Handheld Laser Welding Gun Drive Communication Protocol

Version	Time	Author	Review	Remark
V1.0	2024-12-17			First Edition

CONTENTS

1 Overview

This agreement is for the handheld control panel and handheld laser welding gun driver (hereinafter referred to as "welding gun"), specifying the hardware interface, communication format, communication content, etc., between the welding gun and laser welding.

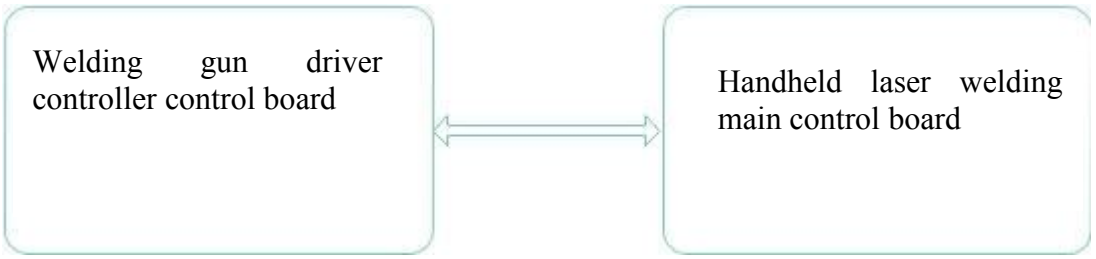


Figure 1 Position of this communication in the system

2 Hardware Interface

2.1 Hardware Interface Specifications

The welding gun driver controller is connected to the laser welding main control board using an IDC2.54/20P ribbon cable (Figure 2). The socket specifications on the welding gun driver controller and the laser welding main control board PCB are: through-hole pin type 2×10P 2.54mm locking connector (Figure 3).

Figure 2 IDC2.54/20P Ribbon Cable

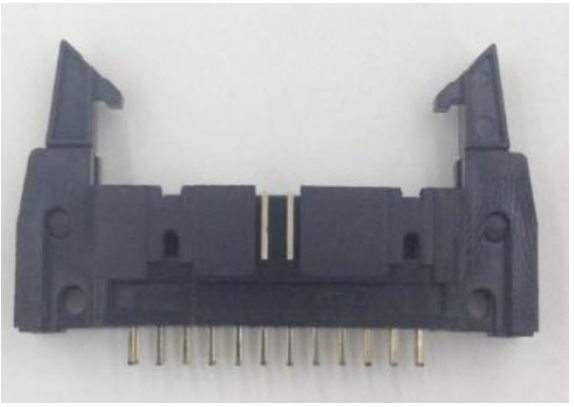


Figure3 2×10P 2.54mm Socket

2.2 Hardware Interface Definition

The pin distribution of the socket connecting the laser welding main control board and the welding gun driver is shown in Figure 4:

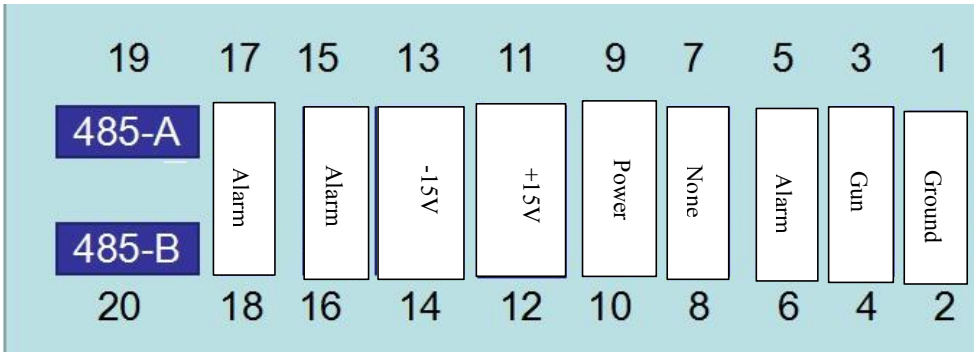


Figure 4 Socket Pin Distribution Diagram

Detailed pin descriptions are shown in Table 1:

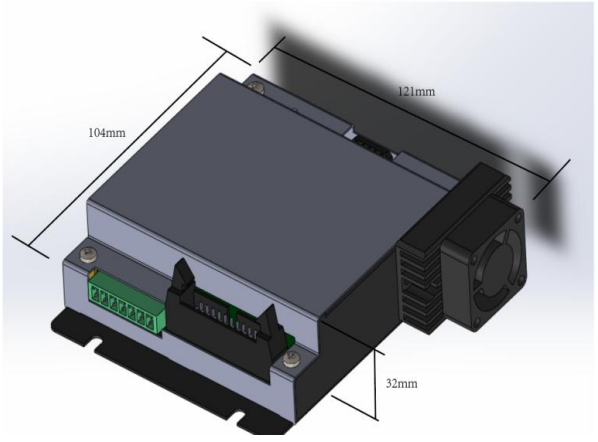
Pin Number	Definition	Remarks
1、2	Ground Lock Signal	The signal is transferred from the driver board to the main control board of the welder.
5、6	Gun Switch Signal	
9、10	GND	Power Ground
11、12	+15V	+15V Power
13、14	-15V	-15V Power
15、16	GND	Alarm Signal Ground
17、18	ALM	Alarm Signal
19	RS485__A	RS485 Signal A
20	RS485__B	RS485 Signal B

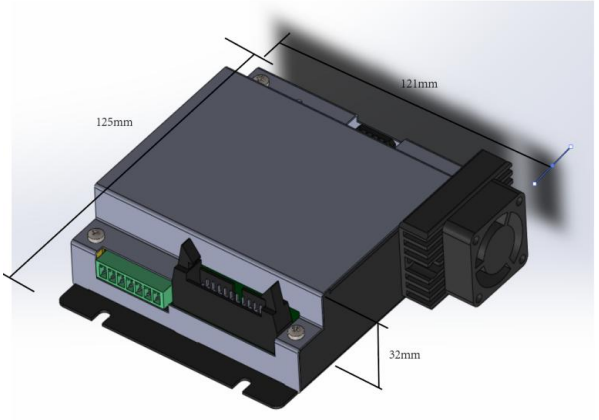
Table 1 Interface Pin Definition Explanation

Note: The ALM signal is input from the driver to the welding machine main control board. The driver side is an open-drain output, normally outputting a low level, and abnormal is a high-impedance state (floating). The control board side must connect a pull-up resistor, with the detection logic as follows: Normal---Low Level; Abnormal---High Level.

2.3 Driver Dimensions

Enclosure (including fan dimensions): 104mm*121mm*32mm





3 Communication Format

3.1 Basic Parameters of the Communication Module

In this communication protocol, the welding machine main control board acts as the master, and the driver acts as the slave. The communication protocol is compatible with the Modbus RTU specification. The recommended communication interval is greater than 50ms.

Slave Address	0x09
Encoding Format	8-bit Binary
Data Bits	8 Bits
Parity Bit	None
Stop Bit	1 Bit
Baud Rate	115200

Table 2 Basic Parameters of the Communication Module

3.2 Data Format

(1) Function Code 0x03 Read Register (Master Request), its instruction structure is shown in Table 3:

0x03 Function Code Communication Protocol									
Read Register (Master Request)									
Data Direction		Master (Welder) sends data frame to Slave (Gun Driver)							
Purpose		Read register data from one or more consecutive addresses of the gun driver							
Data Frame Format Sent by Master	Name:	Slave Address	Function Code	Register Starting Address		Number of Registers (N)		Error Check Code	
	Byte Count:	1 Byte	1 Byte	2 Byte		2 Byte		2 Byte	
	Example (Hex)	09	03	Register Starting Address (High Byte)	Register Starting Address (Low Byte	Number of Registers (High Byte)	Number of registers (lower byte)	CRC16 (Low Byte)	CRC16 (High Byte)
				0xXX	0xXX	N		0xXX	0xXX

Table 3 Function Code 0x03 Master Request Instruction

(2) Function Code 0x03 Read Register (Slave Response), its instruction structure is shown in Table 4:

0x03 Function Code Communication Protocol											
Read Register (Slave Response)											
Data Direction		Slave (Gun Driver) sends data frame to Master (Welder)									
Purpose		Send the read driver board register data from one or more consecutive addresses to the Master									
Slave Response Data Frame Format	Name:	Slave Address	Function Code	Data Byte Count	Register Data					Error Check Code	
	Byte Count	1 Byte	1 Byte	1 Byte	2*N Byte					2*N Byte	
	Example (Hex)	09	03	2*N	Register 1 Data		...	Register N Data		CRC16 (Low Byte)	CRC16 (High Byte)
					High Byte	Low Byte	...	High Byte	Low Byte		
					0xXX	0xXX	...	0xXX	0xXX	0xXX	0xXX

Table 4 Function Code 0x03 Slave Response Instruction Format

(3) Function Code 0x03 Read Register (Slave Response Error Receipt), its instruction structure is shown in Table 5:

0x03 Function Code Communication Protocol						
Read Register (Slave Response)						
Data Direction		The slave (driver board) sends a data frame to the master (welding machine)				
Purpose		Sending error receipt response information to the host				
Format of the Slave Response Data Frame	Name:	Slave Address	Function Code	Error code	Error Check Code	
	Byte Count:	1Byte	1 Byte	1 Byte	2 Byte	
	Example (Hex)	9	83/90	01/02/03	CRC16 (Low Byte)	CRC16 (High Byte)
					0xXX	0xXX

Table 5 Function Code 0x03 Slave Response Instruction Format

Abnormal function code corresponding receipt relationship:

0x03 — 0x83 When the function value is abnormal, the high bit of the receipt function code is set to 1, i.e., 0x83.

0x10 — 0x90 When the function value is abnormal, the high bit of the receipt function code is set to 1, i.e., 0x90.

Error Codes:

0x01—Illegal Function;

0x02—Illegal Register Address;

0x03—Illegal Register Value.

(4) Function Code 0x10 Write Register (Master Request), its instruction structure is shown in Table 6:

<table>
<tr><td colspan="12">0x10 Function Code Communication Protocol</td></tr>
<tr><td colspan="12">Write Register (Master Request)</td></tr>
<tr><td colspan="2">Data Direction</td><td colspan="10">Master (Welder) sends data frame to Slave (Driver Board)</td></tr>
<tr><td colspan="2">Purpose</td><td colspan="10">Write data to one or more consecutive addresses of the driver board registers</td></tr>
<tr><td rowspan="3">Slave Response Data Frame Format</td><td>Name：</td><td>Slave Address</td><td>Function Code</td><td colspan="2">Register Starting Address</td><td colspan="2">Number of Registers (N)</td><td>The number of data bytes.</td><td>Number of Registers</td><td colspan="2">Error Check Code</td></tr>
<tr><td>Byte Count：</td><td>1Byte</td><td>1Byte</td><td colspan="2">2Byte</td><td colspan="2">2Byte</td><td>1Byte</td><td>2Byte</td><td colspan="2">2*NByte</td></tr>
<tr><td rowspan="2">Example (Hex)</td><td rowspan="2">09</td><td rowspan="2">03</td><td>High Byte</td><td>Low Byte</td><td>High Byte</td><td>Low Byte</td><td rowspan="2">2*N</td><td rowspan="2">  </td><td>CRC16 (Low Byte)</td><td>CRC16 (High Byte)</td></tr>
<tr><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td></tr>
</table>

Table 6 Function Code 0x10 Master Request Instruction Format

(5) Function Code 0x10 Write Register (Slave Response), its instruction structure is shown in Table 7:

<table>
<tr><td colspan="10">0x10 Function Code Communication Protocol</td></tr>
<tr><td colspan="10">Write Register (Slave Response)</td></tr>
<tr><td colspan="2">Data Direction</td><td colspan="8">Slave (Driver Board) sends data frame to Master (Welder)</td></tr>
<tr><td colspan="2">Purpose</td><td colspan="8">Respond with the written register addresses and quantities to the Slave</td></tr>
<tr><td rowspan="3">Slave Sends Data Frame Format</td><td>Name:</td><td>Slave Address</td><td>Function Code</td><td colspan="2">Register Starting Address</td><td colspan="2">Number of Registers (N)</td><td colspan="2">Error Check Code</td></tr>
<tr><td>Byte Count:</td><td>1 Byte</td><td>1 Byte</td><td colspan="2">2Byte</td><td colspan="2">2 Byte</td><td colspan="2">2 Byte</td></tr>
<tr><td rowspan="2">Example (Hex</td><td rowspan="2">09</td><td rowspan="2">10</td><td>High Byte</td><td>Low Byte</td><td>High Byte</td><td>Low Byte</td><td>CRC16 (Low Byte）</td><td>CRC16 (High Byte）</td></tr>
<tr><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td><td>0xXX</td></tr>
</table>

Table 7 Function Code 0x10 Slave Response Instruction Format

(6) Function Code 0x10 Write Register (Slave Response Error Receipt), its instruction structure is shown in Table 8:

<table>
<tr><td colspan="8">0x10 Function Code Communication Protocol</td></tr>
<tr><td colspan="8">Write Register (Slave Response)</td></tr>
<tr><td colspan="2">Data Direction</td><td colspan="6">Slave (Driver Board) sends data frame to Master (Welder)</td></tr>
<tr><td colspan="2">Purpose</td><td colspan="6">Send error acknowledgment response information to the Master</td></tr>
<tr><td rowspan="3">Slave Response Data Frame Format</td><td>Name：</td><td>Slave Address</td><td>Function Code</td><td>Error code</td><td colspan="3">Error Check Code</td></tr>
<tr><td>Byte Count：</td><td>1 Byte</td><td>1 Byte</td><td>1 Byte</td><td colspan="3">2 Byte</td></tr>
<tr><td>Example (Hex)：</td><td>09</td><td>83/90</td><td>01/02/03</td><td>CRC16 (Low Byte)</td><td colspan="2">CRC16 (High Byte)</td></tr>
<tr><td colspan="4"></td><td>0xXX</td><td colspan="2">0xXX</td></tr>
</table>

Table 8 Function Code 0x10 Slave Response (Error Receipt) Instruction Format

Abnormal function code corresponding receipt relationship:

0x03 — 0x83 When the function value is abnormal, the high bit of the receipt function code is set to 1, i.e., 0x83.

0x10 — 0x90 When the function value is abnormal, the high bit of the receipt function code is set to 1, i.e., 0x90.

Error Codes:

0x01—Illegal Function;

0x02—Illegal Register Address;

0x03—Illegal Register Value.

3.3 Register Address Definition

Note: R/W—indicates that the parameter can be read and written; R—indicates that the parameter can only be read; W—indicates that the parameter can only be written.

NO.	Register Content	Data Length (Bytes)	Data Type	Data Range	Register Address	R/W Attribute
Dynamic Process Address: 0x0000 ～0x002e (Note: Supports 0x03/06/0x10)						
1	Scanning Frequency	2	Unsigned	Welding Mode: 5～150Hz (When the width is greater than 3mm, it is recommended to control within 150Hz to reduce motor failure rate; the conventional demand range is 5～150Hz) Cleaning Mode: 10～50Hz	0x0000	R/W
2	Scanning Width	2	Unsigned	Welding Mode: 0.0～5.0mm Cleaning Mode: 10～90.0mm Expanded by 10 times, retaining 1 decimal place. Note: The driver will dynamically adjust the range based on the swing range mode selected at address 0x0032. An error will be returned if it does not meet the range constraints.	0x0001	R/W
Special Instruction Address: 0x002f～0x004f (Note: Supports 0x03/06/0x10 to read multiple addresses at once, but can only write to one address.)						
1	Swing Range Mode	2	Unsigned	See Table 9 Note: Settings are automatically saved and do not require separate saving.	0x0032	R/W

2	Drive Type	2	Unsigned	0: Drive Type 0 (Handheld Welding) 1: Drive Type 1 (Handheld Cleaning) Note: Different nozzle configurations have different drives, and the mode values of different drive types (Type 0, Type 1) cannot be switched between each other. Initialization occurs only once at the factory; the driver program will restrict the selection of swing range modes based on this configuration. Note: Settings are automatically saved and do not require separate saving.	0x0033	R/W
3	RS485 Address Configuration	2	Unsigned	Default Address: 0x09 1～247: Valid Slave Addresses Note: Broadcast address 0 is used to write the RS485 address, but the slave does not respond. It is for cases where the address is forgotten; modifying the default address is not recommended. Settings are automatically saved and do not require separate saving.	0x0034	R/W
4	Alarm Detection	2	Unsigned	Default: 1 Write 0: Disable alarm detection Write 1: Enable alarm detection When set to 0, temperature and voltage alarms, as well as alarm output functions (buzzer/ALM output signal), are disabled, and the current alarm is cleared. If there is a false alarm, this function can be enabled. Note: Settings are automatically saved and do not require separate saving.	0x0035	R/W
5	Restore Factory Settings	2	Unsigned	Write 1 Home page, parameters, and processes are restored to factory default values (excluding swing range mode, drive type, RS485).	0x003E	R/W
6	Save Parameters and Processes	2	Unsigned	Write 1	0x003F	R/W
Reserved Unused: 0x50～0xff						

	Reserved Unused	/			0x50～0xff	
Wire Feeder Related Parameter Address (Note: Requires a wire feeder that supports this function): 0x0100～0x01ff						
Welder Home Page Address: 0x0200～ 0x022f (48 Addresses) (Note: Supports 0x03/06/0x10)						
	Indicator Red Light	2	Unsigned	0: Point 1: Line Note: Settings are automatically saved and do not require separate saving.	0x0201	R/W
Welder Parameter Page Address: 0x0230～0x025f (48 Addresses)						
1	Scanning Calibration (Coefficient) - (Y-axis)	2	Unsigned	0.01～4.00, scaled 100 times, retain 2 decimal places	0x0238	R/W
2	Motor Zero Point Offset - (Y-axis)	2	Signed	Default: 0 Welding Mode: -3.00～ 3.00mm Cleaning Mode: -75.00～+75.00mm, scaled 100 times, retain 2 decimal places Note: The driver will automatically adjust the zero point offset proportionally based on the focal length of the lens in Table 9 "Swing Range Mode." That is, after modifying the current lens's zero point offset, the zero point offsets of other lenses with different lengths will be automatically adjusted proportionally. After switching system modes (welding/cleaning switch or changing the cleaning mode lens), this value may not reflect the previously set value due to proportional adjustments.	0x0239	R/W
3	Driver Temperature Alarm Threshold	2	Unsigned	Default: 65 0.0～100.0, scaled 10 times, retain 1 decimal place Note: Setting to 0 will not trigger an alarm.	0x023a	R/W
4	Protective Lens Temperature Alarm Threshold	2	Unsigned	Default: 65 0.0～100.0, scaled 10 times, retain 1 decimal place Note: Setting to 0 will not trigger an alarm.	0x023b	R/W

5	Collimating Lens Temperature Alarm Threshold	2	Unsigned	Default: 65 0.0～100.0, scaled 10 times, retain 1 decimal place Note: Setting to 0 will not trigger an alarm.	0x023c	R/W
6	+15V Voltage Alarm Upper Limit	2	Unsigned	Default: 17V 0～17 Note: Setting to 0 will not check.	0x023d	R/W
7	+15V Voltage Alarm Lower Limit	2	Unsigned	Default: 12V 0～17 Note: Setting to 0 will not check.	0x023e	R/W
8	-15V Voltage Alarm Upper Limit	2	Unsigned	Default: -17V 0～-17 Note: Setting to 0 will not check.	0x023f	R/W
9	-15V Voltage Alarm Lower Limit	2	Unsigned	Default: -12V 0～-17 Note: Setting to 0 will not check.	0x0240	R/W
10	+15V Current Alarm Upper Limit	2	Unsigned	Default: 600mA 0～1500mA Note: Setting to 0 will not check.	0x0241	R/W
11	-15V Current Alarm Upper Limit	2	Unsigned	Default: 600mA 0～1500mA Note: Setting to 0 will not check.	0x0242	R/W
12	Temperatu re Alarm Recovery Voltage Difference	2	Unsigned	Default: 5 degrees 0～10 The temperature will cancel the alarm when it recovers below the alarm threshold of 5 degrees; all temperature alarms use this parameter.	0x0243	R/W
Welder (Main Unit) Monitoring Page Address: 0x0400～0x043f (64 addresses) (Note: supports 0x03)						
1	+15V Power Supply Voltage	2	Unsigned	0.0～24.0V Scaled 10 times, retain 1 decimal place	0x0418	R
2	-15V Power Supply Voltage	2	Signed	-24V～0 Scaled 10 times, retain 1 decimal place	0x0419	R

3	+15V Power Supply Current	2	Unsigned	0-9999mA	0x041a	R
4	Reserved	2	Unsigned	0	0x041b	R
5	-15V Power Supply Current	2	Unsigned	0-9999mA	0x041c	R
6	Reserved	/			0x041d	R
7	Motor Driver Board Temperature	2	Signed	-20.0-999.0 Scaled by 10 times, with 1 decimal place. Note: 999.0 indicates temperature measurement not connected or error (this version does not have it).	0x041e	R
8	Protection Mirror Temperature	2	Signed	-20.0-999.0 Scaled by 10 times, with 1 decimal place. Note: 999.0 indicates temperature measurement not connected or error.	0x041f	R
9	Collimating Mirror Temperature	2	Signed	-20.0-999.0 Scaled by 10 times, with 1 decimal place. Note: 999.0 indicates temperature measurement not connected or error (this version does not have it).	0x0420	R
10	+15V Voltage Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0421	R
11	-15V Voltage Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0422	R
12	+15V Current Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0423	R
13	-15V Current Alarm	2	Unsigned	0: No alarm1: Alarm present	0x0424	R
14	Motor Driver Board Temperature Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0425	R
15	Protection Mirror Temperature Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0426	R

16	Collimating Mirror Temperature Alarm	2	Unsigned	0: No alarm 1: Alarm present	0x0427	R
17	Reserved	2	Unsigned		0x0428	R
18	Driver ID High 2 Bytes	2	Unsigned		0x0429	R
19	Driver ID Low 2 Bytes	2	Unsigned		0x042a	R
20	Driver Hardware Version	2	Unsigned		0x042b	R
21	Driver Software Version	2	Unsigned		0x042c	R