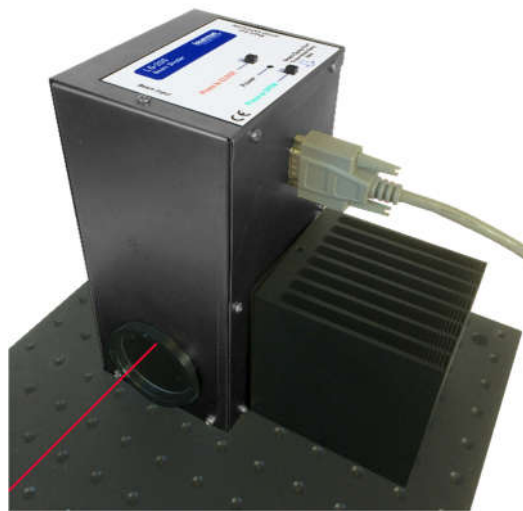


LASERMET LS-200

INSTRUCTION MANUAL



LASER SAFETY SHUTTER

LASERMET LS-200 Instruction Manual

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1 Declaration of Conformity



LASERMET LIMITED

LASER BEAM SHUTTER

Part no.	LS-200-24	01297-00-000
	LS-200 SIL24	01507-00-000

DECLARATION OF CONFORMITY

This is to certify that the Laser Beam Shutter designated by Lasernet Part Number LS-200 and LS-200 SIL3 has been tested in accordance with the following directives and standards and found to comply.

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

Directives: Machinery Directive 2006/42/EC
EMC Directive 2014/30/EU

Standards: EN ISO 13849-1:2015
Safety of Machinery – Safety-related parts of Control Systems
EN 61010-1:2010 +A1:2016 +A2:2019
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use

Supplier:

Lasernet Limited
Lasernet 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 beam shutter works by diverting the incoming laser beam into an external beam dump. It is not intended to absorb the laser energy within itself and can only successfully divert a laser beam if no part of it becomes overheated.

Users must read and understand the section, 'Using with Powerful Lasers' later in this manual.

Be aware that once degradation starts to occur rapid failure is likely, possibly leading to the beam passing unhindered through the shutter.

Due to the huge number of different types, powers and beam sizes of lasers Lasernet cannot guarantee suitability of this shutter in every case and testing may be necessary to ensure that the shutter provides the desired level of protection.

Always ensure that an appropriate beam dump is fitted.

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

The Lasermet LS-200 Laser Safety Shutter is intended to provide a means of preventing accidental exposure to a potentially harmful laser beam.

When open, the laser beam passes in clear air through the shutter. When closed, the shutter deflects the incoming laser beam out of a separate port onto which a suitable external beam dump must be fitted.

The shutter has been designed to form part of a high-integrity safety system and features a gravity-close blade and force-disconnect proving contacts.

A 'SIL3' dual version is available which, when correctly wired to a Lasermet Interlock Control System can provide a safety interlock which meets SIL-3 and EN13849-1 up to performance level 'e'.

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 Control Options

The shutter is usually powered by a laser interlock system such as Lasermet ICS-6. These systems will provide power to allow operation of the shutter once all safety interlocks (for example, doors, covers etc.) have been closed. If the interlock system is tripped out, the shutter will immediately close. It then cannot be opened until the interlock system is re-armed.

The shutter may be wired to operate in one of three different ways:

- 1) The Arming of the interlock system enables operation of the shutter. The buttons on top of the shutter may then be used to open and close it as desired.
- 2) The Arming of the interlock system enables operation of the shutter. The shutter may then be remotely opened and closed by external controls or buttons such as Lasermet's LS-20 LS-RS units. The buttons on top of the shutter may also be used.
- 3) The arming of the interlock system causes the shutter to open immediately.

The shutter may also be wired into bespoke custom systems.

The shutter operates on 24VDC and draws typically 200mA when open and 40mA when closed. There is an initial impulse of approximately 1A on opening and the specification of power supplies and cabling must take this into account.

SIL3 shutters draw twice as much current as standard units.

Note that the LS-200 will not operate on 12V systems as used for older LS-10 and LS-100 shutters. Lasermet interlock systems can be reconfigured to provide the necessary 24V.

3.2 Indications

The shutter has two sets of isolated volt-free monitor contacts which are available on its connector. For maximum integrity the 'shutter closed' contacts are directly mechanically driven by the blade—they do not rely on opto sensors or other noncontact methods. This means that the blade cannot open without opening the 'shutter closed' contacts.

Each contact set has a common terminal which is connected to either the 'open' or the 'closed' terminal according to the state of the shutter. Each contact is rated at 100mA resistive load at 30VDC. The two sets of contacts are isolated from each other and from the control circuitry of the shutter.

These contacts may be used by external circuitry to monitor and indicate the state of the shutter.

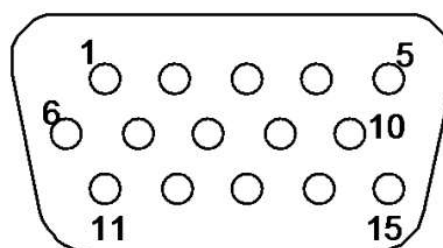
The shutter also has two low power indication outputs, one for open and one for closed. These output 24VDC at 50mA maximum and are typically used to operate LED indicators on remote control buttons.

The buttons on the shutter illuminate to show the state. A red light means the shutter is open, a green indicates the safe condition, i.e. closed.

4 Wiring

The LS-200 shutter has a 15-way high density D plug. The connector makes available all of the various control and indication features of both the standard and the 'SIL3' versions. The pin connections are as follows:

1	0V
2	Monitor Contact 1 'Open'
3	Monitor Contact 1 Common
4	Monitor Contact 1 'Closed'
5	Monitor Contact 2 'Open'
6	'Open' +24V output
7	Monitor Contact 2 Common
8	Remote Open Command +24V Input
9	Monitor Contact 2 'Closed'
10	Monitor Supply +24V
11	'Closed' +24V output
12	Control Supply +24VDC input
13	Not used
14	Not used
15	Not used



View looking at plug pins

Lasermet produce a range of Distribution Boxes and Remote Switches fitted with sockets specially for use with LS-20 and LS-200 shutters, which provide convenient screw terminals to make installation neat and simple. Units are available in both freestanding and fixed installation versions and full wiring instructions are supplied with each one.

Lasermet also supply extender cables to lengthen the shutter lead.

Diagram 1 below shows the usual basic control wiring between a Lasermet ICS-6 Interlock Control System and LS-200.

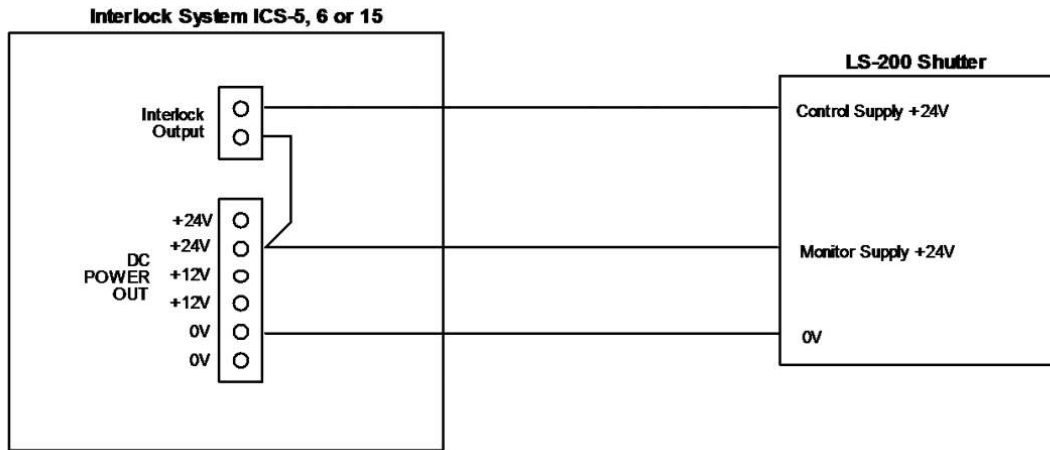


Diagram 1. Basic Control Wiring between ICS-6 and LS-200

In this arrangement the shutter buttons are operative allowing the shutter to be opened and closed when the ICS is armed.

If it is necessary for the shutter to open immediately the ICS is armed, fit a link to connect the Remote Open Command input to the Control Supply +24V. Make sure the link is not connected to the Monitor Supply.

Diagram 2 below shows how to implement a SIL-3 / EN13849 PL'e' safety system using the 'SIL3' version of LS-200.

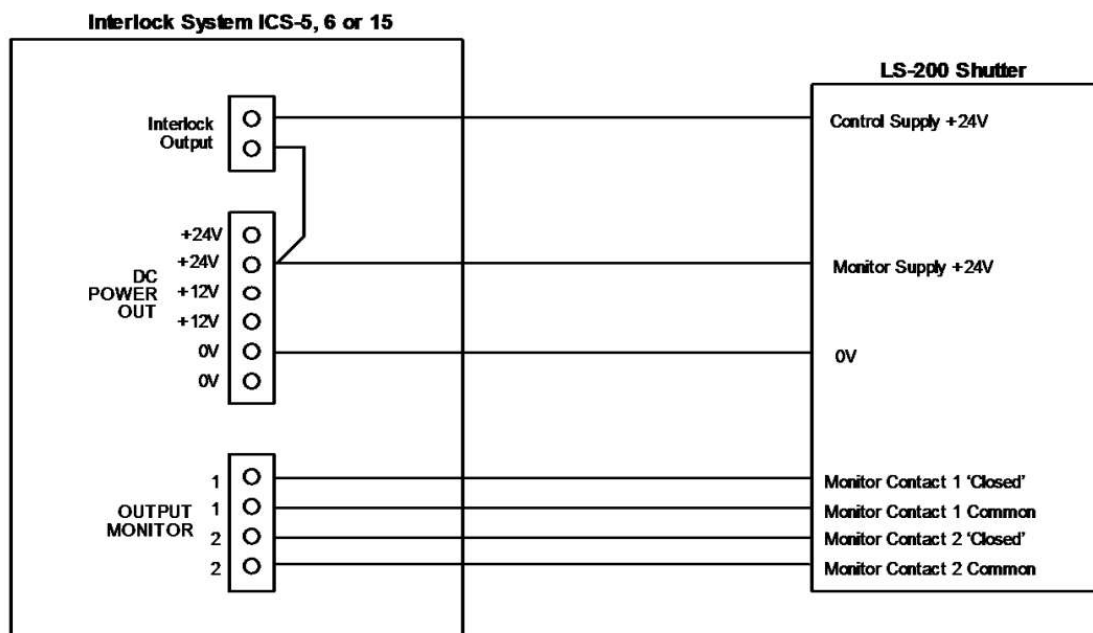


Diagram 2. Implementing a SIL-3 System using 'SIL3' LS-200

Note for correct operation, installation wiring should use at least 16/0.2mm wire to avoid problems of voltage drop on the wiring run. On very long distances, when using 'SIL3' shutters, or in situations where two shutters may be connected simultaneously 24/0.2mm wire may be advisable for the 24V supply wires.

For other options including the use of illuminated signs in conjunction with the shutter please discuss your requirements with Lasernet.

5 Installation

The shutter baseplate has two mounting slots and a pair of M6 threaded T-nuts are provided which are loaded into the slots through the beam entry and exit ports.

The slots allow for mounting and adjustment on a variety of standard optomechanical breadboards as well as custom mounting. The slots are aligned with the beam centreline.

Both slots should always be used. Dimensions are given at the end of this manual.

The shutter has a through aperture of $\varnothing 50$ mm. The beam and beam dump ports are threaded M52 X 0.75mm. Lasernet can provide custom containment tubes and adaptors to order. Please contact us for details at the address at the end of this manual.

Ensure that the laser beam is travelling in the direction of the arrow shown on the top of the shutter.

See the section, 'Dimensions' later in this manual.

5.1 SIL-3 Version LS-200-SIL24

To achieve EN13849-1 performance level 'e' the 'SIL3' version must be used wired as shown in diagram 2. The 'SIL3' version is a twin unit which has one shutter behind another. Both shutters must be open to allow the beam to pass through.

In this unit one set of monitor contacts is dedicated to one of the shutters, the other contact to the other shutter, so the state of both blades can be monitored. When correctly interfaced to a Lasernet ICS, the interlock system cannot be armed if either one or both blades are not detected closed.

5.2 Blade and Beam Dump Options

It is vital that the external beam dump is mounted as close as possible to the shutter and that the beam path is suitably contained to avoid risk of exposure.

Lasermet produce an air-cooled beamdump specifically for the LS-200 shutter, part number BD200-AC.

It is also possible to locate a laser power meter in place of the beam dump so that the laser power can be determined while the shutter is closed. In this arrangement it is essential that the power meter head damage threshold is sufficient to withstand the laser beam for the length of time for which the laser may be active with the shutter closed.

Consideration should be given to the type of blade fitted, see below.

Note that the unit is primarily intended as a safety shutter rather than a precision beam diverter or timing shutter. Due to the free moving nature of the blade the exact exit angle of the beam through the beam dump aperture is slightly variable, therefore any external apparatus must be mounted as close as possible to the shutter, it must have an aperture the same size or bigger than the port and be able to accept small variations in beam position and angle.

Blade Type

The standard LS-200 has an angled bare stainless-steel blade with a non-precision surface which deflects and to some extent scatters the beam. This surface is generally suitable for most applications. To prevent permanent damage and invalidation of warranty it is essential that the power density of the laser is insufficient to ablate the blade.

It is possible to order the LS-200 with other blade materials which may be more appropriate for more powerful lasers.

The ceramic blade option is recommended for Q-switched lasers where the standard stainless-steel blade may become ablated.

There are a number of mirror blade options featuring front silvered or dielectric mirrors for various wavelengths. These allow the shutter to be used with higher power lasers than the standard blade. The mirror blade option is also advisable when mounting a laser power meter at the beam dump port.

For SIL3 shutters the laser beam will normally be directed out of the beam dump port nearest the laser, however consideration should be given to the consequences if the first shutter fails to close and the beam is directed to the second shutter beam dump port.

Observe the warnings given in the next section, 'Using with Powerful Lasers'.

6 Using with Powerful Lasers

If the blade or beam dump become overheated, they will be permanently damaged. Moreover, once damage has started to occur the situation is likely to deteriorate further unless immediate action is taken to turn off the laser.

Modern lasers which cut or burn are now readily available. With regard to the shutter blade, it is essential that it absorbs insufficient energy for it to be damaged, which means that the excess must be reflected away towards the beam dump.

At 20°C ambient the standard stainless steel blade can dissipate about 5W. The copper blade option can dissipate no more than about 2.5W.

Glass mirror options can dissipate less because they are not such good conductors.

Heating of metal or metal-surfaced glass blades is likely initially to cause oxidisation which darkens the metal causing it to absorb and heat more.

Furthermore, there may be localised damage if the laser has a high power density, i.e. the beam is concentrated in a small diameter. For metal blades this appears as ablation, in which the area where the beam impinges reaches the melting point of the metal before conduction can carry the heat away. For glass mirror blades the localised heating expands the glass causing it to crack.

In all cases once the point of contact of the laser beam ceases to reflect as well, it will heat and fail. If the laser is left running when this happens, the shutter will be progressively damaged and burn-through of the beam may occur. Once damage has occurred a 100W laser may burn through the stainless steel blade. More powerful lasers will burn through quite quickly. Also, any optional blade mirror that has been fitted will detach if it exceeds several hundred degrees Celsius.

Ultimately users must be aware of the hazards of operating powerful lasers and the suitability of any shutter being used. Tests may need to be undertaken to establish the suitability of any shutter when used with powerful lasers.

The blade should be checked before use to ensure that it is spotlessly clean, unoxidised and unblemished. Appropriate optical cleaning methods may be required to clean the blade. It must be understood that whilst a perfectly clean blade will successfully divert a beam, should a speck of contamination at the surface occur rapid progressive failure and burn-through are possible. Risk assessments should be undertaken to determine the effects of such an event and identify any mitigation measures that may be necessary.

7 Specifications

Supply Voltage	24VDC	
Current	Closed	40mA
	Opening	210mA
	Open	110mA
Operating Time	Fully Open	800ms
	Fully Close	200ms
Aperture	Ø50mm	
Weight	Single Shutter	1.6kg
	Dual SIL Shutter	TBC
	Air-cooled Beamdump	1kg
Mounting	2x M6 threads, T-Nuts supplied	
User Controls	Open, Close	
LED Indications	Power, Open, Closed	

Laser Blocking Specification

Irradiated Area	PEL (T2) 100s	PEL (T1) 10000s
4 mm ²	5 MW/m ²	5 MW/m ²
20 mm ²	2.5 MW/m ²	2.5 MW/m ²
80 mm ²	1.3 MW/m ²	1.3 MW/m ²

Maximum Average beam power:

Using standard blade	100W
Using mirror blade	As per mirror specification ¹

Also ensure that the beamdump specifications are not exceeded.

¹ See section on Using with Powerful Lasers

Safety Performance

Standard LS-200	EN ISO13849-1:2008 performance level 'c'
LS-200 SIL-24	EN ISO13849-1:2008 performance level 'e'
	IEC 61508-1 SIL 3

when correctly wired to a suitably rated control system.

The LS-200 SIL-24 is a dual channel electromechanical safety laser shutdown device.

System Type	Type A System
Hardware Fault Tolerance	1

When connected to an interlock control system as shown in this manual, the LS-200SIL-24 has the following characteristics. This can also be achieved by correctly connecting to another suitable safety control system which has dual channel monitoring of the shutdown device.

Safe Failure Fraction	95%
PFD	1.56×10^{-7}

When used as described above, the LS-200SIL-24 is suitable for use as the sole laser shutdown device in a system which is required to achieve Safety Integrity Level 3 (SIL 3) or lower as defined in IEC 61508.

Note: The actual SIL rating of the entire system will depend on the other system components, how they are connected together and how the system is used.

Reliability

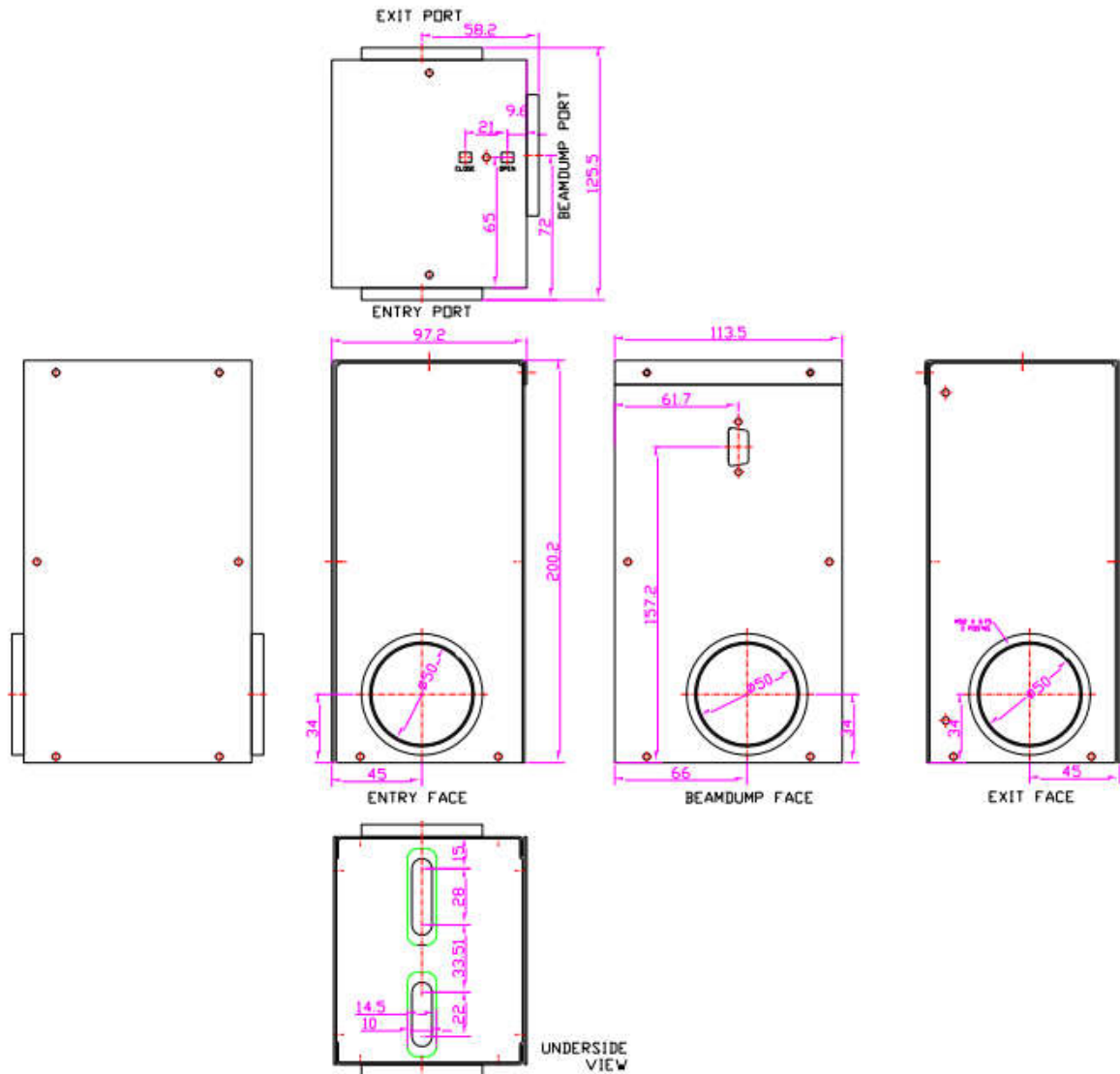
Mean time to dangerous failure (MTTF _d)	100 years
Number of operations after which 10% of units have failed (B10 _d)	$> 1 \times 10^7$

It is important to note that the Performance Level established for the LS-200 are those that may be achieved by the system when the board is properly integrated into a safety related part of a control system.

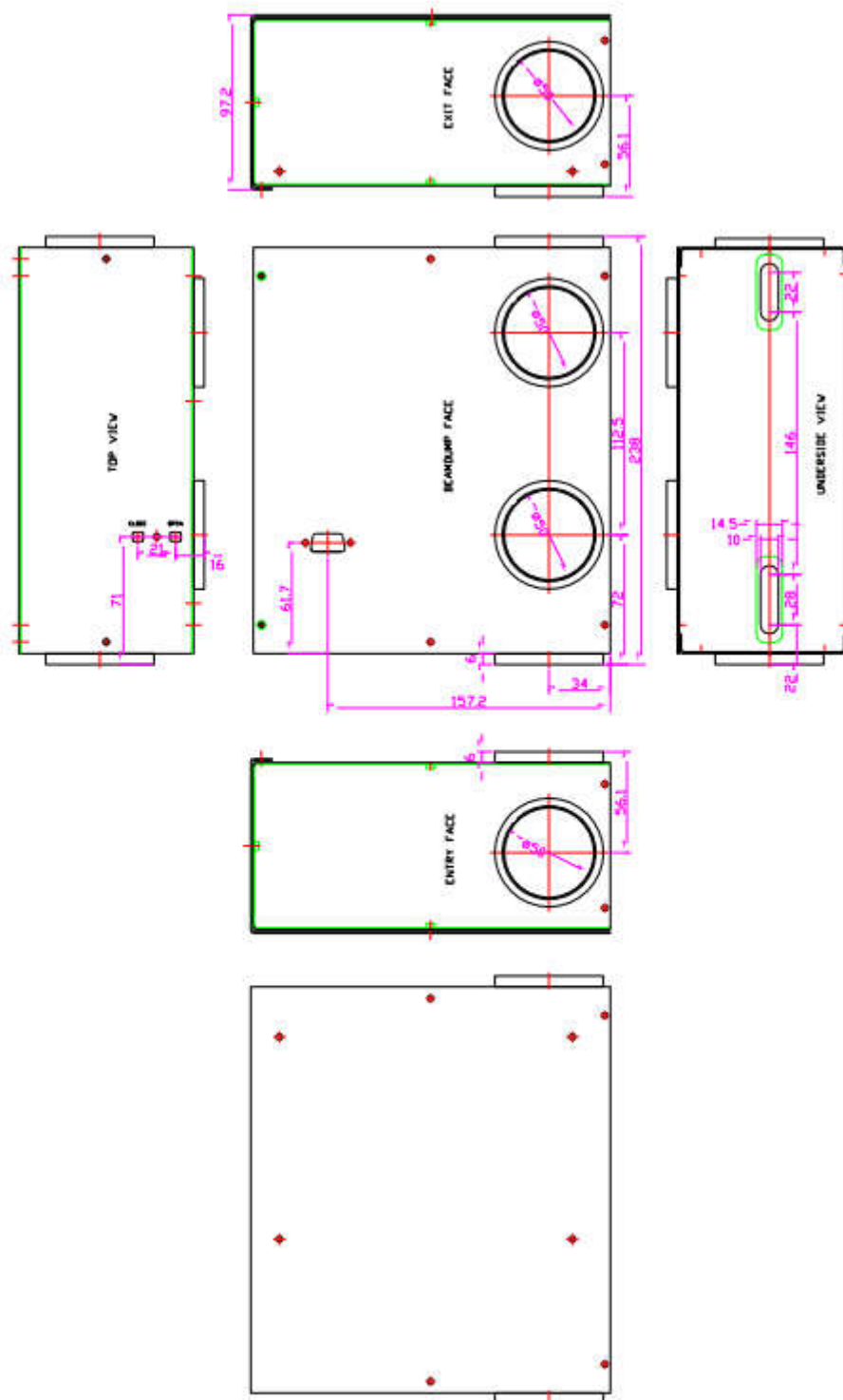
Lasernet reserve the right to alter any specification without prior notice.

Dimensions

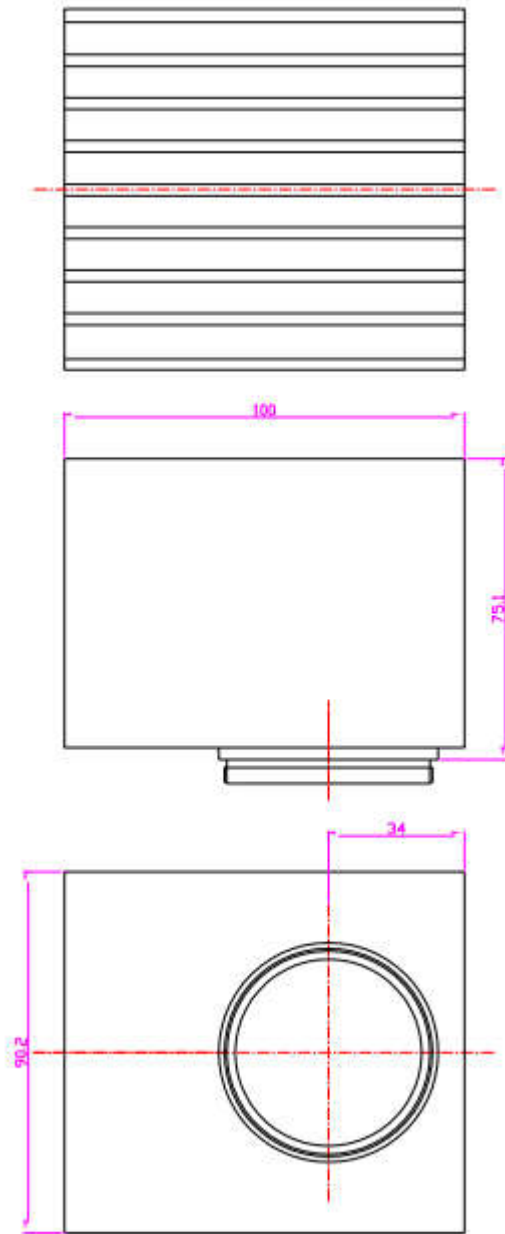
Dimensions are approximate. Values given as 'typical' are average values measured across a number of samples and are not guaranteed. Lasernet reserve the right to alter any specification without prior notice.



LS-200 Single Version Outline Dimensions



LS-200 Dual SIL Version Outline Dimensions



LS-200 Air-cooled Heat Sink BD200-AC Outline Dimensions

8 Warranty

Lasernet provide a 12-month warranty for defects in materials and manufacture, from the date of installation or delivery. Installations completed by Lasernet 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.

9 Contact Details

Lasernet 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 Lasernet, please contact us for any queries.

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