WARNING

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi4aGC071001FMEN3

Hi4a Controller Function Manual

Welding Gun Change

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

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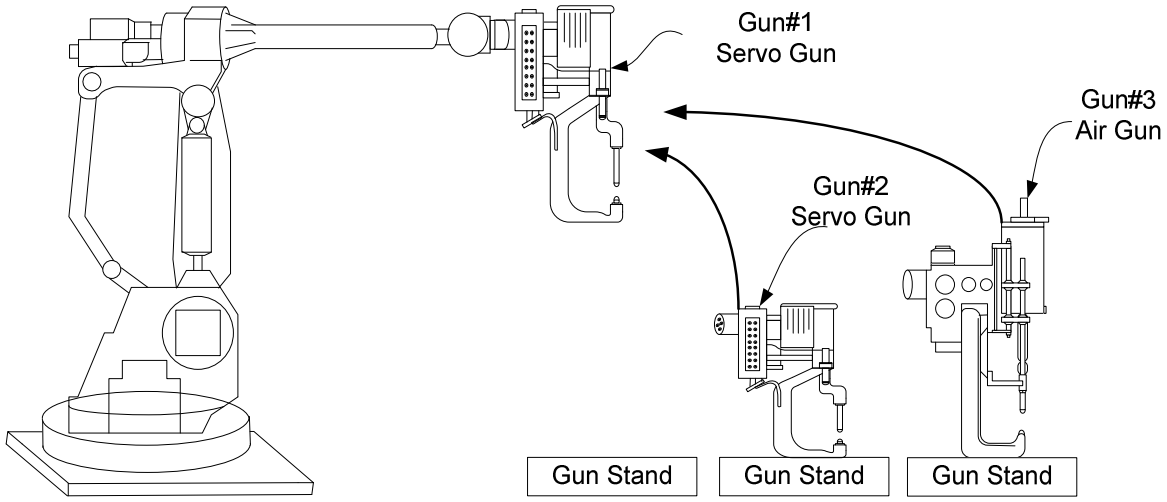
1 Overview

1.1. Welding Gun Change Function Overview

Welding gun change function is for connection/disconnection of a robot and guns, when one existing gun cannot complete all jobs or when servo guns should be disconnected and Air guns should be attached. In other words, multiple tools can be used alternately.

When there is one servo gun change, no.3 becomes a Air gun. In other cases, the total number of welding gun changes becomes the number of a Air gun. The following figure is the case of two servo gun changes.



1.2. Main Functions

1.2.1. Main Function Specification

Main Function Specification	Note				
	After V10.05-05		After V10.05-09	After V10.07-04	After V10.07-27
Number of welding gun change(s)	2	3	5	7	9
Number of servo gun change(s)	1	2	4	6	8
Number of Air gun change(s)	1	1	1	1	1
Servo gun number	1	1~2	1~4	1~6	1~8
Air gun number	3	3	5	7	9
Air gun specification	Equalizer/equalizer-less option				
Manual connection/disconnection function					
Servo gun/Air gun simultaneous support					

◆【CAUTION】◆

- In the gun change mode, servo gun cannot be used as a fixed gun.
- When a Air gun (robot gun, fixed gun) is used, the Air gun is assigned to welding series no.2. A servo gun is assigned to welding series no.1, and a Air gun to no.2.
- Refer to 2.2.4 for how to assign a tool number to each gun.
- In the gun change mode, manual tool change function (R29) cannot be used. Tool numbers can be renewed only by the gun change function.

1.2.2. Function Features

- **Gun lock**
  By using the welding gun change function, a manipulator can control a robot and servo guns separately. When servo guns are separated from a robot, gun-lock state does not allow the servo gun axis to perform servo control.

- **Servo gun parameter setting**
  Parameters of servo guns to be changed can be set automatically by the manual/automatic connection function of welding guns.

- **Manual connection disconnection**
  In the manual mode, welding guns can be connected/disconnected.

- **Teaching**
  Teaching of the welding gun change function is done separately to connection part and to disconnection part of welding guns by using the manual connection / disconnection function.

- **Playback**
  Taught programs are automatically connected/disconnected by the connection / disconnection command of a welding gun. When servo guns are disconnected, servo control of a servo gun axis is not performed.

1.2.3. Manipulation Order

Initialize
Additional axis constant and parameter are set up. Servo parameter of servo gun to be changed is set up.

▼

Servo gun parameter creation
Pressure table and servo gun parameter are created for each servo gun by connecting / disconnecting servo guns manually.

▼

Input/output Signal Assignment
To make welding gun use possible, input/output signals are allotted. Input/output signals for servo gun change are also allotted.

▼

Teaching
Teaching for connection/disconnection part of guns are linked to GUNCHNG command by using the manual connection/disconnection function for welding gun change.
Input/output Signal Assignment
To make welding gun use possible, input/output signals are allotted. Input/output signals for servo gun change are also allotted.

▼

Test operation
In the manual mode, test operation can be performed by the step forward/backward function.
Servo gun connection/disconnection state can be checked by gun number.

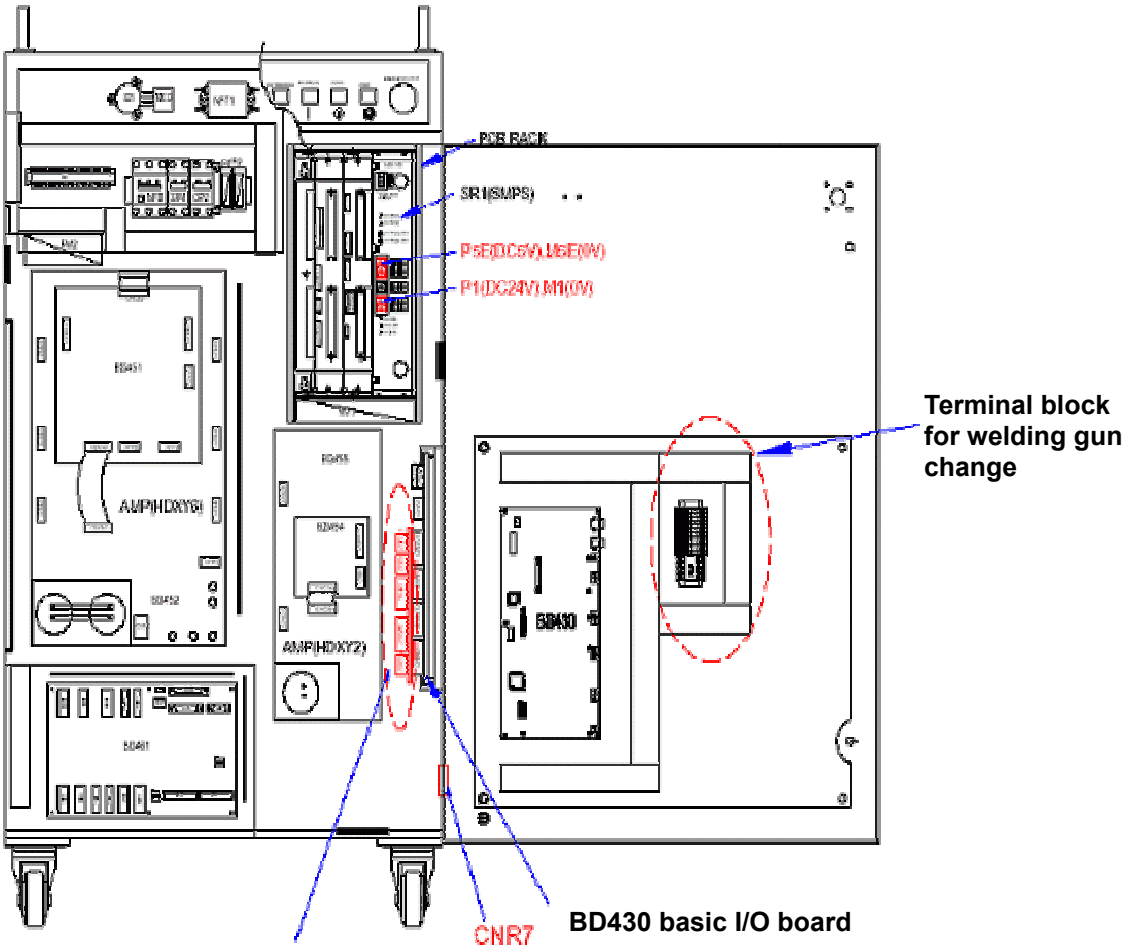
▼

Continual operation
Convert to the automatic mode. If no abnormal state is checked in the test operation, operate gun change in the auto mode.

2 System Setting

2.1. Hardware Structure

Terminal block and BD481 board should be installed and wiring should be done for the welding gun change function, as follows. These are optional for Hi4a.



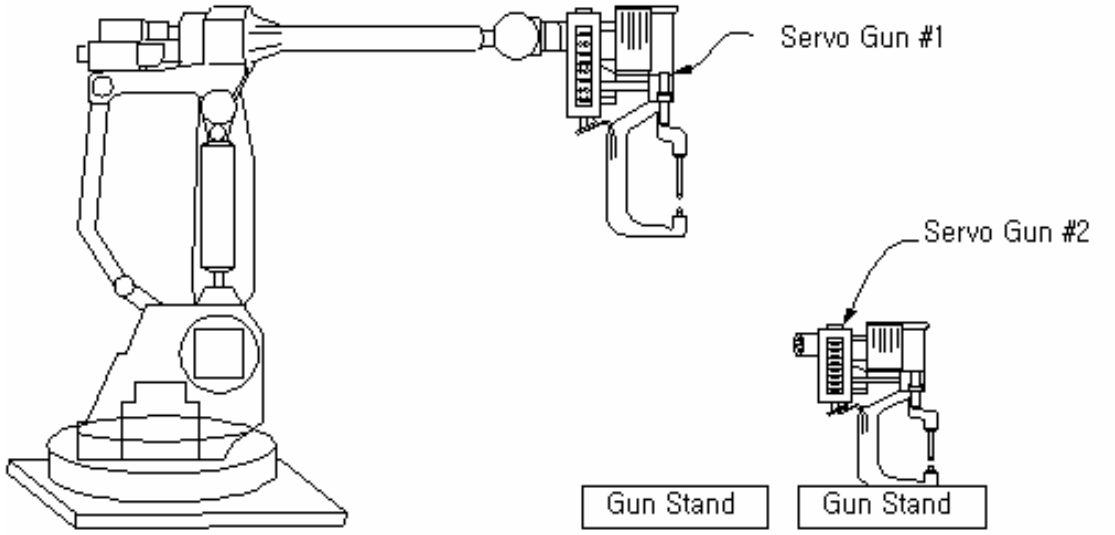
Option board(BD481) for welding gun change
1) MAKER : HHI
2) TYPE : BD430baby

2.2. System Structure

Servo gun change system is for servo guns and Air guns. Number of changeable servo guns is different according to main software version. In case of lower version, ask HHI for software version upgrade.

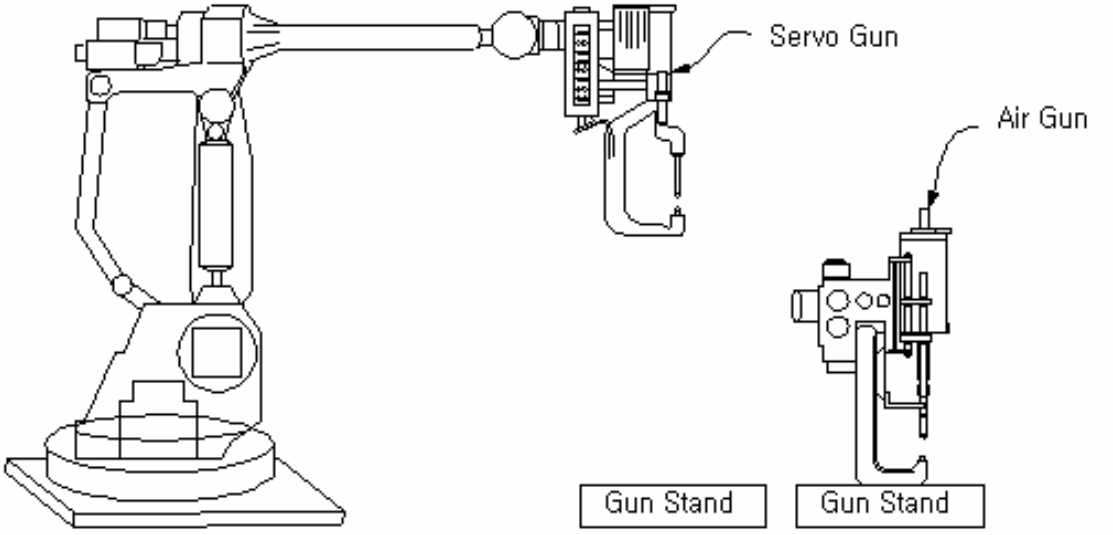
2.2.1. Servo Gun + Servo Gun Structure

If a gun change system has two servo guns, one is assigned to gun no.1 and the other to gun no.2.



2.2.2. Servo Gun + Air gun Structure

If a gun change system has one servo gun and one Air gun, the servo gun is assigned to gun no.1 and the Air gun to gun no.3. However, this is only when the number of gun changes is 2 or less. In other cases, the gun whose number is one more than the number of gun changes set in the initialization can be assigned to the Air gun. The Air gun supports both an equalizer gun and an equalizer-less gun.



◆【TIP】◆

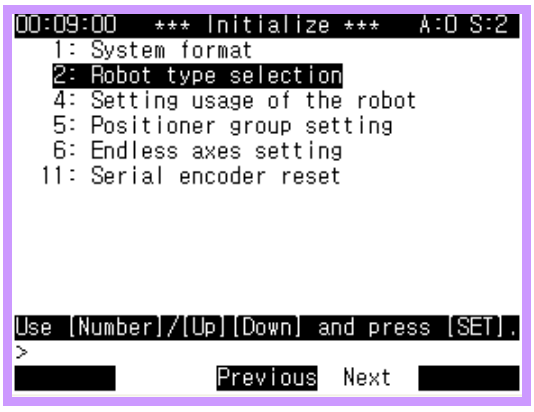
When ‘servo gun + hanger (for handling)’ structure needs to be changed,

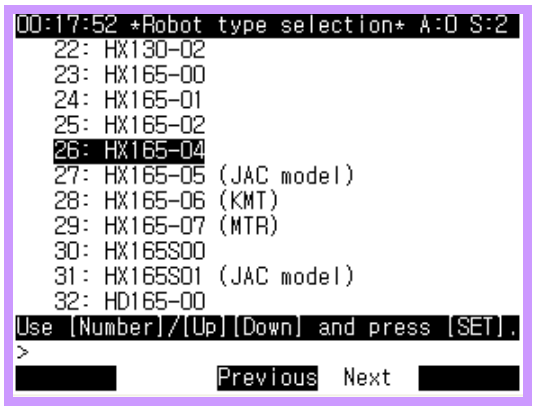
- If there is one servo gun change, a hanger can be used as G2 (tool number 2). (In case of gun change command input, gun number is no.2.)
- If there are two servo gun changes, G2 is assigned as a servo gun and does not support a hanger. However, users can use G3 as a hanger instead of a Air gun at their disposal, if gun change is performed like a Air gun. Users must be careful, because G3 is set as a Air gun, 『Pressure→Welding』 signal is outputted, if teaching pendant screen and manual welding command ([Shift]+[GUN]) or SPOT command are given to G3.

2.3. Controller Setting

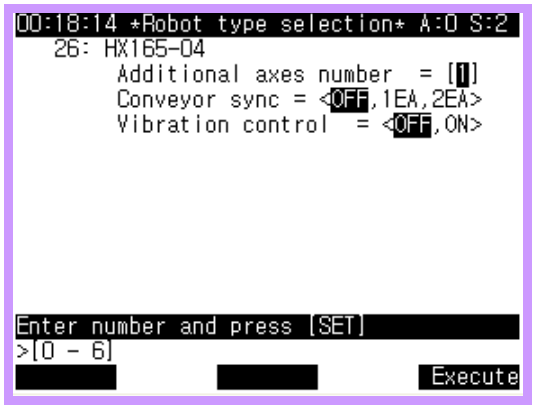
2.3.1. Initialize

(1) Robot type selection

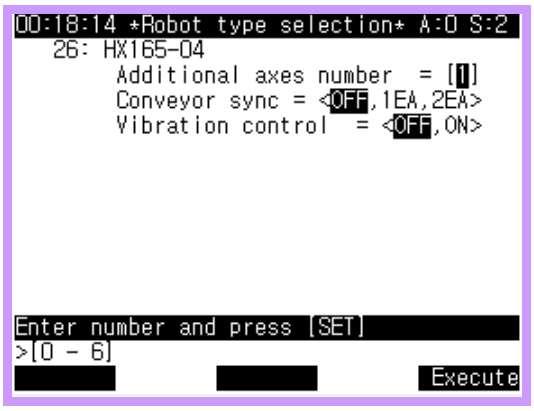


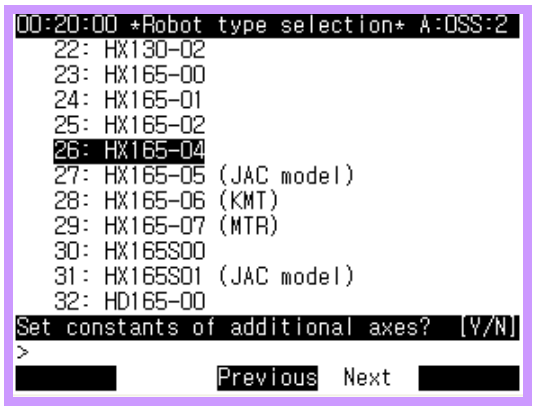


(2) Number of additional axes
Set number of additional axes. When servo gun change is used, number of servo gun axis should not be more than 1.

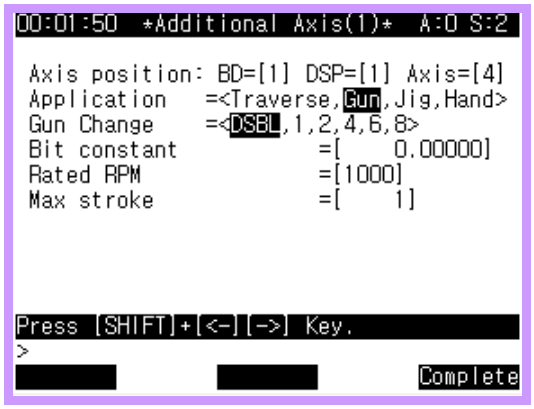


(3) Set servo parameter for gun no.1 (servo gun no.1) through additional axis constant setting.

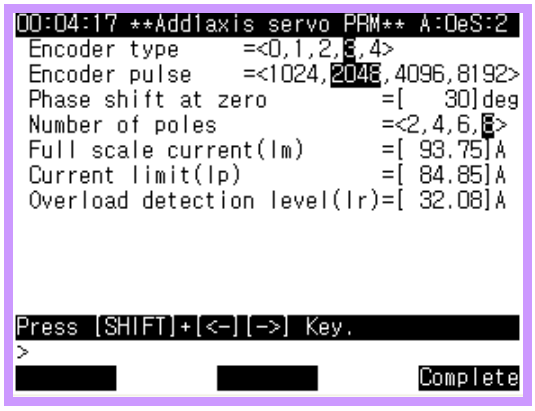




(4) Set number of servo gun changes. (Set servo welding gun change as available.)
Input number of servo gun changes in number of gun changes. Bit constant, rated rotation speed and maximum stroke are parameters for gun no.1 (servo gun 1). Supported number of changes is different according to the main software version, and “Gun Change” Setting screen may be different from the following.



(5) Set additional axis servo parameters after Setting is completed.
All parameters including AMP type and AMP maximum current are set as parameters for gun no.1 (servo gun 1).



(6) Complete initialization Setting. Turn the power on to restart the system.

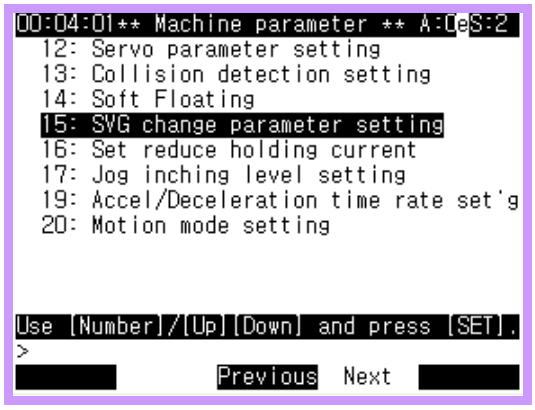
◆【CAUTION】◆

- After initialization, gun number and tool number are recognized as connected to servo gun 1.
- If initialization is performed when a servo gun is not connected, encoder disconnection error(E105) occurs in a servo gun axis. In this case, set servo gun axis lock as ‘ENBL’ in condition Setting, turn the power on and disconnect the gun by using the servo gun manual disconnection function (R358.0).

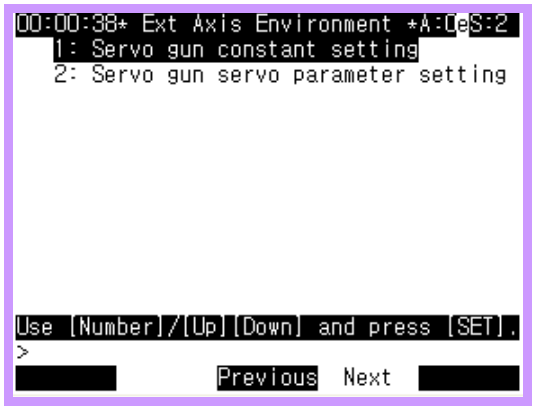
2.3.2. Servo Gun Change Parameter Setting

If number of gun changes is set in additional axis constant setting, servo parameters of servo gun and servo gun parameters can be set.

(1) Go to 『[PF2]: System』 → 『3: Machine parameter』 → 『15: SVG change parameter setting』.



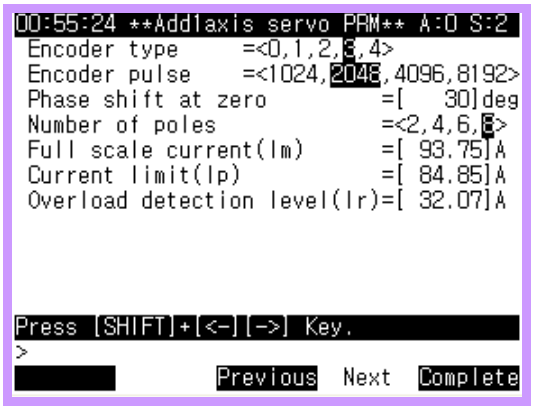
(2) 『1: Servo gun constant setting』 is for motor specification of the servo gun to be changed. 『2: Servo gun servo parameter setting』 is for servo parameter Setting.

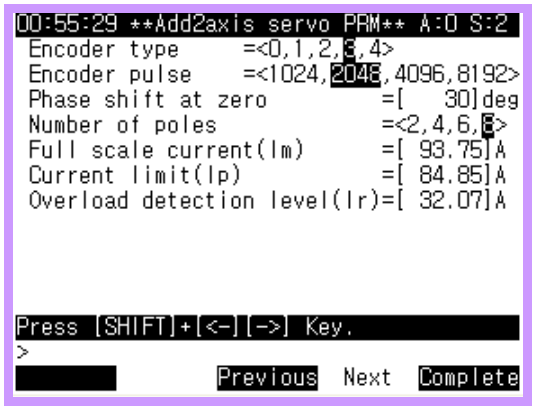


◆【CAUTION】◆

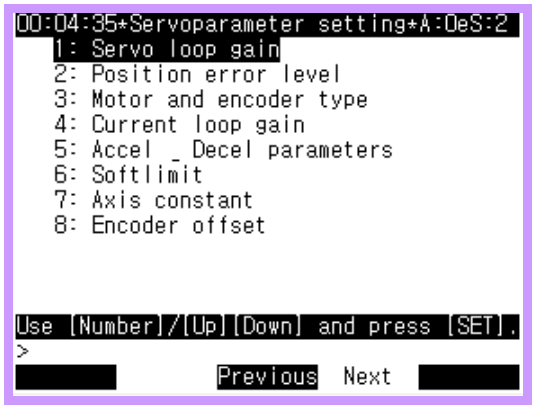
- Servo gun change parameters are indicated only when Engineer Code (R314) is inputted.
- Servo gun parameters not set in initialization should be set in servo gun change parameter Setting.

(3) Servo gun constant Setting
Integer constants for Gun1 is registered as the value already set in initialization. Set servo gun integer constants for the other servo guns by using [PF4] or [PF3]. After Setting, press [PF5].





(4) Servo gun servo parameter Setting
When each sub menu is selected, servo parameters as many as the number of servo gun changes and servo parameters for each servo gun can be set up.

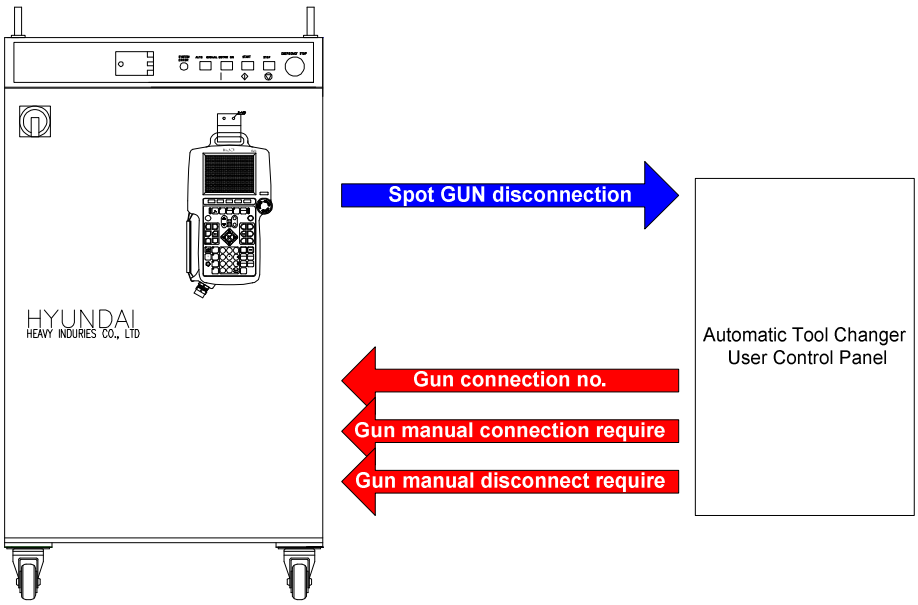


◆【CAUTION】◆

- Set values of soft limit, axis integer and encoder offset are indicated. Only parameters of currently connected servo guns can be changed.

- Parameter Setting as seen above is also possible in the sub menu under 『3: Machine parameter』. After connecting a servo gun of appropriate gun number, go to 『[PF2]: System』 → 『3: Machine parameter』.

2.3.3. Input/output Signal Assignment



(1) Input/output signal use

- Spot gun disconnection
  This signal outputs the state of welding gun whose electric signals such as encoder power and motor current are all off. Mechanical separation of welding gun is made possible by this signal.

- **Gun connection no.**
  This signal is an input signal which informs the gun number to be connected from outside to the controller. This signal is used when the manual connection function through an external input signal is in use or when gun number is set as 0 in GUNCHNG command.

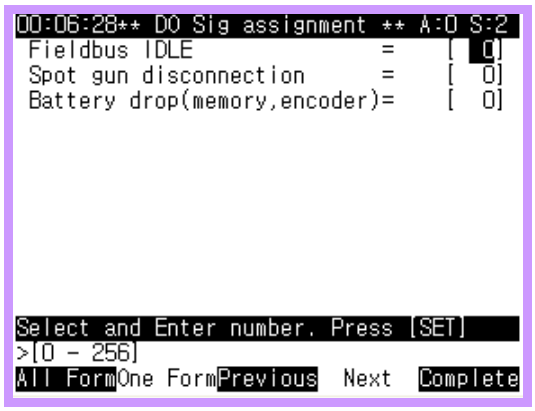
- **Gun manual connection require**
  In the manual mode, when ON signal is inputted in I/O allotted to this number, the process of welding gun connection begins. This signal has the same function as R358,1.

- **Gun manual disconnect require**
  In the manual mode, when ON signal is inputted in I/O allotted to this number, the process of welding gun disconnection begins. This signal has the same function as R358,0.

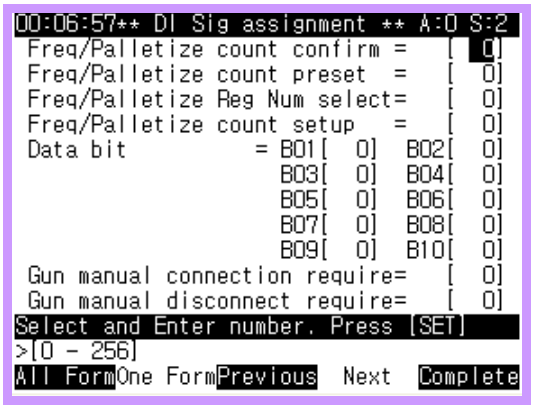
◆【CAUTION】◆

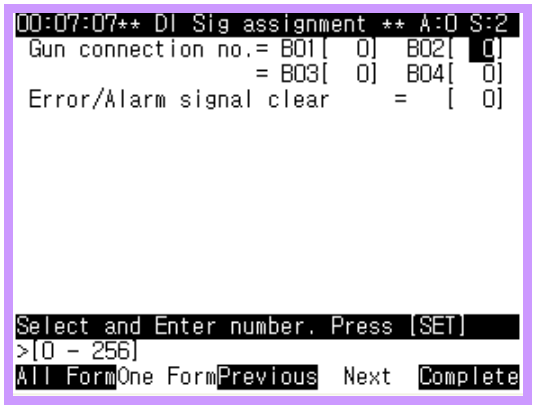
- Gun manual connection require signal can be used after welding gun selection signal is inputted.

(2) Output signal Assignment
Go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: DIO Setting input & output signal』 → 『6: Output signal assigning』. Allot 『Spot gun disconnection』 signal by using [PF4].



(3) Input signal Assignment
Go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: DIO Setting input & output signal』 → 『7: Input signal assigning』.
The following screen appears. Choose a spot gun selection signal among 'Gun manual connection require,' 'Gun manual disconnect require' and 'Gun connection no.' and assign it. Then press 『[PF5] Complete』.



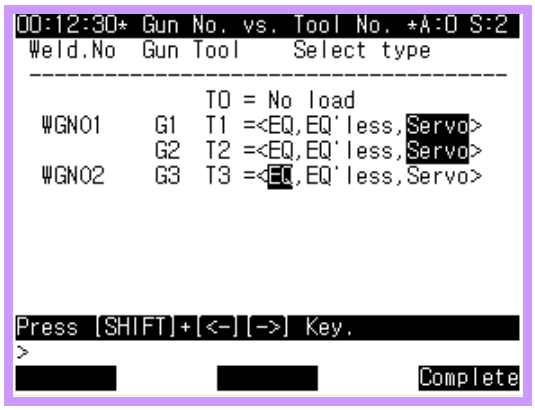


2.3.4. Gun Number and Tool Number Correspondence

(1) Go to 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『2: Servo Gun Parameter』 → 『9: Gun No. vs. Tool No.』.

(2) 『Gun No. vs. Tool No』's item number can be different according to main software version.

(3) T0 is indicated when a gun is separated. Gun numbers and tool numbers are correspondent one to one. The following screen may be different, because supported gun type differs according to the number of servo gun changes.



◆【CAUTION】◆

- Allot signal to G1 area for input/output signal Assignment, because servo guns use welding series 1.
- Allot signal to G2 area for input/output signal Assignment, because Air guns use welding series 2.
- Signal Assignment is not necessary for hanger, because hanger is not relevant to welding series.

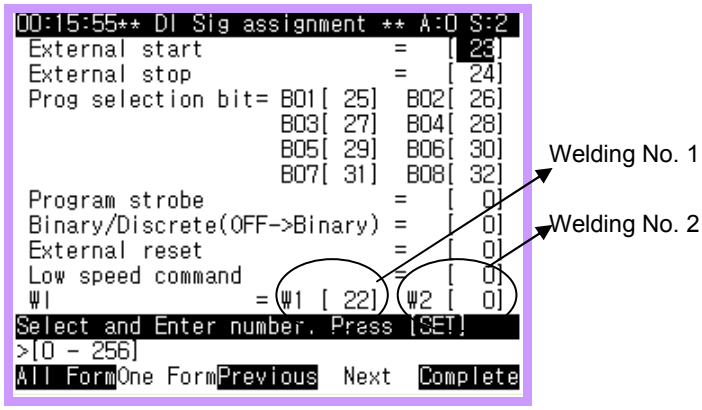
2.3.5. Welding Series Number (WGNO)

(1) Welding series number is input/output signal series for welding. When servo gun change is available, WGNO1 is used for servo guns and WGNO2. For example, if number of gun changes is six, G1~G6 for servo gun change use WGNO1 and Air gun G7 uses WGNO2.

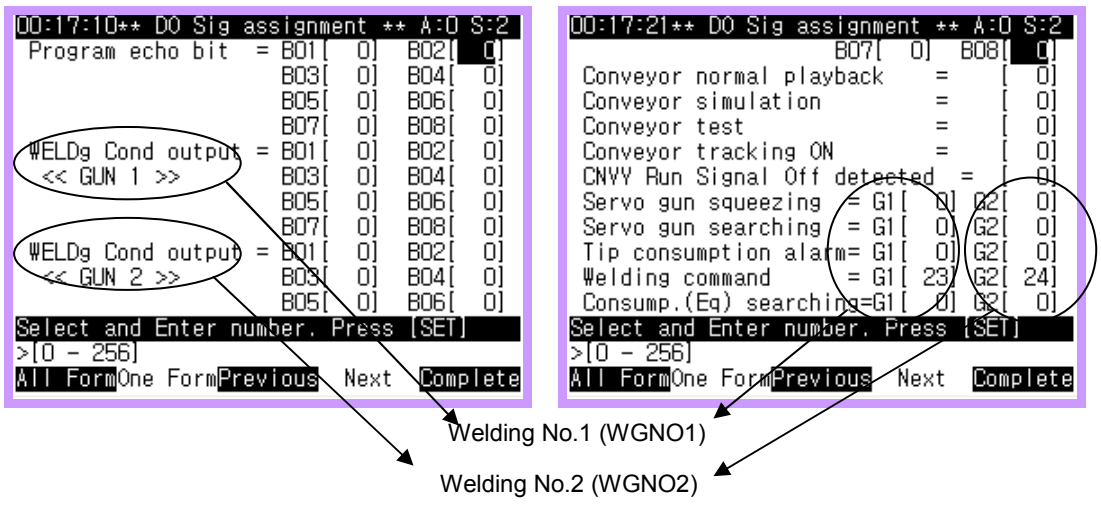
(2) Welding series is port section which provides gun pressure/current output, welding completion (WI) input and welding condition output. When WI common use is available, only welding series1 (W1) is used. (Go to 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『1: Air-gun welding data』. 『WI Common Use = Enable』 is under 『1: Air-gun welding data』.

(3) When input/output signal is allotted, G1 means WGNO1 and G2 means WGNO2.

- Input signal assigning



- Output signal assigning

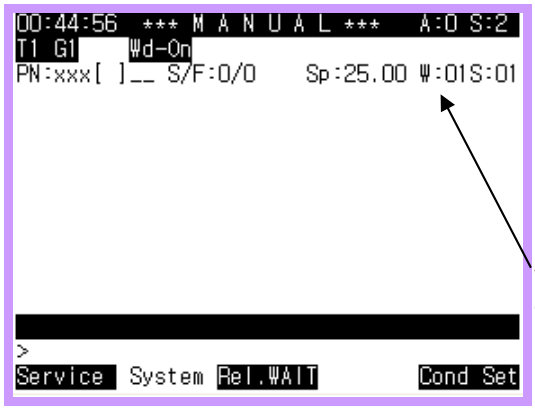


2.3.6. Air gun Data Output

In welding gun change, Air gun output signal can be operated manually or automatically.

(1) Manual output

- Welding condition signal: In welding gun change, welding condition manual output (R204) cannot be operated. This signal is simultaneously outputted when GUN manual output is operated. The welding condition number is appointed in output data under 『3: Servo Gun Welding Data (Condition, Sequence)』. (Go to 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『3: Servo-gun welding data(Cnd,Seq)』.) Number of welding condition data buffers are 64 in total. Currently selected buffer number is indicated on the upper screen (『W:01』). The following is the order to set this number manually: go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『11: f-key setting』.



- Mx2 (two-stage stroke) signal: Mx2 user key and output signal are allotted. To allot Mx2 user key, go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『11: f-key setting』. To allot output signal, go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『1: DIO Signal Attribute』 → 『6: Output signal assigning』. Press [Shift] on the teach pendant and allotted f key (Mx2) at the same time to turn on the output signal. If the keys are pressed again, output signal will be turned off.

- GUN pressure signal: GUN pressure signal and Air gun welding data are set up. To allot a number to GUN pressure output signal, go to 『[PF2]: System』 → 『2: Controller Parameter』 → 『**1: Input signal logic or 3: Output signal attribute**』 → 『6: Output signal assigning 』. To set welding data in GUN2, go to 『[PF2]: System』 → 『4: Application Parameter』 → 『1: Spot & Stud』 → 『1: Air-gun welding data』. Press [Shift] and [GUN] on the teach pendant at the same time to turn on the output signal. If the keys are pressed again, output signal will be turned off. Welding condition signal is also outputted at this point.

(2) Automatic operation output

- Welding condition signal: Condition number of welding condition buffer number set in the SPOT function is outputted.
- Mx2 signal: Mx2 signal is outputted as on or off according to the option state set in step (Move command). To record Mx2, press f key already allotted (LED light will be on), and then “Record” key. Then, Mx2 will be automatically recorded as output option of step.
- GUN pressure signal: When SPOT function is operated with Air guns, GUN pressure signal is turned on in welding series 2 (G2). After welding is completed (WI signal), GUN pressure signal is turned off. At this point, welding condition signal is also outputted in sync.

3

Manual Gun Connection/Disconnection (Tool Number Change)

This function is used for manual gun connection and disconnection in the manual mode. When servo welding gun change is available, tool numbers can be changed by manual gun connection/disconnection.

This function provides two means. When users want to connect/disconnect by manipulating the teaching pendant, R code is used. When users want to connect/disconnect by external input signal, connection/disconnection is possible after input signal Assignment.

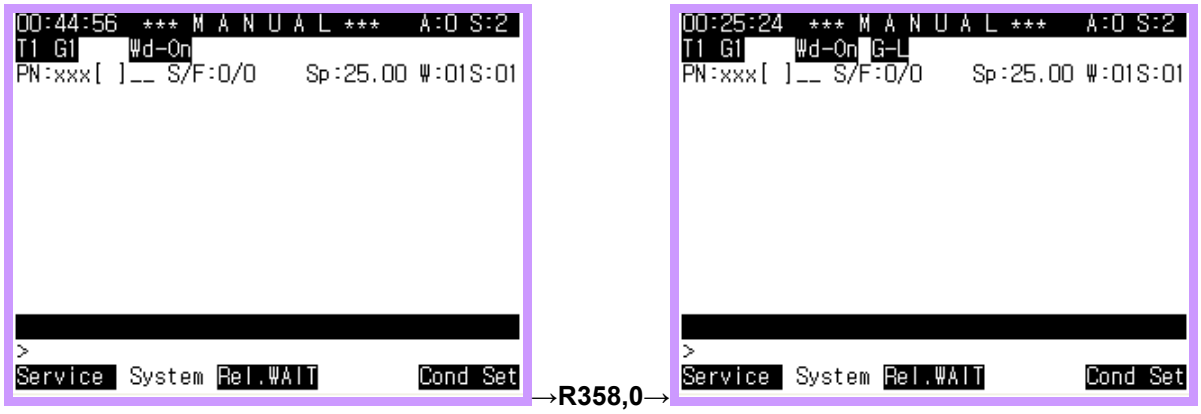
3.1. R358

To change welding gun number (tool number when servo welding gun change is available), R358 code is used when the motor (Enable switch on) is on in the manual mode. When the controller is initialized at the beginning, gun no.1 is set.

<table>
<tr><th>Operation</th><th>Parameter</th><th>#1</th><th>#2</th></tr>
<tr><td rowspan="3">R358,#1,#2</td><td>Meaning</td><td>Connection/
disconnection</td><td>Gun number</td></tr>
<tr><td>Set value</td><td>connection=1,
disconnection=0</td><td>Different according to the number of servo gun changes.
Same as the total number of welding gun changes</td></tr>
<tr><td rowspan="2">Example</td><td colspan="2">R358,1,2 (Gun no.2 is connected.)</td></tr>
<tr><td colspan="2">R358,0 (Gun is disconnected.)</td></tr>
</table>

Screen in case of disconnection

When guns are disconnected manually, gun number disappears on the screen and tool number is set as TO. Also, when servo guns are disconnected, the screen is changed to Gun Lock (G-L) state.



◆ 【CAUTION】 ◆

- Only after guns are disconnected, gun number can be changed.
- When servo gun is indicated as connected, if R358,1 is operated, error will occur. When servo gun is indicated as disconnected, if R358,0 is operated, error will occur.

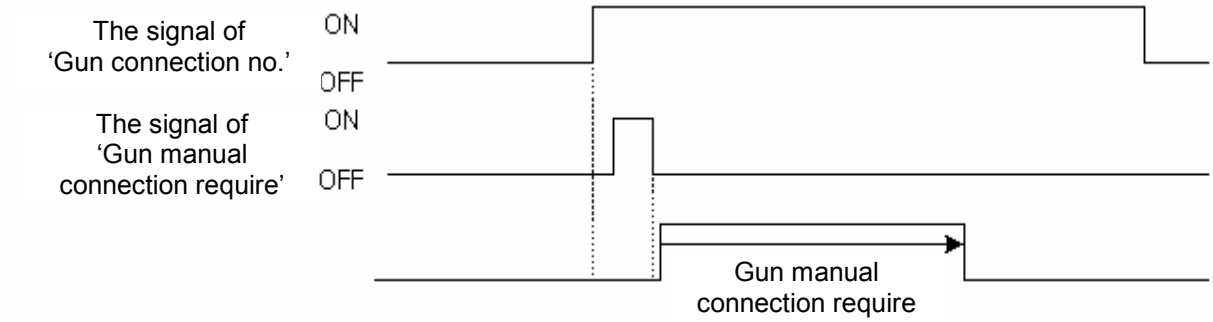
3.2. Connection/disconnection by External Signal

Input/output signal Assignment is prerequisite. Refer to 『2.2.3 Input/output Signal Assignment』 for signal Assignment.

3.2.1. Connection by External Signal

First, gun number should be inputted in input signal allotted to 'welding gun selection signal.'

When gun number is not inputted (0 is inputted) or gun number is bigger than the total number of welding gun changes, connection cannot be processed, even though 'gun manual connection request' is on.



3.2.2. Disconnection by External Signal

When output signal allotted to 'welding gun disconnection request' is converted from on to off, disconnection by external signal can be processed.

◆【CAUTION】◆

- Connection/disconnection by external signal can be processed when motor is on in the manual mode.

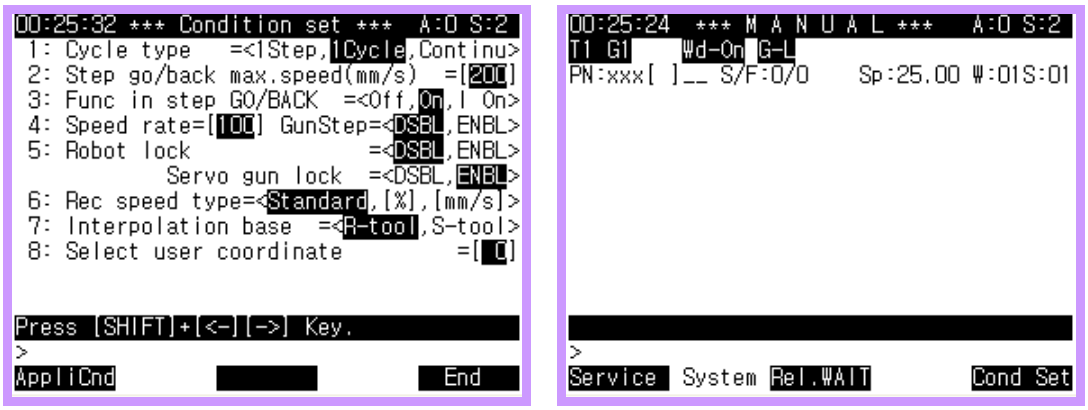
4
Gun Lock

4.1. Gun Lock Function

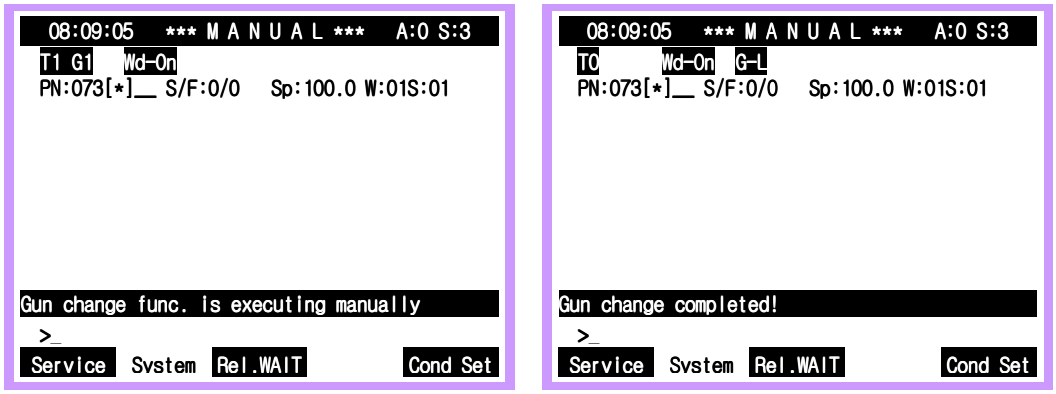
Gun lock means that servo is not controlled in servo gun axis. To use this function, servo gun change function should be available. Refer to 2.2.1. for gun change Setting.

4.1.1. Gun Lock Setting Change

(1) Condition Setting change
Gun lock manual Setting can be changed in condition Setting menu. Servo guns are recognized as connected, because gun numbers and tool numbers are maintained. However, servo of servo gun axis is turned off and servo gun axis manipulation becomes impossible.



(2) Gun connection/disconnection
When system performs servo gun disconnection command (R358,0 or GUNCHNG OFF), the state is automatically changed to gun lock. When system performs servo gun connection command, gun lock state ends.



4.1.2. Forced Tool Number Change

If controller recognizes a gun as attached although a gun is not attached to the system or if attached gun number is different from gun number on teaching pendant, gun should be disconnected first, and gun number and tool number should be changed. In case of initialization Setting or main board replacement, attached gun number may be different from gun number set in the controller.

- If error occurs in servo gun axis, because servo gun is not attached:

  ① Set servo gun axis lock as <Available> in condition Setting. Then G-L will be indicated on the upper screen.
  ② Turn the power on again.
  ③ Operate motors on. At this point, the servo gun motor is not operated, because it is in gun lock state.
  ④ Input R358,0 to forcibly disconnect the gun number set in the controller.

- If set servo gun number is different from attached servo gun:

  ① Set servo gun axis lock as <ENBL> in condition Setting. Then G-L will be indicated on the upper screen.
  ② Operate motors on. At this point, the servo gun motor is not operated, because it is in gun lock state.
  ③ Input R358,0 to forcibly disconnect the gun number set in controller.
  ④ Input R358,1,{Connected servo gun number}.
  ⑤ When the gun is connected normally, G-L on the upper screen will be cancelled and the gun number will be changed.

◆【CAUTION】◆

- R358 code is available only in the manual mode. When a Air gun number is connected, gun lock is not cancelled. Only when a servo gun is connected, gun lock is cancelled.

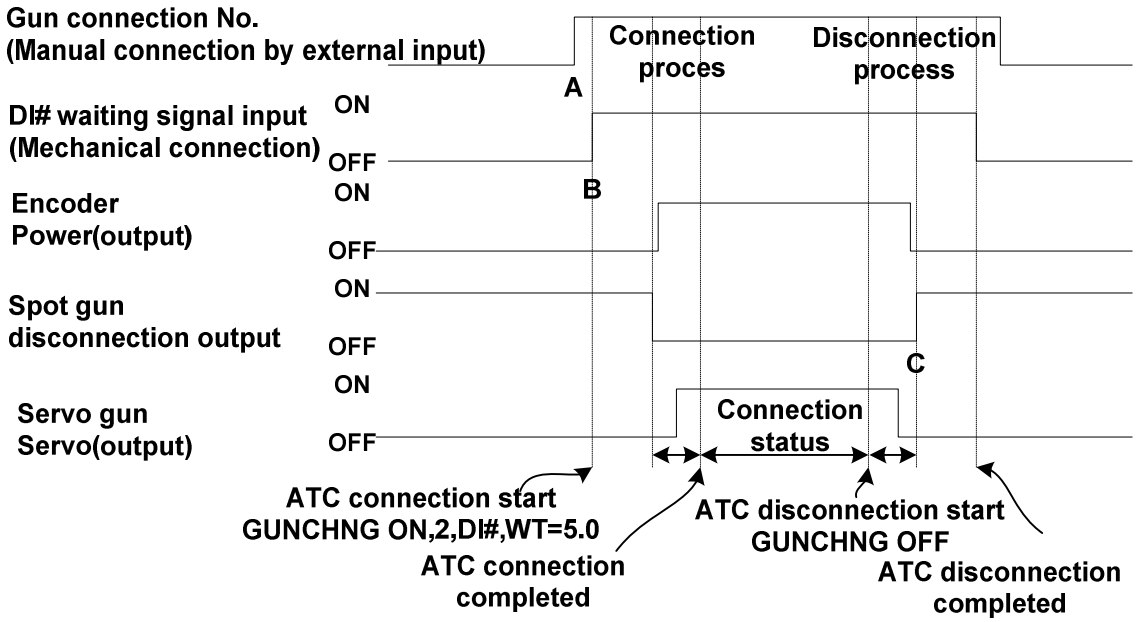
5
Program Teaching

Manual connection/disconnection function is used for welding gun change program teaching according to tool number and gun connection number. Robot language applied to the program is GUNCHNG.

5.1. GUNCHNG Command

<table>
<tr><th colspan="4">GUNCHNG ON/OFF, Gun number, Connection completion input, T=connection completion waiting time</th></tr>
<tr><td rowspan="2">ON/OFF</td><td>ON</td><td colspan="2">Gun connection command</td></tr>
<tr><td>OFF</td><td colspan="2">Gun disconnection command</td></tr>
<tr><td rowspan="3">Gun number</td><td>0</td><td colspan="2">Gun number selection by external input signal</td><td rowspan="4">Ignored parameters when GUNCHNG is off</td></tr>
<tr><td>Total number of welding gun changes</td><td colspan="2"><table><tr><th>Number of servo gun changes</th><th>Servo gun</th><th>Air gun</th></tr><tr><td>1</td><td>1</td><td>3</td></tr><tr><td>2</td><td>1~2</td><td>3</td></tr><tr><td>4</td><td>1~4</td><td>5</td></tr><tr><td>6</td><td>1~6</td><td>7</td></tr><tr><td>8</td><td>1~8</td><td>9</td></tr></table></td></tr>
<tr><td>Connection completion input</td><td>1~256</td><td colspan="2">Input signal number selection for servo gun mechanical connection completion</td></tr>
<tr><td colspan="2">Connection completion waiting time
<0~5.0> (sec)</td><td colspan="2">Waiting time until servo gun connection completion signal input, when a gun is connected.</td></tr>
</table>

5.2. Connection/Disconnection Timing



(1) Servo gun connection
In case of allotted external input gun number connection (GUNCHNG ON,GN=2,DI1), if servo gun number is inputted (A) and a robot and a servo gun are mechanically connected, connection completion signal is inputted (B) and connection is processed in the controller.

(2) Servo gun disconnection
In case that servo gun disconnection command (GUNCHNG OFF) is performed, servo gun disconnection is processed in the controller. Then, the controller sends welding gun disconnection output signal to automatic tool changer (ATC), and ATC allows mechanical gun disconnection.

5.3. Program Teaching Method

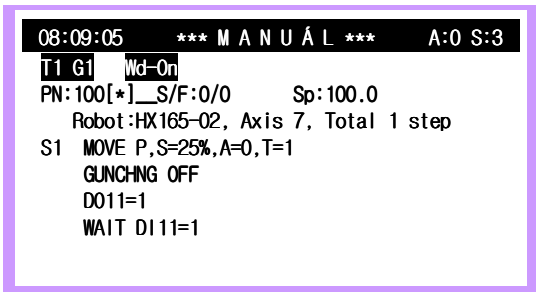
5.3.1. Welding Gun Disconnection (Tool Detachment)

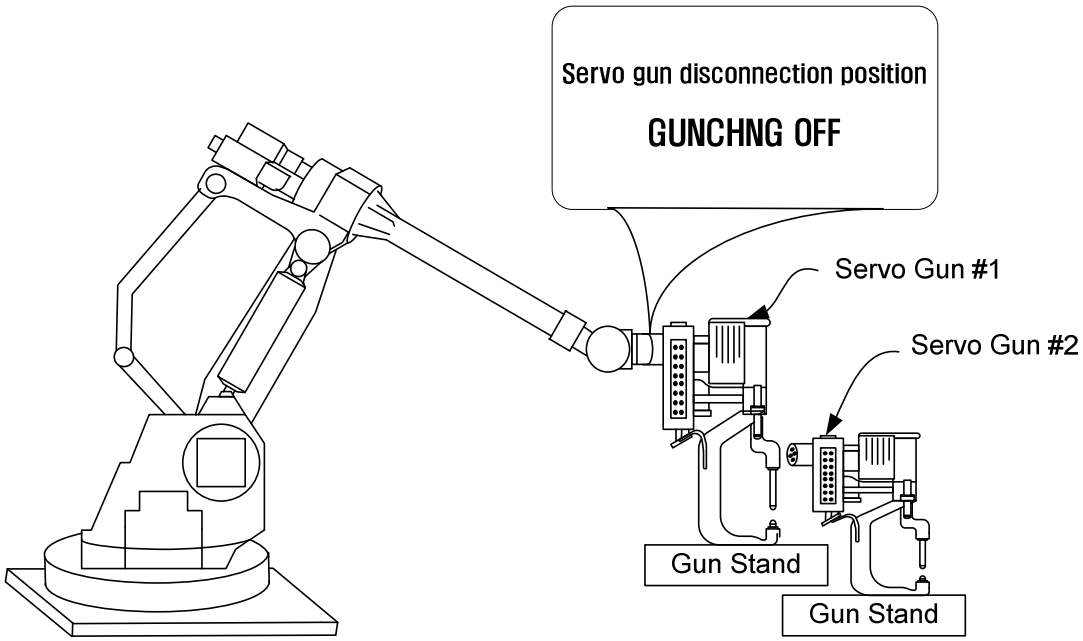
(1) Record step in welding gun disconnection position. (Step 1)

(2) Record GUNCHNG function in step 1.

(3) Record ATC Cam open signal.

(4) Record ATC Cam open completion input waiting.





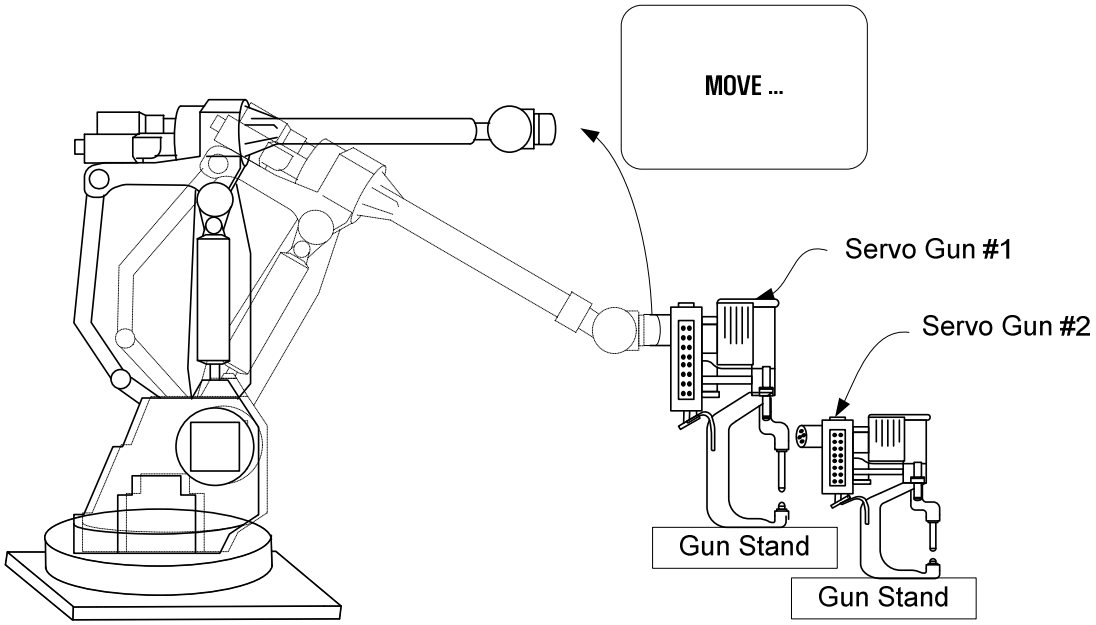
(5) Servo gun is manually disconnected. The following is the method.
Input R358,0 on the lower teaching pendant screen, and then G-L will appear on the upper screen.

(6) ATC Cam is manually disconnected by signal manual output. (For example, DO11=1)

(7) A robot is disconnected from a servo gun by orthogonal coordinates system jog. Disconnection position is recorded by linear interpolation (L).

```
08:09:05      *** M A N U Á L ***      A:0 S:3
TO        Wd-On    G-L
PN:100[*]__S/F:0/0        Sp:100.0
   Robot:HX165-02, Axis 7, Total 1 step
S1  MOVE P,S=25%,A=0,T=1
    GUNCHNG OFF
    DO11=1
    WAIT DI11=1
S2  MOVE L,S=300mm/s,A=0,T=0
```

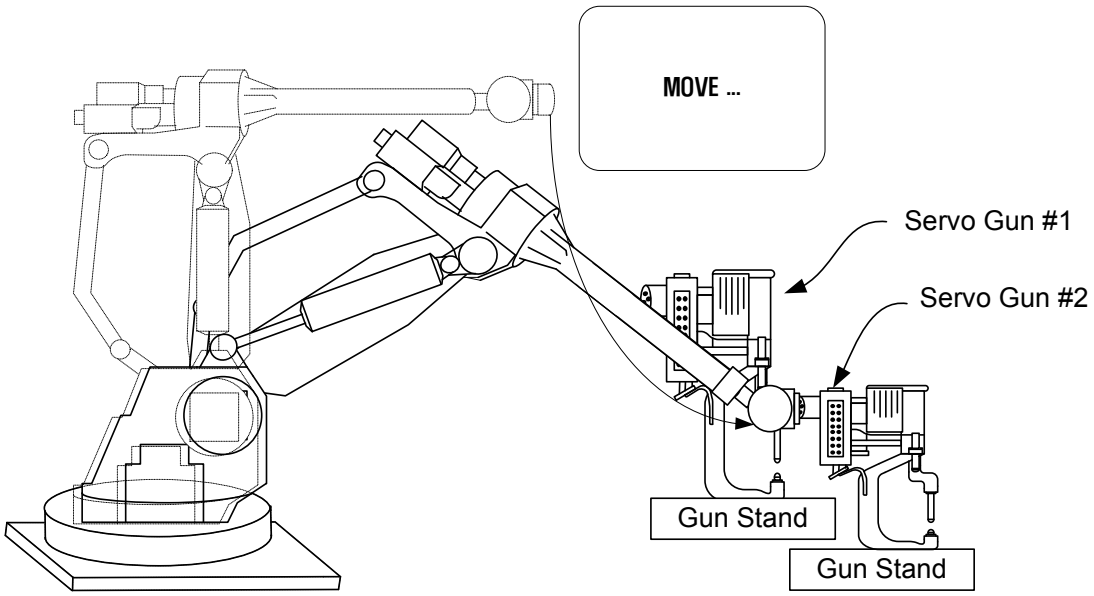
(8) Moving position of the robot is recorded.




```
08:09:05      *** M A N U A L ***      A:0 S:3
TO        Wd-On    G-L
PN:100[*]__S/F:0/0        Sp:100.0
   Robot:HX165-02, Axis 7, Total 1 step
S1  MOVE P,S=25%,A=0,T=1
    GUNCHNG OFF
    DO11=1
    WAIT DI11=1
S2  MOVE L,S=300mm/s,A=0,T=0
S3  ...
```

5.3.2. Welding Gun Connection (Tool Attachment)

(1) Move the robot to the position where welding guns can be connected. Teach passing points for connection.

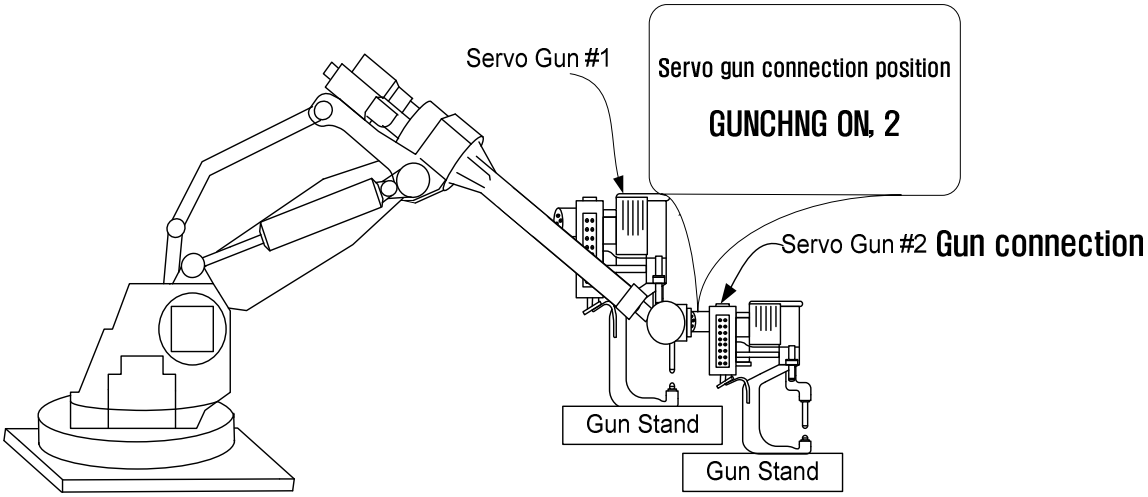


(2) Insert wait command until ATC connection available signal is inputted. (For example, the signal is allotted to input signal no.12.)

(3) Insert signal output command to close ATC Cam. (For example, DO11=0)

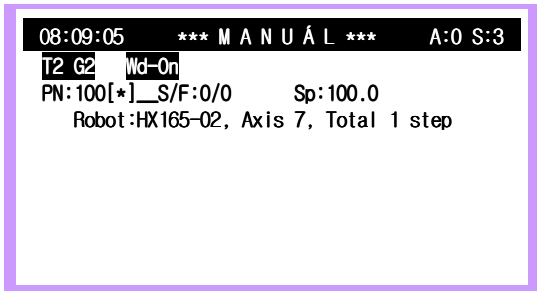
(4) Insert gun connection command in ATC connection position step of the gun.

```
08:09:05      *** M A N U Á L ***      A:0 S:3
TO        Wd-On    G-L
PN:100[*]__S/F:0/0       Sp:100.0
   Robot:HX165-02, Axis 7, Total 1 step
S1  MOVE P,S=25%,A=0,T=1
    GUNCHNG OFF
    DO11=1
    WAIT DI11=1
S2  MOVE L,S=300mm/s,A=0,T=0
S3  MOVE ...
S4  MOVE ...
S5  MOVE L,S=300mm/s,A=0,T=0
    WAIT DI12=1
    DO11=0
    GUNCHNG ON,GN=2,DI1
```

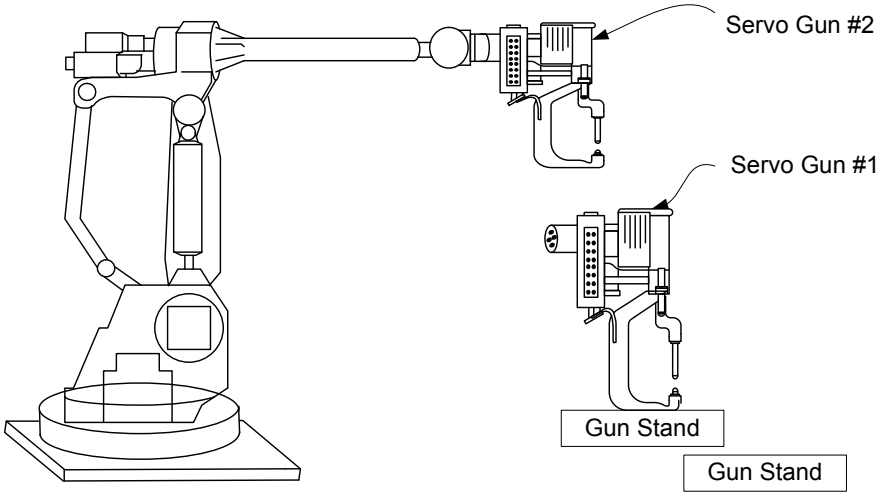


(5) Connect servo guns manually. (R358,1,2)

(6) Connect ATC Cam manually by using manual output signal. (For example, DO11=0) Gun lock is cancelled, and the state is changed to the one where Gun2 is connected.



(7) When Gun 2 is connected, teaching for Gun2 can start.



5.4. Program Teaching Examples

Connection/disconnection program		Command meaning	Note	Signal direction		
Step B	....	(Servo gun detachment position)		ROBOT		ATC
	GUNCHNG OFF	Servo gun disconnection sequence operation				
		Welding gun disconnection output	Exclusive output		→	
	DO11=1	ATC cam open (ON)			→	
	WAIT DI11	ATC cam open signal confirmation	Signal confirmation		←	
	MOVE L, ...	i				
	MOVE L, ...	Robot move				
	MOVE L, ...	i				
Step K		(Servo gun attachment position)				
	WAIT DI12	Attachment available signal confirmation			←	
	DO11=0	ATC cam close (OFF)			→	
	GUNCHNG ON,GN=1,DI1	Mechanical connection completion input			←	
		Servo gun connection process	GUNCHNG			
		i				
	MOVE L, ...	Robot move				

◆【CAUTION】◆

- GUNCHNG command includes ‘Connection Completion Input.’ Make sure that a gun to be changed is mechanically connected first, and connection completion signal is inputted in the controller.
- Exclusive output signal of GUNCHNG command and R358 is ‘Spot gun disconnection Output.’ This output signal can be used as open and close signal of the CAM of the ATC.

6

Servo Gun Change Program Playback

The method of servo gun change program's playback has the same method of general program.

6.1. Program Playback

(1) In the manual mode, turn the jog on and confirm the program by using step forward.

(2) If the program does not show any unusual state, operate the program in the auto mode.

7
Error

7.1. System Error

Code	E0210 Fail of Init. of SVG Connection
Cause	Initializing the servo gun connection failured as GUNCHNG ON is instructiond or manual welding gun connection is instructioned.
Action	Check the DSP version is higher than 4.13. In case of lower version, make contact with our company to upgrade. Check if ATC connection is poor or if encoder power is not applied.
Code	E0211 SVG Servo On fail in time limit
Cause	Servo of servo gun is not ON within the limit time.
Action	It is because ATC does not normally process encoder signal due to its poor connection. Remove any foreign matters from ATC, and try again.
Code	E0212 SVG's Servo filter clear is failed
Cause	Filter clear failed during servo gun connection.
Action	Communication is poor between main board and servo board. Check the connection between each board and controller. If no error is found, replace board.
Code	E0213 SVG Servo Off fail in time limit
Cause	Servo is not OFF within the limit time while separating the servo gun.
Action	Check the condition of ATC connection. Replace the servo board.
Code	E0214 SVG Encoder power is not connected
Cause	When processing the servo gun connection, the encoder power connection failed.
Action	Check errors in power control system of servo gun axis encoder, and replay the corresponding part(relay, BD481).
Code	E0215 SVG Encoder power off is failed
Cause	When separating the servo gun axis, encoder power separation failed.
Action	Check errors in power control system of servo gun axis encoder, and replay the corresponding part(relay, BD481).
Code	E0216 SVG Encoder data error
Cause	The result of encoder receiving is abnormal in the processing of servo gun axis connection.
Action	Check the followings on the connected servo gun. Check if encoder battery is discharged, and replace it if so. After replacing battery, reset encoder first before retry.(Be aware that encoder offset reset is required after encoder reset.)

7.2. Operation Error

Code	E1048 Gun connection number signal error
Cause	Gun connection number values are incorrectly selected in a welding gun manual/automatic connection by external input signal.
Action	Check the input value of gun connection number.

Code	E1049 Spot gun was already connected
Cause	Welding gun is not possible to operate with re-connection(GUNCHNG ON or manual connection) because welding gun has been already attached to system.
Action	Check the attaching condition of welding gun.

Code	E1050 Spot gun was already separated
Cause	Welding gun has been already separated from system, and GUNCHNG OFF instruction or manual separation has been used again.
Action	Check the attaching condition of welding gun

Code	E1051 Improper environment to gun change
Cause	GUNCHNG instruction or manual gun connection/separation is not operated in an environment for welding gun change.
Action	Reset the controller to welding gun change environment.

Code	E1052 Gun change time by manual is over
Cause	When performing the welding gun connection/separation instruction manually, the corresponding instruction fails to be completed wihin 5 seconds.
Action	Make contact with our company.

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