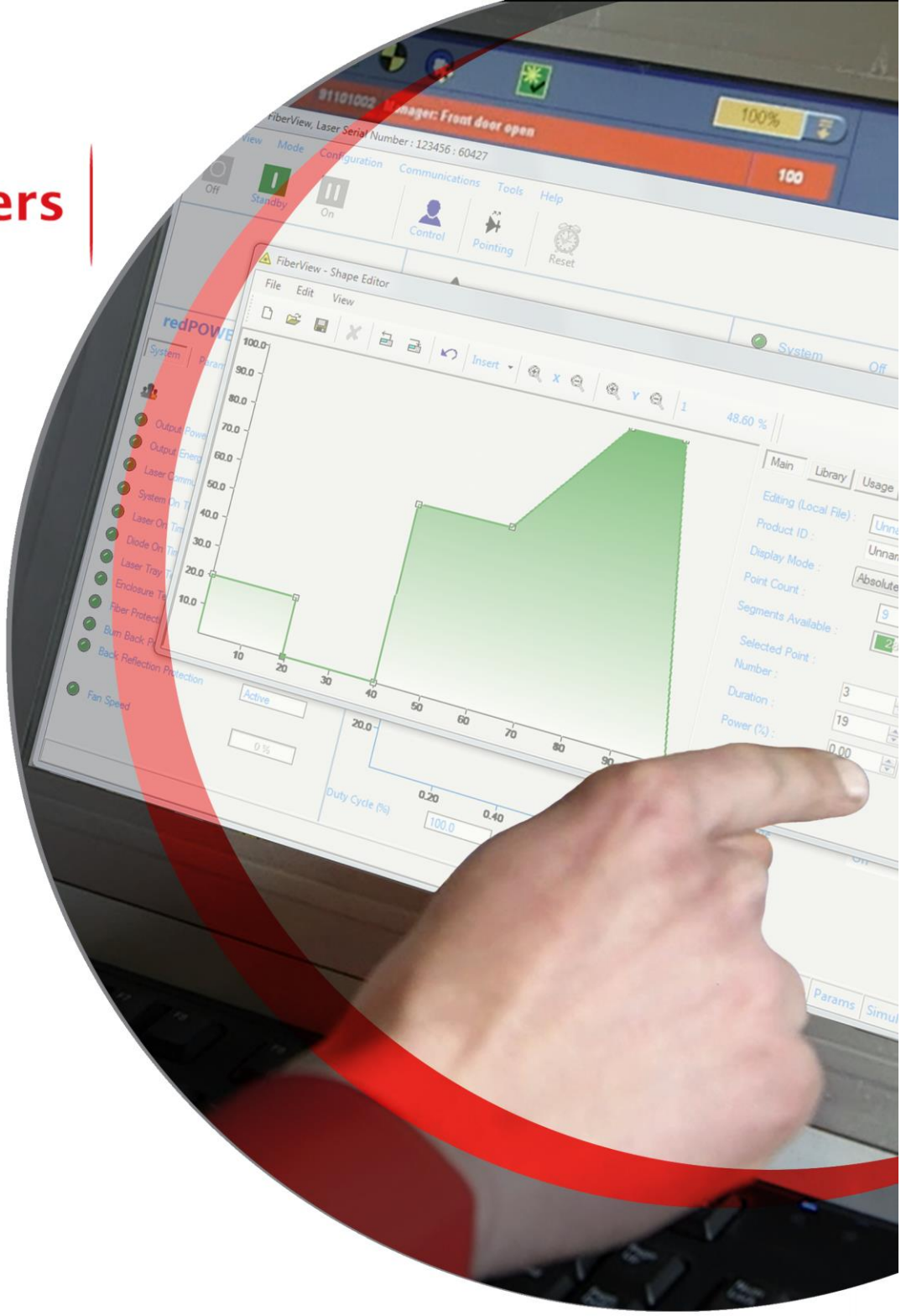
SPI Lasers



redPOWER

FiberView and Machine Control Interface

Instructions for Use

Safety Notes

Refer to the Instructions for Use of the **redPOWER®** PRISM or QUBE Fiber Laser for safety notes which indicate potential hazards associated with PRISM and QUBE Lasers and the probable consequences of not avoiding them.

Throughout these Instructions for Use warning messages are given in contexts in which a hazard may occur.

General Hazard Information

WARNING: Ensure that all Users are fully aware of all safety implications identified in these Instructions for Use before attempting to operate a PRISM or QUBE Fiber Laser using FiberView.

Laser Hazard Information

WARNING: PRISM and QUBE Fiber Lasers may emit both invisible and visible laser radiation.

The invisible laser radiation will be Class 4 laser radiation. The invisible radiation can be up to approximately 115% of rated power CW in normal operation and 150% with a single fault. The wavelength of this invisible radiation is in the range 1050-1250nm.

Additionally, PRISM and QUBE Fiber Lasers contain embedded lasers that emit invisible laser radiation up to approximately 170% of rated power CW in normal operation and 250% CW with a single fault. The wavelength of this invisible radiation is in the range 900-1000nm.

AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.

Contact with direct or scattered laser radiation can cause damage to the eyes, burn human tissue and start fires.

WARNING: The output aperture of PRISM and QUBE Fiber Lasers may emit both invisible and visible laser radiation.

The visible laser radiation is below the Accessible Emission Limit (AEL) for a Class 2 laser. The wavelength of the visible laser radiation is in the range 630 – 680nm.

DO NOT STARE INTO BEAM.

Table of Contents

FIGURES

TABLES

1 Structure and Scope of Instructions for Use

FiberView is SPI Lasers' graphical user interface (GUI) software which together with a FiberView Control Unit (FVCU) can be used to operate **redPOWER**® Fiber Lasers over a serial interface. **redPOWER** PRISM Rack and QUBE Cased and Cabinet Fiber Lasers have an integral FVCU, while it is available as an accessory for **redPOWER** PRISM Module Fiber Lasers. The FVCU also provides a Machine Control Interface (MCIF) which allows **redPOWER** Fiber Lasers to be controlled by a PLC (Programmable Logic Controller).

These Instructions for Use for Use contain all the information that Users need to know for the safe and efficient operation of **redPOWER** Fiber Lasers using a serial or PLC interface. This information is important. These Instructions for Use must be read before using FiberView or the MCIF and made available for reference at the location where the Laser is being used. Additional or replacement copies are available from SPI Lasers.

These Instructions for Use are divided into the sections below which provide Users with health and safety information before introducing FiberView and the Machine Control Interface and then guiding them through their use. Lastly, they provide other useful information.

The PRISM and QUBE Fiber Lasers covered by these Instructions for Use have order codes:

$$SP\text{ - }PPPP\text{ - }\begin{matrix}\mathbf{R}\\\mathbf{C}\\\mathbf{F}\end{matrix}\text{ - }C\text{ - }DDD\text{ - }LL\text{ - }CON\text{ - }xxx\text{ - }yyy\text{ - }zzz$$

The letters in **bold** indicate the Laser housing type: R for PRISM Rack, C for QUBE Cased and F for QUBE Cabinet. The meanings of the letters in *italics* are given in the Instructions for Use

of the PRISM or QUBE Fiber Laser. These Instructions for Use also cover the FVCU when bought as an accessory, with order codes SP-FVCU-*N*.

The order code can be found on a label on the Laser or FVCU or can be read from the Laser using FiberView.

2 Definition of Symbols and Terms

This symbol alerts the user to the hazard of exposure to laser radiation.

This general warning symbol emphasizes important information needed during installation and operation.

WARNING: Indicates a hazard with a medium risk which, if not avoided, could result in death or serious injury.

Warnings must be observed to prevent personal injury to yourself and others.

CAUTION: Indicates a hazard with a low risk which, if not avoided, could result in minor or moderate injury.

Cautions must be observed to prevent personal injury and damage to or destruction of equipment or loss of operational effectiveness.

PRISM Fiber Laser, QUBE Fiber Laser and Laser: PRISM Fiber Laser, QUBE Fiber Laser and Laser as used herein means the item that was procured from SPI Lasers.

Laser Integrator: Any person, company or organisation who integrates a Laser into equipment, or any person, company or organisation who uses a Laser in the form as supplied by SPI Lasers.

A Laser Integrator is skilled in and understands the integration issues surrounding the use, design and supply of laser products to end users in the end markets which it supplies.

User: Individuals or organizations that use a Laser. User includes the Laser Integrator and the end user.

Authorised Personnel: Those who have attended official training courses and have been certified as competent.

SPI Lasers: SPI Lasers UK Ltd.

3 Health and Safety

3.1 General

This section gives information on the hazards which may be encountered when controlling Lasers using FiberView or the Machine Control Interface and steps to reduce the risk. All safety instructions, including those in the Safety Notes, those in other sections of these Instructions for Use, and those in the Instructions for use of the Laser being controlled must be followed. Not following safety instructions may constitute a hazard to Users and third parties or cause damage to property and the Laser.

Only Authorised Personnel who have been instructed in, and fully understand, the necessary safety procedures should control Lasers using FiberView or the MCIF. Access must be restricted to Authorised Personnel.

Any local safety requirements for the operation of this equipment must be complied with.

Throughout the documentation, '**WARNING**', and '**CAUTION**' paragraphs appear. It is the responsibility and duty of all Users who operate and maintain this equipment to fully understand the **WARNING** and **CAUTION** and act to reduce or eliminate hazards.

3.2 Laser Hazards

All Warnings, including those in the Safety Notes, those in other sections of these Instructions for Use, and those in the Instructions for use of the Laser being controlled, must be heeded.

WARNING: Care must be taken especially when controlling a Laser remotely across a network.

Failure to do so could result in another User being exposed to hazardous levels of radiation.

It is the responsibility of the Laser Integrator to ensure that when controlled remotely no hazardous levels of radiation are emitted when unsafe to do so.

4 Document References

Document number	Description
SM-S00496	PRISM Rack Fiber Laser Instructions for Use
SM-S00500	QUBE Cased Fiber Laser Instructions for Use
SM-S00521	QUBE Cabinet Fiber Laser Instructions for Use
SM-S01000	QUBE Low Power Cased Laser Instructions for Use
SM-S00530	redPOWER FVCU Instructions for Use

These documents may be downloaded by going to 'Customer Login' at the top right of SPI Lasers' home page: www.spilasers.com.

5 FiberView Key Features

FiberView is the Graphical User Interface (GUI) specifically written for those **redPOWER** Fiber Lasers with a FiberView Control Unit (FVCU): QUBE Fiber Lasers and PRISM Rack Fiber Lasers. The FVCU is also available as an accessory for use with PRISM Module Fiber Lasers.

FiberView is used to monitor and control **redPOWER** Fiber Lasers, to program Shapes, Parameter Sets and Process Cycles, to alert the User to any maintenance requirements, and to aid in fault diagnosis. FiberView is an advanced and versatile Laser control system offering many features not available in other systems, but it still can be used to perform simple functions such as turning laser emission on and off, turning the alignment laser on and off, and monitoring Laser parameters, and alarms and warnings.

The versatility of FiberView comes from its ability to build full Process Cycles out of Parameter Sets which, in turn, are constructed from basic Shapes. FiberView has predefined Shapes – CW, single sector pulse and sine – and allows up to 50 multi-sector Shapes to be defined by Users and saved in the FVCU for instant access when changing Parameter Sets on the fly. The CW, single sector pulse and sine Shapes are used to generate simple CW, modulated or sinusoidal outputs from the Laser.

A unique feature of **redPOWER** Fiber Lasers with High Power Combiners (HPCs) is Pierce Detect[1]. All laser cutting systems need some form of pierce detection to operate economically. Without it long pierce dwell times have to be programmed in. Due to processing variations, these can be up to three times longer than needed. Many commercial systems are available, but they usually require extra optical surfaces in the beam path or larger process head space and they increase system cost. SPI Lasers' proprietary Pierce Detect system is integrated into its hardware and software. Using Pierce Detect can offer 5-15% improvement in cutting productivity, depending on the specific material and process. A clear digital signal is set, ready to integrate to a system level controller, on any of the programmable outputs of the Machine Control Interface (MCIF) when pierce through is detected. Often piercing is carried out while modulating the power to give a slower but very controlled process. SPI Lasers has demonstrated that Pierce Detect will properly respond under these conditions.

Pierce Detect monitors power reflected from the work piece to determine when there is a clear path through the material – when the material has been pierced. The nature of the reflected power is different for different materials and process set-ups, and so FiberView offers the User adjustments to ensure reliable operation of the feature.

A useful feature of FiberView is that if it is run without a Laser connected, then an option is available to simulate a Laser. This feature is useful for safely familiarising Users with the operation of the FiberView and for setting up Shapes, Parameter Sets and Process Cycles for subsequent download to a Laser. When downloaded the Process Cycles may be controlled by FiberView or directly using the MCIF without FiberView.

FiberView allows different levels of access (Operator, Supervisor and Maintenance) for control of the Laser in a production environment. Additionally, FiberView can be locked to prevent unauthorised adjustment of Laser or process parameters.

[1] Patent applied for.

While FiberView provides a richly featured graphical user interface to **redPOWER** Fiber Lasers, the protocol is available from SPI Lasers to allow Laser Integrators to integrate control of these Lasers into an overall system controller.

6 Machine Control Interface Key Features

The Machine Control Interface (MCIF) provided by the FVCU allows total operational integration of the Laser into a production line or cell. The seven digital inputs and seven digital outputs are PLC compatible and can be software configured using FiberView to perform specific functions selected from a list of available functions. There is also one analogue input and one analogue output. The default configuration, given in Table 1, should be suitable for the majority of applications, but the flexibility allows Laser Integrators to tailor the MCIF to their application.

On all Lasers the MCIF connection is made through connector PL5. The MCIF is opto-isolated, to prevent operational problems caused by ground loops, and requires an external 24V supply for the outputs to function. The Laser can be controlled entirely using the MCIF (Remote Control), but if it is controlled over a serial interface (Local Control) then the configured outputs are still available, provided the MCIF is supplied with 24V.

Some of the inputs and outputs are multiplexed depending on the processing mode. For example, the same output functions as **Laser ON** or **Process Cycle Start** depending on whether the Laser is processing in Parameter Sets mode or Process Cycle mode.

Table 1 MCIF Default Configuration

Pin Name	Function		Pin Name	Function
Configurable pins				
IN0	**Laser STANDBY**		OUT0	**Laser STANDBY**
IN1	**Laser ON** **Process Cycle Start**		OUT1	**Laser ON** **Process Cycle Active**
IN2	**Process Cycle Step**		OUT2	**Remote Status**
IN3	Not configured		OUT3	**Alarm Status**
IN4	**Alarm Reset**		OUT4	**Warning**
IN5	Not configured		OUT5	Not configured
IN6	**Trigger Input**		OUT6	**Process Cycle Wait**
Fixed pins				
AIN-	Analogue Input Demand Negative			
AIN+	Analogue Input Demand Positive			
AOUT	Laser Power Analogue Feedback			
COMMON	Digital Input Common Return Path			
PEXT	External 24V DC (two pins)			
GNDEXT	External 0V DC (three pins)			

7 Laser States

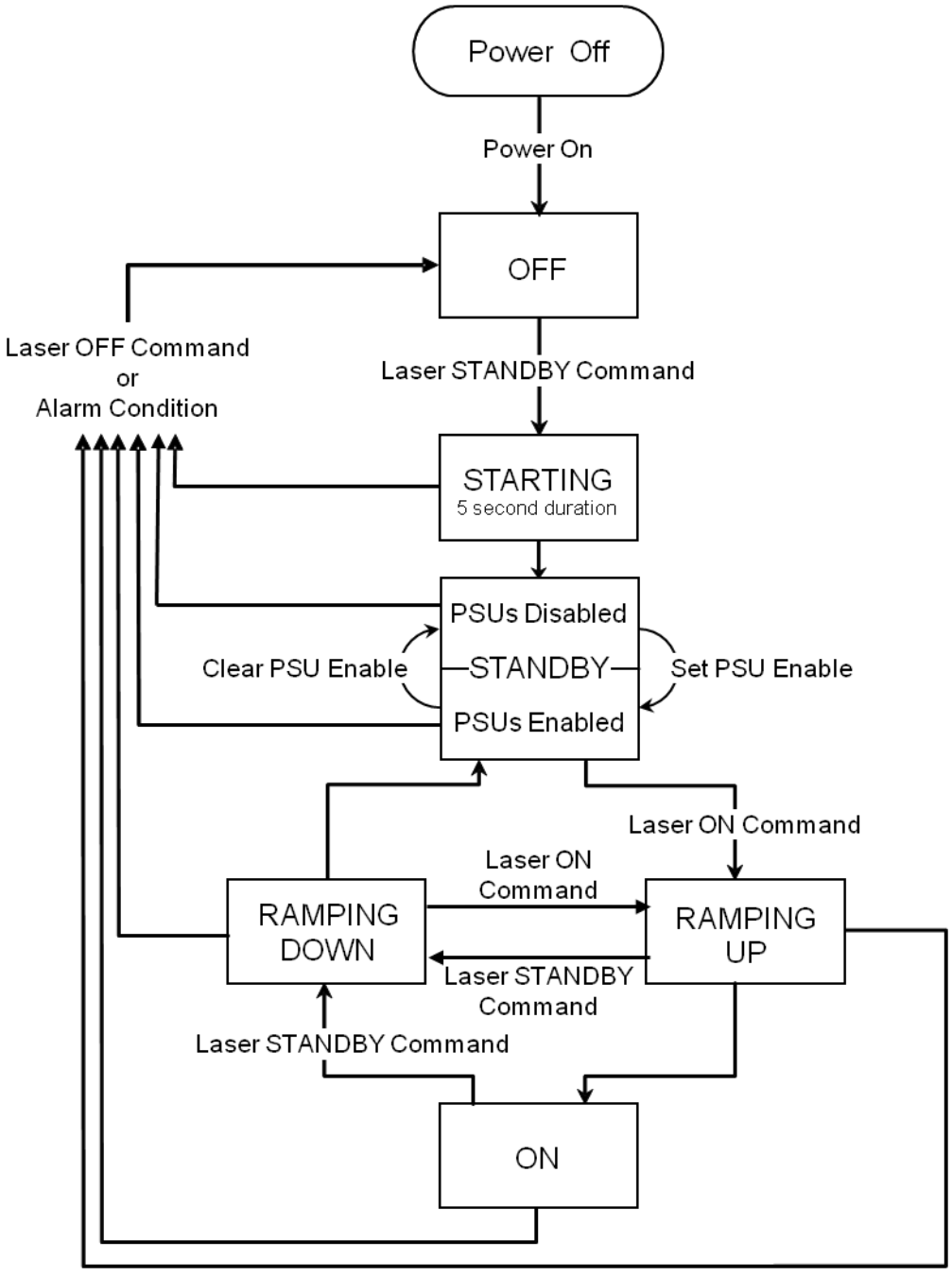


Figure 1 State Transition Diagram

The Laser can be in one of six states: OFF, STARTING, STANDBY, RAMPING UP, ON or RAMPING DOWN. These states, and their relationships, are shown in Figure 1. Note that for QUBE Fiber Lasers, 'Power Off' means that the AC Power is off, while for PRISM Rack Fiber Lasers, 'Power Off' means the 24V DC supply is off.

PRISM Rack Fiber Lasers do not have internal PSUs (Power Supply Units) and so have no PSU Enable function and only a single STANDBY state.

Three commands can be issued to change the state. The other states are controlled by the Laser or the Parameter Set.

- Laser OFF
- Laser STANDBY
- Laser ON

The states and their transitions are described in more detail below.

OFF State

OFF is entered under the following conditions:

- Following the application of power (AC Power or the 24V DC supply).
- Following a **Laser OFF** command.
- Following an alarm.

OFF is left after receiving a **Laser STANDBY** command.

STARTING State

When in OFF, the STARTING state is entered after receiving a **Laser STANDBY** command. The STARTING state automatically sequences to STANDBY after a fixed time of 5s.

OFF is entered if an alarm occurs.

STANDBY State

STANDBY is entered under the following conditions:

- Following the STARTING state after a **Laser STANDBY** command is received.
- Following RAMPING DOWN after a **Laser STANDBY** command is received.

STANDBY is left after receiving a **Laser ON** command.

OFF is entered if an alarm occurs.

RAMPING UP State

When in the RAMPING DOWN or STANDBY states, RAMPING UP is entered after receiving a **Laser ON** command.

When in other states the **Laser ON** command is ignored.

RAMPING UP automatically sequences to ON after the ramp up duration has elapsed. The ramp up duration is determined by the active Parameter Set.

OFF is entered if an alarm occurs.

ON State

ON is entered automatically from RAMPING UP after the ramp up duration has elapsed. The ramp up duration is determined by the active Parameter Set.

ON is left after receiving a **Laser STANDBY** command.

OFF is entered if an alarm occurs.

RAMPING DOWN State

When in the RAMPING UP or ON states, RAMPING DOWN is entered after receiving a **Laser STANDBY** command.

RAMPING DOWN automatically sequences to STANDBY after the ramp down duration has elapsed. The ramp down duration is determined by the active Parameter Set.

OFF is entered if an alarm occurs.

8 FiberView Installation

8.1 Minimum Requirements

Before installing FiberView, check that the PC meets the requirements in .

Table 2 Requirements for PC Supplied by Laser Integrator

Parameter	Requirement
Operating system	Windows 7 and above
Microsoft .NET	4 or higher
Minimum hardware specification	Processor 1GHz
	Hard drive with 250MB free space Approximately 50MB for FiberView installation
	2GB RAM
	RS-232 Interface Port or RJ45 Network Port Up to 57,600 Baud.
	Minimum screen resolution 1024 x 768
	Size of text 100% recommended
Interconnect cable connections	RS-232:9-pin D-type, Null Modem (Pins connected 2-3, 3-2, 5-5) Ethernet: Cross-over cable for direct connection to PC, Standard cable for LAN connection.
PC settings Control Panel – Regional & Language Options – Advanced Tab – Language for non-Unicode Programs	English

8.2 Installing FiberView

The latest version of FiberView is available from the customer login area of the SPI lasers website: https://www.spilasers.com/

1. Run the FiberView x.x.x.msi program (where x.x.x indicates the version number) provided by SPI Lasers to install FiberView. A message box will appear.

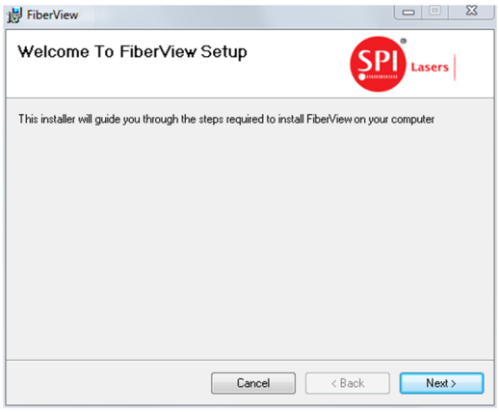


Figure 2 Welcome Message Box

2. Click [Next].

3. Review the licence agreement, select “I Agree” and click [Next].

4. Select the installation folder and click [Next].

   The default path C:\Program Files (x86)\SPI Lasers\FiberView\ is recommended. Clicking [Disk Cost] gives an indication of the disk space required for the installation.

5. Click [Next] to start the installation.

6. Click [Yes] in the User Account Control message box if it appears.

7. When the Installation Complete message box appears, click [Close].

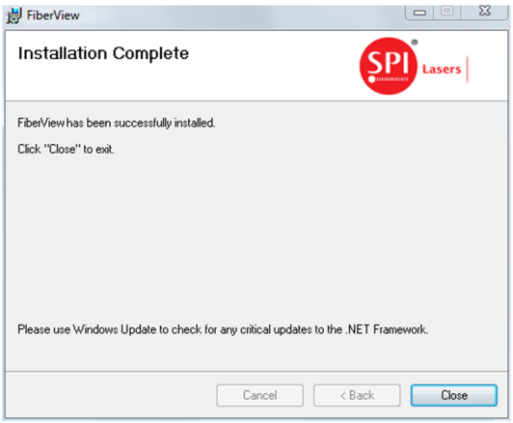
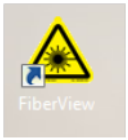


Figure 3 Installation Complete Message Box

8.3 Start FiberView

There are various ways to start the FiberView application. Select one of the following…



1. Click on the desktop icon.
2. Click shortcut in Windows start menu, Programs, SPI Lasers, FiberView.
3. Navigate using Windows explorer and then click on FiberView shortcut in C:\ProgramData\Microsoft\Windows\Start Menu\Programs\SPI Lasers.
4. Navigate using Windows explorer and then click on the FiberView.exe in either …

   C:\Program Files (x86)\SPI Lasers\FiberView\ for x64 PCs

   C:\Program Files SPI Lasers\FiberView\ for x86 PCs.

If a Windows Security Alert appears, click [Allow access]. This sets the Windows Firewall to allow connections from FiberView out from the network adapter on the PC.

The dialogue box similar to Figure 4 FiberView Start Window should appear.

Figure 4 FiberView Start Window

9 Before Operation

All Users must be officially trained and authorised within their respective organisations. They must also be fully conversant with the following:

- Laser hazards, safety procedures and correct use of related safety equipment.
- Hazards related to the use of lasers for materials processing, prescribed safety procedures and related equipment.
- The contents of these Instructions for Use and the Instructions for Use of the Laser controlled by FiberView, and therefore the safety provisions in them.

10 Connection Guide

A serial connection is needed to control a Laser using FiberView. RS-232 and Ethernet are available. Refer to the laser specific manuals (section 4) for the positioning of the serial connectors.

It is possible to have more than one instance of FiberView running on a single PC with each instance controlling a separate **redPOWER** Fiber Laser.

It is also possible to have multiple instances of FiberView running on the same PC or separate PCs with each instance connected to the same **redPOWER** Fiber Laser. In this case a primary connection can be selected so that only a single User can control the Laser at a time. The Laser can be locked using the primary connection so that no other User can take control without the Laser first being unlocked, which must be done using the primary connection. All other Users can still monitor the Laser and can disconnect from it without affecting it.

10.1 Serial Port – PL1

A cable with standard 9-way D-plug is used to connect the Laser to the system controller or a PC. The interface operates with signal levels defined by the RS-232 specification. The pin-out is shown in .

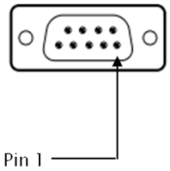
Pin connections are 2-3, 3-2, 5-5, with no other connections necessary.

RS-232 is the preferred standard. If longer cable runs are required than allowed for by the standard, then an RS-232 to RS-422 converter can be used, but this will be the responsibility of the User.

Table 3 Serial Port Connections

Pin	RS-232 Connections
2	Receive Data input (RX)
3	Transmit Data Output (TX)
5	Ground

When connecting to a standard computer serial port, pins 2 and 3 should be crossed over at the computer end. (Normally, female-female NULL MODEM cable)



The port should be configured to use a standard non-return-to-zero (NRZ) asynchronous protocol with...

- one start bit,
- one stop bit,
- eight data bits
- no parity

The baud rate can be selected using switches 7 & 8 on SW2 if this is accessible. See lasers specific documentation in section 4 for the location of the SW2 connector. This connector is not accessible from all lasers.

The selectable rates are 9600 and 57600 baud depending on the laser model.

Please check with product support (17 Contact Information) if in any doubt.

SW2 -7	SW2 - 8	RS232 Baud Rate
OFF	OFF	9600
ON	ON	57600

10.2 Ethernet – SK2

The Ethernet port can be used to connect the Laser to a LAN or directly to the network port on a PC. The port uses standard RJ45 connectors. A standard straight through cable is required for connection to a LAN. For direct connection to a PC a cross-over cable needs to be used if the PC network card doesn't support auto cross over detection (typically for older PCs).

10.2.1 Default IP mode

When the laser leaves the factory, the IP mode will be set to DHCP by default.

The laser by default should be connected to a network where a DHCP address will be allocated to it automatically.

10.3 Searching for a Laser using FiberView

1. Physically connect the PC to the laser using a RS232 cable or an Ethernet cable.

   If the laser is new from the factory then DHCP is the default IP mode and so the laser should go onto a network where it can be allocated an IP address automatically. If the laser is to be connected to directly from the PC, then follow the steps in section 10.4.2 FIXED/STATIC.

2. Start FiberView and wait while the automatic search detects the laser. The search will detect any laser connected on the serial COM port and any lasers on the same network as the PC and any lasers directly connected to the PC via an Ethernet cable.

3. Any lasers found will appear in a list. See fig Figure 5 FiberView Search Results.

4. To open the main FiberView window, double click on the desired laser from the list.

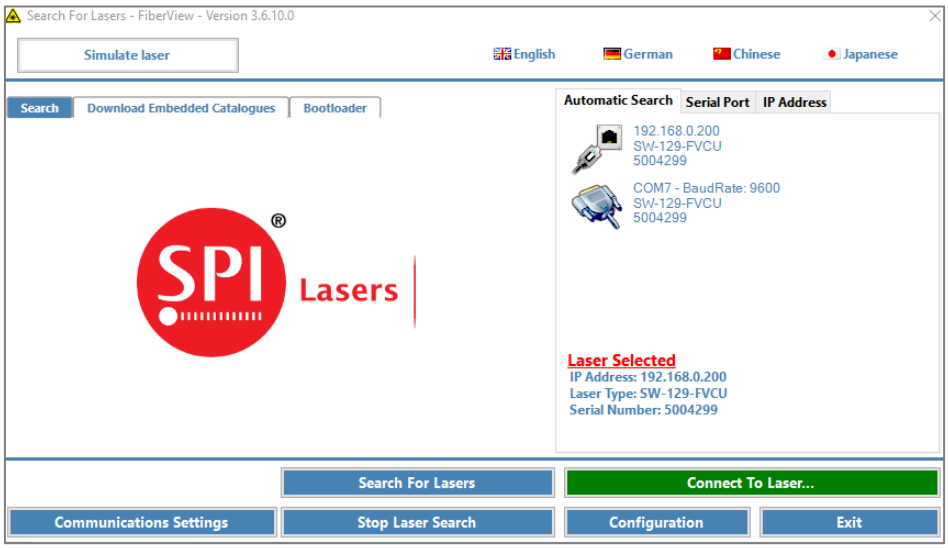


Figure 5 FiberView Search Results

10.4 IP Configuration

10.4.1 DHCP

DHCP is used when a laser is on a network where a DHCP server can allocate an IP address to the laser and PC automatically. FiberView on the PC connected to the same network as the laser will be able to find the laser if both laser and ethernet adapter IP settings are set to DHCP.

10.4.1.1 FiberView settings for DHCP

To set the Ethernet configuration for DHCP open the Laser Connection window in FiberView from the Communications option under the main menu.

1. Set the address mode to DHCP. No other settings are required. Click OK.

2. Recycle the power to the laser for the changes to take effect.

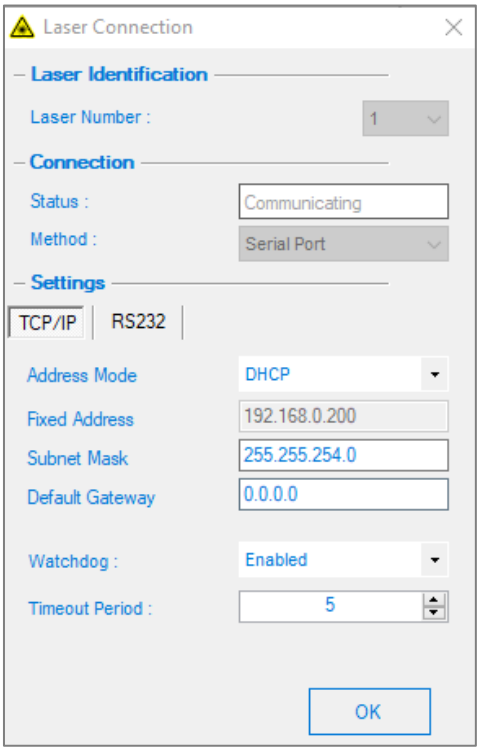


Figure 6 DHCP Configuration on FiberView

10.4.1.2 PC Adapter settings for DHCP

To set the Ethernet adapter for DHCP go to the control panel of the PC and navigate to Network connections - Control Panel\ Network and Internet\Network Connections.

1. Find the adapter that is connected to the same network as the laser.
2. Right click on the adapter and select “Properties”.
3. A new window will open with the Ethernet properties.
4. Select “Internet Protocol Version 4 (TCP/IPv4)” and click the Properties button.

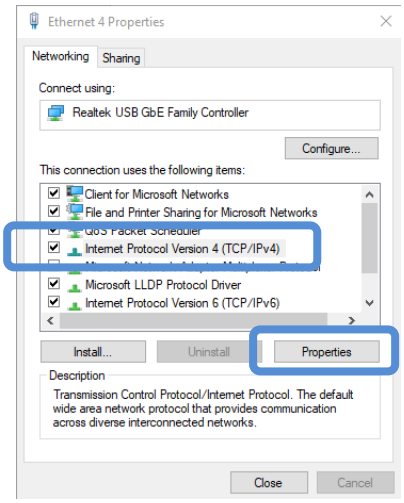


Figure 7 Internet Protocol version 4 properties

5. In the Internet Protocol Version 4 (TCP/IPv4) Properties window, make sure the “Obtain IP address automatically” option is selected.

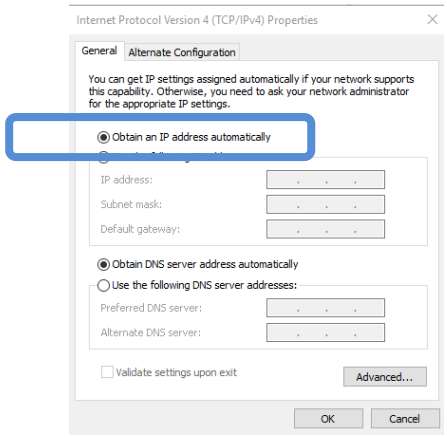


Figure 8 PC Adapter DHCP Configuration

6. Close all of the PC network adapter Windows for the changes to take effect.

10.4.2 FIXED/STATIC

For lasers connected by Ethernet cable directly to the PC, a static IP configuration can be used. The Ethernet adapter on the PC and the laser need to be configured with a fixed IP address and matching subnet mask.

NOTE: When configuring the laser to use a fixed address it is important to keep a note of the new address. A good idea is to put a label on the laser for future use.

10.4.2.1 FiberView settings for Fixed /Static address

To set the Ethernet configuration for the laser to Fixed/Static addressing, open the Laser Connection window in FiberView from the Communications option under the main menu.

1. Set the address mode to Fixed.
2. Set the Fixed IP Address e.g. 192.168.0.1

   Make a note of the fixed address as it will be required when setting the PC adapter.
3. Set the subnet mask e.g. 255.255.254.0.
4. Leave the default gateway as all zeros.
5. Recycle the power to the laser for the changes to take effect.

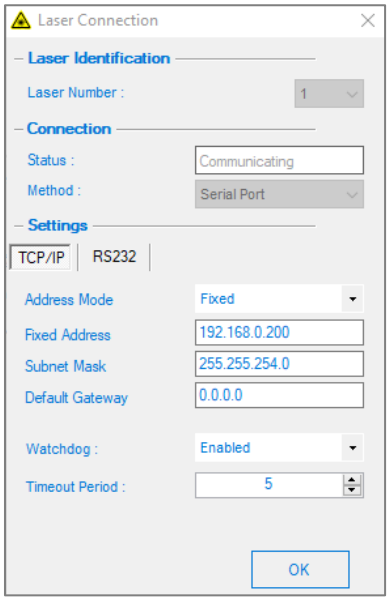


Figure 9 Fixed address Configuration on FiberView

10.4.2.2 PC Adapter settings for a Fixed / static address

To set the PC Ethernet adapter to fixed/static go to the control panel of the PC and navigate to Network connections - Control Panel\ Network and Internet\Network Connections.

Find the adapter that is connected to the network that the laser is also connected to.

1. Right click on the adapter to get a menu and select “Properties”.

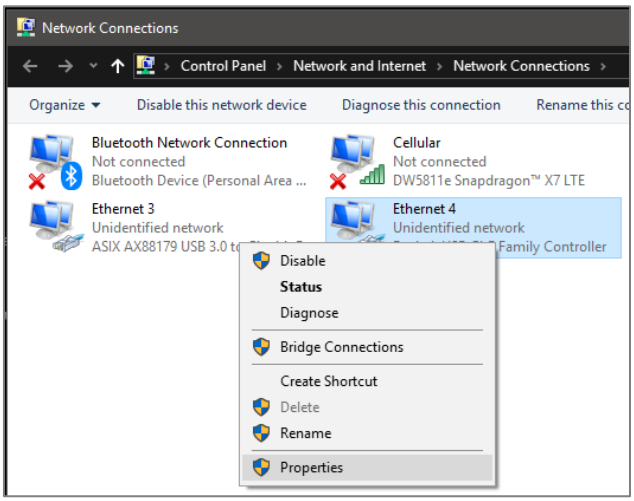


Figure 10 Network Connections

2. A new window will open with the Ethernet properties.
3. Select “Internet Protocol Version 4 (TCP/IPv4)” and click the Properties button.

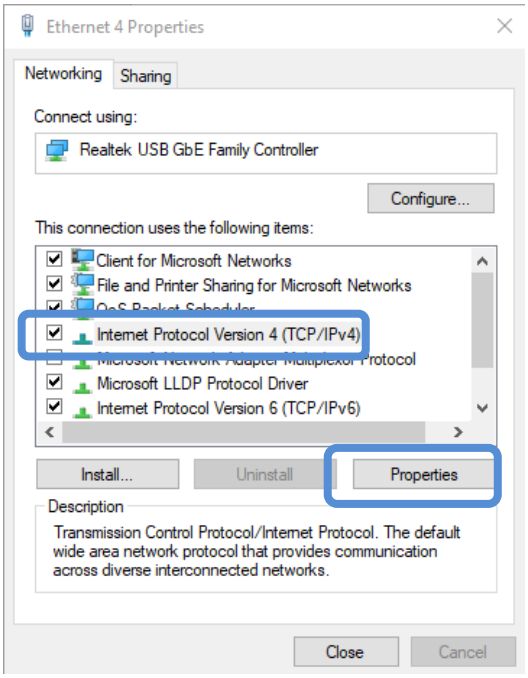


Figure 11 Internet Protocol version 4 properties

4. In the Internet Protocol Version 4 (TCP/IPv4) Properties window, make sure the Use the following IP address is selected.

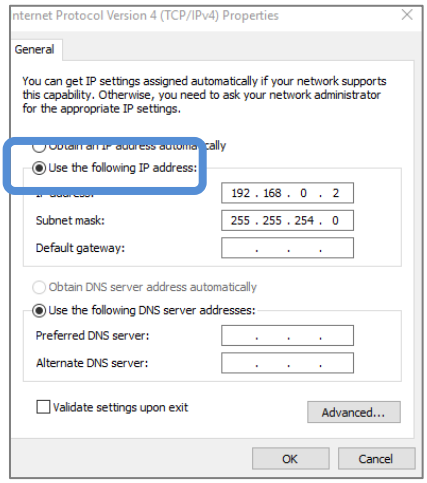


Figure 12 PC Adapter Fixed Configuration

In the next sections there are some suggested IP address, subnet mask and gateway settings.

10.4.2.3 Choosing an IP address

For faster search results and easy configuration, the first 3 parts of the 4-part adapter IP address should match those of the laser.

For example, if the

Laser IP address = 192.168.0.1

then

PC ethernet Adapter IP address = 192.168.0.**2**

Only the last number needs to be different. It can be anywhere within the 255 range but make sure it is not the same as that of the laser.

10.4.2.4 Choosing a subnet mask

To follow on from choosing an IP address (examples above) a simple subnet mask to use is

255.255.254.0

This should however match the subnet mask of the laser.

10.4.2.5 Choosing a gateway

The gateway can be left blank or it should be set to that of the lasers gateway

10.5 Connection Problems

There are various reasons why a laser may not be found during the search from FiberView. Check each item in this section for any that may solve the connection issue.

Quick checklist

- Check the laser has power 0
- Check FiberView has the correct search criteria 10.5.2
- Check the COM port 10.5.3
- Check IP configuration has been configured 10.5.5
- Check Ethernet setting for networks 10.5.6
- Check Ethernet for point to point 10.5.7
- Check the Windows firewall 10.5.8
- Check the correct Ethernet cables have been used 10.5.10
- Check VPN type connections 10.5.11
- Check FiberView installed correctly 10.5.12

10.5.1 Check the laser has power

Check that the laser has the correct AC power and the power is currently turn on.

10.5.2 Check FiberView Search properties

If the laser is not found using the FiberView search it could be that the search properties are not set to search using the correct criteria. Check the search properties.

1. Open FiberView and from the search screen, open the Configuration window by clicking the Configuration button as shown in Figure 13 FiberView Search Configuration Button

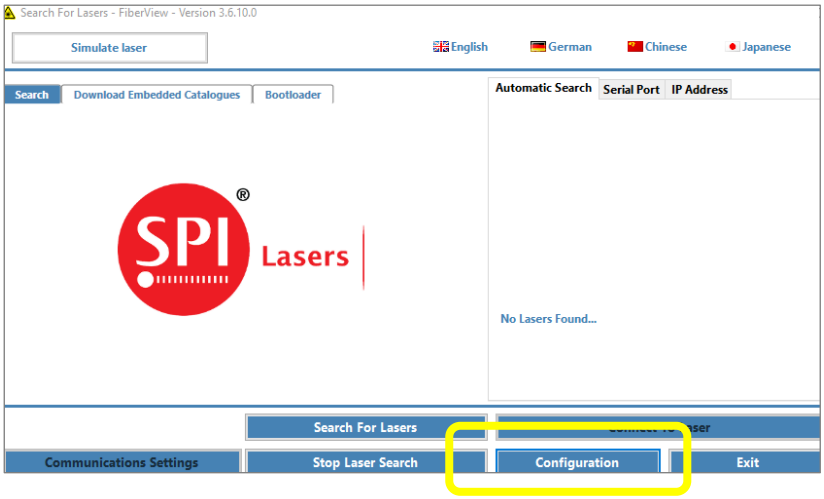


Figure 13 FiberView Search Configuration Button

2. Check that the correct options are ticked for the laser's connection type.
   - For COM port connected lasers make sure the correct baud rate is ticked.
   - For Ethernet connected lasers check that the Ethernet search enabled is ticked.

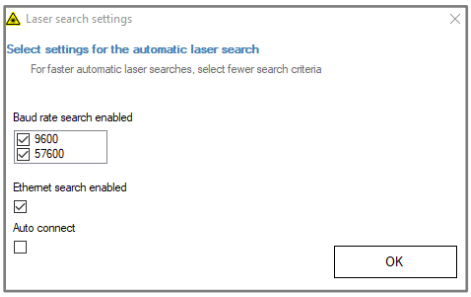


Figure 14 FiberView Search Configuration

3. Click OK

10.5.3 Check Serial COM port

1. Check the laser has power and is switched on.
2. Check that there is a suitable serial cable being used and that the connectors are securely connected to the laser and the PC.
3. If using a serial to USB adapter, check that the correct driver is installed and working correctly.
4. Check that there is not already another device attached to the COM port.

10.5.4 Connecting to a New laser

If you are trying to connect to a laser straight from the factory, the default configuration will be DHCP. Place the laser on a network where there is a DHCP server to allocate the IP address and handle the configuration.

Alternatively, if there is no network available, the TCP/IP configuration on the laser can be modified to fixed addressing by connecting via a RS232 connection. See section 10.4.2

10.5.5 Can’t connect after changing the IP configuration on the laser

When the IP configuration is changed on the laser, the laser will need to be recycled for the changes to take effect. Turn the power off and then back on again.

10.5.6 Problems with lasers on a network

When connecting to a laser on a network and using DHCP, check that the ethernet adapter has the correct configuration. It should obtain an IP address automatically. See section 10.4.1 DHCP.

When connecting to a laser where a fixed address is required see section 10.4.2 FIXED/STATIC.

10.5.7 Problems with lasers directly connected to the PC

When connecting to a laser where there is an ethernet cable directly running from the PC to the laser you will need to use fixed addressing. See section 10.4.2 FIXED/STATIC.

10.5.8 Check the Firewall for blocked connections

Check that the laser application you are using has the correct firewall permissions

Navigate to - Control Panel\System and Security\Windows Firewall\Allowed apps

Find the application in the list and make sure the network check box is ticked. If it is not, then click the “Change settings” button to change the configuration.

You may need your network administrator to change the settings.

10.5.9 Forcing the IP Mode Using SW2

Some lasers have the additional option of setting the SW2 connectors to allow the laser to be forced into DHCP or Fixed IP addressing mode.

The SW2 is not accessible from all lasers. See section 4 Document References for the correct manual for the specific location of the SW2 switch or contact product support (17 Contact Information).

Forced DHCP

set dip switch SW2-5 to ON
set dip switch SW2-6 to OFF
switch power to the laser OFF *if it is not already OFF*
switch power to the laser ON

The PC network adapter will need to be set to DHCP (see section 10.4.1.2)

Forced to Fixed

set dip switch SW2-5 to ON
set dip switch SW2-6 to ON
switch power to the laser OFF *if it is not already OFF*
switch power to the laser ON

The PC network adapter will need to be set to Fixed (see section 10.4.2.2)

Static/Fixed/DHCP

The control card can be set to recall the previous Ethernet address settings each time it is powered on.

set dip switch SW2-5 to OFF
set dip switch SW2-6 to OFF
switch power to the laser OFF *if it is not already OFF*
switch power to the laser ON

The PC network adapter will need to be set to DHCP or Fixed depending on what is required. See section 10.4 IP Configuration.

The state of SW2 is only read by the firmware at power ON

The default setting of the SW2 switch is dip switch 5 OFF & 6 OFF so that the laser will use the last configured IP settings.

10.5.10 Ethernet Cable Issues

Connect the RJ45 ethernet port on the PC to the RJ45 ethernet port SK2 on the control card.

Most ethernet cables are “patch” cables with pin 1 wired to pin 1 etc. The orientation and position of the wires are the same at both ends.

However, older PCs require the use of a “crossover” cable, such as SPI part numbers PT-E02556 or PT-E02557. The crossover cable will have different pin orientation and the wires will not be in the same positions at either end of the cable. Many recent PCs have the ability to automatically crossover transmit and receive if required; this is called Auto MDI-X. If in doubt, use a crossover cable. An Ethernet to USB adapter can also be used.

10.5.11 Other security issues (e.g. VPN)

If your PC is being managed by a corporate administrator and your connections are managed through software such as VPN then connection tunnelling is used.

In the rest of this section the example used will be VPN, but this could equally apply to various other applications that manage secure connections.

Your VPN may stop split tunnelling which would stop access to a local LAN or fixed address device. Its purpose is to keep your PC secure while connected to the corporate network.

To see if it is the VPN connection application causing the issue, disconnect from VPN and try to connect to the laser.

If the connection to the laser now works and you wish to also be connected to VPN you will need to speak to your system administrator.

10.5.12 Check FiberView Installation

Occasionally the Windows registry does not update correctly after FiberView has been installed. For any connection issues that cannot be solved by any of the other suggestions it may be necessary to turn of the PC and then turn it back on again to get the Windows registry to update correctly.

11 FiberView GUI

Configuration and status information is stored on the laser.

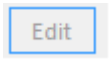
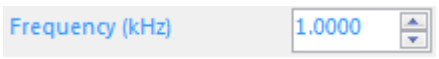
- Parameter Sets
- Process Cycles
- Alarm and warning levels
- Calibration data
- Laser Control information

On start-up, FiberView reads the configuration information from the Laser. Thus, one installation of FiberView can be connected to any Laser and will know the Laser's status and capabilities.

11.1 FiberView Control Terminology

In these Instructions for Use the following terminology is used.

Table 4 Terminology

Name	Appearance	Description
Tabs		Click the appropriate tab.
Button		Click the button to perform the action indicated by the label. Shown in the manual with square brackets [Connect].
Text box		Displays information.
Drop down list		Click the arrow to select the input value. Alternatively, a value can be typed in the box.
Up-Down Control		Type an input value in the box. Alternatively use the arrows to set the value.

Once a value has been edited by the user in a control, the user needs to click the "Enter" button on the PC keyboard or Click on another control on FiberView before the changes will take effect.

11.2 FiberView Search Screen

The start window has several tabs and buttons. The text on the buttons is white when they are enabled and black when they are not.

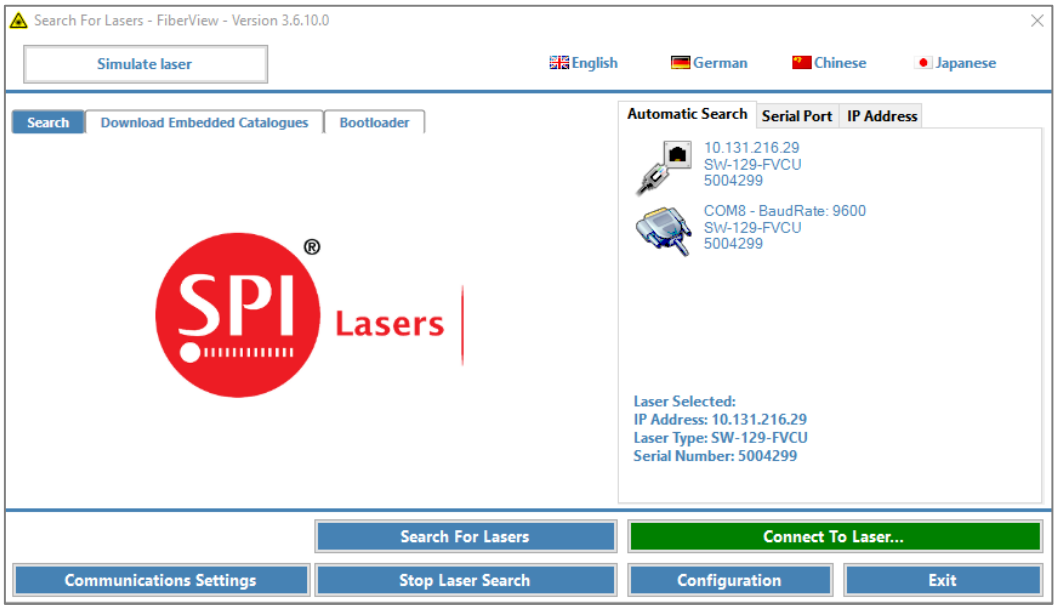
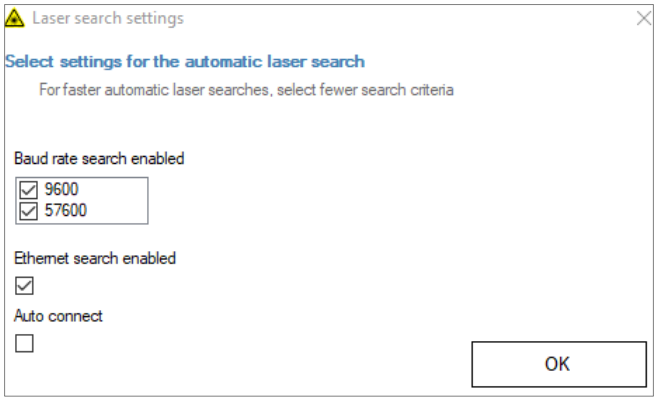


Figure 15 FiberView Search Screen

- [Search for Lasers] searches for **redPOWER** Fiber Lasers connected to the PC using a RS-232 (COM Port) or Ethernet connection. The search systematically checks all RS-232 and Ethernet connections to the PC to see if there are any lasers attached. Any lasers found will be displayed in the right hand list.
- [Connect to Laser] connects to the selected Laser.
- [Communications Settings] allows the configuration of the serial or Ethernet connection to be changed for the selected laser.
- [Stop Laser Search] stops the search for Lasers.
- [Configuration] determines the connections and baud rates used to search for Lasers.

  If experiencing slow searching when using FiberView to search for lasers, there are a few things that can be done to speed up the search. Having multiple com ports enabled on the PC slows down the com port search as each port is checked for a laser by FiberView sending a protocol command and awaiting an appropriate response. Bluetooth ports are particularly slow to respond with a fail or timeout. To reduce the search time, use the configuration options to select the items to search for.



If no Bluetooth is required, then these devices can be disabled using Windows device Manager although this is only a suggestion and will be the responsibility of the User.

- [Exit] exits FiberView.
- The ‘Automatic Search’ tab displays the Lasers found by [Search for Lasers].
- ‘Serial Port’ is used to connect to a Laser when the port number and baud rate are known.
- ‘IP Address’ is used to connect to a Laser when the IP address is known.

[Simulate laser] opens a list of lasers that can be simulated. Select a laser to simulate to get the main FiberView window to view various features without a laser being present.

11.3 Tour of User Interface

On connecting to a Laser, FiberView displays its overview window. The window is divided into several areas, as shown in Figure 16.

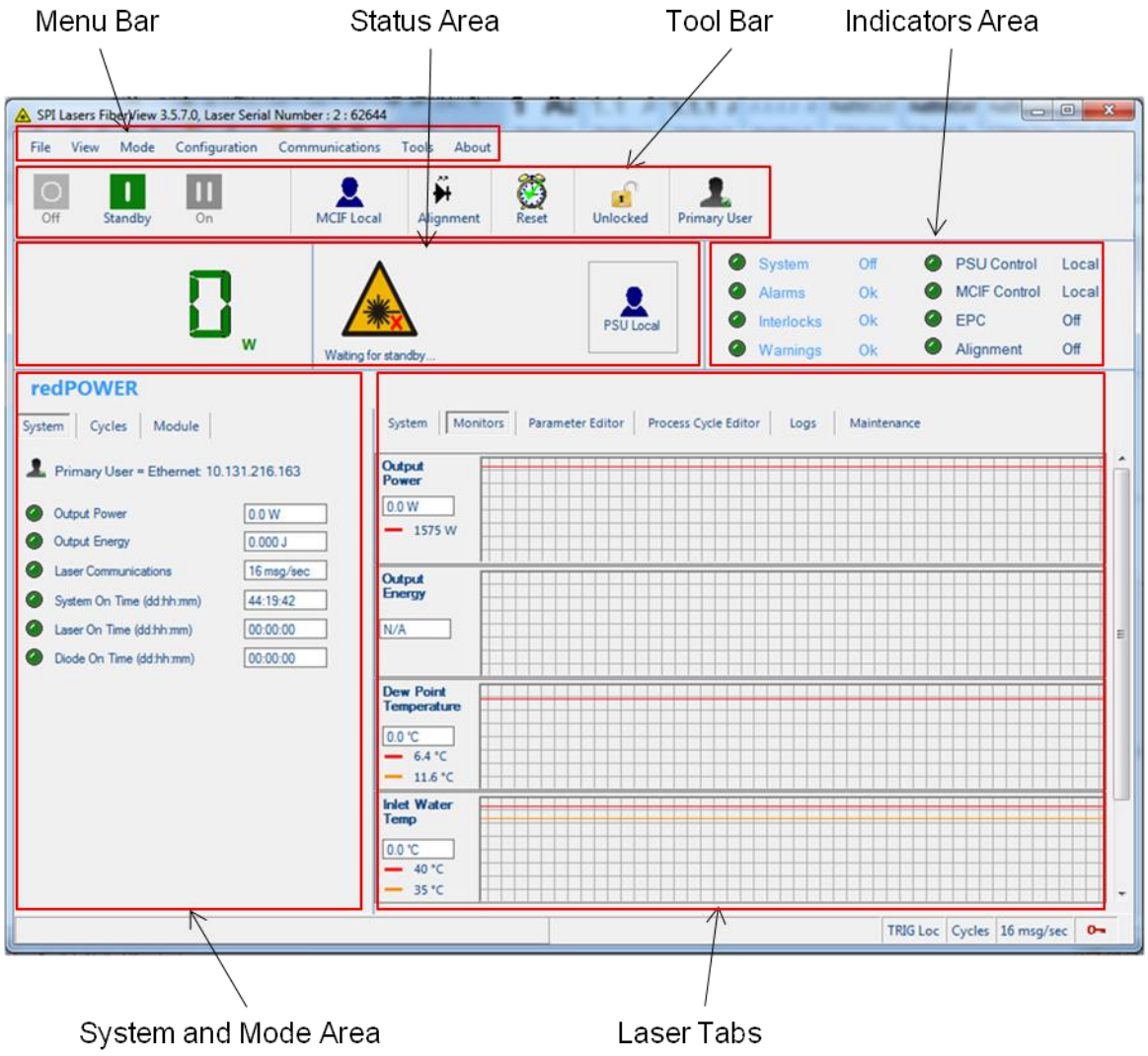


Figure 16 FiberView Overview Window

Clicking on the tabs in FiberView's menu bar opens further menus which can be used to select more functions as described in Section 11.4.

Clicking on the icons in the Tool Bar changes the state of the Laser, for example turning it on or turning the alignment laser on, as described in Section 11.5.

The Status Area gives the output power and other important information while the indicators in the Indicators Area give an overview of other key parameters as described in Sections 11.6 and 11.7.

At the top of the System and Mode area the product range of the connected or simulated Laser is displayed. Beneath are tabs which toggle between displaying detailed system information and the parameters of the active Parameter Set or Process Cycle as described in Section 11.8. Additionally, an icon indicates whether the instance of FiberView has the primary connection.

The Laser Tabs are used to set-up and monitor the Laser:

- ‘System’ opens a window giving information of the Laser system configuration: live events, warnings and alarms are displayed in the left panel while the right panel lists Laser system configuration information.
- ‘Monitors’ gives graphical representations of key parameters over time.
- ‘Parameter Editor’ allows Shapes and Parameter Sets to be edited and saved or opened to or from the FVCU or the PC or network.
- ‘Process Cycle Editor’ enables Parameter Sets to be assembled into Process Cycles.
- ‘Logs’ allows the alarm, warning, event and maintenance logs to be viewed, analysed, saved and deleted.
- ‘Maintenance’ gives access to status and version information of software, communications, the MCIF and advanced diagnostics. The configuration of the MCIF can also be changed here.

Further details are given in Section 11.8.1.

11.4 Menu Bar

Clicking on the tabs in FiberView’s menu bar opens further menus which can be used to select more functions as shown in Figure 17. These tabs and menus are described in the remainder of this section.

FiberView	File	Exit		
	View	Display Values ►	Power	
			Energy	
		Windows ►	Laser Overview	
			Parameter Set Programming	
			Process Cycle Editor	
			Logs	
			Maintenance ►	Interlock Status
				Software Versions
				Communications
				Machine Interface
				Advanced Diagnostics
		Change Text Colour		
	Mode	Parameter Mode ►	Parameter Sets	
			Process Cycles	
		Control Mode ►	Local	
			Remote	
	Configuration	User Access Level ►		
		Laser…		
	Communications	Laser Connection…		
	Tools	Safe Mode Recovery		
		Process Vision		
		Options…		
		Soak and Cycle Tests		
		Process Monitoring ►	Pierce Detect…	
	About	About FiberView		
		SPI Lasers on the Web		

Figure 17 Menu Tree

11.4.1 File

11.4.1.1 Exit

FiberView can be configured to do various things on exiting the application. The configuration menu for choosing what happens when the application terminates can be found under the Tools – Options – Settings – Application – When Application Terminates menu.

When the exit menu item is clicked, one of the 3 options below will occur depending on how the “When Application terminates” option has been configured.

1. “Show Desk Top”

   This will close FiberView and return user to the desktop.

2. “Shut Down Computer”

   This will close FiberView and then shutdown the PC.

3. “Search for Lasers”

   This will Return FiberView to the Start window.

11.4.2 View

11.4.2.1 Display Values

Selecting ‘View’ ‘Display Value’ allows the display in the Module Status Area to be changed from Power (watts) to Energy (joules). Energy is calculated by integrating over the active Parameter Set.

11.4.2.2 Windows

Selecting ‘View’ ‘Windows’ gives the options

Laser Overview

Parameter Set Programming

Process Cycle Editor

Logs

Maintenance

Selecting these options is equivalent to clicking the corresponding Laser tab. The options are described in Section 11.8.1.

11.4.2.3 Change Text Colour

Selecting ‘View’ ‘Change Text Colour’ allows the colour of the text on FiberView to be changed.

11.4.3 Mode

11.4.3.1 Parameter Mode

- ***Parameter Sets***

  Allows the Laser to run Parameter Sets (see Section 13.1.1)

- ***Process Cycles***

  Allows the laser to run Process Cycles (see Section 13.1.1)

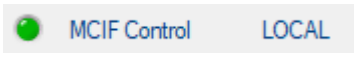
The information displayed in the Mode tab of the System and Mode Area switches between Parameter Sets and Process Cycles to show the current status of the chosen mode.

11.4.3.2 Control Mode

- ***Local***

  Allows the laser to be controlled using FiberView and the serial interface.

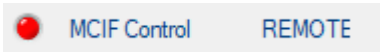
  Toolbar Icon 

  Status Indicator 

- ***Remote***

  Allows the laser to be controlled remotely using the machine interface (MCIF).

  Toolbar Icon 

  Status Indicator 

11.4.4 Configuration

11.4.4.1 User Access Level

Selecting ‘Configuration’ ‘Access Level’ allows the FiberView access level to be changed or for FiberView to be locked. Passcodes can be set up so that changing the access level or locking and unlocking the FiberView can only be done with authorisation from the Laser Integrator.

Setting up passcodes is described in the Security section.

Table 5 Access Levels

Level	Configuration
Locked	No changes to the Laser can be made until it is unlocked
Operator	Basic access to FiberView functions
Supervisor	Allows Shapes, Parameter Sets and Process Cycles to be programmed
Maintenance	Gives full access to all User functions in FiberView

11.4.4.2 Laser…

Selecting ‘Configuration’ ‘Laser…’ opens the Laser Settings window to allow some parameters, including the brightness and timeout of the alignment laser, to be adjusted.

11.4.5 Communications

Selecting ‘Communications’ opens the Laser Connection Window which allows the type of connection to the Laser – serial or Ethernet – and the associated RS-232 or TCP/IP parameters to be configured. FiberView must be restarted so a new automatic search can take place using the reconfigured connection type. See section 10 Connection Guide.

11.4.6 Tools

11.4.6.1 Safe Mode Recovery

See section 13.8 Safe Mode Recovery

11.4.6.2 Process Vision

Launches ProcessVision – a GUI for viewing and recording camera output of the work piece – if installed.

11.4.6.3 Options…

Selecting ‘Tools’ ‘Options’ opens the FiberView Options window.

Settings

- **Application**

  Start-Up mode

  - Local
  - Remote
  - Last State

  Application Display Mode

  - Advanced
  - System tray
  - Basic

  When Application terminates

  - Show Desktop
  - Shutdown Computer

- Search for lasers

- **Communications**
  - Ignore communications checksum errors
  - Ignore communications timeouts
  - Ignore communication errors

- **History**
  - Do not display history
  - Do not display warning history
  - Do not display event history

- **Features**
  - Enable Sounds
  - Hotkey turns laser off
  - Allow user to type parameter
  - Log key metrics when alarm occur

- **File locations**
  - Log file location
  - Parameter set file location
  - Process cycle data file location

Security

Passcodes may be set for different access levels and lockout.

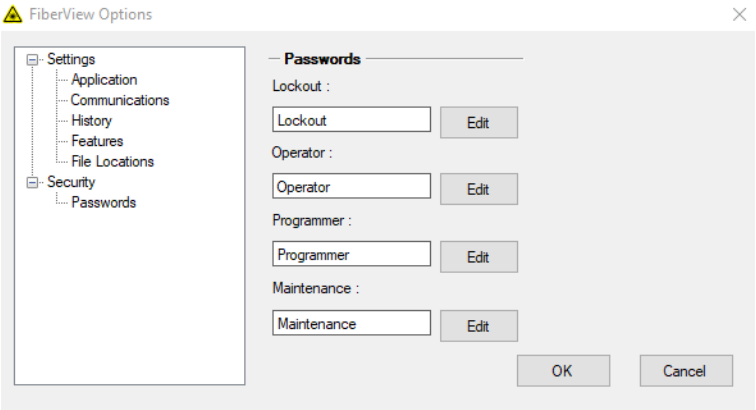


Figure 18 Password Settings

11.4.6.4 Soak and Cycle Tests

Soak tests and cycle tests are automated routines which aid in fault diagnosis and troubleshooting. They should be run under guidance from SPI Lasers Product Support.

11.4.6.5 Process Monitoring…

Selecting ‘Process Monitoring…’ ‘Pierce Detect…’ opens the Pierce Detect window. See Section 13.3 Pierce Detect for instructions in using Pierce Detect.

11.4.7 About

- About FiberView

  Selecting ‘About’ ‘About FiberView’ gives information, including the version number, of FiberView.

- SPI Lasers on the Web

  Selecting ‘About’ ‘SPI Lasers on the Web’ opens SPI Lasers’ home page in the default browser.

11.5 Tool Bar

Clicking one of the three leftmost icons moves the Laser to the OFF, STANDBY or ON state. Available states are indicated by coloured icons; grey icons indicate states, including the present state, which are not available to move to.

Clicking the Control icon toggles the control mode from Local Control, indicated by the silhouette a person, to Remote Control, indicated by a gear wheel. See Section 11.4.3.

Clicking the Alignment Laser icon turns the alignment laser on and off.

Figure 19 Reset Icon No Alarms

Figure 20 Reset Icon Alarms

The Reset icon is grey (Figure 19) when there are no alarms and coloured (Figure 20) when alarms are present. Clicking it will clear alarms provided that the fault (or faults) have been put right.

The lock and user icons are used to manage multiple connections to the Laser. See Section 13.9.

11.6 Status Area

The Laser power is displayed at the left of the Status Area. When the number is red, the Laser is ON. When the number is green, the Laser is in STANDBY or OFF.

The laser warning symbol has a green tick when the PSU is enabled (ON or STANDBY) or a red cross when it is not (STANDBY or OFF).

When a QUBE Fiber Laser is connected one of the icons shown in Figure 21 or Figure 22 will be displayed to the right of the Status Area. The icon indicates whether FiberView has control of the Laser’s PSUs. The PSUs in QUBE Fiber Lasers may be enabled and disabled using the

PSU enable input on connector PL82. (Refer to the Instructions for Use of the Laser for further information.)

Figure 21 PSU Local Icon **Figure 22 PSU Remote Icon**

If FiberView has control over the PSU, the icon in Figure 21 is displayed. In this case FiberView can ensure that the PSU is enabled when the Laser is ON. The icon in Figure 22 indicates that FiberView does not have control over the PSU, and that it must be enabled using the PSU enable input on connector PL82. In this case the PSU may not be enabled when the Laser is ON, and so there may be no emission. The PSU Control indicator, in the indicators area, turns red to warn Users that, although they can turn the Laser ON by selecting the ON icon on the Tool Bar, the Laser will not actually have any power until the PSU is enabled.

In order to ensure that the Laser is safe when the process cabinet doors are opened the PSUs must be disabled. This is done by clicking the button in the Status Area shown in Figure 23. The cabinet doors can then be opened without triggering an alarm.

Figure 23 PSU Disable Button

Disabling the PSUs in this way keeps the Laser in STANDBY, and so it can be moved directly to ON which is quicker than moving from OFF through STARTING and STANDBY to ON had an alarm been triggered. Refer to Section 7 for more information on the transitions between Laser states.

The figures below show the Status Area, Tool Bar and Indicators Area for different Laser conditions.

Figure 24 Laser OFF, PSU Local

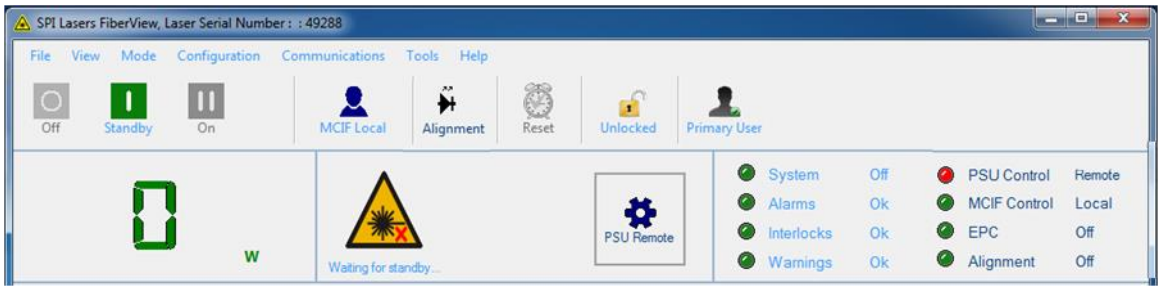


Figure 25 Laser OFF, PSU Remote

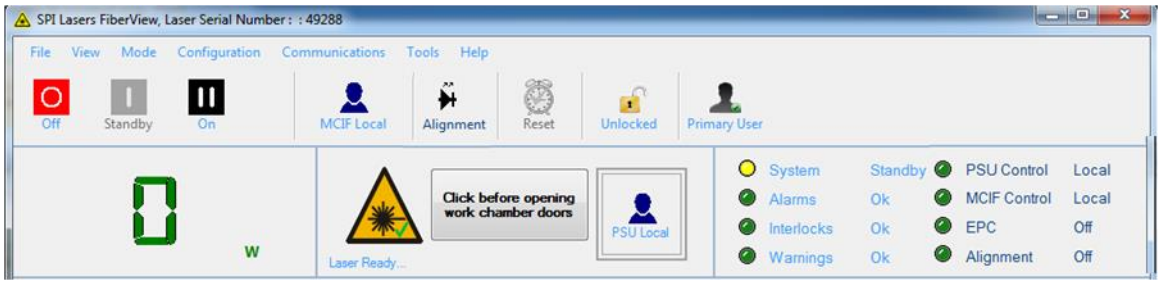


Figure 26 Laser STANDBY, PSU Local, PSU Enabled

Figure 27 Laser STANDBY, PSU Local, PSU Disabled

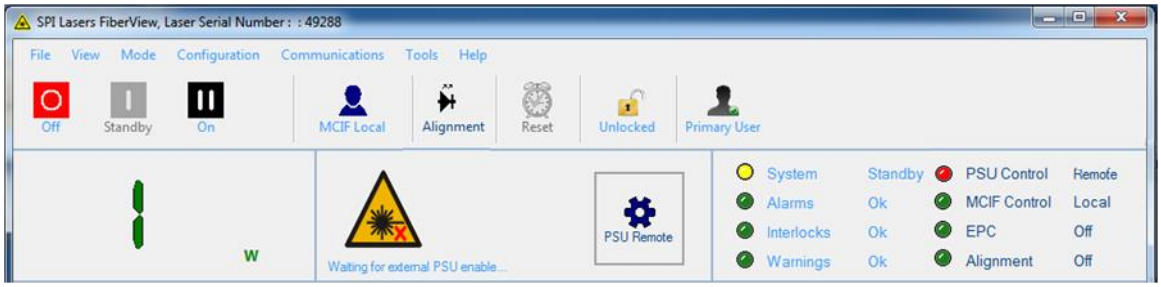


Figure 28 Laser STANDBY, PSU Remote

11.7 Indicators Area

The Indicators Area give an overview of:

- The system state: green - OFF, yellow - STANDBY, red - ON
- Alarms: green – no alarms, red – one or more alarms.

  Hovering the cursor over the word ‘Alarms’ will indicate which alarms are set.

  Click the reset icon in the Tool Bar to clear alarms provided that the fault (or faults) have been put right.

- Interlocks: green – interlocks closed, red – interlock open.

  Hovering the cursor over the word ‘Interlocks’ will indicate which interlocks are open. Alternatively, open the Maintenance Laser Tab then select ‘Intlk’ to determine which interlocks are open. Refer to Section 11.8.1.6.

  The 100W & 200W Air cooled lasers have an Interlock reset button to clear any Interlock indications. Refer to section 13.7

- Warnings: green – no warnings, red – one or more warnings – the number is indicated if more than one

  Hovering the cursor over the word ‘Warnings’ will indicate which warnings are set.

- PSU Control: green – local, red – remote

  Refer to Section 11.6 and the Instructions for Use of the Laser for further information.

- MCIF Control: green – local, red – remote

  Refer to Section 11.4.3 for information on changing the control mode.

- EPC (External Power Control): green – off (internal control), red – external control (absolute or relative)

  EPC is a parameter of Parameter Sets. Refer to Table 7 Parameter Set Parameters for information on the use of EPC.

- Alignment: green – the alignment laser is off, red – the alignment laser is on

  Refer to Section 13.4 Alignment Laser for information on the alignment laser.

11.8 System and Mode Area

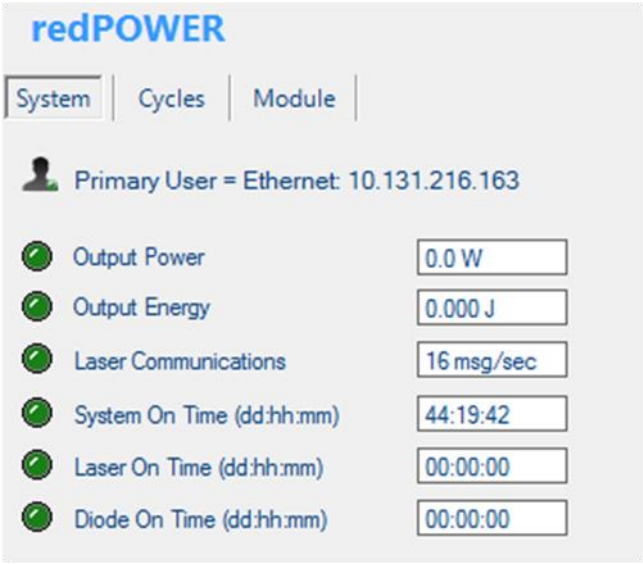


Figure 29 System and Mode Area (System Tab)

At the top of the System and Mode area the order code of the connected Laser or the product range of the simulated Laser is displayed. FiberView can be used with legacy product families.

In this case the legacy name, such as JK1000FL will be displayed. These Instructions for Use apply only when FiberView is used with a **redPOWER** PRISM or QUBE Fiber Laser.

Beneath the name are three tabs. As shown in Figure 29, the left tab displays continuously updated system information. Additionally, an icon indicates whether the instance of FiberView is the primary connection. Address information of the primary connection is given next to the icon.

The centre tab can be configured to be ‘Parameters’ or ‘Cycles’ by selecting ‘Mode’ ‘Parameter Mode’ and then ‘Parameter Sets’ or ‘Process Cycles’ from the Menu Bar.

When Parameters is selected the parameters of the active Parameter Set are displayed.

When Cycles is selected the Parameter Sets and Control Attributes of the current Process Cycle are displayed.

The right tab gives information on the PRISM Fiber Laser modules in the Laser.

11.8.1 Laser tabs

11.8.1.1 System

Selecting ‘System’ opens the Laser Status window. Live events, warnings and alarms are displayed in the left panel with a timestamp. Items are added to the list as they occur. The list can be cleared using a right click on the list and selecting clear display. The right panel lists Laser system configuration information. The information may be saved to PC or network storage if required.

11.8.1.2 Monitors

Selecting ‘Monitors’ graphically displays continuously updated system information.

11.8.1.3 Parameter Editor

Select ‘Parameter Editor’ to edit, save and open Shapes and Parameter Sets. How to do this is described in Section 13.1.4 Shapes and Section 13.1.1 Parameter Sets.

11.8.1.4 Process Cycle Editor

Select ‘Process Cycle Editor’ to edit, save and open Process Cycles. How to do this is described in Section 13.1.6 Process Cycles and Steps.

11.8.1.5 Logs

Select ’Logs’ to display and manage logs of alarms (Alm), events (Evnt), warnings (Warn), maintenance (Maint), and alarm data (Alm+).

11.8.1.6 Maintenance

Select ‘Maintenance’ to display information useful in diagnosing faults and to reconfigure the MCIF. There are six subsections, selected by tabs.

1. SPI Service use only.
2. Select ‘Intlk’ to view the status of the interlocks.
3. Select ‘Soft’ to view details of the FiberView installation and the firmware embedded in the Laser.

4. Select ‘Com’ to monitor communications. The information displayed depends on the type of connection.
5. Select ‘MCIF’ to view the configuration of the Machine Control Interface and to reconfigure it. Refer to Section 13.5 for further information.
6. Select ‘Diags’ to display advanced diagnostic information.

12 Basic Control of the laser

To operate the Laser, check in the Indicators Area to see that there are no alarms and that the interlocks are closed.

Set the laser control to Local by clicking the MCIF button.

Set the laser mode to parameter sets by selecting “Parameter Sets” from the main menu – Mode – Parameter Mode.

Select an Output Shape in the Parameter Editor and set a mean demand or peak demand.

For QUBE Lasers, check that the internal PSUs are under local control, or for PRISM rack Lasers (which do not have internal PSUs) check that the external PSUs are ready to power the Laser.

Click the green Standby icon on the Tool Bar to put the Laser in STANDBY.

After the safety delay of the STARTING state, the On icon will turn black. Click it to move to ON and start laser emission.

To stop laser emission, click the red Off icon or the green Standby icon to move to the OFF or STANDBY state respectively.

Note that restarting from STANDBY is faster than from OFF as there is no the safety delay of the STARTING state.

13 Functions

13.1 Parameter Sets and Process Cycles

The laser can be configured to run with parameter sets or process cycles. This section describes how to set the parameter set or process cycle mode and how to configure and use parameter sets and process cycles.

Figure 30 shows the relationship between parameter sets, process cycles and shapes. It is intended that this diagram be used in conjunction with information in the sections that follow on parameter sets and process cycles.

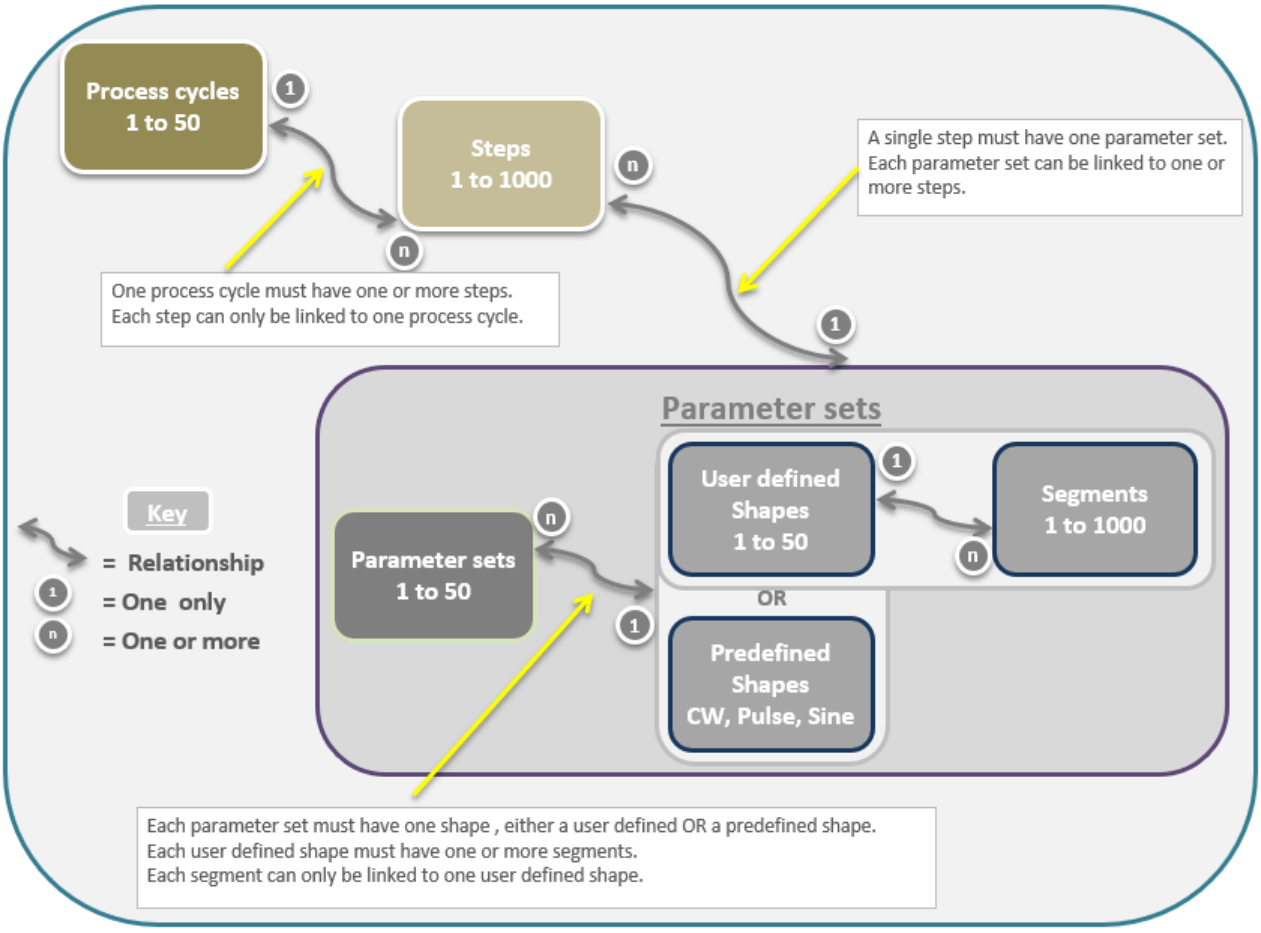


Figure 30 Parameter Set and Process Cycle Relationship Diagram

13.1.1 Parameter Sets

When running in parameter sets mode, the laser will use the active parameter set to control the laser output. The laser has just 1 active set out of a possible 50 configurable parameter sets. The laser can store all 50 Parameter Sets and can switch quickly between them during processing.

Parameter Sets take a Shape and add power (demand) and time (frequency and width) information together with ramp up and ramp down times, the trigger mode and the External Power Control (EPC) mode. For detailed information on shapes refer to Section 13.1.4

To select Parameter Sets Mode, use the main menu of FiberView. Refer to Figure 31.

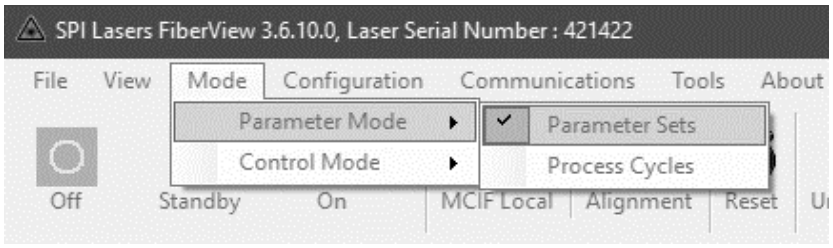


Figure 31 Configure Parameter Sets Mode

Each parameter set is constructed from the parameters listed in Figure 32. For more detail of each item refer to Table 7 Parameter Set Parameters.

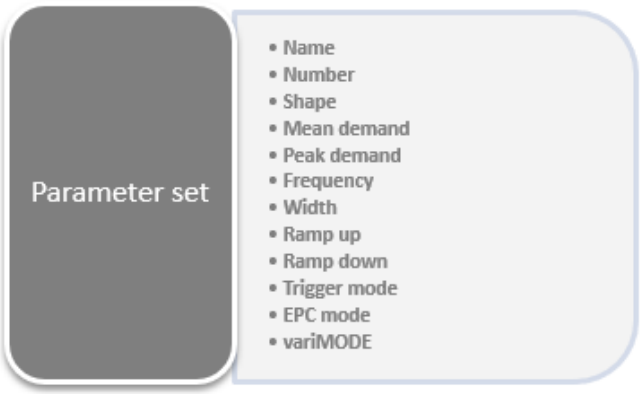


Figure 32 A Parameter Set and Associated Parameters

A parameter set can be configured while the laser is in the OFF state, STANBY state and in the ON state. The parameter set in use when the laser is in the ON state is the **active set**.

13.1.2 Set Active Parameter Set

Just one of the fifty parameter sets will be defined as the **active set**. The active set defines the parameters that the laser will use for the laser output.

Local control

When the laser is in local control, the active set can set manually using the parameter editor.

To change a parameter set to be the active set, click the “Make Active” button as shown in .

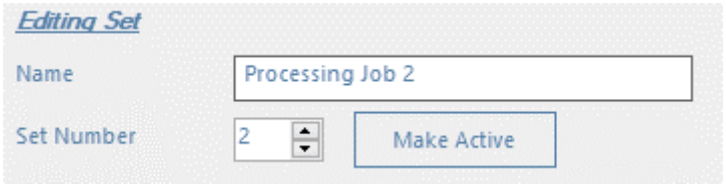


Figure 33 Make Active

Remote control

When using remote control, the active set can be set by using the machine interface (MCIF) inputs and using strobe.

Example

If the inputs of the machine interface (MCIF) are configured as follows, then the laser can be switched between parameter sets 1 to 7.

- MCIF Input 2 = Set Select 0
- MCIF Input 3 = Set Select 1
- MCIF Input 4 = Set Select 2
- MCIF Input 5 = Strobe

Set the value of the parameter set by using the Set Select inputs and then set the Strobe input from LOW to HIGH (see 14.4). It is the strobe that set the parameter set as active.

Table 6 Parameter Set Select Input Table

Parameter Set	Set Select 0 (MCIF Input 2)	Set Select 1 (MCIF Input 3)	Set Select 2 (MCIF Input 4)	Strobe (MCIF Input 5)
1	HIGH	LOW	LOW	LOW to HIGH
2	LOW	HIGH	LOW	LOW to HIGH
3	HIGH	HIGH	LOW	LOW to HIGH
4	LOW	LOW	HIGH	LOW to HIGH
5	HIGH	LOW	HIGH	LOW to HIGH
6	LOW	HIGH	HIGH	LOW to HIGH
7	HIGH	HIGH	HIGH	LOW to HIGH

13.1.3 Configure Parameter Set Parameters

To configure a Parameter Set, select the Parameter Editor Laser Tab or, on the Main Menu Bar, select ‘View’ ‘Windows’ ‘Parameter Set Programming’. The Parameter Editor appears as shown in Figure 34, although the Shape and parameters shown may be different.

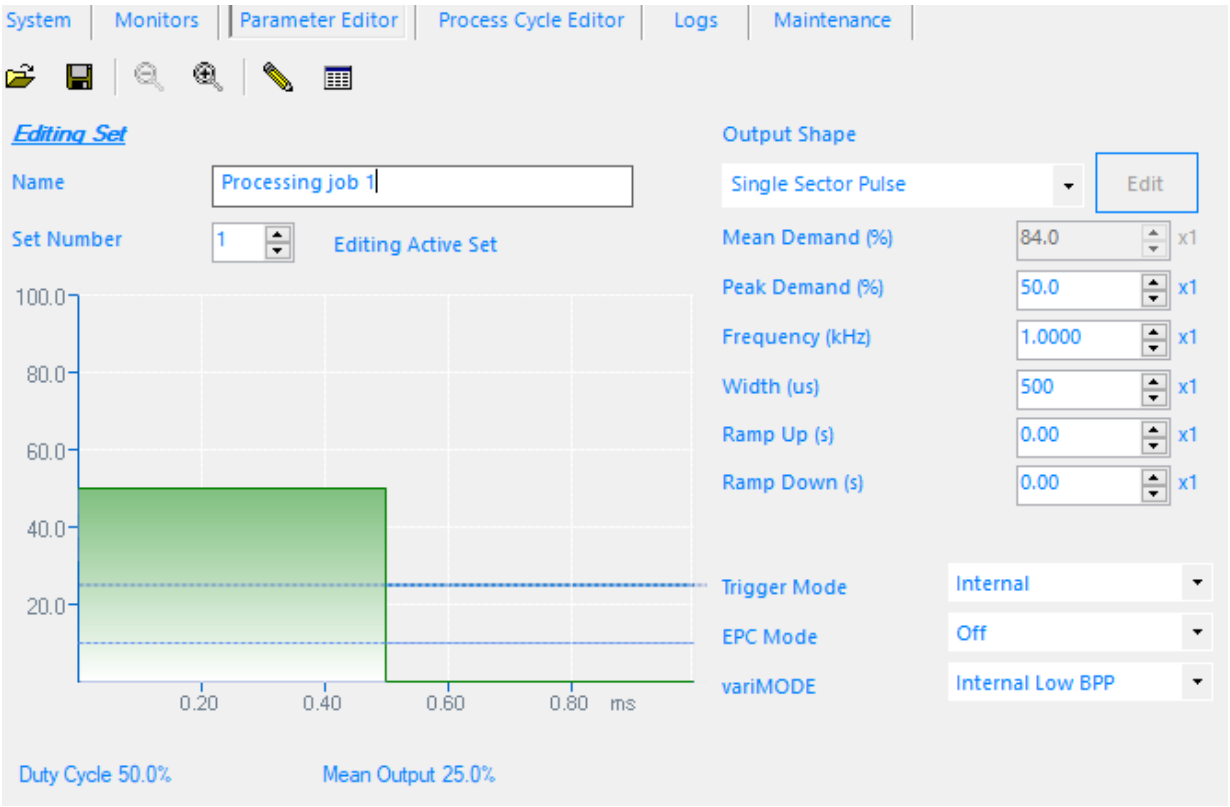


Figure 34 FiberView Parameter Editor

The Parameter Set to be edited can be selected from the ‘Set Number’ up-down control and its parameters can be modified using the drop-down lists and up-down control to the right. Use the up and down arrows by each parameter to adjust by amount shown as multiplier to right of box. Alternatively, type the desired value directly into the appropriate parameter box. To adjust the multiplier, right click on it and select the desired value from the popup menu.

Table 7 describes the parameters in a Parameter Set and the configuration options for each item.

To edit a parameter set value, type directly into the text box and when completed click the enter key or select another control in the Window for the changes to take effect.

When the user changes a parameter value in the parameter editor, the new value will be sent straight to the laser.

If the laser rejects the new value, the control will revert to its original value.

If a parameter is greyed out, then it is not valid for the selected output shape.

Table 7 Parameter Set Parameters

Parameter	Information
Name	A 16-character string giving the Parameter Set an identifying name.
Set Number	A number from 1 to 50
Shape	The Shape used in the Parameter Set. Refer to section 13.1.4 Shapes.
Mean Demand	The mean power of CW and Sine outputs.
Peak Demand	The peak power of Single Sector Pulse, Sine and User Defined Shape outputs.
Frequency	The frequency at which the Shape is repeated. The maximum frequency that can be set is 50kHz. Refer to the Instructions for Use of the Laser for the Laser's capability.
Width	The output pulse width for the Single Sector Pulse and User Defined Shapes, scaled in microseconds, with a maximum duration of 1s.
Ramp Up	The duration of RAMPING UP: the time to ramp up from the STANDBY to ON. The maximum duration is 10s. During RAMPING UP the output increases linearly from 0% to the Mean Demand power for a CW Shape or the Peak Demand power for other Shapes.
Ramp Down	The duration of RAMPING DOWN: the time to ramp down from the ON to STANDBY. The maximum duration is 10s. During RAMPING DOWN the output decreases linearly to 0%.
Trigger Mode	**Internal** The output is repeated at the rate given by the Frequency parameter. **External Gated** The output is triggered when the MCIF Trigger input is set. There is no output when the MCIF Trigger input is clear. If the Shape is not CW, the output is repeated at the rate given by the Frequency parameter. **External Edge** One Single Sector Pulse or User Defined Shape is output each time the MCIF Trigger input transitions from clear to set.

Parameter	Information
EPC Mode	By setting the shape to CW and using EPC (External Power Control) mode, the output of the Laser can be made to follow any arbitrary externally applied waveform. **Off** The power is determined by the Mean Demand for a CW Shape or the Peak Demand for other Shapes. **Relative** The voltage on the Analogue Input Demand lines, pins 11 and 24 on PL5, determines the mean power for a CW Shape or the peak power for other Shapes. The upper limit is determined by the Mean Demand for a CW Shape or the Peak Demand for other Shapes. With a sine shape the voltage on the Analogue Input Demand lines also controls the mean power relative to the Mean Demand. **Absolute** The voltage on the Analogue Input Demand lines, pins 11 and 24 on PL5, determines the mean power for a CW Shape or the peak power for other Shapes. The upper limit is 102% to 110% of rated power, depending on the Laser type.
variMODE	variMODE allows the User to select Low or High BPP mode. These two modes (and their associated BPP levels) are optimised for processing performance across a range of applications using with a Ø100µm delivery fiber. The modes can be configured to be selected externally through the MCIF or internally using a parameter set. **External** variMODE is controlled using the MCIF Inputs. **Internal LOW BPP** With a BPP of 3.3 ± 0.3mm.mrad this profile concentrates the beam energy to the centre of the mode and is optimised for high speed, high quality piercing in thick sheets whilst giving fastest cut speeds for thin metal sheets of stainless steel, aluminium and copper. **Internal HIGH BPP** With a BPP of 5.5 ± 0.3mm.mrad this profile concentrates the beam energy around the edge of the mode and is optimised for cutting through thick metal sheets at high speed, producing an excellent surface finish on mild steel.

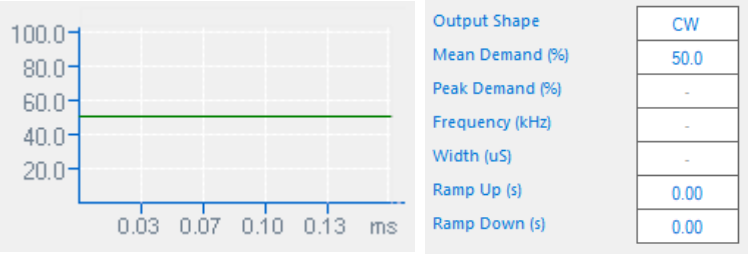
For a CW output, 100% demand is calibrated to deliver the rated power of the Laser. The upper limit of demand is 102% to 110% of rated power, depending on the Laser type. This extra headroom can be used to fine tune the process or compensate for small variations over time in the processing conditions.

Parameters are automatically stored on the laser. A parameter set can be stored/saved locally on the PC.

Use the Open or Save buttons to Open or Save a parameter set to a file on the PC. The file can be used to save a parameter set on a different laser.

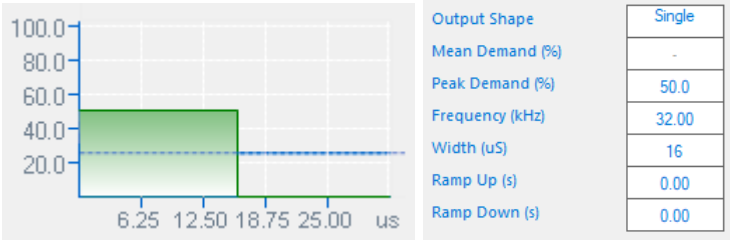
13.1.4 Shapes

CW



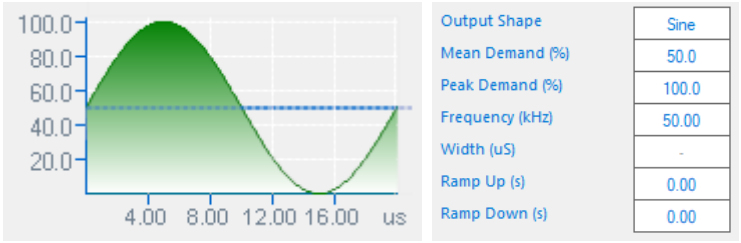
The CW Shape is used to generate a constant output power.

Single Sector Pulse



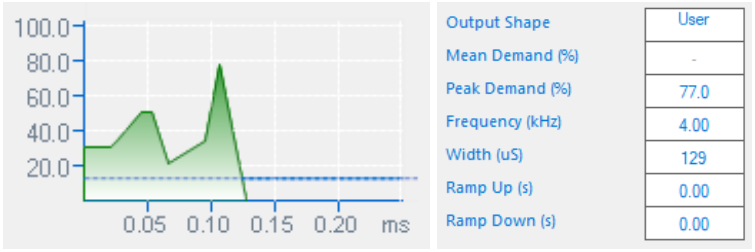
The Single Sector Pulse Shape is used to generate a simple square wave output.

Sine



The Sine Shape is used to generate a sinusoidal output.

User Defined Shape



Any arbitrary Shape can be defined using FiberView

There is one shape that is associated with a parameter set. The shape determines the output of the laser as each shape has a different set of parameters that can be configured.

CW	Mean Demand, Ramp Up, Ramp Down.
Single Sector Pulse	Peak Demand, Frequency, Width, Ramp Up, Ramp Down.
Sine	Mean Demand, Peak Demand, Frequency, Ramp Up, Ramp Down.
User Defined Shape	Peak Demand, Frequency, Width, Ramp Up, Ramp Down.

13.1.5 User Defined Shapes

Any arbitrary Shape can be defined using the Shape Editor then saved to the FVCU or the PC or network.

Users can define multi-sector Shapes using Shape Editor – a simple graphical interface within FiberView. Each Shape is formed from sectors, which can be added as points, pulses, ramps or levels. Once added, the sectors can be adjusted by drag and drop. 1000 sectors are available: they can be divided between up to 50 user defined shapes. Any arbitrary Shape can be defined then saved either to the FVCU or to the PC or network. There is no power or time duration associated with a Shape: this is added when the Shape is used in a Parameter Set. A Shape can be used in any Parameter Set, where it is scaled to the peak power and pulse width associated with that Parameter Set. Once a parameter set is defined it can be used to produce a laser output – CW, or modulated with a sine, or square or arbitrary profile.

The Shape Editor window, shown in , is opened from the Parameter Editor tab by selecting the ‘Pencil’ icon or, for a User defined shape, clicking [Edit]. Clicking on the arrow of the Insert button or right clicking in the graphic area allows the Shape to be started or extended with a point, pulse, ramp or level. Any node on the Shape can be selected and dragged to a new position to alter the Shape.

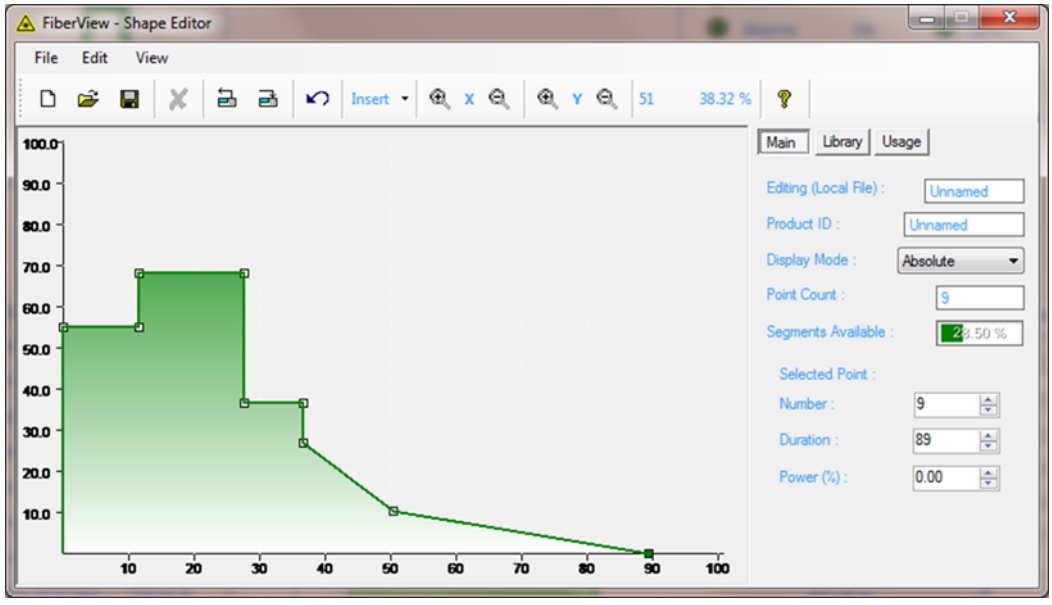


Figure 35 Shape Editor Window

When the shape is completed, click on the ‘Save to Laser Storage’ icon and assign a User Defined number or save to local storage by clicking the floppy disk icon. The Shape can later be recalled from ether location and used in any Parameter Set.

The ‘Library’ and ‘Usage’ tabs can be used to see which pulse shapes are currently in use by the Laser

13.1.6 Process Cycles and Steps

Process Cycles are an automation feature provided by the FVCU. They allow a programmed sequence of Parameter Sets to be output using minimal input to control the entire sequence.

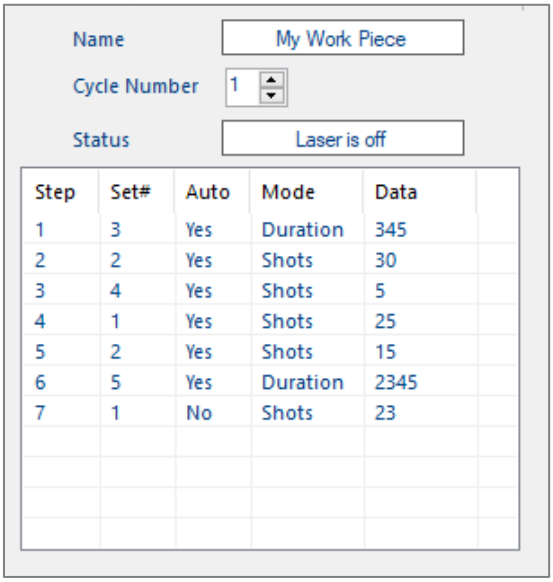
For example, a single Process Cycle could be used when a part has to be made with different types of spot and seam welds at different locations.

Process Cycles are constructed from one or more elements known as Steps. Each Step holds a Parameter Set reference and Control Attributes. The Control Attributes of the Steps can be set so that the Process Cycle executes fully automatically from start to finish or set to require an external input or command to execute the next Step, or to any combination of the two.

Process Cycle Steps determine the sequence of Parameter Sets that are executed, along with their timing and transition type. All the other information required to specify the output is determined by the Parameter Set.

An example Process Cycle and its steps – each with its Parameter Set and Control Attributes – is shown in Figure 36.

Within the Process Cycle, Parameter Sets may be different or may be reused with the same or different Control Attributes, and similarly the Shapes may be different or may be reused in different Parameter Sets.



Step	Set#	Auto	Mode	Data
1	3	Yes	Duration	345
2	2	Yes	Shots	30
3	4	Yes	Shots	5
4	1	Yes	Shots	25
5	2	Yes	Shots	15
6	5	Yes	Duration	2345
7	1	No	Shots	23

Figure 36 A Process Cycle Built from Steps and Parameter sets

The laser has the capacity to store up to 1000 Steps which can be grouped into up to 50 Process Cycles. In this way, for example, a single Process Cycle of 1000 Steps or 50 Process Cycles of 20 Steps can be set up. Any number of Steps can be linked to create a range of Process Cycles, provided that there are no more than 50 Process Cycles and no more than a combined total of 1000 Steps.

A 16-character name is stored with each active Process Cycle to allow it to be identified. For example, the name of the Process Cycle could be the name of the article the Process Cycle has been developed for.

13.1.7 Configure Process Cycle

To configure a Process Cycle, click the Process Cycle Editor Laser Tab or select ‘View’ ‘Windows’ ‘Process Cycle Editor’ from the Menu Bar.

The Process Cycle Editor appears as shown in Figure 37, although the information shown may be different.

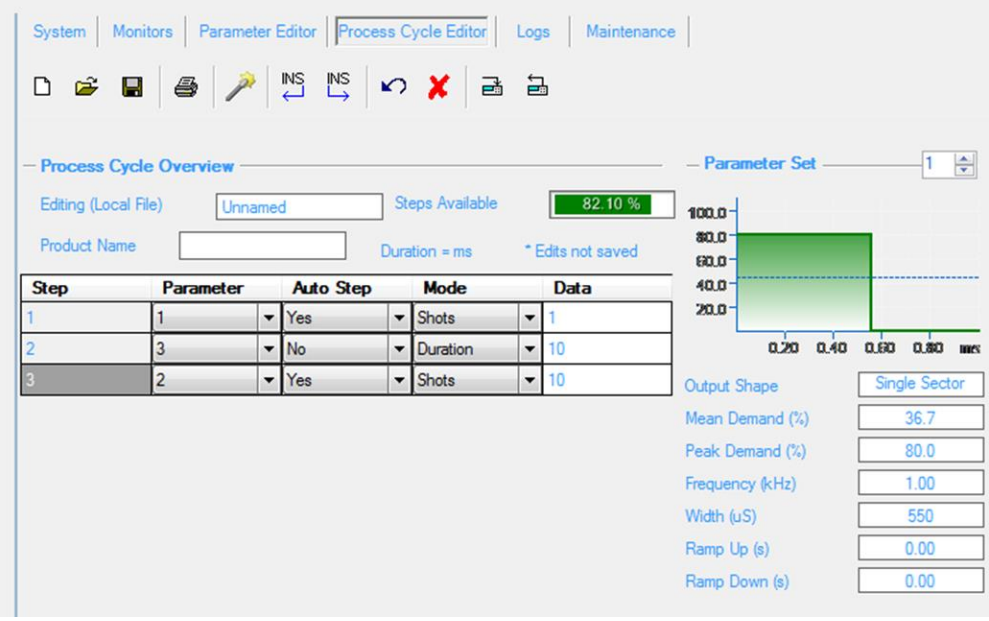


Figure 37 FiberView Process Cycle Editor

The Process Cycle Steps contain the attributes listed in Table 8.

The steps available value on the process cycle editor shows the percentage of steps left over that can still be used with in a process cycle.

The right-hand side of the process cycle editor is a quick reference guide to how each parameter set is configured. Before configuring a process cycle step to a particular parameter set, the parameter set can be checked here to make sure it is going to meet the requirements.

To insert a step, use the INS INS buttons to insert a step before or after the current step.

To delete a step, select the step use the button.

To save the process cycle to the laser use the button and select a process cycle number when prompted.

To read the process cycle from the laser use the button and select the process cycle number when prompted.

Table 8 Process Cycle Step Attributes

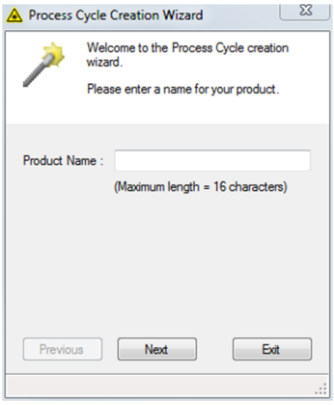
Field	Information
Step	The number of the Step in the Process cycle.
Parameter Set	A reference to the number of the Parameter Set used in the Step.
Auto Step	No Execution of the Process Cycle halts after completion of the current Step. An external Step command is required to resume execution. Yes Execution of the Process Cycle advances to the next Step automatically after completion of the current Step.
Mode	Shots The Step is completed after a fixed number of repetitions of the Parameter Set. The number of repetitions is set in the Data field. Duration The Step is completed after a fixed time. The time is set in the Data field.
Data	Shots Mode The number of repetitions of the Parameter Set, from 0 to 10000. Setting a value of 0 causes the Parameter Set to repeat continuously. An external Step command is required to move to the next Step irrespective of whether the Auto Step field is set to No or Yes. Duration Mode The time period in milliseconds, from 0 to 10000. Setting a value of 0 causes the Parameter Set to repeat continuously. An external Step command is required to move to the next Step irrespective of whether the Auto Step field is set to No or Yes.

13.1.8 Process Cycle Wizard

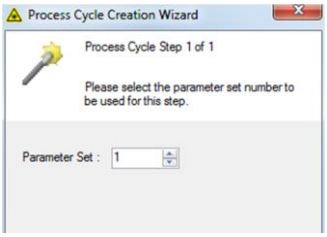
Another way to create a Process Cycle is to use the Process Cycle Creation Wizard.

1 Click the magic wand icon to launch the Process Cycle Creation Wizard.

2 Enter a name for the new process cycle.



3 Select the number of the first Parameter Set to be used in the Process Cycle.



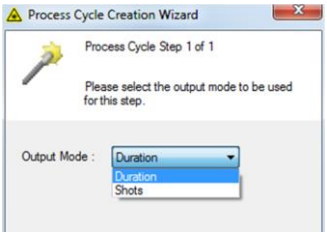
4 Select how the Step is completed.

Duration

The Step is completed after a fixed time.

Shots

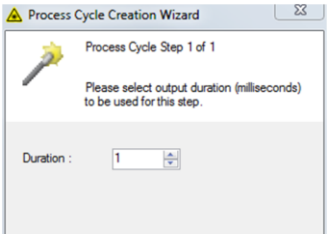
The Step is completed after a fixed number of repetitions of the Parameter Set.



5a Select when the Step is completed.

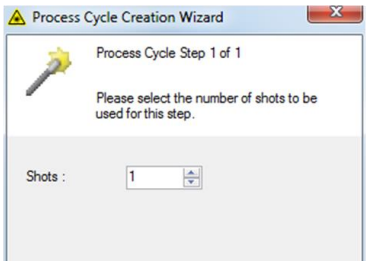
Duration

Enter the duration of the step-in milliseconds.



5b Shots.

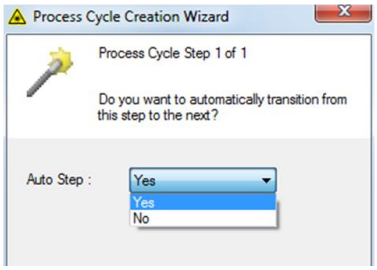
Enter the number of shots.



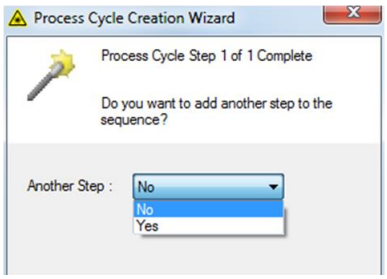
6 Select whether the transition to the next step should be automatic.

Yes - Execution of the Process Cycle advances to the next Step automatically after completion of the current Step.

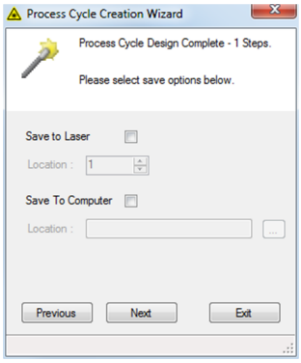
No - Execution of the Process Cycle halts after completion of the current Step. An external Step command is required to resume execution.



7 Select whether to add another Step.



8 Save the Process Cycle to the Laser, computer or both.



Alternatively, Process Cycles can be created and edited directly in the Process Cycle Editor Laser Tab.

13.2 variMODE

variMODE is an optional feature on SPI Fiber Lasers that allows the user to change the beam profile of their laser and select the best Beam Quality (BPP) value for each individual process.

The beam spatial profile energy distribution changes with the Beam Quality, with more energy being distributed to edge of beam for the higher BPP values.

variMODE is available for PRISM Racks and QUBE Cabinets.

SPI Lasers' variMODE allows the User to select in real time either Beam Profile. These two modes (and their associated BPP levels) are optimised for processing performance across a range of applications using a Ø100µm delivery fiber.

13.2.1 variMODE Configuration

There are two beam profiles that can be configured on the laser using FiberView.

variMODE

Low BPP and **High BPP**

The control of variMODE is very flexible and can be controlled in various ways. The key to setting variMODE control starts with the parameter set.

Each parameter set has 3 options for variMODE. These can be configured using the parameter editor refer to Figure 38. Select the required option from the drop-down list.

1. External

With **External** configured within a parameter set, the laser will use the MCIF Input for the BPP profile selection.

If external has been set then Configure a MCIF Input as variMODE and then set the input logic as follows…

MCIF Input Logic High, variMODE is set to HIGH BPP.

MCIF Input Logic Low, variMODE is set to LOW BPP.

If External is selected but there is no MCIF Input configured for variMODE, then variMODE is set to low BPP.

Refer to 14.5 PL5 Connection Configurations for MCIF voltage requirements.

2. Internal Low BPP

With **Internal LOW BPP** configured, the laser will use the parameter set configuration ignoring the MCIF and set variMODE to LOW BPP.

Internal LOW BPP is the default configuration within the parameter set for variMODE.

3. Internal High BPP

With **Internal HIGH BPP** configured, the laser will use the parameter set configuration ignoring the MCIF and set variMODE to HIGH BPP.

Refer to Table 9 variMODE Configuration and Resulting BPP Profile.

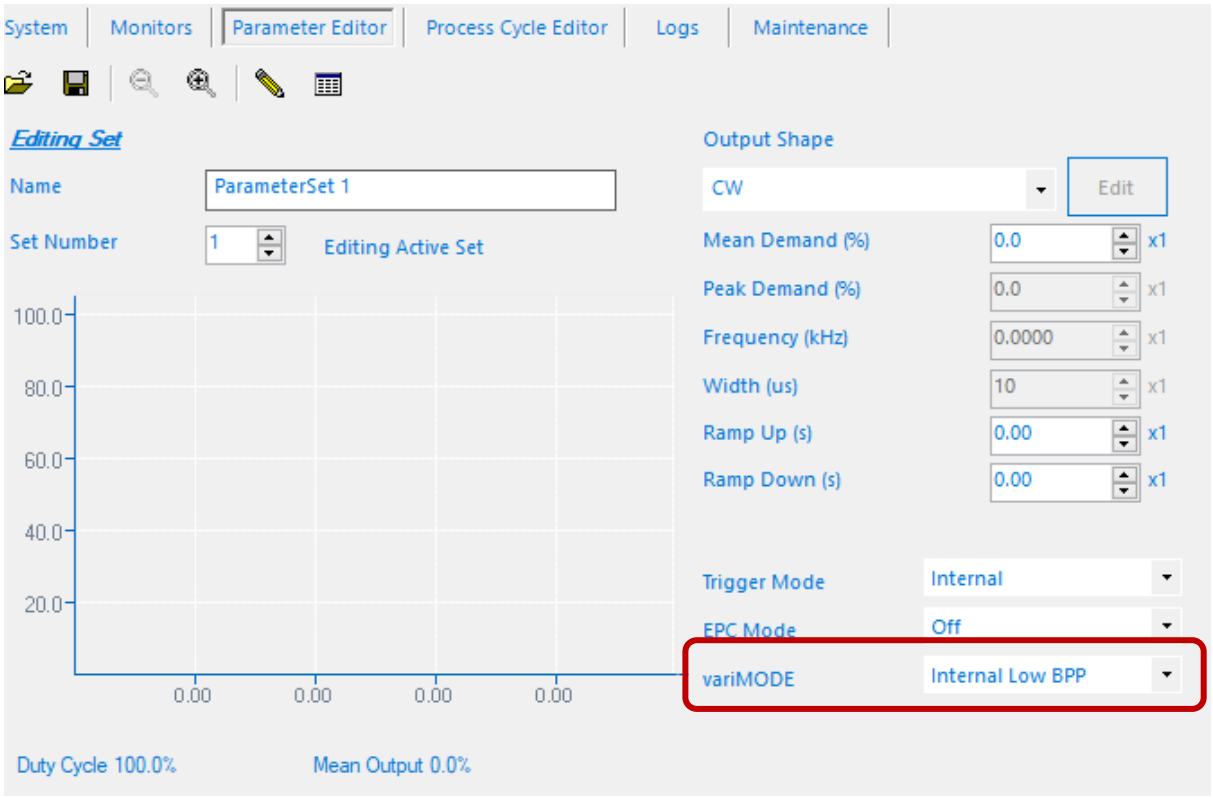


Figure 38 variMODE Configuration using FiberView

Active Parameter Set			MCIF Input		RESULT	
External	Internal Low BPP	Internal High BPP	Low BPP	High BPP	BPP PROFILE	CONTROL
	TRUE				LOW	USES PARAMETER SET
		TRUE			HIGH	USES PARAMETER SET
TRUE					LOW	NONE - NO MCIF INPUT
	TRUE		TRUE		LOW	USES PARAMETER SET
		TRUE	TRUE		HIGH	USES PARAMETER SET
TRUE			TRUE		LOW	USES MCIF
	TRUE			TRUE	LOW	USES PARAMETER SET
		TRUE		TRUE	HIGH	USES PARAMETER SET
TRUE				TRUE	HIGH	USES MCIF

Table 9 variMODE Configuration and Resulting BPP Profile

13.2.2 variMODE Switching Behaviour

There is a 40ms delay in the laser power demand that the laser will introduce when transitioning between variMODE low and high states.

If the laser is OFF when switching the BPP Profile, there will be no delay in the laser power demand when setting the laser to ON as the delay will be masked by the laser to standby delay which is greater than 40ms.

If the laser is in STANDBY when switching the BPP Profile 40ms or more before the laser is set to ON then there will be no delay in the laser power demand.

If the laser is in STANDBY when switching the BPP Profile less than 40ms before the laser is set to ON then there will be a delay in the laser power demand.

Figure 39 shows various scenarios that can occur while switching the BPP profile.

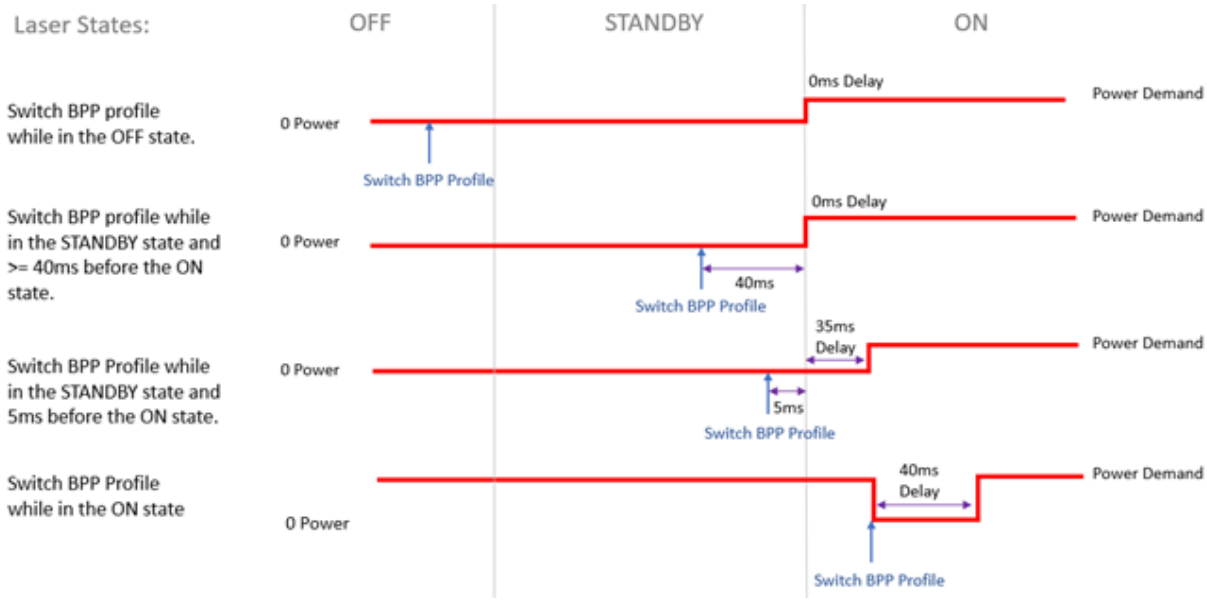


Figure 39 Switching from Low BPP to High BPP

13.3 Pierce Detect

13.3.1 Pierce Detect Overview

Pierce Detect uses power reflected from the work piece back into the Laser to determine when the work piece has been pierced. The Laser sets an output on the MCIF when pierce is detected. As different work pieces reflect power in different ways, depending on the material and the process, FiberView offers Users adjustments to the threshold and sample time to ensure reliable detection of the pierce.

When the Laser enters ON from STANDBY and the reflected power, averaged over the sample time, has exceeded a threshold Pierce Detect will be armed. Once armed, the Pierce Detect MCIF output will be set when the reflected power averaged over the sample time falls below the Pierce Detect threshold. The Pierce Detect MCIF output is cleared when the Laser enters STANDBY.

The Pierce Detect MCIF output will also be set after a configurable timeout period. This is in case the reflected power is insufficient to arm the function or does not fall below the threshold in an expected amount of time. The timeout will commence following ON being entered at the beginning of the process or after the MCIF Trigger input is set.

When the Laser output is modulated during the pierce process, the sample time must be sufficiently long to keep the average above the Pierce Detect threshold.

13.3.2 Pierce Detect Parameters

The parameters which the User can adjust are given in Table 10.

Table 10 Pierce Detect Parameters

Field	Function
Pierce Detect Threshold	Percentage of the dynamic range of the reflected power sensor where pierce threshold is set.
Sample Time	Time period in milliseconds over which the back reflection is averaged before being compared to the Pierce Detect threshold. This time is used to arm, and trigger Pierce Detect.
Timeout Period	Time period in milliseconds after which the Pierce Detect MCIF output will be set if a pierce has not been detected.

The parameters can be adjusted in FiberView by selecting ‘Tools’ ‘Process Monitoring’ ‘Pierce Detect’. A window opens with up-down controls for the parameters. The adjacent text boxes show the current parameters saved to the Laser. Adjust the parameters and then click [Set] to save them to the Laser. Note that a lower threshold gives greater sensitivity.

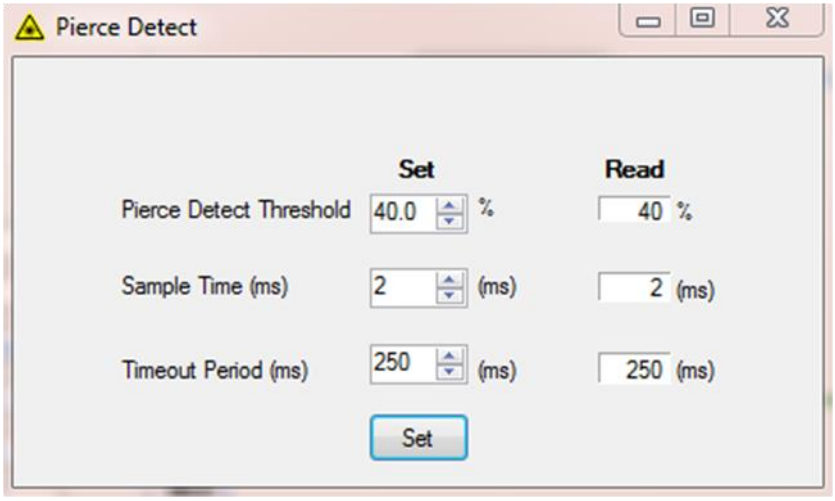


Figure 40 Pierce Detect Window

Figure 41 shows the relationship between the Pierce Detect parameters, the reflected power and other Laser parameters.

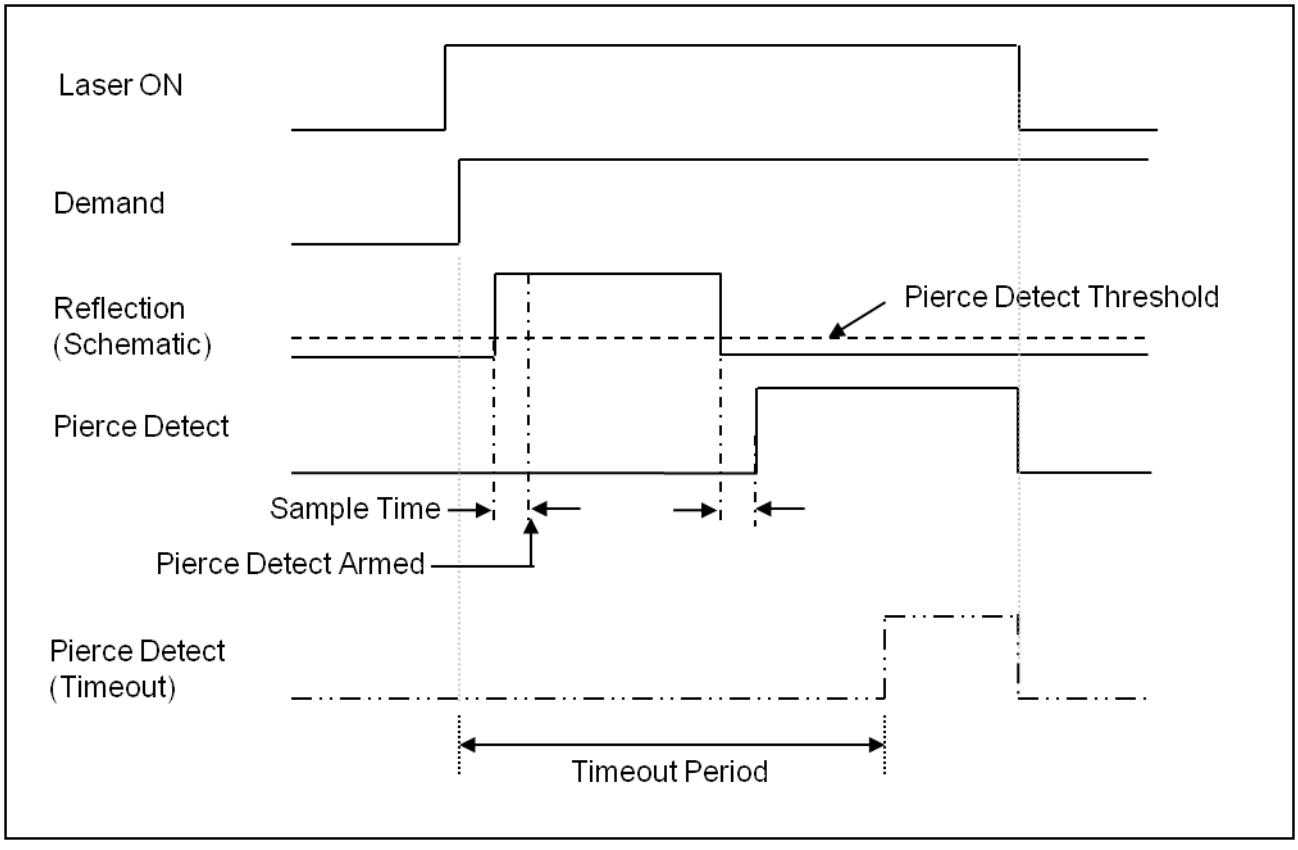


Figure 41 Pierce Detect Timing Diagram

Figure 42 shows an example of the operation of Pierce Detect. The reflection signal (black) is high during piercing but falls below the threshold (red dash) when the work piece is pierced. The Pierce Detect output (red) is set a sample time (green bar) after the reflection signal falls below the threshold.

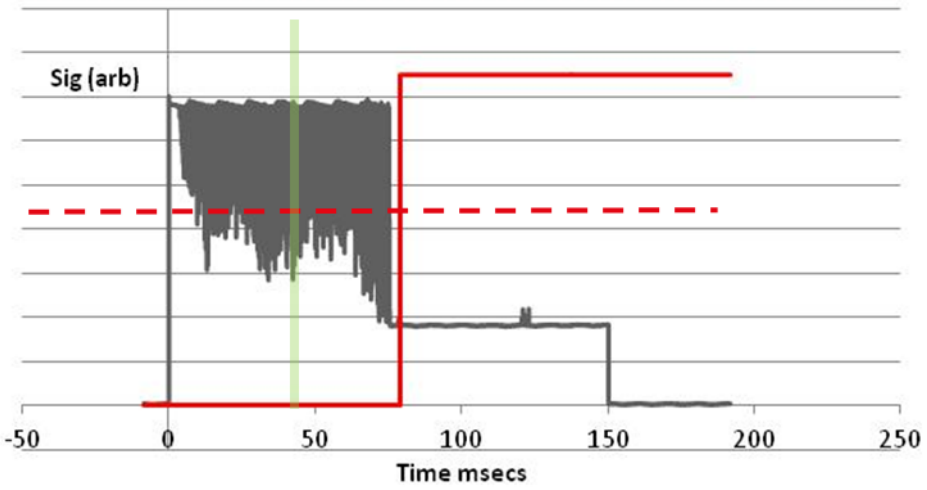


Figure 42 Pierce Detect (CW) Showing Typical Back Reflection Signal (Black), Threshold (Red Dash), Sample Time (Green) and Pierce Detect Output (Red)

Figure 43 shows an example of the operation of Pierce Detect with modulated power. Note that the sample time must be sufficiently long to keep the average above the pierce threshold.

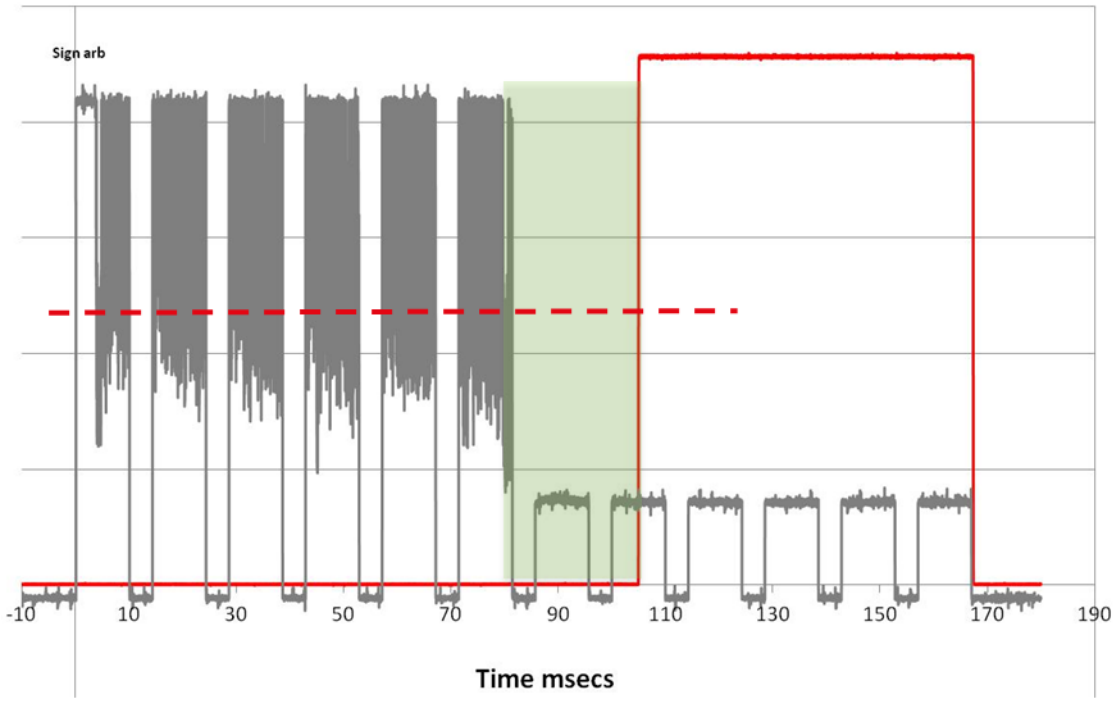


Figure 43 Pierce Detect (Modulated) Showing Typical Back Reflection Signal (Black), Sample Time (Green) and Pierce Detect Output (Red)

The Pierce Detect output flag can assigned to any output line of the MCIF using FiberView, as described in Section 13.5. Figure 44 shows Pierce Detect assigned to OUT0.

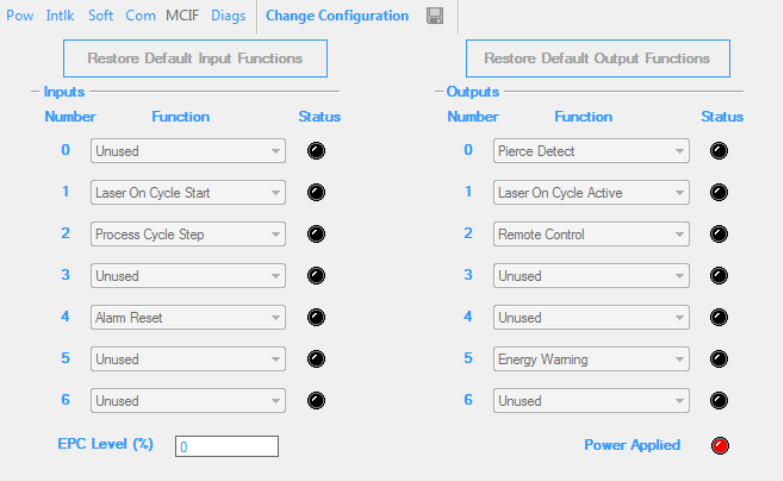


Figure 44 Assignment of Pierce Detect on MCIF

13.4 Alignment Laser

The alignment laser assists in aligning the process tool to the correct position on the work piece. Red light from a low power laser diode is transmitted to the work piece using the same delivery fiber as the Laser output.

The alignment laser can be activated at any time by clicking the diode icon on the Tool Bar. The icon changes as shown below to indicate whether the alignment laser is off or on.

Off On

The state of the Laser is considered when activating the alignment laser, as follows:

Laser OFF:

- Clicking the diode icon will start the emission indicator flashing (similarly to the Laser STANDBY command). The alignment laser will turn on after the emission delay time and the emission indicator will be on.
- Turning the alignment laser off will turn off the emission indicator.

Laser STANDBY:

- Clicking the diode icon will turn the alignment laser on immediately.
- Turning the alignment laser off will not turn the emission indicator off.

Laser ON:

- The Laser will be emitting, so when the alignment laser is activated the laser will turn the alignment laser on immediately.
- If the alignment laser is on and the laser is turned OFF the emission indicator will remain on.

If the alignment laser is left on, by default it will automatically switch off after 30 minutes. This timeout can be disabled. Refer to

The MCIF can be configured to control the alignment laser. Refer to 14 Machine Control Interface and Functions for more information.

13.4.1 Alignment Laser brightness adjustment

Warning

By adjusting the brightness of the alignment laser, the Class 2 classification could be changed to Class 3. The user is responsible for using an appropriate power meter to safely monitor the brightness during the adjustment routine.

The brightness will get updated in incremental steps to avoid over brightening.

The laser module will not return a value that would represent the actual brightness and so FiberView has no way of knowing how dim or bright the alignment laser is before, during or after adjustment.

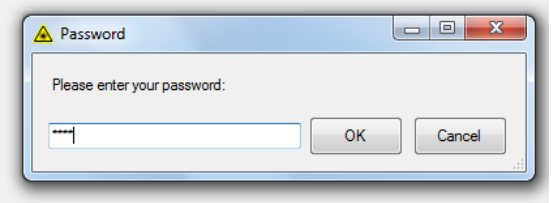
There is no value or graph or other representation to show actual brightness level.
The user interface will not know what the starting level is for the brightness (i.e. it could be already 1 step from its max).

To adjust the alignment laser brightness for FiberView go to the Laser Settings window.

- Configuration->Laser...->***Alignment laser***

13.4.2 Alignment laser password

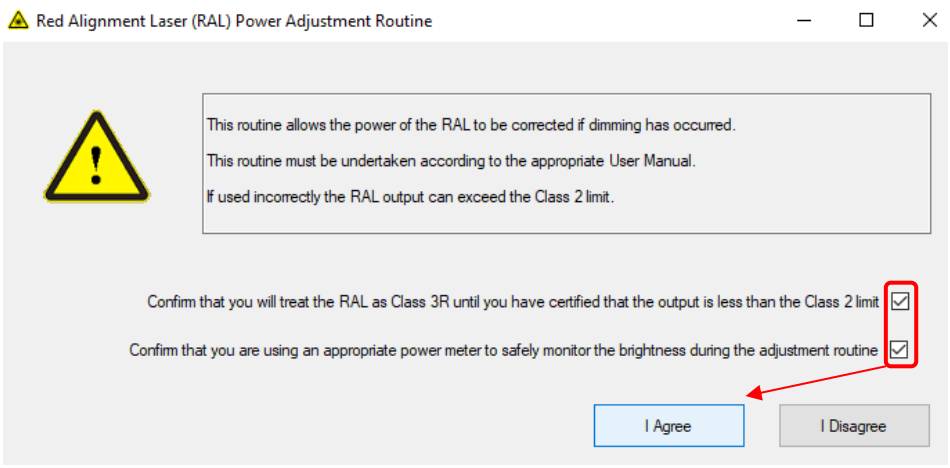
Enter a SPI Customer supervisor level password or greater when prompted.



13.4.3 Alignment laser agreement

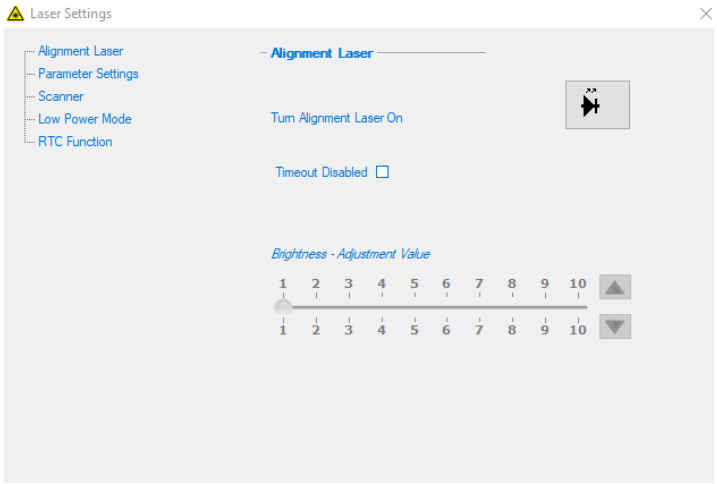
Before proceeding the user must agree to treat the RAL as class 3R until it has been certified that the output is less than the class 2 limit. The user must also agree that an appropriate power meter has been used to measure the output power.

The user must tick both boxes for the “I agree” button to be enabled and to be able to continue and adjust the alignment laser.



13.4.4 Alignment laser form

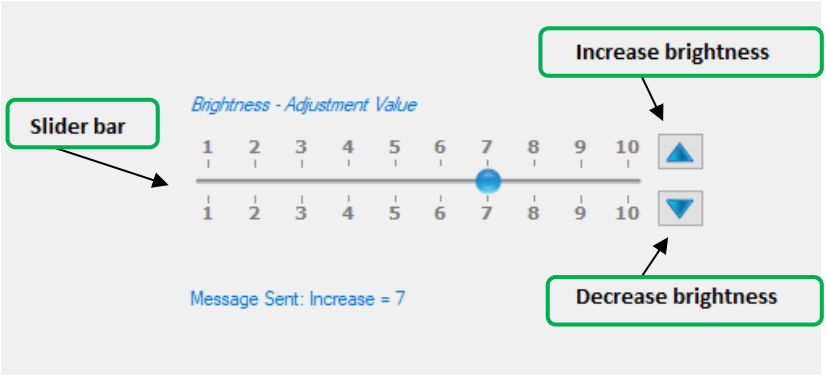
Once the correct password has been entered, the alignment laser form will be shown.



13.4.5 Alignment laser brightness controls

There are 3 controls.

1. A slider bar to select a value between 1 and 10
2. A button with a up arrow on it to increase the brightness
3. A button with a down arrow to decrease the brightness



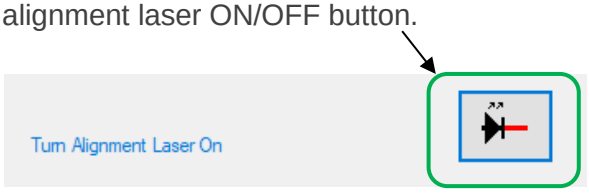
Use the slider bar to select the amount of adjustment required.

Then click either the up or down arrow to send the adjustment command to the laser module.

There will be no response from the laser module directly so all that FiberView can do is confirm that the command has been sent.

13.4.6 Alignment Laser Enable Control

The alignment laser needs to be ON for the alignment controls to be enabled. To switch on the alignment laser, use the alignment laser ON/OFF button.



13.4.7 Alignment Laser with Multiple laser modules

FiberView will have only 1 set of new interface controls, as only one laser module can be used for the alignment laser.

13.4.8 Alignment Laser Timeout Delay Disable

This timeout can be disabled in the Laser Settings window. Tick the Timeout Disabled box to disable the timeout delay.

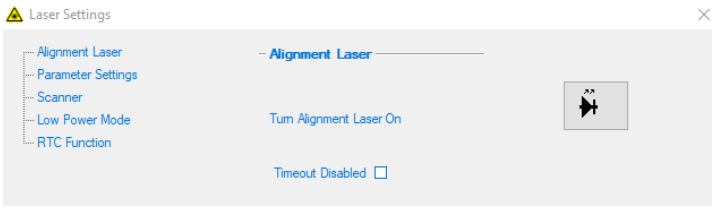


Figure 45 Alignment Laser Timeout Delay Enable/Disable

Note: that running the alignment laser continuously will reduce its life. A SPI Customer supervisor level password or greater is required to disable the timeout for the alignment laser.

13.5 Configuring the Machine Control Interface

The Machine Control Interface (MCIF) connection is made through connector PL5, a 25-way male D-Type connector on the Laser. It has seven inputs and seven outputs. Each input and output can be configured to perform a specific function selected from the list of functions described in Section 14. The configuration of the inputs and outputs can be seen by selecting either the Maintenance Tab from the Laser Tabs and then MCIF from its Tool Bar, or from the Menu bar: ‘View’ ‘Windows’ ‘Maintenance’ ‘Machine Interface’.

The default configuration should be suitable for most applications, but the ability to reconfigure allows Laser Integrators to tailor the interface to their application. To alter the configuration, click on Change Configuration. The function for each input and each output can be selected from the adjacent drop-down list. To write the new configuration to the Laser, click on the save icon.

Input 6 is designed for the Trigger Input, with higher speed hardware than the other inputs, and should be used for it, if it is required.

13.6 Alarms and Warnings

If there is an error condition that triggers an alarm or warning, the corresponding indicator in the Status Indicators Area of the FiberView window will turn red. A list of the alarm and warning messages and codes is given in Section 14.13.

To find more information on which alarm or warning has been activated, hover the mouse over the red indicator and a pop-up box will show which has been activated.

Alarms and warning are logged by FiberView and stored on the local PC. FiberView will create separate logs for each Laser, identified by serial number, it is connected to. To view the logs, click Logs on the Laser Tabs or ‘View’ ‘Windows’ ‘Logs’ on the Menu Bar, and then click ‘Alm’ or ‘Warn’ on the Logs window Tool Bar.

After the fault has been put right, click the Reset button on the main Tool Bar to reset the indicator status and allow the Laser to be restarted.

13.7 Interlock Reset

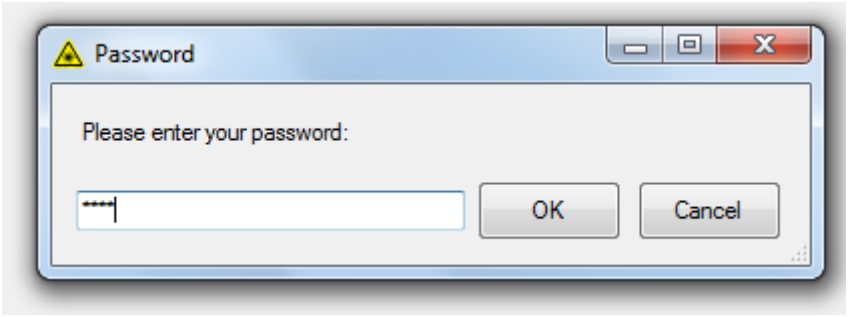
On the 100W – 200W Air cooled Qube lasers there is an Interlock reset button. Refer to Figure 46

Figure 46 Interlock reset button

The button is password protected to make sure that interlocks are managed correctly. To clear any interlocks, click the reset button and then enter the password. Refer to section 13.7.1

13.7.1 Interlock Reset button password

Enter a SPI Customer supervisor level password or greater when prompted. Contact SPI product Support (17 Contact Information) for the password.



13.8 Safe Mode Recovery

If an optical fault is detected, the Laser enters Safe Mode. In this mode, the Laser is limited to a pre-configured Parameter Set that will output a low energy, low frequency pulse. This allows checks to be made by the laser without making any damage worse.

Optical fault detection needs to be sensitive enough to react quickly so that damage is minimised. However, sensitive detection increases the risk of false detection.

The safe mode recovery routine will get the Laser out of safe mode and enable all the PRISM Modules if it is safe to do so.

13.8.1 Run Safe Mode Recovery Routine

To run the safe mode recovery routine the laser needs to be in the standby state.

1. Clear any alarms or interlocks.
2. Put the laser into standby.
3. Select Safe Mode Recovery from the Tools menu.
4. Click Recover.

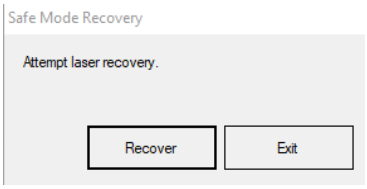


Figure 47 Safe Mode Recovery

The laser will now check each laser module in turn to see if they are functional to use. Any module found faulty will be left in the disabled state. If one or more laser modules is enabled, then the laser can continue to run but will have lost maximum output power potential.

13.9 Primary/Secondary/Locked Connections

With the possibility of a serial and multiple Ethernet connections being made to a single Laser, The laser has a feature to enable FiberView to select a primary connection so that only one connection can control the Laser at a time. The Laser can be locked using the primary connection so that no other connection can take control without the Laser first being unlocked using the primary connection. The Laser can still be monitored using all other connections, and they can be disconnected without interrupting the Laser.

The primary connection gives security when a connection has been established, but also the Laser does not become locked out if it fails.

13.9.1 Primary/Secondary

If a connection is the primary connection, the icon shown in Figure 48 appears in the Tool Bar and in the System tab of the System and Mode Area, otherwise the icon shown in Figure 49 appears. In both cases the address of the primary connection (where known) is shown in the System tab of the System and Mode Area to aid in finding its location.

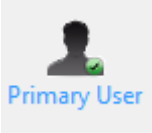


Figure 48 Primary Connection Icon

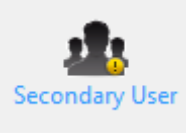


Figure 49 Secondary Connection Icon

The primary connection can be requested if the laser is not locked, by clicking the “Secondary user” button as shown in Figure 49 on FiberView. When the primary connection has been granted by the laser the button will change from Secondary (Figure 49) to Primary (Figure 48)

13.9.2 Laser Lock

If the Laser has been locked using the primary connection, then the closed padlock icon shown in Figure 51 is shown in the Tool Bar of both primary and secondary connections. If the connection has not been locked, the icon shown in Figure 51 is shown.

Figure 50 Connection Locked Icon

Figure 51 Connection Unlocked Icon

13.9.3 Operation

There is no primary connection when the laser is first powered up, so any connection can become the primary connection. This happens in 2 ways:

1. Request primary control

   Clicking on the ‘Primary User’ icon on the Tool Bar will request primary connection status for the connection being used. This does not lock the connection, so if a request is sent by another connection, the primary status will be passed on.

2. Use one of these commands

   - OFF
   - STANDBY
   - ON

   Using one of these commands will request primary status for the connection being used. It will also automatically lock the connection, as it is assumed that it is the controlling connection. All other connections can be used, but these commands can only be issued by the primary connection.

If the primary connection is locked, the lock can only be cleared using the primary connection to allow other connections to take the primary status.

The primary connection cannot be changed if the laser is not OFF.

13.9.4 Prevention of Lockout

The primary connection and locking feature have been designed so that the Laser cannot be locked by a failed connection.

If the Laser is OFF and the primary connection has locked the Laser and subsequently it fails, the lock will release after 5 seconds to allow another connection to request primary status.

If the Laser is not OFF the behaviour depends on whether the communications watchdog is enabled for the primary connection.

The status of the watchdog can be checked and set by selecting ‘Communications’ ‘Laser Connection…’ from the Menu Bar. Note that each connection has its own watchdog.

If the watchdog is enabled, and the primary connection has locked the Laser and subsequently it fails, the lock will release after a timeout period. The Laser will shut down with an alarm. Another connection can then request primary status.

If the watchdog is disabled and the primary connection has locked the Laser, and subsequently it fails, the lock and primary status will release after 5 seconds. The Laser will not shut down with an alarm because of the disabled watchdog, but the lack of a primary connection will allow another connection to stop the Laser. The new connection will become the primary connection and lock the Laser.

14 Machine Control Interface and Functions

14.1 Overview

The Machine Control Interface (MCIF) allows **redPower** Fiber Lasers to work with Laser Integrators PLCs. The seven digital inputs and seven digital outputs are PLC compatible and can be software configured using FiberView to perform specific functions selected from a list of available functions. There is also one analogue input and one analogue output. The default configuration should be suitable for most applications, but the flexibility allows Laser Integrators to tailor the MCIF to their application.

The MCIF connection is made through PL5, a 25-way male D-Type connector on the Laser. To prevent operational problems caused by ground loops, the MCIF I/O hardware is opto-isolated and requires an external 24V supply, connected as described in Section 14.2 in order for the outputs to function. The configured outputs are available whether or not the inputs are being used to control the laser.

Please read all of this section before using the MCIF to be familiar with all its operation.

14.2 MCIF Supply

Table 11 MCIF Supply

Parameter	Min	Typ	Max	Units	Notes
Voltage Range	15	24	30	V DC	-
Input Current			400	mA	-

An appropriately certified[2] DC power supply with the capabilities given in Table 11 and which is adequately protected is required to power the MCIF. Power is provided by connecting the external supply between PEXT and GNDEXT on the pins on PL5 shown in. Two PEXT and three GNDEXT connections are provided for convenience. Each group is linked internally, and normally only one of each group needs to be connected to the external supply.

[2] Preferably, the power supply should be certified against at least the requirements of IEC 60950 2nd edition amendment A1 by a Nationally Recognized Testing Laboratory

14.3 PL5 Pinout and Default MCIF Configuration

Table 12 below shows the pinout of PL5. The functions of inputs IN0 to IN6 and outputs OUT0 to OUT6 can be reconfigured using FiberView. The default configuration is shown in Table 12.

The function of IN6 (pin 16) can be reprogrammed as can the other Inputs. However, if a **Trigger Input** is required it is recommended to use IN6, as the hardware behind this connection is optimised to operate up to 50kHz. At this maximum frequency it will accommodate up to a 50% duty cycle comfortably. However, if one of the other inputs (IN0 to IN5) is used, the frequency will be limited to around 5kHz.

Do not assign **Laser ON** to IN6 as the high-speed hardware of this input may cause internal timing conflicts.

Table 12 PL5 Pinout with Default MCIF Configuration

PIN	I/O	PIN NAME	FUNCTION	Reference
1	PEXT	PEXT	External 24V DC	
2	PEXT	PEXT	External 24V DC	
3	I	IN0	**Laser STANDBY** (Default MCIF configuration)	14.11.1
4	I	IN1	**Laser ON / Process Cycle Start** (Default MCIF config)	14.11.2
5	I	IN3	Unused (Default MCIF configuration)	
6	I	IN5	Unused (Default MCIF configuration)	
7	O	OUT1	**Laser ON / Process Cycle Active** (Default MCIF config)	14.12.2
8	O	OUT3	**Alarm Status** (Default MCIF configuration)	14.12.4
9	O	OUT5	Unused (Default MCIF configuration)	
10	O	AOUT	**Laser Power** Analogue Feedback	
11	AI	AIN+	**Analogue Input** Demand Positive	
12	-	-	-	
13	I	COMMON	Digital Input Common Return Path	
14	GNDEXT	GNDEXT	External 0V DC	
15	GNDEXT	GNDEXT	External 0V DC	
16	I	IN6	**Trigger Input** (Default MCIF configuration)	14.11.5
17	I	IN2	**Process Cycle Step** (Default MCIF configuration)	14.11.3
18	I	IN4	**Alarm Reset** (Default MCIF configuration)	14.11.4
19	O	OUT0	**Laser STANDBY** (Default MCIF configuration)	14.12.1
20	O	OUT2	**Remote Status** (Default MCIF configuration)	14.12.3
21	O	OUT4	**Warning** (Default MCIF configuration)	14.12.5
22	O	OUT6	**Process Cycle Wait** (Default MCIF configuration)	14.12.6
23	GNDEXT	GNDEXT	External 0V DC	
24	AI	AIN-	Analogue Input Demand Negative	
25	-	-	-	

14.5 PL5 Connection Configurations

The MCIF inputs and outputs are set up for operation with 24V PLC controllers. Inputs are set by applying a voltage in the range 15.0V to 24.0V and cleared by applying a voltage in the range 0.0V to 4.0V. These logic levels are illustrated in Figure 52. Logic outputs have the voltage provided by the Laser Integrator Controller.

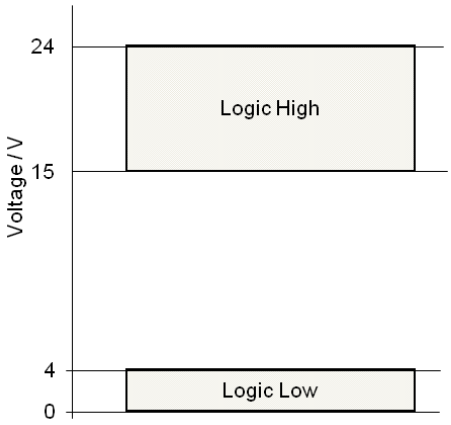


Figure 52 PLC Logic Levels

Figure 53 shows the configuration and connection circuit.

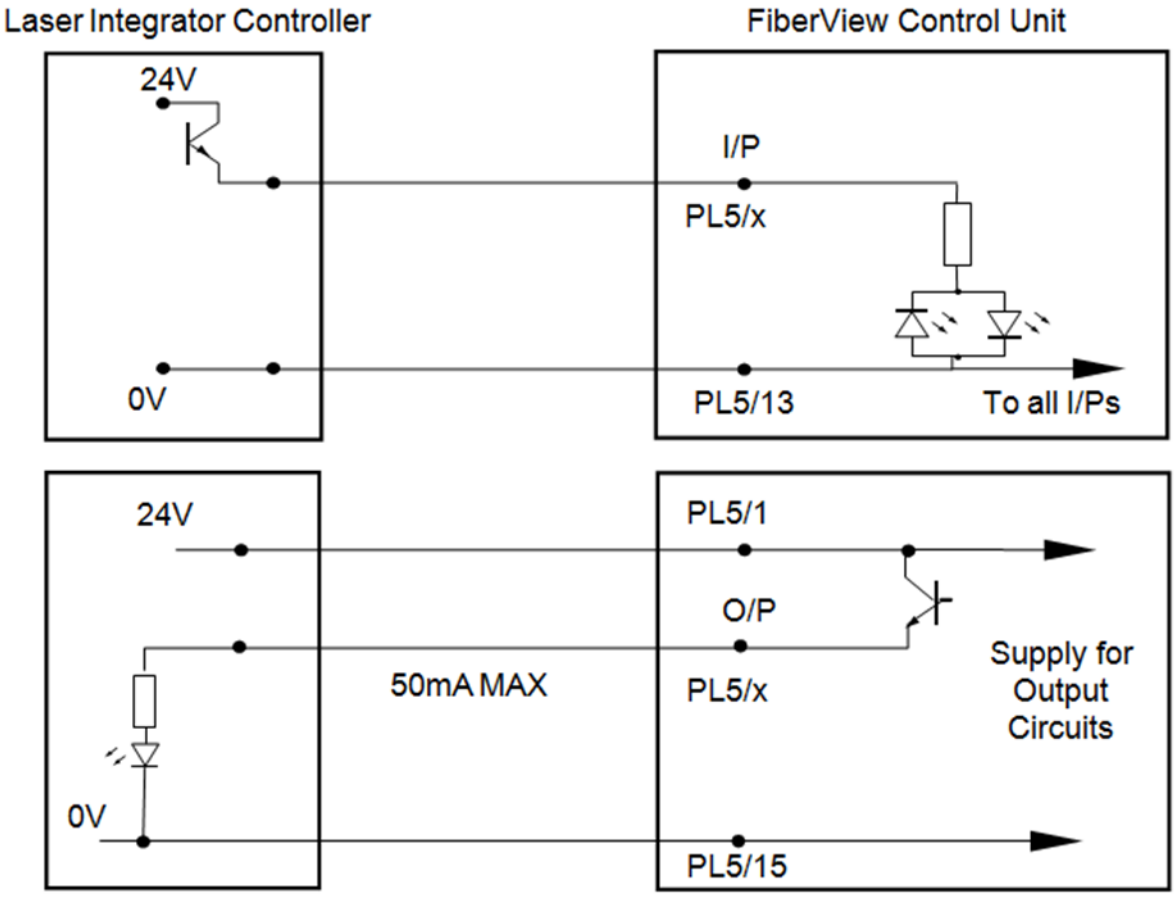


Figure 53 PL5 Connection Circuits

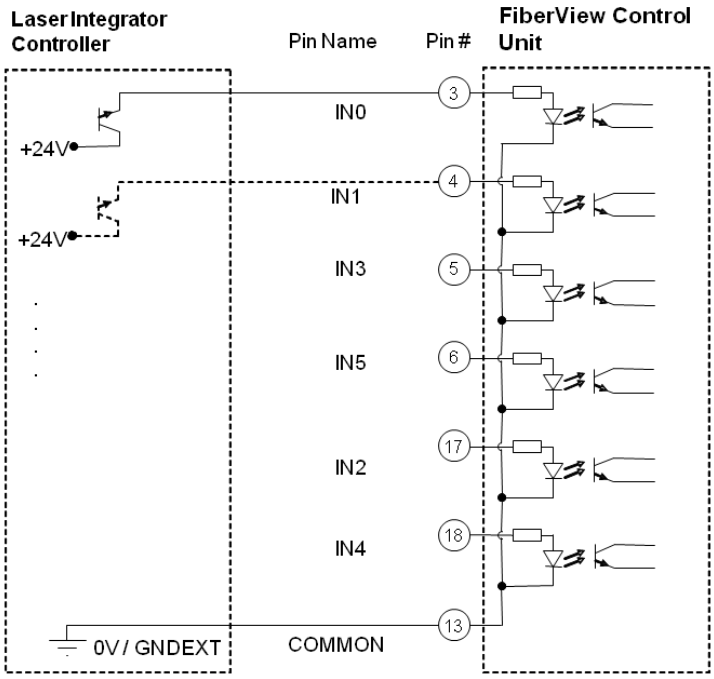


Figure 54 PL5 Programmable Inputs IN0 to IN5

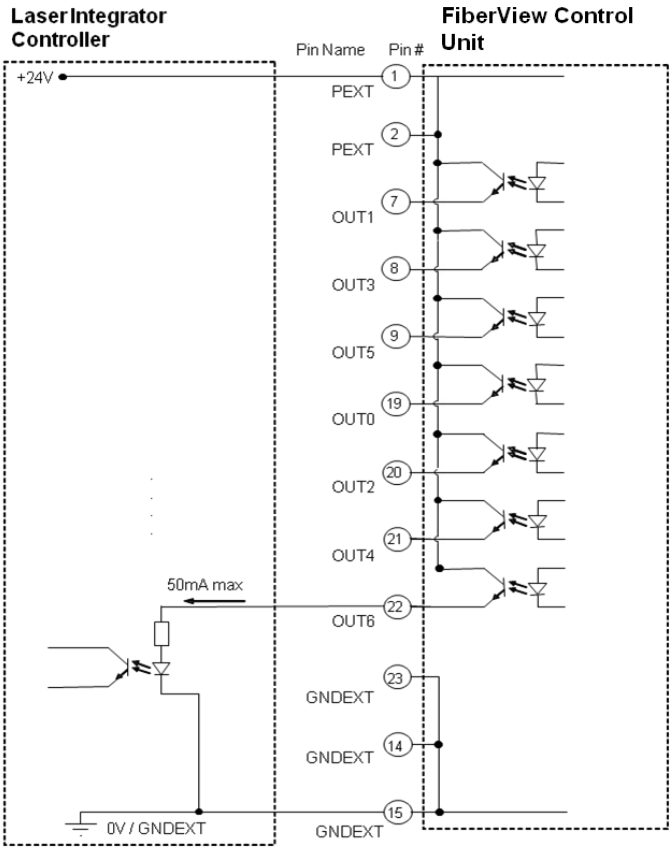


Figure 55 PL5 Programmable Outputs

The nominal load for each input on PL5 is 5mA and the maximum current capability of each output is 50mA.

14.6 MCIF Inputs

The Laser can be controlled in Remote Mode by using the inputs on the MCIF. Ensure Remote Control is set before using any of the inputs. Table 13 shows the full list of functions that can be configured to apply to any of IN0 to IN6. With the exception of 'Unused' (ID 0) input function, each input function can only be applied to one of IN0 to IN6.

Table 13 MCIF Inputs

ID	Input Function Description	**Notes -** In Remote Control
0	Unused	Inputs assigned this value are ignored.
1	**Laser STANDBY**	**Set:** moves Laser from OFF to STANDBY. **Clear:** moves Laser to OFF.
2	**Laser ON** **Process Cycle Start**	**Set:** If laser already in STANDBY the laser moves to ON when running in parameter sets mode or starts a defined Process Cycle when running in process cycle mode. **Clear:** Moves Laser to STANDBY when running in parameter sets mode or stops a defined Process Cycle when running in process cycle mode.
3	**Trigger Input**	**Set:** output triggered gated mode: the output is triggered. edge mode: an output pulse on rising edge. **Clear:** no laser output.
4	**Trigger Source Select**	**Set:** Laser responds to Trigger Input. **Clear:** Laser does not respond to Trigger Input, but follows Active Parameter Set.
5	**Process Cycle Step**	**Set:** advances to next Step on rising edge. **Clear:** no effect.
6	**Alarm Reset**	**Set:** resets alarm on rising edge. **Clear:** no effect.
7	**Strobe**	**Set:** reads Parameter Set / Process Cycle Select bits (ID8 to ID13) on rising edge. **Clear:** no effect.

Table 14 continued on next page

8	**Bit 0**	**Parameter Set Select** **Process Cycle Select**	Six-bit word to select Parameter Set or Process Cycle. Only operational in Remote Control. (See Table 6 Parameter Set Select Input Table for example)
9	**Bit 1**		
10	**Bit 2**		
11	**Bit 3**		
12	**Bit 4**		
13	**Bit 5**		
14	**Alignment Laser Demand**		**Set:** alignment laser on. **Clear:** alignment laser off.
15	**Scanner Start Input**		
16	**Safe Mode Recovery Start**		**Set:** starts safe mode recovery on rising edge. **Clear:** no effect.
17	Not supported		
18	**Low Power Mode Enable**		**Set:** enable Low Power Mode. **Clear:** disable Low Power Mode.
19	**variMODE**		**Set:** enable variMODE HIGH BPP. **Clear:** disable variMODE LOW. Refer to Table 7 Parameter Set Parameters

14.7 MCIF Outputs

Status outputs are provided by the MCIF. Table 14 shows the full list of functions that can be configured to apply to any of OUT0 to OUT6 as shown in Table 12. With the exception of ID 0, the 'Unused' output function, each output function can only be applied to one of OUT0 to OUT6.

Table 14 MCIF Outputs

ID	Output Function Description	Notes
0	Unused	Outputs assigned this value are not updated.
1	**Laser STANDBY**	**Set**: Laser in STANDBY. **Clear**: Laser OFF or ON.
2	**Laser ON** **Process Cycle Active**	**Set**: Laser ON or Process Cycle Running. **Clear**: Laser OFF or STANDBY or Process Cycle Stopped.
3	**Remote Control Status**	**Set**: remote control. **Clear**: local control.
4	**Sync**	**Set**: demanded output. **Clear**: no demanded output.
5	**Process Cycle Wait**	**Set**: Waiting for Process Cycle Step input. **Clear**: Process cycle running or in Auto step mode.
6	**Processing Mode**	**Set**: Process Cycles Mode. **Clear**: Normal Mode.
7	**Alarm**	**Set**: Alarm present. **Clear**: Alarm not present.
8	**Warning**	**Set**: Warning present. **Clear**: Warning not present.
9	Energy Warning	
10	**Acknowledge**	**Set**: Data accepted. **Clear**: Data not accepted or **Strobe** clear.
11	**Bit 0**	Six bit word giving the number of the Parameter Set or Process Cycle selected.
12	**Bit 1**	
13	**Bit 2**	**Parameter Set Selected** **Process Cycle Selected**
14	**Bit 3**	
15	**Bit 4**	
16	**Bit 5**	
17	**Scanner Start Output**	
18	**Ready To Start**	NOT **Alarm**.

ID	Output Function Description		Notes
19	Emission Indicator		**Set**: laser emission. **Clear**: no laser emission. **Note**: this output follows the yellow indicator on the Laser.
20	Not supported		
21	**Safe Mode Recovery Active**		**Set**: safe mode recovery in progress. **Clear**: safe mode recovery not in progress.
22	Ready for bulk supply enable		
23	Laser Modules Ready		
24	PSU Safe		
25	PSU Ready		
26	Back Reflection Warning		
27	**Burn Back / Safe Mode detected**		**Set**: condition detected. **Clear**: condition not detected.
28	**Laser Over Temperature**		**Set**: one of monitored temperatures above alarm level. **Clear**: temperatures OK.
29	Back Reflection Alarm		
30	Emergency Stop Pressed		
31	Cooler Interlock		
32	**Bit 0**	**Process Cycle Active Step**	Ten bit word to indicate Process Cycle active Step.
33	**Bit 1**		
34	**Bit 2**		
35	**Bit 3**		
36	**Bit 4**		
37	**Bit 5**		
38	**Bit 6**		
39	**Bit 7**		
40	**Bit 8**		
41	**Bit 9**		
42	**Pierce Detected**		**Set**: Pierce Detected. **Clear**: Pierce Detect not armed. Pierce not detected. Refer to Section 13.3 Pierce Detect
43	**Low Power Mode Enabled**		**Set**: Low Power Mode enabled.

ID	Output Function Description	Notes
		Clear: Low Power Mode not enabled.
44	**variMODE**	**Set**: High BPP **Clear**: Low BPP

14.8 Analogue Input

A voltage or waveform applied between Pins 11 and 24 of PL5 can be used to control the output power. The active Parameter Set must also be set to EPC using FiberView - refer to Section 13.1.3.

There are two modes for this function:

Relative:

> The peak power is determined by the voltage between the Analogue Input Demand pins and the value of the Peak Demand parameter of the Parameter Set. A signal level between 0V and 10V will linearly control the peak power between 0% and 100% of the value of the Peak Demand parameter of the Parameter Set.

Absolute:

> The peak power is determined by the voltage on the Analogue Input Demand pins. A signal level between 0V and 10V will linearly control the peak power up to 102% to 110% of rated power, depending on the Laser type.

The MCIF needs to have an external power supply connected as described in Section 14.2 for this function to operate.

14.9 Analogue Output

The output AOUT (Pin 10) can be used to monitor the Laser's output power. AOUT is calibrated linearly from 0V to 10V, to read 10V at the rated output power of the Laser.

AOUT is either the CW power when in CW mode or a time averaged value when in modulated mode. It is the same value as displayed in the Status Area of FiberView.

The MCIF needs to have an external power supply connected as described in Section 14.2 for this function to operate.

14.10 Diagnostic Outputs

Diagnostic outputs are grouped into:

- Alarms, which stop operation.
- Warnings, which indicate a problem but allow operation to continue.

The presence of an alarm or warning is indicated when **Alarm Status** or **Warning Status** is set.

Alarm status will remain set until the alarm has been reset by the User either by setting **Alarm Reset** on the MCIF or clicking the Reset icon in FiberView's Tool Bar.

Warning Status will remain set until the condition causing the warning has cleared. This may not require User intervention.

The type of alarm or warning can be established remotely by reading the alarm or warning code using the serial interface. See Section 14.13.

14.11 Default Input Description and Sequence Diagrams

14.11.1 Laser STANDBY (Input Function ID 1)

14.11.1.1 Description

- Default configuration
  - PL5 pin number 3
  - Input number 0
- Basic Function Description
  - Only operational in Remote Control
  - Moves the state from OFF to STANDBY under Remote Control
  - Input is edge sensitive in Remote Control
  - Input is level sensitive when entering Remote Control
- Detailed Function Description
  - Setting the input sequences the state to STANDBY
  - Clearing the input moves the state to OFF
  - When entering Remote Control, the way **Laser STANDBY** acts depends on the state of the Laser as follows:
    - When the state is OFF, and **Laser STANDBY** is set, the state will remain OFF when entering Remote Control, as a positive edge must be detected to change the state. Alternatively a software command can be issued to sequence the state to STANDBY while **Laser STANDBY** remains set
    - When the state is STANDBY or ON, and **Laser STANDBY** is clear, the state will move to OFF when entering Remote Control. In this case, the **Laser STANDBY** input is level sensitive. While in Remote Control, the only way to sequence the state into STANDBY is to set **Laser STANDBY**
    - When the state is STANDBY or ON, and **Laser STANDBY** is set, the state will not move to OFF when entering Remote Control. In this case, the state of the **Laser STANDBY** input is level sensitive and the state is also dependant on the **Laser ON** / **Process Cycle Start** input
  - Therefore, care must be taken to ensure the **Laser STANDBY** input (if configured) is in the correct state when entering Remote Control
- This function has no effect if it is not configured on the MCIF
- This function can be assigned to any of the seven inputs
- Associated default functions
  - **Laser STANDBY** - Output Function

- **Remote Control Status** - Output Function

14.11.1.2 Sequence diagrams:

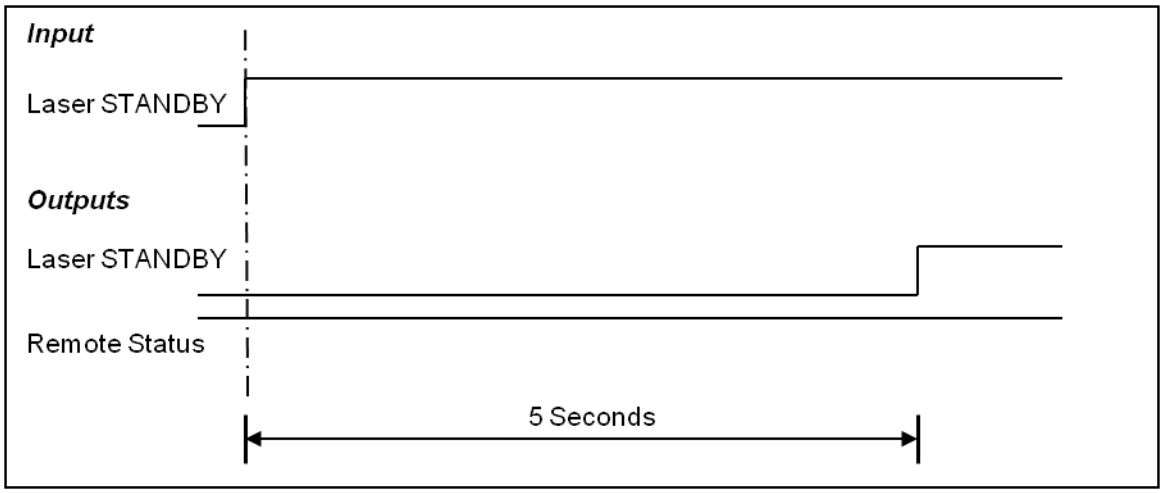


Figure 56 Moving to STANDBY in Remote Control

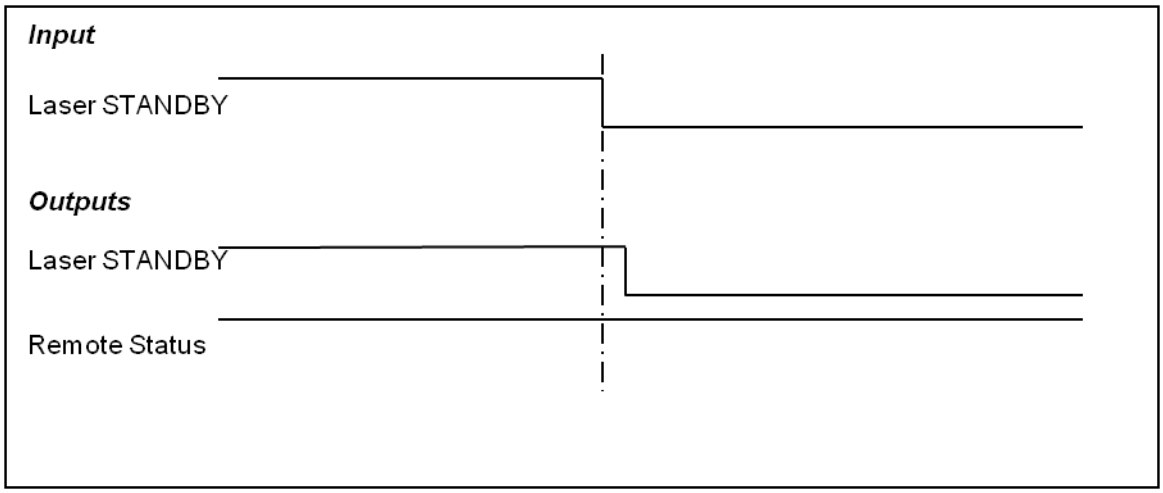


Figure 57 Moving to OFF in Remote Control

Note: There is a small switching delay before **Laser STANDBY** is acted on (<1ms)

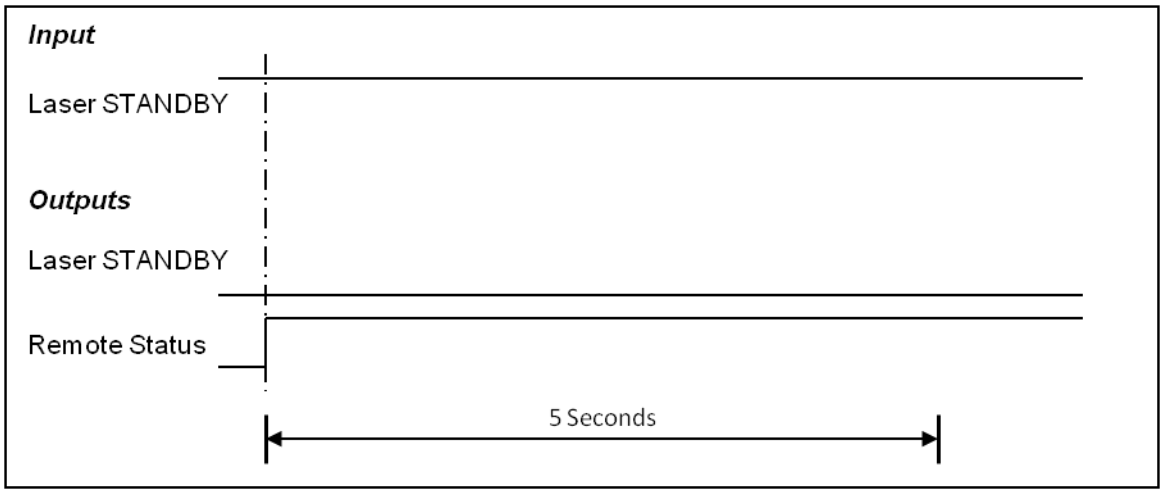


Figure 58 Entering Remote Control (OFF State, Laser STANDBY Set)

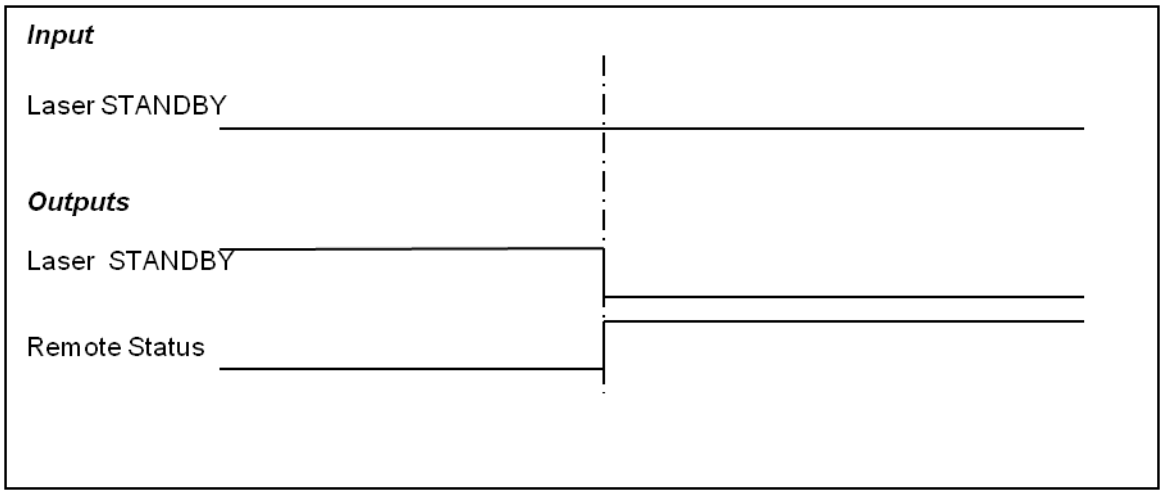


Figure 59 Entering Remote Control (STANDBY or ON State, Laser STANDBY Clear)

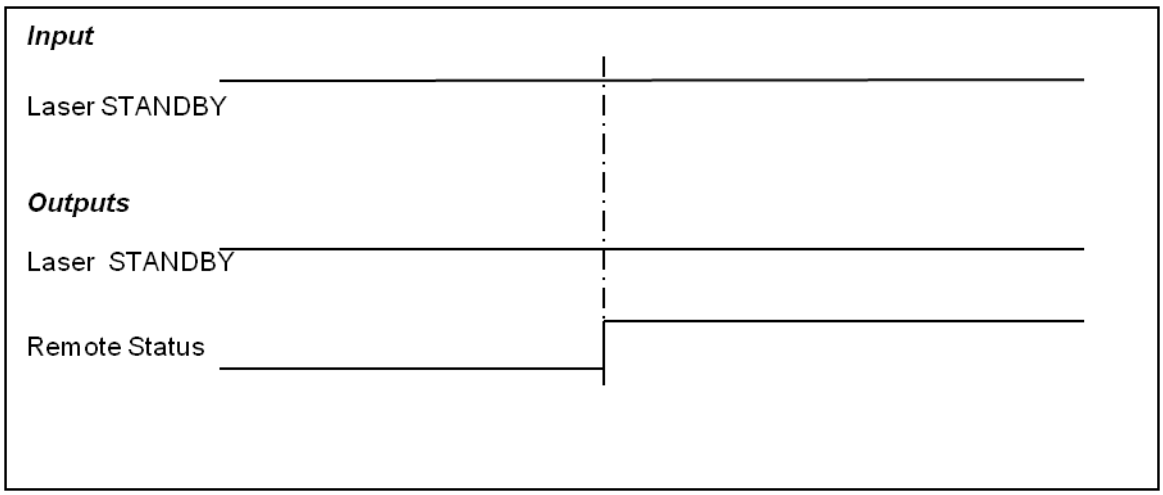


Figure 60 Entering Remote Control (STANDBY or ON State, Laser STANDBY Set)

14.11.2 Laser ON / Process Cycle Start (Input Function ID 2)

14.11.2.1 Description

- Default configuration
  - PL5 pin number 4
  - Input number 1
- Basic Function Description
  - Multiplexed input depending on processing mode
  - Moves the state from STANDBY to ON when set and ON to STANDBY when cleared under Remote Control in Parameter Set mode
  - Starts / stops a Process Cycle under Remote Control in Process Cycle mode
  - Input is edge sensitive in Remote Control
  - Input is level sensitive when entering Remote Control
  - Only operational in Remote Control

- Detailed Function Description

a) Parameter Set Operation

- When the Laser is in Remote Control **Laser ON** provides the following action:
    - From STANDBY, setting the input moves the state to ON or, if a ramp up time is configured in the active Parameter Set, to RAMPING UP
    - From ON, clearing **Laser ON** moves the state to STANDBY or, if a ramp down time is configured in the active Parameter Set, to RAMPING DOWN
- When entering Remote Control **Laser ON** is acted upon depending on the initial state:
    - When the state is STANDBY, and **Laser ON** is set, the state will not move to ON when entering Remote Control. In this case the **Laser ON** input is edge triggered
    - When the state is ON, and **Laser ON** is clear, the state will move to RAMPING DOWN (if a ramp is set) or to STANDBY when entering Remote Control. In this case the **Laser ON** input is level sensitive
    - When the state is ON, and **Laser ON** is set (and **Laser STANDBY** is either not configured or is configured and set), the state will remain ON. In this case **Laser ON** is level sensitive
    - When the state is OFF, or sequencing to STANDBY, and **Laser ON** is set, the state will not sequence to ON after it enters STANDBY

b) Process Cycle Operation

- When the Laser is in Remote Control **Process Cycle Start** provides the following action:
    - From STANDBY, setting **Process Cycle Start** starts a Process Cycle
    - If a Process Cycle is running, clearing **Process Cycle Start** stops it. If a ramp down time is set in the Parameter Set of the active Process Cycle Step, RAMPING DOWN will be entered when the **Process Cycle Start** is cleared and the state will sequence to STANDBY
- When entering Remote Control the action of **Process Cycle Start** depends on the initial state:
    - If the state is STANDBY, and **Process Cycle Start** is set, a Process Cycle will not start when entering Remote Control. In this case **Process Cycle Start** is edge triggered
    - If a Process Cycle is active when entering Remote Control it will stop regardless of whether **Process Cycle Start** is set or clear. If a ramp down time is set in the Parameter Set linked to the active Process Cycle Step, when entering Remote Control RAMPING DOWN will be entered and the state will sequence to STANDBY
    - When the state is OFF, or sequencing to STANDBY, and **Process Cycle Start** is set, a Process Cycle will not start when the state reaches STANDBY
- Care must be taken to ensure the **Laser STANDBY** and **Laser ON** / **Process Cycle Start** inputs (if configured) are in the correct state when entering Remote Control

- **Process Cycle Start** is only operational in Remote Control and when the state is STANDBY. If **Process Cycle Start** is configured and set, when STANDBY is entered from OFF, the state will not sequence to ON. **Process Cycle Start** must be cycled to provide a leading edge to sequence the state to ON
- **Process Cycle Start** has no effect if it is not configured on the MCIF
- **Process Cycle Start** can be assigned to any of the seven inputs
- Associated functions
    - **Laser STANDBY** - Input Function
    - **Laser STANDBY** - Output Function
    - **Laser ON / Process Cycle Active** - Output Function
    - **Remote Status** - Output Function

14.11.2.2 Sequence Diagrams

a) Parameter Set Operation

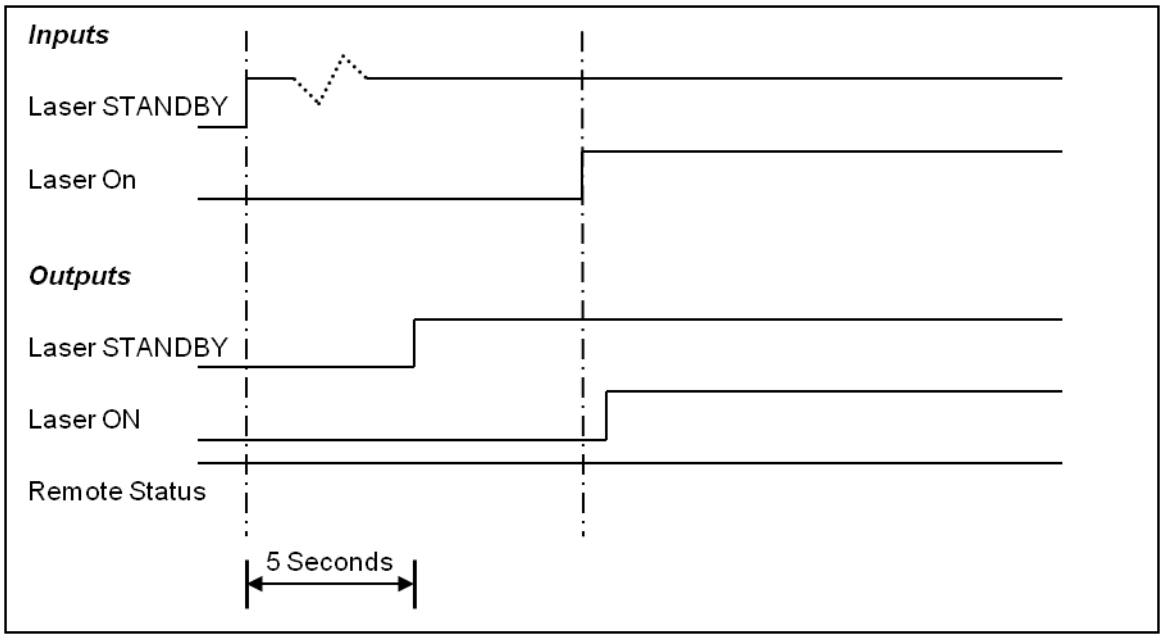


Figure 61 Moving to ON in Remote Control

Note: The Laser can be moved to ON using a serial protocol message, as long as **Laser STANDBY** is set.

Laser ON can be set at any time to move the state to ON as long as the initial state is STANDBY.

There is a small switching delay before **Laser ON** is acted on (<1ms) and **Laser ON** status is set or cleared.

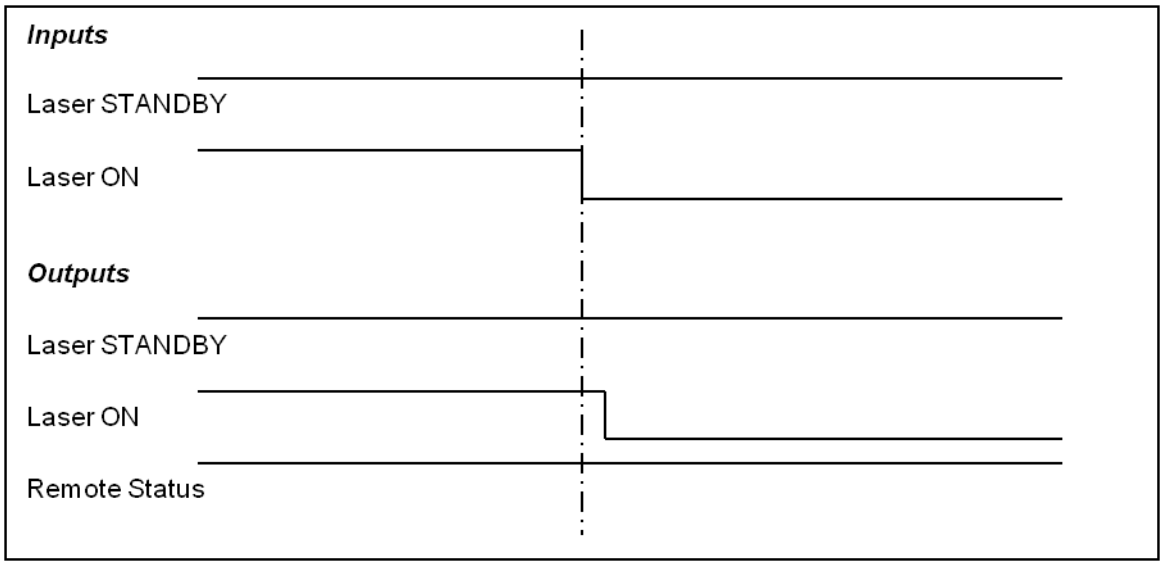


Figure 62 Moving to STANDBY in Remote Control (No Ramp Down Time Configured)

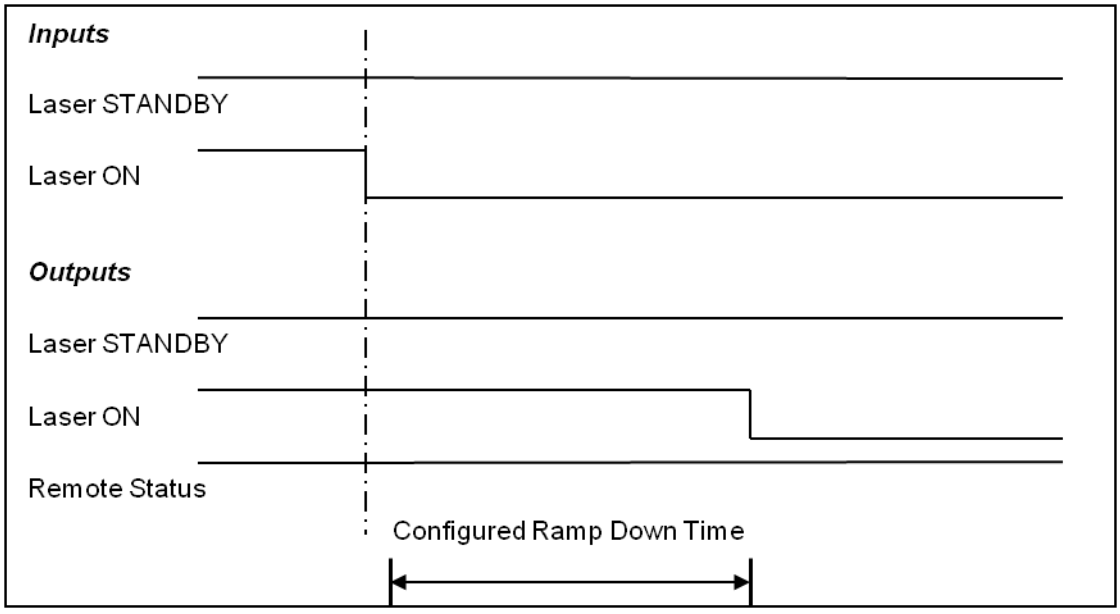


Figure 63 Moving to STANDBY in Remote Control (Ramp Down Time Configured)

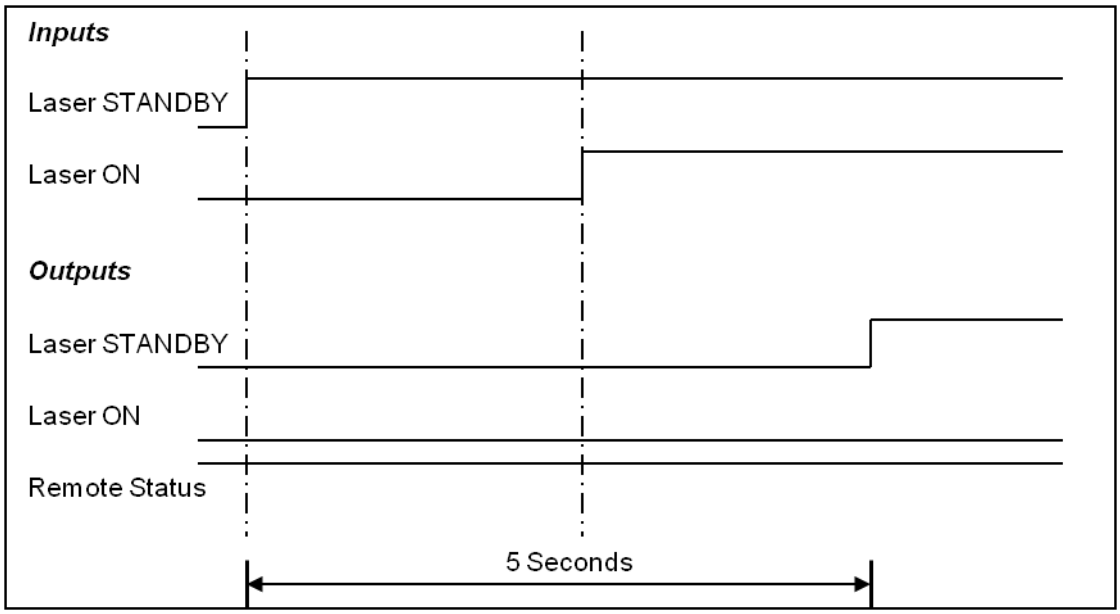


Figure 64 Moving to ON in Remote Control Before the State has Moved to STANDBY

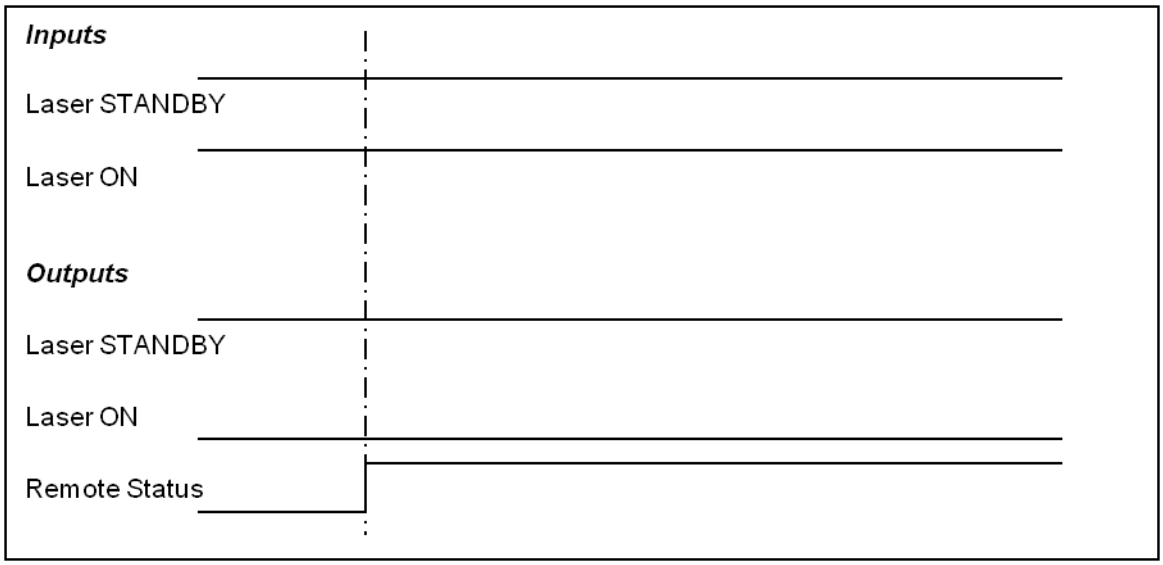


Figure 65 Entering Remote Control (STANDBY State, Laser ON Input Set)

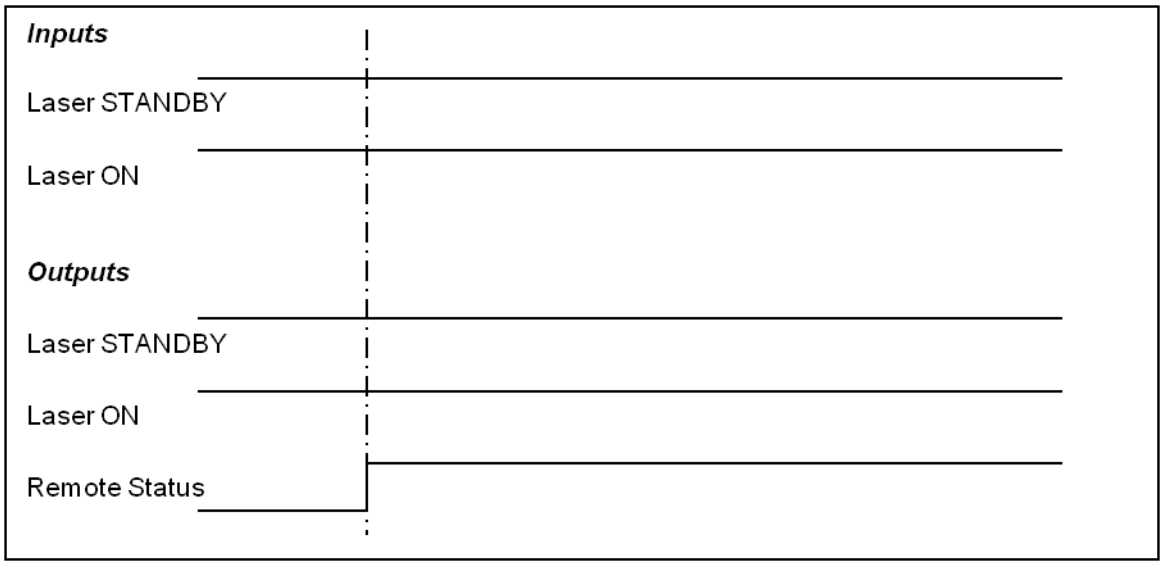


Figure 66 Entering Remote Control
(ON State, Laser ON Input Set)

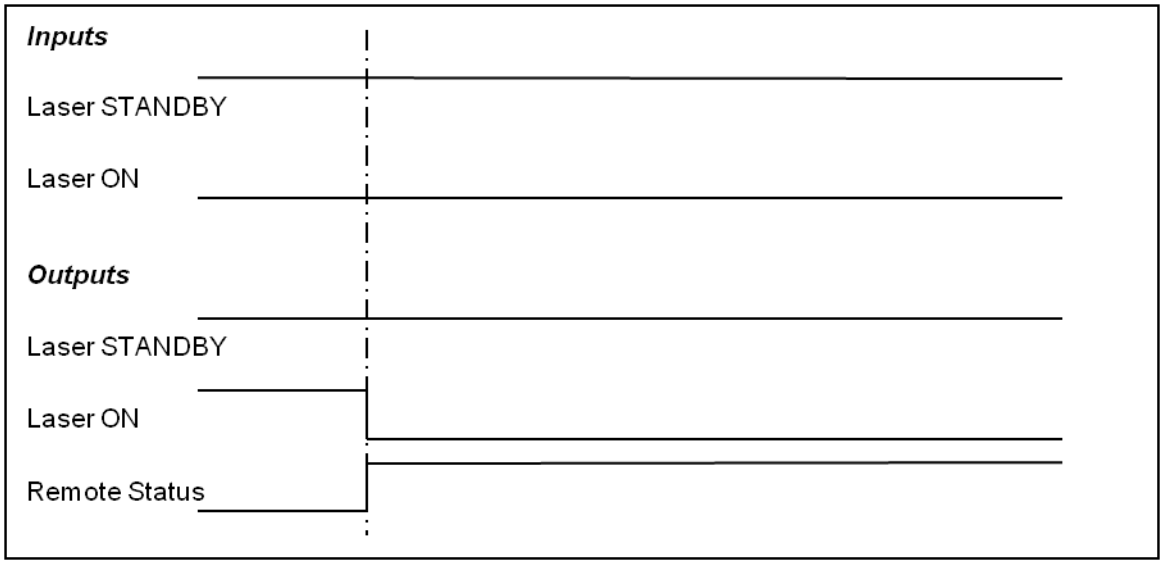


Figure 67 Entering Remote Control
(ON State, Laser ON Input Clear, No Ramp Down Time Configured)

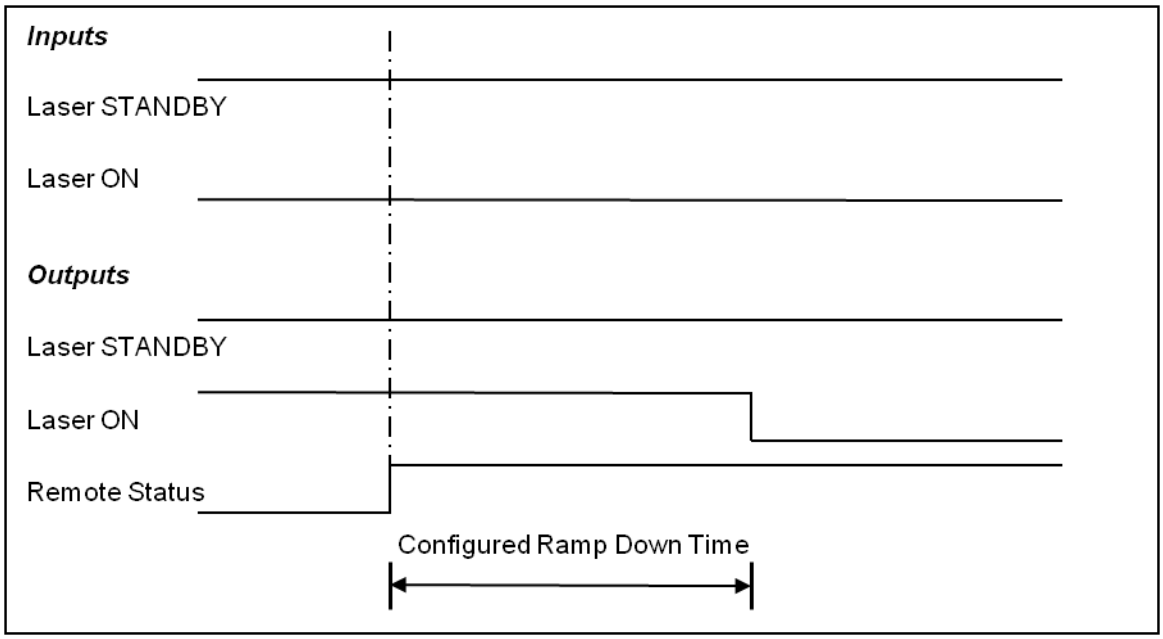


Figure 68 Entering Remote Control
(ON State, Laser ON Input Clear, Ramp Down Time Configured)

b) Process Cycle Operation

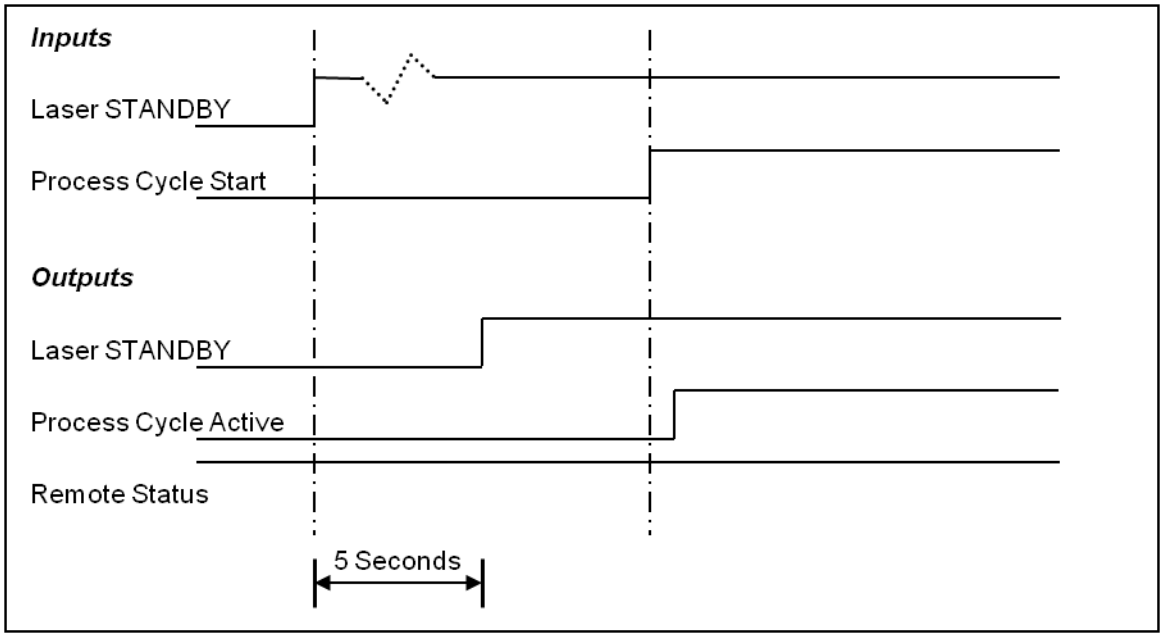


Figure 69 Starting a Process Cycle in Remote Control

Note: The state can be moved to ON using a serial protocol message, as long as **Laser STANDBY** is set.

Process Cycle Start can be set at any time to start a Process Cycle as long as the state is STANDBY.

There is a small switching delay before **Process Cycle Start** is acted on (<1ms) and **Process Cycle Active** is set.

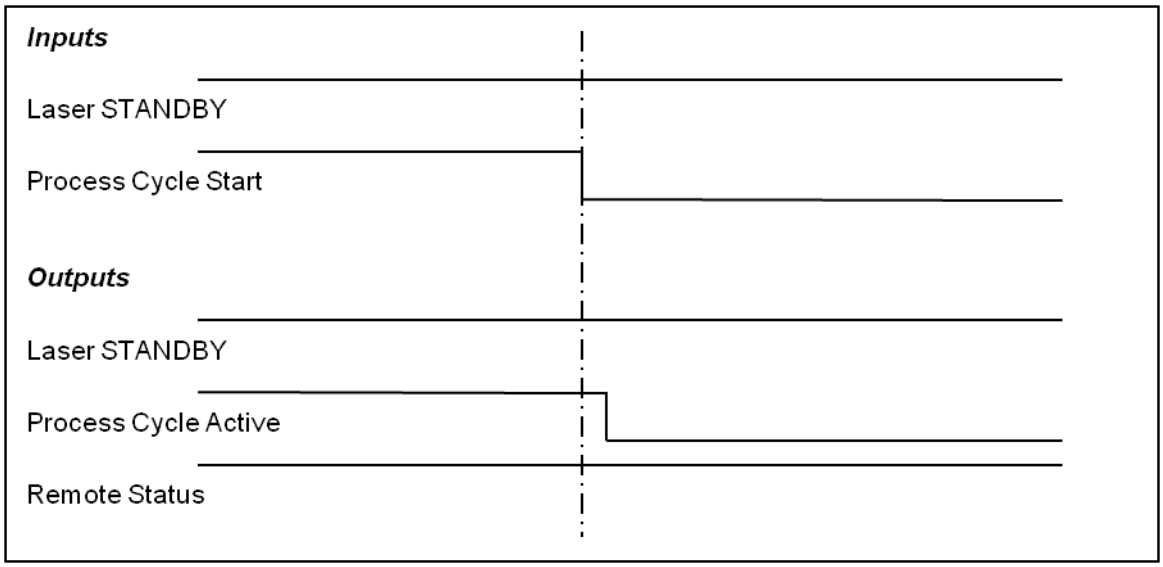


Figure 70 Stopping a Process Cycle in Remote Control
(No Ramp Down Time Configured in Active Step Parameter Step)

Note: there is a small switching delay before **Process Cycle Start** is acted on (<1ms) and **Process Cycle Active** status is cleared.

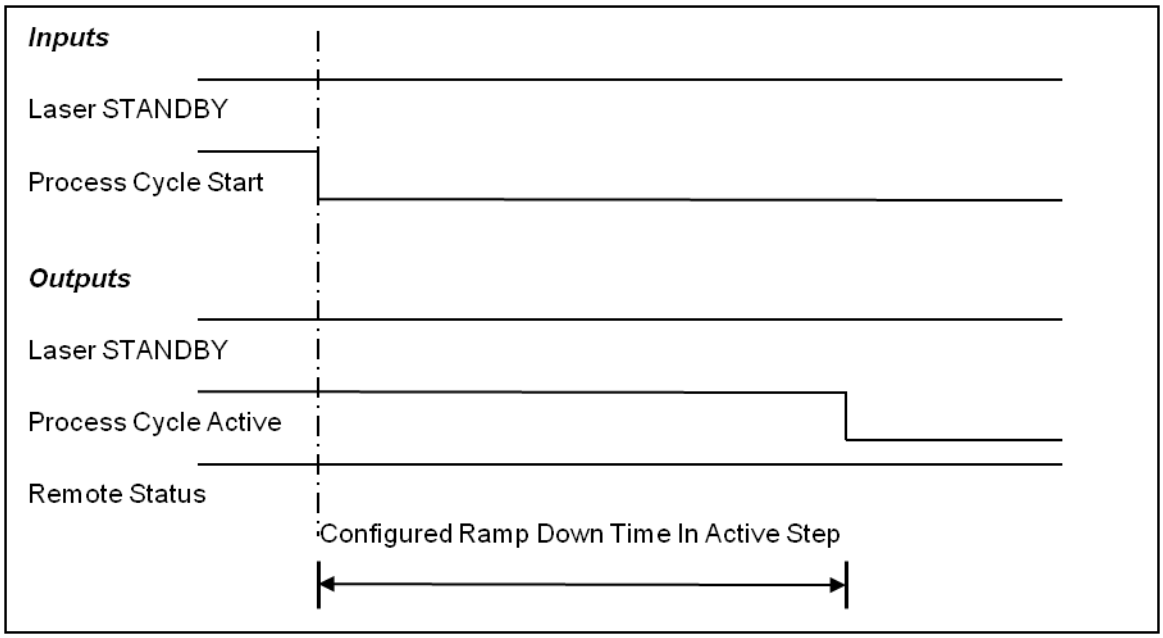


Figure 71 Stopping a Process Cycle in Remote Control
(Ramp Down Time Configured in Active Step Parameter Step)

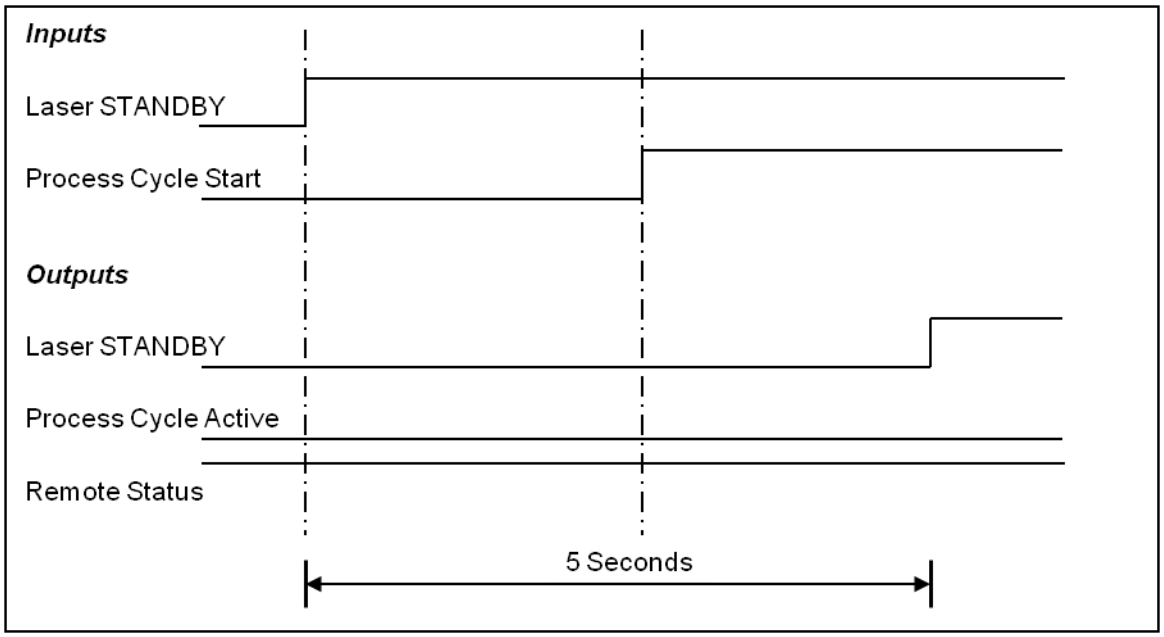


Figure 72 Starting a Process Cycle in Remote Control Before the State has Moved to STANDBY

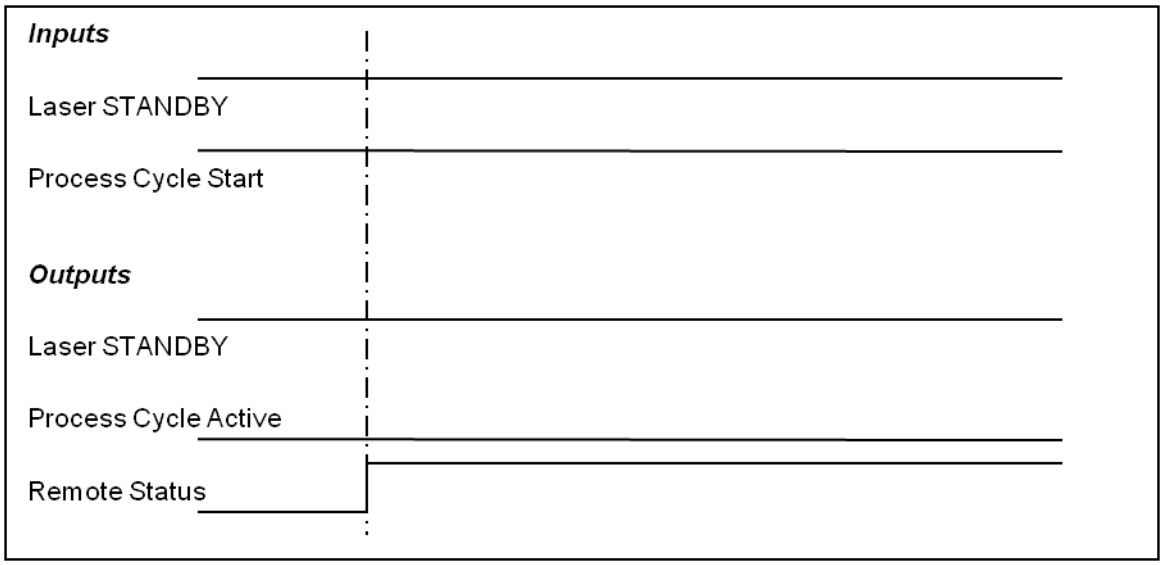


Figure 73 Entering Remote Control (STANDBY State, Process Cycle Start Input Set)

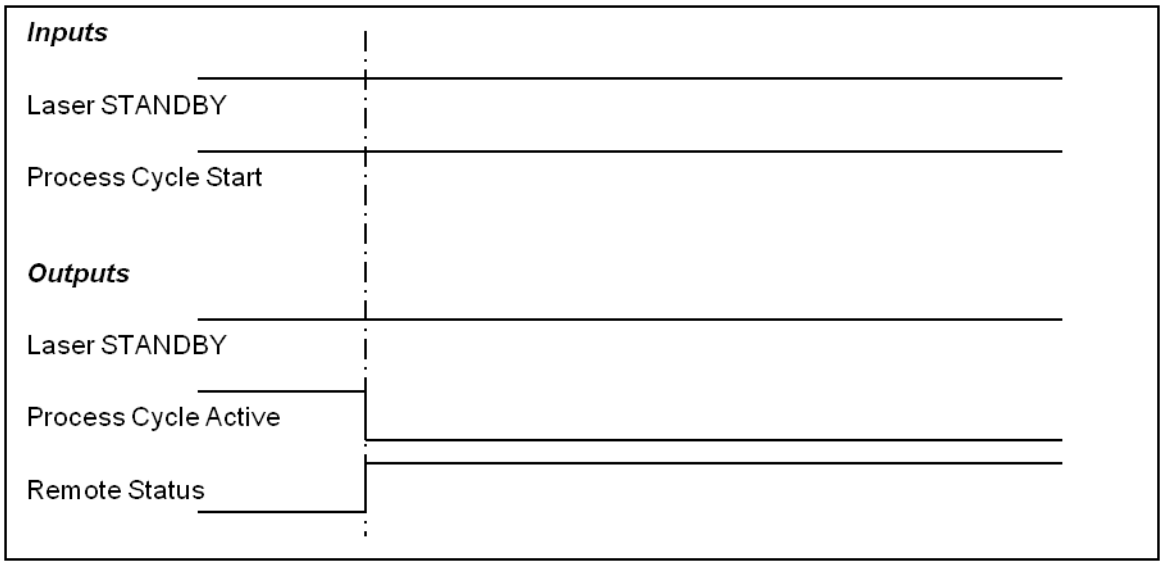


Figure 74 Entering Remote Control (Process Cycle Active, Process Cycle Start Input Set, No Ramp Down Time Configured in Active Step Parameter Step)

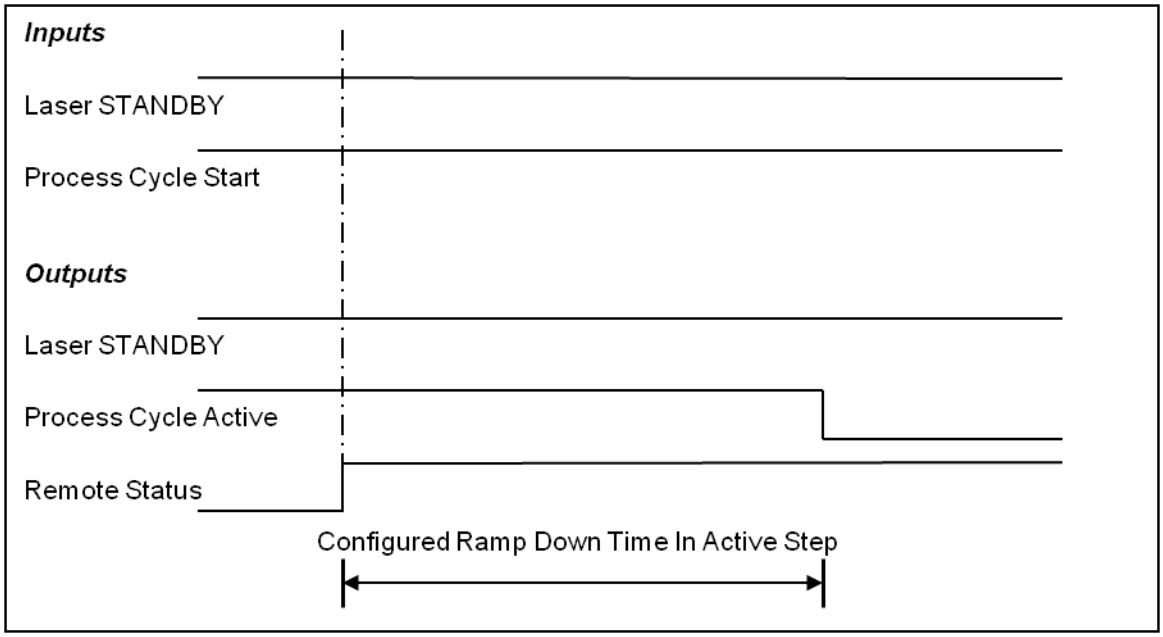


Figure 75 Entering Remote Control (Process Cycle Active, Process Cycle Start Input Set, Ramp Down Time Configured in Active Step Parameter Step)

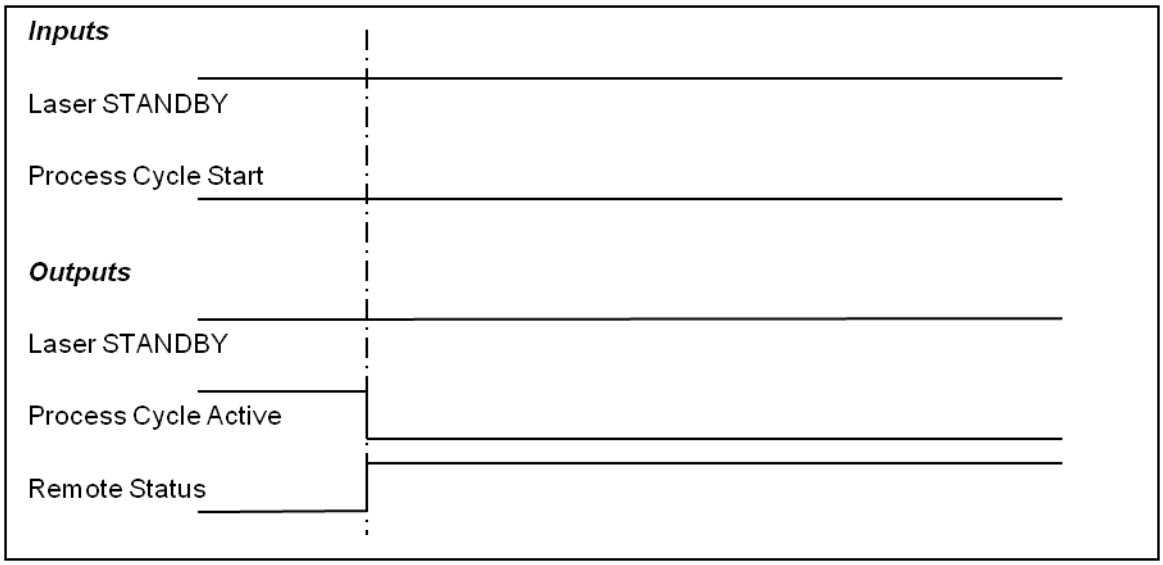


Figure 76 Entering Remote Control (Process Cycle Active, Process Cycle Start Input Clear, No Ramp Down Time Configured in Active Step Parameter Step)

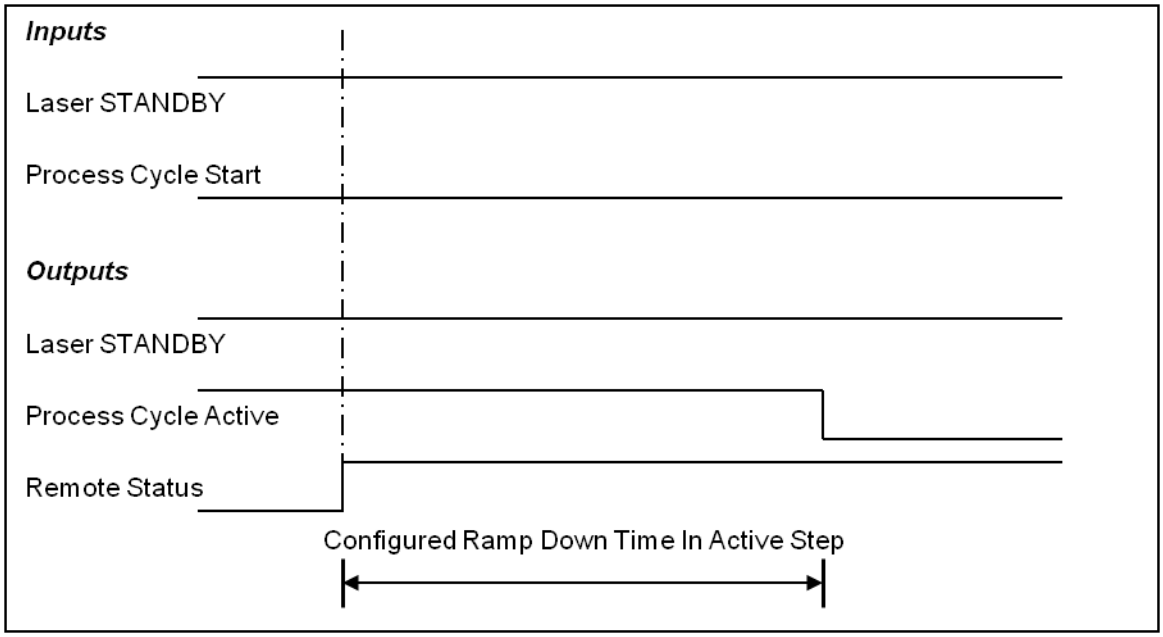


Figure 77 Entering Remote Control (Process Cycle Active, Process Cycle Start Input Clear, Ramp Down Time Configured in Active Step Parameter Step)

14.11.3 Process Cycle Step (Input Function ID 5)

14.11.3.1 Description

- Default configuration
  - PL5 pin number 17
  - Input number 2
- Basic Function Description

- Only in Process Cycle mode
- Advance to the next Process Cycle Step once the duration or shots have completed
- Input is leading edge sensitive
- Only operational in Remote Control

- Detailed Function Description
  - **Process Cycle Step** is used in conjunction with the Process Cycles feature of the Laser. It is used to advance a Process Cycle to the next Step when the active Step is configured not to automatically advance, or the Step duration is infinite. **Process Cycle Step** becomes active when the Step has completed and the Process Cycle is waiting to advance unless the step duration is infinite, in which case **Process Cycle Step** is active from the start of the Step.
  - An output function, **Process Cycle Wait**, can be configured on the MCIF to indicate that the Process Cycle is waiting for a Step input in order to advance
  - If **Process Cycle Step** is not configured on the MCIF a Process Cycle cannot be advanced using the MCIF. In this situation, a Process Cycle can be advanced using the serial protocol, or all Steps in the Process Cycle must be configured to advance automatically.
  - **Process Cycle Step** is only operational in Remote Control
  - **Process Cycle Step** can be assigned to any of the seven inputs
  - Associated functions
    - **Laser ON** / **Process Cycle Start** - Input Function
    - **Laser ON** / **Process Cycle Active** - Output Function
    - **Process Cycle Wait** - Output Function

14.11.3.2 Sequence Diagrams

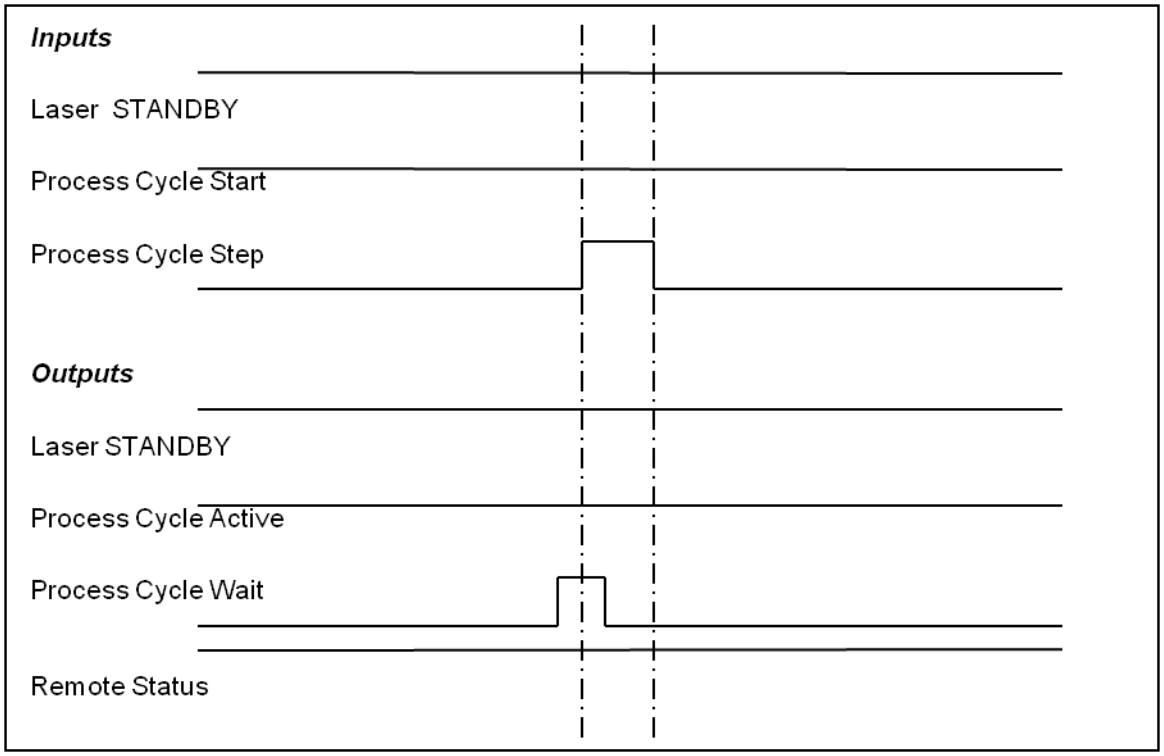


Figure 78 Advancing Process Cycle Steps in Remote Control

Notes: If a Process Cycle is waiting, it will only advance when it receives a **Process Cycle Step** command.

The **Process Cycle Wait** output will clear once the **Process Cycle Step** command has been processed. It is not synchronised with **Process Cycle Step** clearing.

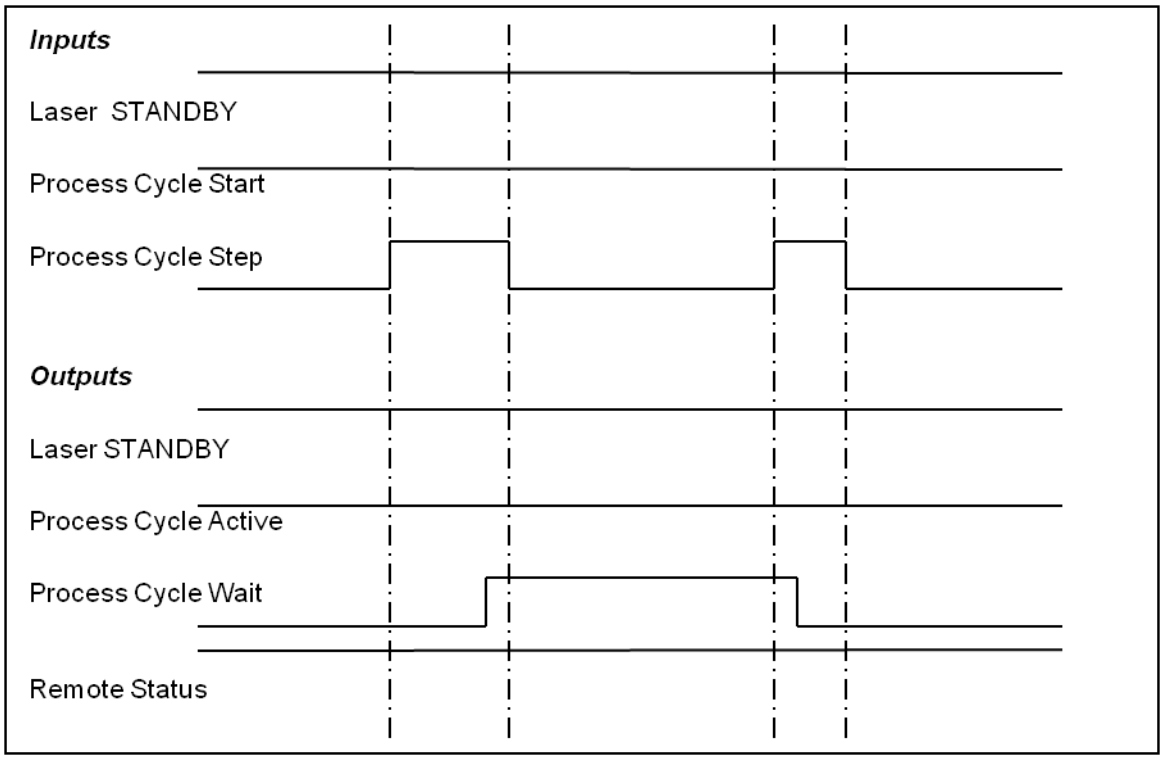


Figure 79 Advancing Process Cycle Steps in Remote Control (Before Process Cycle Wait is Set)

Note: The Process Cycle does not advance the first time **Process Cycle Step** is set as **Process Cycle Wait** is clear. It advances the second time **Process Cycle Step** is set as the leading edge occurs while **Process Cycle Wait** is set, indicating that the Process Cycle is waiting to advance.

14.11.4 Alarm Reset (Input Function ID 6)

14.11.4.1 Description

- Default configuration
  - PL5 pin number 18
  - Input number 4
- Basic Function Description
  - Resets Laser (normally after an alarm has occurred, and the fault has been put right)
  - Input is leading edge sensitive
  - Only operational in Remote Control
- Detailed Function Description
  - **Alarm Reset** allows the Laser to be reset via the MCIF. It acts only when the input transitions from clear to set. It can be used following an alarm, once the fault has been identified and put right, to clear the latched alarm state.

- Setting **Alarm Reset** while the state is STANDBY or ON will move the state to OFF
- **Alarm Reset** is only operational in Remote Control
- **Alarm Reset** can be assigned to any of the seven inputs
- Associated functions
  - **Alarm** - Output Function
  - **Laser STANDBY** - Output Function

14.11.4.2 Sequence diagrams

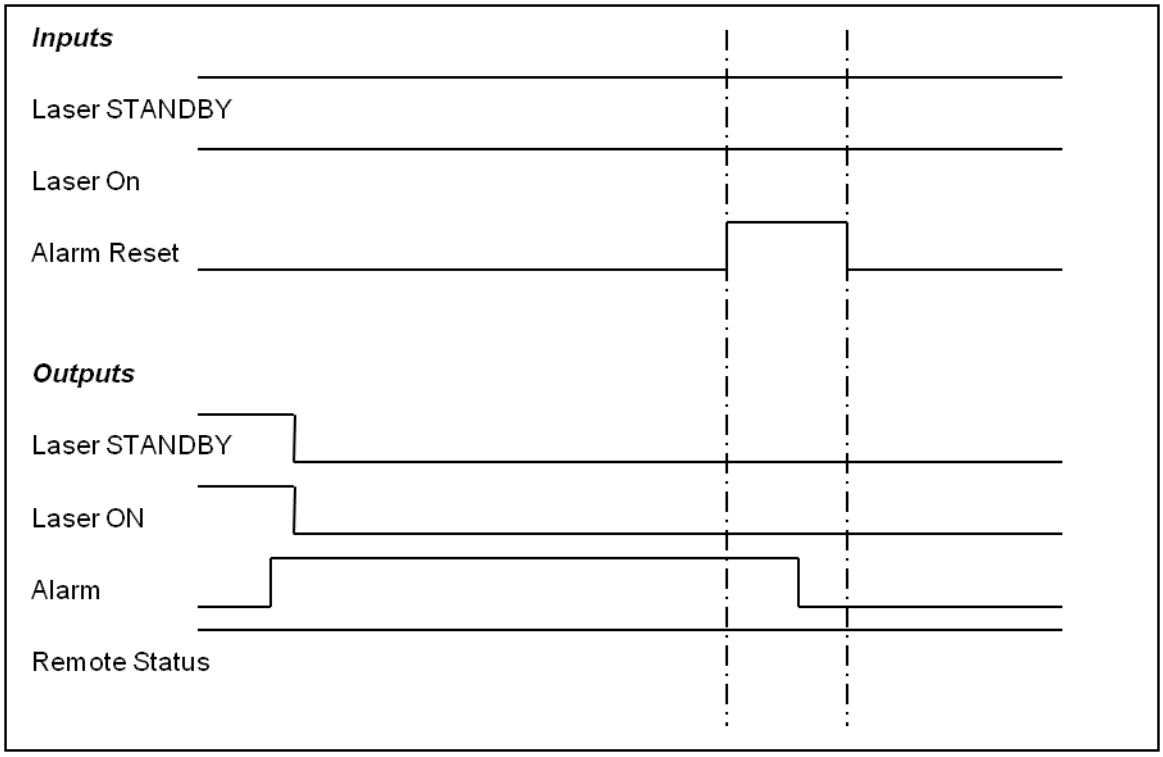


Figure 80 Alarm Reset

Notes:

An alarm condition causes the state to move to OFF.

The fault must be identified and put right before resetting otherwise the alarm may recur following the reset.

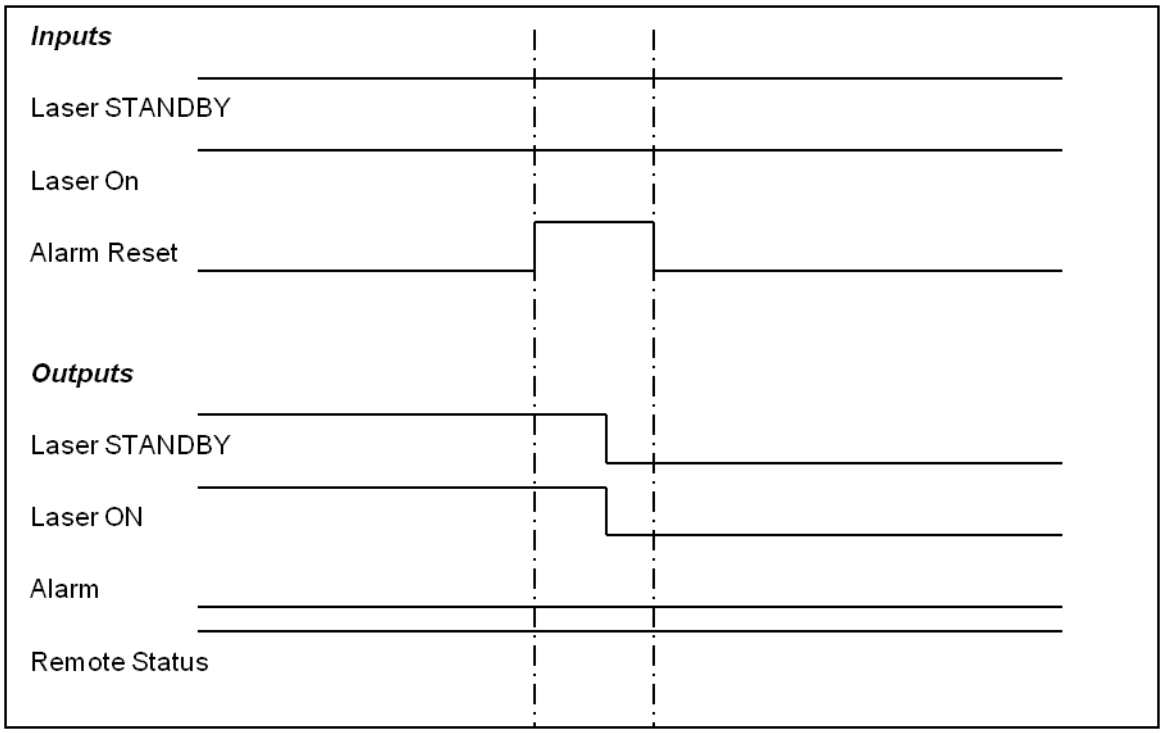


Figure 81 Alarm Reset when ON

14.11.5 Trigger (Input Function ID 3)

14.11.5.1 Description

- Default configuration
  - PL5 pin number 16
  - Input number 6
- Basic Function Description
  - Provides a signal to the Laser to start output
  - Configurable for edge or gated triggering
  - **Trigger** is edge sensitive when edge triggering
  - **Trigger** is level sensitive when gated triggering
  - Operational in both Local and Remote Control
- Detailed Function Description
  - **Trigger** allows the Laser output to be controlled externally. It can be configured in two ways. When configured as ‘gated’ (level sensitive) power will be output when it is set and stopped when it is cleared. When configured as ‘edge’ (leading edge sensitive) a single defined pulse, determined by the active Parameter Set, will be output each time it is set.
  - **Trigger** is operational in both Remote and Local Control as follows:
    - In Local Control the active Parameter Set determines whether **Trigger** is configured as gated or edge.

- In Remote Control, if **Trigger Source Select** is configured on the MCIF and set **Trigger** is operational. Otherwise, the active Parameter Set settings are used.

- **Trigger** can be assigned to any of the seven inputs, although it is recommended to use IN6, as this input uses higher bandwidth electronics
- Associated functions
  - **Trigger Source Select** - Input Function
  - **Sync** - Output Function

14.11.5.2 Sequence Diagrams

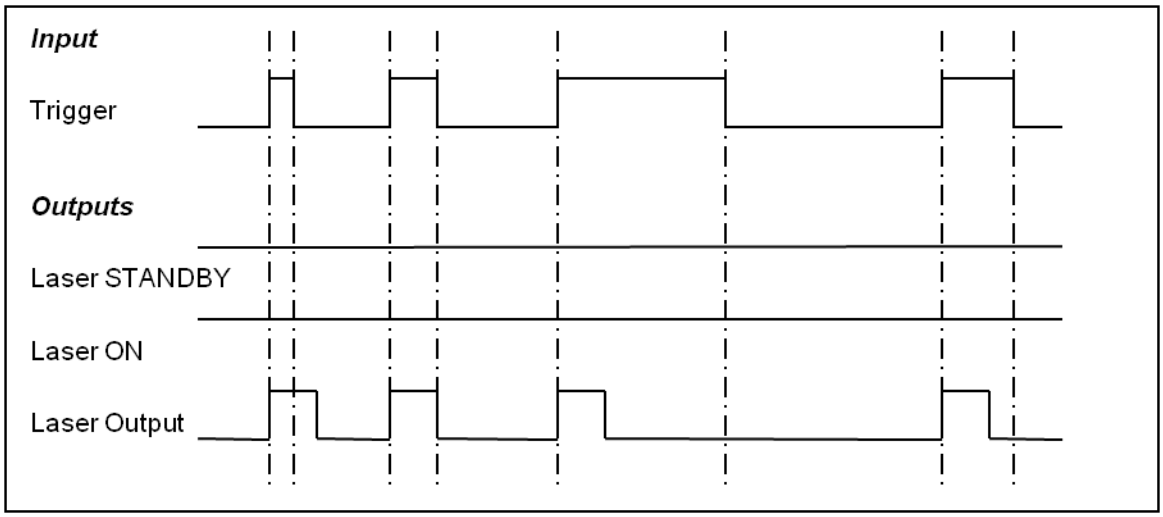


Figure 82 Edge Trigger Operation (Pulsed Output Only)

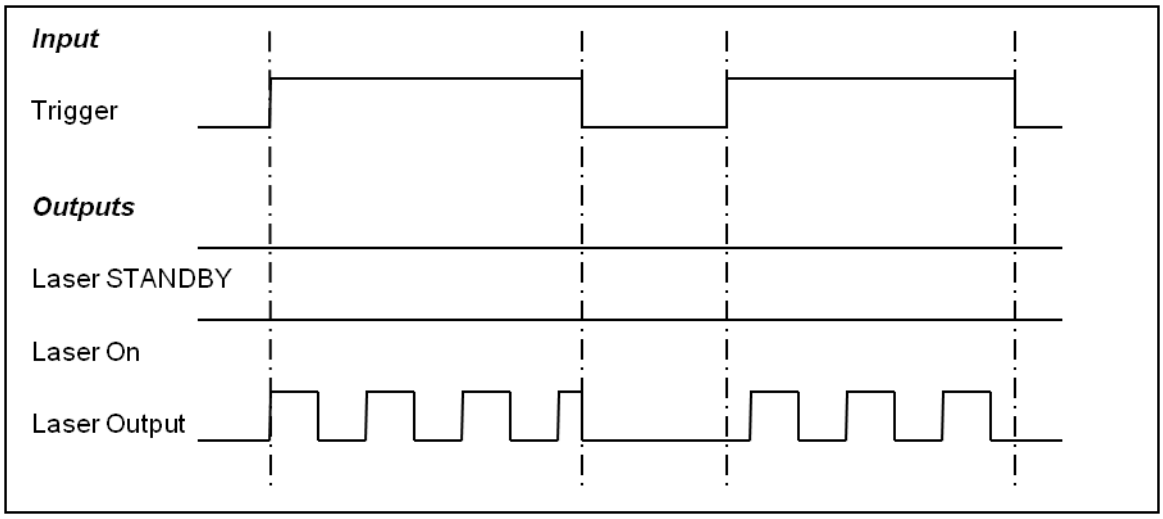


Figure 83 Gated Trigger Operation (Pulsed Output)

Note: gated triggering is not synchronised with the output pulses.

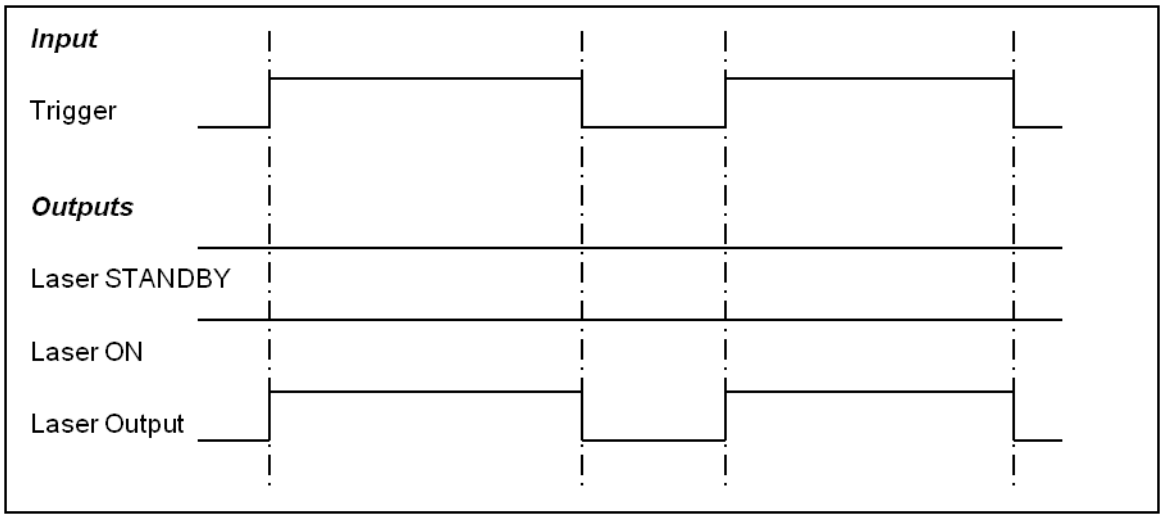


Figure 84 Gated Trigger Operation (CW Output)

14.12 Default Output Description and Sequence Diagrams

14.12.1 Laser STANDBY (Output Function ID 1)

14.12.1.1 Description

- Default configuration
  - PL5 pin number 19
  - Output number 0
- Basic Function Description
  - Set when the state is STANDBY
  - Clear when the state is OFF
  - Operational in both Local and Remote Control
- Detailed Function Description
  - **Laser STANDBY** indicates when the state is STANDBY. It will not be set until the emission indication time (5s) has expired following a **Laser STANDBY** command from either the MCIF (if **Laser STANDBY** is configured), or a **Laser STANDBY** serial command message.
  - **Laser STANDBY** will also be set when the state is ON, or a Process Cycle is active
  - **Laser STANDBY** is clear when the state is OFF or STARTING
  - **Laser STANDBY** can be assigned to any of the seven outputs
  - Associated functions
    - **Laser STANDBY** - Input Function

14.12.1.2 Sequence Diagrams

- See Figure 56 to Figure 84 for examples.

14.12.2 Laser ON / Process Cycle Active (Output Function ID 2)

14.12.2.1 Description

- Default configuration
  - PL5 pin number 7
  - Output number 1
- Basic Function Description
  - Set when the state is RAMPING UP, ON or RAMPING DOWN, or a Process Cycle is active
  - Clear when the state is STANDBY or OFF, or no Process Cycle is active
  - Operational in both Local and Remote Control
- Detailed Function Description
  - This output function is used to indicate when the state is RAMPING UP, ON or RAMPING DOWN in Parameter Sets mode, or a Process Cycle is active in Process Cycle mode
  - The operation of the function is subtly different depending on whether the Laser is operating in Parameter Set mode or Process Cycles mode as follows:

    a) Parameter Sets mode:

    - **Laser ON** will be set following a **Laser ON** command from the MCIF (if **Laser ON** is configured in the MCIF and set in Remote Control), or a **Laser ON** serial command.
    - **Laser ON** will be set during the RAMPING UP, ON and RAMPING DOWN states of a Parameter Set, and will remain set until the state returns to STANDBY or moves to OFF.
    - **Laser ON** remains set for the duration of a configured ramp down time following the issue of a **Laser STANDBY** command from the MCIF (if Laser STANDBY is configured in the MCIF and set in Remote Control), or a **Laser STANDBY** serial command.

    b) Process Cycles mode:

    - **Process Cycle Active** will be set following the setting of **Process Cycle Start** command on the MCIF (if **Process Cycle Start** is configured in the MCIF and set in Remote Control), or a Process Cycle Start serial command.
    - **Process Cycle Active** will be clear when a Process Cycle completes, or the Process Cycle is stopped following the clearing of **Process Cycle Start** on the MCIF (if **Process Cycle Start** is configured in the MCIF and cleared in Remote Control), or following a **Process Cycle Stop** command on the serial interface.

- When the Process Cycle is stopped following the clearing of **Process Cycle Start** on the MCIF (if **Process Cycle Start** is configured in the MCIF and cleared in Remote Control), or following a **Process Cycle Stop** command on the serial interface, if the current Step being executed is referencing a Parameter Set with a defined ramp down time, **Process Cycle Active** remains set for the duration the ramp down time.

- This function can be assigned to any of the seven outputs
- Associated functions
  - **Laser ON / Process Cycle Start** - Input Function
  - **Laser STANDBY** - Output Function

14.12.2.2 Sequence Diagrams

- See Figure 61 to Figure 84 for examples.

14.12.3 Remote Control (Output Function ID 3)

14.12.3.1 Description

- Default configuration
  - PL5 pin number 20
  - Output number 2
- Basic Function Description
  - Set when in Remote Control
  - Clear when in Local Control
- Detailed Function Description
  - **Remote Control** is used to indicate whether the Laser is in Remote or Local Control mode. Remote Control indicates that the Laser is monitoring and being controlled by the MCIF inputs. Control is local when the output is clear and remote when it is set.
  - Some or all of the Local Control functionality can be utilised when in Remote Control, depending on the MCIF configuration
  - The mode can only be changed between Remote and Local Control using the serial interface
  - **Remote Control** can be assigned to any of the seven outputs

14.12.3.2 Sequence Diagrams

- See Figure 56 to Figure 82 for example functionality

14.12.4 Alarm (Output Function ID 7)

- Default configuration
  - PL5 pin number 8

- Output number 3

- Basic Function Description
  - Set when there is an alarm
  - Clear when there is no alarm
  - Operational in both Local and Remote Control

- Detailed Function Description
  - **Alarm** indicates that there is an alarm. It is cleared, once the fault (or faults) has been put right, by issuing an **Alarm Reset** command from the MCIF (if **Alarm Reset** is configured in the MCIF and set in Remote Control) or an **Alarm Reset** serial command
  - **Alarm** can be assigned to any of the seven outputs
  - Associated function
    - **Alarm Reset** - Input Function

14.12.5 Warning (Output Function ID 8)

- Default configuration
  - PL5 pin number 21
  - Output number 4

- Basic Function Description
  - Set when there is a warning
  - Clear when there is no warning
  - Operational in both Local and Remote Control

- Detailed Function Description
  - This output is used to indicate when there is a warning
  - This output function is set for any warning. It is clear when there are no warnings
  - This function can be assigned to any of the seven outputs

14.12.6 Process Cycle Wait (Output Function ID 5)

14.12.6.1 Description

- Default configuration
  - PL5 pin number 22
  - Output number 6

- Basic Function Description
  - Set during a Process Cycle at the end of a Step for which AutoStep is ‘No’ to indicate the that Process Cycle is waiting for a **Process Cycle Step** command in order to continue

- Clear at any other time
- Operational in both Local and Remote Control

- Detailed Function Description
  - **Process Cycle Wait** is used to indicate when the Process Cycle is waiting for a **Process Cycle Step** command to continue Process Cycle execution
  - The **Process Cycle Step** command can be from the MCIF (refer to Section 14.11.3) or a **Process Cycle Step** command on the serial interface
  - **Process Cycle Wait** can be assigned to any of the seven outputs
  - Associated functions
    - **Laser ON** / **Process Cycle Start** - Input Function
    - **Process Cycle Step** - Input Function
    - **Laser STANDBY** - Output Function
    - **Laser ON** / **Process Cycle Active** - Output Function

14.12.6.2 Sequence Diagrams

- See Figure 78 and Figure 79 for example functionality

14.13 Basic Control using the MCIF

In order for the Laser to be controlled using the MCIF it is necessary to put it in Remote Control mode using FiberView. This is done, as described in Section 11.4.3, by clicking on the control icon (silhouette of a person) on the FiberView Tool Bar, which will become a gear wheel to indicate that Remote Control is selected. Additionally, the control indicator in the Indicators Area will show red and the adjacent text will say ‘Remote’.

The connections necessary (based on the default MCIF configuration) to start using the Laser in Remote Control mode are:

Laser STANDBY (IN0, Pin 3)

Setting this moves the Laser from OFF to STANDBY.

Laser ON (IN1, Pin 4)

This moves the Laser from STANDBY to ON. A positive edge is required for this input to act. If the Laser is not in STANDBY, the input is ignored.

In order for the Laser to be fully controlled using the MCIF it is necessary to configure one of the inputs as **Trigger Source Select**. When set, the MCIF **Trigger Input** is enabled (external trigger). If it is clear, or is not configured on the MCIF, the active Parameter Set setting is used. When using external Trigger exclusively, this input needs to be held high continuously.

15 Alarm and Warning Messages

15.1 Alarm Code Definitions

Each alarm code contains information about the zone and module associated with the failure. The code can be broken down as follows:

Alarm Code = ZMNN

Where

Z is the zone associated with the alarm.
M is the module number to identify devices where there is more than one.
NN is the alarm code identifying the problem.

15.1.1 PRISM FL Module Zone Alarms

Code	Description
8m01	Module communications failure
8m02	Temperature Optics 1 fault
8m03	Temperature Optics 2 fault
8m04	Temperature 3 fault
8m05	Pumps Temperature 4 fault
8m06	Inlet Water Temperature 5 fault
8m07	Ambient Temperature 6 fault
8m08	Snap switch fault
8m09	Memory corruption fault
8m10	Auxiliary power supply low fault
8m11	Driver power supply not present
8m12	Fiber failure
8m13	BDO open
8m14	BDO short
8m15	Humidity
8m16	Internal communications failure
8m17	Unexpected emission
8m18	Driver negative power supply failure
8m19	PLC driver output fault

15.1.2 System Zone Alarms

Code	Description
1102	System configuration memory failure. Unknown configuration data loaded. Laser will not operate. Factory configuration setup required.
1120	Serial communications failure
1123	Ethernet communications failure
1130	HPFL – combiner base plate - high temperature
1131	High internal optics temperature
1133	HPFL – LCMS cover temperature
1160	Serial watchdog timeout
1162	Ethernet watchdog timeout

15.1.3 Control Zone Alarms

Code	Description
2101	Modulation frequency error – frequency demand out of range
2102	Update error – attempted parameter update failed
2103	Peak current demand error – peak current demand out of range
2105	Ramp time error – ramp timing out of range

15.1.4 Modulator Zone Alarms

Code	Description
3m02	PRISM FL module fault
3m03	PRISM FL module communications failure
3m04	PRISM FL module communications failure

15.1.5 Fiber Zone Alarms

Code	Description
4m01	HPFL – case
4m02	FCMS fault
4m03	Fiber output housing over temperature
4m04	Power monitor signal out of range
4m05	Excessive peak back reflections detected
4m06	Excessive back reflections detected

15.1.6 MCIF Zone Alarms

Code	Description
5101	Configuration memory failure, defaults loaded.

15.1.7 GUI Zone Alarms

Code	Description
6101	Serial communications fault

15.1.8 PSU Zone Alarms

Code	Description
7101	PSU 1 failed
7102	PSU 1 voltage dip detected

15.2 Warning Code Definitions

Each warning code contains information about the zone, and module associated with the failure. It can be broken down as follows:

Warning Code = ZMNN

Where

Z is the zone associated with the warning.
M is the module number to identify devices where there is more than one.
NN is the warning code identifying the problem.

15.2.1 PRISM FL Module Zone Warnings

Code	Description
8m51	PRISM FL module disabled
8m52	Temperature Optics 1 warning
8m53	Temperature Optics 2 warning
8m54	Temperature 3 warning
8m55	Pumps Temperature 4 warning
8m56	Inlet water Temperature 5 warning
8m57	Ambient Temperature 6 warning
8m58	Calibration warning
8m59	Thermistor out of range warning
8m60	Humidity warning

Code	Description
8m61	Calibration failed
8m62	Fan failed

15.2.2 System Zone Warnings

Code	Description
1102	Unknown configuration.
1108	Parameter defaults in use.
1120	Serial communications buffer approaching full
1121	Serial communications buffer full. Messages will be rejected until space available.
1122	Ethernet communications buffer approaching full
1123	Ethernet communications buffer full. Messages will be rejected until space available.
1130	High optics tray temperature
1131	High internal optics temperature
1133	High diode tray temperature
1148	Modulator fault detected
1150	Shape data has been reset
1151	Segment data has been reset
1152	Process cycle data reset
1153	Process cycles Step data reset

15.2.3 Control Zone Warnings

Code	Description
2101	Ramp up incomplete
2102	Ramp down incomplete
2103	Ramp between parameters incomplete
2104	In safe mode following optical fault detection
2105	Modulation frequency error – frequency demand out of range
2106	Fiber pierce frequency error – frequency demand out of range

15.2.4 Fiber Zone Warnings

Code	Description
4m01	LPFL - Burn back protection disabled HPFL - Main power monitor burn back protection disabled
4m02	FCMS circuit broken
4m03	Fiber output housing over temperature
4m04	Back reflection protection disabled
4m05	Excessive back reflections detected

15.2.5 MCIF Zone Warning

Code	Description
5101	Using default MCIF configuration

15.2.6 PSU Zone Warnings

Code	Description
7150	PSU not present.

16 General Information

16.1 Trade Marks

The SPI Lasers logo, SPI, GTWave, variMODE, **redPOWER** and **redENERGY** are trademarks (registered or applied for) of SPI Lasers in at least one of the United States of America, the United Kingdom, the European Community and China, and in various other territories throughout the world. All other trademarks are the property of their registered owners.

16.2 Licensing

This Laser carries no licence by IMRA America, Inc. for pulsed operation less than 100ps.

16.3 Software

Any software forming part of this equipment should be used only for the purpose for which it was supplied by SPI Lasers. No changes, modifications or copies (except for producing a necessary back-up copy) shall be undertaken by the User.

SPI Lasers accepts no responsibility for equipment malfunction resulting from any of the above actions.

16.4 Warranties

SPI Lasers makes no warranties, expressed or implied, including and without limitation warranties as to merchantability or fitness for a particular purpose except as expressly set forth in the standard Terms and Conditions of sale.

16.5 Copyright

16.6 Changes

These Instructions for Use are supplied without liability for errors or omissions. SPI Lasers reserves the right to change the information and specifications contained in these Instructions for Use without prior notice.

17 Contact Information

Table 15 Contact Information

UK Head Office and Manufacturing Facility	US Corporate Office	China Office	Korea Office
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Order Management orders@spilasers.com Tel: +44 (0)1489 779696 - Option 5		**Company Web Site** www.spilasers.com	
Service service@spilasers.com Tel: +44 (0)1489 779696 - Option 2 productsupportasia@spilasers.com Contact your local office number		Or contact your local distributor.	

18 Service

In the unlikely event that the Laser requires attention outside the scope of the maintenance requirements as detailed in Section 10, contact SPI Lasers for advice on further on-site fault diagnosis and/or return of the Laser. Contact information is given in Section 17.

When contacting a Customer Centre, please have the following information at hand:

- The order code.
- The serial number.
- The number of accumulated hours of operation.
- Typical operating parameters.
- Any other relevant information (e.g. fault codes and descriptions) that would assist in fault diagnosis.

If the Laser requires fault-diagnosis or servicing or is to be returned to SPI Lasers, it is the system integrator's responsibility to remove the Laser from the integrated laser system and make it safe and, if the Laser is to be returned to SPI Lasers, to ensure that all relevant return documentation is in place before shipment. Details of documentation requirements and copies can be obtained where required from SPI Lasers.

The Laser must be drained of all coolant and the end caps fitted to all pipes prior to shipment. If the Laser is shipped without the end caps fitted then any residual coolant will escape during transit and may cause permanent damage.

Pack the Laser in the original packaging and include all original accessories and documentation as detailed in the original inventory. The correct and original packaging should be used to prevent damage in transit. If all or part of the original packaging is unavailable, contact SPI Lasers for replacement items. Please take time to complete all return documentation, which can be obtained from SPI Lasers. Accurate details, diagnosis and comments in the documentation reduce turnaround time for repair at SPI Lasers.

On request, SPI Lasers will supply a report detailing faults found and repairs carried out necessary to return the Laser to full operational specification.