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iPulse LED Lighting Controller

User Manual

Revision History

Ver.	Date	Description
1.1	31 Oct 2019	Initial release
2.1	13 Apr 2023	Overall reorganization
2.2	11 September 2023	Read monitoring parameters added
2.3	22 January, 2024	Controller Model and Specification Update
2.4	14 March, 2024	IP-1P1S-100A continuous current change
2.5	1 April 2025	P30,31 Sequence index correction
2.6	4 Aug, 2025	Max Power Output Modification

Contents

1. Safety

Please use this manual before using the iPulse product. This is an electronic device that requires safety precautions for safe use. Please pay close attention to the symbol and its description below:

1.1 Instructions on electric factors

· In consideration of the risk of electrical damage to the LED and internal circuits upon power input, it is recommended to the greatest extent possible to supply power in a state where the digital IO, communication channel, and LED wires are connected.

· Since high voltage remains in the LED and output pins even after the power is turned off, it is recommended to disconnect the LED connector or disconnect the power supply for at least 30 seconds while handling the cable.

· While the digital IO input terminal is disconnected electrically by the photo coupled element, the digital output terminal includes its output pin connected to the internal ground. Therefore, when an external device is to be connected, it is recommended to connect to an input terminal that is electrically disconnected. For connection to a device that is not disconnected, it is advisable to connect the (-) negative pole wire and then the (+) positive pole wire.

· As for the PSU, it is advisable to use a model recommended by the manufacturer. If the user has to select a product at his/her discretion, a product that meets electrical safety standards should be used. It is recommended to use a product with short circuit protection and current limit functions.

· Cables used for the PSU need to satisfy the specifications of electrical insulation and output current.

· As for the LED output cables, cable specifications may be determined based on the continued current output. However, the voltage fluctuation upon high current pulse output as stated in Section 2.3 Cable Selection must be taken into consideration.

2. Product standard

2.1 Overview

iPulse is a high-power LED controller specifically designed for machine vision applications. It is capable of high-speed current control and high-efficiency operation. Regardless of the LED voltage and type, it can control the current accurately under optimal conditions. iPulse products include high-efficiency power circuits sufficient enough to operate high power LEDs. Even at high currents up to 50A, it can respond quite quickly, generating a current pulse at least as much as 1us. It contains an over-driving function to operate LEDs instantly at high current. Upon over-driving, it initiates the duration limit and duty limit functions to protect LED elements.

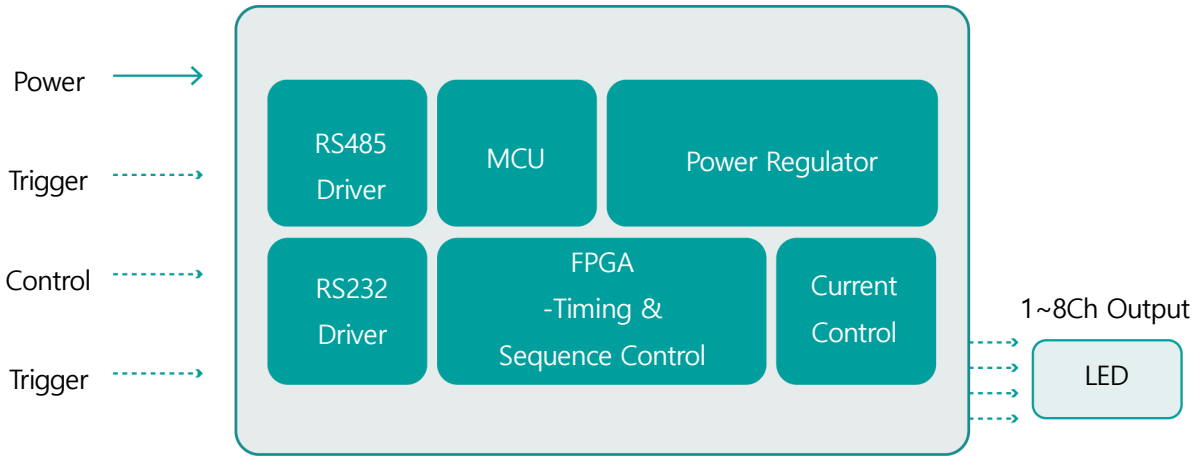


Figure 1 iPulse Remote controllers

Features

- Constant Current Drive
- LED Driving Voltage 1 ~ 80V
- Minimum Current Pulse Duration 0.1μs (The best performance at 0.5 μs)
- Maximum Switching Frequency 300KHz
- Support Current Over-driving
- Support LED Protection
- Built-in LED Voltage Automatic Control for High Efficiency
- Built-in Trigger Sequence Generator

2.2 Components

- iPulse LED Lighting Controller
- LED Connector
- 4 Pin Digital IO connector
- 2 Pin Power Connector

Figure 2 iPulse strobe controllers

Figure 3 iPulse high-power strobe controller

Separate components

- Power supply Unit
- RS-485 communication device
- RS-232 cable
- Power / IO cable
- Remote Controller

Figure 4 RS-485 communication module

* This product includes no separate components, but if required by the user, necessary components may be provided.

2.3 Specifications

Model	IP-1P1S-20A	IP-1P1S-50A	IP-1P1S-100A	IP-1P1S-2C	IP-1P1S-5C
No. of channel	1				
Current Resolution (Continuous / Pulse)	2.5 mA / 6 mA	6 mA / 15 mA	12 mA / 30 mA	2.5 mA / 6 mA	6 mA / 15 mA
Max. Output Current Per Channel (Continuous / Pulse)	2A / 20A	5A / 50A	5A / 100A	2A / 2A	5A / 5A
Max. Output power (per channel / Total)	30W / 30W	30W / 30W	30W / 30W	30W / 30W	30W / 30W
Max. Driving Voltage	80V				
Trigger Source	External IO / RJ45 Port / Soft Trigger Input				
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)				
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)				
Trigger Delay	0.0 - 5,000 μs (Step 0.1μs)				
Continuous Brightness	0 ~ 100%	0 ~ 100%	0 ~ 50%	0 ~ 100%	0 ~ 100%
Pulse Brightness	0 ~ 1,000%			0 ~ 100%	
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)				
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)				
Digital IO Output	TTL Output (5V, 330 ohm Output)				
Mechanical Spec.(W×H×L), weight	90 x 76 x 48 mm 300g				
Power Requirements	12 – 48V 120 W @ 24 V				
Operation Temperature	Case temperature : 0 ℃ ~ 50℃				
Connectors	Control : RJ45 8 Pin Connector Power : Molex 26013114(5569-02A3) Digital IO : 3.5 mm pitch 4 pin Terminal LED Output : 5.08 mm pitch 2 pin Terminal				

Table 1 1 channel strobe controller

Model	IP-1P1S-200A	IP-1P4S-20A	IP-1P4S-50A	IP-1P4S-100A
No. of channel	1	4	4	4
Current Resolution (Continuous / Pulse)	6 mA / 15 mA	2.5 mA / 6 mA	6 mA / 15 mA	12 mA / 30 mA
Max. Output Current Per Channel (Continuous / Pulse)	5A / 200A	0.2A / 20A	0.5A / 50A	1A / 100A
Max. Output power (per channel / Total)	30W / 30W	30W / 30W	30W / 30W	30W / 30W
Max. Driving Voltage	80V			
Trigger Source	External IO / RJ45 Port / Soft Trigger Input			
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)			
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)			
Trigger Delay	0.0 - 5,000 μs (Step : 0.1μs)			
Continuous Brightness	0 ~ 25%	0 ~ 10%	0 ~ 10%	0 ~ 10%
Pulse Brightness	0 ~ 1,000%			
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)			
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)			
Digital IO Output	TTL Output (5V, 330 ohm Output)			
Mechanical Spec.(W×H×L), weight	145 X 90 X 48 mm 500g			
Power Requirements	12 – 48V 120 W @ 24 V			
Operation Temperature	Case temperature : 0 °C ~ 50°C			
Connectors	Control : RJ45 8Pin Connector Power : Molex 26013114(5569-02A3) Digital IO : 3.5 mm pitch 4pin Terminal LED Output : 5.08 mm pitch 8 pin Terminal.			

Table 2 Advanced flashing strobe controllers

Model	IP-2P2S-20A	IP-2P2S-50A	IP-2P2S-2C	IP-2P2S-5C
No. of channel	2			
Current Resolution (Continuous / Pulse)	2.5mA / 6mA	6mA / 15mA	2.5mA / 6mA	6mA / 15mA
Max. Output Current Per Channel (Continuous / Pulse)	2A / 20A	5A / 50A	2A / 2A	5A / 5A
Max. Output power (per channel / Total)	30W / 60W	125W / 250W	30W / 60W	125W / 250W
Max. Driving Voltage	80V	48V	80V	48V
Trigger Source	External IO / RJ45 Port / Soft Trigger Input			
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)			
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)			
Trigger Delay	0.0 - 5,000 μs (step 0.1μs)			
Continuous Brightness	0 ~ 100%			
Pulse Brightness	0 ~ 1,000%		0 ~ 100%	
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)			
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)			
Digital IO Output	TTL Output (5V, 330 ohm Output)			
Mechanical Spec.(W×H×L), weight	145 x 90 x 48 mm 500g			
Power Requirements	12 – 48V 120 W @ 24 V	12 – 48V 250 W @ 48 V	12 – 48V 120 W @ 24 V	12 – 48V 250 W @ 48 V
Operation Temperature	Case temperature : 0 ℃ ~ 50℃			
Connectors	Control : RJ45 8 Pin Connector Power : Molex 26013114(5569-02A3) Digital IO : 3.5 mm pitch 4 pin Terminal LED Output : 5.08 mm pitch 2 pin Terminal			

Table 3 2 channel strobe controller

Model	IP-4P4S-20A	IP-4P4S-50A	IP-4P4S-3C
No. of channel	4		
Current Resolution (Continuous / Pulse)	2.5 mA / 6 mA	6 mA / 15 mA	2.5 mA / 6 mA
Max. Output Current Per Channel (Continuous / Pulse)	3A / 20A	3A / 50A	3A / 3A
Max. Output power (per channel / Total)	75W / 300W	75W / 300W	75W / 300W
Max. Driving Voltage	48V		
Trigger Source	External IO / RJ45 Port / Soft Trigger Input		
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)		
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)		
Trigger Delay	0.0 - 5,000 μs (Step : 0.1μs)		
Continuous Brightness	0 ~ 100%		
Pulse Brightness	0 ~ 1000%		0 ~ 100%
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)		
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)		
Digital IO Output	TTL Output (5V, 330 ohm Output)		
Mechanical Spec.(W×H×L), weight	145 X 90 X 48 mm 500g		
Power Requirements	12 – 48V 150 W @ 48 V		
Operation Temperature	Case temperature : 0 °C ~ 50°C		
Connectors	Control : RJ45 8Pin Connector Power : Molex 26013114(5569-02A3) Digital IO : 3.5 mm pitch 4pin Terminal LED Output : 5.08 mm pitch 8 pin Terminal.		

Table 4 4 channel strobe controller

Model	IP-8P8S-20A	IP-8P8S-3C
No. of channel	8	
Current Resolution (Continuous / Pulse)	2.5 mA / 6 mA	2.5 mA / 6 mA
Max. Output Current Per Channel (Continuous / Pulse)	3A / 20A	3A / 3A
Max. Output power (per channel / Total)	75W / 600W	75W / 600W
Max. Driving Voltage	48V	
Trigger Source	External IO / RJ45 Port / Soft Trigger Input	
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)	
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)	
Trigger Delay	0.0 - 5,000 μs (Step : 0.1μs)	
Continuous Brightness	0 ~ 100%	
Pulse Brightness	0 ~ 1,000%	0 ~ 100%
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)	
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)	
Digital IO Output	TTL Output (5V, 330 ohm Output)	
Mechanical Spec.(W×H×L), weight	212 X 100 X 48 700g	
Power Requirements	12 – 48V 150 W @ 48 V	
Operation Temperature	Case temperature : 0 ℃ ~ 50℃	
Connectors	Control : RJ45 8Pin Connector Power : Molex 26013114(5569-02A3) Digital IO : 3.5 mm pitch 4pin Terminal LED Output : 5.08 mm pitch 8 pin Terminal.	

Table 5 8 channel strobe controller

Model	IP-2P2S-200A	IP-2P2S-200B
No. of channel	2	
Current Resolution (Continuous / Pulse)	25 mA / 60 mA	25 mA / 60 mA
Max. Output Current Per Channel (Continuous / Pulse)	20A / 200A	20A / 200A
Max. Output power (per channel / Total)	250W / 500W	500W / 1000W
Max. Driving Voltage	48V	
Trigger Source	External IO / RJ45 Port / Soft Trigger Input / Channel Port	
Duration Setting	0.5 μs ~ 1,000,000 μs (step 0.1μs)	
Internal Period	1.0 - 1,000,000 μs (Step : 0.1μs)	
Trigger Delay	0.0 - 5,000 μs (Step : 0.1μs)	
Continuous Brightness	0 ~ 100%	
Pulse Brightness	0 ~ 1,000%	
Control Interface	RS-485 (for Multiple Device Control) / RS-232(for Single Device Control)	
Digital IO Input	Opto-coupled Input (3 ~ 24 V, 4 ~ 50 mA)	
Digital IO Output	TTL Output (5V, 330 ohm Output)	
Mechanical Spec.(W×H×L), weight	143 X 160 X 55 mm 900g	143 X 160 X 55 mm 1400g
Power Requirements	12 – 48V 250 W @ 48 V	12 – 48V 500 W @ 48 V
Operation Temperature	Case temperature : 0 °C ~ 50°C	
Connectors	Control : RJ45 8Pin Connector Power : 5.08 mm pitch 2 pin Terminal Digital IO : 3.5 mm pitch 4pin Terminal LED Output : DSUB 7W2 30A Female Connector	

Table 6 2 channel high-power controller

2.4 Cable Selection

2.4.1 LED cable selection

LED Cable *	0 ~ 5 M	5 ~ 10 M	10 ~ 20 M
Continuous 1A Pulse 10A	≤AWG 24	≤AWG 22	≤AWG 20
Continuous 2A Pulse 20A	≤AWG 22	≤AWG 20	≤AWG 18
Continuous 5A Pulse 50A**	≤AWG 20	≤AWG 18	≤AWG 16

Table 7 Cable length vs Cable AWG

* Voltage drop by the cable needs to be under 10V.
** Upon 50A operation, the cable may undergo a voltage drop, generating radiation intensity decrease. Thus, the wire needs to be short if possible.

2.4.2 IO cable selection

IO Cable	Cable AWG (0 ~ 20 M)	Note
Digital IO Cable	≤AWG 24	Twisted pair or shielded cables have excellent noise characteristics

Table 8 IO Cable Selection

2.4.3 Voltage Drop Expected voltage drop according to AWG and current

Wire AWG	Wire Diameter (mm)	Resistance (Ω / m)	10A 5 meter *	20A 5 meter	50A 5 meter
24 AWG	0.511	0.084	0.084 * 10 * 10 ** = 8.42V	0.084 * 20 * 10 = 16.84V	0.084 * 50 * 10 = 42.10V
22 AWG	0.64	0.053	0.053 * 10 * 10 = 5.3V	0.053 * 20 * 10 = 10.6V	0.053 * 50 * 10 = 26.50V
20 AWG	0.81	0.033	0.033 * 10 * 10 = 3.33V	0.033 * 20 * 10 = 6.66V	0.033 * 50 * 10 = 16.65V
18 AWG	1.02	0.021	0.021 * 10 * 10 = 2.10V	0.021 * 20 * 10 = 4.20V	0.021 * 50 * 10 = 10.05V

Table 9 Voltage Drop Specification by Cable AWG

* Voltage Drop = Resistance/m * Current * Cable Length
** Since LED wires are connected in series, the cable connecting the LED and the device is up to 10m in length.

2.5 Connectors and LED Display

As shown in the figure below, three types of connectors and the status LED are located on the front side of the product, and their functions are as follows.

Front Panel	info
2 Pin power input connectors	Power input
4 Pin digital IO connectors	External trigger input and trigger output
LED output connector	LED current output
Alarm LED	Alarm status indication
Run LED	Operation status indication
Output Status LED	LED operation and Sequence status

Table 10 Front Panel

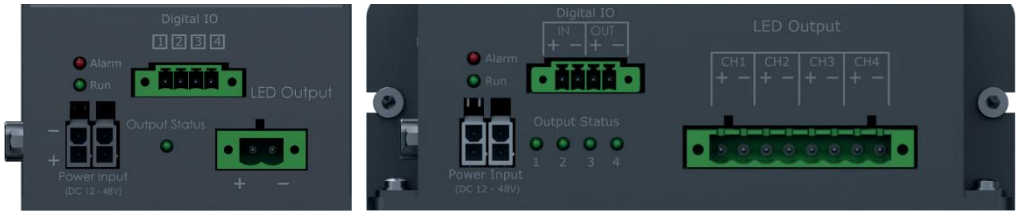


Figure 5 Front connectors and LED for 1 Channel controller and 4Channel controller

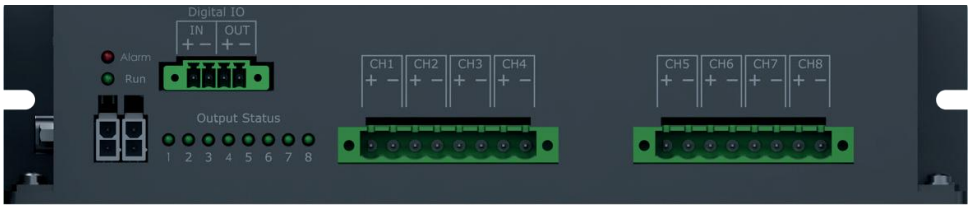


Figure 6 Front connectors and LED for 8 Channel controller

As shown in the figure below, two types of connectors and the DIP switch are located in the lateral part of the product, and their functions are as follows:

Side Panel	info
8 Pin RJ45 connector	RS-485 communication and trigger signal input
9 Pin RS-232 connector	RS-232 communication
DIP switch	Device Address setting

Table 11 Side connectors and switch

Figure 7 Side connectors and switch

As the below, two types of connectors and status LED's are located on the front of the high-capacity iPulse product (IP-2P2S-200A/200B), and their respective functions are as follows.

Front Panel	info
4-pin Channel Port Connector	Input trigger signal independently to LED channel 1 and channel 2
LED Output Connector	LED current output
Alarm LED	Alarm status indication
Run LED	Operation status indication
Output Status LED	LED operation and Sequence status

Table 12 Front connectors and LED for 2 Channel high-power controller

Figure 8 Front connectors and LED for 2 Channel high-power controller

Four types of connectors, a DIP switch, and a power switch are located on the rear of the product, and each function is as follows.

Rear Panel	info
2-pin Power Input Connector	Power Input
4-pin Digital IO Connector	External trigger signal input and trigger signal output
8-pin RJ45 connector	RS-485 Communication and Trigger Signal Input
9-pin RS-232 connector	RS-232 Communications
DIP switch	RS-232 Communications
Power switch	Power On/Off

Table 13 Back side connectors and switches for 2 Channel high-power controller

Figure 9 Back side connectors and switches for 2 Channel high-power controller

2.5.1 Power Input / Output Connector

The power input connector uses Molex 2-pin connectors. Two connectors of the same specifications are arranged on the front side. These two connectors, with the same poles directly connected to each other, can be utilized as a power output when multiple devices are connected in parallel by using one PSU. Image 2.7 below shows an example of connecting in parallel one power output, through which multiple devices can be supplied with power. As for the power plug, Molex 5557-02R bundled in the product package or a compatible plug may be used. As for the power supplier, the applicable power range is 12V to 48V. It is recommended to use an SMPS of 24V voltage output and 2A current output.

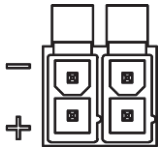
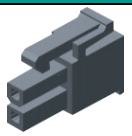
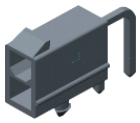
Power input connector	Plug	Receptacle
	 Molex 39012020 (5557-02R)	 Molex 26013114 (5569-02A2)

Table 14 Power connector

Figure 10 Power parallel connection

The power input connector of the high-capacity iPulse (IP-2P2S-200A/200B) uses 5.08 mm Pitch Terminal, the power supply can use a wide range of power from 12V to 48V and using SMPS with a 48V voltage output and a current output of 5A or more is recommended.

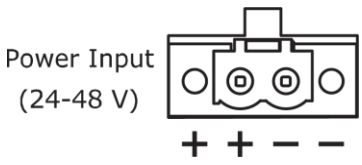


Figure 11 Power input connector for IP-2P2S-200A/200B

2.5.2 Digital IO Connector

As shown in the figure below, the digital IO connector for the trigger input/output is arranged on the front side of the product. A 3.5mm pitch terminal connector is used. The trigger input part is insulated internally by means of a photo coupler. It can receive 3.3-24V trigger signals. When the voltage input is as high as 24V, resistance needs to be added in series in order to protect the photo coupler from damage. Digital IO output signals are of 5V TTL, and the output impedance is 330 ohm. A plug compatible with the digital IO connector is delivered in the same product package.

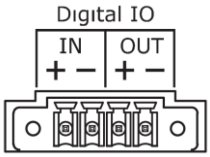


Figure 12 Digital IO connector

2.5.3 Channel Port

High-capacity iPulse products (IP-2P2S-200A/200B) have trigger ports that can input independent triggers on LED channel 1 and LED channel 2, respectively. It uses a 3.5 mm Pitch terminal connector, and the Trigger input is internally insulated using a Photo Coupler, and can receive a trigger signal of 3.3 to 24 V. If a high voltage input of 24V or higher is used, a series resistor shall be added to prevent damage to the Photo Coupler element. The plug compatible with the Channel Port connector is shipped with the product.

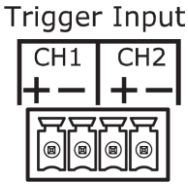


Figure 13 Channel Port

2.5.4 LED Output Connector

As shown in the figure below, the connector for the LED output is arranged on the front side of the product. A 5.08 mm pitch terminal connector is used. As shown in the table below, it is possible to use an LED with + and - separate from each other or with a common anode. A plug to connect the LED output connector with an LED is delivered in the same product package.

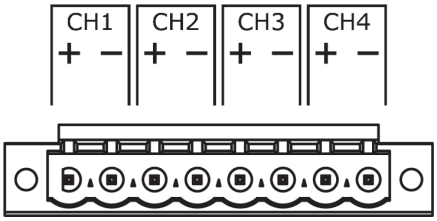


Figure 14 LED Output Connector

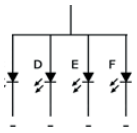
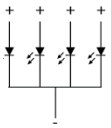
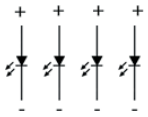
Wire AWG	Common anode	Common cathode	Independent
LED Configuration	 Supported	 Not Supported	 Supported

Table 15 LED Channel configuration

A connector for LED output is placed on the front of the high-capacity iPulse (IP-2P2S-200A/200B) product and a solder-type DSUB 7W230A Female Connector is used.

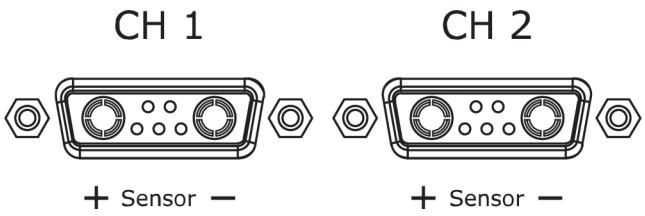


Figure 15 LED Output Connectors for (IP-2P2S-200A/200B)

2.5.5 LED Display

LEDs are used to indicate the status of the front and lateral sides of the product. Indications of the display status are as below.

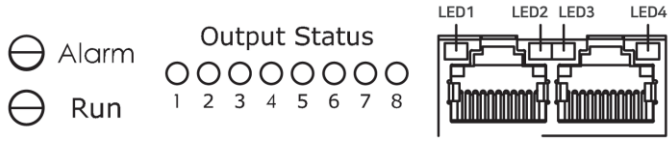


Figure 16 LED Display

LED	Color	Description
Alarm LED	Red	Alarm status indication - Blinking 1s: Alarm status indication. The alarm status register indicates symptoms. To release the alarm, execute the [Alarm Reset] command. - Single Pulse 10ms: When there is an undefined parameter access or a trigger input error
Run LED	Green	Operation status indication - Blinking 50 Hz: Normal operation status - Blinking 1 Hz: Boot loader status - Blinking 10 Hz: Firmware Download status
Output Status LED	Green	LED channel enable status indication. - The 'LED Enable' status of each channel
RJ45 LED1	Yellow	The trigger input status of the digital IO port
RJ45 LED2	Green	The trigger input status of RJ45
RJ45 LED3	Yellow	Serial communication receive operation status
RJ45 LED4	Green	Serial communication transmit operation status

Table 16 LED Display description

2.5.6 DIP-Switch setting

The DIP switch at the lateral part of the case is for setting up the Device ID. An address may be allotted in the following way: IDs available for the DIP setting are No. 0 to No. 14. If there are more devices to be connected, set all the DIP switches to ON (No. 15) and set up the Device ID by using the Slave Address (0x0200) parameter. The valid range is from 0 to 249. An address can be allotted to a max. of 250 devices. The 'Slave Address 0x0200' parameter is 'Write-protected.' It may be modified once '1' is entered into the 'Write Enable (0x300)' register.

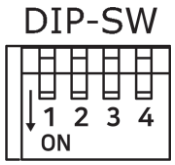


Figure 17 DIP Switch

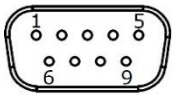
Switch 1	Switch 2	Switch 3	Switch 4	Slave Address
0	0	0	0	sID0
1	0	0	0	sID1
...				...
1	0	1	1	sID13
0	1	1	1	sID14
1	1	1	1	Programable sID0 ~ sID249

Table 17 DIP-Switch setting

* Switch OFF is 0, Switch ON is 1

2.5.7 Device Communication Interface

As for communication interfaces, RS-232 and RS-485 Ports are available. RS-232 is for one-on-one communication between a PC and a device while RS-485 is for 1 on N communication. Max. of 250 devices can be controlled. The section below is about pin placements and descriptions of each interface.



RS-232

Figure 18 RS-232 Connector

Pin number	Name	Description
2	RXD	Receive Data (Data is received though this pin)
3	TXD	Transmit Data (Data is transmitted through this pin)
5	GND	Ground (Used as reference for all pin voltage pulses)
1,4,6,7,8,9	NC	Not Connected.

Table 18 RS-232 Port Pin configuration

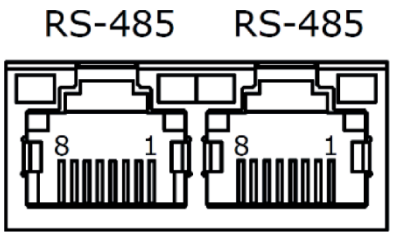


Figure 19 RS-485 connector

Pin number	Name	Description
1,2	N.C	Not Connected
3	RS485 Data(A)+	Non-inverting receiver input and non-inverting driver output
6	RS485 Data(B)-	Inverting receiver input and inverting driver output
4	Trigger Input RJ45 +	Trigger Input RJ45 Port +
5	Trigger Input RJ45 -	Trigger Input RJ45 Port -
7,8	GND	Ground (Used as reference for all pin voltage pulses)

Table 19 RS-485 port pin configuration

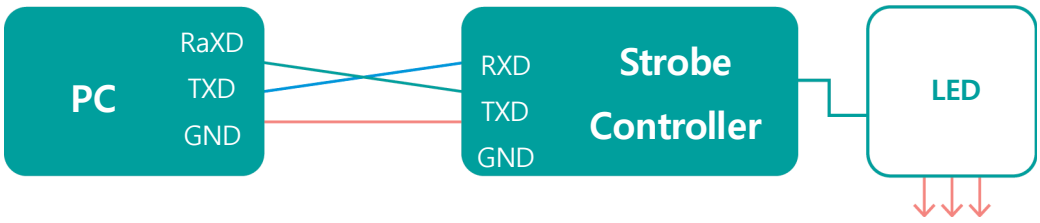


Figure 20 RS-232 Single Device Connection

* RS-232 Cross Cable (Length : <15 meter)

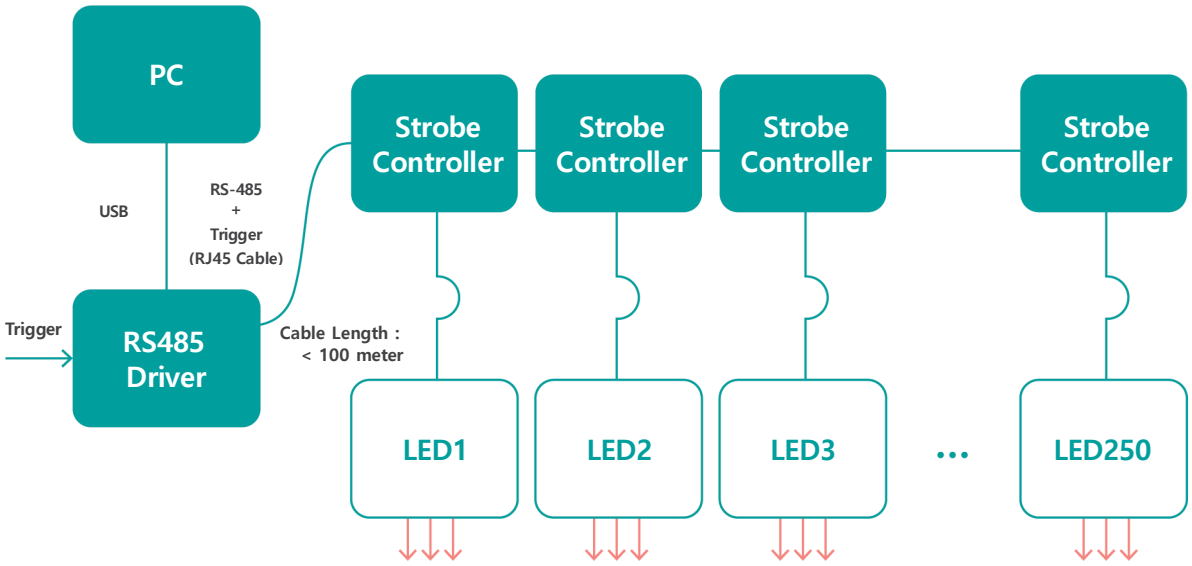


Figure 21 RS-485 Multi Device Connection

2.6 Mechanical Specification

Figure 22 Mechanical Dimension (in mm) for 1 channel strobe controller

Figure 23 Mechanical Dimensions(in mm) for Advanced flashing strobe controller, 2 channel strobe controller, 4 channel strobe controller

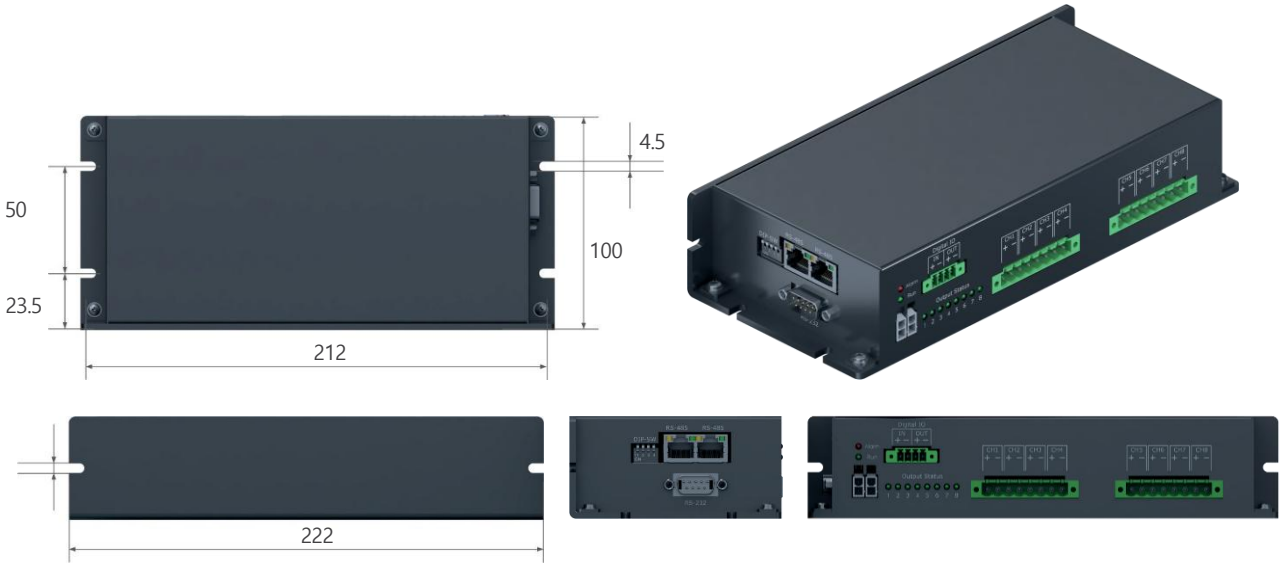


Figure 24 Mechanical Dimensions (in mm) for 8ch controller

Figure 25 Mechanical Dimensions (in mm) for 2channel High power strobe controller

3. Main Features

3.1 iPulse Configurator

iPulse Configurator is a program to control the LED controller. This program searches connectable serial ports and detects connected devices automatically. Double-clicking a detected device leads to the device setting window below.

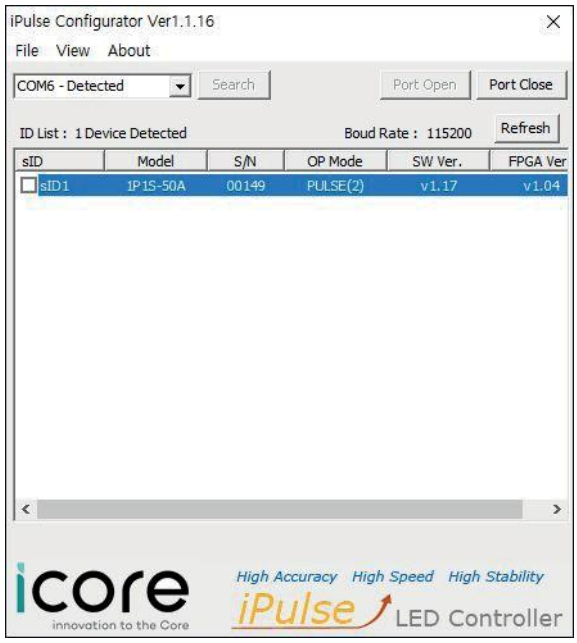


Figure 26 iPulse configurator program

In the device setting window, there are specific parameters that can be set up.

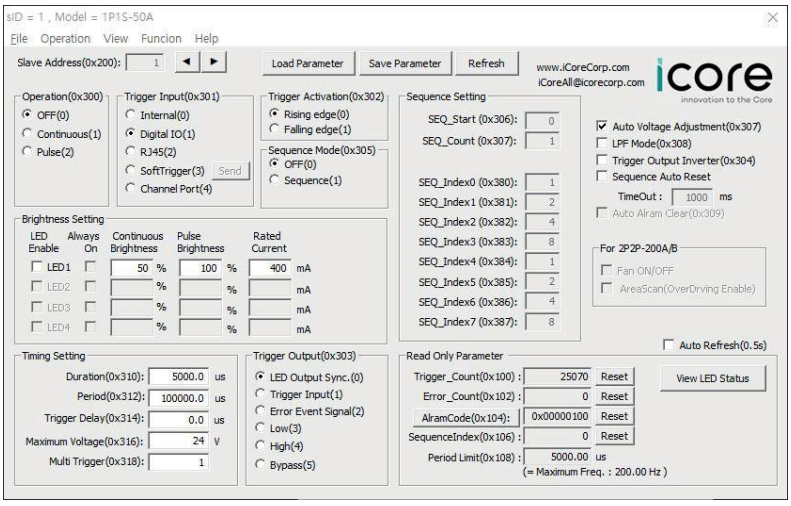


Figure 27 Device setting window

3.2 Operation Mode (0x300)

The 'Operation Mode' is used to set up 3 motions: OFF, Continuous, and Pulse.

- OFF(0) : To turn off LEDs of every channel.
- Continuous(1) : To operate LEDs continually.
- Pulse(2) : To operate with the pulse in the set duration.

3.3 Trigger Input Source (0x301)

This is to set up the Trigger Input Source. There are 4 input settings.

- Internal(0) : To generate periodic trigger signals by setting the internal period.
- Digital IO(1) : To receive trigger signals through an external digital IO port.
- RJ45 Port(2) : To receive signals through RJ45 Port's trigger inputs.
- Soft Trigger(3) : To receive trigger inputs through the [Soft Trigger] command.
- Channel Port(4) : To receive signals through Channel Port(for IP-2P2S-200A/200B)

3.4 Trigger Input Activation

This is to set up 'Activation' of Trigger Input signals. There are 2 settings.

- Rising edge(0) To execute 'Activation' of trigger signals at the rising edge.
- Falling edge(1) : To execute 'Activation' of trigger signals at the falling edge.

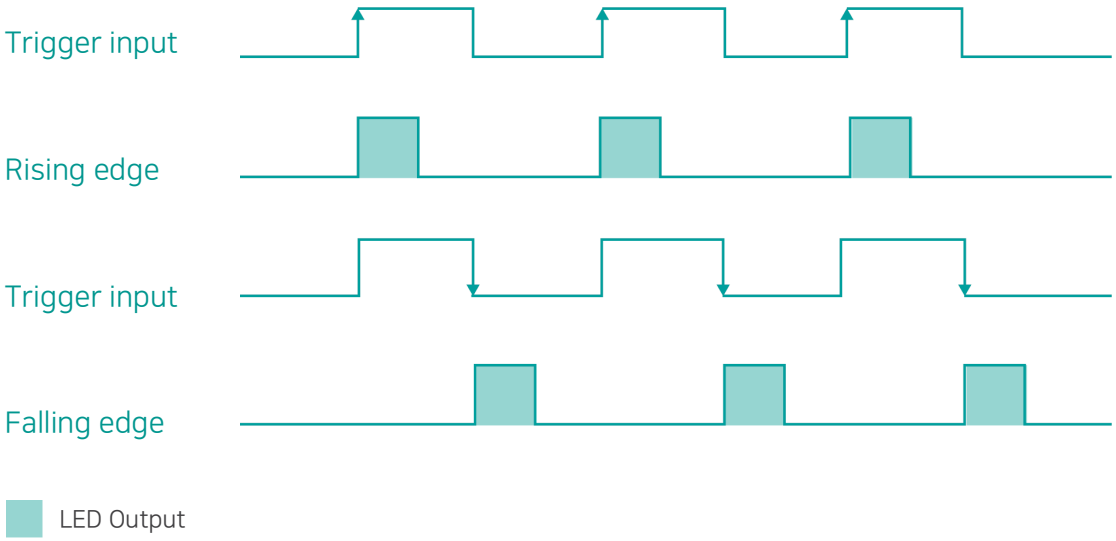


Figure 28 Trigger activation

3.5 Trigger Output Source (0x303)

This is to set up types of trigger output. There are 5 settings.

- LED Output Sync(0) : LED output that is synchronized with LED output signals to which 'Duration' and 'Delay' are applied.
- Trigger Input(1) : To output trigger with 1μs of pulse duration. 'Trigger delay' can shift the output trigger.
- Trigger Error Signal(2) : To output trigger error event signals.
- Low(3) : To output digital '0' signals.
- High(4) : To output digital '1' signals.
- Bypass(5) : To output input trigger bypassing

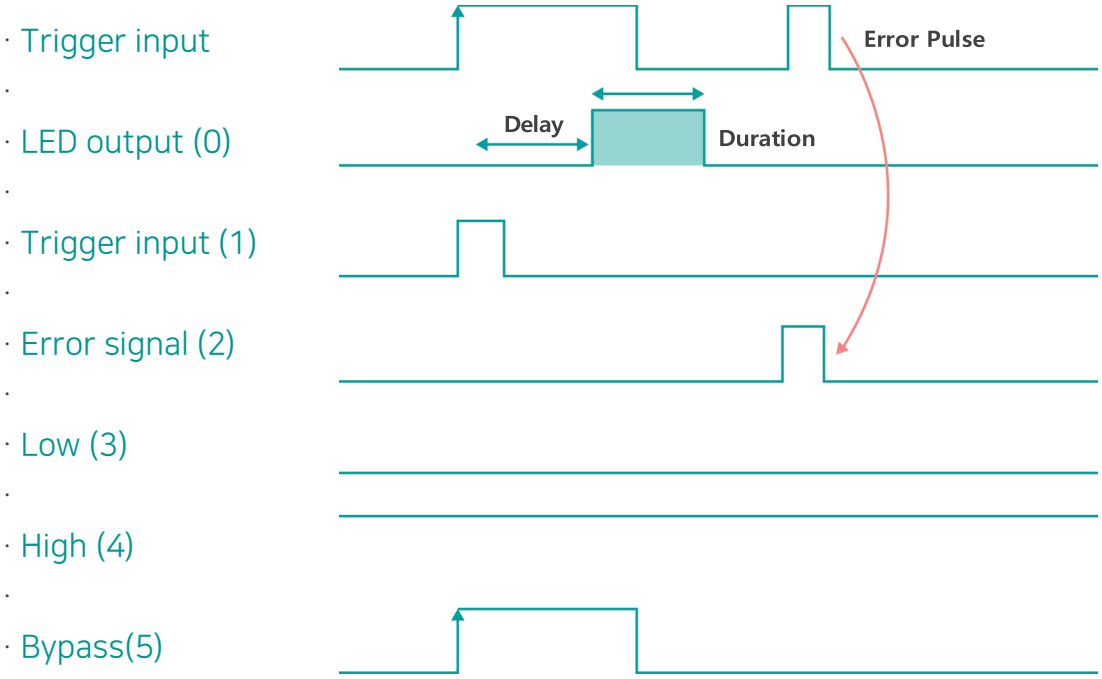


Figure 29 Trigger output source

3.6 Trigger Output Inverter (0x304)

To invert and output trigger output signals.

3.7 Brightness Setting

Brightness setting items include channel ON/OFF, brightness and rated current settings in 'Continuous' and 'Pulse' modes, etc.

- LED Enable : LED Enable is an LED driving control signal that blocks the current into LEDs when it is off.
- Continuous Brightness : This is to set up the brightness in the 'Continuous' mode. The value of the current when the brightness is 100% is the same with the value of the 'Rated Current.'
- Pulse Brightness : This is to set up the brightness in the 'Pulse' mode between 0 and 1000%. The value of the current when the brightness is 1000% is 10 times larger than the value of the 'Rated Current.' Between 101% and 1000%, the current value is larger than the rated value of LEDs. Thus, this may be viewed as an over-driving condition, in which 'Duty' and 'Duration' are limited in order to protect LED elements.
- Rated Current: Enter the rated current of the LED used. If the rated current is exceeded, there is a risk of LED damage, so enter carefully.

3.8 Timing Setting

For the timing setting, the following items can be configured.

- Duration(0x310): This is a parameter to set up the pulse width for LED operation between 0.1μs and 1,000,000μs.
- Period(0x312): When the 'Trigger Input Source' is set to 'Internal,' it is possible to set up the operation cycle of the LED internally by means of this function between 2.0μs and 1,000,000.0 μs.
- Delay(0x314): This parameter is to generate a pulse after a certain period of delay following an external trigger signal input. The unit is 'μs' and the valid range is 0.0 to 5,000 μs.
- Maximum Voltage(0x316) : This parameter is to set up the max. operation voltage of LEDs. It is recommended to set up the value twice as much as the rated voltage.
- Multi Trigger (0x318): is the number of LED drives generated by iPulse when an input signal is input. The LED is driven by the number of Multi Triggers according to the Duration and Period input by the user.

3.9 Sequence Setting

The 'Sequence' function is to turn on the LEDs of each channel sequentially upon the 'Trigger' input or to change the combination of each channel. This function can be configured by using the parameter items below:

- Sequence Mode (0x305) : Set the sequence mode on/off. When activated, the output of the LED channel given as the Sequence Index may be sequentially changed in synchronization with the Trigger signal.
- SEQ_Start (0x306) : Setting the index that starts the sequence after the sequence reset
- SEQ_Count (0x307) : Set Sequence Count

When the [Sequence Reset] command is sent, it is initialized to the sequence index specified by the 'Seq_Start' parameter. The 'SEQ_Count' parameter is to set up the number of sequence to be run. The sequence index is adjusted according to the designated number and then reloaded back to 'Index 0.' Table 13 Shows how to set up the 'Sequence Index' value. The ON/OFF status of each LED channel is designated in the bit unit. The bit value may be converted into a decimal value.

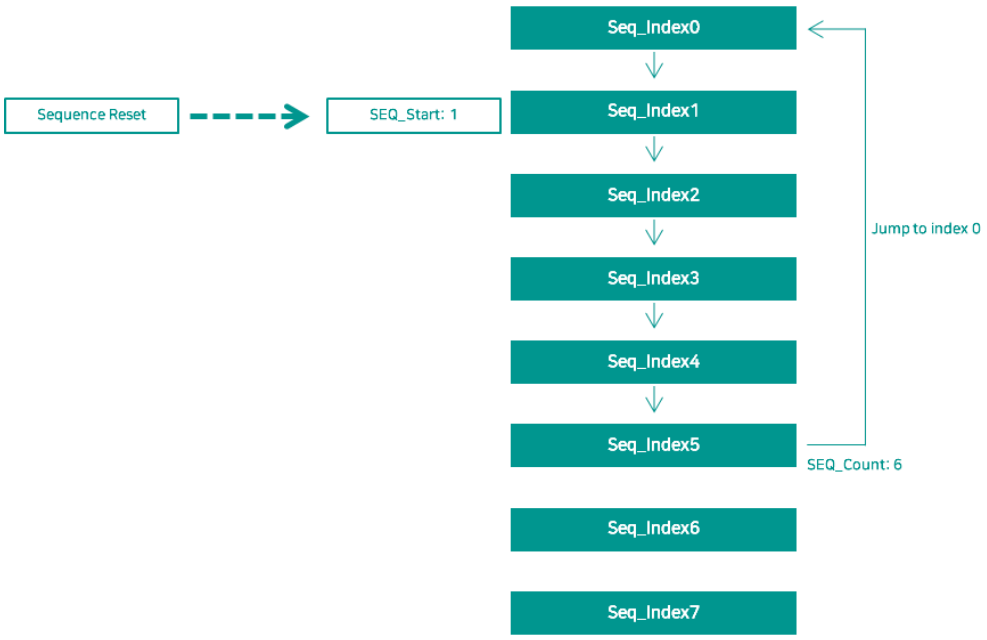


Figure 30 Sequence mode operation

LED ch4	LED ch3	LED ch2	LED ch1	Sequence index
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	1	0	0	4
1	0	0	0	8
1	1	1	1	15

Table 20 Sequence mode operation (except 8ch controller)

LED ch8	LED ch7	LED ch6	LED ch5	LED ch4	LED ch3	LED ch2	LED ch1	Sequence index
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	1	0	0	4
0	0	0	0	1	0	0	0	8
0	0	0	1	0	0	0	0	16
0	0	1	0	0	0	0	0	32
0	1	0	0	0	0	0	0	64
1	0	0	0	0	0	0	0	128
1	1	1	1	1	1	1	1	255

Table 21 Sequence mode operation for 8ch controller

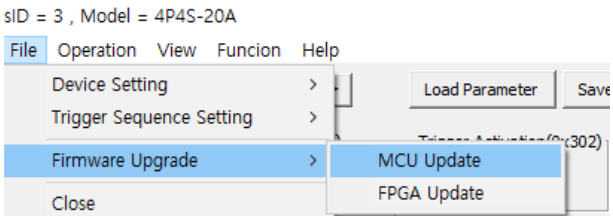
3.10 IP-2P2S-200A/200B Only Parameters

· Fan ON/OFF : Internal Fan operation On/Off control

· AreaScan(Over-Driving Enable) : AreaScan mode On. Overdrive not driven when Area Scan mode is off. It is recommended to disable the function when taking a line scan.

3.11 Firmware Update

upgrade Bootloader, MCU, and FGPA logic through the Serial interface.



4. Serial Communication

4.1 Setting command

Every setting command of iPulse uses the RTU Modbus Protocol and is executed through the serial interface of RS-485 or RS-232. If a user intends to control it directly, the following communication setting may be used. Setting commands use the Modbus protocol, which is an asynchronous half duplex communication method. Once a command is transmitted from a master device (PC or controller), the receiving device returns a response to that command.

When Windows is in the stand-by mode or sleep mode, basically, the serial communication may be disconnected. After restoration from this mode, the serial communication needs to be reconnected.

4.1.1 Communication specifications

- Baudrate 115200bps(Selectable 9600, 38400)
- Data Bit 8Bit
- Parity Bit No Parity
- Stop Bit 1 Stop Bit
- Flow control None
- CRC Check Yes
- Cable Length < 100meter (@Baudrate 115200)

4.1.2 Modbus Communication Frame

Slave Address	Function	Start Register	# of Register	CRC Checksum
1Byte	1Byte	2Byte	2Byte	2Byte
0 ~ 249(For user)	0X03(Read)	0X0000	Read Count	CRC Value
254(For bust read)	0X06(Write)	~	Write Value	
255(For broad cast)	0X10(Multi Write)	0x04FF		

Table 22 Request packet

4.2 Parameter Address Area

Parameters may be divided into 4 address areas depending on the attributes as shown in the figure below. System parameters and user parameters are stored in flash memory so that their status can remain even while the power is off.

Operation parameters are in the register area where the counter is initialized or such actions as saving in or loading from the memory are executed. The 'Read Only' parameter is to report the internal status of a device. This is used to read the value of a device's internal status.

The system parameter area includes information on a device's factory default and version. Reading is possible but writing is restricted. User parameters for user settings. Both reading and writing are possible. Once settings are saved in flash memory, they are loaded automatically upon rebooting.

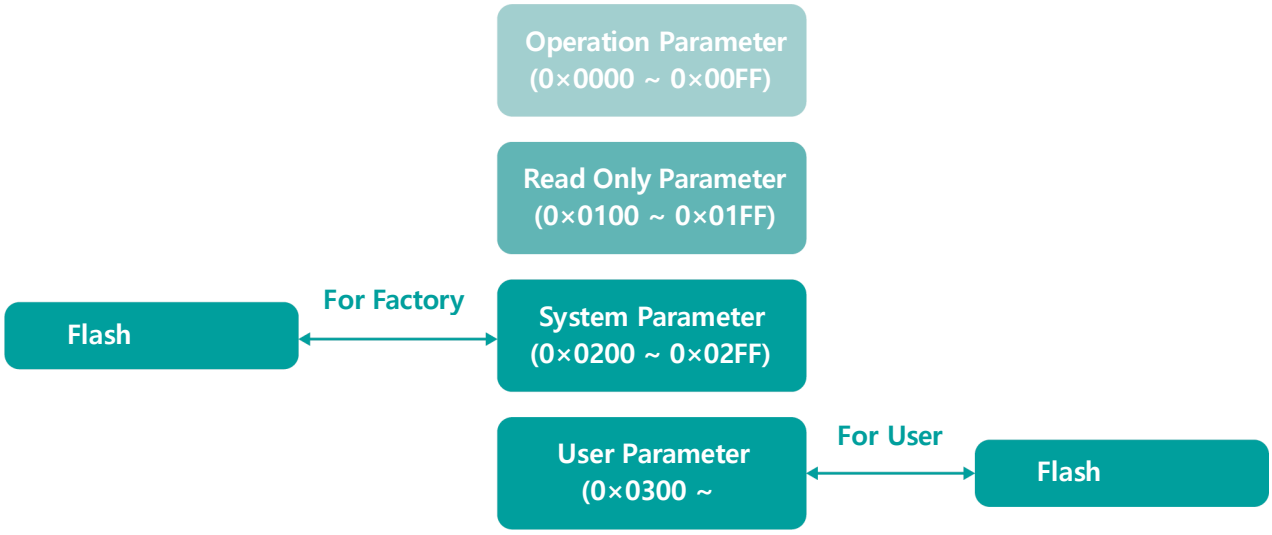


Figure 31 Parameter Area

Data Format Definition

- U16(=unsigned integer 16 bit) 2 Byte
- U32(=unsigned integer 32 bit) 4 Byte
- float 4 Byte

4.2.1 Operation Parameter

Parameter	Register Address	Attribute	Data Format	Description
Reboot device	0X0000	R/W	U16	0 : Default 1 : Run reboot device
Save parameter	0X0001	R/W	U16	0 : Completed or Default 1 : Save to User Setting
Load parameter	0X0002	R/W	U16	0 : Completed or Default 1 : Load from User Setting
Write enable	0X0003	R/W	U16	0 : Default 1 : Write Enable Status
Alarm reset	0X0004	R/W	U16	1 : Run Alarm Reset
Soft trigger	0X0005	R/W	U16	1 : Send Soft Trigger Single Pulse
Trigger counter reset	0X0006	W	U16	1 : Reset Trigger Counter
Error counter reset	0X0007	R/W	U16	1 : Reset Error Counter
Sequence index reset	0X0008	R/W	U16	1 : Reset Sequence Index

4.2.2 Read Only Parameter

Parameter	Register Address	Attribute	Data Format	Description
Trigger Count	0X0100	R	U32	Return Trigger Counter value
Error Count	0X0102	R	U32	Return Error Counter value
Alarm Code	0X0104	R	U32	Return Alarm Code*
Sequence Index Number	0X0106	R	U32	Return Sequence Index Number
Period Limit	0X0108	R	float	Return Period Limit. [us]
LED+ Voltage	0X010C	R	float	Return LED+ Voltage [V]
PCB Temperature	0X010E	R	float	Return PCB Temperature [℃]
LED-Voltage	0X0110	R	float	Return LED- Voltage [V]

* For more details on alarm codes, refer to the 'Alarm Code' section below.

Read Monitoring For 1P1S Model

Parameter	Address	Attribute	Format	Description
LED Current	0X010A	R	float	Return LED Current
LED+ Voltage	0X010C	R	float	Return LED+ Voltage [V]
PCB Temperature	0X010E	R	float	Return PCB Temperature [℃]
LED-Voltage	0X0110	R	float	Return LED- Voltage [V]

Read Monitoring For 1P4S Model

Parameter	Address	Attribute	Format	Description
LED+ Voltage	0X010C	R	float	Return LED+ Voltage [V]
PCB Temperature	0X010E	R	float	Return PCB Temperature [℃]
LED-Voltage	0X0110	R	float	Return LED- Voltage [V]
LED Current CH1	0X0124	R	float	Return LED Current
LED Current CH2	0X0126	R	float	Return LED Current
LED Current CH3	0X0128	R	float	Return LED Current
LED Current CH4	0X012A	R	float	Return LED Current

Read Monitoring For 2P2S-20A/50A/200A(B) Model

Parameter	Address	Attribute	Format	Description
PCB Temperature	0X010E	R	float	Return PCB Temperature [℃]
Heat-Sink Temperature	0X0124	R	Int32	Return Input Voltage (For 2P2S-200A(B))
Sensor1 Temperature	0X0124	R	float	Return LED- Voltage CH1 [V] (For 2P2S-200A(B))
Sensor2 Temperature	0X0126	R	float	Return LED- Voltage CH2 [V] (For 2P2S-200A(B))
Input Voltage	0X0124	R	Int32	Return Input Voltage (For 2P2S-50A, 2P2S-200A(B))
LED- Voltage CH1	0X0124	R	float	Return LED- Voltage CH1 [V]
LED- Voltage CH2	0X0126	R	float	Return LED- Voltage CH2 [V]
LED+ Voltage CH1	0X0128	R	float	Return LED+ Voltage CH1 [V]
LED+ Voltage CH2	0X012A	R	float	Return LED+ Voltage CH2 [V]

LED Current CH1	0X0130	R	float	Return LED- Voltage CH1 [V]
LED Current CH2	0X0132	R	float	Return LED- Voltage CH2 [V]

Read Monitoring For 4P4S/8P8S Model

Parameter	Address	Attribute	Format	Description
PCB Temperature	0X010E	R	float	Return PCB Temperature [℃]
Input Voltage	0X0128	R	float	Return Input Voltage
LED+ Voltage CH1	0X0124	R	float	Return LED+ Voltage CH1 [V]
LED- Voltage CH1	0X0126	R	float	Return LED- Voltage CH1 [V]
LED Current CH1	0X0128	R	float	Return LED Current CH1 [A]
LED+ Voltage CH2	0X012A	R	float	Return LED+ Voltage CH2 [V]
LED- Voltage CH2	0X012C	R	float	Return LED- Voltage CH2 [V]
LED Current CH2	0X012E	R	float	Return LED Current CH2 [A]
LED+ Voltage CH3	0X0130	R	float	Return LED+ Voltage CH3 [V]
LED- Voltage CH3	0X0132	R	float	Return LED- Voltage CH3 [V]
LED Current CH3	0X0134	R	float	Return LED Current CH3 [A]
LED+ Voltage CH4	0X0136	R	float	Return LED+ Voltage CH4 [V]
LED- Voltage CH4	0X0138	R	float	Return LED- Voltage CH4 [V]
LED Current CH4	0X013A	R	float	Return LED Current CH4 [A]
LED+ Voltage CH5	0X013C	R	float	Return LED+ Voltage CH5 [V]
LED- Voltage CH5	0X013E	R	float	Return LED- Voltage CH5 [V]
LED Current CH5	0X0140	R	float	Return LED Current CH5 [A]
LED+ Voltage CH6	0X0142	R	float	Return LED+ Voltage CH6 [V]
LED- Voltage CH6	0X0144	R	float	Return LED- Voltage CH6 [V]
LED Current CH6	0X0146	R	float	Return LED Current CH6 [A]
LED+ Voltage CH7	0X0148	R	float	Return LED+ Voltage CH7 [V]
LED- Voltage CH7	0X014A	R	float	Return LED- Voltage CH7 [V]
LED Current CH7	0X014C	R	float	Return LED Current CH7 [A]
LED+ Voltage CH8	0X014E	R	float	Return LED+ Voltage CH8 [V]

LED- Voltage CH8	0X0150	R	float	Return LED- Voltage CH8 [V]
LED Current CH8	0X0152	R	float	Return LED Current CH8 [A]

4.2.3 System Parameter

Parameter	Register Address	Attribute	Data Format	Description
Device Address	0X0200	R/W	U16	Return Device Slave Address
Boot Loader Version	0X0202	R	U16	Return Boot Loader Version
SW Version	0X0204	R	U16	Return SW Version
FPGA Version	0X0206	R	U16	Return FPGA Version
Serial Number	0X0208	R	U16	Return Serial Number
Model Code	0X020A	R	U16	Return Model Code

4.2.4 User Parameter

Parameter	Register Address	Attribute	Data Format	Description
Operation Mode	0x0300	R/W	U16	0 : OFF 1 : Continuous Mode 2 : Pulse Mode
Trigger Input Source	0x0301	R/W	U16	0 : Internal 1 : Digital Input Port 2 : RJ45 Input Port 3 : Soft Trigger 4 : Channel Port (For 2P2S-200A(B))
Trigger Input Activation	0x0302	R/W	U16	0 : Active High 1 : Active Low
Trigger Output Source	0x0303	R/W	U16	0 : LED Output Sync. 1 : Trigger Input Signal(Bypass) 2 : Error Event Signal 3 : Low 4 : High 5 : Bypass
Trigger Output Inverter	0x0304	R/W	U16	0 : Normal 1: Inverter
Sequence Mode	0x0305	R/W	U16	0 : OFF 1 : Sequence Mode Enable
Sequence Initial Index	0x0306	R/W	U16	Set Sequence Initial Index n (0 ~ 7)
Sequence Number	0x0307	R/W	U16	Set Sequence Number n (1 ~ 8)
Auto Sequence Reset	0x0308	R/W	U16	Auto Sequence Reset 0 : OFF / 1 : Enable (**Supported from MCU Ver 1.04)
Auto Sequence Reset Time Out	0x0309	R/W	U16	Auto Sequence Reset Time Out [ms] n : (1 ~ 65535) (**Supported from MCU Ver 1.04)
Auto Voltage	0x030A	R/W	U16	0 : OFF 1 : Auto Voltage Enable
LPF Mode	0x030B	R/W	U16	0 : Default 1 : Low Pass Filter Enable
Power Down	0X030C	R/W	U16	0 : Default 1 : Power Down

Duration	0X0310	R/W	float	Duration Setting [μs] 0.1 ~ 1,000,000.0μs
Period	0X0312	R/W	float	Internal Period Setting [μs] 2.0 ~ 1,000,000.0μs
Trigger Delay	0X0314	R/W	float	Trigger Delay Setting [μs] 0.0 ~ 5,000μs
Voltage	0X0316	R/W	U16	Set Maximum LED Voltage n : (0 ~ 80V)
Multi Trigger	0X0318	R/W	U32	Set the number of Multi trigger n : (1 ~ 16777214)
Fan On/Off	0X031A	R/W	U16	0: OFF 1: Fan Enable (For 2P2S-200A(B))
LED1 Enable	0X0320	R/W	U16	0: OFF 1: LED Enable
LED2 Enable	0X0321	R/W	U16	0: OFF 1: LED Enable
LED3 Enable	0X0322	R/W	U16	0: OFF 1: LED Enable
LED4 Enable	0X0323	R/W	U16	0: OFF 1: LED Enable
LED5 Enable	0X0324	R/W	U16	0: OFF 1: LED Enable
LED6 Enable	0X0325	R/W	U16	0: OFF 1: LED Enable
LED7 Enable	0X0326	R/W	U16	0: OFF 1: LED Enable
LED8 Enable	0X0327	R/W	U16	0: OFF 1: LED Enable
LED1 Current Rate Continuous	0X0330	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED2 Current Rate Continuous	0X0331	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED3 Current Rate Continuous	0X0332	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED4 Current Rate Continuous	0X0333	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED5 Current Rate Continuous	0X0334	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)

LED6 Current Rate Continuous	0X0335	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED7 Current Rate Continuous	0X0336	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED8 Current Rate Continuous	0X0337	R/W	U16	Set Current Rate in Continuous mode[%] n : (0 ~ 100)
LED1 Current Rate Pulse	0X0340	R/W	U16	Set LED1 Current Rate for Pulse [%] n : (0 ~ 1000)
LED2 Current Rate Pulse	0X0341	R/W	U16	Set LED2 Current Rate for Pulse [%] n : (0 ~ 1000)
LED3 Current Rate Pulse	0X0342	R/W	U16	Set LED3 Current Rate for Pulse [%] n : (0 ~ 1000)
LED4 Current Rate Pulse	0X0343	R/W	U16	Set LED4 Current Rate for Pulse [% n : (0 ~ 1000)
LED5 Current Rate Pulse	0X0344	R/W	U16	Set LED5 Current Rate for Pulse [%] n : (0 ~ 1000)
LED6 Current Rate Pulse	0X0345	R/W	U16	Set LED6 Current Rate for Pulse [%] n : (0 ~ 1000)
LED7 Current Rate Pulse	0X0346	R/W	U16	Set LED7 Current Rate for Pulse [%] n : (0 ~ 1000)
LED8 Current Rate Pulse	0X0347	R/W	U16	Set LED8 Current Rate for Pulse [% n : (0 ~ 1000)
LED1 Rated Current	0X0350	R/W	U16	Set LED1 Rated Current [mA]
LED2 Rated Current	0X0351	R/W	U16	Set LED2 Rated Current [mA]
LED3 Rated Current	0X0352	R/W	U16	Set LED3 Rated Current [mA]
LED4 Rated Current	0X0353	R/W	U16	Set LED4 Rated Current [mA]
LED5 Rated Current	0X0354	R/W	U16	Set LED5 Rated Current [mA]
LED6 Rated Current	0X0355	R/W	U16	Set LED6 Rated Current [mA]
LED7 Rated Current	0X0356	R/W	U16	Set LED7 Rated Current [mA]
LED8 Rated Current	0X0357	R/W	U16	Set LED8 Rated Current [mA]
Sequence Data[8]	0X0380 ~ 0x387	R/W	U16	Set Sequence Data, 8 Array n : (0 ~ 255) ** Refer to Sequence Mode section

4.2.5 Alarm Code

Alarm Code	Description	조치 사항
0X0002	PCB Temperature over 70 ° C	· When it is used at high temperature or generates heat out of overloading, the PCB temperature may increase. It is recommended to attach the case on a structure that radiates heat well.
0X0008	FPGA Register Check Error	· If FPGA communication errors occur after FPGA upgrading, the upgrading process needs to be retried.
0X0010	Flash Memory Check Error	· When this symptom occurs, consult with the manufacturer.
0X0020	Power Range Over	· An alarm is issued when the LED output exceeds the output setting.
0X0040	LED Short Circuit	· An alarm is issued when there is a short in the LED wire or when the LED + operation voltage is lower than 2V. Remove the LED wire and check the symptoms.
0X0100	LED1 Not Connected	· An alarm is issued when there is no load on the LED output. · Check the LED polarity and connection status. · When the LED voltage exceeds the rated operation voltage, the LED does not work with the operation voltage increasing to the peak.
0X0200	LED2 Not Connected	
0X0400	LED3 Not Connected	
0X0800	LED4 Not Connected	

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