OTC DAIHEN Corporation

Almega AX series

INSTRUCTION MANUAL

WELDING INTERFACE
(DIGITAL)

	■ Read and follow these instructions and all safety blocks carefully. ■ Have only trained and qualified persons install, operate, or service this unit.
	■ Give this manual to the operator.
	■ For help, call your distributor.

DAIHEN Corporation

Be Sure to Read Instruction Manuals Before Use

Thank you for selecting DAIHEN arc welding robot Almega series.

Almega series are the robots with high performance and various functions developed by making full use of the latest technology. Since the knowledge of welding peculiar to a welding machine maker is applied to both hardware and software, we are sure that each user can be fully satisfied.

In order to use the superior performance and the abundant functions safely and fully, be sure to read the following instruction manuals including this manual and other attached documents, and understand the knowledge of the machines, safety information, and notes thoroughly.

Instruction manuals related to the manipulator, and the robot control unit are as follows.

■AX series Standard Manuals

Instruction Manual Type	Instruction Manual No.	Main Contents
INSTALLATION	1L8800A	Safety precautions, installing & connecting method, starting up, periodical inspection, solution at the time of failure
CONTROLLER MAINTENANCE/ STANDARD CONFIGURATIONS	1L8800B	Specifications of controller, explanation of each parts and maintenance, parts list, etc.
MANIPULATOR （AX-MV4AP/ MV6/ MV6L/ MV16/ MG3/ MH3/ MS3）	1L7700A	Specifications or maintenance of manipulator, parts list, etc.
MANIPULATOR (AX-MV50)	1L7721A	
MANIPULATOR (AX-MV133, MV166)	1L7722A	
MANIPULATOR (AX-MV160)	1L7723A	
BASIC OPERATIONS	1L8800C	Explanation of manual operation, teaching, automatic operation, file utilities, backing-up data, basic operations of Arc/Spot welding application, etc.
REFERENCE (Built-in Tutorial)	1L8800D	Basic operations, terms, explanations of Constants/Service menus, Details of function command, list of short-cut code, parts replacing procedure, trouble shooting, etc. ※ This manual is not provided as the paper manual, but is built in the robot as Help tutorial function.
EXTERNAL INPUT/OUTPUT	1L8800H	Interfacing method with external control device, list of I/O signals, start/halt the automatic operation, and usage of software PLC, etc.
CONTROLLER MAINTENANCE ADDENDUM (for AXCLN1/ AXCLL1)	1L9440B	Measures for safety, transportation, installation, and connection Controller's specification, maintenance for each parts, part list and others

■AX series Application Manuals

Instruction Manual Type	Instruction Manual No.	Main Contents
APPLICATION MANUAL (ARC WELDING)	1L8800F	Basic settings, functions for arc welding, teaching technic, etc.
APPLICATION MANUAL (HANDLING)	1L8800G	Basic settings, functions for handling, teaching technic, etc.
APPLICATION MANUAL (SPOT WELDING)	1L8800E	Basic settings, functions for spot welding, teaching technic, etc.

Instruction manuals are available other than the above for each optional function that you have purchased.

[Notes]
1. Specifications and information contained in these manuals are subject to change at any time without notice.
2. Optional hardware or software is necessary in order to use the function described as "Optional" in the manual.
3. The screen display of a teach pendant shown in the manual are described as examples, which may be different from the actual ones.
4. Although we cautiously compiled this standard specifications to eliminate as much error as possible, we do not take any responsibility for damages resulting from neither direct nor indirect errors.
5. The manual is a part of robot products.   When transferring or selling off a robot, be sure to append the manual.
6. No part of this manual may be reproduced without permission.
7. Prohibited altering or remodeling
   - Do not alter or remodel our products.
   - You may get injured or have your equipment damaged because of fire, failure or malfunction caused by altering or remodeling the product.
   The warranty does not cover any altered or remodeled products.

Notice

Notes on Safety

Before installation, operation, be sure to read "Chapter 1 Points on Safety" in INSTALLATION manual and other attached documents thoroughly and acquire all the knowledge of machines, safety information, and precautions.

Furthermore, before maintenance, inspection, and trouble scene, be sure to read CONTROLLER MAINTENANCE manual and MANIPULATOR manual and other attached documents thoroughly and acquire all the knowledge of machines, safety information, and precautions.

If operating machines in a wrong way, the accident resulting in various ranks of injury or death, or damage may occur.

In order to call attention to wrong handling, the following four ranks of safety notes ("DANGER", "WARNING", "CAUTION", and "IMPORTANT") are provided.

DANGER	Cases where a mistake made in handling is likely to cause the user to be exposed to the danger of death or serious injury and where the degree of the urgency (imminence) of the warning given for the danger to occur is at the high end of the scale (including high-level danger).
WARNING	Cases where a mistake made in handling is likely to cause the user to be exposed to the danger of death or serious injury.
CAUTION	Cases where a mistake made in handling is likely to cause the user to be exposed to the danger of minor injuries or of property damage only.

The following symbol is also used for particularly important checkpoints:

IMPORTANT   This is a particularly important checkpoint.

Note that even the matters which are described as **CAUTION** can result in serious accident depending on the conditions.
Be sure to keep the safety notes since they describe very important matters.

The meanings of "Serious injury", "Minor injury", and "Damage" described above are as follows.

Serious injury   :   Injury which has the aftereffect by loss of eyesight, an injury, the burn (high/low temperature), an electric shock, fracture, poisoning, etc. and that which requires hospitalization and long-term treatment as an outpatient.

Minor injury   :   Injury which does not require either hospitalization or long-term treatment as an outpatient, a burn (high temperature, low temperature), and an electric shock.

Damage   :   Direct and indirect damage in connection with damage of property and equipment.

Table of Contents

Chapter 4 Maintenance

Chapter 1   Introduction

This chapter provides a general description of Welding Interface (Digital).

1.1   Welding Interface (Digital)

When "Welding Interface (Digital)" is used, the latest Welbee Inverter series welding power source can be connected to an AXC controller using digital communication. Compared to Welding Interface (AXWF-10∗∗) that is connected using analog signals, many more welding parameters that are available in the Welbee Inverter series welding power source can be controlled by the robot controller. Also, various useful functions are available, such as the real-time monitoring of the welding current and voltage during welding.

When the interface is used, D series welding power sources shown in Table 1.2.3 that are connected to the AXC controller can be easily replaced with Welbee Inverter series welding power sources. In this case, you only need to adjust the welding conditions. You can continue using the existing programs and welding condition file.
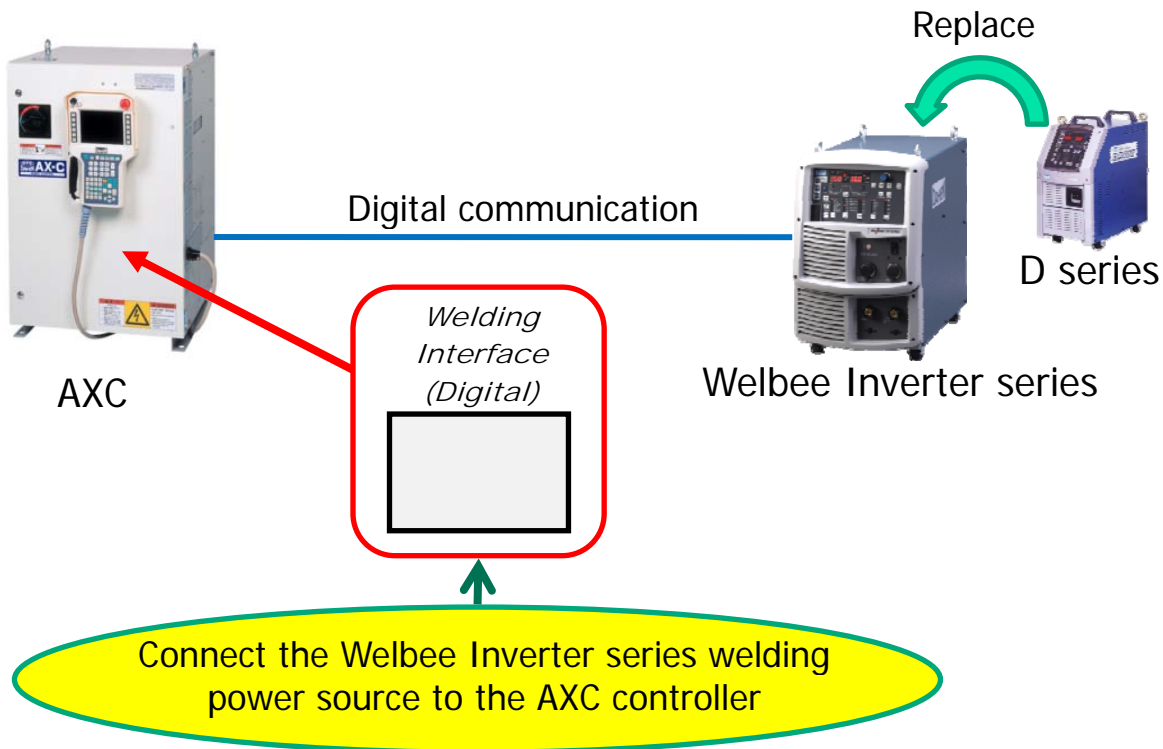
Figure 1.1.1   Overview of Welding Interface (Digital)

1.2 Main specifications

The interface is installed inside the AXC controller. The main specifications are as follows.

1.2.1 Hardware specifications

Table 1.2.1   Hardware specifications

Item	Specification
Product name	Welding Interface (Digital)
Part number	L22440A00
Input power supply (rated voltage)	DC24V ± 10%
Permissible operating temperature range	0 to 60℃, 20 to 80% RH (no condensation)
Permissible storage temperature range	-30 to 70℃, 10 to 90% RH (no condensation)
Communication interface	CAN, 2ch
USB port	1 port For USB memory (settings, maintenance) ∗ Operation is not guaranteed to work with a commercially available USB memory. Use the USB memory (parts number L21700U00) recommended by OTC.

1.2.2 Connectable robot controllers

The interface can be connected to an AXC controller. It cannot be used with robot controllers other than AXC robot controllers.

1.2.3 Connectable welding power sources

When the interface is used, the Welbee Inverter series welding power sources shown in Table 1.2.2 can be connected to the AXC controller. Up to 4 Welbee Inverter series welding power sources can be connected to the interface. These welding power sources are used by registering them in f5 <Arc Constant> - [1 Registration of welder] on the AXC controller as the welding power sources shown in "Configuration on the robot controller" in Table 1.2.2.

> **IMPORTANT**
> - Control software that supports the interface must be installed on the Welbee Inverter series welding power source that is connected to the interface. To confirm whether your welding power source is supported by the interface, check the software version of the welding power source, and then contact OTC's Service.
> - You can check the software version of the welding power source on the front panel.
>   For details, see the instruction manual of your welding power source.
> - D series welding power sources and Welbee Inverter series welding power sources cannot be used at the same time.

Table 1.2.2   Connectable welding power sources

| Connectable welding power sources | Configuration on the robot controller | |
	W.P.S.	Area
Welbee Inverter M350L (specifications for Japan)	DL *1	Japan
Welbee Inverter M350L (specifications for CCC)		
Welbee Inverter M350L (specifications for Asia)		
Welbee Inverter M350 (specifications for Japan)	DR *2	Japan
Welbee Inverter M350 (specifications for CCC)		
Welbee Inverter M350 (specifications for Asia)		
Welbee Inverter M500 (specifications for Japan)	DM *3	Japan
Welbee Inverter M500 (specifications for Asia)		
Welbee Inverter P350 (specifications for Japan)	DP *4	Japan
Welbee Inverter P500L (specifications for Japan)	DPR *5	Japan

*1 You can also use when set to DL or DL (S-2).
*2 Only when replacing an existing DM or DM(S-2) with the Welbee Inverter series, continue using DM or DM(S-2)
*3 You can also use when set to DM or DM(S-2).
*4 Apply the welding characteristic data for a rated current 350A when WB-P350 is in connection.
*5 Continue using DP as is only when the existing DP-500 is replaced with WB-P500L. Also, when using WB-P500L, a rated current 500A for WB-P500L is available at the maximum even if it is registered as DPR in the robot controller.

POINT — Welbee Inverter series welding power sources connected using the interface are handled by the AXC controller as the D series welding power sources shown in "Configuration on the robot controller" in Table 1.2.2 for operations and teaching.

If you replace an existing D series welding power source connected to the AXC controller with a Welbee Inverter series welding power source as shown in Table 1.2.3, you can continue to use the existing programs and welding condition file (however, you need to adjust the welding conditions).
To replace using Welding Interface (AXWF-10∗∗), you need to re-teach the arc start/end functions (AS/AE functions) (delete and re-teach the AS/AE functions), and re-create the welding condition file.

Table 1.2.3   Replacing the D series with the Welbee Inverter series

| Welding power source before replacement | | Welding power source after replacement | |
Welding power source	Area	Welding power source	Area
DM350	Japan	Welbee Inverter M350	Japan
DM350(S-2)	Japan		
DM350	Asia		Asia
DM500	Japan	Welbee Inverter M500	Japan
	Asia		Asia
DR350	Japan	Welbee Inverter M350	Japan
DL350	Japan	Welbee Inverter M350L	Japan
DL350 (S-2)	Japan		
DP350	Japan	Welbee Inverter P350	Japan
DP400R	Japan	Welbee Inverter P500L	Japan
DP500	Japan		

1.2.4 Available functions

Table 1.2.4 shows the functions related to welding that are available when a Welbee Inverter series welding power source is connected to the AXC controller using the interface.

Table 1.2.4　Available welding related functions

	Item	Availability
Standard functions	Welding condition setting	○*1
	TP arc monitor	○
	Online changes	○
	Arc monitor signal output	○
	Arc retry	○
	Check welding	○
	User check function	○
	Welding condition database	○
	Welding section batch shift	○
	AS function with V variable specification (ASV, ASMV)	○
	Welding characteristic data automatic adjustment	✕
	Arc restart	✕
Optional functions	PC arc monitor	○
	Twin synchro welding	○
	Arc sensor	○
	Multi-pass welding	○
	Welding mode option	✕
	Synchro MIG/FC-MIG	✕
	Servo torch	✕
	RS control	✕
	Robot RS control	✕
	Stitch pulse welding	✕
	Gas Saver GFC	✕

○: Available
✕: Not available

＊1: The items that can be set as welding conditions vary depending on the combination of the Welbee Inverter welding power sources to be connected and the welding power sources registered in the robot controller. For details, see "Chapter 3 Configurations".

IMPORTANT

- Even when a function is shown as available in the table above, it cannot be used if the function is not supported by the connected Welbee Inverter welding power source.
- Functions not shown in the table above cannot be used.

1.2.5 "Welding Interface (Digital) Setup" tool

To use Welding Interface (Digital), you must configure the interface settings on your computer using the "Welding Interface (Digital) Setup" tool. For details, see "Chapter 3 Configurations".
To use this software, your system environment must comply with Table 1.2.5.

Table 1.2.5   System Requirements

Item		Specifications	
Operating System	(Note 1)	Windows XP, Windows 7(32bit)	
Personal Computer	Model	IBM PC/AT compatible PC	
	CPU	Pentium III or higher processor (Pentium III 1 GHz or higher is recommended)	
	Memory	256 MB or more	
	Hard disk	More than 5 MB of available hard-disk space	
	Disc unit	CD-ROM drive is mounted.	
	USB port (Note 2)	One or more	
Display		1024 × 768 dots or more	
USB memory (Note 2)		Required	64 MB or more
		Recommended	USB memory (1GB) for external storage: L21700U00
CF card (Required for obtaining the backup data)		Required	64 MB or more
		Recommended	External storage CF (256 MB) for AXC: L9742U00
CF card reader		One or more (required for reading the backup data)	

(Note 1)   The product of our company develops and sells English version and Japanese version Windows as operation guarantee target OS. Please acknowledge not guaranteeing operation on other language versions Windows.

(Note 2)   For this interface, USB memory is required when writing the setup data onto the Welding Interface (Digital) board.

1.2.6   External view

Install the Welding Interface (Digital) board (Figure 1.2.1) inside the robot controller. For details on the installation method, see "Chapter 2 Connections".

Unit（mm）
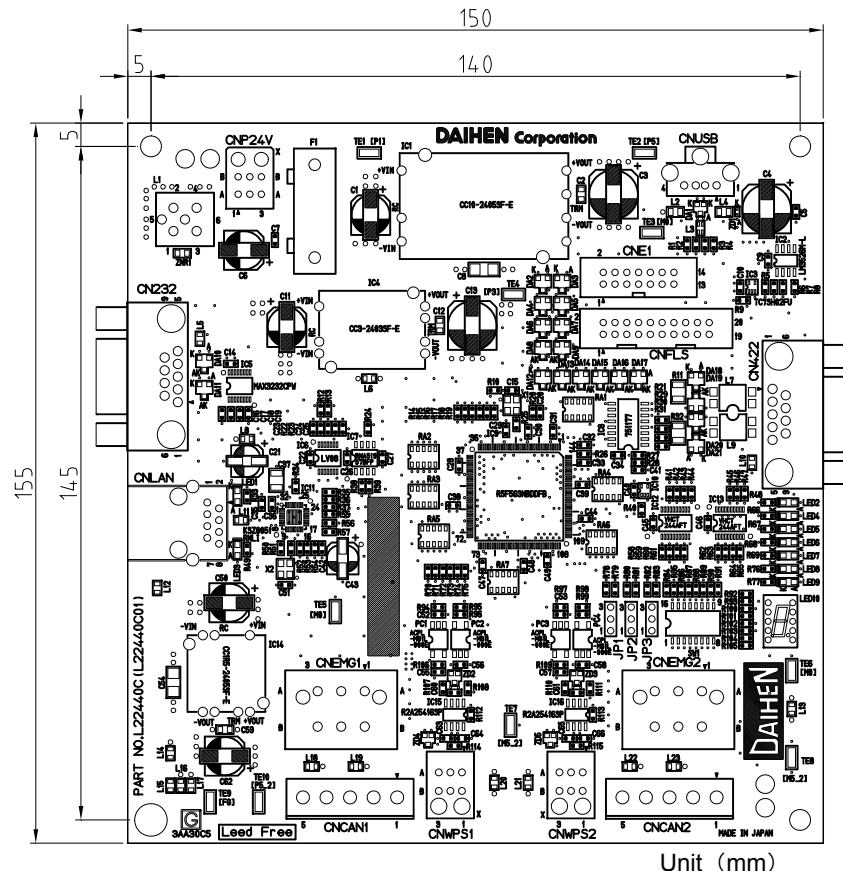
Figure 1.2.1   External view of Welding Interface (Digital) board

1.3 Standard configuration

This section describes the standard configuration for a system that performs robot welding using Welding Interface (Digital). For details on the basic configuration for the AX series and the optional products, see the AX series instruction manual "Controller Maintenance Manual".

1.3.1 Components of Robot controller/Welding power source Peripherals

Table 1.3.1 Configuration

Ref. No.	Parts Name		Model Type / Part number	Specifications
(1)	Welding Interface (Digital)		L22440A00	Refer to Table 1.2.1
		Welding Interface (Digital) board	L22440C00	Installed inside the robot controller
		Fuse (F1)	2171.25MXP (Parts number: 100-1742)	Rated 250V - 1.25A, UL, CSA, CCC certified product
		Communication cable	L22440E00	between Storage board and Welding Interface (Digital) board
		Power cable	L22440J00	for power supply 24V
(2)	Cable and hose		AXRB-4#**	# 1 : WB-M350 MV4AP, MV4LAP, MV6, MV6L, MV16, MG3 2 : WB-M350 MH3, MS3 4 : WB-M500/ WB-P500L※ MV4AP, MV4LAP, MV6, MV6L, MV16, MG3 5 : WB-M500 / WB-P500L※ MH3, MS3 6 : WB-M350L MV4AP, MV4LAP, MV6, MV6L, MV16, MG3 7 : WB-M350L MH3, MS3 D : WB-P500L MV4AP, MV4LAP, MV6, MV6L, MV16, MG3 E : WB-P500L MH3, MS3 ** 05 : Cable length 5m 10 : Cable length 10m 15 : Cable length 15m
(3)	Control cable 5		A2RB-52**	** 05 : Cable length 5m for Welbee Inverter 10 : Cable length 10m for Welbee Inverter 15 : Cable length 15m for Welbee Inverter
-	Voltage detecting cable (workpiece side)		L9509B00(5m)	L9509C00(10m), L9509D00(15m) for WB-M350L

※: When used for aluminum welding.

(2)
Gas hose

(2)
Control cable 4

Welding power
supply

(2)
Torch side welding
cable

(2)
Workpiece side
welding cable

(3)
Control cable 5

(1)
Welding Interface (Digital)

AX-C
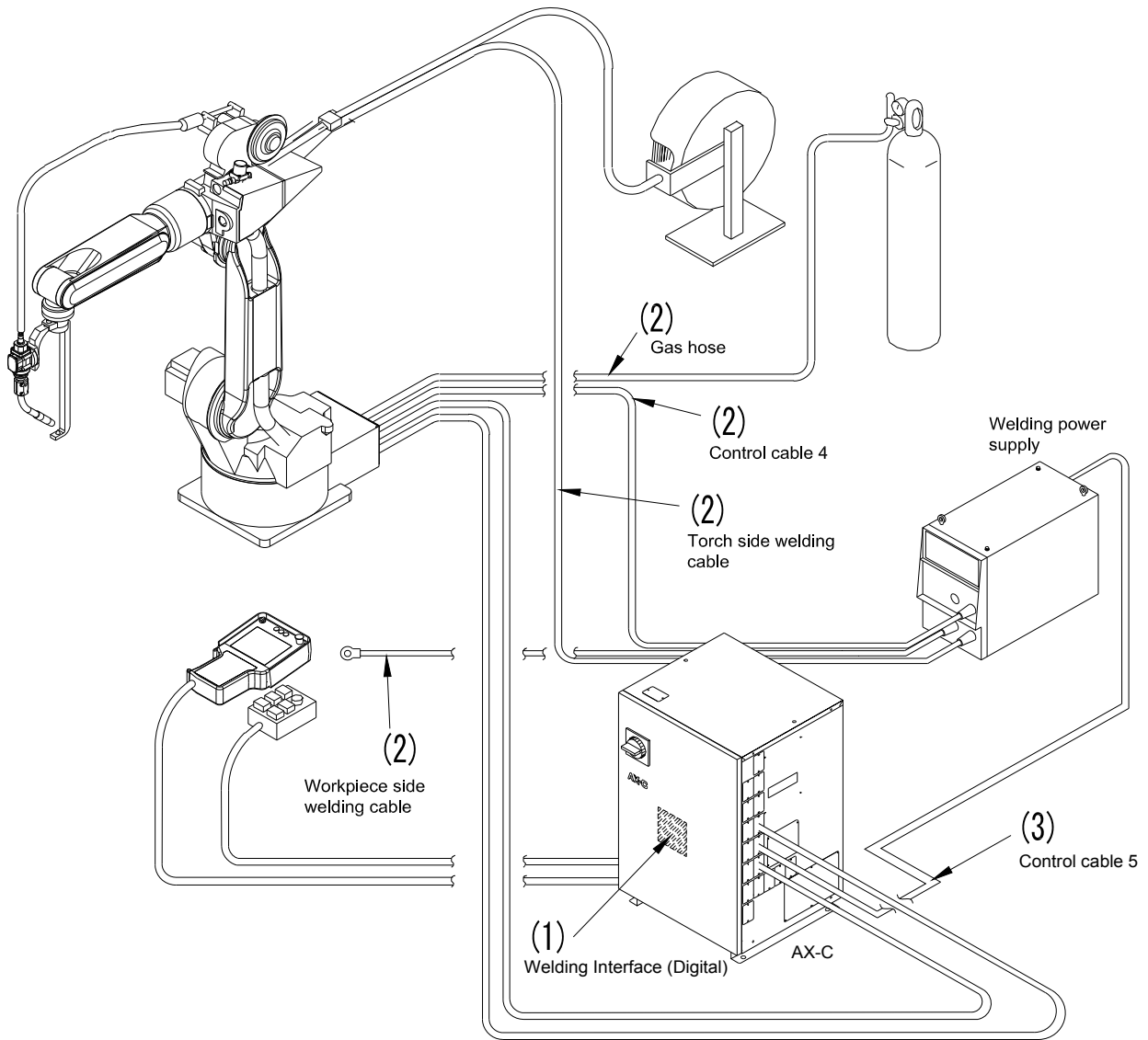
Figure 1.3.1   Components for Peripherals of Robot controller and Welding power source

1.4 Welding mode lists

The welding modes shown below can be used with a Welbee Inverter series welding power source that is connected to the robot controller using the interface.

1.4.1 Welding mode list of Welbee Inverter M350L

Table 1.4.1   Welbee Inverter M350L (specifications for Japan/CCC/Asia)

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC	CO2	Mild steel solid	0.8	Standard	350A Co2 DC φ0.8 (Low)	$WTBD1719
"	"	"	0.9	"	350A Co2 DC φ0.9 (Low)	$WTBD1720
"	"	"	1.0	"	350A Co2 DC φ1.0 (Low)	$WTBD1721
"	"	"	1.2	"	350A Co2 DC φ1.2 (Low)	$WTBD1722
"	"	Mild steel cored	1.2	"	350A Co2 DC φ1.2 (Cored) (Low)	$WTBD1724
"	"	"	1.4	"	350A Co2 DC φ1.4 (Cored) (Low)	$WTBD1725
"	"	SUS cored	0.9	"	350A Co2 DC φ0.9 SuS(Cored) (Low)	$WTBD1729
"	"	"	1.2	"	350A Co2 DC φ1.2 SuS(Cored) (Low)	$WTBD1730
"	MAG	Mild steel solid	0.8	"	350A Mag DC φ0.8 (Low)	$WTBD1732
"	"	"	0.9	"	350A Mag DC φ0.9 (Low)	$WTBD1733
"	"	"	1.0	"	350A Mag DC φ1.0 (Low)	$WTBD1734
"	"	"	1.2	"	350A Mag DC φ1.2 (Low)	$WTBD1735
"	MIG	SUS	0.8	"	350A Mig_4 DC φ0.8 SuS (Low)	$WTBD1736
"	"	"	0.9	"	350A Mig_4 DC φ0.9 SuS (Low)	$WTBD1737
"	"	"	1.0	"	350A Mig_4 DC φ1.0 SuS (Low)	$WTBD1738
"	"	"	1.2	"	350A Mig_4 DC φ1.2 SuS (Low)	$WTBD1739

1.4.2　Welding mode list of Welbee Inverter M350

Table 1.4.2　　Welbee Inverter M350 (specifications for Japan/CCC/Asia)

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC	CO2	Mild steel solid	0.8	High	350A Co2 DC φ0.8 (High)	$WTBD2000
〃	〃	〃	0.9	〃	350A Co2 DC φ0.9 (High)	$WTBD2001
〃	〃	〃	1.0	〃	350A Co2 DC φ1.0 (High)	$WTBD2002
〃	〃	〃	1.2	〃	350A Co2 DC φ1.2 (High)	$WTBD2003
〃	MAG	〃	0.8	〃	350A Mag DC φ0.8 (High)	$WTBD2004
〃	〃	〃	0.9	〃	350A Mag DC φ0.9 (High)	$WTBD2005
〃	〃	〃	1.0	〃	350A Mag DC φ1.0 (High)	$WTBD2006
〃	〃	〃	1.2	〃	350A Mag DC φ1.2 (High)	$WTBD2007
〃	MIG	SUS	0.8	〃	350A Mig_4 DC φ0.8 SuS (High)	$WTBD2008
〃	〃	〃	0.9	〃	350A Mig_4 DC φ0.9 SuS (High)	$WTBD2009
〃	〃	〃	1.0	〃	350A Mig_4 DC φ1.0 SuS (High)	$WTBD2010
〃	〃	〃	1.2	〃	350A Mig_4 DC φ1.2 SuS (High)	$WTBD2011
〃	CO2	Mild steel solid	0.8	Standard	350A Co2 DC φ0.8 (Low)	$WTBD2012
〃	〃	〃	0.9	〃	350A Co2 DC φ0.9 (Low)	$WTBD2013
〃	〃	〃	1.0	〃	350A Co2 DC φ1.0 (Low)	$WTBD2014
〃	〃	〃	1.2	〃	350A Co2 DC φ1.2 (Low)	$WTBD2015
〃	〃	Mild steel Cored	1.2	〃	350A Co2 DC φ1.2 (Cored) (Low)	$WTBD2016
〃	〃	〃	1.4	〃	350A Co2 DC φ1.4 (Cored) (Low)	$WTBD2017
〃	〃	SUS cored	0.9	〃	350A Co2 DC φ0.9 SuS(Cored) (Low)	$WTBD2018
〃	〃	〃	1.2	〃	350A Co2 DC φ1.2 SuS(Cored) (Low)	$WTBD2019
〃	MAG	Mild steel solid	0.8	〃	350A Mag DC φ0.8 (Low)	$WTBD2020
〃	〃	〃	0.9	〃	350A Mag DC φ0.9 (Low)	$WTBD2021
〃	〃	〃	1.0	〃	350A Mag DC φ1.0 (Low)	$WTBD2022
〃	〃	〃	1.2	〃	350A Mag DC φ1.2 (Low)	$WTBD2023
〃	MIG	SUS	0.8	〃	350A Mig_4 DC φ0.8 SuS (Low)	$WTBD2024
〃	〃	〃	0.9	〃	350A Mig_4 DC φ0.9 SuS (Low)	$WTBD2025
〃	〃	〃	1.0	〃	350A Mig_4 DC φ1.0 SuS (Low)	$WTBD2026
〃	〃	〃	1.2	〃	350A Mig_4 DC φ1.2 SuS (Low)	$WTBD2027
〃	CO2	Mild steel solid	0.8	Extension cable	350A Co2 DC φ0.8 (Low*)	$WTBD2028
〃	〃	〃	0.9	〃	350A Co2 DC φ0.9 (Low*)	$WTBD2029
〃	〃	〃	1.0	〃	350A Co2 DC φ1.0 (Low*)	$WTBD2030
〃	〃	〃	1.2	〃	350A Co2 DC φ1.2 (Low*)	$WTBD2031
〃	〃	Mild steel Cored	1.2	〃	350A Co2 DC φ1.2 (Cored) (Low*)	$WTBD2032
〃	〃	〃	1.4	〃	350A Co2 DC φ1.4 (Cored) (Low*)	$WTBD2033
〃	〃	SUS cored	0.9	〃	350A Co2 DC φ0.9 SuS(Cored) (Low*)	$WTBD2034
〃	〃	〃	1.2	〃	350A Co2 DC φ1.2 SuS(Cored) (Low*)	$WTBD2035
〃	MAG	Mild steel solid	0.8	〃	350A Mag DC φ0.8 (Low*)	$WTBD2036
〃	〃	〃	0.9	〃	350A Mag DC φ0.9 (Low*)	$WTBD2037
〃	〃	〃	1.0	〃	350A Mag DC φ1.0 (Low*)	$WTBD2038
〃	〃	〃	1.2	〃	350A Mag DC φ1.2 (Low*)	$WTBD2039
〃	MIG	SUS	0.8	〃	350A Mig_4 DC φ0.8 SuS (Low*)	$WTBD2040
〃	〃	〃	0.9	〃	350A Mig_4 DC φ0.9 SuS (Low*)	$WTBD2041
〃	〃	〃	1.0	〃	350A Mig_4 DC φ1.0 SuS (Low*)	$WTBD2042
〃	〃	〃	1.2	〃	350A Mig_4 DC φ1.2 SuS (Low*)	$WTBD2043

POINT

Use welding characteristic data with a "High" Travel speed as the welding characteristic data for Table 1.4.2. If the welding speed is low (generally, 50 cm/min or less) and the welding is unstable, use welding characteristic data with a "Standard" Travel speed.

Welding performance may become unstable when using the extended power cable depending on the layout condition of cables (when the total length exceeds 30m or the cable is coiled). In that case, voltage adjustment will normally bring about stable condition. However, use the welding characteristic data dedicated to "Extension cable" application if the welding performance is not yet stable.

1.4.3 Welding mode list of Welbee Inverter M500

Table 1.4.3   Welbee Inverter M500 (specifications for Japan)

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC	CO2	Mild steel solid	1.2	High	500A Co2 DC φ1.2 (High)	$WTBD2103
"	"	"	1.4	"	500A Co2 DC φ1.4 (High)	$WTBD2104
"	"	"	1.6	"	500A Co2 DC φ1.6 (High)	$WTBD2105
"	MAG	"	1.2	"	500A Mag DC φ1.2 (High)	$WTBD2109
"	"	"	1.4	"	500A Mag DC φ1.4 (High)	$WTBD2110
"	"	"	1.6	"	500A Mag DC φ1.6 (High)	$WTBD2111
"	MIG	SUS	1.2	"	500A Mig_4 DC φ1.2 SuS (High)	$WTBD2115
"	"	"	1.6	"	500A Mig_4 DC φ1.6 SuS (High)	$WTBD2116
"	CO2	Mild steel solid	1.2	Standard	500A Co2 DC φ1.2 (Low)	$WTBD2120
"	"	"	1.4	"	500A Co2 DC φ1.4 (Low)	$WTBD2121
"	"	"	1.6	"	500A Co2 DC φ1.6 (Low)	$WTBD2122
"	"	Mild steel solid	1.2	"	500A Co2 DC φ1.2 (Cored) (Low)	$WTBD2124
"	"	"	1.4	"	500A Co2 DC φ1.4 (Cored) (Low)	$WTBD2125
"	"	"	1.6	"	500A Co2 DC φ1.6 (Cored) (Low)	$WTBD2126
"	"	SUS cored	1.2	"	500A Co2 DC φ1.2 SuS(Cored) (Low)	$WTBD2127
"	"	"	1.6	"	500A Co2 DC φ1.6 SuS(Cored) (Low)	$WTBD2128
"	MAG	Mild steel solid	1.2	"	500A Mag DC φ1.2 (Low)	$WTBD2132
"	"	"	1.4	"	500A Mag DC φ1.4 (Low)	$WTBD2133
"	"	"	1.6	"	500A Mag DC φ1.6 (Low)	$WTBD2134
"	MIG	SUS	1.2	"	500A Mig_4 DC φ1.2 SuS (Low)	$WTBD2138
"	"	"	1.6	"	500A Mig_4 DC φ1.6 SuS (Low)	$WTBD2139
"	CO2	Mild steel solid	1.2	Extension cable	500A Co2 DC φ1.2 (Low*)	$WTBD2140
"	"	"	1.4	"	500A Co2 DC φ1.4 (Low*)	$WTBD2141
"	"	"	1.6	"	500A Co2 DC φ1.6 (Low*)	$WTBD2142
"	"	Mild steel Cored	1.2	"	500A Co2 DC φ1.2 (Cored) (Low*)	$WTBD2143
"	"	"	1.4	"	500A Co2 DC φ1.4 (Cored) (Low*)	$WTBD2144
"	"	"	1.6	"	500A Co2 DC φ1.6 (Cored) (Low*)	$WTBD2145
"	"	SUS cored	1.2	"	500A Co2 DC φ1.2 SuS(Cored) (Low*)	$WTBD2146
"	"	"	1.6	"	500A Co2 DC φ1.6 SuS(Cored) (Low*)	$WTBD2147
"	MAG	Mild steel solid	1.2	"	500A Mag DC φ1.2 (Low*)	$WTBD2148
"	"	"	1.4	"	500A Mag DC φ1.4 (Low*)	$WTBD2149
"	"	"	1.6	"	500A Mag DC φ1.6 (Low*)	$WTBD2150
"	MIG	SUS	1.2	"	500A Mig_4 DC φ1.2 SuS (Low*)	$WTBD2151
"	"	"	1.6	"	500A Mig_4 DC φ1.6 SuS (Low*)	$WTBD2152

POINT

Use welding characteristic data with a "High" Travel speed as the welding characteristic data for Table 1.4.3. If the welding speed is low (generally, 50 cm/min or less) and the welding is unstable, use welding characteristic data with a "Standard" Travel speed.

Welding performance may become unstable when using the extended power cable depending on the layout condition of cables (when the total length exceeds 30m or the cable is coiled). In that case, voltage adjustment will normally bring about stable condition. However, use the welding characteristic data dedicated to "Extension cable" application if the welding performance is not yet stable.

1.4.4 Welding mode list of Welbee Inverter P350

Table 1.4.4   Welbee Inverter P350 (specifications for Japan)

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC	CO2	Mild steel solid	0.8	High	350A Co2 DC φ0.8(High)	$WTBD2400
"	"	"	0.9	"	350A Co2 DC φ0.9(High)	$WTBD2401
"	"	"	1.0	"	350A Co2 DC φ1.0(High)	$WTBD2402
"	"	"	1.2	"	350A Co2 DC φ1.2(High)	$WTBD2403
"	MAG	Mild steel solid	0.8	"	350A Mag DC φ0.8(High)	$WTBD2408
"	"	"	0.9	"	350A Mag DC φ0.9(High)	$WTBD2409
"	"	"	1.0	"	350A Mag DC φ1.0(High)	$WTBD2410
"	"	"	1.2	"	350A Mag DC φ1.2(High)	$WTBD2411
"	MIG*	SUS	0.8	"	350A Mig_4 DC φφ0.8 SuS(High)	$WTBD2412
"	"	"	0.9	"	350A Mig_4 DC φ0.9 SuS(High)	$WTBD2413
"	"	"	1.0	"	350A Mig_4 DC φ1.0 SuS(High)	$WTBD2414
"	"	"	1.2	"	350A Mig_4 DC φ1.2 SuS(High)	$WTBD2415
"	"	Hard aluminum	1.0	"	350A Mig DC φ1.0 Hard Al(High)	$WTBD2416
"	"	"	1.2	"	350A Mig DC φ1.2 Hard Al(High)	$WTBD2417
"	"	"	1.6	"	350A Mig DC φ1.6 Hard Al(High)	$WTBD2418
"	"	Soft aluminum	1.2	"	350A Mig DC φ1.2 Soft Al(High)	$WTBD2419
"	"	"	1.6	"	350A Mig DC φ1.6 Soft Al(High)	$WTBD2420
DC pulsed	MAG	Mild steel solid	0.9	"	350A Mag DC-Pulse φ0.9(High)	$WTBD2421
"	"	"	1.0	"	350A Mag DC-Pulse φ1.0(High)	$WTBD2422
"	"	"	1.2	"	350A Mag DC-Pulse φ1.2(High)	$WTBD2423
"	MIG*	SUS	0.9	"	350A Mig_4 DC-Pulse φ0.9 SuS(High)	$WTBD2424
"	"	"	1.0	"	350A Mig_4 DC-Pulse φ1.0 SuS(High)	$WTBD2425
"	"	"	1.2	"	350A Mig_4 DC-Pulse φ1.2 SuS(High)	$WTBD2426
"	"	Hard aluminum	1.0	"	350A Mig DC-Pulse φ1.0 Hard Al(High)	$WTBD2427
"	"	"	1.2	"	350A Mig DC-Pulse φ1.2 Hard Al(High)	$WTBD2428
"	"	"	1.6	"	350A Mig DC-Pulse φ1.6 Hard Al(High)	$WTBD2429
"	"	Soft aluminum	1.2	"	350A Mig DC-Pulse φ1.2 Soft Al(High)	$WTBD2430
"	"	"	1.6	"	350A Mig DC-Pulse φ1.6 Soft Al(High)	$WTBD2431
DC	CO2	Mild steel solid	0.8	Standard	350A Co2 DC φ0.8(Low)	$WTBD2432
"	"	"	0.9	"	350A Co2 DC φ0.9(Low)	$WTBD2433
"	"	"	1.0	"	350A Co2 DC φ1.0(Low)	$WTBD2434
"	"	"	1.2	"	350A Co2 DC φ1.2(Low)	$WTBD2435
"	"	Mild steel Cored	1.0	"	350A Co2 DC φ1.0 (Cored) (Low)	$WTBD2436
"	"	"	1.2	"	350A Co2 DC φ1.2 (Cored) (Low)	$WTBD2437
"	"	SUS Cored	0.9	"	350A Co2 DC φ0.9 SuS(Cored) (Low)	$WTBD2438
"	"	"	1.2	"	350A Co2 DC φ1.2 SuS(Cored) (Low)	$WTBD2439
"	MAG	Mild steel solid	0.8	"	350A Mag DC φ0.8(Low)	$WTBD2440
"	"	"	0.9	"	350A Mag DC φ0.9(Low)	$WTBD2441
"	"	"	1.0	"	350A Mag DC φ1.0(Low)	$WTBD2442
"	"	"	1.2	"	350A Mag DC φ1.2(Low)	$WTBD2443
"	MIG*	SUS	0.8	"	350A Mig_4 DC φ0.8 SuS(Low)	$WTBD2444
"	"	"	0.9	"	350A Mig_4 DC φ0.9 SuS(Low)	$WTBD2445
"	"	"	1.0	"	350A Mig_4 DC φ1.0 SuS(Low)	$WTBD2446
"	"	"	1.2	"	350A Mig_4 DC φ1.2 SuS(Low)	$WTBD2447
"	"	Hard aluminum	1.0	"	350A Mig DC φ1.0 Hard Al(Low)	$WTBD2448
"	"	"	1.2	"	350A Mig DC φ1.2 Hard Al(Low)	$WTBD2449
"	"	"	1.6	"	350A Mig DC φ1.6 Hard Al(Low)	$WTBD2450
"	"	Soft aluminum	1.2	"	350A Mig DC φ1.2 Soft Al(Low)	$WTBD2451
"	"	"	1.6	"	350A Mig DC φ1.6 Soft Al(Low)	$WTBD2452

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC pulsed	MAG	Mild steel solid	0.9	″	350A Mag DC-Pulse φ0.9(Low)	$WTBD2453
″	″	″	1.0	″	350A Mag DC-Pulse φ1.0(Low)	$WTBD2454
″	″	″	1.2	″	350A Mag DC-Pulse φ1.2(Low)	$WTBD2455
″	MIG*	SUS	0.9	″	350A Mig_4 DC-Pulse φ0.9 SuS(Low)	$WTBD2456
″	″	″	1.0	″	350A Mig_4 DC-Pulse φ1.0 SuS(Low)	$WTBD2457
″	″	″	1.2	″	350A Mig_4 DC-Pulse φ1.2 SuS(Low)	$WTBD2458
″	″	Hard aluminum	1.0	″	350A Mig DC-Pulse φ1.0 Hard Al(Low)	$WTBD2459
″	″	″	1.2	″	350A Mig DC-Pulse φ1.2 Hard Al(Low)	$WTBD2460
″	″	″	1.6	″	350A Mig DC-Pulse φ1.6 Hard Al(Low)	$WTBD2461
″	″	Soft aluminum	1.2	″	350A Mig DC-Pulse φ1.2 Soft Al(Low)	$WTBD2462
″	″	″	1.6	″	350A Mig DC-Pulse φ1.6 Soft Al(Low)	$WTBD2463
DC	CO2	Mild steel solid	0.8	Extension cable	350A Co2 DC φ0.8(Low*)	$WTBD2464
″	″	″	0.9	″	350A Co2 DC φ0.9(Low*)	$WTBD2465
″	″	″	1.0	″	350A Co2 DC φ1.0(Low*)	$WTBD2466
″	″	″	1.2	″	350A Co2 DC φ1.2(Low*)	$WTBD2467
″	″	Mild steel Cored	1.0	″	350A Co2 DC φ1.0 (Cored) (Low*)	$WTBD2468
″	″	″	1.2	″	350A Co2 DC φ1.2 (Cored) (Low*)	$WTBD2469
″	″	SUS Cored	0.9	″	350A Co2 DC φ0.9 SuS(Cored) (Low*)	$WTBD2470
″	″	″	1.2	″	350A Co2 DC φ1.2 SuS(Cored) (Low*)	$WTBD2471
″	MAG	Mild steel solid	0.8	″	350A Mag DC φ0.8(Low*)	$WTBD2472
″	″	″	0.9	″	350A Mag DC φ0.9(Low*)	$WTBD2473
″	″	″	1.0	″	350A Mag DC φ1.0(Low*)	$WTBD2474
″	″	″	1.2	″	350A Mag DC φ1.2(Low*)	$WTBD2475
″	MIG*	SUS	0.8	″	350A Mig_4 DC φ0.8 SuS(Low*)	$WTBD2476
″	″	″	0.9	″	350A Mig_4 DC φ0.9 SuS(Low*)	$WTBD2477
″	″	″	1.0	″	350A Mig_4 DC φ1.0 SuS(Low*)	$WTBD2478
″	″	″	1.2	″	350A Mig_4 DC φ1.2 SuS(Low*)	$WTBD2479
″	″	Hard aluminum	1.0	″	350A Mig DC φ1.0 Hard Al(Low*)	$WTBD2480
″	″	″	1.2	″	350A Mig DC φ1.2 Hard Al(Low*)	$WTBD2481
″	″	″	1.6	″	350A Mig DC φ1.6 Hard Al(Low*)	$WTBD2482
″	″	Soft aluminum	1.2	″	350A Mig DC φ1.2 Soft Al(Low*)	$WTBD2483
″	″	″	1.6	″	350A Mig DC φ1.6 Soft Al(Low*)	$WTBD2484
DC wave pulsed	MAG	Mild steel solid	0.9	High	350A Mag DC-Wave φ0.9(High)	$WTBD2485
″	″	″	1.0	″	350A Mag DC-Wave φ1.0(High)	$WTBD2486
″	″	″	1.2	″	350A Mag DC-Wave φ1.2(High)	$WTBD2487
″	MIG*	SUS	0.9	″	350A Mig_4 DC-Wave φ0.9 SuS(High)	$WTBD2488
″	″	″	1.0	″	350A Mig_4 DC-Wave φ1.0 SuS(High)	$WTBD2489
″	″	″	1.2	″	350A Mig_4 DC-Wave φ1.2 SuS(High)	$WTBD2490
″	″	Hard aluminum	1.2	″	350A Mig DC-Wave φ1.2 Hard Al(High)	$WTBD2491
″	″	″	1.6	″	350A Mig DC-Wave φ1.6 Hard Al(High)	$WTBD2492
″	″	Soft aluminum	1.2	″	350A Mig DC-Wave φ1.2 Soft Al(High)	$WTBD2493
″	″	″	1.6	″	350A Mig DC-Wave φ1.6 Soft Al(High)	$WTBD2494
″	MAG	Mild steel solid	0.9	Standard	350A Mag DC-Wave φ0.9(Low)	$WTBD2495
″	″	″	1.0	″	350A Mag DC-Wave φ1.0(Low)	$WTBD2496
″	″	″	1.2	″	350A Mag DC-Wave φ1.2(Low)	$WTBD2497
″	MIG*	SUS	0.9	″	350A Mig_4 DC-Wave φ0.9 SuS(Low)	$WTBD2498
″	″	″	1.0	″	350A Mig_4 DC-Wave φ1.0 SuS(Low)	$WTBD2499
″	″	″	1.2	″	350A Mig_4 DC-Wave φ1.2 SuS(Low)	$WTBD2500
″	″	Hard aluminum	1.2	″	350A Mig DC-Wave φ1.2 Hard Al(Low)	$WTBD2501
″	″	″	1.6	″	350A Mig DC-Wave φ1.6 Hard Al(Low)	$WTBD2502
″	″	Soft aluminum	1.2	″	350A Mig DC-Wave φ1.2 Soft Al(Low)	$WTBD2503

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
"	"	"	1.6	"	350A Mig DC-Wave φ1.6 Soft Al(Low)	$WTBD2504

∗ : MIG gas defers in its mixing ratio depending on the wire material as below. For more details, refer to the instruction manial for welding power supply.

     When the wire material is a SUS/Ferrite   : Argon (Ar) 98% / Oxygen (O_2) 2%
     When the wire material is a Hard/Soft aluminum   : Argon (Ar) 100%

POINT   Use welding characteristic data with a "High" Travel speed as the welding characteristic data for Table 1.4.4. If the welding speed is low (generally, 50 cm/min or less) and the welding is unstable, use welding characteristic data with a " Standard " Travel speed.

Welding performance may become unstable when using the extended power cable depending on the layout condition of cables (when the total length exceeds 30m or the cable is coiled). In that case, voltage adjustment will normally bring about stable condition. However, use the welding characteristic data dedicated to "Extension cable" application if the welding performance is not yet stable.

1.4.5 Welding mode list of Welbee Inverter P500L

Table 1.4.5　Welbee Inverter P500L (specifications for Japan)

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
DC	CO2	Mild steel solid	0.8	High	500A Co2 DCφ0.8(High)	$WTBD2600
″	″	″	0.9	″	500A Co2 DC φ0.9(High)	$WTBD2601
″	″	″	1.0	″	500A Co2 DC φ1.0(High)	$WTBD2602
″	″	″	1.2	″	500A Co2 DC φ1.2(High)	$WTBD2603
″	″	″	1.4	″	500A Co2 DC φ1.4(High)	$WTBD2604
″	″	″	1.6	″	500A Co2 DC φ1.6(High)	$WTBD2605
″	MAG	Mild steel solid	0.8	″	500A Mag DC φ0.8(High)	$WTBD2613
″	″	″	0.9	″	500A Mag DC φ0.9(High)	$WTBD2614
″	″	″	1.0	″	500A Mag DC φ1.0(High)	$WTBD2615
″	″	″	1.2	″	500A Mag DC φ1.2(High)	$WTBD2616
″	″	″	1.4	″	500A Mag DC φ1.4(High)	$WTBD2617
″	″	″	1.6	″	500A Mag DC φ1.6(High)	$WTBD2618
″	MIG*	SUS	0.8	″	500A Mig_4 DC φ0.8 SuS(High)	$WTBD2619
″	″	″	0.9	″	500A Mig_4 DCφ0.9 SuS(High)	$WTBD2620
″	″	″	1.0	″	500A Mig_4 DCφ1.0 SuS(High)	$WTBD2621
″	″	″	1.2	″	500A Mig_4 DC φ1.2 SuS(High)	$WTBD2622
″	″	″	1.6	″	500A Mig_4 DC φ1.6 SuS(High)	$WTBD2623
″	″	Ferrite	0.8	″	500A Mig_4DC φ0.8 Ferrite(High)	$WTBD2624
″	″	″	0.9	″	500A Mig_4DC φ0.9 Ferrite(High)	$WTBD2625
″	″	″	1.0	″	500A Mig_4DC φ1.0 Ferrite(High)	$WTBD2626
″	″	″	1.2	″	500A Mig_4DC φ1.2 Ferrite(High)	$WTBD2627
″	″	Hard aluminum	1.0	″	500A Mig DC φ1.0 Hard Al(High)	$WTBD2628
″	″	″	1.2	″	500A Mig DC φ1.2 Hard Al(High)	$WTBD2629
″	″	″	1.6	″	500A Mig DC φ1.6 Hard Al(High)	$WTBD2630
″	″	Soft aluminum	1.2	″	500A Mig DC φ1.2 Soft Al(High)	$WTBD2631
″	″	″	1.6	″	500A Mig DC φ1.6 Soft Al(High)	$WTBD2632
DC pulsed	MAG	Mild steel solid	0.8	″	500A Mag DC-Pulse φ0.8(High)	$WTBD2649
″	″	″	0.9	″	500A Mag DC-Pulse φ0.9(High)	$WTBD2650
″	″	″	1.0	″	500A Mag DC-Pulse φ1.0(High)	$WTBD2651
″	″	″	1.2	″	500A Mag DC-Pulse φ1.2(High)	$WTBD2652
″	″	″	1.4	″	500A Mag DC-Pulse φ1.4(High)	$WTBD2653
″	″	″	1.6	″	500A Mag DC-Pulse φ1.6(High)	$WTBD2654
″	MIG*	SUS	0.8	″	500A Mig_4 DC-Pulseφ0.8 SuS(High)	$WTBD2655
″	″	″	0.9	″	500A Mig_4 DC-Pulseφ0.9 SuS(High)	$WTBD2656
″	″	″	1.0	″	500A Mig_4 DC-Pulseφ1.0 SuS(High)	$WTBD2657
″	″	″	1.2	″	500A Mig_4 DC-Pulse φ1.2 SuS(High)	$WTBD2658
″	″	″	1.6	″	500A Mig_4 DC-Pulse φ1.6 SuS(High)	$WTBD2659
″	″	Ferrite	0.8	″	500A Mig_4 DC-Pulse φ0.8 Ferrite(High)	$WTBD2660
″	″	″	0.9	″	500A Mig_4 DC-Pulse φ0.9 Ferrite(High)	$WTBD2661
″	″	″	1.0	″	500A Mig_4 DC-Pulse φ1.0 Ferrite(High)	$WTBD2662
″	″	″	1.2	″	500A Mig_4 DC-Pulse φ1.2 Ferrite(High)	$WTBD2663
″	″	Hard aluminum	1.0	″	500A Mig DC-Pulse φ1.0 Hard Al(High)	$WTBD2664
″	″	″	1.2	″	500A Mig DC-Pulse φ1.2 Hard Al(High)	$WTBD2665
″	″	″	1.6	″	500A Mig DC-Pulse φ1.6 Hard Al(High)	$WTBD2666
″	″	Soft aluminum	1.2	″	500A Mig DC-Pulse φ1.2 Soft Al(High)	$WTBD2667
″	″	″	1.6	″	500A Mig DC-Pulse φ1.6 Soft Al(High)	$WTBD2668
DC	CO2	Mild steel solid	0.8	Standard	500A Co2 DC φ0.8(Low)	$WTBD2671
″	″	″	0.9	″	500A Co2 DC φ0.9(Low)	$WTBD2672
″	″	″	1.0	″	500A Co2 DC φ1.0(Low)	$WTBD2673

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
〃	〃	〃	1.2	〃	500A Co2 DC φ1.2(Low)	$WTBD2674
〃	〃	〃	1.4	〃	500A Co2 DC φ1.4(Low)	$WTBD2675
〃	〃	〃	1.6	〃	500A Co2 DC φ1.6(Low)	$WTBD2676
〃	〃	Mild steel Cored	1.0	〃	500A Co2 DC φ1.0 (Cored) (Low)	$WTBD2677
〃	〃	〃	1.2	〃	500A Co2 DC φ1.2 (Cored) (Low)	$WTBD2678
〃	〃	〃	1.4	〃	500A Co2 DC φ1.4 (Cored) (Low)	$WTBD2679
〃	〃	〃	1.6	〃	500A Co2 DC φ1.6 (Cored) (Low)	$WTBD2680
〃	〃	SUS Cored	0.9	〃	500A Co2 DC φ0.9 SuS(Cored) (Low)	$WTBD2681
〃	〃	〃	1.2	〃	500A Co2 DC φ1.2 SuS(Cored) (Low)	$WTBD2682
〃	〃	〃	1.6	〃	500A Co2 DC φ1.6 SuS(Cored) (Low)	$WTBD2683
〃	MAG	Mild steel solid	0.8	〃	500A Mag DC φ0.8(Low)	$WTBD2684
〃	〃	〃	0.9	〃	500A Mag DC φ0.9(Low)	$WTBD2685
〃	〃	〃	1.0	〃	500A Mag DC φ1.0(Low)	$WTBD2686
〃	〃	〃	1.2	〃	500A Mag DC φ1.2(Low)	$WTBD2687
〃	〃	〃	1.4	〃	500A Mag DC φ1.4(Low)	$WTBD2688
〃	〃	〃	1.6	〃	500A Mag DC φ1.6(Low)	$WTBD2689
〃	MIG*	SUS	0.8	〃	500A Mig_4 DC φ0.8 SuS(Low)	$WTBD2690
〃	〃	〃	0.9	〃	500A Mig_4 DCφ0.9 SuS(Low)	$WTBD2691
〃	〃	〃	1.0	〃	500A Mig_4 DCφ1.0 SuS(Low)	$WTBD2692
〃	〃	〃	1.2	〃	500A Mig_4 DC φ1.2 SuS(Low)	$WTBD2693
〃	〃	〃	1.6	〃	500A Mig_4 DC φ1.6 SuS(Low)	$WTBD2694
〃	〃	Ferrite	0.8	〃	500A Mig_4DC φ0.8 Ferrite(Low)	$WTBD2695
〃	〃	〃	0.9	〃	500A Mig_4DC φ0.9 Ferrite(Low)	$WTBD2696
〃	〃	〃	1.0	〃	500A Mig_4DC φ1.0 Ferrite(Low)	$WTBD2697
〃	〃	〃	1.2	〃	500A Mig_4DC φ1.2 Ferrite(Low)	$WTBD2698
〃	〃	Hard aluminum	1.0	〃	500A Mig DC φ1.0 Hard Al(Low)	$WTBD2699
〃	〃	〃	1.2	〃	500A Mig DC φ1.2 Hard Al(Low)	$WTBD2700
〃	〃	〃	1.6	〃	500A Mig DC φ1.6 Hard Al(Low)	$WTBD2701
〃	〃	Soft aluminum	1.2	〃	500A Mig DC φ1.2 Soft Al(Low)	$WTBD2702
〃	〃	〃	1.6	〃	500A Mig DC φ1.6 Soft Al(Low)	$WTBD2703
DC (APCS)	CO2	Mild steel solid	0.8	〃	500A Co2 DC φ0.8(Low#)	$WTBD2704
〃	〃	〃	0.9	〃	500A Co2 DC φ0.9(Low#)	$WTBD2705
〃	〃	〃	1.0	〃	500A Co2 DC φ1.0(Low#)	$WTBD2706
〃	〃	〃	1.2	〃	500A Co2 DC φ1.2(Low#)	$WTBD2707
〃	MAG	Mild steel solid	0.8	〃	500A Mag DC φ0.8(Low#)	$WTBD2708
〃	〃	〃	0.9	〃	500A Mag DC φ0.9(Low#)	$WTBD2709
〃	〃	〃	1.0	〃	500A Mag DC φ1.0(Low#)	$WTBD2710
〃	〃	〃	1.2	〃	500A Mag DC φ1.2(Low#)	$WTBD2711
〃	MIG*	SUS	0.8	〃	500A Mig_4 DC φ0.8 SuS(Low#)	$WTBD2712
〃	〃	〃	0.9	〃	500A Mig_4 DCφ0.9 SuS(Low#)	$WTBD2713
〃	〃	〃	1.0	〃	500A Mig_4 DCφ1.0 SuS(Low#)	$WTBD2714
〃	〃	〃	1.2	〃	500A Mig_4 DC φ1.2 SuS(Low#)	$WTBD2715
〃	〃	Ferrite	0.8	〃	500A Mig_4DC φ0.8 Ferrite(Low#)	$WTBD2716
〃	〃	〃	0.9	〃	500A Mig_4DC φ0.9 Ferrite(Low#)	$WTBD2717
〃	〃	〃	1.0	〃	500A Mig_4DC φ1.0 Ferrite(Low#)	$WTBD2718
〃	〃	〃	1.2	〃	500ª Mig_4DC φ1.2 Ferrite(Low#)	$WTBD2719
DC pulsed	MAG	Mild steel solid	0.8	〃	500A Mag DC-Pulse φ0.8(Low)	$WTBD2720
〃	〃	〃	0.9	〃	500A Mag DC-Pulse φ0.9(Low)	$WTBD2721
〃	〃	〃	1.0	〃	500A Mag DC-Pulse φ1.0(Low)	$WTBD2722
〃	〃	〃	1.2	〃	500A Mag DC-Pulse φ1.2(Low)	$WTBD2723
〃	〃	〃	1.4	〃	500A Mag DC-Pulse φ1.4(Low)	$WTBD2724
〃	〃	〃	1.6	〃	500A Mag DC-Pulse φ1.6(Low)	$WTBD2725
〃	MIG*	SUS	0.8	〃	500A Mig_4 DC-Pulseφ0.8 SuS(Low)	$WTBD2726
〃	〃	〃	0.9	〃	500A Mig_4 DC-Pulseφ0.9 SuS(Low)	$WTBD2727
〃	〃	〃	1.0	〃	500A Mig_4 DC-Pulseφ1.0 SuS(Low)	$WTBD2728
〃	〃	〃	1.2	〃	500A Mig_4 DC-Pulse φ1.2 SuS(Low)	$WTBD2729
〃	〃	〃	1.6	〃	500A Mig_4 DC-Pulse φ1.6 SuS(Low)	$WTBD2730
〃	〃	Ferrite	0.8	〃	500A Mig_4 DC-Pulse φ0.8	$WTBD2731

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
					Ferrite(Low)	
"	"	"	0.9	"	500A Mig_4 DC-Pulse φ0.9 Ferrite(Low)	$WTBD2732
"	"	"	1.0	"	500A Mig_4 DC-Pulse φ1.0 Ferrite(Low)	$WTBD2733
"	"	"	1.2	"	500A Mig_4 DC-Pulse φ1.2 Ferrite(Low)	$WTBD2734
"	"	Hard aluminum	1.0	"	500A Mig DC-Pulse φ1.0 Hard Al(Low)	$WTBD2735
"	"	"	1.2	"	500A Mig DC-Pulse φ1.2 Hard Al(Low)	$WTBD2736
"	"	"	1.6	"	500A Mig DC-Pulse φ1.6 Hard Al(Low)	$WTBD2737
"	"	Soft aluminum	1.2	"	500A Mig DC-Pulse φ1.2 Soft Al(Low)	$WTBD2738
"	"	"	1.6	"	500A Mig DC-Pulse φ1.6 Soft Al(Low)	$WTBD2739
DC	CO2	Mild steel solid	0.8	Extension cable	500A Co2 DC φ0.8(Low*)	$WTBD2740
"	"	"	0.9	"	500A Co2 DC φ0.9(Low*)	$WTBD2741
"	"	"	1.0	"	500A Co2 DC φ1.0(Low*)	$WTBD2742
"	"	"	1.2	"	500A Co2 DC φ1.2(Low*)	$WTBD2743
"	"	"	1.4	"	500A Co2 DC φ1.4(Low*)	$WTBD2744
"	"	"	1.6	"	500A Co2 DC φ1.6(Low*)	$WTBD2745
"	"	Mild steel Cored	1.0	"	500A Co2 DC φ1.0 (Cored) (Low*)	$WTBD2746
"	"	"	1.2	"	500A Co2 DC φ1.2 (Cored) (Low*)	$WTBD2747
"	"	"	1.4	"	500A Co2 DC φ1.4 (Cored) (Low*)	$WTBD2748
"	"	"	1.6	"	500A Co2 DC φ1.6 (Cored) (Low*)	$WTBD2749
"	"	SUS Cored	0.9	"	500A Co2 DC φ0.9 SuS(Cored) (Low*)	$WTBD2750
"	"	"	1.2	"	500A Co2 DC φ1.2 SuS(Cored) (Low*)	$WTBD2751
"	"	"	1.6	"	500A Co2 DC φ1.6 SuS(Cored) (Low*)	$WTBD2752
"	MAG	Mild steel solid	0.8	"	500A Mag DC φ0.8(Low*)	$WTBD2753
"	"	"	0.9	"	500A Mag DC φ0.9(Low*)	$WTBD2754
"	"	"	1.0	"	500A Mag DC φ1.0(Low*)	$WTBD2755
"	"	"	1.2	"	500A Mag DC φ1.2(Low*)	$WTBD2756
"	"	"	1.4	"	500A Mag DC φ1.4(Low*)	$WTBD2757
"	"	"	1.6	"	500A Mag DC φ1.6(Low*)	$WTBD2758
"	MIG*	SUS	0.8	"	500A Mig_4 DC φ0.8 SuS(Low*)	$WTBD2759
"	"	"	0.9	"	500A Mig_4 DCφ0.9 SuS(Low*)	$WTBD2760
"	"	"	1.0	"	500A Mig_4 DCφ1.0 SuS(Low*)	$WTBD2761
"	"	"	1.2	"	500A Mig_4 DC φ1.2 SuS(Low*)	$WTBD2762
"	"	"	1.6	"	500A Mig_4 DC φ1.6 SuS(Low*)	$WTBD2763
"	"	Ferrite	0.8	"	500A Mig_4DC φ0.8 Ferrite(Low*)	$WTBD2764
"	"	"	0.9	"	500A Mig_4DC φ0.9 Ferrite(Low*)	$WTBD2765
"	"	"	1.0	"	500A Mig_4DC φ1.0 Ferrite(Low*)	$WTBD2766
"	"	"	1.2	"	500A Mig_4DC φ1.2 Ferrite(Low*)	$WTBD2767
"	"	Hard aluminum	1.0	"	500A Mig DC φ1.0 Hard Al(Low*)	$WTBD2768
"	"	"	1.2	"	500A Mig DC φ1.2 Hard Al(Low*)	$WTBD2769
"	"	"	1.6	"	500A Mig DC φ1.6 Hard Al(Low*)	$WTBD2770
"	"	Soft aluminum	1.2	"	500A Mig DC φ1.2 Soft Al(Low*)	$WTBD2771
"	"	"	1.6	"	500A Mig DC φ1.6 Soft Al(Low*)	$WTBD2772
DC wave pulsed	MAG	Mild steel solid	0.8	High	500A Mag DC-Wave φ0.8(High)	$WTBD2773
"	"	"	0.9	"	500A Mag DC-Wave φ0.9(High)	$WTBD2774
"	"	"	1.0	"	500A Mag DC-Wave φ1.0(High)	$WTBD2775
"	"	"	1.2	"	500A Mag DC-Wave φ1.2(High)	$WTBD2776
"	"	"	1.4	"	500A Mag DC-Wave φ1.4(High)	$WTBD2777
"	"	"	1.6	"	500A Mag DC-Wave φ1.6(High)	$WTBD2778
"	MIG*	SUS	0.8	"	500A Mig_4 DC-Waveφ0.8 SuS(High)	$WTBD2779
"	"	"	0.9	"	500A Mig_4 DC-Waveφ0.9 SuS(High)	$WTBD2780
"	"	"	1.0	"	500A Mig_4 DC-Waveφ1.0 SuS(High)	$WTBD2781
"	"	"	1.2	"	500A Mig_4 DC-Wave φ1.2 SuS(High)	$WTBD2782
"	"	"	1.6	"	500A Mig_4 DC-Wave φ1.6 SuS(High)	$WTBD2783

Welding mode					Welding mode description	Notes Number of welding characteristic data in AX21/FD11
Welding process	Gas	Wire material	Wire diameter	Travel speed		
"	"	Ferrite	0.8	"	500A Mig_4 DC-Waveφ0.8 Ferrite(High)	$WTBD2784
"	"	"	0.9	"	500A Mig_4 DC-Waveφ0.9 Ferrite(High)	$WTBD2785
"	"	"	1.0	"	500A Mig_4 DC-Waveφ1.0 Ferrite(High)	$WTBD2786
"	"	"	1.2	"	500A Mig_4 DC-Waveφ1.2 Ferrite(High)	$WTBD2787
"	"	Hard aluminum	1.0	"	500A Mig DC-Wave φ1.0 Hard Al(High)	$WTBD2788
"	"	"	1.2	"	500A Mig DC-Wave φ1.2 Hard Al(High)	$WTBD2789
"	"	"	1.6	"	500A Mig DC-Wave φ1.6 Hard Al(High)	$WTBD2790
"	"	Soft aluminum	1.2	"	500A Mig DC-Wave φ1.2 Soft Al(High)	$WTBD2791
"	"	"	1.6	"	500A Mig DC-Wave φ1.6 Soft Al(High)	$WTBD2792
"	MAG	Mild steel solid	0.8	Standard	500A Mag DC-Wave φ0.8(Low)	$WTBD2793
"	"	"	0.9	"	500A Mag DC-Wave φ0.9(Low)	$WTBD2794
"	"	"	1.0	"	500A Mag DC-Wave φ1.0(Low)	$WTBD2795
"	"	"	1.2	"	500A Mag DC-Wave φ1.2(Low)	$WTBD2796
"	"	"	1.4	"	500A Mag DC-Wave φ1.4(Low)	$WTBD2797
"	"	"	1.6	"	500A Mag DC-Wave φ1.6(Low)	$WTBD2798
"	MIG*	SUS	0.8	"	500A Mig_4 DC-Waveφ0.8 SuS(Low)	$WTBD2799
"	"	"	0.9	"	500A Mig_4 DC-Waveφ0.9 SuS(Low)	$WTBD2800
"	"	"	1.0	"	500A Mig_4 DC-Waveφ1.0 SuS(Low)	$WTBD2801
"	"	"	1.2	"	500A Mig_4 DC-Wave φ1.2 SuS(Low)	$WTBD2802
"	"	"	1.6	"	500A Mig_4 DC-Wave φ1.6 SuS(Low)	$WTBD2803
"	"	Ferrite	0.8	"	500A Mig_4 DC-Waveφ0.8 Ferrite(Low)	$WTBD2804
"	"	"	0.9	"	500A Mig_4 DC-Waveφ0.9 Ferrite(Low)	$WTBD2805
"	"	"	1.0	"	500A Mig_4 DC-Waveφ1.0 Ferrite(Low)	$WTBD2806
"	"	"	1.2	"	500A Mig_4 DC-Waveφ1.2 Ferrite(Low)	$WTBD2807
"	"	Hard aluminum	1.0	"	500A Mig DC-Wave φ1.0 Hard Al(Low)	$WTBD2808
"	"	"	1.2	"	500A Mig DC-Wave φ1.2 Hard Al(Low)	$WTBD2809
"	"	"	1.6	"	500A Mig DC-Wave φ1.6 Hard Al(Low)	$WTBD2810
"	"	Soft aluminum	1.2	"	500A Mig DC-Wave φ1.2 Soft Al(Low)	$WTBD2809
"	"	"	1.6	"	500A Mig DC-Wave φ1.6 Soft Al(Low)	$WTBD2810

∗ : MIG gas defers in its mixing ratio depending on the wire material as below. For more details, refer to the instruction manial for welding power supply.

When the wire material is a SUS/Ferrite : Argon (Ar) 98% / Oxygen (O_2) 2%
When the wire material is a Hard/Soft aluminum : Argon (Ar) 100%

POINT

Normally, use the welding characteristic data given in Table 1.4.5 dedicated to "High" application. The ones for "Standard" application must be used only when the welding speed is low (50cm/min or lower in general), which causes unstable welding performance.

Welding performance may become unstable when using the extended power cable depending on the layout condition of cables (when the total length exceeds 30m or the cable is coiled). In that case, voltage adjustment will normally bring about stable condition. However, use the welding characteristic data dedicated to "Extension cable" application if the welding performance is not yet stable.

IMPORTANT

The welding mode cannot be switched as follows during welding. Do not perform teaching for the following.
• From DC low spatter to DC/DC pulse/DC wave pulse
• From DC/DC pulse/DC wave pulse to DC low spatter

Switching the welding mode as above causes "A5021 Arc welding characteristic data failure." or "A5023 Failure of the welding power supply occurred.".

Chapter 2   Connections

This chapter describes how to connect the Welding Interface (Digital).

2.1 Connect Welding Interface (Digital)

2.1.1 Installation of the Welding Interface (Digital) Board

Described here are the connections for the Welding Interface (Digital) Board that is used with the robot controller.

1 Turn off the primary power supply and circuit breaker on the robot controller.

2 The Welding Interface (digital) board is fixed to the position shown in Figure 2.1.1 of the robot controller by the plate and the locking card spacer.
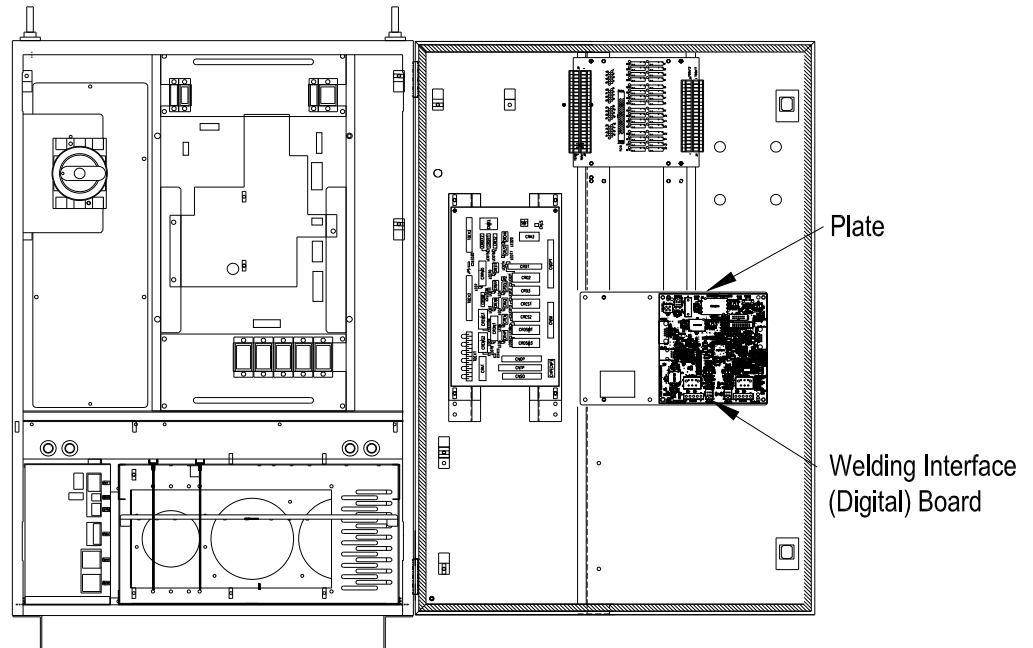
Figure 2.1.1   Installation Positions of the Welding Interface (Digital) Board

> **INFO.** If you use two Relay Units and the Built-in Touch Sensor at the same time, the Built-in Touch Sensor and the Welding Interface (Digital) Board are fixed to the position shown in Figure 2.1.2.
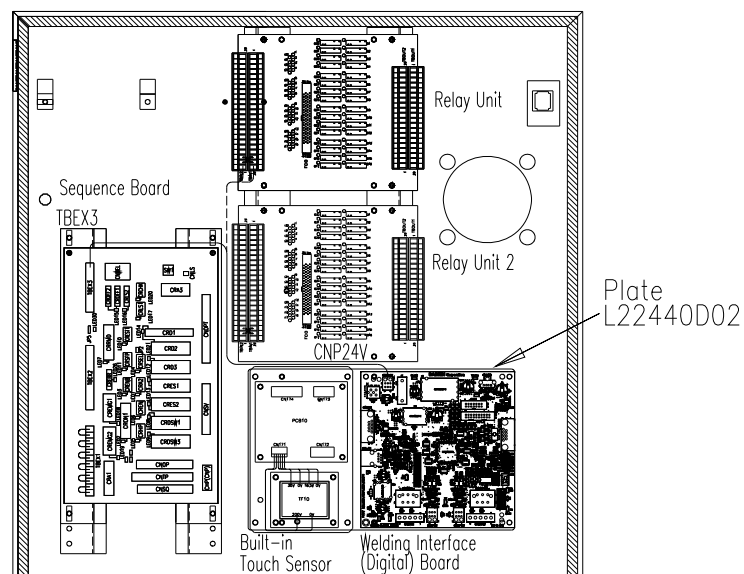
Figure 2.1.2   Installation Positions of the Built-in Touch Sensor

3　Wire the signal cable, and connect the Welding Interface (Digital) Board CNCAN1 and the Storage Board CNCAN.

4　Wire the 24V power supply cable, and connect the Welding interface (Digital) Board CNP24V and the Sequence board TBEX3(P1), (M1). If the terminal block on the Sequence Board is used for another purpose, connect the terminal to the Relay unit TBIN1(24V), TBIN2(0V).
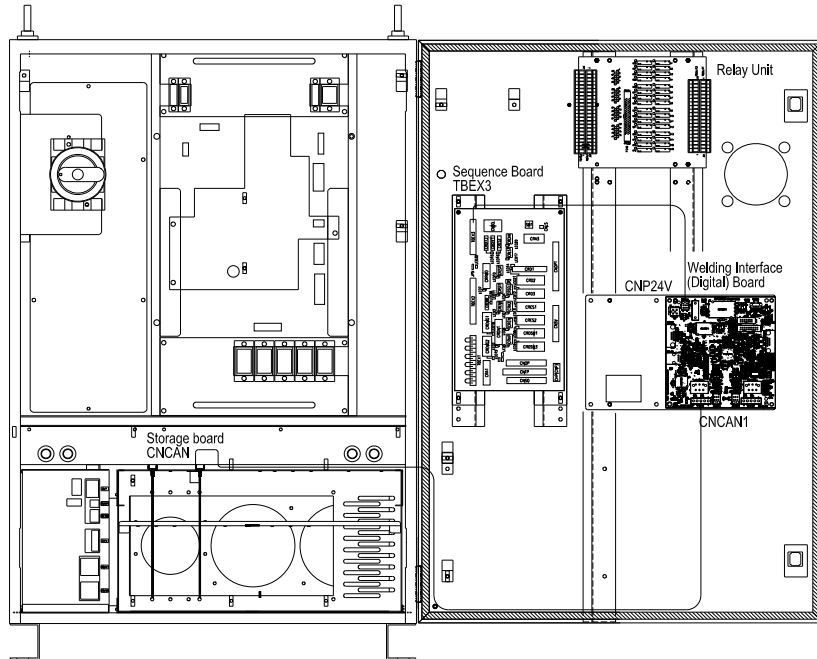
Figure 2.1.3　Cable wiring and connector connection

2.1.2 Connection of Control cable 5 (Robot controller side)

1 Turn off the primary power supply and circuit breaker on the controller.

2 Pull the control cable 5 connector through the control cable 5 inlet on the right side of the robot controller as shown in Figure 2.1.4.
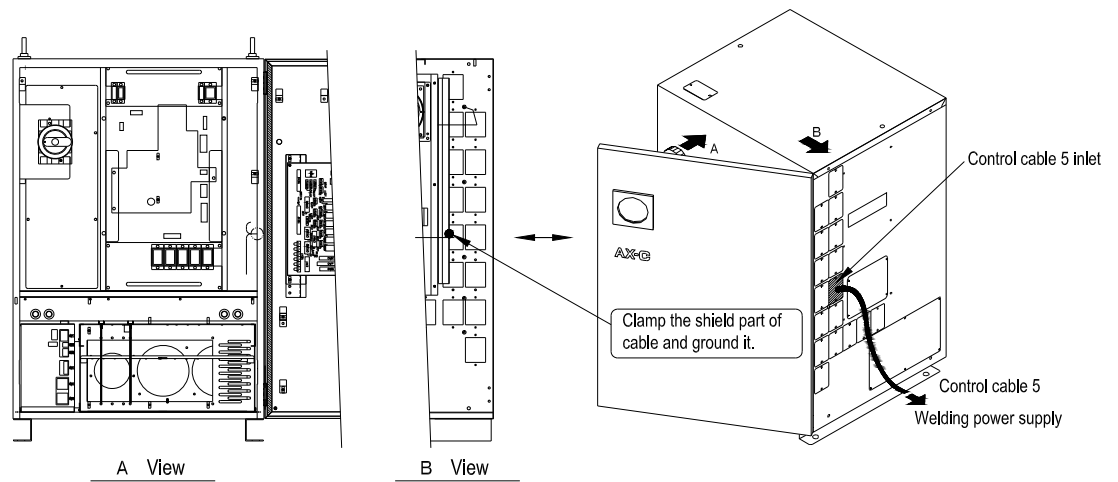
Figure 2.1.4 Connection of control cable 5 (Pull cable through)

3 Fix the shield section of the cables to the shield fixing fixtures on the left side of the service entrance as shown in Figure 2.1.5.
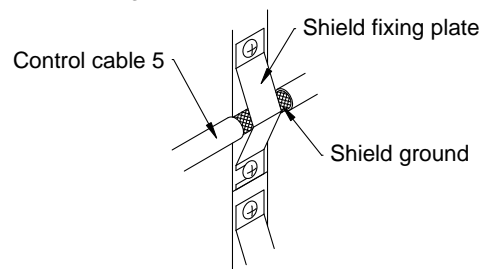
Figure 2.1.5 Connection of control cable 5 (Fix the shielding ground)

4 Wire the cables as shown in Figure 2.1.6, and connect the Welding Interface (Digital) Board CNCAN2 and the Sequence Board CNWEL.
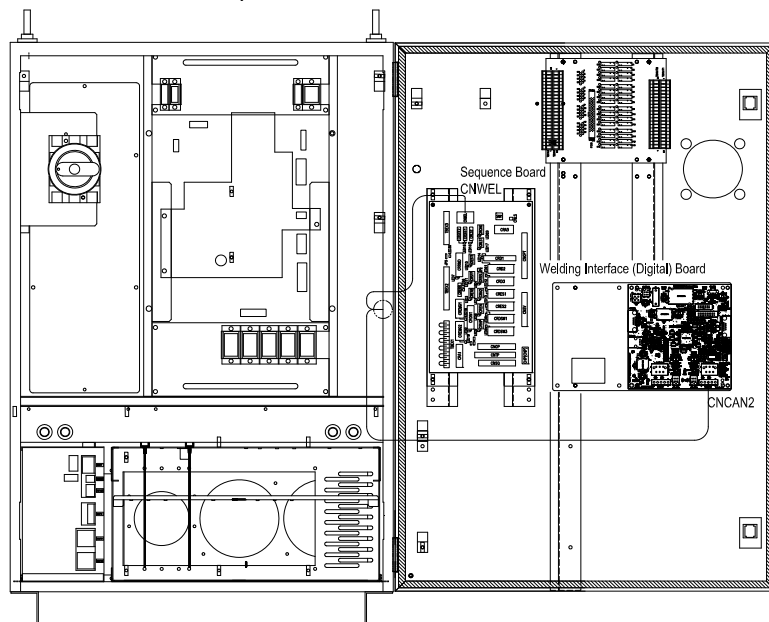
Figure 2.1.6 Connection of control cable 5 (Cable wiring and connector connection)

2.1.3 Connection of Control cable 5 (Welding power source side)

For WB-M350L / WB-M350 / WB-M500 / WB-P350 / WB-P500L

1 Turn off the primary power supply and circuit breaker on the welding power source.

2 Remove the back cover on the welding power source.

3 Pull the connector of control cable 5 from the back of the welding power source and fix the cable flange with the attached screws.

4 Connect the connector of control cable 5 to the connector CN17 on the printed circuit board PCB1.

5 Connect the grounding cable to the grounding terminal.

6 Remove the "STOP" jumper wire connected to the terminal block TM3 on the printed circuit board PCB10 in the welding power source.

7 Attach the back cover.
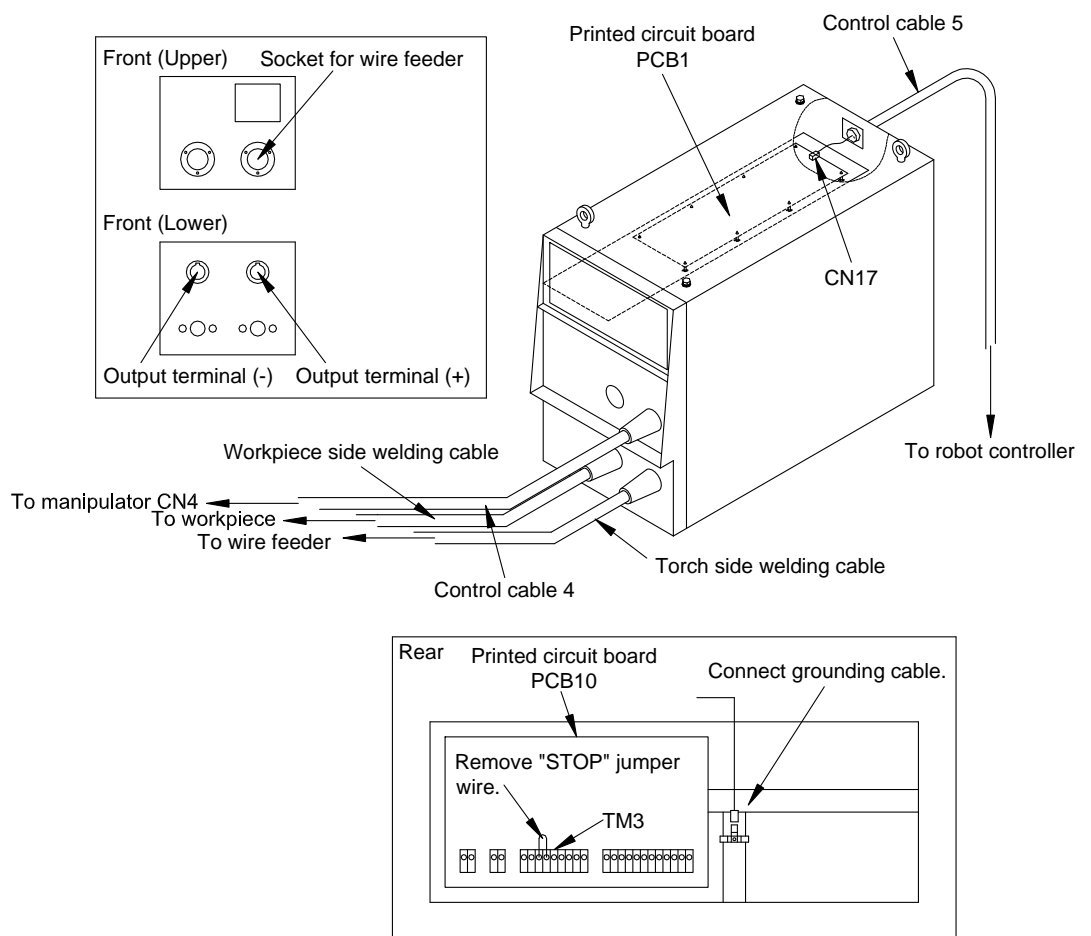
Figure 2.1.7   Connection of digital welding power source (WB-M350L/ WB-M350 / WB-M500)

2.1.4 Connection of Control cable 4

Connect each connector of the control cable 4 to the socket ICN4 for wire feeder on the welding power source and to the connector CN4 on the rear panel of the manipulator, respectively.

2.1.5 Connection of Workpiece side welding cable / Torch side welding cable

Connect the cable respectively referring to "CONNECTION PROCEDURE AND GROUND FOR SAFETY USE" in the instruction manual of each welding power source.

CAUTION
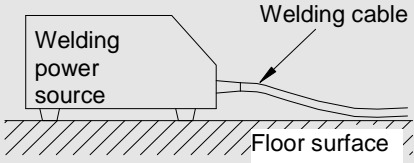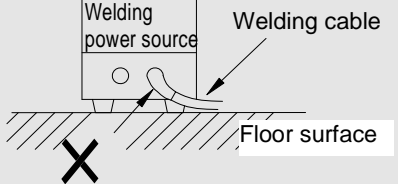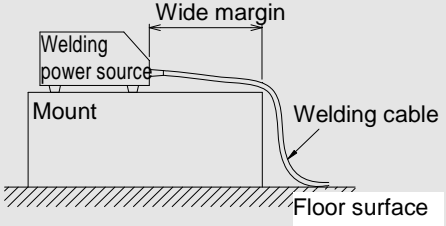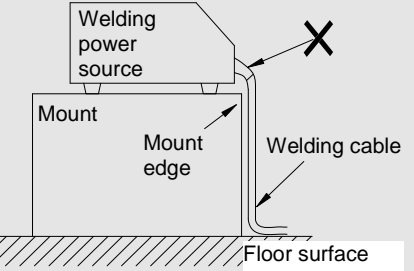
Installation of the welding power source and welding cables

Fix the welding power source on a firm and level surface, such as a concrete floor, rendering it immovable.
Wire the welding cable with some margin, so that no unreasonable force is applied to the connector of the welding cable.
If you bend the connector section forcedly for wiring, it may cause damage of the connector.

(Good example)	(Wrong example)
In case of installation on the floor: Provide some margin in wiring so as to avoid any force applied to the connector.	In case of forced wiring of the welding cable: If you bend the connector section forcedly for wiring, force is applied to the connector.
In case of installation on a mount, etc: Place it sufficiently away from the mount edge or take other measures, so that no force is applied to the connector.	In case of installation near the mount edge: The connector may be pulled under the weight of the welding cable and subjected to force.

2.1.6 Connection of Gas hose

Connect the gas hose to the connector GAS on the rear side of the manipulator and to the gas regulator, respectively.

2.1.7 Connection of Voltage detecting cable (workpiece side) (for WB-M350L/WB-P500L)

To fully utilize the welding performance of WB-M350L / WB-P500L(When the wire material is other than a steel or SUS, such as an aluminum), it is difficult to wire the voltage detecting cable in such a manner to ensure accurate feedback of the arc voltage.

> **INFO.** Connect the voltage detecting cable (torch side) to the connector of the upper arm. For installation procedure, please refer to the instruction manual "Welding Torch for Robot" and "Coaxial Power Cable for Robot".

Connection of Voltage detecting cable (workpiece side)

(1) Connecting the voltage detecting cable (workpiece side)

- Connect voltage detection cable (workpiece side) to a place near to workpiece as possible.

- Wire the torch (voltage detecting wire) to along with the voltage detecting cable (workpiece side) as much as possible and lower the shaded area Figure 2.1.8.
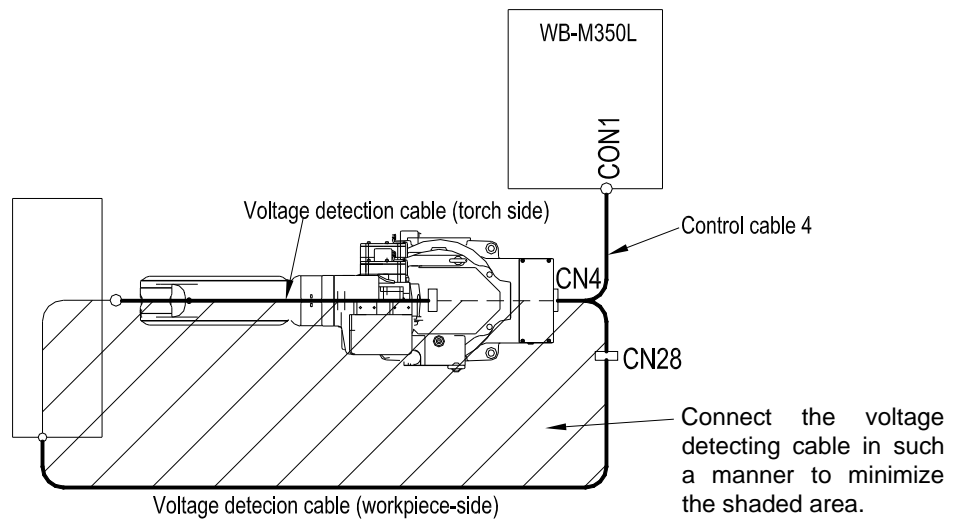
Figure 2.1.8   Routing of the Voltage Detecting Cable (workpiece side)

(2) In case of plural welding stages

Connect the workpiece cable to each stage subsequently, and then connect the voltage detecting cable (workpiece side) to the stage which was connected at last (so as to avoid detection of voltage drop occurring in the workpiece cable).
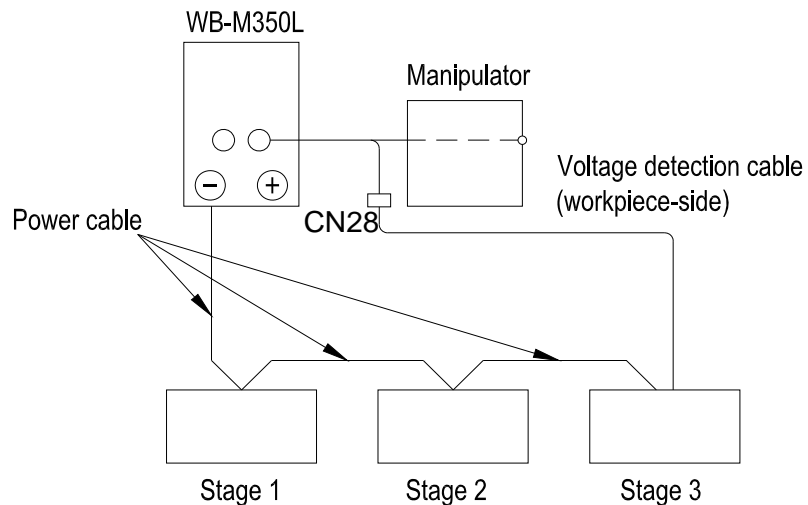
Figure 2.1.9   Routing of the Voltage Detecting Cable (Workpiece side)
(In case of plural welding stages)

(3) In case of installing the workpiece on a rotary jig
Connect it in such a manner to minimize the voltage drop due to the resistance.

Example 1:   In case that the positioner which has a voltage detection terminal is combined
Connect a voltage detection cable (workpiece side) to the voltage detection terminal.
Be sure to confirm that there exists a stable electrical connection among a workpiece, a jig and a surface of the table of the positioner.
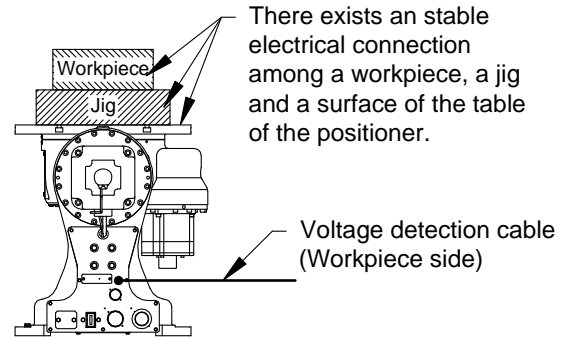
2PF series / 1PB series

Figure 2.1.10   Routing of the Voltage Detecting Cable (Workpiece side)
(In case of use of 2PF / 1PB series positioner)

Example 2:   In case that the positioner which has no voltage detection terminal is combined
Connect it directly to the table. When connecting it, select such a position as not to cause any obstruction during rotation (e.g. lower side of the table).
Be sure to confirm that there exists a stable electrical connection among a workpiece, a jig and a surface of the table of the positioner.

POINT   If the voltage detection cable (workpiece side) is connected the place where the part has a different voltage level, the welding power source may not give the best performance.
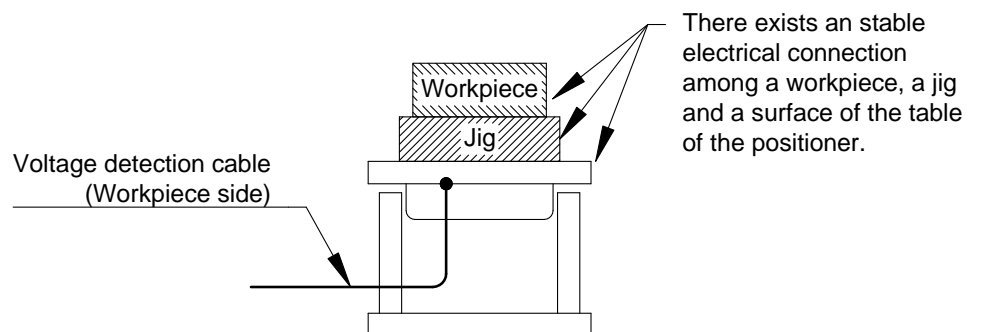
Figure 2.1.11   Routing of the Voltage Detecting Cable (Workpiece side)
(In case that the positioner which has no voltage detection terminal is combined)

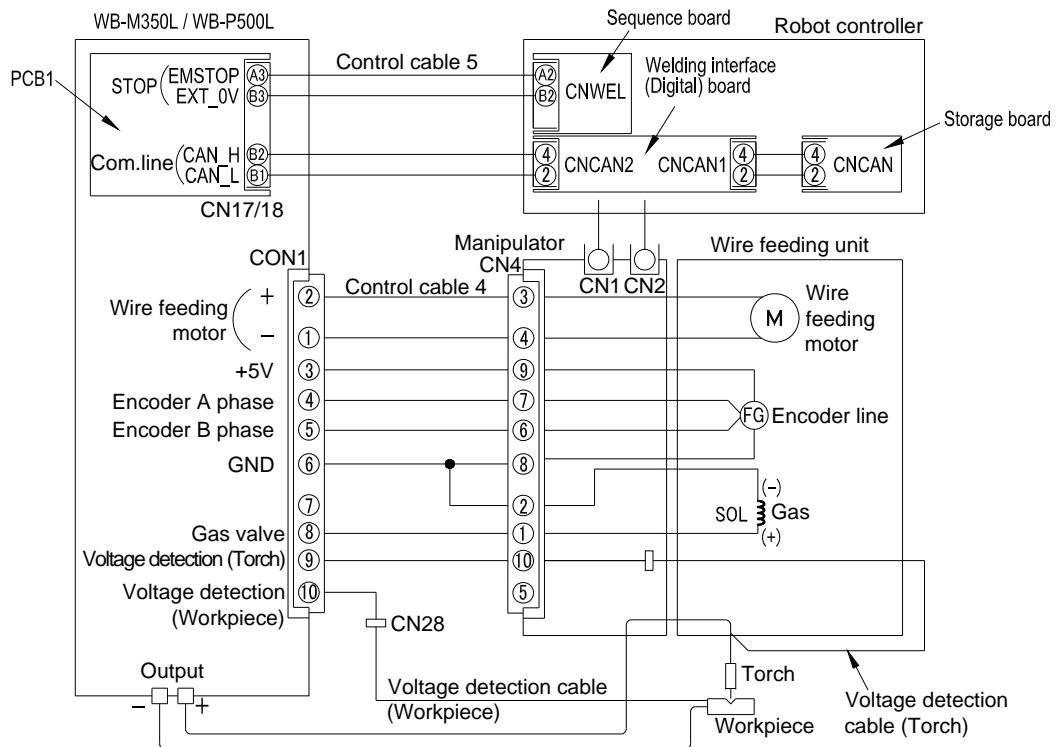# 2.2 Electrical connection diagram

WB-M350L/ WB-P500L*1

Figure 2.2.1   Electrical connection diagram of WB-M350L / WB-P500L*1
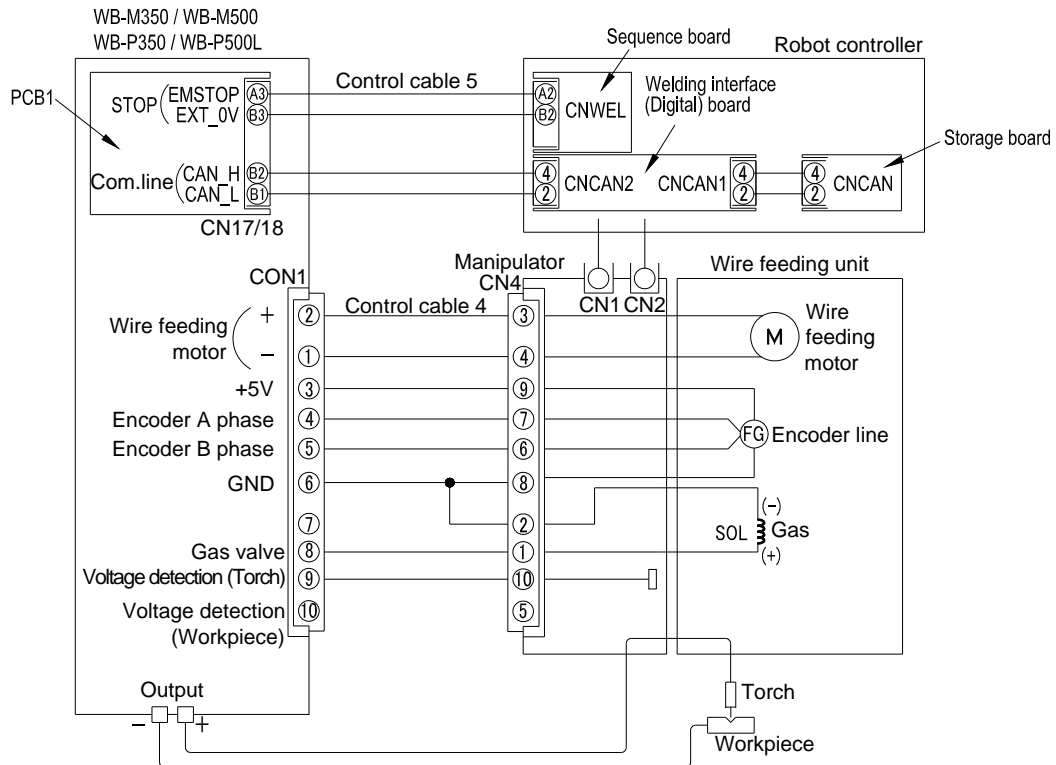
WB-M350 / WB-M500 / WB-P350 / WB-P500L*2

Figure 2.2.2   Electrical connection diagram of WB-M350 / WB-M500 / WB-P350 / WB-P500L*2

＊1 When the wire material is other than a steel or SUS, such as an aluminum.
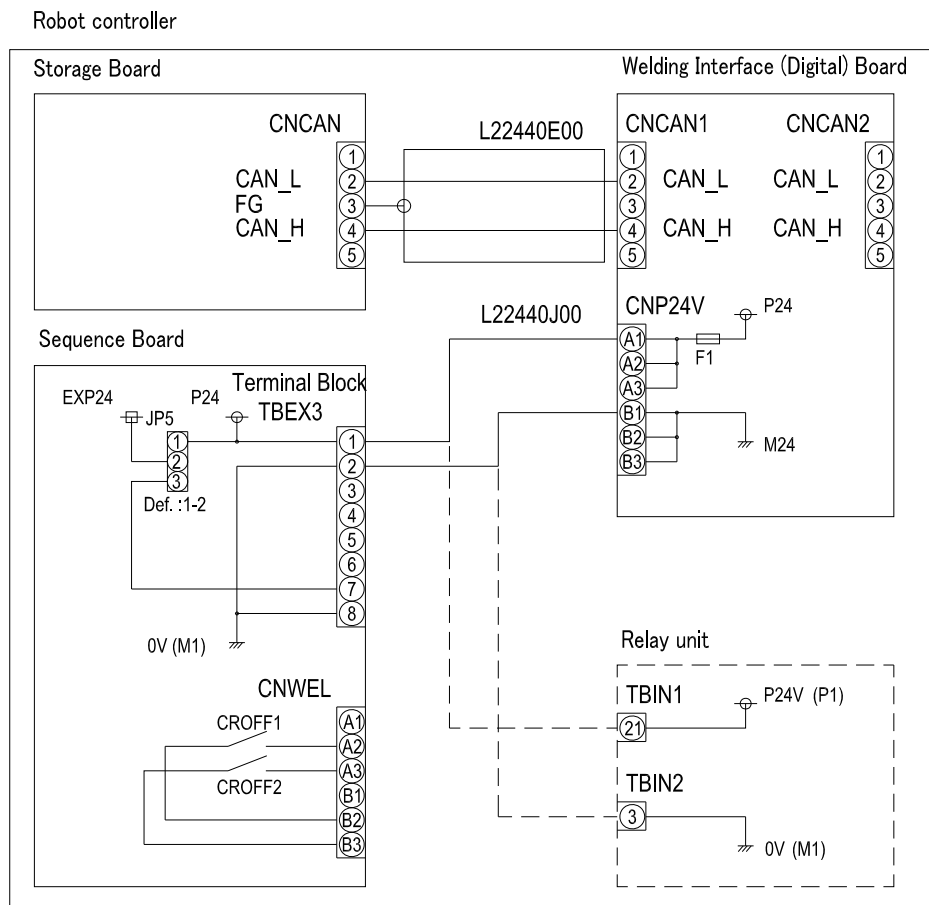＊2 When the wire material is a steel or SUS.

Robot controller

Robot controller

Figure 2.2.3   Electrical connection diagram of AXC

Chapter 3 Configurations

To use Welding Interface (Digital), you must create setup data using the "Welding Interface (Digital) Setup" tool. This chapter describes the configuration method after connecting the various devices, and the method for creating the setup data and writing it onto the robot controller and the interface.

3.1 Workflow

Configure Welding Interface (Digital) on your computer using the "Welding Interface (Digital) Setup" tool. The workflow is shown below.

Configuration preparations ☞ Page 3-3	**1** Download the "Welding Interface (Digital) Setup" tool Download the "Welding Interface (Digital) Setup" tool onto your computer.
Configuring the Welbee Inverter series welding power source ☞ Instruction manual for the welding power source	**2** Configure the welding power source Configure the Welbee Inverter series welding power source to enable communication with the interface. Configure the internal functions as shown in the table below by operating the front panel of the welding power source. For details on the operation methods, see the instruction manual of your welding power source.

No.	Function name	Setting
F4	Auto/Semi auto mode	Set "3: OTC robot 1".
F43	CANID	When connecting 1 welding power source to the interface, set "1". When connecting multiple welding power sources to the interface, set the same number as the registration number in the next item, "Register the welding power source".

Configuring the robot controller ☞ Page 3-4	**3** Registering the welding power source Register the welding power source to use for the robot controller. In this step, register a D series welding power source instead of the Welbee Inverter series welding power source. When changing the welding power source from the D series to the Welbee Inverter series as shown in Table 1.2.3 and continuing to use the existing programs, this step is not required.
	4 Register the welding mode Register the welding mode to use for the robot controller. When changing the welding power source from the D series to the Welbee Inverter series as shown in Table 1.2.3 and continuing to use the existing programs, this step is not required.
	5 Creating a backup Back up all the robot control data onto a CF card.
Creating the setup data ☞ Page 3-9	**6** Create the setup data Create the setup data for configuring the robot controller and the interface by using the "Welding Interface (Digital) Setup" tool.

Writing the setup data
☞ Page 3-14

| 7 | Writing the setup data |
| | Write the setup data onto Welding Interface (Digital) and the robot controller. |

Check the configuration
☞ Page 3-17

| 8 | Check the configuration |
| | Check that the interface is configured correctly and the welding power source can be used. |

Adjusting the welding characteristic data

WB-M350L
☞ Page 3-20

WB-M350/500
☞ Page 3-25

WB-P350
☞ Page 3-28

WB-P500L
☞ Page 3-35

| 9 | Adjust the welding conditions |
| | Adjust the welding conditions to suit your welding power source. For details on the welding conditions that can be used with the interface, see the welding conditions for the various welding power sources from the section 3.8 . Also, for details on editing the welding conditions, see the APPLICATION MANUAL (ARC WELDING) instruction manual for your robot controller. |

IMPORTANT

Be sure to check the welding conditions that can be used in step 9.
The welding condition editing screen of the robot controller includes the parameters for D series welding power sources, which are not used by Welbee Inverter series welding power sources.
When you turn on a robot controller again, please also turn on a welding power source again .

POINT

To change the registration of the welding characteristic data in f5 <Arc Constant> - [4 Setting of weld data] on the robot controller in order to change the welding mode that is used, repeat steps 4 to 7 in this procedure.

3.2 Configuration preparations

This section describes the preparation for the "Welding Interface (Digital) Setup" tool and the USB media.

3.2.1 "Welding Interface (Digital) Setup" tool preparations

Download the "Welding Interface (Digital) Setup" tool from the OTC website onto your computer.

Downloading the setup tool

1 **Access the DAIHEN website, and then download the "Welding Interface (Digital) Setup" tool.**

Download page for the "Welding Interface (Digital) Setup" tool
(DAIHEN Welding and Mechatronics System Corporation > Downloads)
   http://www.daihen.co.jp/yosetsu/other/download_e.html

2 **Unzip the "Welding Interface (Digital) Setup" tool into any folder.**
>> This completes the setup tool preparations.

3.2.2 USB memory preparations

Create a folder in the USB memory for saving the setup data.

IMPORTANT

Operation is not guaranteed to work with a commercially available USB memory. Use the USB memory (parts number L21700U00) recommended by OTC.

USB memory preparations

1 **Create an "UPDATE" folder and "BACKUP" folder in the USB memory.**

IMPORTANT

Create the "UPDATE" folder and "BACKUP" folder in the top level of the USB memory hierarchy, as shown in the figure.

FLASH DISK (F:)
   Backup
   Update

Figure 3.2.1 USB memory preparations

3.3 Configuring the robot controller

This section describes the procedure for the configuration performed on the robot controller.

3.3.1 Registering the welding power source

When using the interface to connect a Welbee Inverter series welding power source, register the welding power source as the corresponding D series welding power source shown in Table 3.3.1 in f5 <Arc Constant> - [1 Registration of welder] on the robot controller.
When changing from an existing D series welding power source to a Welbee Inverter series welding power source as shown in Table 1.2.3 and continuing to use the existing programs, this step is not required.

IMPORTANT

D series welding power sources and Welbee Inverter series welding power sources cannot be used at the same time.

POINT

Register the Welbee Inverter series welding power source in the robot controller as the corresponding D series welding power source shown below.

Table 3.3.1   Recommended settings

WB series welding power source to be connected	D series welding power source to register in the robot controller
WB-M350	DR *1
WB-M500	DM
WB-M350L	DL(S-2)
WB-P350	DP *2
WB-P500L	DPR *3

*1 Only when replacing an existing DM or DM(S-2) with the Welbee Inverter series, continue using DM or DM(S-2).

*2 Apply the welding characteristic data for a rated current 350A when WB-P350 is in connection.

*3 Continue using DP as is only when the existing DP-500 is replaced with WB-P500L. Also, when using WB-P500L, a rated current 500A for WB-P500L is available at the maximum even if it is registered as DPR in the robot controller.

For details, see the "1.2.3 Connectable welding power sources".

INFO.

After registering the welding power source, configure the robot to which the welding power source will be connected, and the connection type. For details on the configuration method, see "Chapter 1 Basic settings" in the APPLICATION MANUAL (ARC WELDING) instruction manual for the robot controller.

3.3.2 Register the welding mode

Register the welding mode you will use with the Welbee Inverter series welding power source in f5 <Arc Constant> - [4 Setting of weld data] on the robot controller. For details on the welding modes that can be used in the Welbee Inverter series welding power source, see "Chapter 1 Introduction" in this manual.

The robot controller handles the Welbee Inverter series welding power source as the D series welding power source registered in "3.3.1 Registering the welding power source". For this reason, as shown in the examples in Table 3.3.2 to Table 3.3.4, in the robot controller, register the welding characteristic data of the D series welding power source that is most similar to the welding mode used in the Welbee Inverter series welding power source. During robot playback operation, welding is performed after the interface converts the welding mode registered in the robot controller into the welding mode that will actually be used. Create the information required for this conversion in "3.4 Creating the setup data" described later, and then install it onto the interface.

> **IMPORTANT**
> For the welding characteristic data to be registered in the robot controller, select data that matches as much as possible the welding mode used in the Welbee Inverter series welding power source in terms of welding process, wire material and polarity. The welding start/end condition setting items that can be edited vary depending on the welding characteristic data to be registered in the robot controller.

Table 3.3.2 Welding mode registration example (registering WB-M350L as DL(S-2))

	Welding mode used in WB-M350L	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	350A Co2 DC φ1.2 (Low)	$WTBD1410	350A Co2 DC φ1.2 (High)
Characteristic 2	350A Mig_4 DC φ1.2 SuS (Low)	$WTBD1439	350A Mig DC φ1.2 SuS (High)
Description	• Register a welding mode where the welding process and wire material match. • For "Travel speed: Low", register "Polarity: Electrode positive" of "Welding speed: High/Low". • For the "Mig_4" gas type, register the similar "MIG".		

Table 3.3.3 Welding mode registration example (registering WB-M350 as DR)

	Welding mode used in WB-M350	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	350A Co2 DC φ1.2 (High)	$WTBD824	350A Co2 DC φ1.2 (High)
Characteristic 2	350A Co2 DC φ1.2 (Low)	$WTBD803	350A Co2 DC φ1.2
Characteristic 3	350A Mig_4 DC φ1.2 SuS (High)	$WTBD832	350A Mig DC φ1.2 SuS (High)
Characteristic 4	350A Mig_4 DC φ1.2 SuS (Low)	$WTBD815	350A Mig DC φ1.2 SuS
Description	• Register a welding mode where the welding process and wire material match. • For "Travel speed: High", register "Welding speed: High". • For "Travel speed: High", register "Welding speed: High". • For the "Mig_4" gas type, register the similar "MIG".		

Table 3.3.4 Welding mode registration example (registering WB-M500 as DM)

	Welding mode used in WB-M500	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	500A Co2 DC φ1.2 (High)	$WTBD824	500A Co2 DC φ1.2
Characteristic 2	500A Co2 DC φ1.2 (Low)	$WTBD815	500A Co2 DC φ1.4
Description	• Register a welding mode where the welding process and wire material match. • Independent Standard and High welding speed modes are not available for the DM series welding modes. Register as unused wire diameter welding characteristic data where the welding process and wire material match (Characteristic 2).		

Table 3.3.5 Welding mode registration example (registering WB-P350 as DP)

	Welding mode used in WB-P350	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	350A Co2 DC ϕ1.2(High)	$WTBD603	350A Co2 DC ϕ1.2
Characteristic 2	350A Co2 DC ϕ1.2(Low)	$WTBD602	350A Co2 DC ϕ1.0
Characteristic 3	350A Mig_4 DC-Pulse ϕ1.2 SuS(High)	$WTBD635	350A Mig DC-Pulse ϕ1.2 Sus
Description	• Register a welding mode where the welding process and wire material match. • Apply the welding characteristic data for a rated current 350A when WB-P350 is in connection. • Independent Standard and High welding speed modes are not available for the DP-350. Register as unused wire diameter welding characteristic data where the welding process and wire material match (Characteristic 2). • For the "Mig_4" gas type, register the similar "MIG".		

Table 3.3.6 Welding mode registration example（registering WB-P500L as DPR）

	Welding mode used in WB-P500L	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	500A Co2 DC ϕ1.2 (High)	$WTBD1503	400A Co2 DC ϕ1.2
Characteristic 2	500A Co2 DC ϕ1.2 (Low)	$WTBD1502	400A Co2 DC ϕ1.0
Characteristic 3	500A Co2 DC ϕ1.2(Low#)	$WTBD1501	400A Co2 DC ϕ0.9
Characteristic 4	500A Mig_4 DC-Pulse ϕ1.2 SuS(High)	$WTBD1528	400A Mig DC-Pulse ϕ1.2 Sus
Characteristic 5	500A Mig_4 DC-Wave ϕ1.2 SuS(High)	$WTBD1546	400A Mig DC-Wave ϕ1.2 Sus
Description	• Register a welding mode where the welding process and wire material match. • Independent Standard and High welding speed modes are not available for the DP-400R. Register as unused wire diameter welding characteristic data where the welding process and wire material match (Characteristic 2). • DC low spatter welding mode is registered as DC welding mode of DP-400R (Characteristic 3). • For the "Mig_4" gas type, register the similar "MIG".		

Table 3.3.7 Welding mode registration example (registering WB-P500L as DP)

	Welding mode used in WB-P500L	Welding characteristic data registered in the robot controller	
		No.	File comment
Characteristic 1	500A Co2 DC ϕ1.2(High)	$WTBD703	500A Co2 DC ϕ1.2
Characteristic 2	500A Co2 DC ϕ1.2(Low)	$WTBD702	500A Co2 DC ϕ1.0
Characteristic 3	500A Co2 DC ϕ1.2(Low#)	$WTBD701	500A Co2 DC ϕ0.9
Characteristic 4	500A Mig_4 DC-Pulse ϕ1.2 SuS(High)	$WTBD738	500A Mig DC-Pulse ϕ1.2 Sus
Characteristic 5	500A Mig_4 DC-Wave ϕ1.2 SuS(High)	$WTBD752	500A Mig DC-Wave ϕ1.2 Hard Al
Description	• Register a welding mode where the welding process and wire material match. • Apply the welding characteristic data for a rated current 500A when WB-P500 is in connection. • Independent Standard and High welding speed modes are not available for the DP-500. Register as unused wire diameter welding characteristic data where the welding process and wire material match (Characteristic 2). • DC low spatter welding mode is registered as DC welding mode of DP-400R (Characteristic 3) • For the "Mig_4" gas type, register the similar "MIG". • Use these settings only when replacing from DP-500.		

3.3.3 Creating a backup

Use the following procedure to create a backup on the CF card.

POINT

This section reproduces the backup operation procedure from the instruction manual of the robot controller (only this procedure is reproduced). For details on the backup function and the other file operation functions, see "6 File operations" in the BASIC OPERATIONS instruction manual of the robot controller.

INFO.

The name of the backup folder is given automatically using the following format.

NRA2001–2012–12–20–1200

| | Date | Time |

Opening the backup screen
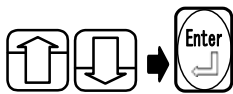
1 **Select "10 File Backup" on the file operation menu, and press [Enter].**

>> The [File Backup] screen is now opened.
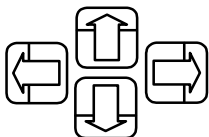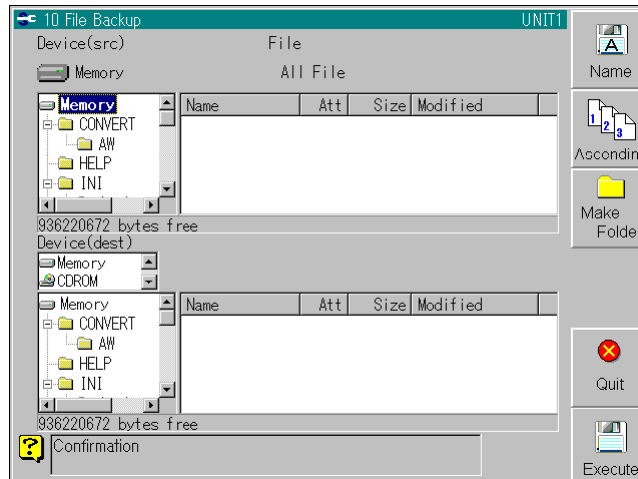
2 **Files are backed up on this screen.**
To move through each field, use the left and right keys.
To select the items displayed in the fields, use the up and down keys.

Backing up the folders

1   **In the device selection field, select "Card1" for instance.**

2   **Move to the folder selection field, select the backup destination folder, and press [Enter].**
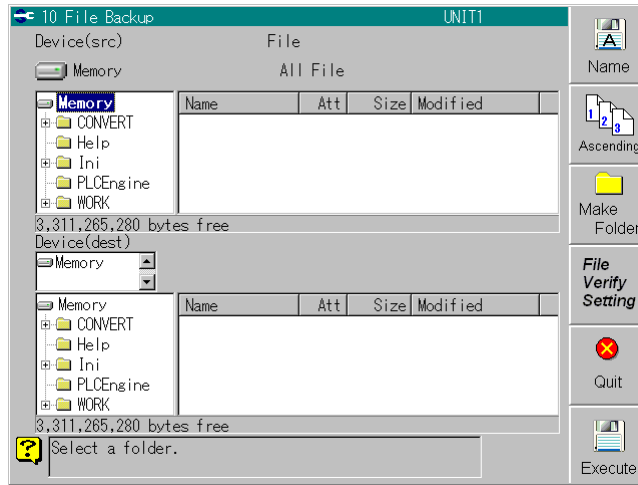
3   **Press f12 <Execute>.**

    >> Backup now starts.

3.4   Creating the setup data

This section describes the procedure for creating the data required for connecting a Welbee Inverter series welding power source to the interface and using the power source (this is called the "setup data").
The setup data consists of the following 2 data types.

- Data to be written onto the interface
  This is the data for converting the welding mode registered in the robot controller (see 3.3.2) into the welding mode that will actually be used in the Welbee Inverter series welding power source.
- Welding characteristic data file to be written onto the robot controller
  This is the welding characteristic data file with the current and voltage output characteristics changed to match the welding mode of the Welbee Inverter series welding power source that will be used.

The "Welding Interface (Digital) Setup" tool is used in the operations in this section.

3.4.1   Configuring the setup tool

Select the folder for saving the backup created in "3.3 Configuring the robot controller", and the folder for saving the setup data of Welding Interface (Digital).

Selecting a backup folder

1   **Connect the CF card that stores the backup data obtained in "3.3.3 Creating a backup" to a computer.**

2   **Double-click "MakeConfigWIF.exe" in the "Welding Interface (Digital) Setup" folder.**
>> The setup tool starts and the folder browse window opens.

Alternatively, after "Welding Interface (Digital) Setup" starts, select "Select Backup folder" in the "Settings" menu.
>> The folder browse window opens.
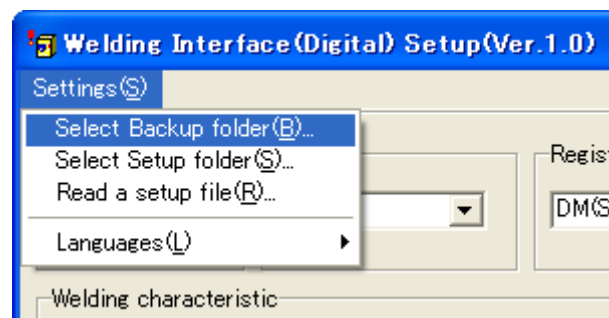
3   **Select the backup you created in "3.3.3 Creating a backup".**
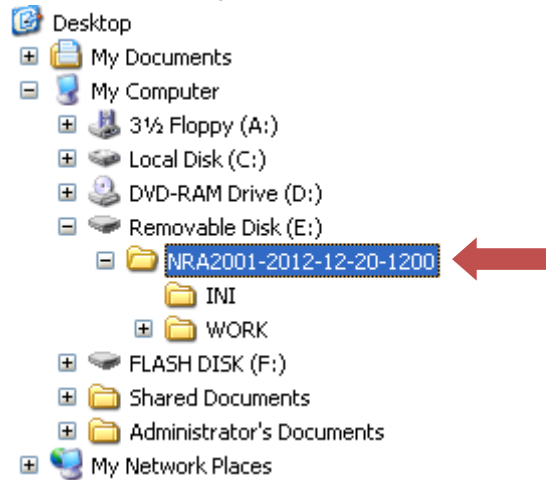
4   **Select the backup folder.**

>> The backup data of the robot controller is loaded from the selected backup folder, and "Welding Interface (Digital) Setup" starts.
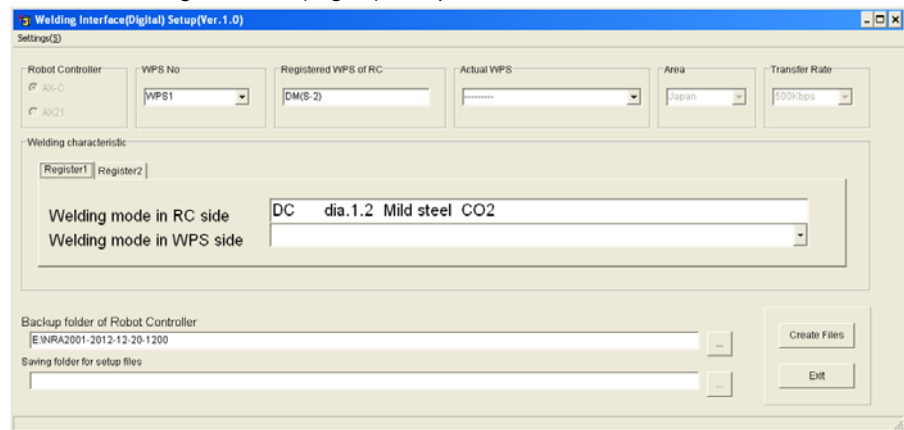

The name of the backup folder is given automatically using the following format.

NRA2001−2012−12−20−1200

Date   Time

Selecting the save folder for the setup data

1   **Connect the USB memory you prepared in "3.2.2 USB memory preparations" to the computer.**

2   **Select "Select Setup folder" in the "Settings" menu.**
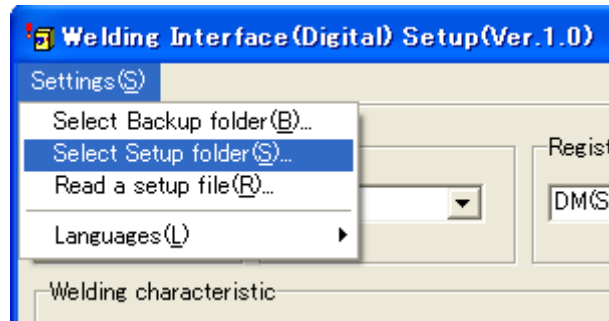
3   **Select the "UPDATE" folder that you created in the USB memory.**
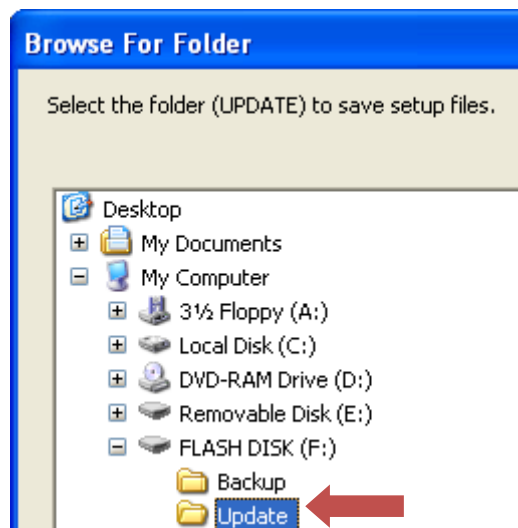
INFO.   If you have not yet created the "UPDATE" folder, you can create it with the "Create new folder" button. For details on the "UPDATE" folder location, see "3.2.2 USB memory preparations".

3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source

Associate the welding mode used in the Welbee Inverter series welding power source with the welding mode registered in the robot controller, and save this information in the setup data. For details on the welding modes that can be used, see "Chapter 1 Introduction" in this manual.

> **POINT**
>
> When the setup data is created, the welding characteristic data selected in "3.3.2 Register the welding mode" is replaced with the data for Welbee Inverter welding power source.
> The welding characteristic data saved in the backup data specified in "3.4.1 Configuring the setup tool" is replaced.

Associating the welding modes of the robot controller and Welbee Inverter welding power source

1   In [WPS No], select the welding power source registered in the robot controller.

>> The type of the registered welding power source is displayed in [Registered WPS of RC].

2   In [Actual WPS], select the Welbee Inverter series welding power source to be used.

>> If you cannot select the power source you want, refer to "3.3.1 Registering the welding power source" and check the correspondence between the D series welding power source and Welbee Inverter series welding power source. If there is no corresponding power source, perform the procedure again from "3.3.1 Registering the welding power source".

> **POINT**
>
> **When the "Use welding char." checkbox is displayed**
>
>
>
> Check this box when replacing an existing D series welding power source with a Welbee Inverter series welding power source. Checking this box changes the welding characteristic data file to current and voltage output characteristics silimar to those of the D series welding power source.
> Unchecking the box changes the welding characteristic data file to the original current and voltage output characteristics for the Welbee Inverter series welding power source.

3   **In the [Welding characteristic] item, select the welding mode to use with the Welbee Inverter series welding power source.**

>> The welding mode displayed in [Welding mode in RC side] is associated with the welding mode set in this step.
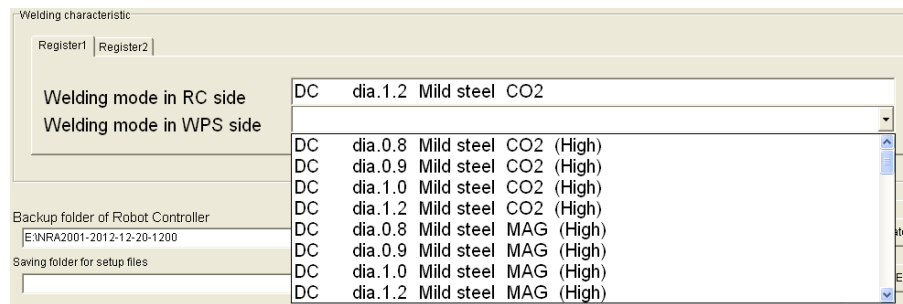
INFO.	For details on selecting the welding mode, also see "3.3.2 Register the welding mode".

4   **If multiple welding modes are registered in the robot controller, select the next [Register] tab and repeat the operation from step 3. In this way, associate all the welding modes registered in the robot controller with the welding modes of the Welbee Inverter series welding power source.**

5   **Press the [Create Files] button.**

>> The setup data is created. The setup data is saved on **both the USB memory and the CF card (that stores the robot controller backup)** selected in "3.4.1 Configuring the setup tool".
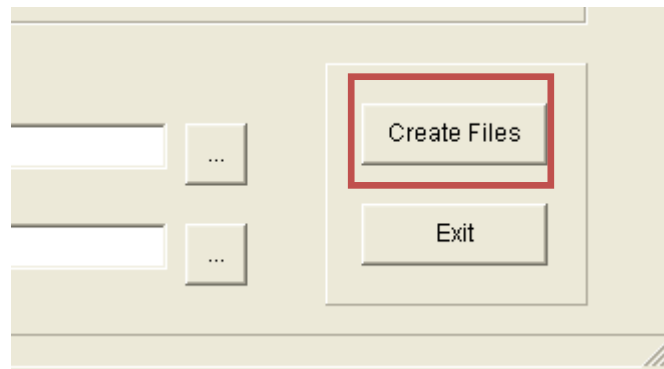
3.5 Writing the setup data

This section describes the procedure for writing the setup data you created in "3.4 Creating the setup data" onto Welding Interface (Digital) and the robot controller.

3.5.1 Writing the setup data onto the robot controller

Write the setup data you created in "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source" onto the robot controller.

Writing the setup data onto the robot controller

1 **While the power of the robot controller is OFF, insert the backup CF card that you created in "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source" into the robot controller.**
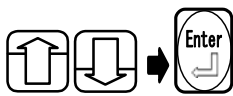
2 **While the power of the robot controller is ON,**
Select "1 File Copy" on the file operation menu, and press [Enter].

>> The [File Copy] screen is now opened.
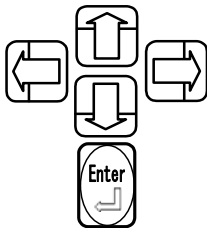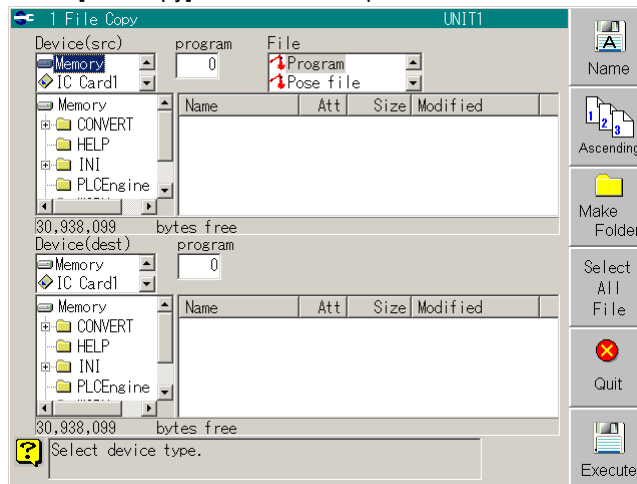
3 **Select "Card 1" in the Device (src) selection field.**
To move through each field, use the [left or right] keys.
To select the items displayed in the fields, use the [up or down] keys.

4 **In "Card 1", select the folder that stores the backup, select "WORK" →**
"A_APPLICATION" → "WELD" in this order, and then press [Enter].

>> The "WELD" folder is selected.
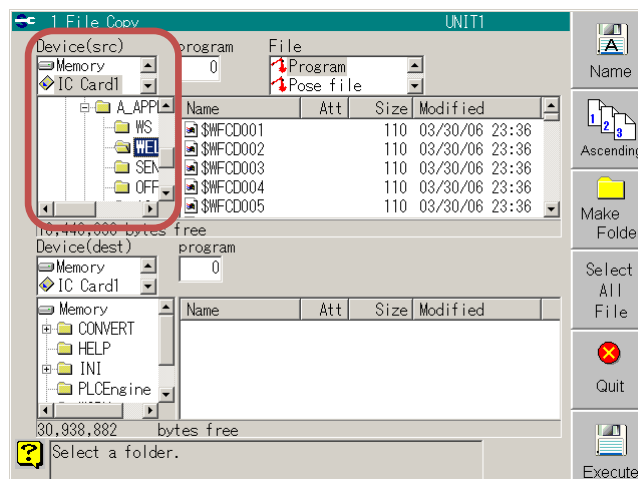
5 **In the "Device (dest)" folder selection field, select the folders in the order of "Internal memory" → "WORK" → "A_APPLICATION", and then press [Enter].**

>> The "A_APPLICATION" folder is selected.
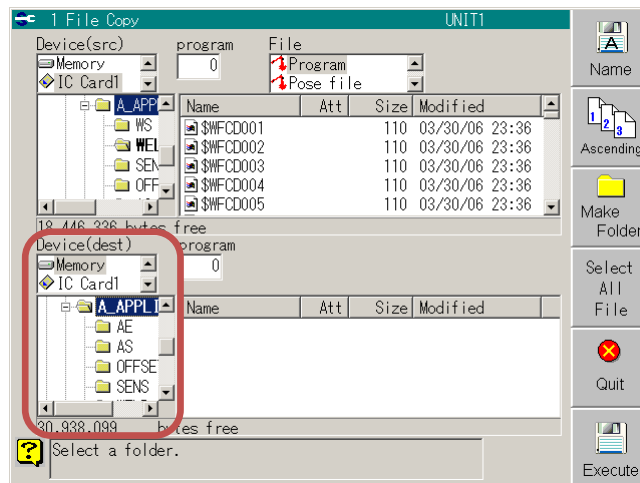
POINT In step **5**, select "A_APPLICATION", not the "WELD" folder you selected in step **4**.

6 **Press f12 <Execute>.**

>>The setup data is written onto the robot controller.

3.5.2 Writing the setup data onto Welding Interface (Digital)

Write the setup data you created in "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source" onto Welding Interface (Digital).

Writing the setup data onto Welding Interface (Digital)

IMPORTANT

Make sure that the power of the robot controller is OFF before inserting the USB memory or operating a DIP switch.

1 **While the power of the robot controller is OFF, connect the USB memory to the Welding Interface (Digital) board.**

USB port

7 segment LED
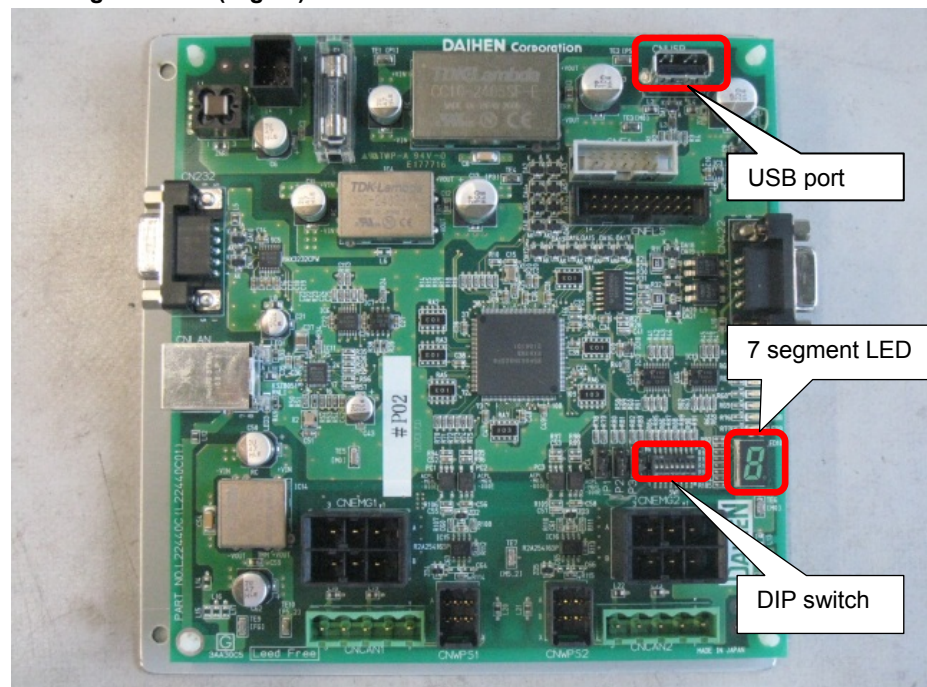
DIP switch

2 **While the power of the robot controller is OFF, turn ON the No. 3 DIP switch on the Welding Interface (Digital) board. Turn OFF the other DIP switches.**

3 **Turn ON the power of the robot controller.**

>> After 10 seconds, the writing of the setup data onto the interface starts automatically. The setup data writing finishes after approximately 10 seconds.

4 **When the 7-segment LED displays 'E' → 'n' → 'd' in order, check on the robot controller teach pendant that the robot controller has started, turn OFF the robot controller power, and then turn OFF all the DIP switches. Take off the USB memory.**

>> This completes the configuration of the Welding Interface (Digital) board.

IMPORTANT

After turning ON the power of the robot controller, do not turn OFF the power until the starting process has completed (do not turn OFF during startup).

INFO.

If 'E' → 'n' → 'd' is not displayed, see "Chapter 4 Maintenance".

When these steps are performed, the setup file already written in this board is backed up automatically to a USB memory.
If step **2** is changed "Both No.2 and No.3 of a DIP switch are turned ON", the setup file can be restored from backup.

3.6 Check the configuration

Use the following procedure to check that the configuration up to section 3.5 was performed correctly.

Writing the setup data onto the robot controller

1 **Turn OFF the power of the robot controller and welding power source.**

2 **Turn ON the power of the welding power source.**

>> Check that "000 000" blinks on the front panel of the welding power source.

If different from above, refer to "Chapter 2 Connections", and check that control cable 5 is connected, and that the STOP (+) / STOP (-) jumper wire of terminal block TM3 on the PCB10 printed circuit board of the Welbee Inverter series welding power source is removed.

3 **Turn ON the power of the robot controller.**

>> On the teach pendant (TP) of the robot controller, check that the starting process has completed and that the robot controller is ready for operation.

>> Next, check on the TP that no errors related to the welding power source have occurred, such as "A5013 Power of arc welding power source not ON."

If different from above, refer to "Chapter 2 Connections" and "Chapter 4 Maintenance", and check that the interface and the robot controller, and the interface and the welding power source are connected correctly. Also, perform "3.5 Writing the setup data" again.

4 **Check that the emergency stop is not being input to the robot controller, and check whether errors other than those described above have occurred.**

If the emergency stop is being input, cancel it.
If an error has occurred, troubleshoot by referring to the instruction manual of the robot controller.

5 **Check that the front panel display of the welding power source is as follows.**

    (1) **The "000 000" blinking has gone off.**

    (2) **The dots to the bottom right of the left and right digital meters are blinking.**

    (3) **The display indicating the welding mode (wire diameter, material and gas) is the last welding mode (mode with the highest registration number) that was registered in "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source".**

If different from (1) above, refer to "Chapter 2 Connections" and check that the interface is connected correctly.

If different from (2) or (3) above, refer to "Chapter 4 Maintenance" and check that no errors have occurred for the interface. Also, perform "3.3 Configuring the robot controller" to "3.5 Writing the setup data" again.

6 **Operate the TP of the robot controller to check that the gas check and the inching/retracting of the welding wire was executed correctly.**

If different from above, check that "3.3 Configuring the robot controller" was performed correctly.

>> The setup operations were completed correctly.

3.7 Configuring the Welbee Inverter series welding power source

This section describes the front panel operations and internal functions of the welding power source when a Welbee Inverter series welding power source is to be connected with the robot.

3.7.1 The welding power source operations when a robot is connected

When Welbee Inverter Series welding characteristics is connected to the robot, operable keys are displayed in Table 3.7.1. The keys, other than the ones indicated, cannot be used.
All basic settings such as selecting the welding modes and setting the welding conditions are performed by commands from the robots.

> **INFO.**
>
> **Concerning the operation of the welding power source**
> For details on how to operate the welding power source, refer to its instruction manual.
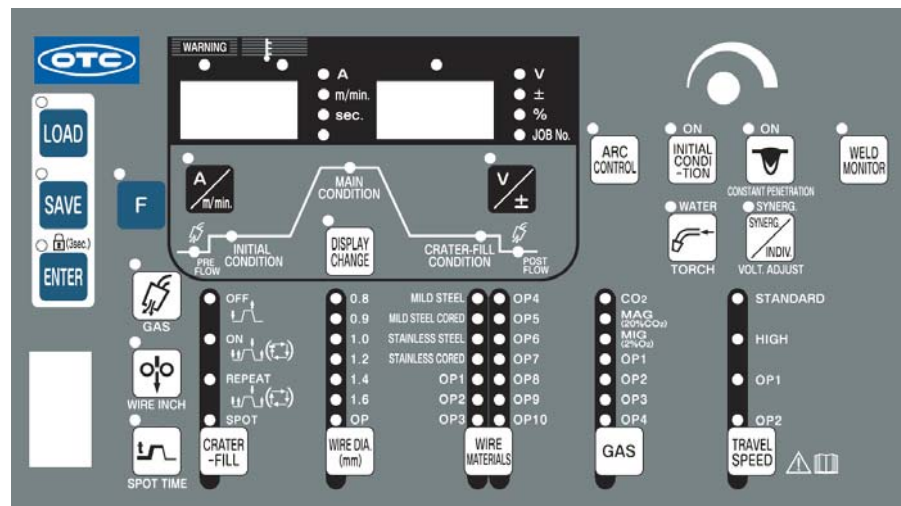
Figure 3.7.1   Welbee Inverter series welding power source Front Panel

Table 3.7.1   Keys that can be used when the welding power source is connected to a robot

Key name	Description of function
LOAD	Used when saving a simple data log to a USB memory. For details, see the instruction manual for the welding power source.
ENTER	This key cannot work alone. Press [ENTER] key for a while (Approx. 3 sec.) to switch the key lock ON/OFF. When the key lock is ON, LED for [ENTER] key flashes.
GAS CHECK	When the key is pressed once, gas is discharged (for up to 2 minutes), and the LED lights. When it is pressed again, the gas discharge stops, and the LED goes off.
F	When the key lock is disabled, the functions (status settings) become available by holding down this key for a few seconds. But the settings of the functions are ignored when Welbee Inverter series is configured for a robot. If holding down the [F] key when turning ON the power, the software version is displayed.

> **INFO.**
>
> When set for the robot dedicated application, all LEDs in TRAVEL SPEED key are OFF.

3.7.2 The welding power source internal functions when a robot is connected

When a Welbee Inverter series welding power source is connected to the robot, internal functions that can be used with the welding power source are displayed in Table 3.7.2. Any other functions related to the welding control and welding performance itself are configured by the welding constants.

Table 3.7.2   Internal functions that can be used when the Welbee Inverter series welding power source is connected to a robot

Function number	Function name	Function
4	Auto/Semi auto mode	Switches the I/O settings for the welding power source. 0 : Semi-automatic machine 1 : Automatic 1 2 : Automatic 2 3 : OTC robot 1 (500Kbps mode) 4 : OTC robot 2 (1Mbps mode)
8	Setting of Result Display Holding Time	See the instruction manual for the welding power source.
21	Cooling fan maximum operation	See the instruction manual for the welding power source.
22	Keypad tone ON/OFF Selection	See the instruction manual for the welding power source.
43	Welders ID (CANID)	This is used to set the numbers (1 to 4) of the welding power sources. Select <Arc Constant> – [1 Registration of welder], and select the numbers corresponding to the welding power sources to be registered.

IMPORTANT

- Do not change any other internal functions other than the above.
  If changes are made, the welding power source may not operate properly. However, it may be necessary to configure the settings separately for the function when the registered welding power source is DP. For details, see "3.11.7   Settgins on the Welding Power Source Side" or "3.11.7 Settgins on the Welding Power Source Side".
- As for the function number 4 [Auto/Semi-auto mode], set it to "3: OTC robot 1 (500Kbps)".

INFO.

In the initial factory settings, the setting for function number 4 "Auto/Semi auto mode" is set to "0: Semi-automatic machine".
If the welding power source is communicating normally with the robot controller, the lowest dots in the left/right digital meters are blinked.

3.8 Welding conditions of WB-M350L

This section describes the welding conditions that can be set when WB-M350L is connected.

3.8.1 About the welding condition parameters

The welding conditions that can be set when WB-M350L is connected using the interface are shown in Table 3.8.1. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.8.1   Welding conditions of WB-M350L

Welding conditions		Welding power source registered in robot controller	
		DL	DL(S-2)
AS	Welding process	○ [*1]	○ [*1]
	Current cond.	○	○
	Welding current / Wire speed	○	○
	Welding voltage / Arc length tun.	○	○
	Welding speed	○	○
	Arc char.1(Short)	○	○
	Arc char.2(Arc)	○	○
	APCS cond.	○	○
	APCS parameter 1 / APCS parameter 1 EP [*2]	○	○
	APCS parameter 2 / APCS parameter 2 EP [*2]	○	○
	Slope time / Slope distance	○	○
	Initial current / Ini. wire speed	○	○
	Initial voltage / Ini. arc length	○	○
	Start adjust time	×	○
	Start voltage adj	×	○
AE	Welding process	○ [*1]	○ [*1]
	Current cond.	○	○
	Welding current / Wire speed	○	○
	Welding voltage / Arc length tun.	○	○
	Crater time	○	○
	Post flow time	○	○
	Arc char.1(Short)	○	○
	Arc char.2(Arc)	○	○
	APCS cond.	× [*3]	× [*3]
	APCS parameter 1 / APCS parameter 1 EP [*2]	○	○
	APCS parameter 2 / APCS parameter 2 EP [*2]	○	○
	Slope time / Slope distance	○	○
	Burnback pulse	○	○
	Burnback pulse value	○	○

○: Can be used

×: Cannot be used (operates with the initial value of the welding power source)

*1: The welding mode displayed on the robot controller may be different from the welding mode of the Welbee Inverter welding power source. For details, see "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source".

*2: The parameter names may be different depending on the welding power source, but the functions are not different. For details on the functions, see "3.8.3 How the spatter adjustment parameter (APCS cond.) is used" described later.

*3: Always set to "AUTO".

3.8.2 Points for setting the conditions

The points to be observed when setting the welding conditions are set forth below.

Concerning the welding current and wire feed speed
The welding current (or wire feed speed) which is input as a welding condition becomes the average current (or average wire feed speed) during welding. The welding waveform control parameter optimally suited for the welding current (or wire feed speed) which has been set is calculated automatically on the basis of the welding current (or wire feed speed) which has been input.

Concerning the arc length tuning
The WB-M350L has two modes: synergic adjustments and individual adjustments.
When it is used in the synergic adjustment, the optimum voltage for the current which has been set is output automatically. The "arc length tun." is an adjustment value for increasing or reducing the voltage which is output automatically. For instance, if a setting of +5 is used, the output voltage will be raised by about 0.5 V as a theoretical value.

Concerning the input of the wire feed speed
The wire feed speeds which are actually valid as welding conditions differ according to the welder and welding mode used. If the standard software has been installed in the welder, the minimum speed is approximately 130 cm/min. and the maximum speed is approximately 1800 cm/min. as a general rule. However, depending on the welding mode, the maximum and minimum wire feed speed may be more restricted than the ranges given.

Concerning the setting range of the welding speed
Although any speed from 1 to 999 cm/min. can be set as the welding speed, the maximum speed is actually 600 cm/min. or so. Since this is also the maximum operable speed and not a speed which can be used for actual welding, it must be adjusted to ensure optimum welding.

Concerning the Arc char.1 (Short)
The arc characteristic is expressed in the form of a numerical value which enables the arc hardness or softness to be set.
A "+" figure yields a soft arc with minimized short-circuit current peaks.
A "−" figure yields a hard arc yielded by a high short-circuit current.

Concerning the Arc char.2 (Arc)
As with the Arc char.1 setting, the values for this condition enable hard or soft to be set for the arcs.
A "+" figure yields a soft arc with minimized current change in the arc discharge.
A "−" figure yields a hard arc with the large current change in the arc discharge.

> **INFO.**
> In the case where the arc characteristic is set in "+" side, the further minimizing spatter may be found in the current area where the angular-advance spatter-reducing effect can be produced. However, if the value is set too high, the welding easily becomes unstable and the electrical tolerance of the condition will drop to a lower value. A "−" figure setting yields a stronger immunity to the fluctuations in the protruding wire and an improved stability of the posture welding. Note that if the high value is set in the respective sides "+" and "−", the welding may become unstable.
> Normally, set the same values to Arc char.1 (Short) and Arc char.2 (Arc).

What is the slowdown speed?
The slowdown speed denotes the speed at which the wire is fed until the arc is started at the arc start point.

When crater treatment is not performed
When crater treatment is not going to be performed, set the crater time to "0." However, in this case, set the same conditions as for regular welding as the crater current or wire feed speed setting value. Unless the same conditions are set, the appropriate burnback voltage level may not be displayed properly at the teaching stage.

> **IMPORTANT**
> When the crater time has been set at 0, the "Welding method" for the arc end condition shall be set to the same one for the main welding.

Concerning the burnback pulse control
Teaching of this parameter is available only when the wire material is SUS. This should be normally set to "ON".
Meanwhile, the burnback pulse output value should be normally set to "0".
This shall be set to "OFF" only when a meltdown occurs on the thin plate during burnback.

3.8.3 How the spatter adjustment parameter (APCS cond.) is used

In short arc welding where short-circuits and arcs are repeated, most of the spatter is generated when short-circuiting occurs and immediately before arc generation. A phenomenon referred to as "necking" occurs in the wires immediately before arc generation of the latter category, as shown in the figure below. By detecting this necking and sharply reducing the current at that instant, the melted metal is not blown about by the arc force and the generation of spatter can be significantly reduced. To achieve this, it is most essential to detect the necking. Unless the necking is detected at the appropriate timing, it will lead to the generation of spatter. The sensitivity with which necking is detected can be adjusted using the APCS parameters.
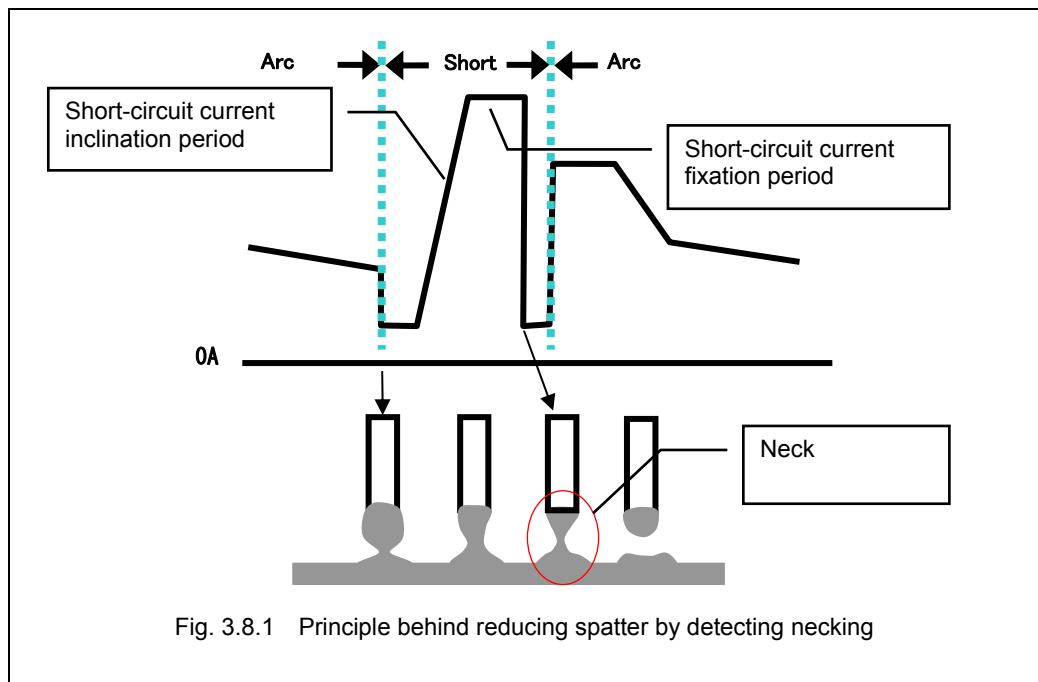
Fig. 3.8.1   Principle behind reducing spatter by detecting necking

The sensitivity for detecting necking is set in advance for each welding method and wire diameter. However, this sensitivity is affected by such factors as the welding environment (lengths and routing of secondary cables) and the actual welding conditions (welding conditions such as the posture, lap welding and fillet welding, and the protrusion length of the wire). For this reason, the preset necking detection sensitivity is not necessarily optimal, and the generation of spatter may not be reduced satisfactorily.
WB-M350L has a function for automatically adjusting the necking detection sensitivity in the face function. It is called the automatic necking sensitivity adjustment function.

Whether the necking is being detected properly can be determined by the "reduction rate" on the arc monitor.

Table 3.8.2   Reduction rate

Reduction rate (%)	Denotation
100 to 90	"Necking" detection has been performed properly.
90 to 70	"Necking" detection has been performed basically. The reduction rate may be improved by reviewing the working environment.
Under 70	Review the working environment in accordance with "working environment checklist" described in the instruction manual for the welding power source. In addition, if the welding is unstable, review the welding conditions.
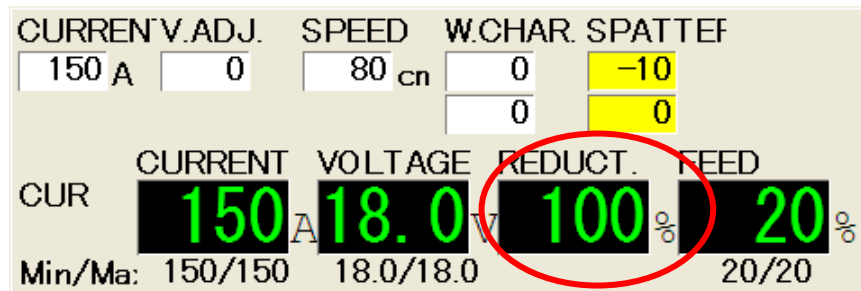
The automatic adjustment results are displayed on the arc monitor upon completion of welding (after the AE command has been executed). If, however, welding is suspended due to a temporary stop or other action, the adjustment results immediately prior to the action will be displayed.

POINT

How to reduce the spatter and keep the condition
In order to reduce spatter, it is necessary for necking to be detected properly. To this end, the arc voltage must be fed back accurately. If the voltage cannot be obtained properly because the arc voltage feed back is affected by noise, the necking will not be detected properly, and this will give rise to spatter. Furthermore, the automatic necking sensitivity adjustment function will not work properly either. If the welding is unstable and large amount of spatter are generated, review the routing of the voltage detection cable in accordance with the "working environment checklist" described in the instruction manual for the welding power source.

INFO.

How to automatically adjust APCS parameter specifying the initial value
It is possible to set the initial value to APCS parameter. To set it, first, select "TEACH" for the spatter adjustment method and input the values in "APCS parameter 1 EP/EN" or "APCS parameter 2 EP/EN".
Then, select "AUTO" for the spatter adjustment method and store the data.

How to reflect the results of the automatic necking sensitivity adjustment in the AS command
When the automatic necking sensitivity adjustment function is enabled (AUTO is selected as the APCS cond. setting), the background of "Spatter" on the arc monitor turns yellow.
At this point, press [Edit] on the arc monitor to establish a status which enables on-line changes to be made. When f12 <Complete> or [Edit] is pressed, the APCS parameters set at the time are stored in the memory as the conditions of the AS command.
As with on-line changes, these parameters can also be stored in the memory automatically upon completion of welding.

> **POINT**
>
> **In the case where the automatic necking sensitivity adjustment is not performed**
>
> In the case of corresponding to the welding conditions shown in Table 3.8.3, automatic adjustment isn't applied. The fixed adequate conditions in the welding power source are applied.

Table 3.8.3　Field where automatic necking sensitivity adjustment is not performed

Welding mode			Current setting value
Wire material	Gas	Wire diameter	
Mild steel solid	CO2	0.8, 0.9, 1.0, 1.2	300A or over
	MAG	0.8, 0.9, 1.0, 1.2	

3.8.4　About the welding constants

The welding constants that can be set when WB-M350L is connected using the interface are shown in Table 3.8.4. Welding constants not included in this table cannot be used.

Table 3.8.4　Welding constants of WB-M350L

Item	Welding power source registration	
	DL(S1)	DL(S2)
Inching/Retract speed	○	○
Inching/Retract Key operation	○	○
Gas check operation	○	○
Preflow time	○	○
Arc outage detect time	○	○
Online modification cycle	○	○
Auto. storing for online mod.	○	○
Arc start failure detect time	○	○
Arc start timing adjust time	○	○
Arc start retry number	○	○
Wire retract time	○	○
Scratch start	○	○
Waiting time after welding starts	○	○
Arc end timing adjustment time	○	○
Wire stick check	○	○
Wire stick release time	○	○
WIF timeout check	○	○
Restart retract distance	○	○
Arc monitor display cycle	○	○
Arc monitor sample data num	○	○
Welding curr./volt. fail. act.	○	○
Welding current failure limit	○	○
Welding voltage failure limit	○	○
Wire feed load fail action	○	○
Wire feed load fail rate	○	○
Stop welder at END	○	○
WIF timeout check adjust.	○	○
Turbo start	○	○
Arc outage detect. time (Arc End)	○	○

○: Can be used.

3.9 Welding conditions of WB-M350/500

This section describes the welding conditions that can be set when WB-M350/500 is connected.

3.9.1 About the welding condition parameters

For the WB-M350/500 welding power source, the welding conditions shown in Table 3.9.1 can be set. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding conditions not included in this table cannot be used with the interface.

Table 3.9.1   Welding conditions of WB-M350/500

Welding condition		Welding power source registered on robot controller		
		DM	DM(S-2)	DR
AS	Welding process	○*1	○*1	○*1
	Current cond.	○	○	○
	Penetration adjustment	×	×	×
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Welding speed	○	○	○
	Arc character.	○	○	○
	Slope time / Slope distance	×	○	○
	Initial current / Ini. wire speed	×	○	○
	Initial voltage / Ini. arc length	×	○	○
AE	Welding process	○*1	○*1	○*1
	Current cond.	○	○	○
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Crater time	○	○	○
	Post flow time	○	○	○
	Arc character.	○	○	○
	Slope time / Slope distance	×	○	○

○: Can be used

×: Cannot be used (operates with the initial value of the welding power source)

*1: The welding mode displayed on the robot controller may be different from the welding mode of the Welbee Inverter welding power source. For details, see "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source".

3.9.2 Points for setting the conditions

The points to be observed when setting the welding conditions are set forth below.

Concerning the welding current and wire feed speed
The welding current (or wire feed speed) which is input as a welding condition becomes the average current (or average wire feed speed) during welding. The welding waveform control parameter optimally suited for the welding current (or wire feed speed) which has been set is calculated automatically on the basis of the welding current (or wire feed speed) which has been input.

Concerning the arc length tuning
The WB-M350/500 has two modes: synergic adjustments and individual adjustments.
When it is used in the synergic adjustment, the optimum voltage for the current which has been set is output automatically. The "arc length tun." is an adjustment value for increasing or reducing the voltage which is output automatically. For instance, if a setting of +5 is used, the output voltage will be raised by about 0.5 V as a theoretical value.

Concerning the input of the wire feed speed
The wire feed speeds which are actually valid as welding conditions differ according to the welder and welding mode used. If the standard software has been installed in the welder, the minimum speed is approximately 130 cm/min. and the maximum speed is approximately 1800 cm/min. as a general rule. However, depending on the welding mode, the maximum and minimum wire feed speed may be more restricted than the ranges given.

Concerning the setting range of the welding speed
Although any speed from 1 to 999 cm/min. can be set as the welding speed, the maximum speed is actually 600 cm/min. or so. Since this is also the maximum operable speed and not a speed which can be used for actual welding, it must be adjusted to ensure optimum welding.

Concerning the arc characteristic
The arc characteristic is the value that enables to set hard/soft of the arc. Intensive and hard arcs are generated by increasing this value to the (–) side, while extensive and soft arcs to the (+) side.

When crater treatment is not performed
When crater treatment is not going to be performed, set the crater time to "0." However, in this case, set the same conditions as for regular welding as the crater current or wire feed speed setting value. Unless the same conditions are set, the appropriate burnback voltage level may not be displayed properly at the teaching stage.

IMPORTANT

When the crater time has been set at 0, the "Welding method" for the arc end condition shall be set to the same one for the main welding.

3.9.3 About the welding constants

The welding constants that can be set when WB-M350/500 is connected using the interface are shown in Table 3.9.2. Some of the welding constants available for setting vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.9.2 Welding constants of WB-M350/500

Item	Welding power source registration		
	DM(S1)	DM(S2)	DR
Inching/Retract speed	○	○	○
Inching/Retract Key operation	○	○	○
Gas check operation	○	○	○
Preflow time	○	○	○
Arc outage detect time	○	○	○
Online modification cycle	○	○	○
Auto. storing for online mod.	○	○	○
Arc start failure detect time	○	○	○
Arc start timing adjust time	○	○	○
Arc start retry number	○	○	○
Wire retract time	○	○	○
Scratch start	○	○	○
Waiting time after welding starts	○	○	○
Arc end timing adjustment time	○	○	○
Wire stick check	○	○	○
Wire stick release time	○	○	○
WIF timeout check	○	○	○
Restart retract distance	○	○	○
Arc monitor display cycle	─	─	○
Arc monitor sample data num	○	○	○
Welding curr./volt. fail. act.	○	○	○
Welding current failure limit	○	○	○
Welding voltage failure limit	○	○	○
Wire feed load fail action	○	○	○
Wire feed load fail rate	○	○	○
Stop welder at END	○	○	○
WIF timeout check adjust.	○	○	○
Turbo start	○[*1]	○[*1]	○
Penetration adjustment	─	○	─
Arc outage detect. time (Arc End)	─	○	○

○: Can be used.

×: Cannot be used. (Operates with the initial value of the welding power source.)

∗1: Operates with the "Auto" setting set to "ON".

3.10 Welding conditions of WB-P350

This section describes the welding conditions that can be set when WB-P350 is connected.

3.10.1 About the welding condition parameters

The welding conditions that can be set when WB-P350 is connected using the interface are shown in Table 3.10.1. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.10.1 Welding conditions of WB-P350

Condition		Welding method		
		DC	DC pulsed	DC wave pulsed
AS	Welding process	○※	○※	○※
	Current cond.	○	○	○
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Welding speed	○	○	○
	Pulse arc characteristic	—	○	○
	Arc character.	○	—	—
	Slope time / Slope distance	○	○	○
	Initial current / Ini. wire speed	○	○	○
	Initial voltage / Ini. arc length	○	○	○
	Wave frequency	—	—	○
AE	Welding process	○※	○※	○※
	Current cond.	○	○	○
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Crater time	○	○	○
	Post flow time	○	○	○
	Pulse arc characteristic	—	○	○
	Arc character.	○	—	—
	Slope time / Slope distance	○	○	○
	Wave frequency	—	—	○
	Burnback adj. T.	—	○	○

○: Can be used

—: Cannot be used.

※: The welding mode displayed on the robot controller may be different from the welding mode of the Welbee Inverter welding power source. For details, see "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source".

3.10.2 Points for setting the conditions

The points to be observed when setting the welding conditions are set forth below.

Concerning the welding current and wire feed speed
> The welding current (or wire feed speed) which is input as a welding condition becomes the average current (or average wire feed speed) during welding. The welding waveform control parameter optimally suited for the welding current (or wire feed speed) which has been set is calculated automatically on the basis of the welding current (or wire feed speed) which has been input.

Concerning the arc length tuning
> The WB-P350 has two modes: synergic adjustments and individual adjustments.
> When it is used in the synergic adjustment, the optimum voltage for the current which has been set is output automatically. The "arc length tun." is an adjustment value for increasing or reducing the voltage which is output automatically. For instance, if a setting of +5 is used, the output voltage will be raised by about 0.5 V as a theoretical value.

Concerning the input of the wire feed speed
> The wire feed speeds which are actually valid as welding conditions differ according to the welder and welding mode used. If the standard software has been installed in the welder, the minimum speed is approximately 130 cm/min. and the maximum speed is approximately 1800 cm/min. as a general rule. However, depending on the welding mode, the maximum and minimum wire feed speed may be more restricted than the ranges given.

Concerning the setting range of the welding speed
> Although any speed from 1 to 999 cm/min. can be set as the welding speed, the maximum speed is actually 600 cm/min. or so. Since this is also the maximum operable speed and not a speed which can be used for actual welding, it must be adjusted to ensure optimum welding.

Concerning the arc characteristic
> The arc characteristic is the value that enables to set hard/soft of the arc. Intensive and hard arcs are generated by increasing this value to the (–) side, while extensive and soft arcs to the (+) side.

When crater treatment is not performed
> When crater treatment is not going to be performed, set the crater time to "0." However, in this case, set the same conditions as for regular welding as the crater current or wire feed speed setting value. Unless the same conditions are set, the appropriate burnback voltage level may not be displayed properly at the teaching stage.

IMPORTANT

> When the crater time has been set at 0, the "Welding method" for the arc end condition shall be set to the same one for the main welding.

Concerning the pulse conditions
> To adjust the pulse conditions, proceed by changing "arc characteristic" and "pulse frequency", described in 3.10.1 . And refer to "3.10.2 Points for setting the conditions"

3.10.3 To adjust the pulse conditions

Generally, to adjust the pulse conditions, the following two parameters are the only ones that need to be changed.

• Arc characteristic ... For hardening or softening the condition of the arc.
• Wave frequency ... For adjusting the ripple pitch of the beads shaped like fish scales.

What are the arc characteristic?
The arc characteristic is a parameter used for internally, adjusting the pulse rise time and pulse fall time. When its value is increased, an expansive soft arc is obtained; conversely, when it is reduced, a concentrated hard arc is obtained.

What is the wave frequency?
For the wave pulsed welding method periodical changes of the wire feed speed and the unit pulse condition can be made in low frequencies. Furthermore, synchronizing this periodic cycle, then the deposition rate can be increased / decreased and the vibrations of the molten pool can be made.
For aluminum alloy welding, beads shaped like fish scales can be formed. This welding improves the ability to counter gaps that may exist in the welded areas. Furthermore, grain size can be minimized by the stirring effect, caused by the molten pool vibration, and tolerance of welding cracks will also be improved.
For steel and stainless welding, the melted metal takes time to solidify. Therefore, in this welding, there are cases where clear beads, shaped like fish scales, cannot be formulated, because the metal flows before it can solidify. However, the blowhole can be reduced by the stirring effect caused by the molten pool vibrations.
The wave pulsed welding method will change the wire feed speed, unit pulse conditions, etc. However, for changes of the wire feed speed, if the wire feed motor's response characteristic comes close to a limiting value, the feed amplitude will automatically be reduced. If the wave frequency is over 3 Hz, the speed of the wire feed will gradually be reduced. If it exceeds over 5 Hz the amplitude will run out. In this case, the wire feed speed with stabilize and only the unit pulse condition will change.
For aluminum alloy welding where the beads can be formed in shapes of fish scales, it is possible to adjust the ripple pitches freely, depending on the combinations between the welding speed and wave frequency.
The width of the pitches will become narrow if the wave frequencies are expanded without changing the welding speed. Vise versa, if the frequencies are made smaller with the welding speed unchanged, the pitches will widen.

Bead

The beads shaped like fish scales can be adjusted using the wave frequency. During automatic operation a fixed interval is maintained, but the ripple pitch interval may be disrupted by temporary stop and restart thereafter.

Detail

The ripple pitch

Fig 3.10.1 Adjustment of beads shaped like fish scales using wave frequency

INFO.

• In some cases, ripple patterns of the welded beads may not be precisely visible depending on the type of material used, welding speed and the heat input during welding. Especially, the patterns of welding materials such as the SUS, a mild steel that takes time to harden, cannot be seen unlike the welded beads of aluminum alloy welding.

• There is a major relationship between the reduction of blowholes and the measure of the melted metal's vibration. The bigger the extent of the molten pool, the bigger the vibrations as well; reducing more blowholes. On the contrary, if the molten pool is small, then fewer blowholes will be eliminated. If thicker beads are used for welding, the effects are bigger. However, blowholes should not be taken away from all of the welding materials such as extremely thick coated or oil-based steel products and cast materials.

• If short-circuit occurs frequently while welding using soft aluminum, the overview of the bead could appear black.

3.10.4 Waveform control with DC wave pulsed welding

DC wave pulsed welding is essentially pulsed welding, where a wave frequency period consists of a low pulse section and high pulse section. The number of pulses in a low pulse section and high pulse section in each period depends on the wave frequency and pulse conditions.

Waveform control (arc start - welding underway - crater treatment) is conducted as follows.

Fig 3.10.2   Waveform control with the DC wave pulsed welding method
(arc start – welding underway – crater treatment)
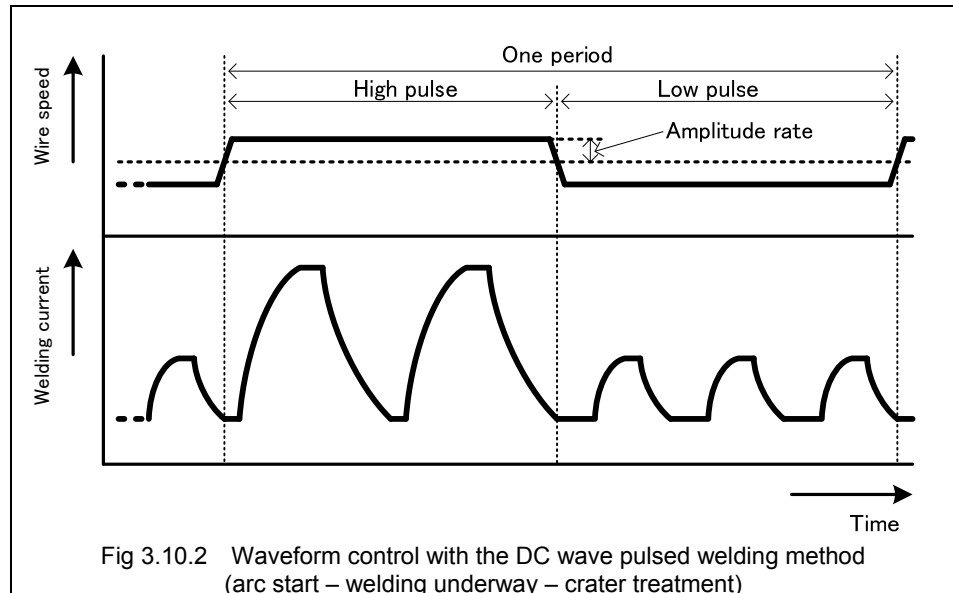
3.10.5 About the welding constants

The welding conditions that can be set when WB-P350 is connected using the interface are shown in Table 3.10.2. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.10.2   Welding conditions of WB-P350

Item	Enable /Disable
Inching/Retract speed	○
Inching/Retract Key operation	○
Gas check operation	○
Preflow time	○
Arc outage detect time	○
Online modification cycle	○
Auto. storing for online mod.	○
Arc start failure detect time	○
Arc start timing adjust time	○
Arc start retry number	○
Wire retract time	○
Scratch start	○
Waiting time after welding starts	○
Arc end timing adjustment time	○
Wire stick check	○
Wire stick release time	○
Torch	△
WIF timeout check	△
Restart retract distance	○
Arc monitor display cycle	○
Arc monitor sample data num	○
Welding curr./volt. fail. act.	○
Welding current failure limit	○
Welding voltage failure limit	○
Wire feed load fail action	○
Wire feed load fail rate	○
Stop welder at END	○
WIF timeout check adjust.	○
Arc outage detect. time (Arc End)	○
Processing when fan error	△
Processing when volt shortage	△
Direct arc voltage detection	△

○: Can be used.

△: Perform settings on the front panel of welding power source. For details, see "3.10.6 Settgins on the Welding Power Source Side". The settings made on the screen of welding constants cannot be reflected.

3.10.6　Settgins on the Welding Power Source Side

In order to use the welding constants given below when WB-P500L is connected using this device, it is necessary to configure the settings on the welding power source side.

・Torch
・Penetration adjustment function
・Arc voltage direct detection
・Process in the fan failure
・Process in the shortage of input voltage

1　Turn on the power of welding power source.

2　By holding down Execute key, switch the keylock ON/OFF.

3　Change the function type from Normal to Almega.
The setting manner is as follows.
　① Hold down F key.
　② The front panel indicates "F＊" blinking on its left side.
　③ Hold down Execute key, switch the digital indication to "A＊".

4　Move the kob on the front panel to align the digital indication on the left side to "A1". Press F key.
The digital indication on the right side blinks. Move the kob on the front panel under the condition to set ON.

5　Configure the settings for each function. For the setting manner, see Table 3.10.3.

INFO.　The function type can be switched by pressging Execute key.
It is available to change the number and settings by moving the knob on the front panel.

INFO.　**How to operate the welding power source:**
For the details of operation manner for the welding power source, see the instruction manual for welding poiwer supply.

Table 3.10.3   Setting manner for each function

Function name	Function type	Function number	Function	Initial value
WIF-Digital function ON/OFF	A	1	It switches ON/OFF for the function in this table. ON : Available OFF : Not available	OFF
Penetration adjustment function	A	2	It switches ON/OFF for the penetration adjustment function of the welding power source. ON : Available OFF : Not available	OFF
Process in the fan failure / Process in the shortage of input voltage	F	19	It designates the process on the robot side when the welding power source detects the fan alarm or the shortage alarm of input voltage. ON : Indicates the error by "Alarm". OFF : Not detecting the error.	OFF
Arc voltage direct detection	F	38	Set this function ON when connecting the voltage detection cable for directly detecting the arc voltage (−) to the welding power source. ON : Available OFF : Not available	OFF
Torch	—	—	It selects the torch cooling maner. Press the Torch key on the front panel. By pressing this key, LED indicated as "Water cooled" on the Torch key puts the light on and off. "Water cooled" LED ON : Using the water-cooled torch. "Water cooled" LED OFF : Using the air-cooled torch.	OFF

3.11 Welding conditions of WB-P500L

This section describes the welding conditions that can be set when WB-P500L is connected.

3.11.1 About the welding condition parameters

The welding conditions that can be set when WB-P500L is connected using the interface are shown in Table 3.11.1. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.11.1   Welding conditions of WB-P500L

Welding condition		Welding method		
		DC/ DC(APCS)	DC pulsed	DC wave pulsed
AS	Welding process	○※1	○※1	○※1
	Current cond.	○	○	○
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Welding speed	○	○	○
	Pulse arc characteristic	—	○	○
	Arc character.	○	—	—
	Slope time / Slope distance	○	○	○
	Initial current / Ini. wire speed	○	○	○
	Initial voltage / Ini. arc length	○	○	○
	Start adjust time	○※2	○※2	○※2
	Wave frequency	—	—	○
	Amplitude rate	—	—	○※2
AE	Welding process	○※1	○※1	○※1
	Current cond.	○	○	○
	Welding current / Wire speed	○	○	○
	Welding voltage / Arc length tun.	○	○	○
	Crater time	○	○	○
	Post flow time	○	○	○
	Pulse arc characteristic	—	○	○
	Arc character.	○	—	—
	Slope time / Slope distance	○	○	○
	Robot stop time	○※2	○※2	○※2
	Wave frequency	—	—	○※2
	Amplitude rate	—	—	○
	Burnback adj. V.	—	○	○
	Burnback adj. T.	○※2	○※2	○※2
	Burnback delay T	—	○※2	○※2
	Retract adj. T	○※2	○※2	○※2

○: Can be used

—: Cannot be used.

∗1: The welding mode displayed on the robot controller may be different from the welding mode of the Welbee Inverter welding power source. For details, see "3.4.2 Configuring the welding mode for the Welbee Inverter series welding power source".

∗2: Cannot be used if the registered welding power source is DP.

3.11.2 Points for setting the conditions

The points to be observed when setting the welding conditions are set forth below.

Concerning the welding current and wire feed speed

The welding current (or wire feed speed) which is input as a welding condition becomes the average current (or average wire feed speed) during welding. The welding waveform control parameter optimally suited for the welding current (or wire feed speed) which has been set is calculated automatically on the basis of the welding current (or wire feed speed) which has been input.

Concerning the arc length tuning

For instance, if a setting of +5 is used, the output voltage will be raised by about 0.5 V as a theoretical value.
The WB-P500L has two modes: synergic adjustments and individual adjustments.
When it is used in the synergic adjustment, the optimum voltage for the current which has been set is output automatically.

Concerning the input of the wire feed speed

The wire feed speeds which are actually valid as welding conditions differ according to the welder and welding mode used. If the standard software has been installed in the welder, the minimum speed is approximately 130 cm/min. and the maximum speed is approximately 1800 cm/min. as a general rule. However, depending on the welding mode, the maximum and minimum wire feed speed may be more restricted than the ranges given.

Concerning the setting range of the welding speed

Although any speed from 1 to 999 cm/min. can be set as the welding speed, the maximum speed is actually 600 cm/min. or so. Since this is also the maximum operable speed and not a speed which can be used for actual welding, it must be adjusted to ensure optimum welding.

Concerning the arc characteristic

The arc characteristic is the value that enables to set hard/soft of the arc. Intensive and hard arcs are generated by increasing this value to the (–) side, while extensive and soft arcs to the (+) side.

INFO.

In the case where the arc characteristic is set in "+" side, the further minimizing spatter may be found in the current area where the angular-advance spatter-reducing effect can be produced. However, if the value is set too high, the welding easily becomes unstable and the electrical tolerance of the condition will drop to a lower value. A "–" figure setting yields a stronger immunity to the fluctuations in the protruding wire and an improved stability of the posture welding. Note that if the high value is set in the respective sides "+" and "–", the welding may become unstable.

What is the slowdown speed?

The slowdown speed denotes the speed at which the wire is fed until the arc is started at the arc start point.

When crater treatment is not performed

When crater treatment is not going to be performed, set the crater time to "0." However, in this case, set the same conditions as for regular welding as the crater current or wire feed speed setting value. Unless the same conditions are set, the appropriate burnback voltage level may not be displayed properly at the teaching stage.

IMPORTANT

When the crater time has been set at 0, the "Welding method" for the arc end condition shall be set to the same one for the main welding.

Concerning the pulse conditions

To adjust the pulse conditions, proceed by changing "arc characteristic" and "pulse frequency", described inTable 3.11.1 And refer to "3.11.4 To adjust the pulse conditions"

Concerning the retract adjustment time

The wire is automatically retracted in order to adjust its protrusion length after processing the arc end. By setting the retract adjustment time, it enables to adjust the amount of wire retracting after the arc end.

The retract time before adjustment depends on the type of wire feeding unit as given in Table 3.11.2. Even if setting the retract time to a negative value, the retract time becomes 0, in which the wire cannot be inched.

Table 3.11.2 Retract time before adjustment

Wire feeding unit	Retract time (msec)
Standard wire feeding unit	200
Servo wire feeding unit	100

POINT

When the registered welding power source is DP, it is not available to set the retract adjustment time. Retracting is executed for the time specified in the Table 3.11.2 as the adjustment time of 0.

3.11.3 How the spatter adjustment parameter (APCS cond.) is used

In short arc welding where short-circuits and arcs are repeated, most of the spatter is generated when short-circuiting occurs and immediately before arc generation. A phenomenon referred to as "necking" occurs in the wires immediately before arc generation of the latter category, as shown in the figure below. By detecting this necking and sharply reducing the current at that instant, the melted metal is not blown about by the arc force and the generation of spatter can be significantly reduced. To achieve this, it is most essential to detect the necking. Unless the necking is detected at the appropriate timing, it will lead to the generation of spatter.

Fig. 3.11.1   Principle behind reducing spatter by detecting necking

The sensitivity for detecting necking is set in advance for each welding method and wire diameter. However, this sensitivity is affected by such factors as the welding environment (lengths and routing of secondary cables) and the actual welding conditions (welding conditions such as the posture, lap welding and fillet welding, and the protrusion length of the wire). For this reason, the preset necking detection sensitivity is not necessarily optimal, and the generation of spatter may not be reduced satisfactorily.

WB-P500L function for automatically adjusting the necking detection sensitivity in the face function. It is called the automatic necking sensitivity adjustment function.

POINT

How to reduce the spatter and keep the condition

In order to reduce spatter, it is necessary for necking to be detected properly. To this end, the arc voltage must be fed back accurately. If the voltage cannot be obtained properly because the arc voltage feed back is affected by noise, the necking will not be detected properly, and this will give rise to spatter. Furthermore, the automatic necking sensitivity adjustment function will not work properly either. If the welding is unstable and large amount of spatter are generated, review the routing of the voltage detection cable in accordance with the "working environment checklist" described in the instruction manual for the welding power supply.

POINT

In the case where the automatic necking sensitivity adjustment is not performed

In the case of corresponding to the welding conditions shown in Table 3.11.3, automatic adjustment isn't applied. The fixed adequate conditions in the welding power supply are applied.

Table 3.11.3 Field where automatic necking sensitivity adjustment is not performed

Welding mode			Current setting value
Wire material	Gas	Wire diameter	
Mild steel solid	CO2	0.8, 0.9, 1.0, 1.2	300A or over
	MAG	0.8, 0.9, 1.0, 1.2	
SUS solid	MIG	0.8, 0.9, 1.0, 1.2	

3.11.4 To adjust the pulse conditions

Generally, to adjust the pulse conditions, the following two parameters are the only ones that need to be changed.

• Arc characteristic ... For hardening or softening the condition of the arc.
• Wave frequency ... For adjusting the ripple pitch of the beads shaped like fish scales.

What are the arc characteristic?
The arc characteristic is a parameter used for internally, adjusting the pulse rise time and pulse fall time. When its value is increased, an expansive soft arc is obtained; conversely, when it is reduced, a concentrated hard arc is obtained.

What is the wave frequency?
For the wave pulsed welding method periodical changes of the wire feed speed and the unit pulse condition can be made in low frequencies. Furthermore, synchronizing this periodic cycle, then the deposition rate can be increased / decreased and the vibrations of the molten pool can be made.
For aluminum alloy welding, beads shaped like fish scales can be formed. This welding improves the ability to counter gaps that may exist in the welded areas. Furthermore, grain size can be minimized by the stirring effect, caused by the molten pool vibration, and tolerance of welding cracks will also be improved.
For steel and stainless welding, the melted metal takes time to solidify. Therefore, in this welding, there are cases where clear beads, shaped like fish scales, cannot be formulated, because the metal flows before it can solidify. However, the blowhole can be reduced by the stirring effect caused by the molten pool vibrations.
The wave pulsed welding method will change the wire feed speed, unit pulse conditions, etc. However, for changes of the wire feed speed, if the wire feed motor's response characteristic comes close to a limiting value, the feed amplitude will automatically be reduced. If the wave frequency is over 3 Hz, the speed of the wire feed will gradually be reduced. If it exceeds over 5 Hz the amplitude will run out. In this case, the wire feed speed with stabilize and only the unit pulse condition will change.
For aluminum alloy welding where the beads can be formed in shapes of fish scales, it is possible to adjust the ripple pitches freely, depending on the combinations between the welding speed and wave frequency.
The width of the pitches will become narrow if the wave frequencies are expanded without changing the welding speed. Vise versa, if the frequencies are made smaller with the welding speed unchanged, the pitches will widen.

Bead

Detail

The ripple pitch

The beads shaped like fish scales can be adjusted using the wave frequency. During automatic operation a fixed interval is maintained, but the ripple pitch interval may be disrupted by temporary stop and restart thereafter.

Fig. 3.11.2 Adjustment of beads shaped like fish scales using wave frequency

INFO.

- In some cases, ripple patterns of the welded beads may not be precisely visible depending on the type of material used, welding speed and the heat input during welding. Especially, the patterns of welding materials such as the SUS, a mild steel that takes time to harden, cannot be seen unlike the welded beads of aluminum alloy welding.

- There is a major relationship between the reduction of blowholes and the measure of the melted metal's vibration. The bigger the extent of the molten pool, the bigger the vibrations as well; reducing more blowholes. On the contrary, if the molten pool is small, then fewer blowholes will be eliminated. If thicker beads are used for welding, the effects are bigger. However, blowholes should not be taken away from all of the welding materials such as extremely thick coated or oil-based steel products and cast materials.

- If short-circuit occurs frequently while welding using soft aluminum, the overview of the bead could appear black.

3.11.5 Waveform control with DC wave pulsed welding

DC wave pulsed welding is essentially pulsed welding, where a wave frequency period consists of a low pulse section and high pulse section. The number of pulses in a low pulse section and high pulse section in each period depends on the wave frequency and pulse conditions.

Waveform control (arc start - welding underway - crater treatment) is conducted as follows.
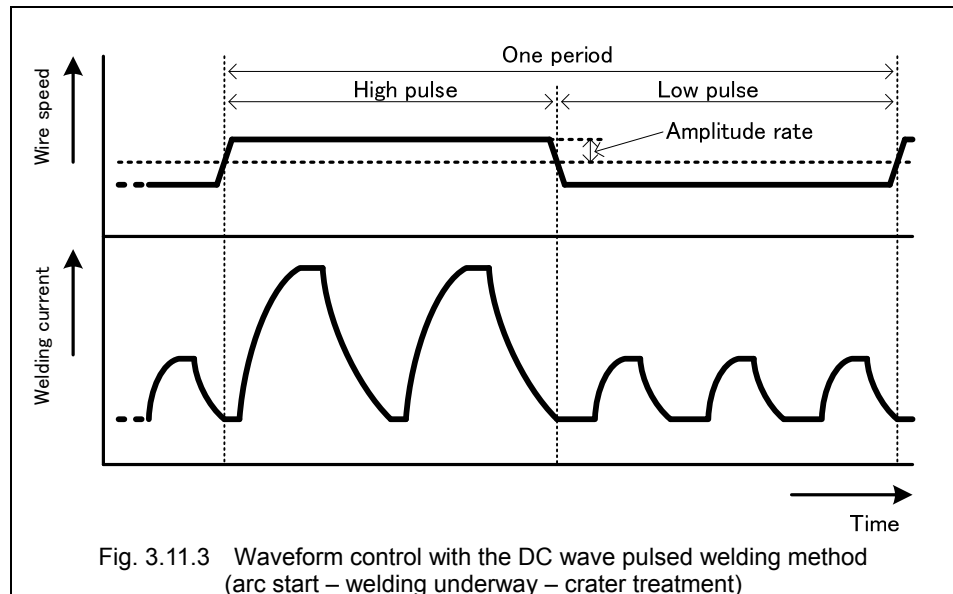
Fig. 3.11.3 Waveform control with the DC wave pulsed welding method
(arc start – welding underway – crater treatment)

What is the Amplitude Rate?

When the wave frequency is below 5 Hz, the wire feed speed is changed in wave pulsed welding. By slightly adjusting the amplitude of this feed speed, welding results intended for different purposes can be achieved.

The amplitude rate is meant for adjusting the shift value of the wire feed. Having 50% as its standard measurement, adjustments can be made within the range from 0 to 100%. The minimum adjustment unit is "1".

The relationship between the settings of the amplitude rate and the welding results are shown in the table below. Adjust the amplitude rate accordingly to its intended purpose.

Table 3.11.4 Relationship between Amplitude Rate and Welding Results

Amplitude rate	0% (Minimum)	50% (Standard)	100% (Maximum)
Shift value of wire feed	None （Stabilized）	⟷	Twice the % of Standard
Shift value of arc length	Small	⟷	Big
Ripple bead	Smooth, small	⟷	Clear, big
Blowhole reduction	Small	⟷	Big
Welding speed	High to Low speed	⟷	Low speed
Gap tolerance	Small	⟷	Large

INFO. Even if "100% (Maximum)" is set for the mild and stainless steels, the melted metal will flow before it hardens. Therefore, there are cases where the bead's ripple does not exceed the ripples that are created at "50% (Standard)."

POINT When the registered welding power source is DP, it is not available to set the amplitude rate.

3.11.6 About the welding constants

The welding conditions that can be set when WB-P500L is connected using the interface are shown in Table 3.11.5. Some welding conditions vary depending on the type of welding power source registered in the robot controller. Welding condition parameters not included in this table cannot be used.

Table 3.11.5 Welding conditions of WB-P500L

Item	Welding power source registration	
	DPR	DP
Inching/Retract speed	O	O
Inching/Retract Key operation	O	O
Gas check operation	O	O
Preflow time	O	O
Arc outage detect time	O	O
Online modification cycle	O	O
Auto. storing for online mod.	O	O
Arc start failure detect time	O	O
Arc start timing adjust time	O	O
Arc start retry number	O	O
Wire retract time	O	O
Scratch start	O	O
Waiting time after welding starts	O	O
Arc end timing adjustment time	O	O
Wire stick check	O	O
Wire stick release time	O	O
Torch	O	△
Penetration adjustment	O	△
WIF timeout check	O	O
Restart retract distance	O	O
Arc monitor display cycle	O	O
Arc monitor sample data num	O	O
Welding curr./volt. fail. act.	O	O
Welding current failure limit	O	O
Welding voltage failure limit	O	O
Wire feed load fail action	O	O
Wire feed load fail rate	O	O
Stop welder at END	O	O
WIF timeout check adjust.	O	O
Arc outage detect. time (Arc End)	O	O
Processing when fan error	O	△
Processing when volt shortage	O	△
Direct arc voltage detection	O	△

O: Can be used.

△: Perform settings on the front panel of welding power source. For details, see "3.11.7 Settings on Welding Power Source Side". The settings made on the screen of welding constants cannot be reflected.

3.11.7　Settgins on the Welding Power Source Side

In order to use the welding constants given below when WB-P500L is connected using this device, it is necessary to configure the settings on the welding power source side.

- ・Torch
- ・Penetration adjustment function
- ・Arc voltage direct detection
- ・Process in the fan failure
- ・Process in the shortage of input voltage

INFO.　The setting of these items can be managed on the screen of welding constants when DPR is registered.

1　Turn on the power of welding power source.

2　By holding down Execute key, switch the keylock ON/OFF.

3　Change the function type from Normal to Almega.
The setting manner is as follows.
　① Hold down F key.
　② The front panel indicates "F∗" blinking on its left side.
　③ Hold down Execute key, switch the digital indication to "A∗".

4　Move the kob on the front panel to align the digital indication on the left side to "A1". Press F key.
The digital indication on the right side blinks. Move the kob on the front panel under the condition to set ON.

5　Configure the settings for each function. For the setting manner, see Table 3.11.6.

INFO.　The function type can be switched by pressging Execute key.
It is available to change the number and settings by moving the knob on the front panel.

INFO.　**How to operate the welding power source:**
　For the details of operation manner for the welding power source, see the instruction manual for welding poiwer supply.

Table 3.11.6   Setting manner for each function

Function name	Function type	Function number	Function	Initial value
WIF-Digital function ON/OFF	A	1	It switches ON/OFF for the function in this table. ON : Available OFF : Not available	OFF
Penetration adjustment function	A	2	It switches ON/OFF for the penetration adjustment function of the welding power source. ON : Available OFF : Not available	OFF
Process in the fan failure / Process in the shortage of input voltage	F	19	It designates the process on the robot side when the welding power source detects the fan alarm or the shortage alarm of input voltage. ON : Indicates the error by "Alarm". OFF : Not detecting the error.	OFF
Arc voltage direct detection	F	38	Set this function ON when connecting the voltage detection cable for directly detecting the arc voltage (−) to the welding power source. ON : Available OFF : Not available	OFF
Torch	—	—	It selects the torch cooling maner. Press the Torch key on the front panel. By pressing this key, LED indicated as "Water cooled" on the Torch key puts the light on and off. "Water cooled" LED ON : Using the water-cooled torch. "Water cooled" LED OFF : Using the air-cooled torch.	OFF

Chapter 4   Maintenance

This chapter describes the maintenance function and warranty of the interface.

4.1 Displaying the Welding Interface (Digital) version

The version of the internal firmware of Welding Interface (Digital) can be checked with the following procedure.

Display the firmware version

1 **Turn ON the power of the robot controller and the welding power source connected to the interface.**

2 **Switch the operator qualification to *EXPERT*.**

IMPORTANT

Display the firmware version while the power of the welding power source connected to the interface is ON.

3 **In the top screen of the teach or playback mode, press [Reset/R].**
>> The [Shortcut R code Entry] screen is displayed.
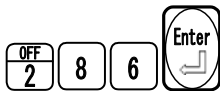
4 **Press [2], [8], [6], [Enter] in this order.**
Press F10(next page).
>> The system environment is displayed as follows.


```
13 System Version                    2/4
Arc WPS1         W-I/F(D):Ver.001
ID Number
ResJpn(JAPANESE)              2,06,19,18
ResGE(GERMAN)                 -----------
ResJpn(FRENCH)                -----------
ResITA(ITALIAN)               -----------
ResCHI(CHINESE)               -----------
ResSPA(SPANISH)               -----------
ResKOR(KOREAN)                -----------
ResTAIWAN(TAIWANESE)          -----------
ResDUT(DUTCH)                 -----------
ResIDN(INDONESIAN)            -----------
ResConsString(ENGLISH)        1,06,19,18
ResConsStringJpn(JAPANESE)    2,06,19,18
ResConsStringGE(GERMAN)       -----------
ResConsStringFRE(FRENCH)      -----------
```

? It is the software version of the arc welding power supply installed now.

The version displayed for the "Arc WPS1" item is the interface firmware version.

POINT

About the welding power source version display
The software version of the Welbee Inverter series welding power source cannot be checked from the robot controller. Check the software version of the welding power source on the front panel. For details, see the instruction manual of your welding power source.

4.2   List of Welding Interface (Digital) error codes

When an error occurs in the interface, the error code is displayed 1 digit at a time on the 7-segment LED on Welding Interface (Digital)board. For example, if E-900 occurs, the error code is displayed as 'E' -> '-' -> '9' -> '0' -> '0'. Check the error code, and take the measures described in Table 4.2.1.

IMPORTANT

When an error occurs in the interface, one of the following errors is displayed on the teach pendant (TP) of the robot controller.
- "A5023 Failure of the welding power supply occurred."
- "E4000 Communication timeout occurred between the controller and the welding power supply."

Table 4.2.1   Error code list of Welding Interface (Digital)

Failure code	Error general description	Contents of failure	Measure

E-001	Communication timeout	The interface cannot communicate with the robot controller or welding power source.	• Check that the power cable that connects the interface to the sequence board (or relay unit) of the robot controller is connected correctly (see Chapter 2).
			• Check that the communication cable that connects the interface to the storage board of the robot controller is connected correctly (see Chapter 2).
			• Check that control cable 5 (on the welding power source side, interface side) that connects the interface to the welding power source is connected correctly (see Chapter 2).
			• Check that the power of the welding power source is ON.
			• Check that the following settings are correct for the welding power source connected to the interface.
			For Welbee Inverter series
			  - Auto/Semi auto mode (F4)
			  - CAN ID(F43)

E-002	Communication control error	This is an interface internal error.	Contact us.
E-003			
E-004			
E-005			
E-006			
E-100	Setup incomplete	The setup data has not been written onto the interface.	Write the setup data onto the interface (see Chapter 3).
E-101	Setup data error	A robot controller not supported by the interface has been specified in the setup data written onto the interface.	• Create the setup data again and write it onto the interface (see Chapter 3). • Check that the interface firmware supports your robot controller or welding power source. For details, contact us.
E-102		A welding power source not supported by the interface has been specified in the setup data written onto the interface.	

Failure code	Error general description	Contents of failure	Measure
E-103	USB memory connection error	The USB memory cannot be recognized.	• Check that the USB memory has been inserted correctly into the interface. The interface does not support the hot plugging of USB memory. Before inserting or removing the USB memory, turn OFF the power of the robot controller (including the interface). • Use the USB memory recommended by us.
E-104	Setup file open error	The setup file stored on the USB memory cannot be opened.	• Check that the USB memory has been formatted with "FAT (FAT16)". • Check that the setup data has been created in an UPDATE folder that is in the root folder of the USB memory (see Chapter 3). • Check that there are no errors in the USB memory.[*1] • Use the USB memory recommended by us.
E-105	Setup file reading error	The setup file stored on the USB memory cannot be read.	• Check that the USB memory has been formatted with "FAT (FAT16)". • Check that there are no errors in the USB memory.[*1] • Use the USB memory recommended by us. • Create the setup data again and write it onto the interface (see Chapter 3).
E-106	Setup file data error	The setup file stored on the USB memory contains an error.	Create the setup data again and write it onto the interface (see Chapter 3).
E-107	Setup file backup error	A backup file cannot be created in the USB memory.	• Check the free space on the USB memory. • Use the USB memory recommended by us. • Check that the USB memory has been formatted with "FAT (FAT16)". • Check that there are no errors in the USB memory.[*1] • Check whether the USB memory is write-protected.
E-200	Setup file delete error	The setup file stored on the interface could not be deleted.	Perform "Writing the setup data" again for the interface (see Chapter 3). If this error persists, the interface may be malfunctioning. Contact us.
E-201	Setup file write error	The setup file could not be written onto the interface.	
E-300	Insufficient memory for control	This is an interface internal error.	Contact us.
E-301			
E-999	Firmware error	The firmware is not installed on the interface.	Contact us.

INFO. You can perform a USB memory error check (∗1 in the previous table) on a Windows computer by right-clicking the drive of the USB memory, and then executing the check in "Properties" → "Tools" tab → "Error checking".

4.3 Errors of Welbee Inverter series welding power source

This section describes the errors detected by the Welbee Inverter series welding power source.

4.3.1 Error code list

When using a Welbee Inverter series welding power source to connect to a robot, refer to table Table 4.3.1 that shows the error codes in the front panel and on the teach pendant of the robot.

Table 4.3.1   Error code list of Welbee Inverter series welding power source

Digital meter		Contents of error	Error code of supporting robots [*4]	Error display release method [*3]
Left	Right			
E-	41	Panel communication error	A5023	(3)
E-	100	Control power supply error	A5039	(3)
E-	110			
E-	150	Input over voltage	A5023	(3)
E-	160	Shortage of input voltage	A5023	(3)
E-	200	Primary current detection error	A5040	(3)
E-	210	Error in the arc voltage detection	A5030	(1)
E-	215	Error in the arc voltage detection (RS Control)	A5097	(1)
E-	220	Primary side main circuit error	A5023	(3)
E-	230	Primary driver error	A5023	(3)
E-	240	Secondary current detection error	A5040	(3)
E-	250	Secondary side main circuit error	A5023	(3)
E-	260	Error in the output voltage detection circuit	A5039	(3)
E-	300	Thermal overload	A5026	(3)
E-	301			
E-	302			
E-	303			
E-	310	Cooling fan error	A5023	(3)
E-	311			
E-	312			
E-	500	Lack of water pressure	For DM/DM(S-2)/DR /DP/DPR A5023 For DL/DL(S-2) A5036	(2)
E-	615	Memory backup error	-	(1)
E-	700	Secondary side output over current error	A5025	(1)
E-	710	Lack of phase error	A5028	(3)
E-	800	Encoder in the wire feeder error	A5032	(1)
E-	801			
E-	810	Thermal overload in the governor circuit	A5042	(1)

Table 4.3.1   Error code list of Welbee Inverter series welding power source

Digital meter		Contents of error	Error code of supporting robots [4]	Error display release method [3]
Left	Right			
E-	830	Motor over current error	For DM/DM(S-2)/DR /DP/DPR A5023 For DL/DL(S-2) A5095	(1)
E-	850	Control power supply error in the governor circuit	A5039	(3)
E-	860			
E-	950	CAN Bus off error	A5023	(4)
E-	957	CAN Timeout error	A5023	(4)
E-	980	Characteristic data error	A5023	(4)
000	000 [1]	Operation Stop	None [2]	(2)

*1: Both right and left displays flash on and off. This display appears when the robot controller is in the following conditions.
  • An emergency stop was input by an emergency stop button or external emergency stop signal
  • An error has occurred
  If this display appears when the robot controller is in a condition other than the above, check the connection of control cable 5.
*2: A5096 is displayed when operating Welding power sources during non-operation.
*3: For details, refer to Table 4.3.2.
*4: May be displayed as a different error code, depending on the software version of your robot controller.

IMPORTANT

About welding power source registration
   The error codes displayed on the robot controller may differ depending on the registered welding power source.

When A5023 occurs
   If "A5023 Failure of the welding power supply occurred." occurs, check the front panel of the welding power source for details of the error.

[2] The failure monitor   1 / 1
⚠ Arc weld failure   9-6-2013 16:33
    A5023 Failure of the welding power supply occurred.
    -:-:- (W1:-5021)
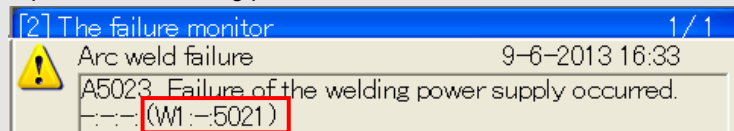
   When a number is displayed in this code, refer to the contents of the error in the table below.
   If no number is displayed, check the error code displayed on the front panel of the welding power source.

Code	Contents of error
5021	The arc characteristic can't be changed while arc welding. Please modify the task program.

When an error not included in the table occurs
   If a welding power source error not included in Table 4.3.1 is displayed, refer to the instruction manual of the welding power source.

4.3.2 How to reset an error indication

If an error code is displayed on the front panel of the Welbee Inverter Series welding power source connected to the robot, the error code display cannot be reset with the "f12 <Failure Reset>" key on the teach pendent or "External reset" signal from the basic input signals.
The error codes displayed on the front panel are released automatically when any of the operations described below are performed. However, the displays of some error codes are not released even with the following operations.

- When pre-flow has started during automatic operation
- When pre-flow has started during a check operation in which check welding is effective
- When the ICH command or RTC command has been executed with welding ON automatic operation
- When inching is performed using f10 <Inching> on the teach pendent [*]
- When retracting is performed using f11 <Retract> on the teach pendent [*]
- When gas check is performed using f12 <Gas> on the teach pendent
- When inching has been performed using the "inching ON/OFF" dedicated arc input signal [*]
- When retract has been performed using the "retract ON/OFF" dedicated arc input signal [*]
- When gas output has been performed using the "gas ON/OFF" dedicated arc input signal

[*] This includes cases where the inching or retract speed is either high or low.

The method for clearing error displays on the "Table 4.3.1   Error code list of Welbee Inverter series welding power source" are as shown below.

Table 4.3.2 Error display release methods

Release method	Description
(1)	When any of the above operations is performed, the error display is released automatically.
(2)	When the cause of the error is eliminated, the error display is released automatically.
(3)	If the cause of the error had been eliminated when any of the above operations was performed, the error display is released automatically. However, since these are errors which originate in the hardware, turn the welding power source off, and take the appropriate action described in the operating manual of the welding power source.
(4)	The welding power source must be turned off and then turned back on in order to release the error display.

4.4   Notes on Scope of Warranty and Liability

4.4.1   The product for a warranty target

It is only as follows the composition of a "Table 1.3.1 Configuration".

- Welding Interface (Digital) board　（Model type : L22440C）

Fuse, Communication cable, Power cable of Ref No.(1) in Table 1.3.1 is outside for a warranty.

4.4.2   Warranty period

Warranty period and its information vary according to region.
For details, contact your nearest sales distributor.

4.4.3   Disclaimer

The following cases are out of the scope of warranty within the warranty period.

(1) Failure caused by improper condition environment, handling and usage that are not described in the instruction manual and catalog
(2) When the cause of failure is due to the reason other than our product
(3) Failure due to the reason other than our product such as customer's equipment or software
(4) Failure caused by the modification and repair implemented by party other than our company (including the specified service shop)
(5) When the failure is caused by improper maintenance or replacement of consumable parts described in the instruction manual and catalog (failure etc. caused by the use of goods other than genuine parts and parts / lubrication oil specified by our company)
(6) When the failure cannot be forecasted by the science / technology level as of purchase
(7) Damage caused by natural disaster such as earthquake, fire, flood disaster or offence by third party and the failure that has a roots in that damage
(8) Failure caused by movement after delivery and defective storage
(9) Sound, vibration, bleeding of oil, color degradation of coated surface, rust and slight dent on appearance that have no problem in performance
(10) Failure caused by transportation and construction work out of range of our construction
(11) In case of reselling, assignment and lend-lease (including the rental equipment)
(12) Other case that conforms to above and consumable parts / service parts

However, the assurance here means the assurance of our product single unit, so the loss caused by the failure of our company is not excluded from the range of assurance.

4.4.4   Limitation of liability

(1) We do not accept any responsibility on the opportunity loss, special loss, indirect loss caused by this equipment, or accident compensation, damage other than out product.
(2) For the programmable this equipment, we do not accept any responsibility on the programming implemented by person other than our company and the result caused by that programming.
(3) We do not accept any responsibility on the processing quality when this equipment is used.
(4) If this equipment is repaired or the parts and/or the software are replaced, it is sometimes necessary to repair or adjust the existing teaching program or parameter.
Note that we do not accept any responsibility on those works and processing quality for the use of this robot system.
(5) This assurance is applied only when this equipment is installed within the country where the equipment is purchased. For the transaction and use in the foreign country, please contact us.

4.4.5 Service in Warranty Period

(1) In case any failure occurs or for information on regular inspection, contact us (or our appointed service providers).

(2) Service expense payment principle is as follows:

    (A) In case of affected product failure is attributed to manufacturing:
    If we deem it necessary to repair the equipment on-site (domestic location only) within above warranty period, we will dispatch engineer for repair work without charge.

    (B) In case of failure is not in affected product itself:
    Costs for analyzing the cause will be charged separately.

    (C) In case of failure cannot be identified:
    If failure part cannot be identified despite certain analysis work, or if the failure cannot be reproduced, we shall consult with customer.