LASERMET LS-20

INSTRUCTION MANUAL

LASER SAFETY SHUTTER
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DECLARATION OF CONFORMITY

LASERMET LIMITED

LASER BEAM SHUTTER
MODELS LS-20-24 AND LS-20 SIL24

Drawing Numbers:
Main Unit 00629-00-000
Tandem Unit 00647-00-000

This is to declare that the LS-20 and LS-20 SIL3 have been found to comply with the requirements of the following directives:

Machinery Directive 2006/42/EC June 2010

EMC Directive 2004/108/EC

And meets the following European Standards:

EN ISO 13849-1:2008 Safety of Machinery: Safety-related parts of Control Systems
EN 61010-1:2001 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use.

Supplier:

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Signed: [Signature]
Date: 6 May 2011

Quality Assurance Manager
Concept

The Lasermet LS-20 Laser Safety Shutter is intended to provide a means of preventing accidental exposure to a potentially harmful laser beam.

When closed, the shutter deflects the incoming laser beam onto an internal beam dump where the energy is converted to heat which is dissipated in the aluminium casing of the shutter.

When the shutter is open, the laser beam passes through the shutter without interruption.

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’ 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’.

Control Options

The shutter is usually powered by a laser interlock system such as Lasermet ICS-1 or ICS-5. These systems will provide power to allow actuation 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 100mA when open and 20mA 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-20 will not operate on 12V systems as used for LS-10 and LS-100. Lasermet interlock systems can be reconfigured to provide the necessary 24V.
Indications

The shutter has two sets of isolated volt-free monitor contacts which are available on it’s connector. For maximum integrity the ‘shutter closed’ contacts are directly mechanically driven by the blade- they do not rely on opto sensors or other non-contact 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.

Wiring

The LS-20 shutter is supplied with a permanently-connected 3m lead terminated in 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
Lasermet produce a range of Distribution Boxes and Remote Switches fitted with sockets specially for use with LS-20, which provide convenient screw terminals to make installation neat and simple. Units are available in both free-standing 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-5 Interlock Control System and LS-20.

![Diagram 1: Basic Control Wiring between ICS-5 and LS-20](image)

In this arrangement the shutter buttons are operative allowing the shutter to be opened and closed when the ICS-5 is armed.

If it is necessary for the shutter to open immediately the ICS-5 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-20.
Diagram 2: Implementing a SIL-3 system using ‘SIL3’ LS-20

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 Lasermet.

**Mounting and Beam Containment**

The shutter is equipped with an M6 female thread in the base, located under the beam centreline. An anti-rotation slot is also provided in the base into which a second M6 stud should be located to prevent the shutter turning or coming unscrewed. The slot allows for posts on imperial and metric optical breadboards.

The shutter has a through aperture of Ø16mm. The beam and beam dump ports are threaded M17 X 1. Lasermet can provide 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.
**SIL-3 Version LS-20-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 Lasermet ICS, the interlock system cannot be armed if either one or both blades are not detected closed.

It is theoretically possible to achieve SIL 4 with the SIL3 shutter however the method of control in this case is outside the scope of this manual.

**Beam Dump options**

The LS-20 beam dump is removeable which allows an external beam dump to be used. This could potentially enable the shutter to be used with more powerful lasers than can be dissipated by the shutter itself. In this instance 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.

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.

If using an external option in place of the integral beamdump, 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 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-20 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 when the integral beamdump is used. To prevent permanent damage and invalidation of warranty it is essential that the
energy density of the laser is insufficient to ablate the blade.

It is possible to order the LS-20 with other blade materials which may be more appropriate particularly when the integral beamdump is removed.

The ceramic blade option is recommended for higher power density beams where the standard stainless steel blade is at risk of being damaged. This should be considered when planning to use an external beamdump.

The mirror blade option features a front-silvered semiprecision mirror which is adviseable when mounting a laser power meter at the beamdump port.

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

Diagram 3: Standard LS-20 Dimensions in mm.
Diagram 4: ‘SIL3’ LS-20 Dimensions in mm.
Specifications

Weight
Standard Unit  600g
‘SIL3’ Unit  1000g

Safety Specification
Standard LS-20  EN 13849-1 performance level ‘c’
LS-20 SIL-24  EN 13849-1 performance level ‘e’
IEC 61508-1 SIL 3

when correctly wired to a suitably rated control system.

The LS-20 SIL-24 is a dual channel electromechanical safety laser shutdown device.

System type:  Type A System
Hardware Fault Tolerance  1

When connected to an ICS-5 control system as shown in this manual, the LS-20SIL-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  $1.56 \times 10^{-7}$

When used as described above, the LS-20SIL-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.

(NB 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 (MTTFd)  100 years
Number of operations after which 10% of units have failed (B10d)  $> 1 \times 10^7$
Contact Details

Lasermet provides 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. Please visit our website.

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