NX100 OPTIONS
INSTRUCTIONS

FOR WORKPIECE THICKNESS DETECTION FUNCTION

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR'S MANUAL
NX100 MAINTENANCE MANUAL

The NX100 operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 158346-1CD
Revision: 0

YASKAWA

MANUAL NO.
HW0483330

MANDATORY

- This manual explains the workpiece thickness detection function of the NX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the NX100.
- General items related to safety are listed in Section 1: Safety of the NX100. To ensure correct and safe operation, carefully read the NX100 INSTRUCTIONS before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

NOTES FOR SAFE OPERATION

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.
In this manual, the Notes for Safe Operation are classified as “WARNING”, “CAUTION”, “MANDATORY”, or ”PROHIBITED”.

 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
 MANDATORY	Always be sure to follow explicitly the items listed under this heading.
 PROHIBITED	Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.

WARNING

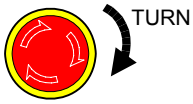
- Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the front door of the NX100 and the programming pendant are pressed.
  When the servo power is turned off, the SERVO ON LED on the programming pendant is turned off.

  Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Emergency Stop Button 

- Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

  Injury may result from unintentional or unexpected manipulator motion.

Release of Emergency Stop 

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator :
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Ensure that you have a safe place to retreat in case of emergency.

  Improper or unintended manipulator operation may result in injury.

- Confirm that no persons are present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning on the NX100 power
  - Moving the manipulator with the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

  Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop buttons are located on the right of the front door of the NX100 and the programming pendant.

CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  -Check for problems in manipulator movement.
  -Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the NX100 cabinet after use.

  The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, on the floor, or near fixtures.
- Read and understand the Explanation of Warning Labels before operating the manipulator.

Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.
The manipulator usually consists of the controller, the programming pendant, and supply cables.
In this manual, the equipment is designated as follows.

Equipment	Manual Designation
NX100 Controller	NX100
NX100 Programming Pendant	Programming Pendant
Cable between the manipulator and the NX100	Manipulator Cable

Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys	The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]
	Symbol Keys	The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key  The cursor key is an exception, and a picture is not shown.
	Axis Keys Number Keys	“Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.
	Keys pressed simultaneously	When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}
Playback Panel	Buttons	Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel

Description of the Operation Procedure

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

Registered Trademarks

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. (R) and TM are omitted.

Explanation of Warning Labels

The following warning labels are attached to the manipulator and NX100.
Fully comply with the precautions on the warning labels.

WARNING

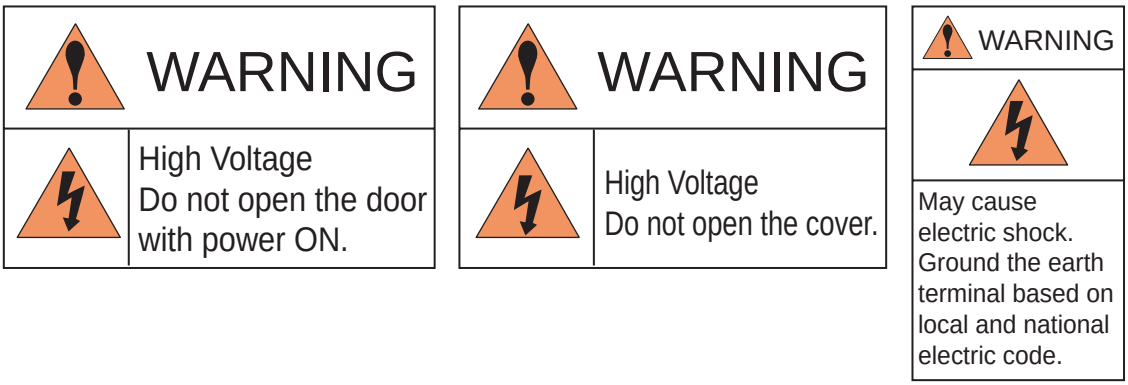
- The label described below is attached to the manipulator.

Observe the precautions on the warning labels.
Failure to observe this caution may result in injury or damage to equipment.

Refer to the manipulator manual for the warning label location.

- The following warning labels are attached to NX100.

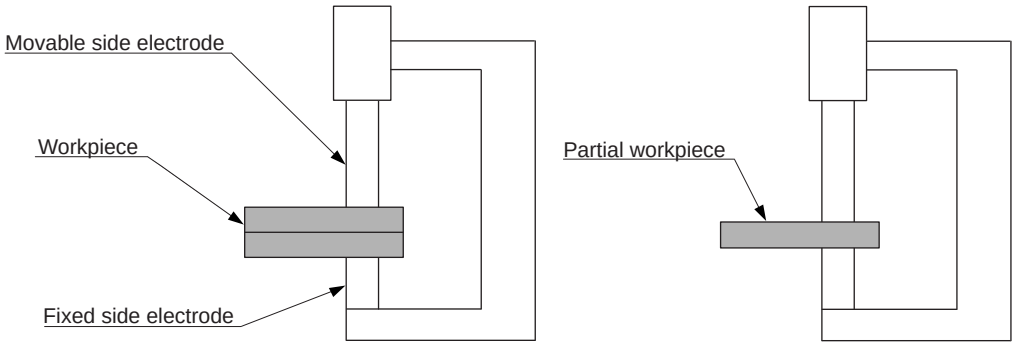
Observe the precautions on the warning labels.
Failure to observe this warning may result in injury or damage to equipment.



Refer to the NX100 INSTRUCTIONS for the warning label location.

1 Outline

The workpiece thickness detection function monitors the thickness of workpice to be welded every welding spot (hit point) at the SVSPOT instruction. This function does not, however, monitor the workpiece thickness when executing the SVGUNCL instruction.
An alarm occurs if the workpiece is missing.

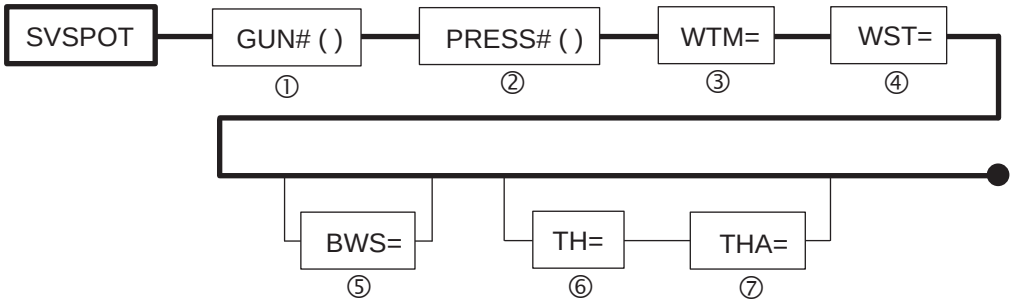


[Normal operation]　　[Error]

2 Instruction

2.1 SVSPOT (Spot Welding Instruction)

The SVSPOT instruction applies pressure to the gun and performs welding according to the specified welding condition number.



① GUN# ( )
Gun condition file number

② PRESS# ( )
Gun pressure file number

③ WTM=
Welding condition number
- Specifies the welding condition number which is output to the power source.

④ WST=
Power source start signal output timing
- Specifies the timing of output signal to start the power source.
- Choose from the following three settings:
  1) Touch motion (WST=0)
  2) Pressure first time (WST=1)
  3) Pressure second time (WST=2)

⑤ BWS=
Welding start gun stroke position
- Specifies the stroke position to which the gun is opened at the execution of SVSPOT instruction.
- Moves the gun to the position that has been adjusted accoding to the amount of electrode wear.
- If the stroke position is not specified, starts the operation with speed control at the touch speed.
- The gun operation speed is set by the gun condition file.

⑥ TH=

Workpiece thickness (unit: mm) (Can be set by constant numbers: 0.0 to 999.9 (the first decimal place is displayed).)

- In the thickness measure mode: the thickness value that has been measured at playback is written.
- In the monitoring mode: At playback, the "TH" value is compared with the measured workpiece thickness.

⑦ THA=

Allowable ratio of workpiece thickness (unit: %, 0 to 100)

- In the thickness measure mode: this condition is not used at the execution of SVSPOT instruction.
- In the monitoring mode: this condition is used for the calculation of workpiece thickness comparison, and allows for variations in % for the specified workpiece thickness "TH".

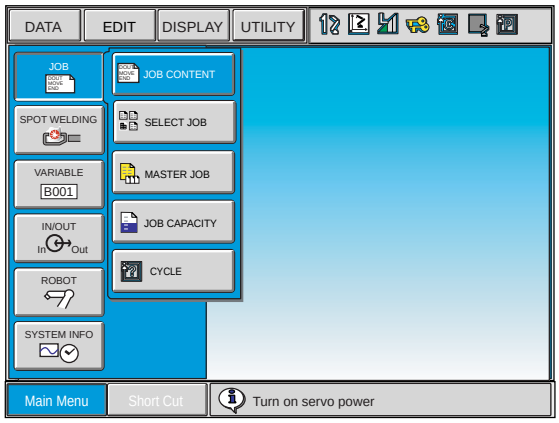
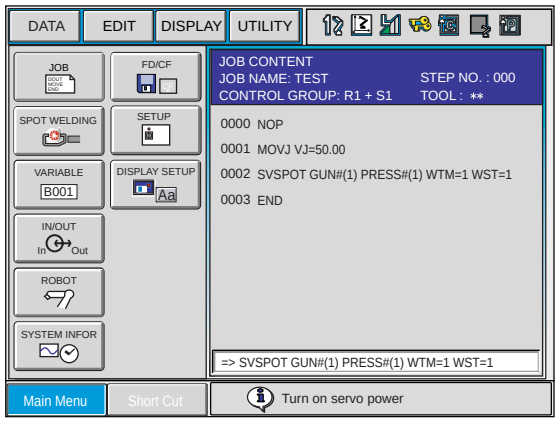
3 Operational Procedure

3.1 Setting of Workpiece Thickness Monitoring

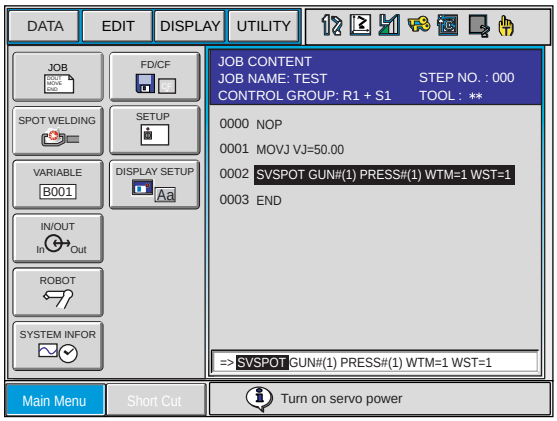
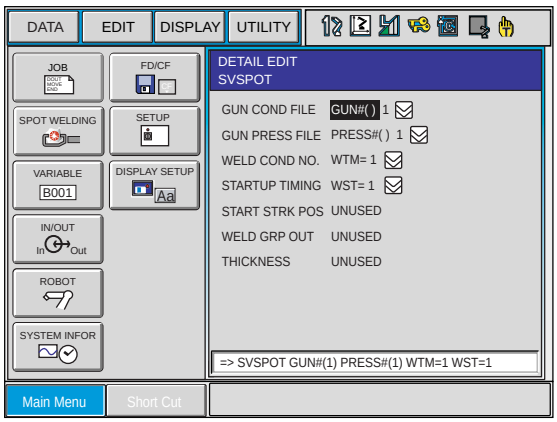
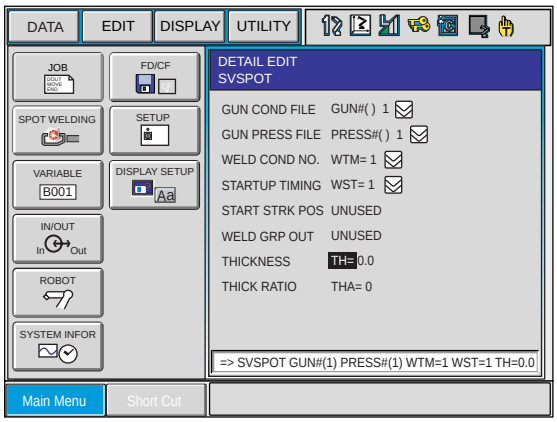
SUPPLE-MENT

- Set the mode switch of programming pendant to the Teach mode.
- Set the security mode to the Edit mode or Management mode to set job data.
- In the Operation mode, only error contents reference is allowed.

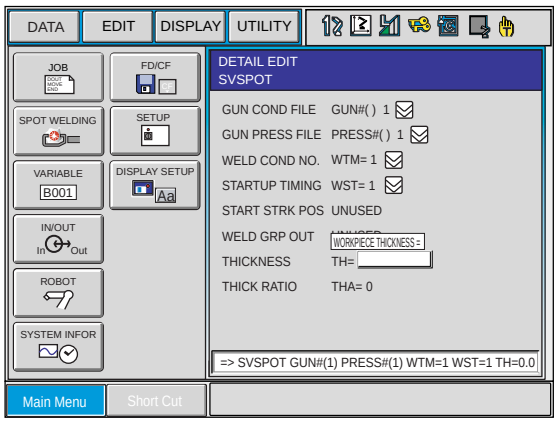
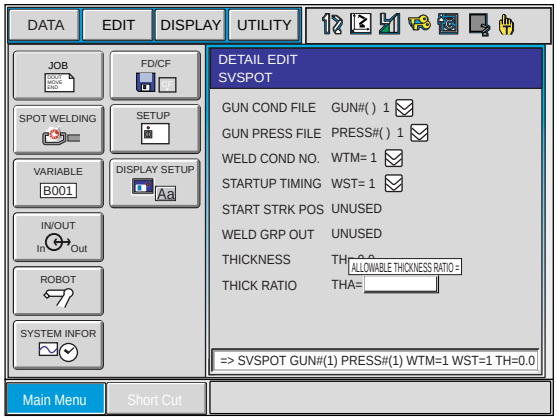
Perform the following operations to set the workpiece thickness monitoring.

	Operation	Explanation
1	Select {JOB} → {JOB CONTENT} under the main menu.	 The JOB CONTENT window appears. 

Setting of SVSPOT Instruction

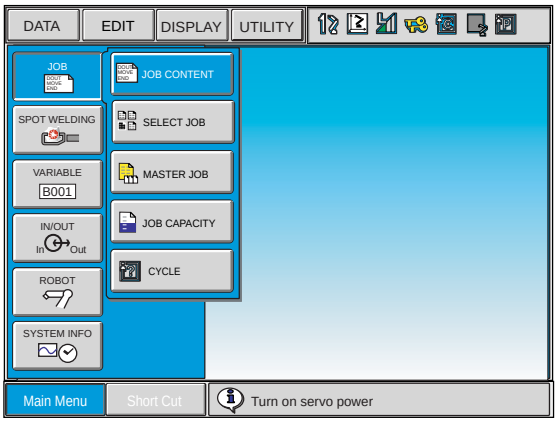
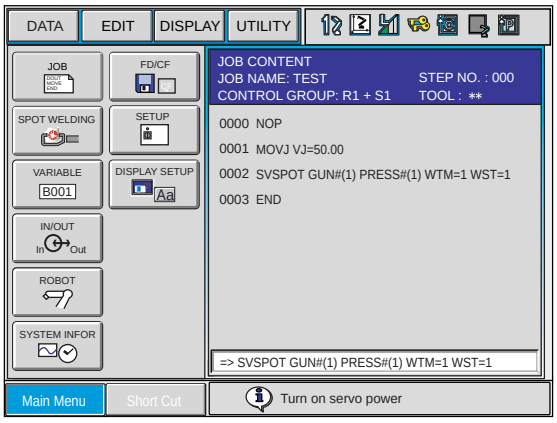
	Operation	Explanation
1	Move the cursor to the "SVSPOT" data and press [SELECT].	
2	Press [ENTER] again to display the DETAIL EDIT window.	
3	Set "THICKNESS": TH = 0 (workpiece thickness) and "THICK RATIO": THA = 0 to 100 [%] (allowable thickness ratio).	
	3.1 Move the cursor to "THICK-NESS" and press [SELECT].	

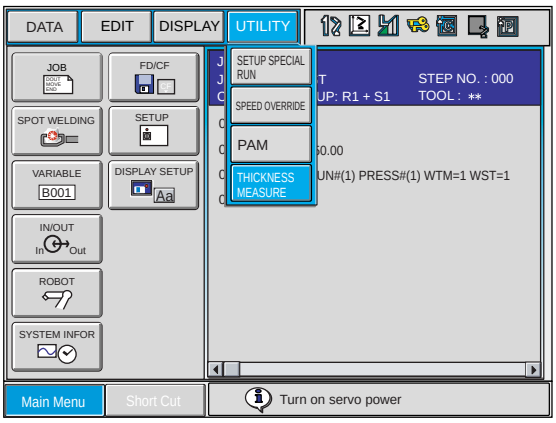
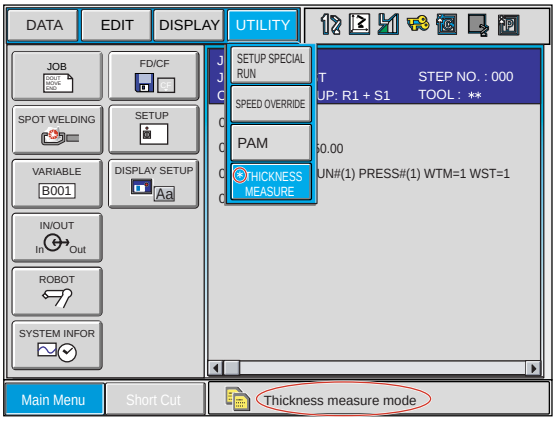
3.1 Setting of Workpiece Thickness Monitoring

	Operation		Explanation
3	3.2	Enter numeric value and press [ENTER].	
	3.3	Move the cursor to "THICK RATIO" and press [SELECT].	
	3.4	Enter numeric value and press [ENTER].	
4	Press [ENTER] again, and the window returns to the JOB CONTENT window.		

3.2 Setting of Thickness Measurement

SUPPLE-MENT Set the mode switch of programming pendant to the Play mode.

	Operation	Explanation
1	Set the mode switch of programming pendant to the Play mode.	
2	Select {JOB} → {JOB CONTENT} under the main menu.	 The JOB CONTENT window appears. 

	Operation	Explanation
3	Select {UTILITY} → {THICKNESS MEASURE}.	 "Thickness measure mode" appears in the message display area. The [THICKNESS MEASURE] key is displayed with the asterisk.  
4	Execute the job.	The "TH" tag value of SVSPOT instruction will be rewritten with the workpiece thickness, the value when the pressure reaches the touch pressure, at each hit point. The following formula is used to calculate the "TH" value. TH=Touch pressure position (Pulse-to-stroke conversion value, mm) + DMF (Fixed side wear + Movable side wear, mm)

3.3 Execution of Thickness Monitoring

SUPPLE-MENT

- Set the mode switch of programming pendant to the Play mode.
- Release the thickness measure mode.
  * Refer to " 4.3 How to Release Thickness Measure Mode " in " 4 Related Functions ".

If playback of a job is performed with the thickness measure mode released, the workpiece thickness measured at each hit point is compared with the value of "TH"/"THA".
If the comparison result is not acceptable, the alarm "Thickness Error" occurs.

Use the following formula to compare the workpiece thickness at each hit point and the value of "TH/THA".

[Acceptable Result]
TH - (TH × THA / 100) ≤ Touch pressure position + DMF ≤ TH + (TH × THA / 100)

[Not-Acceptable Result]
TH - (TH × THA / 100) > Touch pressure position + DMF
Or
Touch pressure position + DMF > TH + (TH × THA / 100)

4 Related Functions

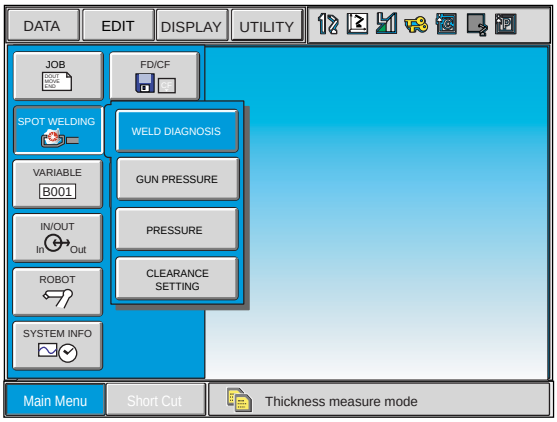
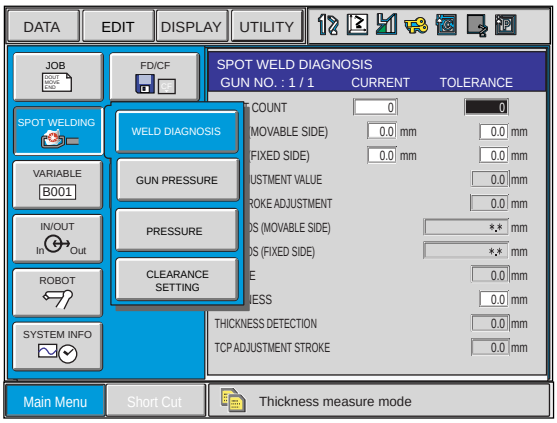
4.1 I/O Output at Thickness Measure Mode

In the thickness measure mode, "1" is output to the general output that has been stored in the parameter "S4C092". For example, if the parameter S4C092 is 20 (S4C092=20), "1" is output to "OUT20".
This parameter can be used to stop welding in the thickness measure mode.

4.2 Display of Measured Thickness

SUPPLE-MENT

- The measured thickness is displayed in mm on the "SPOT WELD DIAGNOSIS" window.
- The latest measured thickness is always displayed on the window.
- Even if the power to the controller is turned OFF, the measured thickness value will remain.

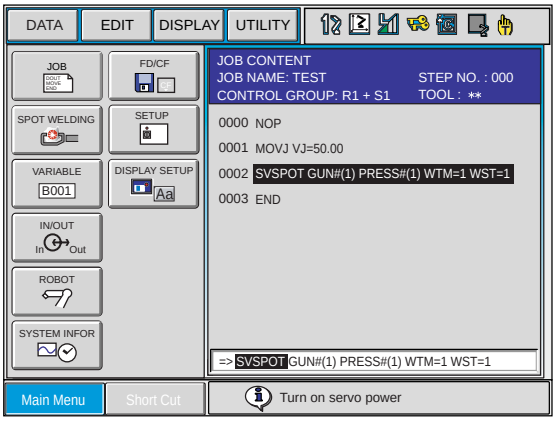
	Operation	Explanation
1	Select {SPOT WELDING} → {WELD DIAGNOSIS} under the main menu.	 The SPOT WELD DIAGNOSIS window appears. 

4.3 How to Release Thickness Measure Mode

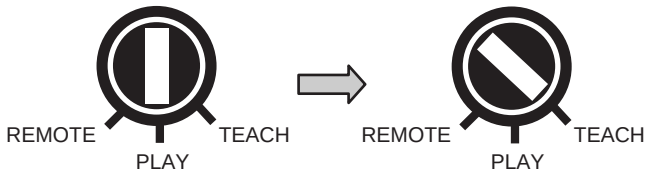
Select one of the following operations to release the thickness measure mode.
If one of the following is performed, the mode is changed to the monitoring mode from the thickness measure mode.

1. END Operation at Playback
2. Switch to Teach Mode
3. Release of [THICKNESS MEASURE]

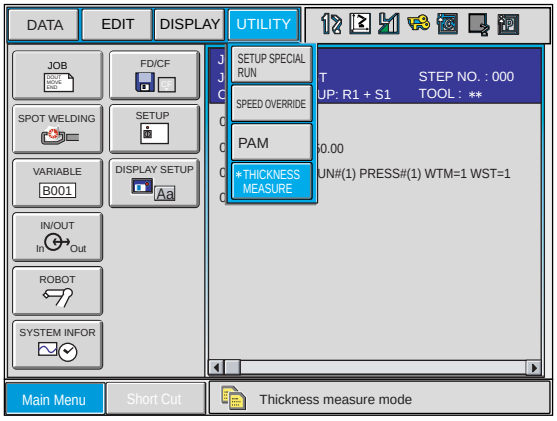
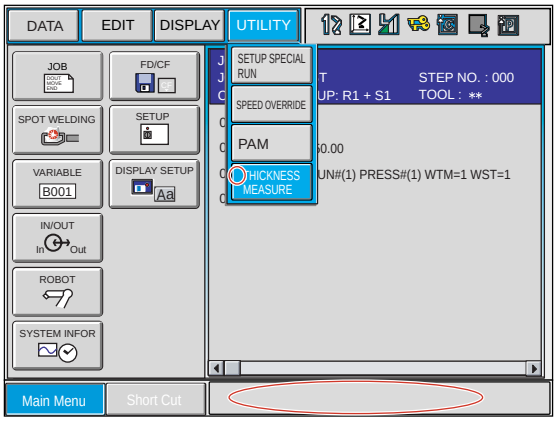
(1) END Operation at Playback.

	Operation	Explanation
1	Move the cursor to "END" and press [SELECT].	

(2) Switch to Teach Mode

	Operation	Explanation
1	Change the mode switch on the programming pedant to Teach mode.	

(3) Release of [THICKNESS MEASURE]

	Operation	Explanation
1	Select [THICKNESS MEASURE] under [UTILITY].	 "Thickness measure mode" disappears in the message display area. The asterisk on the [THICKNESS MEASURE] key disappears.  

5 Notes

1. After a series of teaching operations, it is recommended that the "TH" tag of SVSPOT instruction be specified immediately before thickness measurement.
   If the "TH" tag is specified before that, the alarm "Thickness Error" may occur during test operation, which results in less operating efficiency.

2. The value of measured workpiece thickness is affected by the delay of measurement timing and gun bend at the touch motion. Therefore, an absolute accuracy cannot be guaranteed.
   The faster the touch speed becomes and the more the touch pressure increases, the bigger the error will be. If the pressure specified in the thickness measure mode is equal to that of the monitoring mode, the absolute accuracy will be approximately 1 mm or less.

3. The value of measured workpiece thickness is calculated as follows; find the touch motion position with the pulse value at touch motion according to the pulse-to-stroke conversion table registered in the gun condition file, then add the total wear amount to the touch motion position.

   Value of measured workpiece thickness = Touch motion position + Total wear amount

NX100 OPTIONS
INSTRUCTIONS

FOR WORKPIECE DETECTION FUNCTION

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