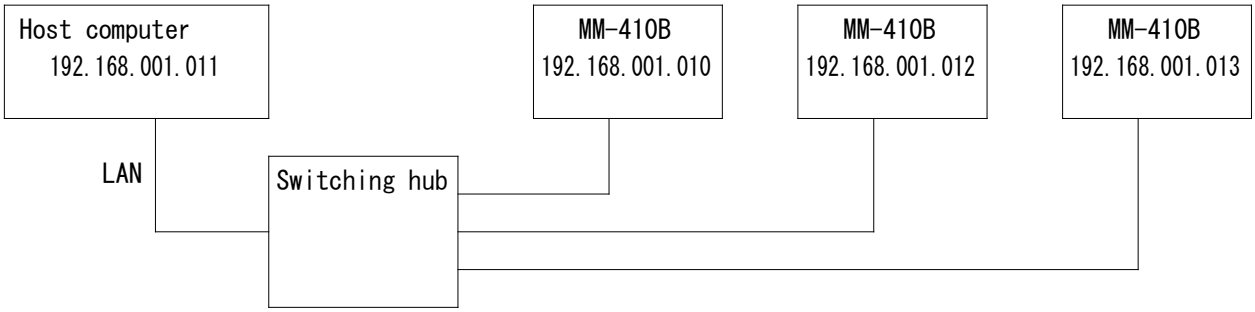
2) After a while, select the Device Manager] from the control panel.
From the start menu, select [Windows System] – [Control Panel].



3) Confirm that the USB serial device status is “This device is working properly.”



b. Ethernet



* Prepare the switching hub at customer's side.
* The LAN cable is optional (straight). Use a cable of Category 6 or higher. In a high noise environment, a cable of Category 7 is recommended.
* How to establish communication

Establish connection from the host computer to the **MM-410B**. Connect it to IP address and Port No. set in the **MM-410B**. Use TCP/IP for communication protocol.

Example)

Host computer

IP address: 192.168.1.11, Subnet mask: 255.255.255.0

MM-410B

IP address: 192.168.1.10, Subnet mask: 255.255.255.0, Port No.: 1024

Establish connection from the host computer to the **MM-410B** with settings of IP address: 192.168.1.10 and Port No.: 1024.

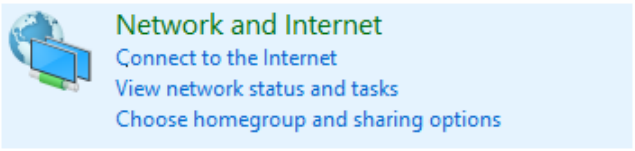
Since connection is released when the settings of the **MM-410B** (MODE, ID NUMBER, IP ADDRESS, SUBNET MASK, DEFAULT GATEWAY, and PORT NUMBER) are changed, the power supply of the **MM-410B** is turned off, and communication from the **MM-410B** cannot be made, establish connection again.

The number of connectable **MM-410B**s changes according to the host computer.

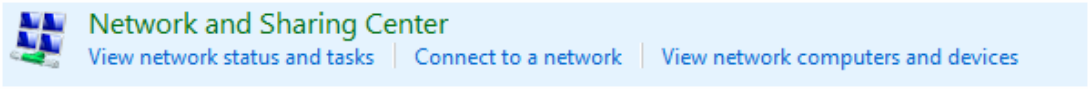
[IP address setting]
Set the IP address of the host computer.
The IP address of the **MM-410B** has been set to [192.168.1.10] at the factory. Use [192.168.1.11] or later for the IP address of the host computer. However, do not set the IP address to the same as the default gateway.

Setting procedure (for Windows 10)
The setting procedure depends on the operating system to use. Check the setting method for your operating system.

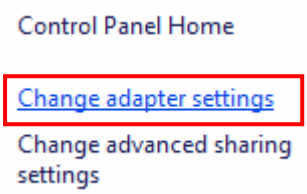
1) From the control panel, select the [Network and Internet].



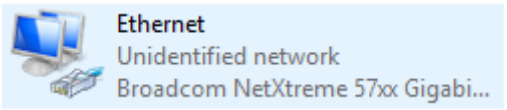
2) Select the [Network and Sharing Center].



3) Select the [Change adapter settings].

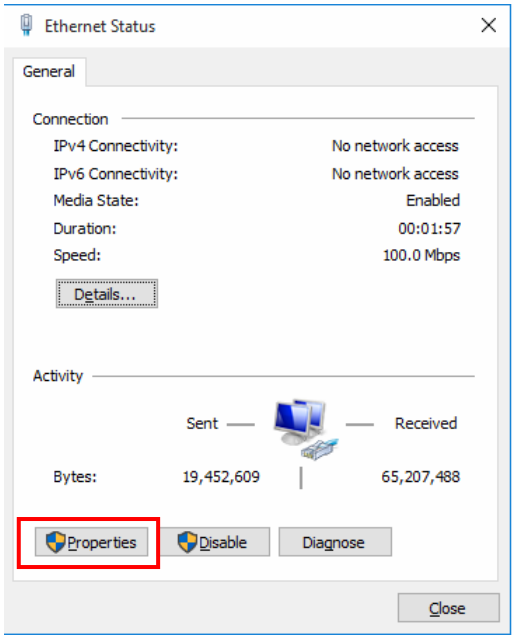


4) Select a network card to use.

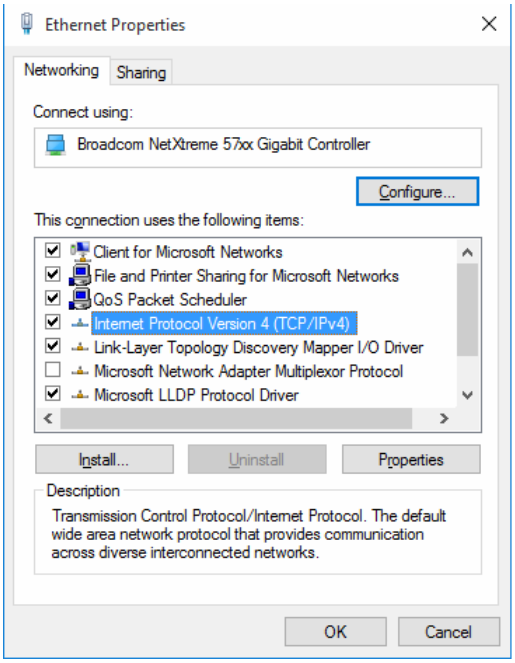


* Displays vary according to the personal computer or network card in use.

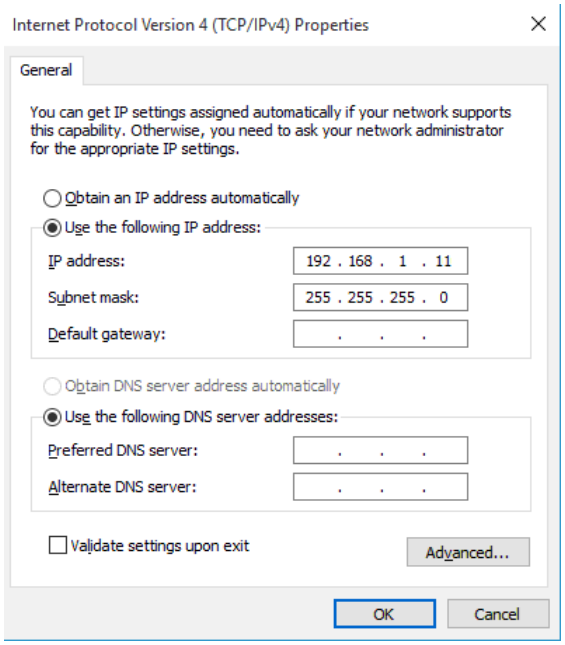
5) Click the [Properties].



6) Select the [Internet Protocol Version 4(TCP/IPv4)] and click the [Properties].

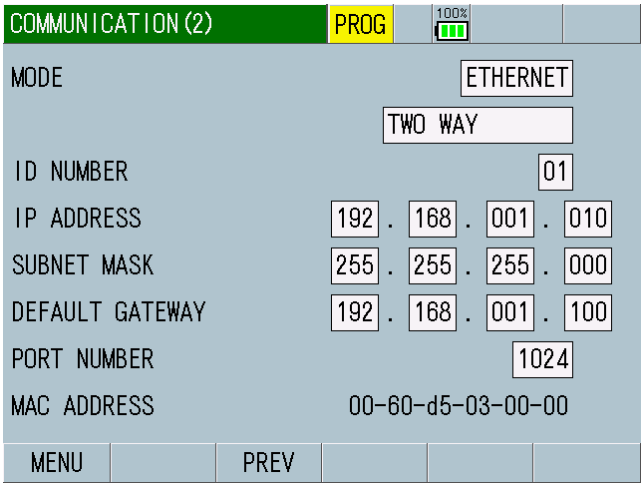


7) Input the IP address. Set the IP address as shown below and click the [OK].



Now the IP address setting is completed.

Set 1024 or later for PORT NUMBER. When you change the setting of the **MM-410B** or turn off the power supply, connect the **MM-410B** again.



(3) Communication Protocol (Single-Directional Communication)

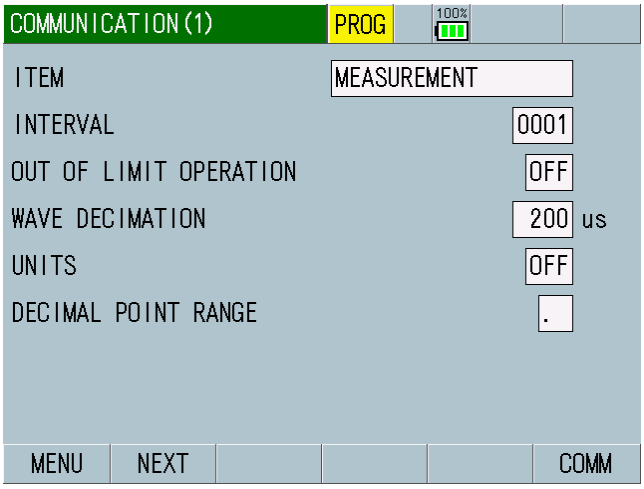
When ONE WAY is selected for MODE in the COMMUNICATION (2) screen, data of MEASUREMENT, WAVEFORM, CURR ALL CYCLE, FORCE ALL CYCLE, HISTORY, HISTORY OUT OF LIM, and SCHEDULE set for ITEM is one-sidedly transmitted for each measurement with the conditions set for INTERVAL and OUT OF LIMIT OPERATION. (Refer to “8. (2) n. COMMUNICATION Screen.”)

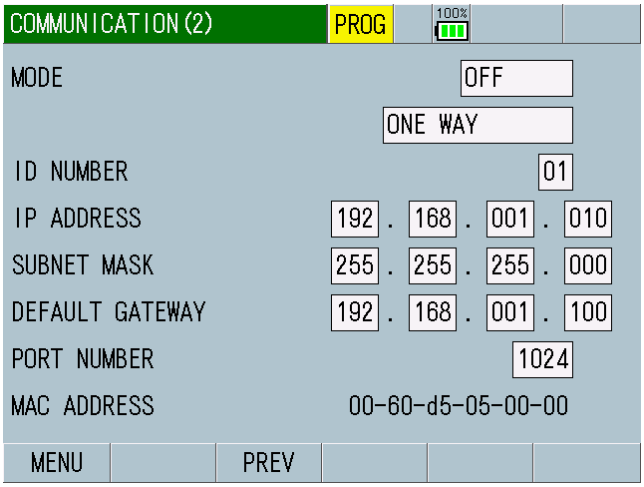
Also, when the COMM key is touched on the COMMUNICATION (1) screen, data set for ITEM is transmitted every time.

When DECIMAL POINT RANGE is changed from “.” (period) to “,” (comma), delimiter between items is changed from “,” (comma) to “:” (colon).

Only for WAVEFORM, CURR ALL CYCLE, and FORCE ALL CYCLE, [EOT] is added at an end of the data.

When SEAM is selected for MODE in the SYSTEM SETTING (1) screen, the measurement data of 1) MEASUREMENT, 2) WAVEFORM, 3) CURR ALL CYCYLE, 4) FORCE ALL CYCLE, 5) HISTORY, and 6) HISTORY OUT OF LIM cannot be transmitted.





1) MEASUREMENT

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	01		2
6	Delimiter	:		1
7	Year	17	16 to 77	2
8	Delimiter	/		1
9	Month	01	01 to 12	2
10	Delimiter	/		1
11	Day	01	01 to 31	2
12	Delimiter	_	(Space)	1
13	Hour	00	00 to 23	2
14	Delimiter	:		1
15	Minute	00	00 to 59	2
16	Delimiter	:		1
17	Second	00	00 to 59	2
18	Delimiter	,		1
19	Measurement item code 1	Refer to the measurement code table (Item code).		2
20	Delimiter	,		1
21	Judgment 1	Refer to the judgment code table (Display).		1
22	Delimiter	,		1
23	MEAS 1	Refer to the measurement code table (Measured value).		1 to 7
24	Unit 1	Refer to the measurement code table (Unit).		0 to 4
25	Delimiter	,		1
26	Measurement item code 2	Refer to the measurement code table (Item code).		2
27	Delimiter	,		1
28	Judgment 2	Refer to the judgment code table (Display).		1
29	Delimiter	,		1
30	MEAS 2	Refer to the measurement code table (Measured value).		1 to 7
31	Unit 2	Refer to the measurement code table (Unit).		0 to 4
32	Delimiter	,		1
33	Measurement item code 3	Refer to the measurement code table (Item code).		2
34	Delimiter	,		1
35	Judgment 3	Refer to the judgment code table (Code).		1
36	Delimiter	,		1

	Item	Display example	Range	Length
37	MEAS 3	Refer to the measurement code table (Measured value).		1 to 7
38	Unit 3	Refer to the measurement code table (Unit).		0 to 4
39	Delimiter	,		1
40	Measurement item code 4	Refer to the measurement code table.		2
41	Delimiter	,		1
42	Judgment 4	Refer to the judgment code table.		1
43	Delimiter	,		1
44	MEAS 4	Refer to the measurement code table (Measured value).		1 to 7
45	Unit 4	Refer to the measurement code table (Unit).		0 to 4
46	Delimiter	,		1
47	Measurement item code 5	Refer to the measurement code table (Item code).		2
48	Delimiter	,		1
49	Judgment 5	Refer to the judgment code table (Code).		1
50	Delimiter	,		1
51	MEAS 5	Refer to the measurement code table (Measured value).		1 to 7
52	Unit 5	Refer to the measurement code table (Unit).		0 to 4
53	Delimiter	,		1
54	Measurement item code 6	Refer to the measurement code table (Item code).		2
55	Delimiter	,		1
56	Judgment 6	Refer to the judgment code table (Code).		1
57	Delimiter	,		1
58	MEAS 6	Refer to the measurement code table (Measured value).		1 to 7
59	Unit 6	Refer to the measurement code table (Unit).		0 to 4
60	Delimiter	,		1
61	Measurement item code 7	Refer to the measurement code table (Item code).		2
62	Delimiter	,		1
63	Judgment 7	Refer to the judgment code table (Code).		1
64	Delimiter	,		1
65	MEAS 7	Refer to the measurement code table (Measured value).		1 to 7
66	Unit 7	Refer to the measurement code table (Unit).		0 to 4
67	Delimiter	,		1
68	Measurement item code 8	Refer to the measurement code table (Item code).		2
69	Delimiter	,		1
70	Judgment 8	Refer to the judgment code table (Code).		1
71	Delimiter	,		1

	Item	Display example	Range	Length
72	MEAS 8	Refer to the measurement code table (Measured value).		1 to 7
73	Unit 8	Refer to the measurement code table (Unit).		0 to 4
74	Delimiter	,		1
75	Measurement item code 9	Refer to the measurement code table (Item code).		2
76	Delimiter	,		1
77	Judgment 9	Refer to the judgment code table (Code).		1
78	Delimiter	,		1
79	MEAS 9	Refer to the measurement code table (Measured value).		1 to 7
80	Unit 9	Refer to the measurement code table (Unit).		0 to 4
81	Delimiter	,		1
82	Measurement item code 10	Refer to the measurement code table (Item code).		2
83	Delimiter	,		1
84	Judgment 10	Refer to the judgment code table (Code).		1
85	Delimiter	,		1
86	MEAS 10	Refer to the measurement code table (Measured value).		1 to 7
87	Unit 10	Refer to the measurement code table (Unit).		0 to 4
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1

(Note) When DECIMAL POINT RANGE is changed from "." (period) to "," (comma), delimiter between items is changed from "," (comma) to ":" (colon).

Communication example

Measurement data (without unit, decimal point is period) of ID NO. 01 and SCH 1 is transmitted from the **MM-410B**.

"**MM-410B** → Host computer"

!01001S01:17/12/31_23:59:59,02,G,01.00,00,G,01.10,05,G,02.0,03,G,02.2,09,G,0300.0,06,-,060,07,G,080.00,08,G,100.00,21,G,18.00,18,G,20.00[CR][LF]

(Note) A space falls into "_".

2) WAVEFORM

Data is transmitted in the order of i), ii) and iii).

i) Measurement data part

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	02		2
6	Delimiter	:		1
7 “Year” to 87 “Unit 10” in 1) MEASUREMENT				
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1

ii) Item code part

	Item	Display example	Range	Length
1	Waveform item code 1	Refer to the waveform code table (Item code).		0 to 1
2	Delimiter	,		0 to 1
3	Waveform item code 2	Refer to the waveform code table (Item code).		0 to 1
4	Delimiter	,		0 to 1
5	Waveform item code 3	Refer to the waveform code table (Item code).		0 to 1
6	Delimiter	,		0 to 1
7	Waveform item code 4	Refer to the waveform code table (Item code).		0 to 1
8	Return code	[CR]	(0x0d)	1
9	Feed code	[LF]	(0x0a)	1

(Note) Omitted when ITEM is not set.

iii) Waveform data part

	Item	Display example	Range	Length
1	TIME	00000.00	00000.00 to 10000.00	8
2	Unit of TIME	ms		2
3	Delimiter	,		1
4	MEAS 1	Refer to the waveform code table (Measured value).		0 to 7
5	Unit 1	Refer to the waveform code table (Unit).		0 to 4
6	Delimiter	,		0 to 1
7	MEAS 2	Refer to the waveform code table (Measured value).		0 to 7
8	Unit 2	Refer to the waveform code table (Unit).		0 to 4
9	Delimiter	,		0 to 1
10	MEAS 3	Refer to the waveform code table (Measured value).		0 to 7

	Item	Display example	Range	Length
11	Unit 3	Refer to the waveform code table (Unit).		0 to 4
12	Delimiter	,		0 to 1
13	MEAS 4	Refer to the waveform code table (Measured value).		0 to 7
14	Unit 4	Refer to the waveform code table (Unit).		0 to 4
15	Return code	[CR]	(0x0d)	1
16	Feed code	[LF]	(0x0a)	1
1 to 16 are output by the number of waveform data.				
17	End of transmission	[EOT]	(0x04)	1

Communication example

Measurement, item and waveform data (without unit, decimal point is period, waveform output: current, voltage, power, and resistance) of ID NO. 01 and SCH 1 is transmitted from the **MM-410B**.

"**MM-410B** → Host computer"

```
!01001S01:17/12/31_23:59:59,02,G,01.00,00,
G,01.10,05,G,02.0,03,G,02.2,09,0300.0,06,
060,07,G,080.00,08,G,100.00,16,G,+01.000,
18,G,00020.00[CR][LF]                          } i) Measurement data part
0,1,2,3[CR][LF]                                  ii) Item data part
00000.00,00.00,00.0,000.00,000.00[CR][LF]
00000.02,00.20,00.2,000.04,001.00[CR][LF]
.                                              } iii) Waveform data part
.
.
00010.00,00.20,02.2,010.04,001.00[CR][LF][EOT]
```

(Note) A space falls into "_".

3) CURR ALL CYCLE

Data is transmitted in the order of i) and ii).

i) Measurement data part

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	03		2
6	Delimiter	:		1
7 “Year” to 87 “Unit 10” in 1) MEASUREMENT				
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1

ii) All cycle data part

	Item	Display example	Range	Length
1	TIME	0000.0 0000	0000.0 to 2000.0 (0.5-CYC increment) 0000 to 5000 (1-ms increment)	6 4
2	Unit of TIME	CYC ms		3 2
3	Delimiter	,		1
4	Measurement range	* _	*: Within measurement range _: Outside of measurement range	1
5	Delimiter	,		1
6	CURRENT	0.000 00.00 000.0	0.000 to 9.999 00.00 to 99.99 000.0 to 999.9	5
7	Unit of CURRENT	kA		2
8	Delimiter	,		1
9	VOLTAGE	0.00 00.0	0.00 to 9.99 00.0 to 99.9	4
10	Unit of VOLTAGE	V		1
11	Delimiter	,		0 to 1
12	ANGLE	000	000 to 180	0 to 3
13	Unit of ANGLE	deg		0 to 3
14	Return code	[CR]	(0x0d)	1
15	Feed code	[LF]	(0x0a)	1
1 to 15 are output by the number of all cycle data. ANGLE is not occasionally output. In that case, 11 Delimiter, 12 ANGLE and 13 Unit of ANGLE are not output.				
16	End of transmission	[EOT]	(0x04)	1

Communication example

Measurement (with unit, decimal point is period) and all cycle data (start 3 CYC) of ID NO. 01 and SCH 1 is transmitted from the **MM-410B**.

"**MM-410B** → Host computer"

```
!01001S03:17/01/17_04:24:31,02,G,01.20kA,00,
G,01.76kA,05,G,00.0V,03,G,00.0V,09,G,
0008.0CYC,19,G,0812N,34,-,0,34,-,0,34,-,
0,34,-,0[CR][LF]
```

i) Measurement data part

```
0000.5CYC, ,01.42kA,00.0V,180deg[CR][LF]
0001.0CYC, ,01.47kA,00.0V,180deg[CR][LF]
0001.5CYC, ,01.47kA,00.0V,180deg[CR][LF]
0002.0CYC, ,01.46kA,00.0V,180deg[CR][LF]
0002.5CYC, ,01.42kA,00.0V,180deg[CR][LF]
0003.0CYC,*,01.45kA,00.0V,180deg[CR][LF]
0003.5CYC,*,01.46kA,00.0V,180deg[CR][LF]
0004.0CYC,*,01.49kA,00.0V,180deg[CR][LF]
.
.
.
0008.0CYC,*,01.48kA,00.0V,180deg[CR][LF][EOT]
```

ii) Current all cycle data part

(Note) A space falls into "_".

4) FORCE ALL CYCLE

Data is transmitted in the order of i) and ii).

i) Measurement data part

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	04		2
6	Delimiter	:		1
7 “Year” to 87 “Unit 10” in 1) MEASUREMENT				
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1

ii) All cycle data part

	Item	Display example	Range	Length
1	TIME	00000	00000 to 10000	5
2	Unit of TIME	ms		2
3	Delimiter	,		1
4	Measurement range of FORCE	* _	*: Within measurement range _: Outside of measurement range	1
5	Delimiter	,		1
6	FORCE	00.00 000.0 00000	00.00 to 99.99 000.0 to 999.9 00000 to 09999	5
7	Unit of FORCE	N kgf lbf		1 3 3
8	Delimiter	,		1
9	Measurement range of EXTERNAL	* _	*: Within measurement range _: Outside of measurement range	1
10	Delimiter	,		1
11	EXTERNAL	+0.000 +00.00 +000.0 +00000	-9.999 to +9.999 -99.99 to +99.99 -999.9 to +999.9 -09999 to +09999	6

	Item	Display example	Range	Length
12	Unit of EXTERNAL	V N kgf lbf degC degF Mpa bar psi		0 1 1 3 3 4 4 3 3 3
13	Return code	[CR]	(0x0d)	1
14	Feed code	[LF]	(0x0a)	1
1 to 14 are output by the number of all cycle data.				
15	End of transmission	[EOT]	(0x04)	1

Communication example

Measurement of ID NO. 03 and SCH 2 and force all cycle data (start 0 CYC) is transmitted from the **MM-410B**.

"**MM-410B** → Host computer"

!03002S01:17/09/09_03:04:05,02,G,00.00kA,
00,G,01.76kA,05,G,00.0V,03,G,00.0V,09,G,
0008.0CYC,19,G,0812N,34,-,0,34,-,0,34,-,
0,34,-,0[CR][LF]

} i) Measurement data part

00010ms,*,0812N,-0056[CR][LF]
00020ms,*,0812N,+0077[CR][LF]
00030ms,*,0812N,-0028[CR][LF]
00040ms,*,0811N,-0061[CR][LF]
.
.
.
00170ms,*,0812N,-0012[CR][LF][EOT]

} ii) Force all cycle data part

(Note) A space falls into "_".

5) HISTORY

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	06		2
6	Delimiter	:		1
7 “Year” to 87 “Unit 10” in 1) MEASUREMENT				
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1
Data transmission of 1 to 89 is repeated by the number of measurement histories (including the judgment error).				
90	End of transmission	[EOT]	(0x04)	1

6) HISTORY OUT OF LIM

	Item	Display example	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	07		2
6	Delimiter	:		1
7 “Year” to 87 “Unit 10” in 1) MEASUREMENT				
88	Return code	[CR]	(0x0d)	1
89	Feed code	[LF]	(0x0a)	1
Data transmission of 1 to 89 is repeated by the number of error histories.				
90	End of transmission	[EOT]	(0x04)	1

If there is no error history, data transmission is not performed.

Communication example

① Measurement history data of ID NO. 01 and SCH 1 is transmitted from the **MM-410B**.
Error history is included in the measurement history and also transmitted.
"**MM-410B** → Host computer"

!01001S07:17/01/17_06:10:16,02,L,01.46kA,00,L,01.78kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0810N,34,-,0,34,
-,0,34,-,0,34,-,0[CR][LF]
!01001S07:17/01/17_06:10:09,02,L,01.46kA,00,L,01.79kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0810N,34,-,0,34
,-,0,34,-,0,34,-,0[CR][LF]
!01001S06:17/01/17_04:24:31,02,G,00.00kA,00,G,01.76kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0812N,34,-,0,34,
-,0,34,-,0,34,-,0[CR][LF]
!01001S06:17/01/17_04:24:00,02,G,01.45kA,00,G,01.76kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0815N,34,-,0,34,
-,0,34,-,0,34,-,0[CR][LF]
!01001S06:17/01/17_03:55:52,02,G,01.40kA,00,G,01.70kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0811N,34,-,0,34
,-,0,34,-,0,34,-,0[CR][LF]

} One data

② Error history data of ID NO. 01 is transmitted from the **MM-410B**.
"**MM-410B** → Host computer"

!01001S07:17/01/17_06:10:16,02,L,01.46kA,00,L,01.78kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0810N,34,-,0,34,
-,0,34,-,0,34,-,0[CR][LF]
!01001S07:17/01/17_06:10:09,02,L,01.46kA,00,L,01.79kA,05,
G,00.0V,03,G,00.0V,09,G,0008.0CYC,19,G,0810N,34,-,0,34,
-,0,34,-,0,34,-,0[CR][LF]

} One data

(Note) A space falls into "_".

7) SCHEDULE

Regardless of seam specification, data is transmitted in order of a) b) c)... as follows.

For data contents, refer to data contents of each item number.

a) Item No. 11 VIEW

b) Item No. 12 BASIC SETUP (common to all schedules), BASIC SETUP (schedules 1 to 127)

c) Item No. 13 EXTEND SETUP (common to all schedules), EXTEND SETUP (schedules 1 to 127)

d) Item No. 14 SYSTEM SETUP

e) Item No. 15 SEAM SETUP (common to all schedules), SEAM SETUP (schedules 1 to 127)

f) Item No. 16 COMPARATOR (schedules 1 to 127)

g) Item No. 18 EXT INPUT

h) Item No. 22 COMMUNICATION

i) Item No. 23 USB

j) Item No. 24 INTERNAL MEMORY

Communication example

!01000S11:0,02,00,05,03,09,34,34,34,34,34,0,1,2,3,1,1,0,0[CR][LF]
!01000S12:90,0,0[CR][LF] a)

!01001S12:ay001,0,1,050,0,0,000000ms,002000ms,0,00,0.000kA,00001ms,80%,0005ms,00.0s,05.0%[CR][LF]
...
!01127S12:ay127,0,0,050,2,1,0000.0CYC,0300.0CYC,0,00,00.00kA,000.5CYC,80%,01.0CYC,00.0s,05.0%[CR][LF] b)

!01000S13:2,1000,0,10.0%,0,09999,0,0,10.0%[CR][LF]
!01001S13:0000ms,00000ms,00000ms,00000ms,00000ms,10%,10%,0000ms,00000ms,00000ms,00000ms,00000ms [CR][LF]
...
!01127S13:+00.000mm,+00.000mm,+00.000mm,00000ms,0000ms,0000ms,0000ms,00000N,00000N,00000N,0000ms...[CR][LF] c)

!01000S14:0,4,000000,000000,07,0,2,227.0mV/kA,0[CR][LF] d)

!01000S15:0,0,2,2,1,90,90,0,05.0%[CR][LF]
!01001S15:ay001,000.0CYC,0.5CYC,00.5CYC,00000.0CYC,18000.0CYC,00000.0CYC,18000.0CYC,00000.0CYC,18000.0CYC,99.99kA...[CR][LF]
...
!01127S15:ay127,000.0CYC,0.5CYC,00.5CYC,00000.0CYC,18000.0CYC,00000.0CYC,18000.0CYC,00000.0CYC,18000.0CYC...[CR][LF] e)

!01001S16:009.999kA,000.000kA,009.999kA,000.000kA,0009.99V,0000.00V,0009.99V,0000.00V,0030000ms, ...[CR][LF]
...
!01127S16:0099.99kA,0000.00kA,0099.99kA,0000.00kA,00099.9V,00000.0V,00099.9V,00000.0V,03000.0CYC, ...[CR][LF] f)

!01000S18:0[CR][LF] g)

!01000S22:7,0001,0,3,0,0,2,0,01,0,192 168 001 010,255 255 255 000,192 168 001 100,1024[CR][LF] h)

!01000S23:09,0001,0,2,0,0[CR][LF] i)

!01000S24:0,0001,0,3[CR][LF] j)

(4) Communication Protocol (Bi-Directional Communication)

When TWO WAY is selected for MODE in the COMMUNICATION (2) screen, data is read or written according to the call from the host computer side. However, data can be read or written in unit of screen and cannot be done in unit of item.

Readable data

1) MEASUREMENT to 6) HISTORY OUT OF LIM of (3) Communication Protocol (Single-Directional Communication)

1) BASIC SETUP to 10) INTERNAL MEMORY of (4) Communication Protocol (Bi-Directional Communication)

Writable data

1) BASIC SETUP to 10) INTERNAL MEMORY of (4) Communication Protocol (Bi-Directional Communication)

Data that can be written by “Bi-Directional Communication” can be written to the flash memory built into the **MM-410B** (even if the power is turned off, the schedule setting written by “Bi-Directional Communication” are retained). There is a method that does not write to the flash memory built into the **MM-410B** (when the power is turned off, the schedule setting written by “Bi-Directional Communication” are not retained).
If you frequently write schedule setting with “Bi-Directional Communication”, use a method that does not write to flash memory.

writing method	Limitations
How to write to flash memory Write code: W	Write to the flash memory built into the **MM-410B**. - Even if the power is turned off, the schedule setting written with the “Write code: W” are retained. - Note that flash memory has a write limit (approximately 100,000 times). - Even if the power is turned off, the schedule setting changed by the screen operation are retained.
How not to write to flash memory Write code: V	Does not write to the flash memory built into the **MM-410B**. - When if the power is turned off, the schedule setting written with the “Write code: V” are not retained. - In “Write code: V”, be sure to write the schedule setting then take measurements. For items other than those to be written with “Write code: V”, change them by operating the screen or write with “Write code: W”. - Schedule setting changed by screen operations are retained even when the power is turned off. Also, after writing with the “Write code V”, if you save the related items by operating the screen, they will be written to the flash memory, so they will be retained even if the power is turned off.

In data writing, a newly set data is returned from the **MM-410B** for check. The returned data is the output data. When a wrong data is written, currently set value is returned for check. Perform the next communication after confirming that the data is returned. (When a part of telegraphic message is wrong, normal data is converted and sent back, and the wrong data returnes the setting value.)

(Note 1) When DECIMAL POINT RANGE is changed from "." (period) to "," (comma), delimiter between items is changed from "," (comma) to ":" (colon).

(Note 2) Only for WAVEFORM, CURR ALL CYCLE, and FORCE ALL CYCLE, [EOT] is added at an end of the data.

(Note 3) When using the bi-directional communication, check the following restrictions.

- PROG mode

Timing for the bi-directional data communication	Restrictions
Not during screen operation	None
During the bi-directional data communication	After completing the response of the previous data communication, perform the next data communication.

- MEAS mode

Timing for the bi-directional data communication	Restrictions
During measurement	Do not perform communication.
After measurement	Do not perform communication while rewriting the screen. - The rewrite time changes depending on the item to display. Start communication after the rewriting is completed. Do not perform communication while sroting in the USB or the internal memory. - The storage time of the USB changes depending on the item to store. Start communication after the storing dislay ("USB" displayed in orange at the upper part of the screen) is turned off. - The storage time of the internal memory changes depending on the item to store. Start communication after the storing dislay ("MEM" displayed in orange at the upper part of the screen) is turned off.
Not during measurement	None
During the bi-directional data communication	After completing the response of the previous data communication, perform the next data communication.

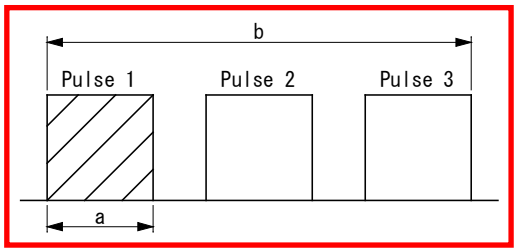
(Note 4) When a write request (write code: W) is made, the data is written to the flash memory. Flash memory write limit (approx 100,000 times). Be careful when writing data frequently.

(Note 5) When SEAM is selected for MODE in the SYSTEM SETTING (1) screen, data of 1) MEASUREMENT to 6) HISTORY OUT OF LIM of (3) Communication Protocol (Single-Directional Communication) cannot be read.

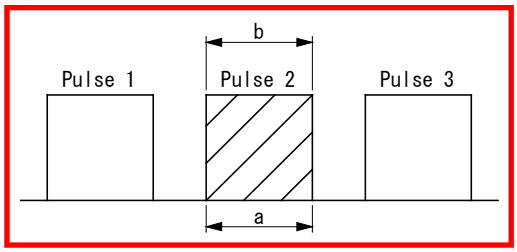
(Note 6) When reading data of 1) MEASUREMENT to 4) FORCE ALL CYCLE of (3) Communication Protocol (Single-Directional Communication), only data displayed on the MEASUREMENT, WAVEFORM or ALL CYCLE screen is output. When reading past measured values on the HISTORY screen, the read out data is output. Also, when measuring the multi-step welding with SET PULSE, data of the specified step is taken out. When measuring the multi-step welding with ALL PULSE settings, data of the 1-step welding is taken out. To output all measured data, use the single-directional communication.

Ex.) When measuring the 3-step welding in the impulse setting

ALL PULSE settings



SET PULSE with PULSE No. “2”



a: Data of 1) MEASUREMENT, 3) CURR ALL CYCLE and 4) FORCE ALL CYCLE
b: Data of 2) WAVEFORM

- Reading request data
- ① read request data

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Read code	R	R: read	1
4	SCH	001	000: (measurement data in the last MEASUREMENT, WAVEFORM, CURR ALL CYCLE, FORCE ALL CYCLE, HISTORY, and HISTORY OUT OF LIM. Setting data of common to all schedules) 001 to 127: (schedule data of each schedule)	3
5	Screen code	S		1
6	Item No.	01	01 to 24 (Refer to the Item number data table.)	2
7	All contents	*		1
8	Return code	[CR]	(0x0d)	1
9	Feed code	[LF]	(0x0a)	1

- ② read request data

	Display	Range
01	MEASUREMEN	Refer to (3) 1) MEASUREMENT
02	WAVEFORM	Refer to (3) 2) WAVEFORM
03	CURR ALL CYCLE	Refer to (3) 3) CURR ALL CYCLE
04	FORCE ALL CYCLE	Refer to (3) 4) FORCE ALL CYCLE
06	HISTORY	Refer to (3) 5) HISTORY
07	HISTORY OUT OF LIM	Refer to (3) 6) HISTORY OUT OF LIM
11	VIEW [Item No. 11]	Refer to (4) 5) ②
12	BASIC SETUP [Item No. 12]	Refer to (4) 1) ② ④
13	EXTEND SETUP [Item No. 13]	Refer to (4) 2) ② ④
14	SYSTEM SETUP [Item No. 14]	Refer to (4) 6) ②
15	SEAM SETUP [Item No. 15]	Refer to (4) 3) ② ④
16	COMPARATOR [Item No. 16]	Refer to (4) 4) ②
18	EXT INPUT [Item No. 18]	Refer to (4) 7) ②
22	COMMUNICATION [Item No. 22]	Refer to (4) 9) ②
23	USB [Item No. 23]	Refer to (4) 10) ②
24	INTERNAL MEMORY [Item No. 24]	Refer to (4) 11) ②

- Writing request and output data

1) BASIC SETUP [Item No. 12]

① Writing request data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	001	001 to 127	3
5	Screen code	S		1
6	Item No.	12		2
7	Delimiter	:		1
8	SCHEDULE NAME	ABCDE	A to Z, 0 to 9	5
9	Delimiter	,		1
10	TRIGGER	0	0: CURRENT 1: AUTO 2: FORCE 3: EXTERNAL 4: REAL TIME 6: FORCE (EXT) 7: EXTERNAL (EXT)	1
11	Delimiter	,		1
12	TIME	0	0: CYC-AC 1: ms-DC 2: CYC***Hz-AC 3: CYC-DC 4: ms-AC 5: SHORT ms-DC 6: LONG CYC-AC	1
13	Delimiter	,		1
14	FREQUENCY	050	030 to 250 030:M050 031:M053 032:M056 033:M059 034:M063 035:M067 036:M071 037:M077 038:M083 039:M091 040:M100 041:M111 042:M125 043:M143 044:M167 045:M200 046:M250 047:M294 048:M417 049:M500 050 to 250:050 to 250Hz	3
15	Delimiter	,		1
16	CURRENT RANGE	0	1x sensitivity coil 0: 2.000kA 1: 6.00kA 2: 20.00kA 3: 60.0kA 4: 200.0kA 10x sensitivity coil 0: 0.200kA 1: 0.600kA 2: 2.000kA 3: 6.00kA 4: 20.00kA	1
17	Delimiter	,		1
18	VOLTAGE RANGE	0	0: 6.00V 1: 20.0V	1
19	Delimiter	,		1

	Item	Display	Range	Length
20	START TIME	0000.0CYC	0000.0 to 0300.0CYC (TIME CYC-AC, in 0.5 CYC steps) 0000.0 to 2000.0CYC (TIME CYC***Hz-AC, in 0.5 CYC steps) 0000.0 to 0120.0CYC (TIME CYC-DC, in 0.5 CYC steps) 0000.0 to 0600.0CYC (TIME LONG CYC-AC, in 0.5 CYC steps) 000000 to 002000ms (TIME ms-DC) 000000 to 005000ms (TIME ms-AC) 000.00 to 300.00ms (TIME SHORT ms-DC)	9
21	Delimiter	,		1
22	END TIME	0000.0CYC	0000.0 to 0300.0CYC (TIME CYC-AC, in 0.5 CYC steps) 0000.0 to 2000.0CYC (TIME CYC***Hz-AC, in 0.5 CYC steps) 0000.0 to 0120.0CYC (TIME CYC-DC, in 0.5 CYC steps) 0000.0 to 0600.0CYC (TIME LONG CYC-AC, in 0.5 CYC steps) 000000 to 002000ms (TIME ms-DC) 000000 to 005000ms (TIME ms-AC) 000.00 to 300.00ms (TIME SHORT ms-DC)	9
23	Delimiter	,		1
24	PULSE MODE	0	0: SET PULSE 1: ALL PULSE (SET) 2: ALL PULSE (NO SET) 3: NO COOL	1
25	Delimiter	,		1
26	PULSE NO.	00	00 to 20	2
27	Delimiter	,		1
28	PULSE 2 TRIG LEVEL	00.00kA	0.000 to 9.999kA (CURRENT RANGE 0.200, 0.600, 2.000kA) 00.00 to 99.99kA (CURRENT RANGE 6.00, 20.00kA) 000.0 to 999.9kA (CURRENT RANGE 60.0, 200.0kA)	7
29	Delimiter	,		1
30	COOL TIME	000.5CYC	000.5 to 100.0CYC (in 0.5 CYC steps) 00001 to 02000ms_ 000.1 to 200.0ms_	8
31	Delimiter	,		1
32	FALL LEVEL	10%	10 to 90%	3
33	Delimiter	,		1
34	MEASUREMENT MIN TIME	00.5CYC	00.5 to 50.0CYC (in 0.5 CYC steps) 0001 to 1000ms_ 000.1 to 100.0ms_	7
35	Delimiter	,		1
36	MEAS INHIBIT TIME	00.0s	00.0 to 10.0s	5
37	Delimiter	,		1
38	END LEVEL	01.5%	01.5 to 15.0%	5
39	Return code	[CR]	(0x0d)	1

	Item	Display	Range	Length
40	Feed code	[LF]	(0x0a)	1

A space falls into "_" for digit matching.

② Output data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	12		2
6	Delimiter	:		1
8 "SCHEDULE NAME" to 38 "END LEVEL" in BASIC SETUP ① Writing request data for schedule				
38	Return code	[CR]	(0x0d)	1
39	Feed code	[LF]	(0x0a)	1

③ Writing request data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	12		2
7	Delimiter	:		1
8	CURRENT TRIGGER LEVEL	01	01 to 99	2
9	Delimiter	,		1
10	Toroidal coil	0	0: TIMES 1 1: TIMES 10	1
11	Delimiter	,		1
12	CALCULATION	0	0: ORIGINAL 1: ISO17657	1
13	Return code	[CR]	(0x0d)	1
14	Feed code	[LF]	(0x0a)	1

④ Output data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2

	Item	Display	Range	Length
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	12		2
6	Delimiter	:		1
8 “CURRENT TRIGGER LEVEL” to 12 “CALCULATION” in BASIC SETUP ③ Writing request data for schedule				
12	Return code	[CR]	(0x0d)	1
13	Feed code	[LF]	(0x0a)	1

Communication example

① Reads the setting data of ID NO. 01 and SCH 2.
“Host computer → **MM-410B**”
#01R002S12*[CR][LF]
“**MM-410B** → Host computer”
!01002S12:ABCDE,0,0,050,0,0,0000.0CYC,0000.0CYC,0,00,00.00kA,000.5CYC,10%,00.5CYC,00.0s,01.5%[CR][LF]

② Writes the setting data in ID NO. 01 and SCH 1.
“Host computer → **MM-410B**”
#01W001S12:ABCDE,0,0,050,0,0,0000.0CYC,0000.0CYC,0,00,00.00kA,000.5CYC,10%,00.5CYC,00.0s,01.5%[CR][LF]
“**MM-410B** → Host computer” (sent for check when the written data is within the range.)
!01001S12:ABCDE,0,0,050,0,0,0000.0CYC,0000.0CYC,0,00,00.00kA,000.5CYC,10%,00.5CYC,00.0s,01.5%[CR][LF]

③ Reads the setting data of ID NO. 01 and part common to schedules.
“Host computer → **MM-410B**”
#01R000S12*[CR][LF]
“**MM-410B** → Host computer”
!01000S12:99,0,0[CR][LF]

④ Changes the current trigger level of ID NO. 01 and part common to schedules to “90.”
“Host computer → **MM-410B**”
#01W000S12:90,0,0[CR][LF]
“**MM-410B** → Host computer” (sent for check when the written data is within the range.)
!01000S12:90,0,0[CR][LF]

2) EXTEND SETUP [Item No. 13]

① Writing request data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	001	001 to 127	3
5	Screen code	S		1
6	Item No.	13		2
7	Delimiter	:		1
FORCE				
8	DELAY TIME	0000ms	0000 to 1000ms	6
9	Delimiter	,		1
10	TIME BEGIN 1	00000ms	00000 to 10000ms (in 10 ms steps)	7
11	Delimiter	,		1
12	TIME END 1	00000ms	00000 to 10000ms (in 10 ms steps)	7
13	Delimiter	,		1
14	TIME BEGIN 2	00000ms	00000 to 10000ms (in 10 ms steps)	7
15	Delimiter	,		1
16	TIME END 2	00000ms	00000 to 10000ms (in 10 ms steps)	7
17	Delimiter	,		1
18	RISE LEVEL	10%	10 to 90%	3
19	Delimiter	,		1
20	FALL LEVEL	10%	10 to 90%	3
21	Delimiter	,		1
EXTERNAL				
22	DELAY TIME	0000ms	0000 to 1000ms	6
23	Delimiter	,		1
24	TIME BEGIN 1	00000ms	00000 to 10000ms (in 10 ms steps)	7
25	Delimiter	,		1
26	TIME END 1	00000ms	00000 to 10000ms (in 10 ms steps)	7
27	Delimiter	,		1
28	TIME BEGIN 2	00000ms	00000 to 10000ms (in 10 ms steps)	7
29	Delimiter	,		1
30	TIME END 2	00000ms	00000 to 10000ms (in 10 ms steps)	7
31	Return code	[CR]	(0x0d)	1
32	Feed code	[LF]	(0x0a)	1

② Output data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	13		2
6	Delimiter	:		1
8 “LEVEL OUTPUT 1” to 30 “TIME END 2” in EXTEND SETUP ① Writing request data for schedule				
30	Return code	[CR]	(0x0d)	1
31	Feed code	[LF]	(0x0a)	1

③ Writing request data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	13		2
7	Delimiter	:		1
FORCE				
8	SENSOR	0	0: MA-520 1: MA-521 2: MA-522 3: MA-770 4: MA-771	1
9	Delimiter	,		1
10	SPAN	0500	0500 to 1500	4
11	Delimiter	,		1
12	UNIT	0	0: N 1: kgf 2: lbf	1
13	Delimiter	,		1
14	TRIGGER LEVEL	02.0%	02.0 to 99.9%	5
15	Delimiter	,		1
EXTERNAL				
16	INPUT	0	0: VOLTAGE 1: CURRENT	1
17	Delimiter	,		1

	Item	Display	Range	Length
18	RATE	00500____ 00500V___ 00500N___ 00500kfg_ 00500lbf_ 00500degC 00500degF 00500Mpa_ 00500bar_ 00500psi_	00500 to 09999 050.0 to 999.9 05.00 to 99.99 0.500 to 9.999 Unit (Range is the same as above.) ____ (Not unit) V___ N___ kgf_ lbf_ degC degF Mpa_ bar_ psi_	9
19	Delimiter	,		1
20	DECIMAL RANGE	0	0: **** 1: ***.* 2: **.** 3: *.***	1
21	Delimiter	,		1
22	UNIT	0	0: No unit 1: V 2: N 3: kgf 4: lbf 5: degC 6: degF 7: Mpa 8: bar 9: psi	1
23	Delimiter	,		1
24	TRIGGER LEVEL	02.0%	02.0 to 99.9%	5
25	Return code	[CR]	(0x0d)	1
26	Feed code	[LF]	(0x0a)	1

* A space falls into "_" for digit matching.

④ Output data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	13		2
6	Delimiter	:		1
8 "SENSOR" to 24 "TRIGGER LEVEL" in EXTEND SETUP ③ Writing request data for schedule				
24	Return code	[CR]	(0x0d)	1
25	Feed code	[LF]	(0x0a)	1

3) SEAM SETUP [Item No. 15]

① Writing request data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	001	001 to 127	3
5	Screen code	S		1
6	Item No.	15		2
7	Delimiter	:		1
8	SCHEDULE NAME	ABCDE	A to Z, 0 to 9	5
9	Delimiter	,		1
10	START MEASUREMENT	000.0CYC	000.0 to 120.0CYC (in 0.5 CYC steps) 00000 to 02000ms_ (in 10 ms steps) 00000 to 00200ms_	8
11	Delimiter	,		1
12	MEASUREMENT RANGE	0.5CYC	0.5 to 6.0CYC (in 0.5 CYC steps) 010 to 100ms_ (in 10 ms steps) 001 to 010ms_	6 *
13	Delimiter	,		1
14	MEASUREMENT INTERVAL	00.5CYC	00.5 to 12.0CYC (in 0.5 CYC steps) 0010 to 0200ms_ (in 10 ms steps) 0001 to 0020ms_	7 *
15	Delimiter	,		1
16	TIME BEGIN 1	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
17	Delimiter	,		1
18	TIME END 1	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
19	Delimiter	,		1
20	TIME BEGIN 2	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
21	Delimiter	,		1
22	TIME END 2	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
23	Delimiter	,		1
24	TIME BEGIN 3	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
25	Delimiter	,		1

	Item	Display	Range	Length
26	TIME END 3	00000.0CYC	00000.0 to 18000.0CYC (in 0.5 CYC steps) 0000000 to 0300000ms_ (in 10 ms steps) 0000000 to 0030000ms_	10 *
27	Delimiter	,		1
28	CURRENT UPPER 1	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
29	Delimiter	,		1
30	CURRENT LOWER 1	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
31	Delimiter	,		1
32	CURRENT UPPER 2	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
33	Delimiter	,		1
34	CURRENT LOWER 2	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
35	Delimiter	,		1
36	CURRENT UPPER 3	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
37	Delimiter	,		1
38	CURRENT LOWER 3	00.00kA	0.000 to 9.999kA 00.00 to 99.99kA 000.0 to 999.9kA	7
39	Delimiter	,		1
40	VOLTAGE UPPER 1	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
41	Delimiter	,		1
42	VOLTAGE LOWER 1	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
43	Delimiter	,		1
44	VOLTAGE UPPER 2	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
45	Delimiter	,		1
46	VOLTAGE LOWER 2	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
47	Delimiter	,		1
48	VOLTAGE UPPER 3	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
49	Delimiter	,		1
50	VOLTAGE LOWER 3	0.00V	0.00 to 9.99V 00.0 to 99.9V	5
51	FREQUENCY	050	050, 060	3

	Item	Display	Range	Length
52	Return code	[CR]	(0x0d)	1
53	Feed code	[LF]	(0x0a)	1

② Output data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	15		2
6	Delimiter	:		1
8 " SCHEDULE NAME " to 51 " FREQUENCY " in SEAM SETUP Writing request data for schedule				
50	Return code	[CR]	(0x0d)	1
51	Feed code	[LF]	(0x0a)	1

③ Writing request data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	15		2
7	Delimiter	:		1
8	TRIGGER (Note)	0	0: CURRENT 1: VOLTAGE	1
9	Delimiter	,		1
10	TIME (Note)	0	0: CYC-AC 1: ms-AC 2: ms-DC 3: CYC-DC 4: SHORT ms-DC	1
11	Delimiter	,		1
12	CALCULATION	0	0: PEAK 1: RMS 2: AVERAGE RMS	1
13	Delimiter	,		1
14	CURRENT RANGE	0	1x sensitivity coil 0: 2.000kA 1: 6.00kA 2: 20.00kA 3: 60.0kA 4: 200.0kA 10x sensitivity coil 0: 0.200kA 1: 0.600kA 2: 2.000kA 3: 6.00kA 4: 20.00kA	1

	Item	Display	Range	Length
15	Delimiter	,		1
16	VOLTAGE RANGE	0	0: 6.00V 1: 20.0V	1
17	Delimiter	,		1
18	CURRENT TRIGGER LEVEL	01	01 to 99	2
19	Delimiter	,		1
20	VOLTAGE TRIGGER LEVEL	01	01 to 99	2
21	Delimiter	,		1
22	TOROIDAL COIL	0	0: TIMES 1 1: TIMES 10	1
23	Delimiter	,		1
24	END LEVEL	01.5%	01.5 to 15.0%	5
25	Return code	[CR]	(0x0d)	1
26	Feed code	[LF]	(0x0a)	1

(Note) When CURRENT is selected for TRIGGER, 0: CYC-AC or 1: ms-AC can be selected for TIME. When VOLTAGE is for TRIGGER selected, 2: ms-DC, 3: CYC-DC, or 4: SHORT ms-DC can be selected for TIME.

④ Output data common to all schedules (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	15		2
6	Delimiter	:		1
8 “TRIGGER” to 24 “END LEVEL” in SEAM SETUP ③ Writing request data for schedule				
24	Return code	[CR]	(0x0d)	1
25	Feed code	[LF]	(0x0a)	1

4) COMPARATOR [Item No. 16]

① Writing request data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	001	001 to 127	3
5	Screen code	S		1
6	Item No.	16		2
7	Delimiter	:		1
8	UPPER 1	Refer to the upper/lower limit table.		Same as left
9	Delimiter	,		1
10	LOWER 1	Refer to the upper/lower limit table.		Same as left
11	Delimiter	,		1
12	UPPER 2	Refer to the upper/lower limit table.		Same as left
13	Delimiter	,		1
14	LOWER 2	Refer to the upper/lower limit table.		Same as left
15	Delimiter	,		1
16	UPPER 3	Refer to the upper/lower limit table.		Same as left
17	Delimiter	,		1
18	LOWER 3	Refer to the upper/lower limit table.		Same as left
19	Delimiter	,		1
20	UPPER 4	Refer to the upper/lower limit table.		Same as left
21	Delimiter	,		1
22	LOWER 4	Refer to the upper/lower limit table.		Same as left
23	Delimiter	,		1
24	UPPER 5	Refer to the upper/lower limit table.		Same as left
25	Delimiter	,		1
26	LOWER 5	Refer to the upper/lower limit table.		Same as left
27	Delimiter	,		1
28	UPPER 6	Refer to the upper/lower limit table.		Same as left
29	Delimiter	,		1
30	LOWER 6	Refer to the upper/lower limit table.		Same as left
31	Delimiter	,		1
32	UPPER 7	Refer to the upper/lower limit table.		Same as left
33	Delimiter	,		1
34	LOWER 7	Refer to the upper/lower limit table.		Same as left
35	Delimiter	,		1
36	UPPER 8	Refer to the upper/lower limit table.		Same as left

	Item	Display	Range	Length
37	Delimiter	,		1
38	LOWER 8	Refer to the upper/lower limit table.		Same as left
39	Delimiter	,		1
40	UPPER 9	Refer to the upper/lower limit table.		Same as left
41	Delimiter	,		1
42	LOWER 9	Refer to the upper/lower limit table.		Same as left
43	Delimiter	,		1
44	UPPER 10	Refer to the upper/lower limit table.		Same as left
45	Delimiter	,		1
46	LOWER 10	Refer to the upper/lower limit table.		Same as left
47	Return code	[CR]	(0x0d)	1
48	Feed code	[LF]	(0x0a)	1

② Output data for each schedule 001 to 127

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	001	001 to 127	3
4	Screen code	S		1
5	Item No.	16		2
6	Delimiter	:		1
8 “UPPER 1” to 46 “LOWER 10” in COMPARATOR ① Writing request data for schedule				
46	Return code	[CR]	(0x0d)	1
47	Feed code	[LF]	(0x0a)	1

5) VIEW [Item No. 11]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	11		2
7	Delimiter	:		1
8	MEASUREMENT DISPLAY	0	0: 5 ITEMS 1: 10 ITEMS	1
9	Delimiter	,		1
10	MEAS 1	00	00 to 34 (Refer to the measurement code table.)	2
11	Delimiter	,		1
12	MEAS 2	00	00 to 34 (Refer to the measurement code table.)	2
13	Delimiter	,		1
14	MEAS 3	00	00 to 34 (Refer to the measurement code table.)	2
15	Delimiter	,		1
16	MEAS 4	00	00 to 34 (Refer to the measurement code table.)	2
17	Delimiter	,		1
18	MEAS 5	00	00 to 34 (Refer to the measurement code table.)	2
19	Delimiter	,		1
20	MEAS 6	00	00 to 34 (Refer to the measurement code table.)	2
21	Delimiter	,		1
22	MEAS 7	00	00 to 34 (Refer to the measurement code table.)	2
23	Delimiter	,		1
24	MEAS 8	00	00 to 34 (Refer to the measurement code table.)	2
25	Delimiter	,		1
26	MEAS 9	00	00 to 34 (Refer to the measurement code table.)	2
27	Delimiter	,		1
28	MEAS 10	00	00 to 34 (Refer to the measurement code table.)	2
29	Delimiter	,		1
30	WAVE 1	0	0 to 7 (Refer to the waveform code table.)	1
31	Delimiter	,		1
32	WAVE 2	0	0 to 7 (Refer to the waveform code table.)	1
33	Delimiter	,		1
34	WAVE 3	0	0 to 7 (Refer to the waveform code table.)	1
35	Delimiter	,		1
36	WAVE 4	0	0 to 7 (Refer to the waveform code table.)	1

	Item	Display	Range	Length
37	Delimiter	,		1
38	Waveform display 1	0	0: OFF, 1: ON	1
39	Delimiter	,		1
40	Waveform display 2	0	0: OFF, 1: ON	1
41	Delimiter	,		1
42	Waveform display 3	0	0: OFF, 1: ON	1
43	Delimiter	,		1
44	Waveform display 4	0	0: OFF, 1: ON	1
45	Return code	[CR]	(0x0d)	1
46	Feed code	[LF]	(0x0a)	1

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	11		2
6	Delimiter	:		1
8 “MEASUREMENT DISPLAY” to 44 “Waveform display 4” in VIEW ① Writing request data for schedule				
44	Return code	[CR]	(0x0d)	1
45	Feed code	[LF]	(0x0a)	1

6) SYSTEM SETUP [Item No. 14]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	14		2
7	Delimiter	:		1
8	MODE	0	0: NORMAL 1: SEAM 2: NORMAL TRACE 3: SINGLE TRACE	1
9	Delimiter	,		1
10	LANGUAGE	0	0: ENGLISH 1: GERMAN 2: FRENCH 3: SPANISH 4: JAPANESE 5: KOREAN 6: CHINESE	1
11	Delimiter	,		1
12	WELD COUNTER PRESET	000000	000000 to 999999	6
13	Delimiter	,		1
14	GOOD COUNTER PRESET	000000	000000 to 999999	6
15	Delimiter	,		1
16	BRIGHTNESS	01	01 to 10	2
17	Delimiter	,		1
18	BRIGHTNESS	0	0: OFF 1: AUTO	1
19	Delimiter	,		1
CURRENT				
20	SAMPLING INTERVAL	0	0: 20us 1: 50us 2: 100us 3: 200us	1
21	Delimiter	,		1
22	CONVERSION COEFFICIENT	100.0mV/kA	100.0 to 250.0mV/kA	10
23	Delimiter	,		1
FORCE / EXTERNAL				

	Item	Display	Range	Length
24	SAMPLING INTERVAL	0	0: 100us 1: 200us 2: 500us	1
25	Return code	[CR]	(0x0d)	1
26	Feed code	[LF]	(0x0a)	1

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	14		2
6	Delimiter	:		1
8 “MODE” to 24 “SAMPLING INTERVAL” in SYSTEM SETUP ① Writing request data for schedule				
24	Return code	[CR]	(0x0d)	1
25	Feed code	[LF]	(0x0a)	1

7) EXT INPUT [Item No. 18]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	18		2
7	Delimiter	:		1
8	INPUT DELAY TIME	0	0: 1ms 1: 10ms	1
9	Return code	[CR]	(0x0d)	1
10	Feed code	[LF]	(0x0a)	1

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	18		2
6	Delimiter	:		1
7	INPUT DELAY TIME	0	0: 1ms 1: 10ms	1
8	Return code	[CR]	(0x0d)	1
9	Feed code	[LF]	(0x0a)	1

8) COMMUNICATION [Item No. 22]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	22		2
7	Delimiter	:		1
8	ITEM	0	0: OFF 1: MEASUREMENT 2: WAVEFORM 3: CURRENT ALL CYCLE 4: FORCE ALL CYCLE 5: HISTORY 6: HISTORY OUT OF LIM 7: SCHEDULE	1
9	Delimiter	,		1
10	INTERVAL	0001	0001 to 1000	4
11	Delimiter	,		1
12	OUT OF LIMIT OPERATION	0	0: OFF 1: ON	1
13	Delimiter	,		1
14	WAVE DECIMATION	0	0: 20us 1: 50us 2: 100us 3: 200us 4: 500us 5: 1000us	1
15	Delimiter	,		1
16	UNIT	0	0: OFF 1: ON	1
17	Delimiter	,		1
18	DECIMAL POINT RANGE (Note)	0	0: . (period) 1: , (comma)	1
19	Delimiter	,		1
20	MODE (Note)	0	0: OFF 3: ETHERNET 4: USB	1
21	Delimiter	,		1
22	MODE (Note)	0	0: ONE WAY 1: TWO WAY	1
23	Delimiter	,		1
24	ID NO.	01	01 to 31	2

	Item	Display	Range	Length
25	Delimiter	,		1
26	IP ADDRESS (Note)	000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
27	Delimiter	,		1
28	SUBNET MASK (Note)	000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
29	Delimiter	,		1
30	DEFAULT GATEWAY (Note)	000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
			Space	1
		000	000 to 255	3
31	Delimiter	,		1
32	PORT NO. (Note)	1024	1024 to 5000	4
33	Return code	[CR]	(0x0d)	1
34	Feed code	[LF]	(0x0a)	1

(Note) Data cannot be changed. Do not make a change while writing data. Input the setting value as it is.

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	22		2
6	Delimiter	:		1
8 “ITEM” to 32 “PORT NO.” in COMMUNICATION ① Writing request data for schedule				

	Item	Display	Range	Length
32	Return code	[CR]	(0x0d)	1
33	Feed code	[LF]	(0x0a)	1

9) USB [Item No. 23]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	23		2
7	Delimiter	:		1
8	Item	0	00: OFF 01: MEASUREMENT 02: WAVEFORM 03: CURRENT ALL CYCLE 04: FORCE ALL CYCLE 05: HISTORY 06: HISTORY OUTOF LIM 07: SCHEDULE 08: SCREEN 10: WAVEFORM 2 11: CURRENT ALL CYCLE 2 12: FORCE ALL CYCLE 2	1
9	Delimiter	,		1
10	INTERVAL	0001	0001 to 1000	4
11	Delimiter	,		1
12	OUT OF LIMIT OPERATION	0	0: OFF 1: ON	1
13	Delimiter	,		1
14	WAVE DECIMATION	0	0: 20us 1: 50us 2: 100us 3: 200us 4: 500us 5: 1000us	1
15	Delimiter	,		1
16	UNIT	0	0: OFF 1: ON	1
17	Delimiter	,		1
18	DECIMAL POINT RANGE	0	0: . (period) 1: , (comma)	1
19	Return code	[CR]	(0x0d)	1
20	Feed code	[LF]	(0x0a)	1

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1

	Item	Display	Range	Length
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	23		2
6	Delimiter	:		1
8 “ITEM” to 18 “DECIMAL POINT RANGE” in USB ① Writing request data for schedule				
18	Return code	[CR]	(0x0d)	1
19	Feed code	[LF]	(0x0a)	1

11) INTERNAL MEMORY [Item No. 24]

① Writing request data (SCH 000)

	Item	Display	Range	Length
1	Start code	#		1
2	ID NO.	01	01 to 31	2
3	Write code	W V	Holds the written data even if the power is turned off. Does not hold the written data if the power is turned off.	1
4	SCH	000	000	3
5	Screen code	S		1
6	Item No.	24		2
7	Delimiter	:		1
8	ITEM	0	0: OFF 1: WAVEFORM 2: CURRENT ALL CYCLE 3: FORCE ALL CYCLE	1
9	Delimiter	,		1
10	INTERVAL	0001	0001 to 1000	4
11	Delimiter	,		1
12	OUT OF LIMIT OPERATION	0	0: OFF 1: ON	1
13	Delimiter	,		1
14	WAVE DECIMATION	0	0: 20us 1: 50us 2: 100us 3: 200us 4: 500us 5: 1000us	1
15	Return code	[CR]	(0x0d)	1
16	Feed code	[LF]	(0x0a)	1

② Output data (SCH 000)

	Item	Display	Range	Length
1	Start code	!		1
2	ID NO.	01	01 to 31	2
3	SCH	000	000	3
4	Screen code	S		1
5	Item No.	24		2
6	Delimiter	:		1
8 “ITEM” to 14 “WAVE DECIMATION” in INTERNAL MEMORY ① Writing request data for schedule				
14	Return code	[CR]	(0x0d)	1
15	Feed code	[LF]	(0x0a)	1

(5) Code Table of Communication and USB Data

Code tables of communication and USB data are shown below.

1) Item number data table

Item No.	Screen	Item No.	Screen
01	MEASUREMENT	13	EXTEND SETUP
02	WAVEFORM	14	SYSTEM SETUP
03	CURRENT ALL CYCLE	15	SEAM SETUP
04	FORCE ALL CYCLE	16	COMPARATOR
06	HISTORY	18	EXT INPUT
07	HISTORY OUT OF LIM	22	COMMUNICATION
11	VIEW	23	USB
12	BASIC SETUP	24	INTERNAL MEMORY

2) Measurement code table

Item code	Item name	Measured value			Unit	
		Display	Range	Length	Display	Length
00	CURR PEAK	0.000 00.00 000.0	0.000 to 9.999 00.00 to 99.99 000.0 to 999.9	5	kA	2
01	CURR RMS					
02	CURR AVG RMS					
03	VOLT PEAK	0.00 00.0	0.00 to 9.99 00.0 to 99.9	4	V	1
04	VOLT RMS					
05	VOLT AVG RMS					
06	COND ANGLE	000	000 to 180	3	deg	3
07	POWER AVE	000.00	000.00 to 300.00	6	kW	2
08	RESISTANCE AVE	000.00	000.00 to 300.00	6	mOhm	4
09	WELD TIME	0000.0 0000 000.00	0000.0 to 3000.0 (in 0.5 CYC steps) 0000 to 3000 000.00 to 300.00	6 4 6	CYC ms	3 2
10	WELD TIME TP	000.00	000.00 to 300.00	6	ms	2
11	WELD TIME TH					
12	FLOW TIME	0000.0 0000 000.00	0000.0 to 3000.0 (in 0.5 CYC steps) 0000 to 3000 000.00 to 300.00	6 4 6	CYC ms	3 2
18	FORCE PEAK	00.00 000.0 0000	00.00 to 99.99 000.0 to 999.9 0000 to 9999	5 5 4	N kgf lbf	1 3 3
19	FORCE AVG1					
20	FORCE AVG2					
21	FORCE INITIAL					
22	FORCE FINAL					
23	FORCE REAL TIME	00.00 000.0	00.00 to 99.99 000.0 to 999.9	5 5		

Item code	Item name	Measured value			Unit	
		Display	Range	Length	Display	Length
		0000	0000 to 9999	4		
24	FORCE TIME	00000	00000 to 30000	5	ms	2
25	EXT PEAK	+0.000	-9.999 to +9.999	6		0
26	EXT AVE1	+00.00	-99.99 to +99.99	6	V	1
27	EXT AVE2	+000.0	-999.9 to +999.9	6	N	1
28	EXT INITIAL	+0000	-9999 to +9999	5	kgf	3
29	EXT FINAL				lbf	3
30	EXT REAL TIME	+0.000 +00.00 +000.0 +0000	-9.999 to +9.999 -99.99 to +99.99 -999.9 to +999.9 -9999 to +9999	6 6 6 5	degC degF Mpa bar psi	4 4 3 3 3
31	EXT TIME	00000	00000 to 30000	5	ms	2
32	WELD COUNT	000000	000000 to 999999	6		0
33	GOOD COUNT	000000	000000 to 999999	6		0
34	No setting	-	No measured value	1		0

3) Judgment code table

Code	Judgment	Display	Length
0	No judgment	-	1
1	GOOD	G	
2	NG LOWER	L	
3	NG UPPER	U	
4	OVER	O	
5	NO CURR	C	
6	IMPULS	I	
8	COUNT UP	-	
9	No judgment	-	

4) Upper/lower limit code table

Item code	Item name	Measured value (*)			Unit (*)
		Display	Range	Length	
00	CURR PEAK	000.000kA 0000.00kA 00000.0kA	000.000 to 009.999kA 0000.00 to 0099.99kA 00000.0 to 00999.9KA	9	kA
01	CURR RMS				
02	CURR AVG RMS				
03	VOLT PEAK	0000.00V 00000.0V	0000.00 to 0009.99V 00000.0 to 00099.9V	8	V
04	VOLT RMS				
05	VOLT AVG RMS				
06	COND ANGLE	-------deg	-------deg	10	deg
07	POWER AVE	0000.00kW	0000.00 to 0300.00kW	9	kW
08	RESISTANCE AVE	0000.00mOhm	0000.00 to 0300.00mOhm	11	mOhm
09	WELD TIME	00000.0CYC	00000.0 to 03000.0CYC (in 0.5 CYC steps)	10	CYC
		0000000ms	0000000 to 0030000ms	9	ms
		0000.00ms	0000.00 to 0300.00ms		
10	WELD TIME TP	0000.00ms	0000.00 to 0300.00ms	9	ms
11	WELD TIME TH				
12	FLOW TIME	00000.0CYC	00000.0 to 03000.0CYC (in 0.5 CYC steps)	10	CYC
		0000000ms	0000000 to 0030000ms	9	ms
		0000.00ms	0000.00 to 0300.00ms		
18	FORCE PEAK	0000.00N 00000.0N 0000000N	0000.00 to 0099.99N 00000.0 to 00999.9N 0000000 to 0009999N	8 10 10	N kgf lbf
19	FORCE AVG1				
20	FORCE AVG2				
21	FORCE INITIAL				
22	FORCE FINAL				
23	FORCE REAL TIME	-------N	-------N		
24	FORCE TIME	-------ms	-------ms	9	ms
25	EXT PEAK	+0.000degC +00.00degC +000.0degC +00000degC	-9.999 to +9.999degC -99.99 to +99.99degC -999.9 to +999.9degC -09999 to +09999degC	10	V N kgf lbf degC degF Mpa bar psi
26	EXT AVE1				
27	EXT AVE2				
28	EXT INITIAL				
29	EXT FINAL				
30	EXT REAL TIME	-------degC	-------degC	11	
31	EXT TIME	-------ms	-------ms	9	ms
32	WELD COUNT	-------	-------	7	
33	GOOD COUNT	-------	-------	7	
34	No setting	-------	-------	7	

5) Waveform code table

Item code	Item name	Measured value			Unit	
		Display	Range	Length	Display	Length
0	CURRENT	+0.000 +00.00 +000.0	-9.999 to +9.999 -99.99 to +99.99 -999.9 to +999.9	6	kA	2
1	VOLTAGE	+0.00 +00.0	-9.99 to +9.99 -99.9 to +99.9	5	V	1
2	POWER	000.00	000.00 to 300.00	6	kW	2
3	RESISTANCE	000.00	000.00 to 300.00	6	mOhm	4
5	FORCE	00.00 000.0 00000	00.00 to 99.99 000.0 to 999.9 00000 to 09999	5	N kgf lbf	1 3 3
6	EXTERNAL	+0.000 +00.00 +000.0 +00000	-9.999 to +9.999 -99.99 to +99.99 -999.9 to +999.9 -9999 to +9999	6 6 6 5	 V N kgf lbf degC degF Mpa bar psi	0 1 1 3 3 4 4 3 3 3

13. Error List and Maintenance

(1) Troubleshooting

The **MM-410B** informs of an error occurrence by showing the error number.

Error code	Description	Cause	Remedy
E01	SYSTEM ERROR	Problem detected in **MM-410B**'s control system	Turn off the power and on again. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E03	TRIGGER LEVEL ERROR	A problem was detected in the current detection circuit.	Turn off the power and on again. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E04	BATTERY VOLTAGE LOW	The backup battery voltage is 2.2 V or less.	The **MM-410B** needs repair. Please contact us.
E05	SCHEDULE ERROR	Schedule data in memory is damaged.	Check all the settings. If the data in memory is damaged, the following are possible causes: • Generation of powerful power supply or electrostatic noise • Abnormal supply voltage resulting, for example, from lightening or induced lightening • Flash memory's rewrite limit (100,000 times) exceeded It would be useful to record the settings in preparation for data damage. Use Chapter 17 "Schedule Data Table." Also, you can save data in a USB (refer to "g. USB Screen" in Chapter 8, "Operation Screens"). When you touch the INITIAL key and select YES (refer to "I-1. SYSTEM SETUP (1) Screen" in Chapter 8, "Operation Screens"), 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. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.

Error code	Description	Cause	Remedy
E07	MONITOR MEMORY ERROR	Measured value data in internal memory is damaged.	If the data in internal memory is corrupt, the following are possible causes: • Generation of powerful power supply or electrostatic noise • Abnormal supply voltage resulting, for example, from lightening or induced lightening • Low memory battery voltage It is advisable to back-up measured value data onto other media often, as a precaution against possible data corruption. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E08	CLOCK ERROR	Loss of the hour due to low voltage of the backup current	The **MM-410B** needs repair. Please contact us.
E09	INTERNAL COMMUNICATION ERROR	Unable to make communication between internal units.	Turn off the power and on again. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E11	FORCE SENSOR ERROR	Setting data of force rest stored in memory is damaged.	Check the following when an error occurs at power on. If the data in memory is damaged, the following are possible causes: • Generation of powerful power supply or electrostatic noise • Abnormal supply voltage resulting, for example, from lightening or induced lightening Perform the zero reset of force sensor, referring to "I-2. SYSTEM SETUP (2) Screen" in Chapter 8, "Operation Screens." For the load cell built in a head, a force is applied in some cases. Perform it without a force applied. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E14	USB ERROR	The USB writing cannot keep up with the measurement.	When MEASUREMENT is selected for ITEM: • USB writing for measurement is not in time. When the USB write buffer (4000) is exceeded, an error occurs. Check the measurement interval. When the USB write delay occurs, replace the USB.
		Data to be read from the USB is abnormal.	When SCHEDULE is selected for ITEM: • The setting value of schedule data to be read exceeds the setting range. • Among CSV files of schedule data to be read, any one of these are lacking (refer to "g. USB screen (9) FILE NO" in Chapter 8, "Operation Screens"). • The decimal point of schedule data to be read is different from the setting.

Error code	Description	Cause	Remedy
E14	USB ERROR (continued from previous page)	Unable to read from or write in the USB.	The following are possible causes: • Reading or writing without inserting a USB • Use of unsupported USB (refer to "g. USB Screen in Chapter 8, "Operation Screens" About the USB memory). Confirm the USB.
E15	INTERNAL MEMORY ERROR	Measured value data in memory is damaged.	If the data in memory is corrupt, the following are possible causes: • Generation of powerful power supply or electrostatic noise • Abnormal supply voltage resulting, for example, from lightening or induced lightening It is advisable to back-up measured value data onto other media often, as a precaution against possible data corruption. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
		The limit of the writing data quantity in the flash memory (120 waveforms or all cycles in total) has exceeded.	Save the loaded data of "o. INTERNAL MEMORY Screen in Chapter 8, "Operation Screens" in the USB and perform the ALL DEL function.
E17	CURRENT TRIGGER ERROR	The current signal continues to be detected.	If, after measurement, the current trigger continues to be applied, bring the current trigger down below the trigger level after measurement. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E18	VOLTAGE TRIGGER ERROR	The voltage signal continues to be detected.	If, after measurement, the voltage trigger continues to be applied, bring the voltage trigger down below the trigger level after measurement. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E19	FORCE TRIGGER ERROR	After measurement, the force input signal remains above the trigger levels.	If, after measurement, force continues to be applied, bring the force down below the trigger level after measurement. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.
E20	EXTERNAL TRIGGER ERROR	After measurement, the external input (±10 V voltage or 4 to 20 mA current) signal remains above the trigger levels.	If, after measurement, external input continues to be supplied, bring the external input down below the trigger level after measurement. However, for 4 to 20 mA current input, an error occurs even with 0 mA or 4 mA or less. Therefore, it is required to input at least 4 mA. Adjust the current level to keep 4 mA to trigger level or less. If the error is not eliminated, the **MM-410B** needs repair. Please contact us.

Error code	Description	Cause	Remedy
E22	COMMUNICATION ERROR	The communication output cannot keep up with the measurement.	Occurs when MEASUREMENT is selected for ITEM. When the communication output buffer (4000) is exceeded, an error occurs. Adjust the measurement interval.
E23	MAIN BATTERY ERROR	The lithium-ion battery cannot be charged.	The lithium-ion battery may come to the end of its life. Replace the lithium-ion battery. Refer to “(3) Replacing the Battery.” If "E23" (MAIN BATTERY ERROR) appears again, the **MM-410B** needs repair. Please contact us.
E24	MAIN BATTERY LOW	The voltage of the lithium-ion battery is low.	Replace the battery with a charged one or charge the battery.

Judgment display		Description
MEASUREMENT screen	HISTORY screen	
GOOD	G	Measured value is between the upper and lower limits set in the COMPARATOR screen.
NG UPPER	U	Measured value is greater than the upper limit set in the COMPARATOR screen.
NG LOWER	L	Measured value is smaller than the lower limit set in the COMPARATOR 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.
PULSE NG	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 UP	None	Count exceeds the preset value. Check the preset counter or reset the count.

(2) Battery Specification

<table>
<tr><td>Operation time</td><td colspan="2">• Approx. 2 hours (with 1 battery)
• Approx. 4 hours (with 2 batteries)</td></tr>
<tr><td>Charge method</td><td colspan="2">Connect the 100 to 240 V AC power supply to the adapter jack on the MM-410B AC with the dedicated AC adapter.</td></tr>
<tr><td>Charge time</td><td colspan="2">Approx. 4 hours</td></tr>
<tr><td rowspan="4">Battery life (at recommended temp. 0 to 40°C)</td><td colspan="2">A lithium-ion battery is used.
The lifetime of the battery is approximately 300 full discharges and charges, depending on use.
If the battery is at the end of its life, the operation time of the MM-410B becomes shorter. In this case, replace the battery.</td></tr>
<tr><td colspan="2">Battery capacity guidance</td></tr>
<tr><td>Charge/discharge count</td><td>Battery capacity</td></tr>
<tr><td>300 times</td><td>70%</td></tr>
</table>

The battery is not charged at the time of factory shipment. When using the **MM-410B** 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-410B** and Power Supply.”)

WARNING

- When charging the battery, always connect the dedicated AC adapter to the **MM-410B**. Connecting an AC adapter of another product may result in malfunction.
- If you do not intend to use the **MM-410B** for extended periods, remove the battery or charge it once every two months.

(3) Replacing the Battery

The chargeable/dischargeable count of the battery is about 300 times. When the count exceeds 300 times or the operation time becomes shorter in a fully charged state, replace the battery according to the following procedure.

WARNING

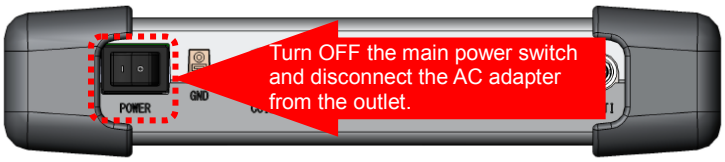
- When replacing the lithium battery, be sure to turn OFF the main power in order to prevent electric shock.

a. Maintenance parts

Item	Model No.
Lithium battery	AS1211535

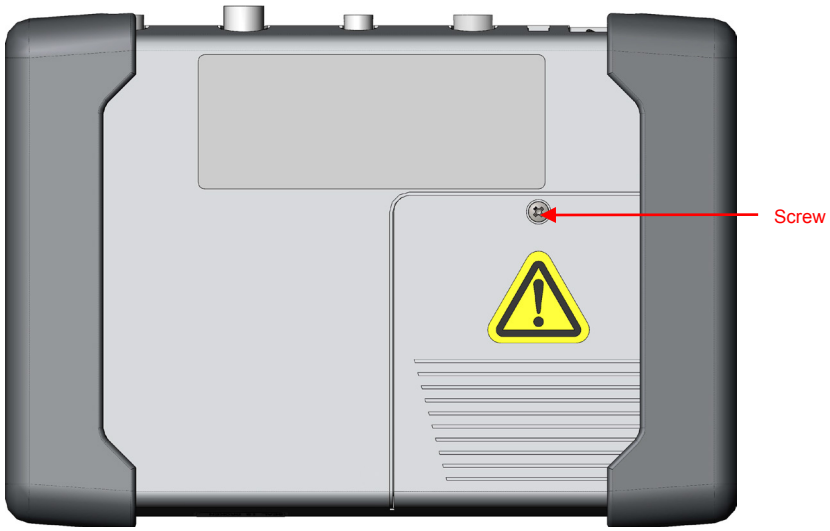
b. Replacement procedure

1) Turn OFF the main power switch and be sure to disconnect the AC adapter from the outlet.



2) After one minute from turning OFF the power switch and disconnecting the AC adapter from the outlet, remove a screw on the rear of the **MM-410B** with a Phillips screwdriver.

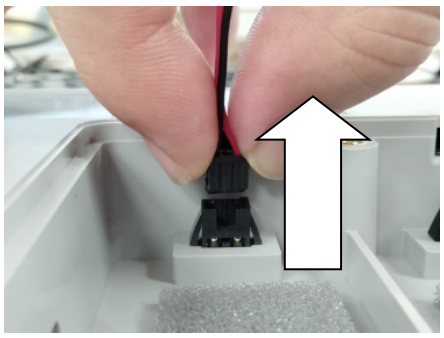
Rear



3) Pull the battery cover downward to remove it.

With the battery cover removed

4) Hold the connector and pull it upward to remove the battery.



Do not pull wires. It may cause malfunctions or damage.

5) Connect the connector of the replacement battery to the connector of the instrument, and then house the battery body in the box.

6) Be careful not to catch the battery cable and pull the battery cover upward to fix it.

7) Tighten a screw with 0.63 N-m of general torque.

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

14. Specifications

(1) Measurement Specification

Target	Specification	
Current	Measurement range	1x sensitivity coil 2.000 kA range: 0.100 to 2.000 kA 6.00 kA range: 0.30 to 6.00 kA 20.00 kA range: 1.00 to 20.00 kA 60.0 kA range: 3.0 to 60.0 kA 200.0 kA range: 10.0 to 200.0 kA 10x sensitivity coil 0.200 kA range: 0.010 to 0.200 kA 0.600 kA range: 0.030 to 0.600 kA 2.000 kA range: 0.100 to 2.000 kA 6.00 kA range: 0.30 to 6.00 kA 20.00 kA range: 01.00 to 20.00 kA
	Measurement time	ms-AC: 1 to 5000 ms CYC-AC: 0.5 to 250.0 CYC (50 Hz), 0.5 to 300.0 CYC (60 Hz) CYC-***Hz-AC: 0.5 to 200.0 CYC (M050: 50 Hz), 0.5 to 300.0 CYC (M063: 63 Hz), 0.5 to 2000.0 CYC (M500: 500 Hz) LONG CYC-AC: 0.5 to 500.0 CYC (50 Hz), 0.5 to 600.0 CYC (60 Hz) CYC-DC: 0.5 to 100.0 CYC (50 Hz), 0.5 to 120.0 CYC (60 Hz) ms-DC: 1 to 2000 ms SHORT ms-DC: 0.50 to 300.00 ms (0.05-ms increment)
	Measurement item	Maximum value (peak value) within the current flow time or RMS in the interval from the start to end of the measurement RMS depending on the measurement mode CYC mode: Arithmetic mean RMS every half-cycle (original mode) RMS of all measurement range (ISO mode) ms mode: Arithmetic mean RMS every 1 ms (original mode) RMS of all measurement range (ISO mode) ms-SHORT mode: RMS in the interval from the start to end of the measurement

Target	Specification		
Current	Measurement accuracy	MM-410B:	± 1% of full scale (excluding sensor error) Conduction angle: ± 9 degrees
		MB-400P/800P:	± 1% of full scale (for measurement up to 20 kA of the RMS current)
	Detection method	Toroidal coil MB-400P, MB-800P (ISO17657-compliant) MB-45G (10x sensitivity coil) Max measurement range:1kA Do not use to measure current over 1kA.	
Voltage	Measurement range	6.00 V range: 0.30 to 6.00 V 20.0 V range: 1.0 to 20.0 V	
	Measurement item	Maximum value (peak value) within the current flow time or RMS in the interval from the start to end of the measurement RMS depending on the measurement mode CYC mode: Arithmetic mean RMS every half-cycle (original mode) RMS of all measurement range (ISO mode) ms mode: Arithmetic mean RMS every 1 ms (original mode) RMS of all measurement range (ISO mode) ms-SHORT mode: RMS in the interval from the start to end of the measurement	
	Measurement accuracy	± 1% of full scale (excluding sensor error)	
Force	Measurement range	MA-520B	4.90 to 98.06 N, 0.50 to 10.00 kgf, 1.10 to 22.04 lbf
		MA-521B	49.0 to 980.6 N, 5.0 to 100.0 kgf, 11.0 to 220.4 lbf
		MA-770A	245 to 4903 N, 25 to 500 kgf, 55 to 1102 lbf
		MA-522B MA-771A	490 to 9806 N, 50 to 1000 kgf, 110 to 2204 lbf
	Measurement time	1 to 10000 ms	
	Measurement item	Mean value/maximum (peak)	
	Measurement accuracy	± 3% of full scale (excluding sensor error)	
	Detection method	Force sensor: MA-520B/521B/522B Current/force sensor: MA-770A/771A	

Target	Specification	
External current / voltage input	Input voltage / current range	-10 to +10 V or 4 to 20 mA
	Measurement range	5% to 100% of rated setting
	Measurement time	1 to 1000 ms
	Measurement item	Mean value/maximum (peak)
	Measurement accuracy	± 3% of full scale (excluding sensor error)
Conduction angle	Measurement range	0 to 180 degrees
	Measured values	Max. conduction angle over measurement interval
	Measurement accuracy	± 9 degrees
Seam measurement	Measurement time*	5 minutes
	Measurement item*	CYC-AC, ms-AC: Current, voltage CYC-DC, ms-DC, SHORT ms-DC: Voltage

Target	Specification
Measured value display	Select ten measured values from the following to display: Peak current RMS current Average RMS current Peak voltage RMS voltage Average RMS voltage Conduction angle Average power Average resistance Weld time Weld time TP Weld time TH Flow time Peak force Average force 1 Average force 2 Initial force Final force Real time force Force time Peak external peak Average external 1 Average external 2 Initial external Final external Real time external External time Weld count Good count
Waveform display	Select four waveforms from the following to display (The waveform is displayed coarsely since the measurement result is skipped.): Current waveform Voltage waveform Power waveform Resistance waveform Force waveform External voltage/current input waveform

Target	Specification
All cycle display	Current, voltage, conduction angle (Conduction angle appears only when CYC-AC, CYC-***Hz-AC or LONG CYC-AC is selected for TIME in the BASIC SETUP (1) screen.) Displays data every half-cycle or 1 ms Force Displays data every 10 ms.
Trigger method	Current trigger Auto trigger Force trigger External voltage/current input trigger Constant trigger Force (external) trigger External (external) trigger
Impulse	Select an option from the following to use (When “00” is selected for PULSE No., a normal measurement is made for SET PULSE and ALL PULSE (SET).): SET PULSE: Measures only specified pulse. ALL PULSE (SET): Measures all specified number of pulses (20 pulses maximum). ALL PULSE (NO SET): Measures when the current flow interval is 500 ms or less. NO COOL (2nd stage measurement): Measurement is possible only if the current at the second stage is larger than that at the first stage.
Judgment function	Upper/lower limit judgment of five measurements selected for measured value display

*: The measurement method is different from that of the normal measurement. Refer to Chapter 8, “p. SEAM WAVEFORM Screen” and “q. SEAM SETUP Screen.”

(2) Specification of the MM-410B

Item		Specifications
Display items		MEASUREMENT screen WAVEFORM screen VIEW screen COMPARATOR screen HISTORY screen USB screen ALL CYCLE screen FORCE TIMING screen BASIC SETUP screen EXTEND SETUP screen SYSTEM SETUP screen EXT INPUT screen COMMUNICATION screen INTERNAL MEMORY screen
External data output		Ethernet/USB communication
Number of schedules		127
Rated input voltage		100 to 240 V AC (50/60 Hz), AC adapter output 9 V DC
Input voltage tolerance		90 to 250 V AC (47 to 63 Hz), AC adapter output 8.55 to 9.45 V DC
Power supply		Single-phase 90 to 250 V AC (50/60 Hz), AC adapter output 9 V DC
Power consumption		7.8 W at normal operation, 30 W at charging (with 2 batteries)
Operating environment*1	Operating ambient temperature	0°C to 45°C (35°C at charging)
	Operating ambient humidity	10°C to 80%RH (no condensation)
	Temperature during transport or storage	-10°C to 55°C
	Humidity during transport or storage	10°C to 85% (no condensation)
	Altitude	1000 m max.
Outer dimensions		157 mm (H) x 224 mm (W) x 47 mm (D) (excluding protrusions)
Mass		Approx. 0.9 kg (excluding accessories)
Overvoltage category		II
Case protection		IP20

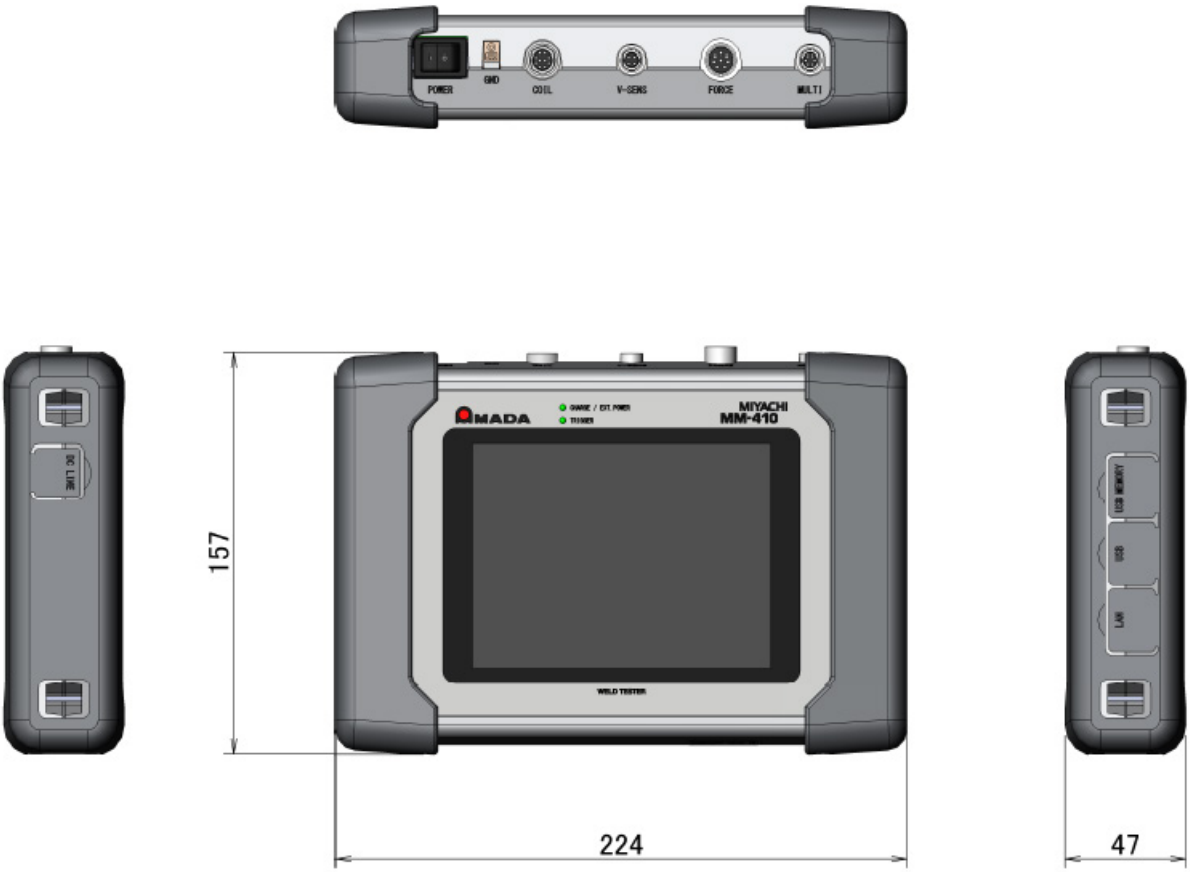
*1: Use this product in the environment without conductive dust. If conductive dust enters in the product, this may result in a failure, electric shock, or fire. When using this product in this environment, make contact with us.

15. Calibration

Regular calibration is required to maintain the **MM-410B** performance.
Calibration is conducted at our facility.
For calibration, please send your toroidal coil and force sensor together with the **MM-410B**.
Depending on the operating environment, the extent of deterioration varies from one **MM-410B** to another. Therefore, the **MM-410B** must be calibrated together with the toroidal coil and the force sensor as a set.
For more information about calibration, contact us.

16. Outline Drawing

(Dimensions in mm)



17. Schedule Data Table

Setting screen	Setting item	Initial value	SCH	SCH	SCH	SCH
BASIC SETUP (1)	SCHEDULE NAME					
	TRIGGER	CURRENT				
	TIME	CYC-AC				
	FREQUENCY	050Hz				
	CURRENT RANGE	20.00kA				
	VOLTAGE RANGE	20.0V				
	START TIME	0000.0CYC				
	END TIME	0300.0CYC				
BASIC SETUP (2)	PULSE MODE	SET PULSE				
	PULSE No.	00				
	COOL TIME	000.5CYC				
	FALL LEVEL (*)	80%				
	MEASUREMENT MIN TIME	01.0CYC				
	MEAS INHIBIT TIME	00.0S				
	END LEVEL	05.0%				
	PULSE 2 TRIG LEVEL (*)	00.00kA				
BASIC SETUP (3)	CURRENT TRIGGER LEVEL	90				
	TOROIDAL COIL	TIMES 1				
	CALCULATION	ORIGINAL				

(Note) (*) is not displayed by default.

Setting screen	Setting item	Initial value	SCH	SCH	SCH	SCH
EXTEND SETUP (1)	DELAY TIME	0000ms				
	START TIME 1	00000ms				
	END TIME 1	10000ms				
	START TIME 2	00000ms				
	END TIME 2	10000ms				
	RISE LEVEL	80%				
	FALL LEVEL	80%				
EXTEND SETUP (2)	SENSOR	MA-771				
	SPAN	1000				
	UNITS	N				
	TRIGGER LEVEL	10.0%				
EXTEND SETUP (3)	DELAY TIME	0000ms				
	START TIME 1	00000ms				
	END TIME 1	10000ms				
	START TIME 2	00000ms				
	END TIME 2	10000ms				
EXTEND SETUP (4)	INPUT	VOLTAGE				
	RATE	9999				
	DECIMAL RANGE	****				
	UNITS					
	TRIGGER LEVEL	10.0%				

Setting screen	Setting item	Initial value	Setting value
SYSTEM SETUP (1)	MODE	NORMAL	
	LANGUAGE	ENGLISH	
	WELD COUNTER PRESET	000000	
	GOOD COUNTER PRESET	000000	
	DATE AND TIME	-	
		-	
	BRIGHTNESS	07	
		OFF	
SYSTEM SETUP (2)	CURRENT SAMPLING INTERVAL	200μs	
	CURRENT CONVERSION COEFFICIENT	227.0mV/kA	
	FORCE / EXTERNAL SAMPLING INTERVAL	500μs	

Setting screen	Setting item	Initial value	SCH	SCH	SCH	SCH
COMPA-RATOR	CURRENT AVERAGE RMS LOWER	00.00kA				
	CURRENT AVERAGE RMS UPPER	99.99kA				
	CURRENT PEAK LOWER	00.00kA				
	CURRENT PEAK UPPER	99.99kA				
	VOLTAGE AVERAGE RMS LOWER	00.0V				
	VOLTAGE AVERAGE RMS UPPER	99.9V				
	VOLTAGE PEAK LOWER	00.0V				
	VOLTAGE PEAK UPPER	99.9V				
	WELD TIME LOWER	0000.0CYC				
	WELD TIME UPPER	3000.0CYC				

Setting screen	Setting item	Initial value	Setting value
VIEW	MEASUREMENT 1	CURR AVE RMS	
	MEASUREMENT 2	CURR PEAK	
	MEASUREMENT 3	CURR AVE RMS	
	MEASUREMENT 4	CURR PEAK	
	MEASUREMENT 5	WELD TIME	
	MEASUREMENT 6	-	
	MEASUREMENT 7	-	
	MEASUREMENT 8	-	
	MEASUREMENT 9	-	
	MEASUREMENT 10	-	
	WAVEFORM 1	CURRENT ON	
	WAVEFORM 2	VOLTAGE ON	
	WAVEFORM 3	POWER ON	
	WAVEFORM 4	RESISTANCE ON	

Setting screen	Setting item	Initial value	Setting value
USB	ITEM	OFF	
	INTERVAL	0001	
	OUT OF LIMIT OPERATION	OFF	
	WAVE DECIMATION	200us	
	UNITS	OFF	
	DECIMAL POINT RANGE	.	
	HISTORY AREA start (*)	2016.01.01	
	HISTORY AREA end (*)	2077.12.31	
	SCHEDULE AREA start (*)	001	
	SCHEDULE AREA end (*)	127	
	FILE NO (*)	01	

(Note) (*) is not displayed by default.

Setting screen	Setting item	Initial value	Setting value
COMMU-NICATION (1)	ITEM	OFF	
	INTERVAL	0001	
	OUT OF LIMIT OPERATION	OFF	
	WAVE DECIMATION	200us	
	UNITS	OFF	
	DECIMAL POINT RANGE	.	
	HISTORY AREA start (*)	2016.01.01	
	HISTORY AREA end (*)	2077.12.31	
	SCHEDULE AREA start (*)	001	
	SCHEDULE AREA end (*)	127	
COMMU-NICATION (2)	MODE	OFF	
		ONE WAY	
	ID NUMBER	01	
	IP ADDRESS	198.168.001.010	
	SUBNET MASK	255.255.255.000	
	DEFAULT GATEWAY	198.168.001.100	
	PORT NUMBER	1024	

(Note) (*) is not displayed by default.

Setting screen	Setting item	Initial value	Setting value
EXT INPUT	INPUT DEBOUNCE TIME	10ms	

Setting screen	Setting item	Initial value	Setting value
INTERNAL MEMORY	ITEM	OFF	
	INTERVAL	0001	
	OUT OF LIMIT OPERATION	OFF	
	WAVE DECIMATION	200us	

Setting screen	Setting item	Initial value	SCH	SCH	SCH	SCH
SEAM SETUP (1)	SCHEDULE NAME					
	START MEASUREMENT	000.0CYC				
	MEASUREMENT RANGE	0.5CYC				
	MEASUREMENT INTERVAL	00.5CYC				
	START TIME 1	00000.0CYC				
	END TIME 1	15000.0CYC				
	START TIME 2	00000.0CYC				
	END TIME 2	15000.0CYC				
	START TIME 3	00000.0CYC				
	END TIME 3	15000.0CYC				
SEAM SETUP (2)	CURRENT 1 LOWER	00.00kA				
	CURRENT 1 UPPER	99.99kA				
	CURRENT 2 LOWER	00.00kA				
	CURRENT 2 UPPER	99.99kA				
	CURRENT 3 LOWER	00.00kA				
	CURRENT 3 UPPER	99.99kA				
	VOLTAGE 1 LOWER	00.0V				
	VOLTAGE 1 UPPER	99.9V				
	VOLTAGE 2 LOWER	00.0V				
	VOLTAGE 2 UPPER	99.9V				
	VOLTAGE 3 LOWER	00.0V				
	VOLTAGE 3 UPPER	99.9V				
	FREQUENCY	050Hz				
SEAM SETUP (3)	TRIGGER	CURRENT				
	TIME	CYC-AC				
	CALCULATION	ORIGINAL				
	CURRENT RANGE	20.00kA				
	VOLTAGE RANGE	20.0V				
	CURRENT TRIGGER LEVEL	90				
	TOROIDAL COIL	TIMES 1				
	END LEVEL	05.0%				

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