

LASERMET SAFETY LOGIC PLUS INSTRUCTION MANUAL



LASERMET ICS-SLP Instruction Manual

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1 Declaration of Conformity



LASERMET LIMITED

SAFETY LOGIC PLUS MODULES

Part no. ICS-SLP

DECLARATION OF CONFORMITY

This is to certify that the Safety Logic Plus Modules designated by Lasermet Part Number ICS-SLP has been tested in accordance with the following directives and standards and found to comply.

Lasermet certifies that this product complies with the basic requirements for health and safety as provided by the following directives and standards:

Directives: Machinery Directive
 EMC Directive

Standards: EN 954-1
 Safety-related Control Systems
 EN 61010-1
 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

Supplier:

Lasermet Limited
Lasermet House
137 Hankinson Road
Bournemouth
BH9 1HR
Dorset
United Kingdom

Country of Origin: England

Signed.

Paul Tozer
Managing Director

Date: 10 June 2019



2 Safety Warnings

This device is intended to be used as part of a safety system which may be used to protect personnel and equipment from possible injury, damage, or loss.

As such it must be installed and wired according to these instructions and tested by suitably qualified persons. No attempt may be made to tamper with the parts, open them, or use them outside of the parameters contained herein.

The units are only designed to be fixed to surfaces using their inbuilt fixing holes. They must not come into contact with each other or any other moving part when in use. The parts should never be subject to impact or mechanical strain.

Safety switches should never be defeated or bypassed. It is imperative that all steps are taken to ensure that any spare actuators are made unavailable, such that they cannot be used to defeat the switch or reduce the protection offered by the system in any way.

3 Concept

When hazardous machinery, or equipment such as lasers, are used it is often essential to provide physical protection to prevent accident or injury. Where there are doors, guards, or covers, they are usually fitted with safety contacts and an interlock system is provided to confirm that such doors and guards are in the correct place to allow the equipment to operate safely.

In some situations, there may be several doors or guards, and there may be various permissible arrangements or modes of operation with different degrees of protection required. It can be difficult to meet the various operational requirements of complex interlocks using hard wiring between door contacts. It can also be difficult to test, fault-find or alter such a system.

With a Safety Logic Plus system, each door contact is individually wired to a central control panel. The control panel contains a number of Safety Logic Plus modules (gates) which are interconnected to create the desired operation. The output of the final module goes active when the inputs are in one of the safe conditions defined by the interconnection of the modules and this may be fed to a Lasermet Interlock Controller such as ICS-6, or to some other safety controller to enable operation of the equipment.

Safety Logic Plus includes a pre-check feature which checks all its internal relays. The safety controller must have the means to turn off power to the Safety Logic Plus system and confirm that the pre-check loop is complete before turning the system on and using it. Lasermet's ICS-6 performs this check automatically when the SLP Interface Card is used.

Safety Logic Plus is fully dual-channel, and each logic signal comprises two wires which carry complementary voltages. The safety controller should only allow the equipment to be used if both inputs are in the correct state.

Furthermore, if a mismatch between the signals exists for more than a fraction of a second it is advised that the controller treats this as a fault. Lasermet's ICS-6 performs this check automatically.

The Safety Logic Plus system provides a range of DIN rail mounted modules, each of which accomplishes a logic function. One or more modules may be used to realise the functions of a safety interlock system. At present there are four types of modules:

00849-00-000	2-Input AND
00850-00-000	2-Input OR
00860-00-000	2-Input Exclusive OR
00897-00-000	NOT gate (inverter)

Note that the SLP system requires a Safety Logic Plus Interface Board (SLP-IF) to be fitted inside the ICS-6 controller.

Lasermet provides a full range of laser interlock equipment including control systems, interlock switches, illuminated warning signs, laser shutters, door locks, external power supplies etc. which can be connected to provide a complete laser interlock system. Full support, design and installation is available from Lasermet, please contact us for any queries. Contact details are given at the end of this manual.

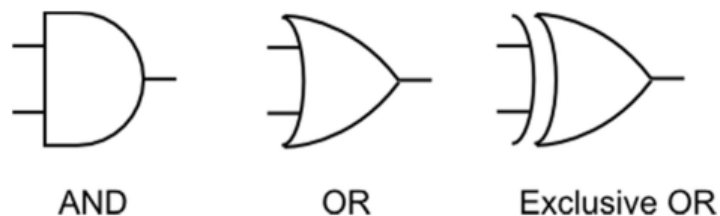
3.1 Logic Rules

As an example, suppose a machine may only be permitted to operate if door A is closed, and either or both of doors B and C.

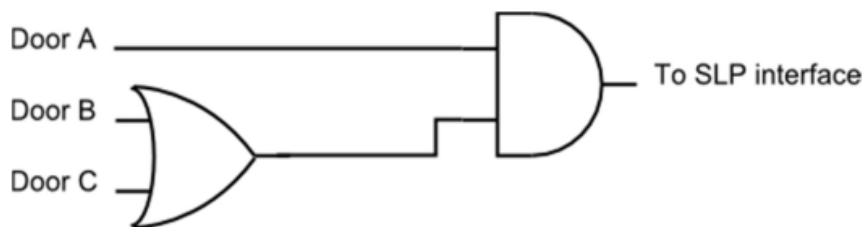
To create this function using Safety Logic Plus, the doors are fitted with safety contacts. The contacts on doors B and C are connected to the two inputs of an OR module. This will give an output if door B OR door C OR both are closed.

The output of the OR module is connected to one input of an AND module. Door A is connected to the other input. The output of the AND module is the required safety function. It only becomes active if door A AND (door B OR door C OR both) are closed.

It is often convenient to use standard logic gate symbols to design the circuit. These are:



Using these symbols, the circuit for our example can be drawn as shown below:



The standard logic rules apply to Safety Logic Plus modules, namely:

- Several inputs may be connected together to read one signal.
- Two or more outputs must never be connected together. Outputs must always be combined using modules.
- An output can drive several inputs.

Additional rules pertinent to Safety Logic Plus:

- Positive logic is used throughout. A logic '1' means it is safe to enable the equipment. Usually this equates to 'Door Closed', 'Emergency Stop Inactivated', etc.
- The inverter (NOT) gate is not normally used for logic since it is usually unwise to invert an unsafe (0) into a safe (1) condition.

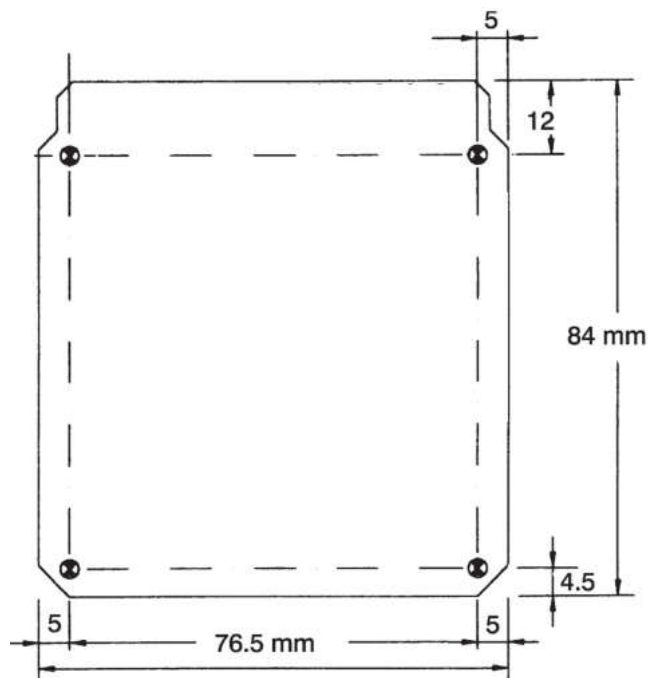
The NOT gate is only recommended to invert the logic state for indicators.

4 Installation

The control cabinet should be equipped with a 35mm DIN rail and each SLP module occupies 23mm of space along the rail.

A module is fitted by hooking the bottom onto the rail and swinging the module upwards until it clicks into place.

SLP DIN Rail Enclosure Dimensions



NOTE:

Unit is approx. 23mm wide.
Allow at least 20mm of extra DIN Rail length for end brackets.

SLP Labels

AND	+24V	GND	PRE+	PRE-	B A	IN 1	IN 2	OUT	BUS	QB	QA	2B	2A	1B	1A
LASERMET 2-IN AND 00847															

OR	+24V	GND	PRE+	PRE-	B A	IN 1	IN 2	OUT	BUS	QB	QA	2B	2A	1B	1A
LASERMET 2-IN OR 00848															

XOR	+24V	GND	PRE+	PRE-	B A	IN 1	IN 2	OUT	BUS	QB	QA	2B	2A	1B	1A
LASERMET 2-IN XOR 00859															

NOT	+24V	GND	PRE+	PRE-	B A	IN 1	OUT	B A	BUS	QB	QA	1B	1A
LASERMET 2-IN NOT 00897													

5 Wiring

Power Supply

The modules operate on 24VDC. At least 140mA should be allowed for each module. The power inputs +24V and GND of all the modules should be wired in parallel.

For the safety controller to verify that there are no relay faults in the Safety Logic Plus module, it should have means to switch the Safety Logic Plus power on and off. This may be by means of a relay.

Pre-check Loop

To ensure that none of the internal relays are faulty a pre-check loop is provided. The PRE- terminal of the first module should be wired to the PRE+ terminal of the second. The PRE- terminal of the second should be wired to PRE+ of the third and so on.

The PRE+ terminal on the first module and the PRE- terminal on the last module will be connected to the Safety Logic Plus Interface Card inside the ICS-6 controller to complete the safety loop.

Pre-check Procedure

The safety controller should verify the operation of the relays within the SLP system as follows:

- Prior to the safety system being armed, the controller should switch off power to the Safety Logic Plus system e.g., by using the relay suggested in 'Power Supply' above.
- The controller should confirm that the pre-check loop is complete. If it is not, operation of the system should be inhibited.
- Assuming the pre-check loop is complete, the safety controller should switch on power to the Safety Logic Plus system.
- The system is now operational, and the pre-check loop should be ignored by the controller.

Connecting to the Safety Logic Plus Interface Card

The interface card, which mounts in an ICS-6, connects the SLP system to the interlock controller via terminal block J6 on the SLP-IF. The connections are as follows:

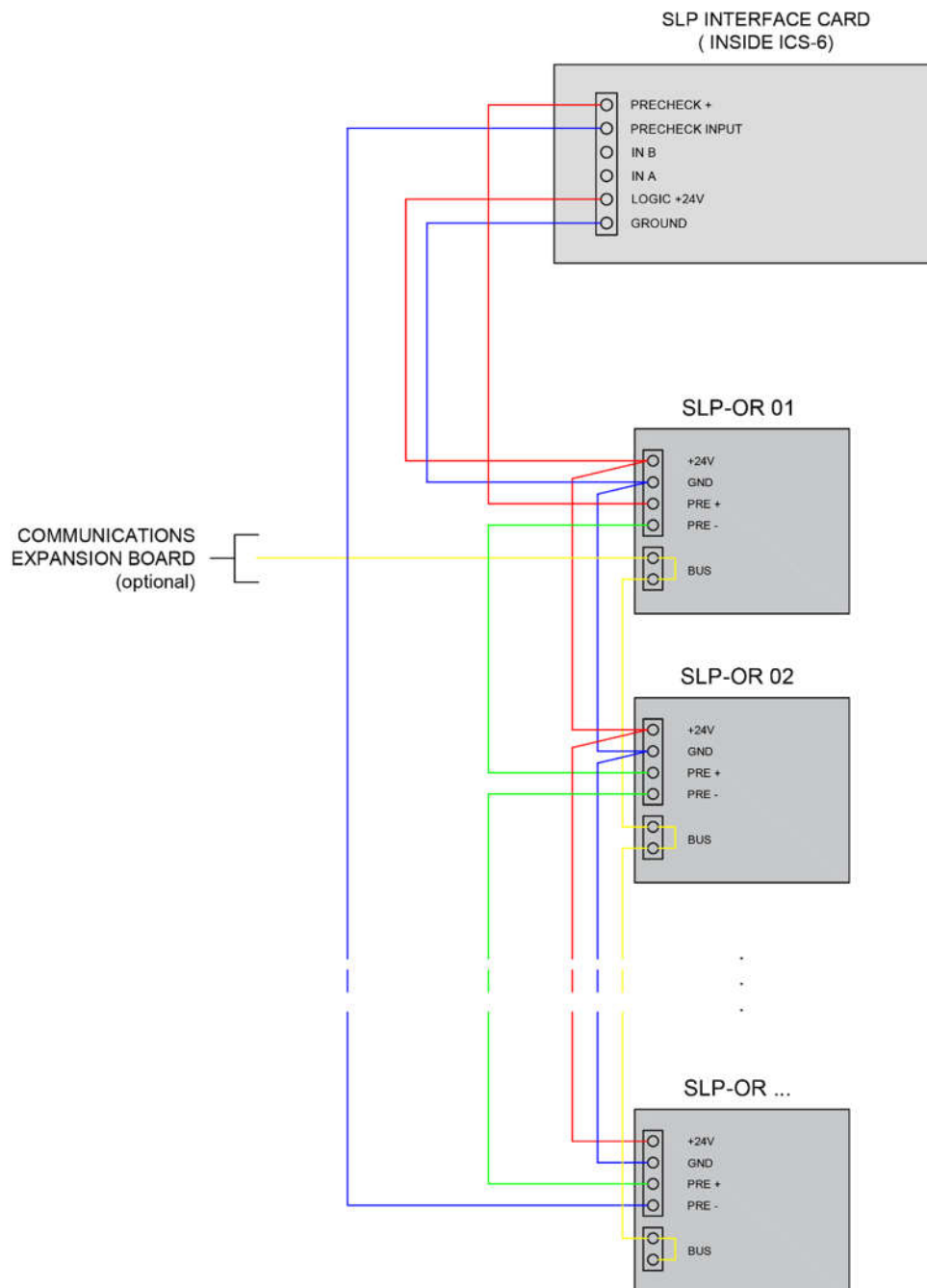
1	PRECHECK +	Connect to the PRE+ terminal on the first SLP gate
2	LOGIC +24V	This is the power supply to the SLP gates
3	IN A	Connect from the QA output of the last SLP gate
4	IN B	Connect from the QB output of the last SLP gate
5	PRECHECK INPUT	Connect from the PRE- terminal on the final SLP gate
6	GROUND	This is the 0V line for the SLP gates

The SLP interface has a jumper marked '>1 ICS'. If more than one ICS is connected to the SLP logic system, this jumper may be fitted. This allows multiple ICS units to be used without conflict.

1-Wire Interface

The most recent versions of the SLP logic gates incorporate a connection for the 1-Wire Bus. This allows the state of the gates to be read by the bus host, which can be the Lasernet Network Interface Card or the Lasernet Communications Expansion Board. For applications of the 1-wire interface, please contact Lasernet.

If the 1-Wire interface is not used, the Bus terminals on all SLP modules should be shorted.



Wiring for the SLP-IF and SLP modules.

LED Indicators

LEDs		
Input 1B	Input 1A	Red
Input 2B	Input 2A	Red
Output B	Output A	Green

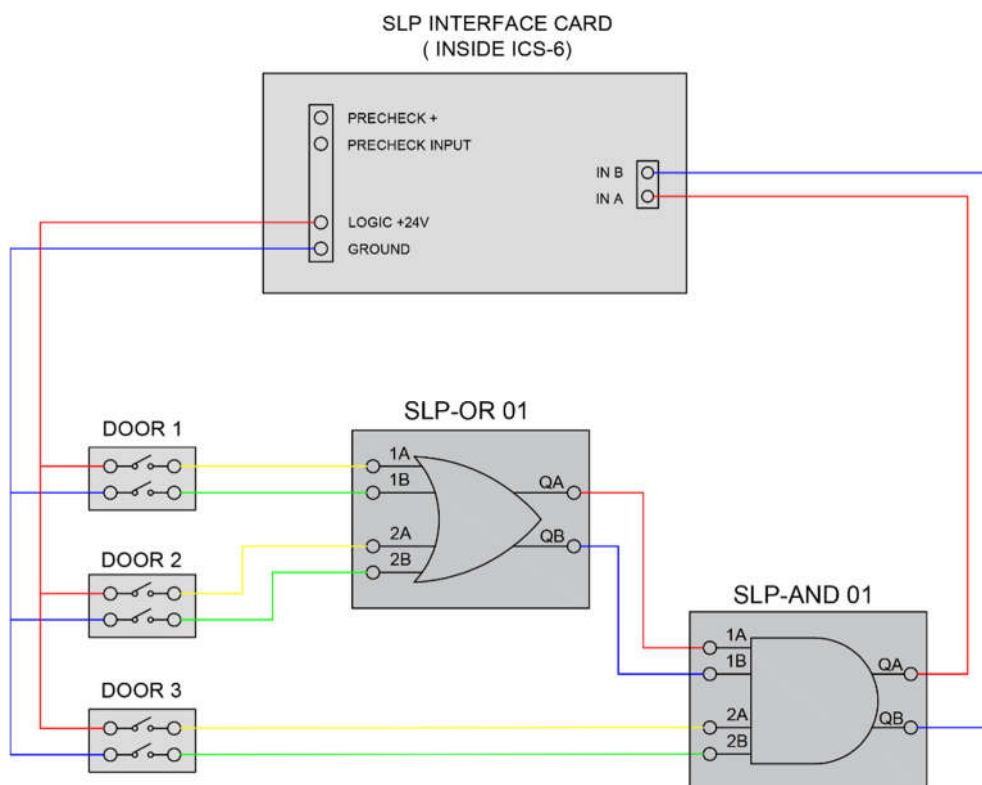
5.1 Logic Inputs

Each logic input signal comprises two wires, A and B. The 'safe' condition (OK to enable the equipment) is when the A input is taken to +24V and the B input is grounded.

The inputs are numbered 1 and 2. As each input comprises two wires, the terminals are 1A and 1B for input 1, and 2A and 2B for input 2.

Door and Safety Cover switches should have two normally closed (NC) contacts which are closed when the door or cover is closed. An additional normally open (NO) contact may be provided for indicating when the door is open, but this is not used by Safety Logic Plus.

When the door is closed, one contact must connect the A input of the module to +24V, the other must connect the B input to 0V (GND). Note that the inputs must not be crossed. Make sure that the two wires that make up the signal are both connected to either input 1 or input 2 and not one wire to 1 and one to 2.



Basic logic circuit using an SLP-OR gate and a SLP-AND gate.

6 Safety Logic Plus Interface Card

The Safety Logic Plus Interface Card (SLP-IF) fits into the expansion sockets of an ICS-6 and allows the ICS to be controlled by a Safety Logic Plus circuit.

It has a single input channel (each channel comprises complementary A and B signals). When the inputs are in the safe condition, the ICS may be armed.

Additionally, the interface provides for automatic testing of the Safety Logic Plus (SLP) relays under control of the ICS. This is the pre-check function.

Arming

When the Arm button is pressed, the ICS turns off the 24V logic supply to the SLP circuit and waits for all the relays, including those on the interface card, to power down and for all the NC contacts (the pre-arm loop) to become closed. Once this happens it powers up the logic circuit again and waits for a valid logic signal to appear at the input. If this is successfully achieved, the ICS arms.

Disarming

If either A or B SLP signal goes inactive, the corresponding ICS safety loop is broken. This will disarm the ICS. Ordinarily both channels should go to the inactive state more or less simultaneously. The ICS safety loop mismatch detector can be used to indicate a fault and inhibit operation if either channel remains active after the other channel goes inactive.

7 Using SLP with Multiple ICS-6

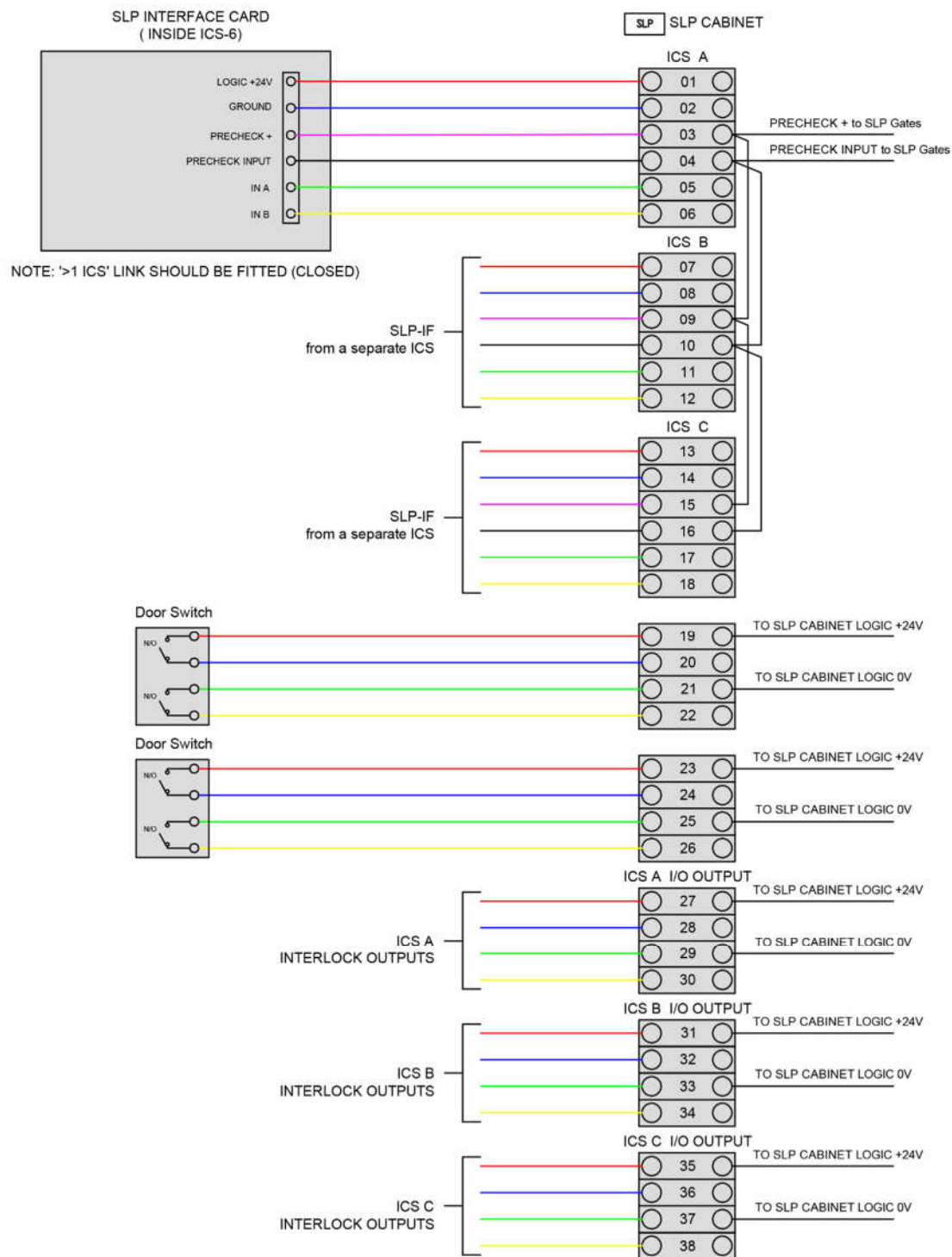
For more complex cases, the Safety Logic Plus system may be used with multiple ICS-6 controllers. This will allow the SLP to monitor several interlocked labs which may be connected to have multiple 'safe' configurations.

Each Safety Logic Plus Interface Card will be wired into a central SLP cabinet.

All PRECHECK+ and PRECHECK INPUT must be connected in parallel.

The +24V terminals of all SLP-IF will be connected together. The connected +24V signal will be used to drive a relay. (e.g., Terminal 01, 07, 13 will be connected)

The 0V terminals of all ICS-6 controllers, PSU, and SLP gates must all be connected together. The connected 0V from the SLP cabinet will be fed into the relay. (e.g., Terminal 02, 08, 14 will be connected)

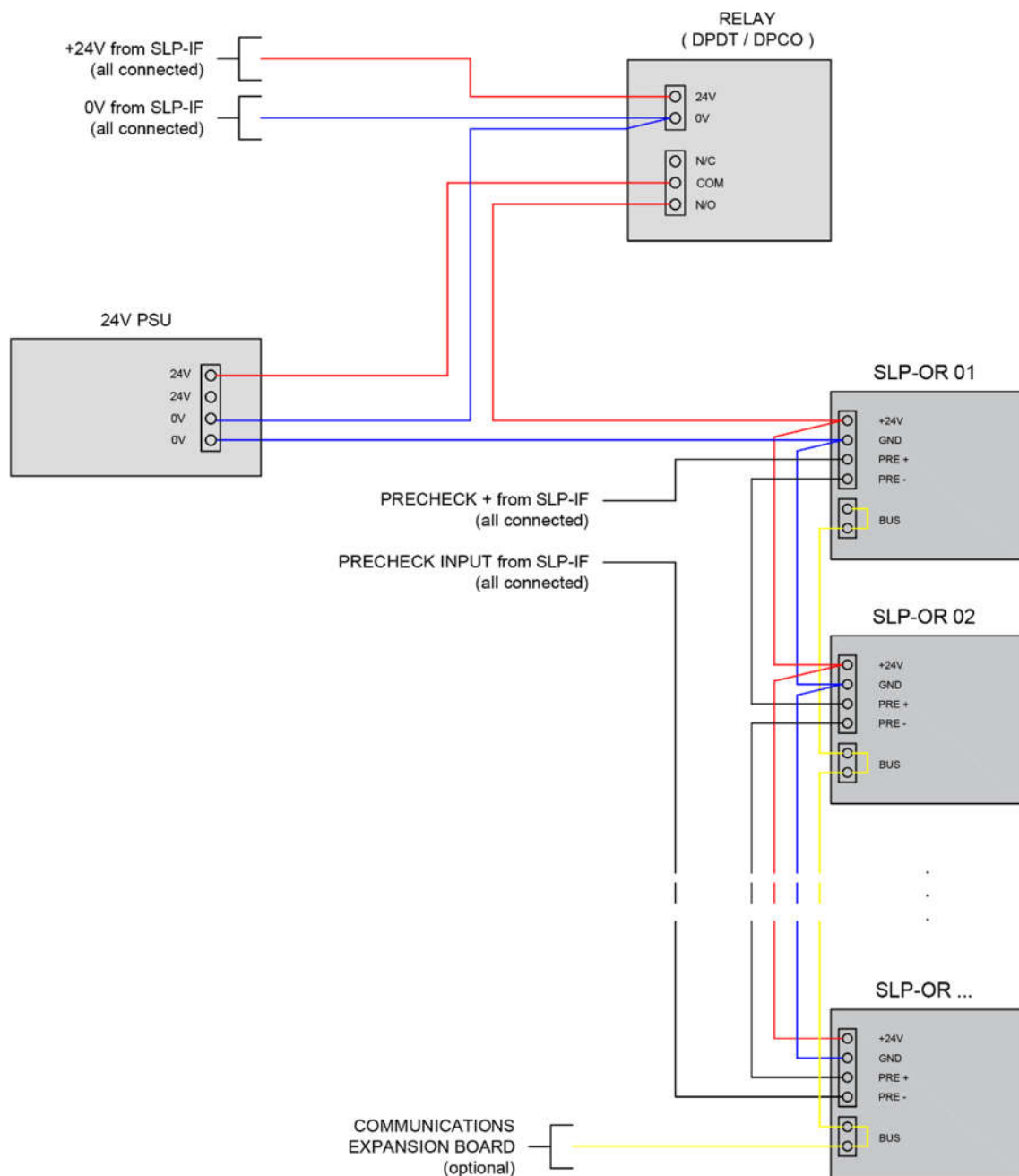


SLP Cabinet Wiring.

Note that all SLP interface cards must have the '>1 ICS' link fitted if more than one ICS is connected to the SLP logic system.

LOGIC +24V from the SLP Interface Cards, all connected in parallel, will be used to drive a relay which switches on the logic supply of the SLP gates. Protection diodes must NOT be fitted as this will prevent all the precheck relays on the various SLP interface boards from latching (diodes are present on the SLP-IF to prevent back feeding of power supplies).

Note that larger systems may require a contactor in place of a relay.



Wiring for Relay and PSU to SLP gates.

Interlock switches (doors, blinds, curtains, etc.) are connected to a DIN rail mounted terminal block within the SLP cabinet. Inputs for the Logic gates will be taken from these terminals.

8 Specifications

Supply Voltage	24VDC
Power Consumption	3.36W (140mA typical)
Size	76.5 x 84 x 22.5 mm

Dimensions are approximate. Values given as 'typical' are average values measured across a number of samples and are not guaranteed. Lasermet reserve the right to alter any specification without prior notice.

9 Warranty

Lasermet provide a 12-month warranty for defects in materials and manufacture, from the date of installation or delivery. Installations completed by Lasermet are covered against defects in workmanship for 12 months.

Damage or defects caused by other factors are not covered. For example, industrial contamination, incorrect cleaning, storm damage. Consequential loss is not covered under warranty. Compensation for indirect or direct loss or damage is expressly excluded. Rectification of the defects or a replacement does not initiate a new warranty period.

For all deliveries, payments and other legal transactions, English law takes precedence for any litigation.

10 Contact Details

Lasermet provide a full range of laser interlock equipment including interlock switches, illuminated warning signs, laser shutters, entry keypads with built-in fail-safe override timer, door locks, external power supplies etc. which can be interconnected to provide a complete system. We also supply equipment and consultancy covering all aspects of laser safety. Full support, design, and installation is available from Lasermet, please contact us for any queries.

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