

firestar series *vi*



OEM vi30 reference guide



4600 Campus Place
Mukilteo, WA 98275 USA
1.800.SYNRAD1
tel 1.425.349.3500
fax 1.425.349.3667
e-mail synrad@synrad.com
web www.synrad.com

Table of Contents

Contents

Warranty information.....	2
Trademark/copyright information	2
Laser safety	3
Terms	3
General hazards.....	3
Firestar OEM vi30 label locations	6
Compliance requirements.....	7
Center for Devices and Radiological Health (CDRH) requirements.....	7
Federal Communications Commission (FCC) requirements.....	7
European Union (EU) requirements	8
Declaration of Conformity	11
Introduction.....	12
Inventory.....	12
Ship kit.....	12
Ship kit contents.....	12
Installation.....	13
Mounting.....	13
Cooling.....	15
Electrical connections.....	16
Control connections	16
Controls and indicators	17
Operation.....	18
Status LEDs	18
Start-up	18
DB-9 I/O connector.....	20
Firestar vi30 general specifications	22
Firestar OEM vi30 package outline drawings.....	23
Troubleshooting	26
Status indications	26
Laser faults	27
DB-9 I/O connector	29
Optics.....	29

Figures

Figure 1 Firestar OEM vi30 label locations	6
Figure 2 European compliance mark.....	10
Figure 3 Firestar OEM vi30 mounting options.....	13

Figures (cont.)

Figure 4 Optional mounting feet installation.....	14
Figure 5 Recommended vi30 cooling fan locations – free-space cooling	15
Figure 6 Recommended fan shroud design – rear cooling.....	15
Figure 7 Firestar vi30 external temperature monitoring point.....	16
Figure 8 Firestar OEM vi30 controls and indicators.....	17
Figure 9 Firestar OEM vi30 standard package outline and mounting dimensions.....	23
Figure 10 Firestar OEM vi30 package outline and mounting dimensions – with optional customer-installed ‘Tall’ mounting feet	24
Figure 11 Firestar OEM vi30 package outline and mounting dimensions – with optional customer-installed ‘Tall/Wide’ mounting feet.....	25

Tables

Table 1 Class 4 safety features.....	9
Table 2 European Union Directives	10
Table 3 Ship kit contents.....	12
Table 4 DB-9 I/O connector pinouts	21
Table 5 Firestar OEM vi30 specifications	22
Table 6 DB-9 I/O connector status signals	26
Table 7 Firestar vi30 error codes	27

Firestar OEM vi30 Reference Guide

Version 1.1

Released November 2011

Part number 900-20162-01



4600 Campus Place
 Mukilteo, WA 98275 USA
 1.800.SYNRAD1
 tel 1.425.349.3500
 fax 1.425.349.3667
 e-mail synrad@synrad.com
 web www.synrad.com

Warranty information

This is to certify that Firestar® OEM vi30 lasers are guaranteed by SYNRAD, Inc. to be free of all defects in materials and workmanship for a period of one year from the date of purchase. This warranty does not apply to any defect caused by negligence, misuse (including environmental factors), accident, alteration, or improper maintenance. We request that you examine each shipment within 10 days of receipt and inform SYNRAD, Inc. of any shortage or damage. If no discrepancies are reported, SYNRAD shall assume the shipment was delivered complete and defect-free.

If, within one year from the date of purchase, any part of the Firestar vi30 laser should fail to operate, contact the SYNRAD Customer Service department at 1.800.SYNRAD1 (outside the U.S. call 1.425.349.3500) and report the problem. When calling for support, please be prepared to provide the date of purchase, model number and serial number of the unit, and a brief description of the problem. When returning a unit for service, a Return Authorization (RA) number is required; this number must be clearly marked on the outside of the shipping container in order for the unit to be properly processed. If replacement parts are sent to you, then you are required to send the failed parts back to SYNRAD for evaluation unless otherwise instructed.

If your Firestar vi30 laser fails within the first 45 days after purchase, SYNRAD, Inc. will pay all shipping charges to and from SYNRAD when shipped as specified by SYNRAD Customer Service. After the first 45 days, SYNRAD will continue to pay for the costs of shipping the repaired unit or replacement parts back to the customer from SYNRAD. The customer, however, will be responsible for shipping charges incurred when sending the failed unit or parts back to SYNRAD or a SYNRAD Authorized Distributor. In order to maintain your product warranty and to ensure the safe and efficient operation of your Firestar vi30 laser, only authorized SYNRAD replacement parts can be used. This warranty is void if any parts other than those provided by SYNRAD, Inc. are used.

SYNRAD, Inc. and SYNRAD Authorized Distributors have the sole authority to make warranty statements regarding SYNRAD products. SYNRAD, Inc. and its Authorized Distributors neither assumes nor authorizes any representative or other person to assume for us any other warranties in connection with the sale, service, or shipment of our products. SYNRAD, Inc. reserves the right to make changes and improvements in the design of our products at any time without incurring any obligation to make equivalent changes in products previously manufactured or shipped. Buyer agrees to hold SYNRAD harmless from any and all damages, costs, and expenses relating to any claim arising from the design, manufacture, or use of the product, or arising from a claim that such product furnished Buyer by SYNRAD, or the use thereof, infringes upon any Patent, foreign or domestic.

Trademark/copyright information

SYNRAD and Firestar are registered trademarks of SYNRAD, Inc.

All other trademarks or registered trademarks are the property of their respective owners.

© 2011 by SYNRAD, Inc.
All rights reserved.

Laser safety

The *Laser safety* section includes terms, symbols, and instructions used in this manual or on the equipment to alert operating and service personnel to the recommended precautions in the care, use, and handling of Class 4 laser equipment.

Terms

Certain terms are used throughout this manual or on the equipment labels. Please familiarize yourself with their definitions and significance.

⚠ Danger: Imminent hazards which, if not avoided, will result in death or serious injury.

⚠ Warning: Potential hazards which, if not avoided, could result in death or serious injury.

⚠ Caution: Potential hazards or unsafe practices which, if not avoided, may result in minor or moderate injury.

Caution: Potential hazards or unsafe practices which, if not avoided, may result in product damage.

Important Note: Important information or recommendations concerning the subject under discussion.

Note: Points of particular interest for more efficient or convenient equipment operation; additional information or explanation concerning the subject under discussion.

General hazards

Following are descriptions of general hazards and unsafe practices that could result in death, severe injury, or product damage. Specific warnings and cautions not appearing in this section are found throughout the manual.

⚠ Danger
serious
personal
injury

This Class 4 laser product emits *invisible* infrared laser radiation in the 10.6 μm CO_2 wavelength band.

Do not allow laser radiation to enter the eye by viewing direct or reflected laser energy. CO_2 laser radiation can be reflected from metallic objects even though the surface is darkened. Direct or diffuse laser radiation can inflict severe corneal injuries leading to permanent eye damage or blindness. All personnel must wear eye protection suitable for 10.6 μm CO_2 radiation when in the same area as an exposed laser beam. Eyewear protects against scattered energy but is not intended to protect against direct viewing of the beam—never look directly into the laser output aperture or view scattered laser reflections from metallic surfaces.

Enclose the beam path whenever possible. Exposure to direct or diffuse CO_2 laser radiation can seriously burn human or animal tissue, which may cause permanent damage.

⚠ Danger
serious
personal
injury

This product is not intended for use in explosive, or potentially explosive, atmospheres.

Laser safety (cont.)

Warning

serious
personal
injury

U.S. customers should refer to and follow the laser safety precautions described in the American National Standards Institute (ANSI) Z136.1-2007 document, *Safe Use of Lasers*. Procedures listed in this Standard include the appointment of a Laser Safety Officer (LSO), operation of the product in an area of limited access by trained personnel, servicing of equipment only by trained and authorized personnel, and posting of signs warning of the potential hazards.

European customers should appoint a Laser Safety Officer (LSO) who should refer to and follow the laser safety precautions described in EN 60825-1, 2007—*Safety of Laser Products*.

Warning

serious
personal
injury

Materials processing can generate air contaminants such as vapors, fumes, and/or particles that may be noxious, toxic, or even fatal. Material Safety Data Sheets (MSDS) for materials being processed should be thoroughly evaluated and the adequacy of provisions for fume extraction, filtering, and venting should be carefully considered. Review the following references for further information on exposure criteria:

ANSI Z136.1-2007, *Safe Use of Lasers*, section 7.3.

U.S. Government's *Code of Federal Regulations*: 29 CFR 1910, Subpart Z.

Threshold Limit Values (TLV's) published by the American Conference of Governmental Industrial Hygienists (ACGIH).

It may be necessary to consult with local governmental agencies regarding restrictions on the venting of processing vapors.

Warning

serious
personal
injury

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Warning

serious
personal
injury

The use of aerosol dusters containing difluoroethane causes “blooming”, a condition that **significantly** expands and scatters the laser beam. This beam expansion can effect mode quality and/or cause laser energy to extend beyond the confines of optical elements in the system, possibly damaging acrylic safety shielding. Do not use air dusters containing difluoroethane in any area adjacent to CO₂ laser systems because difluoroethane persists for long time periods over wide areas.

Laser safety (cont.)

Firestar® OEM vi30 lasers should be installed and operated in manufacturing or laboratory facilities by trained personnel only. Due to the considerable risks and hazards associated with the installation and operational use of any equipment incorporating a laser, the operator must follow product warning labels and instructions to the user regarding laser safety.

To prevent exposure to direct or scattered laser radiation, follow all safety precautions specified throughout this manual and exercise safe operating practices per ANSI Z136.1-2007 at all times when actively lasing.

Always wear safety glasses or protective goggles with side shields to reduce the risk of damage to the eyes when operating the laser.

A CO₂ laser is an intense heat source and will ignite most non-metallic materials under the proper conditions. Never operate the laser in the presence of flammable or explosive materials, gases, liquids, or vapors.

The use of controls or adjustments or performance of procedures other than those specified herein may result in exposure to hazardous *invisible* laser radiation, damage to, or malfunction of the laser. Severe burns will result from exposure to the laser beam.

Safe operation of the laser requires the use of an external beam block to safely block the beam from traveling beyond the desired work area. Do not place your body or any combustible object in the path of the laser beam. Use a water-cooled beam dump or power meter, or similar non-scattering, noncombustible material as the beam block. Never use organic material or metals as the beam blocker; organic materials, in general, are apt to combust or melt and metals act as specular reflectors which may create a serious hazard outside the immediate work area.

Other hazards

The following hazards would be typical for this product family when incorporated for intended use: (A) risk of injury when lifting or moving the unit; (B) risk of exposure to hazardous laser energy through unauthorized removal of access panels, doors, or protective barriers; (C) risk of exposure to hazardous laser energy and injury due to failure of personnel to use proper eye protection and/or failure to adhere to applicable laser safety procedures; (D) risk of exposure to hazardous or lethal voltages through unauthorized removal of covers, doors, or access panels; (E) generation of hazardous air contaminants that may be noxious, toxic, or even fatal.

Disposal

This product contains components that are considered hazardous industrial waste. If a situation occurs where the laser is rendered non-functional and cannot be repaired, it may be returned to SYNRAD, Inc. who, for a fee, will ensure adequate disassembly, recycling, and/or disposal of the product.

Additional laser safety information

The SYNRAD web site (<http://www.synrad.com/LaserFacts/lasersafety.html>) contains an online laser safety handbook that provides information on (1) Laser Safety Standards for Firestar's/System Integrators including product classification, product housing, product features, and other CDRH requirements; (2) Laser Safety Standards for End Users including Class 1 installations, Class 4 installations, laser hazards, ANSI Standard, U.S. State requirements, and OSHA; (3) References and Sources including CDRH, ANSI/OSHA; and (4) Assistance with Requirements.

In addition, the Occupational Safety and Health Administration (OSHA) provides an online Technical Manual (located at http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html). Section III, Chapter 6 and Appendix III are good resources for laser safety information.

Another excellent laser safety resource is the Laser Institute of America (LIA). Their comprehensive web site is located at <http://www.laserinstitute.org>.

Firestar OEM vi30 label locations

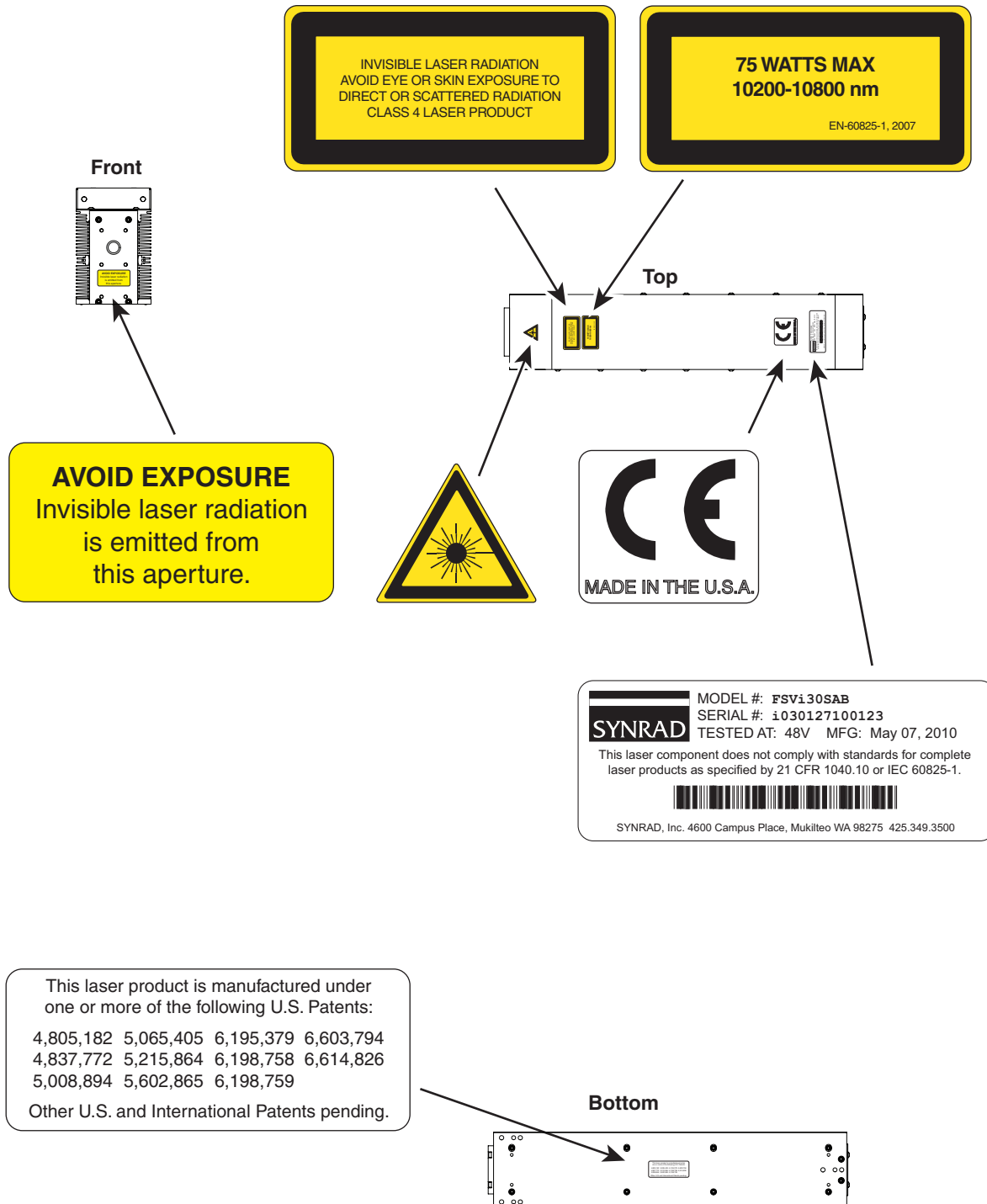


Figure 1 Firestar OEM vi30 label locations

Compliance requirements

SYNRAD lasers are designed, tested, and certified to comply with certain United States (U.S.) and European Union (EU) regulations. These regulations impose product performance requirements related to electromagnetic compatibility (EMC) and product safety characteristics for industrial, scientific, and medical (ISM) equipment. The specific provisions to which systems containing Firestar OEM vi30 lasers must comply are identified and described in the following paragraphs.

In the U.S., laser safety requirements are governed by the Center for Devices and Radiological Health (CDRH) under the auspices of the U.S. Food and Drug Administration (FDA) while radiated emission standards fall under the jurisdiction of the U.S. Federal Communications Commission (FCC). Outside the U.S., laser safety and emissions are governed by European Union (EU) Directives and Standards.

In the matter of CE-compliant laser products, SYNRAD, Inc. assumes no responsibility for the compliance of the system into which the product is integrated, other than to supply and/or recommend laser components that are CE marked for compliance with applicable European Union Directives.

Because OEM laser products are intended for incorporation as components in a laser processing system, they do not meet all of the Standards for complete laser processing systems as specified by 21 CFR, Part 1040 or EN 60825-1. SYNRAD, Inc. assumes no responsibility for the compliance of the system into which OEM laser products are integrated.

Center for Devices and Radiological Health (CDRH) requirements

Firestar vi30 lasers are OEM products intended for incorporation as components in laser processing systems. As supplied by SYNRAD, these lasers do not meet the requirements of 21 CFR, Subchapter J without additional safeguards. In the U.S., the Buyer of these OEM laser components is solely responsible for the assurance that the laser processing system sold to an end user complies with all laser safety requirements before the actual sale of the system. Under CDRH regulations, the Buyer must submit a report to the CDRH prior to shipping the system. In jurisdictions outside the U.S., it is the sole responsibility of the Buyer of these OEM components to ensure that they meet all applicable local laser safety requirements. In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above.

To aid in the development of integrated OEM vi30 systems see Table 1, *Class 4 safety features*. The table indicates which features are available on vi30 OEM lasers, the type and description of the feature, and if the feature is required by CDRH regulations.

Federal Communications Commission (FCC) requirements

The United States Communication Act of 1934 vested the Federal Communications Commission (FCC) with the authority to regulate equipment that emits electromagnetic radiation in the radio frequency spectrum. The purpose of the Communication Act was to prevent harmful electromagnetic interference (EMI) from affecting authorized radio communication services. The FCC regulations that govern industrial, scientific, and medical (ISM) equipment are fully described in 47 CFR, Part 18, Subpart C.

SYNRAD's Firestar vi30 OEM lasers have been tested and found to comply by demonstrating performance characteristics that have met or exceeded the requirements of 47 CFR, Part 18, Radiated and Conducted Emissions.

FCC information to the user

NOTE: The following information to the user is provided to comply with the requirements of 47 CFR, Part 18, Section 213.

Interference Potential

In our testing, SYNRAD, Inc. has not discovered any significant electrical interference traceable to Firestar OEM vi30 lasers.

Compliance requirements (cont.)

System Maintenance

Ensure that all exterior covers are properly fastened in position.

Measures to Correct Interference

If you suspect that your Firestar OEM vi30 laser interferes with other equipment, take the following steps to minimize this interference:

- 1 Use shielded cables to and from the equipment that is experiencing interference problems.
- 2 Ensure that the vi30 laser is properly grounded to the same electrical potential as the equipment or system it is connected to.

FCC caution to the user

The Federal Communications Commission warns the user that changes or modifications of the unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

European Union (EU) requirements

RoHS compliance

SYNRAD Firestar OEM vi30 lasers meet the requirements of the European Parliament and Council Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, as amended by Decision 2005/618/EC establishing maximum concentration values for certain hazardous substances in electrical and electronic equipment.

Laser safety standards

Under the Low Voltage Directive, 2006/95/EC, the European Norm document 60825-1 was developed to protect persons from laser radiation by imposing requirements upon manufacturers of laser products to provide an indication of laser radiation; to classify laser products according to the degree of hazard; to require both user and manufacturer to establish procedures so that proper precautions are adopted; to ensure adequate warning of the hazards associated with accessible radiation through signs, labels, and instructions; to improve control of laser radiation through protective features; and to provide safe usage of laser products by specifying user control measures.

SYNRAD's Firestar vi30 lasers are OEM products intended for incorporation as components in laser processing systems. As supplied by SYNRAD, these lasers do not meet the requirements of EN 60825-1 without additional safeguards. European Union Directives state that "OEM laser products which are sold to other manufacturers for use as components of any system for subsequent sale are not subject to this Standard, since the final product will itself be subject to the Standard." This means that Buyers of OEM laser components are solely responsible for the assurance that the laser processing system sold to an end-user complies with all laser safety requirements before the actual sale of the system. Note that when an OEM laser component is incorporated into another device or system, the entire machinery installation may be required to conform to EN 60825-1, EN 60204-1, *Safety of Machinery*; the Machinery Directive EN 2006/42/EC; and/or any other applicable Standards. In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above.

To aid in the development of integrated vi30 systems see Table 1, *Class 4 safety features*. The table indicates which features are available on Firestar vi30 OEM lasers, the type and description of the feature, and if the feature is required by CDRH regulations.

Compliance requirements (cont.)

Table 1 Class 4 safety features

Feature	Location/Description	Required by:		Provided on Firestar vi30
		CDRH	EN60825-1	
Keyswitch	Rear panel control On/Off/Reset Keyswitch controls power to laser electronics. Key cannot be removed from switch in the “On” position.	Yes	Yes	No
Shutter function	Laser control Functions as a beam attenuator to disable RF driver/laser output when closed.	Yes	Yes	No
PWR (Power) indicator	Rear panel indicator (Green) Illuminates green to indicate DC power is applied.	No	No	Yes
RDY (Ready) indicator	Rear panel indicator (Yellow) Indicates that laser has power applied and is capable of lasing.	Yes	Yes	Yes
LASE indicator	Rear panel indicator (Red) Indicates that Firestar is actively lasing. LASE LED illuminates when the duty cycle of the Command signal is long enough to produce laser output.	Yes	Yes	Yes
Five second delay	Firestar circuit element Disables RF driver/laser output for five seconds after Laser Enable signal is applied.	Yes	No	Yes
Power fail lockout	Firestar circuit element Disables RF driver/laser output if input power is removed then later reapplied (AC power failure or remote interlock actuation) while Keyswitch is in “On” position.	Yes	Yes	No
Remote Interlock	Rear panel connection Disables RF driver/laser output when a remote interlock switch on an equipment door or panel is opened.	Yes	Yes	No
Over temperature protection	Firestar circuit element Temperature shutdown occurs if temperature of the laser tube rises above safe operating limits.	No	No	Yes
Warning labels	Firestar exterior Labels attached to various external housing locations to warn personnel of potential laser hazards.	Yes	Yes	Yes

Electromagnetic interference standards

The European Union’s Electromagnetic Compatibility (EMC) Directive, 2004/108/EC, is the sole Directive developed to address electromagnetic interference (EMI) issues in electronic equipment. In particular, the Directive calls out European Norm (EN) documents that define the emission and immunity standards for specific product categories. For Firestar vi30 lasers, CISPR:11 and EN 61000-6-4 define radiated and conducted RF emission limits while the generic Standard EN 61000-6-2 defines immunity requirements.

SYNRAD’s Firestar OEM vi30 lasers have been tested and found to comply by demonstrating performance characteristics that have met or exceeded the requirements of EMC Directive 2004/108/EC.

Compliance requirements (cont.)

When integrating SYNRAD's OEM vi30 lasers, the Buyer and/or integrator of the end system is responsible for meeting all applicable Standards to obtain the CE mark. To aid this compliance process, SYNRAD's testing program has demonstrated that Firestar vi30 lasers comply with the relevant requirements of 2004/108/EC, the Electromagnetic Compatibility Directive, as summarized in Table 2 below.

Table 2 European Union Directives

Applicable Standards/Norms

2004/108/EC	Electromagnetic Compatibility
2006/95/EC	Low Voltage Directive
2002/95/EC	RoHS Directive (amended 2005/618/EC)
EN 61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1:General Requirements
CISPR 11:2009	Conducted and Radiated Emissions, Group 1, Class A
EN 61000-6-4 (2007)	Emission Standard for Industrial Environments
EN 61000-6-2 (2005)	Immunity for Industrial Environments
EN 61000-4-2:1995 +A1:1998 +A2:2001	Electrostatic Discharge
EN 61000-4-3:2006 +A1:2008	Radiated RF Immunity
EN 61000-4-4:2004 +C1:2006 +C2:2007	Electrical Fast Transient/Burst
EN 61000-4-5:2006	Surge Immunity
EN 61000-4-6:2009	Conducted RF Immunity
EN 61000-4-8:1994 +A1:2000	Power Frequency H-Field Immunity

After a product has met the requirements of all applicable EU Directives, the product can bear the official compliance mark of the European Union as shown in Figure 2.



Figure 2 European compliance mark

Declaration of Conformity

Declaration of Conformity

in accordance with ISO/IEC 17050-2:2004

We,

Manufacturer's Name: SYNRAD, Inc.
Manufacturer's Address: 4600 Campus Place
Mukilteo, WA 98275
U.S.A.

hereby declare under our sole responsibility that the following equipment:

Product Name: Firestar OEM vi30 Laser*
Model Number: FSVi30SAB

conforms to the following Directive(s) and Standard(s):

Applicable Directive(s): 2004/108/EC Electromagnetic Compatibility Directive
2002/95/EC RoHS Directive (amended by 2005/618/EC)

Applicable Standard(s):

EN 61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1
CISPR 11:2009	Conducted and Radiated Emissions, Group 1, Class A
EN 61000-6-4 (2007)	Emission Standard for Industrial Environments
EN 61000-6-2 (2005)	Immunity for Industrial Environments
EN 61000-4-2:1995 +A1:1998 +A2:2001	Electrostatic Discharge
EN 61000-4-3:2006 +A1:2008	Radiated RF Immunity
EN 61000-4-4:2004 +C1:2006 +C2:2007	Electrical Fast Transient/Burst
EN 61000-4-5:2006	Surge Immunity
EN 61000-4-6:2009	Conducted RF Immunity
EN 61000-4-8:1994 +A1:2000	Power Frequency H-Field Immunity

*OEM lasers do not comply with EN 60825-1:2007, *Safety of Laser Products*. Buyers of OEM laser products are solely responsible for meeting applicable Directives and Standards for CE compliance and marking.

Corporate Officer:



Dave Clarke, President of SYNRAD, Inc.

European Contact:

Excel Technology Europe GmbH
Münchner Str. 2a
D-82152 Planegg
Germany

Dated 3 December 2010



Introduction

The Firestar OEM vi30 laser is a more compact version of the Firestar v30 laser and is designed to provide OEMs with the smallest possible 30 W laser package. The optoisolated PWM input, *PWM Positive*, (on the DB-9 I/O connector) is identical to that on the v30 laser and, like the v30, the vi30 does **not** incorporate a built-in tickle generator—users **must** provide a 5 kHz, 1 μs tickle pulse between applied PWM signals. All input/output signals on the vi30’s DB-9 I/O connector are identical to v30 I/O signals and operate at the same 5V logic levels to ensure compatibility and ease of installation when retrofitting the vi30 into existing v30 laser systems. The vi30 user interface consists of only the DB-9 I/O connector, it does **not** include an RJ45 connection.

Note: Although the OEM vi30 is part of the Firestar family of lasers, its user interface differs significantly from the standard Firestar interface design. See the *DB-9 I/O connector* section for details.

In addition to the standard vi30 mounting method (see Figure 8, *Firestar OEM vi30 standard package outline and mounting dimensions*), there are two optional vi30 mounting kits available separately from the factory. The feet in the ‘Tall’ mounting kit (Synrad P/N 250-20190-01) raise the OEM vi30 by 0.231" (5.9 mm) to match the v30’s beam exit height without extending beyond the standard vi30 baseplate. The ‘Tall/Wide’ mounting kit (Synrad P/N 250-20190-02) raises the vi30 to match v30 beam exit height and the wider feet allow the vi30 to be installed using existing v30 mounting holes.

The OEM vi30 laser is available in an air-cooled (SA) configuration only, so the OEM or end-user is required to supply appropriate means of cooling the laser.

The Firestar OEM vi30 laser is an OEM product intended for incorporation as a component in a laser processing system and as such does not comply with 21 CFR, Subchapter J or EN 60825-1 without additional safeguards.

Inventory

Ship kit

Table 3 lists items included in the OEM vi30 ship kit.

Table 3 Ship kit contents

Shipping Box Contents	Qty	Shipping Box Contents	Qty
SYNRAD Firestar OEM vi30 Laser.....	1	Spare Fuse	1
Mounting Bolts	3	Final Test Report	1
Firestar OEM vi30 Reference Guide	1		

Ship kit contents

Each item listed in Table 2 is described below:

SYNRAD Firestar OEM vi30 Laser – for cutting, welding, drilling, and marking a wide variety of products.

Mounting Bolts – 1/4–20 UNC bolts fasten the laser to your mounting surface.

Firestar OEM vi30 Reference Guide – provides setup, operation, and maintenance information for your vi30 laser.

Spare Fuse – fast-blow 15 A fuse protects the Firestar vi30’s internal circuitry.

Final Test Report – contains data collected during the laser’s final pre-shipment test.

Mounting

The Firestar OEM vi30 base plate (and the optional customer-installed mounting feet) are designed so the laser can be easily mounted using only three 1/4–20 UNC or M6 × 1 ISO fasteners. Three ball bearing ‘feet’ eliminate any possible distortion of the laser tube caused by variations in the flatness of the mounting surface.

Important Note: To prevent possible distortion of the laser tube, you must fasten the vi30 laser directly to your mounting surface through the base plate or the optional factory-designed mounting feet. Both the vi30 base plate and the optional ‘Tall’ or ‘Tall/Wide’ feet incorporate a hardened ball bearing design that eliminates any possible distortion caused by variations in the flatness of the mounting surface

Installing the optional mounting feet

For most customers, the standard baseplate design provides the smallest physical footprint for mounting the OEM vi30 in compact laser systems. Where Firestar v30 compatibility is desired, you can install one of the two optional mounting kits (available separately from the factory). The ‘Tall’ mounting kit (Synrad P/N 250-20190-01) raises the vi30 laser by 0.231" (5.9 mm) to match v30 beam exit height. Feet in the ‘Tall/Wide’ mounting kit (Synrad P/N 250-20190-02) raise the vi30 to match v30 beam exit height and mounting dimensions exactly. All three mounting options are shown in Figure 3 below. For dimensional information, see the Firestar vi30 outline and mounting drawings later in this manual.

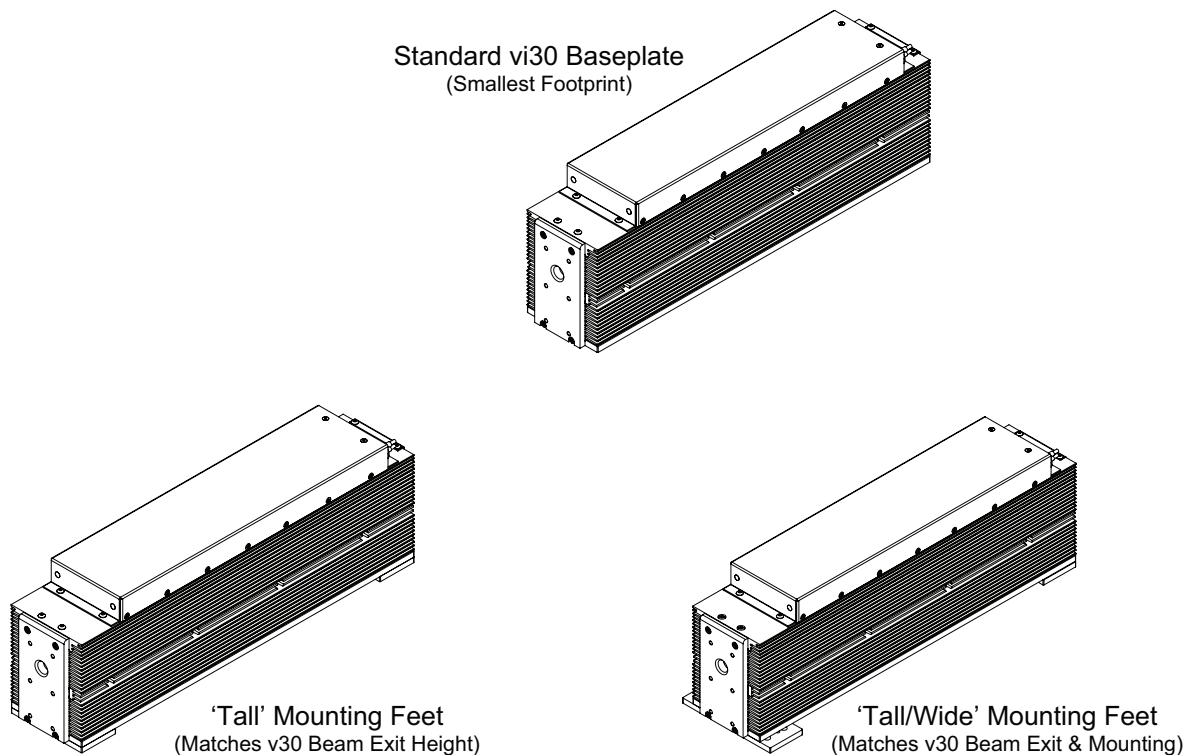


Figure 3 Firestar OEM vi30 mounting options

To attach the optional ‘Tall’ or ‘Tall/Wide’ mounting feet to the vi30 laser, refer to Figure 4 and perform the following steps:

- 1 Carefully place the OEM vi30 laser upside down on the work surface.
- 2 Orient the ‘Tall’ or ‘Tall/Wide’ mounting feet so the ball bearings are facing up and position them over the existing ball bearings/mounting holes in the laser baseplate.

Installation (cont.)

- 3 Locate the M4 × .7 ISO Allen cap screw fasteners in the mounting kit and insert them through the mounting feet into the threaded holes of the vi30 baseplate. Turn the screws by hand until the threads engage.

Note: Mounting bolts must not extend further than 0.24" (6.0 mm) into the optional vi30 mounting feet.

- 4 Evenly tighten all four cap screws to a torque value between 18–26 in lb_f (2–3 N m).

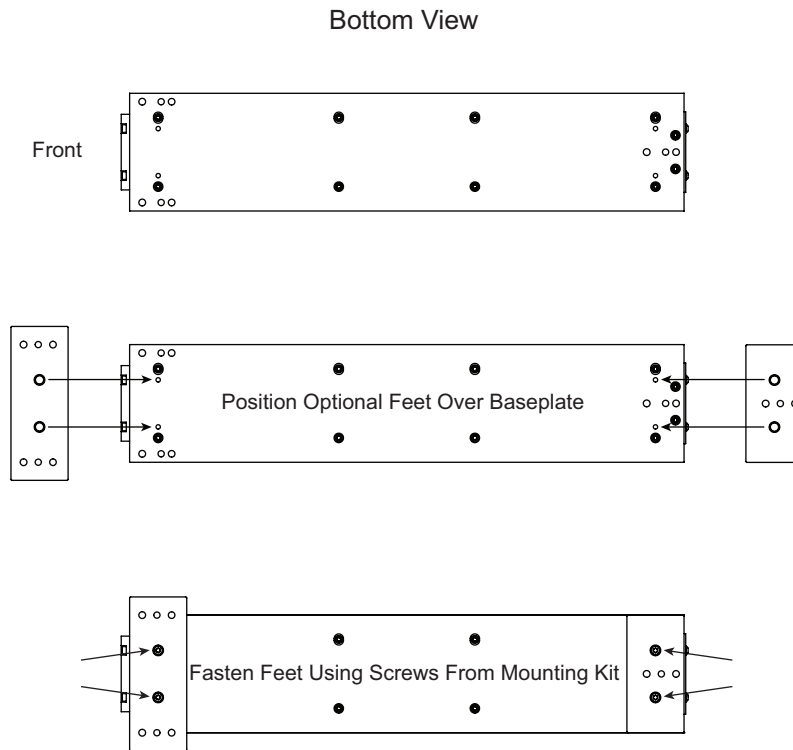


Figure 4 Optional mounting feet installation

Mounting the OEM vi30 laser

To fasten the Firestar OEM vi30 laser to your mounting surface, perform the following steps:

- 1 Refer to the appropriate vi30 outline and mounting diagram and drill three holes into your mounting surface that correspond to either the UNC or metric baseplate (or optional mounting foot) hole pattern.
- 2 Place the vi30 on the mounting surface so that the threaded holes on the baseplate (or optional mounting feet) line up with the holes in your mounting surface.

Note: Mounting bolts must not extend further than 0.24" (6.0 mm) into the vi30 baseplate.

- 3 Insert three 1/4–20 UNC or M6 × 1 ISO Allen cap screws through the mounting surface into the threaded holes of the vi30 baseplate (or mounting feet). Turn the screws by hand until the threads engage.
- 4 Evenly tighten all three cap screws to a maximum torque value of 54 in lb_f (6.1 N m).

Cooling

Cooling fan configuration

Because Firestar vi30 lasers are OEM models, they do not include cooling fans. To prevent an over temperature fault from occurring, customers must provide two 140 CFM cooling fans rated for a static air pressure of 0.94 inches of water (23.9 mm H₂O). The cooling fans should measure 4.7" × 4.7" (120 × 120 mm) and have at least 2.25" (57.2 mm) of unobstructed clearance between the rear face of the fan housing and any mounting surface or enclosure.

For free-space mounting (no fan shroud), position the fans symmetrically as shown in Figure 5 – centered horizontally with the laser chassis and vertically with the heatsink fins. Position both fans so the front face is no more than 3.0" (76 mm) from the vi30's heatsink fins.

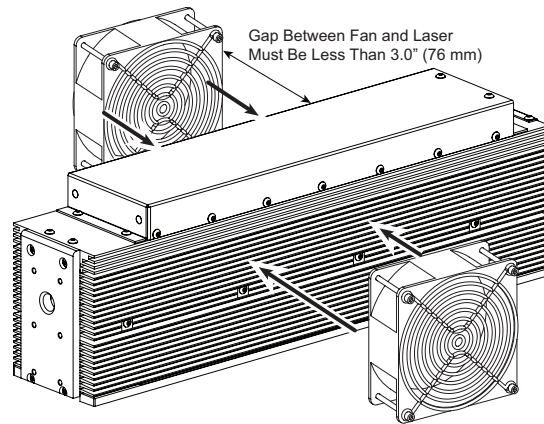


Figure 5 Recommended vi30 cooling fan locations – free-space cooling

When using a tight-fitting fan shroud designed for side cooling, the cooling fans can be positioned between 0.20–1.0" (5–25 mm) of the heatsink fins as long as the same gap is maintained on either side.

A fan shroud designed for rear cooling can be used to minimize the width of the laser installation as shown in Figure 6. The shroud should enclose the full length of the laser and the cooling fan and must fit snugly against the laser's heatsink fins. Use a fan rated for 300 CFM at a static air pressure of 0.94 inches of water (23.9 mm H₂O) and position it approximately 6.0" (15 cm) from the rear of the laser.

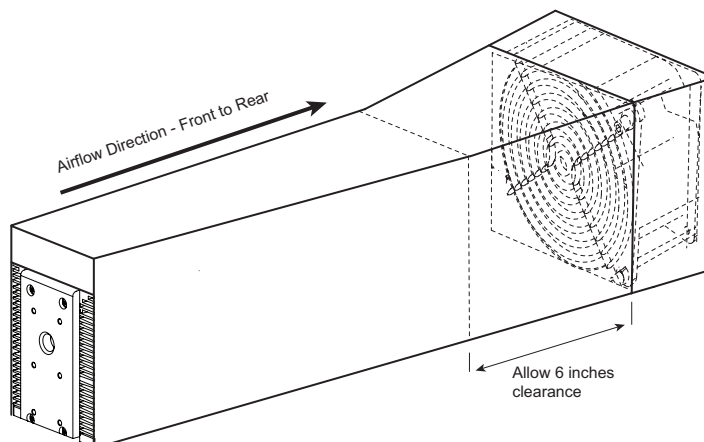


Figure 6 Recommended fan shroud design – rear cooling

Installation (cont.)

The OEM vi30 does not provide a voltage output sufficient to power cooling fans, so customers must provide an external power source to drive the selected cooling fans. Because of the heat generated by internal RF circuitry, establishing significant airflow evenly over the entire surface of the combined laser/RF chassis is vitally important to the performance and longevity of the laser.

Temperature monitoring

For customers who wish to monitor vi30 chassis temperature, Figure 7 shows the recommended location for mounting a customer-supplied, external temperature sensor. A reading of approximately 60 °C (140 °F) at this location is the point where over temperature faults will begin to occur.



Figure 7 Firestar vi30 external temperature monitoring point

Electrical connections

DC power supply

The Firestar OEM vi30 laser requires a DC power supply capable of providing 48 VDC at 10 A minimum (11 A peak for less than 1 ms). To connect the vi30 laser to the 48 VDC power supply, perform the following steps:

- 1 Verify that input AC power to the DC power supply is physically locked out or disconnected.
- 2 Locate the 48 VDC output terminals on the power supply's output section and connect the black (-) DC power cable from the vi30 laser to the negative (-) output terminal.
- 3 Connect the red (+) DC power cable from the laser to the positive (+) 48 VDC output terminal.

Note: The negative (-) side of the DC input to the laser is internally connected so that the laser chassis serves as DC power ground. You should isolate the laser's DC power supply so that the only grounded connection is at the laser. Alternatively, you can mount the laser chassis on an insulating pad or film in order to electrically isolate the laser when other equipment is grounded to the laser's DC power supply.

Control connections

Complete all control connections to the Firestar OEM vi30 laser through the DB-9 I/O connector on the vi30's rear panel. The interface connector receives tickle pulse and PWM Command signals and also serves as the connection point for auxiliary signals between the laser and any parts handling, automation, or monitoring equipment. Refer to the *DB-9 I/O connector* section for specific details about the Firestar vi30 user interface.

The Firestar vi30 control board does **not** incorporate a built-in tickle generator. If you are not using a SYNRAD UC-2000 Universal Laser Controller to operate the laser, you **must** provide a 5 kHz, 1 μ s tickle pulse between applied PWM signals. Refer to the *Firestar v40 Operator's Manual* and see *Controlling laser power* in the Technical Reference chapter for tickle signal descriptions. A PDF version is available from our web site at: <http://www.synrad.com/Products/manuals.htm>.

Controls and indicators

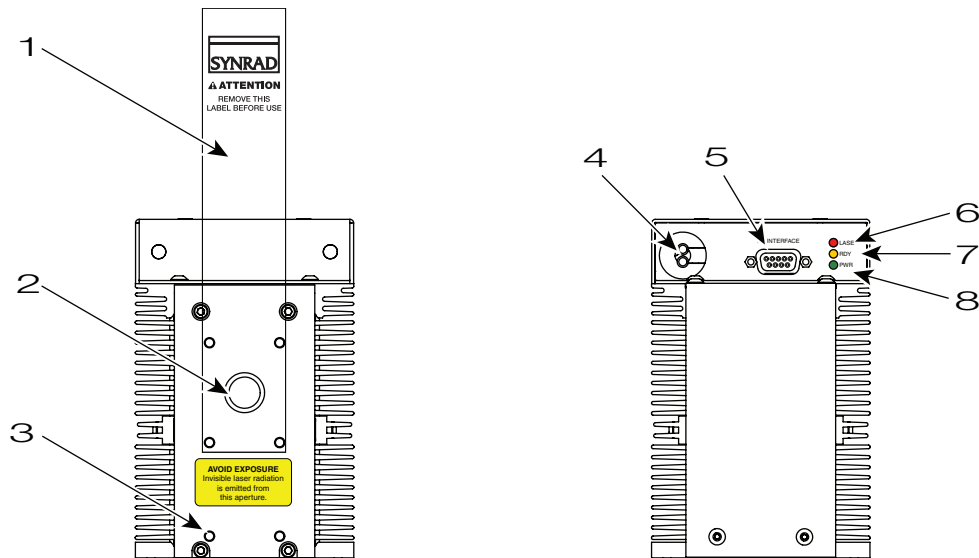


Figure 8 Firestar OEM vi30 controls and indicators

- 1 Aperture Seal – prevents dust from damaging the output coupler during shipping. Remove the red self-adhesive label before applying power to the laser.
- 2 Laser Aperture – provides an opening in the OEM vi30's front panel from which the beam exits.
- 3 Optical Accessories Mounting – provides six threaded holes (8–32 UNC) for mounting optional beam delivery components available from SYNRAD. Because excessive weight may damage the laser, consult SYNRAD before mounting components not specifically designed as Firestar options. Refer to the Firestar OEM vi30 package outline drawings for mounting hole dimensions.

Note: When mounting optical components to the Firestar vi30, excessive fastener length may damage the laser. See the package outline drawings for important information about accessory mounting hole depth.

- 4 DC Power Cables – receives 48 VDC from the DC power supply. The cables are manufactured with #12 AWG wire and measure 1 meter (40 inches) in length. The red (positive) cable contains a replaceable in-line fuse. If fuse replacement is required, replace it with a Bussman ABC15 or a Littelfuse 314015 fuse.
- 5 DB-9 I/O Connector – provides a connection point for auxiliary output power as well as input and output signals. Refer to the *DB-9 I/O connector* section for DB-9 interface details and pinouts.
- 6 LASE Indicator – illuminates red to indicate that the Firestar vi30 is actively lasing. The LASE indicator is off when tickle pulses are being generated and illuminates red when PWM Command signal pulses are long enough to produce laser output.
- 7 RDY Indicator – illuminates yellow when the laser is enabled, indicating that lasing will begin when a Command signal is applied.
- 8 PWR Indicator – illuminates green when +48 VDC power is applied to the laser.

Operation

Status LEDs

Three status LEDs provide a visual indication of operating status. A green *PWR* LED illuminates when DC power is applied to the laser. The yellow *RDY* LED indicates that a *Laser Enable* signal has been applied and that, after a five-second delay, lasing will begin once a PWM Command signal is received. The *LASE* LED illuminates red to indicate that the PWM signal is sufficient to induce laser output.

Start-up

⚠ Danger
serious
personal
injury

This Class 4 laser emits *invisible* infrared laser radiation in the 10.6 μm CO_2 wavelength band. Since direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Do not allow the laser beam to contact a person. This product emits an invisible laser beam that is capable of seriously burning human tissue.

Always be aware of the beam's path and always use a beam block while testing.

⚠ Warning
serious
personal
injury

On Firestar OEM vi30 lasers, DC voltage faults are not latched. Clearing a DC voltage fault (under- or over-voltage) will restore normal operation and lasing is possible after the five-second delay provided that the Laser Enable input signal is high. Because exposure to 10.6 μm CO_2 laser radiation can inflict severe corneal injuries and seriously burn human tissue, the Firestar or System Integrator must ensure that appropriate safeguards are in place to prevent unintended lasing.

Note: After applying 48 VDC, but before operating the laser, you must provide a *Laser Enable* signal to the DB-9 I/O connector.

- 1 If you have not already done so, remove the red self-adhesive aperture seal from the front of the laser.
- 2 Ensure that all personnel in the area are wearing protective eyewear.
- 3 Place a beam block 24 inches from the laser aperture to prevent the beam from traveling beyond the work area.

Note: If you are using a UC-2000 to control the OEM vi30 laser, refer to the *UC-2000 Laser Controller Operator's Manual* for setup and operation instructions before continuing.

If you are not using a UC-2000 to control the laser, you must provide tickle and PWM Command signals to control power output. Refer to the *Firestar v40 Operator's Manual* and see *Controlling laser power* in the Technical Reference chapter for tickle and PWM Command signal descriptions. A PDF version is available from our web site at <http://www.synrad.com/Products/manuals.htm>.

- 4 Set the UC-2000 to *MANUAL* mode, and then set the *PWM Adj Knob* to provide zero percent output (0.0%). The UC-2000's *Lase* indicator should be Off.

If not using a UC-2000, ensure that your PWM controller is set to zero percent output (0.0%).

Operation (cont.)

- 5 Turn on the +48 VDC power supply. The *PWR* LED should illuminate green.
- 6 If the laser has a Diode Pointer installed, remove its aperture dust cover.
- 7 Apply a *Laser Enable* signal to the DB-9 I/O connector. The yellow *RDY* lamp turns on to indicate that, after a five-second delay, lasing is enabled when a PWM Command signal is received.
- 8 Press the UC-2000's *Lase On/Off* button. The *Lase* indicator on the UC-2000 should illuminate.
- 9 Use the *PWM Adj Knob* on the UC-2000 Controller to slowly increase power. The *LASE* LED illuminates red when PWM Command pulses are long enough to produce laser output. The spot where the beam hits the beam block should increase in brightness, indicating an increasing power output.

If you are not using a UC-2000 to control the laser, apply tickle pulses (a +5 VDC, 5 kHz square wave of 1 μ s duration) between *PWM Positive* (Pin 1) and *PWM Negative* (Pin 6) on the DB-9 I/O connector. After five to ten seconds, slowly increase the PWM duty cycle of the square wave. The *LASE* LED illuminates red when PWM Command pulses are long enough to produce laser output. The spot where the beam hits the beam block should increase in brightness, indicating an increasing power output.

- 10 Press the UC-2000's *Lase On/Off* button to remove the PWM Command signal from the laser. The *LASE* LED turns off. If your OEM vi30 laser fails to lase, refer to the *Troubleshooting* section for troubleshooting information.

If you are not using a UC-2000 to control the laser, remove the PWM Command signal from the laser and re-apply tickle pulses every 200 μ s. The *LASE* LED turns off. If your OEM vi30 laser fails to lase, refer to the *Troubleshooting* section for troubleshooting information.

DB-9 I/O connector

The DB-9 I/O connector provides a +5 VDC auxiliary output (*DC Out*), a PWM input, an enable input, and four I/O (status) outputs as described in Table 4. The user inputs, *Laser Enable* and *PWM Positive*, enable lasing and provide output power control. The OEM vi30's PWM input (*PWM Positive*) is optoisolated; however, all other inputs and outputs operate using standard 5V logic levels (0 V – logic low; 5 V – logic high). Inputs and outputs are ESD protected, but are **not** optoisolated; all input signals sent to the laser must be clean or conditioned by the user.

Warning serious personal injury

Always use shielded cable when connecting your PWM Command signal source to the *PWM Positive/PWM Negative* connections. In electrically-noisy environments, long lengths of unshielded wire act like an antenna and may generate enough voltage to trigger uncommanded lasing.

Apply a +5 V signal to the *Laser Enable* input to enable lasing, which occurs after a five-second delay. Connect your PWM Command signal (+5 VDC, 5 kHz nominal) between *PWM Positive* and *PWM Negative* inputs to control laser power. There is no internal tickle signal generated by the Firestar vi30 control board. Users **must** provide a 5 kHz, 1 μ s tickle pulse between applied PWM Command signals.

Important Note: When switching +5 VDC to the *Laser Enable* input (DB-9, Pin 9) through a switch or relay contact, we highly recommend adding a 100 Ohm, 1/4 watt resistor in series between the switching device and the *Laser Enable* input.

Caution possible equipment damage

The *Laser Enable* input is a direct 5V logic input. Do not send a voltage signal to the *Laser Enable* input (Pin 9) until DC power is applied—the control board will be damaged. Observe all 5V logic specifications and precautions when integrating Firestar OEM vi30 inputs and outputs into your control system.

Note: You must connect a *Laser Enable* signal to Pin 9 before applying a PWM Command signal to Pin 1, *PWM Positive*, and Pin 6, *PWM Negative*. Configure your control system to provide a *Laser Enable* signal only after all other safe operating conditions are met.

The DB-9 I/O connector provides four 5V logic level outputs to communicate laser status to the control system. *Laser Ready* goes high when lasing is possible; the output is low when the laser is not ready. *Lase Indicator* goes high when the PWM signal is sufficient to induce laser output; the output is low when no beam is being emitted. *DC Voltage Fault* goes high after sensing an under/over voltage condition; the output is low when the DC supply voltage is within limits. *Overtemp Fault* goes high when laser temp rises above its upper thermal limit; otherwise, the output is low.

Note: When an over temperature condition occurs, cool the laser below its over temperature threshold and then cycle DC power to restore normal operation.

Note: Firestar OEM vi30 outputs are voltage sources. They can provide only 20 mA typical, 40 mA maximum, to a ground referenced load (the ground reference, *GND*, is Pin 8.). **The control board will be damaged if this current maximum is exceeded.**

Note: Unlike the Firestar v30 laser, the OEM vi30 user interface consists of only the DB-9 I/O connector, it does **not** include an RJ45 connection.

DB-9 I/O connector (cont.)

Table 4 DB-9 I/O connector pinouts

Pin Name	Function
1 <i>PWM Positive</i>	Optoisolated voltage input for tickle and PWM signals. Reference Pin 1 to <i>PWM Negative</i> (Pin 6). The tickle signal is a +5 VDC, 1 μ s pulse at 5 kHz while the PWM Command signal is a +5 VDC, 5 kHz nominal (25 kHz maximum) signal.
2 <i>Laser Ready</i>	The <i>Laser Ready</i> output is logic high (+5 V) when the laser is ready to lase; the output is low (0 V) when the laser is not ready. The <i>Laser Ready</i> output sources 20 mA typical, 40 mA maximum.
3 <i>Lase Indicator</i>	The <i>Lase Indicator</i> output is logic high (+5 V) when the laser is actively lasing; the output is low (0 V) when not lasing. The <i>Lase Indicator</i> output sources 20 mA typical, 40 mA maximum.
4 <i>Overtemp Fault</i>	The <i>Overtemp Fault</i> output is logic high (+5 V) when an over temperature condition is detected; the output is low (0 V) when laser temperature is within normal limits. The <i>Overtemp Fault</i> output sources 20 mA typical, 40 mA maximum.
5 <i>DC Out</i>	Pin 5, <i>DC Out</i> , provides a +5 VDC, 250 mA maximum, user output voltage. For example, this voltage can be jumpered, or switched, to drive Pin 9, the <i>Laser Enable</i> input.
6 <i>PWM Negative</i>	Negative side of the optoisolated tickle/PWM Command signal. Reference Pin 6 to <i>PWM Positive</i> (Pin 1).
7 <i>DC Voltage Fault</i>	The <i>DC Voltage Fault</i> output is logic high (+5 V) if DC input voltage is under or over voltage limits; the output is low (0 V) when DC input voltage is within limits. The <i>DC Voltage Fault</i> output sources 20 mA typical, 40 mA maximum.
8 <i>GND</i>	Pin 8, <i>GND</i> , is the ground reference pin for all input/output signals except <i>PWM Positive</i> .
9 <i>Laser Enable</i>	When voltage on the <i>Laser Enable</i> input is logic high (+5 V), the laser is enabled; the laser is disabled when the input is low (0 V). A five-second delay is invoked after this input goes high. The laser must be enabled, <i>Laser Enable</i> must be high, before a signal on Pin 1, <i>PWM Positive</i> , can fire the laser.

Important Note: When switching +5 VDC to the *Laser Enable* input (DB-9, Pin 9) through a switch or relay contact, we highly recommend adding a 100 Ohm, 1/4 watt resistor in series between the switching device and the *Laser Enable* input.

Firestar OEM vi30 general specifications

Table 5 Firestar OEM vi30 specifications

Output Specifications

Wavelength [†]	10.57–10.63 microns
Power Output, continuous ^{1,2}	30 Watts
Power Stability ³	±5%
Power Stability ⁴	±3%
Mode Quality	$M^2 \leq 1.2$
Beam Waist Diameter (at $1/e^2$) ⁵	2.5 mm ±0.5 mm
Beam Divergence, full angle (at $1/e^2$) ⁵ ...	< 7 mrad
Ellipticity	< 1.2
Polarization	Linear, horizontal
Rise Time	< 100 µs

Input Specifications

Power Supply

Voltage	48 ±2.0 VDC
Maximum Current	10 A (11 A peak for < 1 ms @ 100 Hz, 50% duty cycle)

Input Signals Tickle Signal.....PWM Command Signal

Voltage	+3.5 to +6.7 VDC (5V nominal).....	+3.5 to +6.7 VDC (5V nominal)
Current	10 mA @ +6.7 VDC.....	10 mA @ +6.7 VDC
Pulse Duration	1 µs.....	N/A
Frequency	5 kHz.....	DC–25 kHz

Cooling Specifications

Maximum Heat Load, laser	500 Watts
Maximum Chassis Temperature ⁶	65 °C
Minimum Flow Rate	140 CFM per fan (two fans required)

Environmental Specifications

Operating Temperature ⁷	15 °C–40 °C
Humidity	0–95%, non-condensing

Physical Specifications (Air-cooled)

Length	16.74 in (42.52 cm)
Width	3.50 in (8.89 cm)
Height	5.45 in (13.84 cm)
Weight	13.00 lbs (5.90 kg)

* Preliminary specifications. Subject to change without notice.

† Typical. Actual wavelength range may vary from 10.2–10.8 µm.

1 This power level is guaranteed for 12 months regardless of operating hours.

2 Minimum 48 VDC input voltage to obtain guaranteed output power.

3 From cold start (guaranteed) at 95% duty cycle.

4 After two minutes (typical) at 95% duty cycle.

5 Measured at laser output.

6 Measured at location shown by Item 9 in Figure 3, *Firestar OEM vi30 controls and indicators*.

7 Published specifications guaranteed at a temperature of 22 °C. Some performance degradation may occur in ambient temperatures above 22 °C. Typically, laser output power decreases 0.5–1% per degree Celsius increase in ambient temperature.

Firestar OEM vi30 package outline drawings

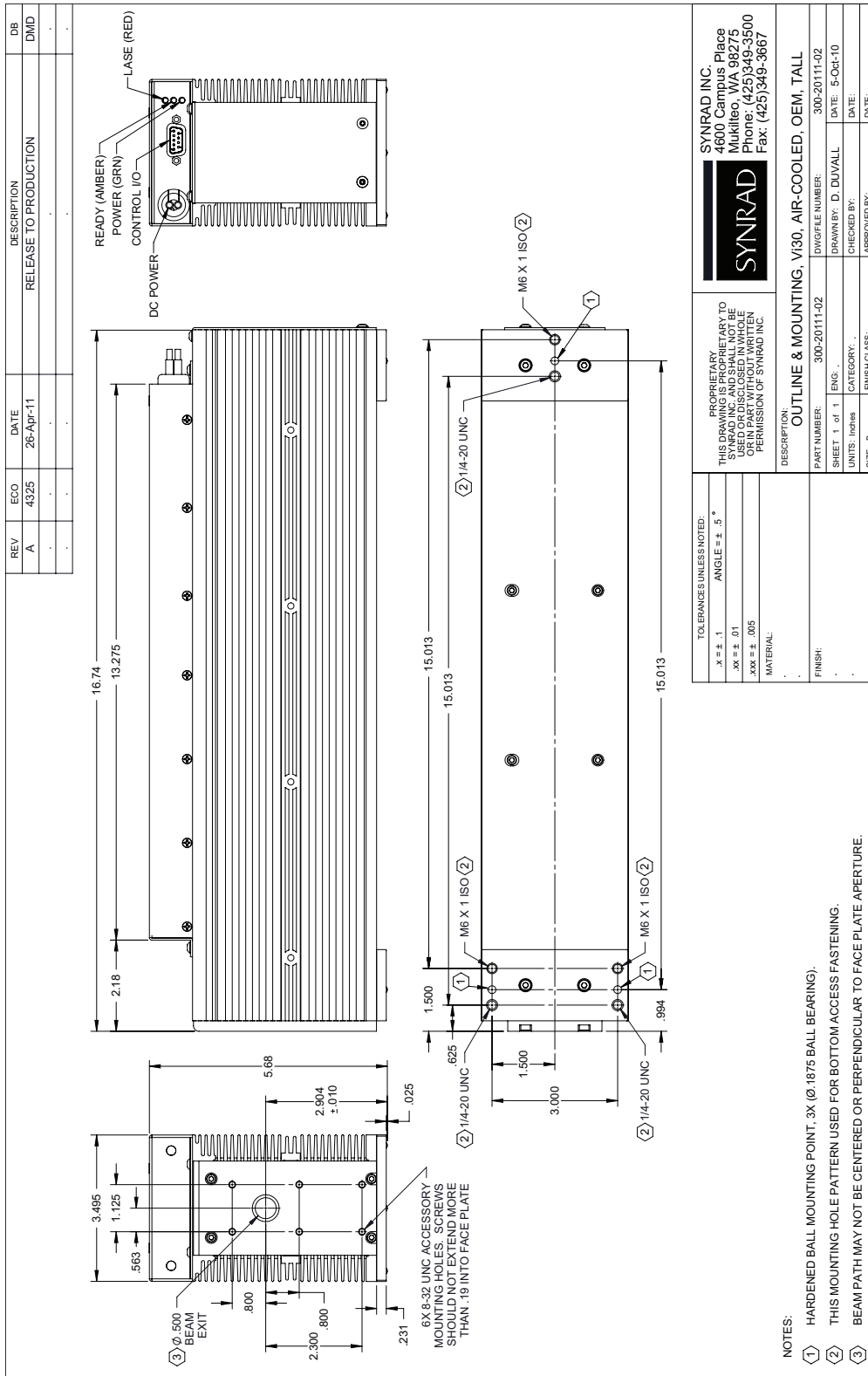


Figure 10 Firestar OEM vi30 package outline and mounting dimensions – with optional customer-installed ‘Tall’ mounting feet

Firestar OEM vi30 package outline drawings

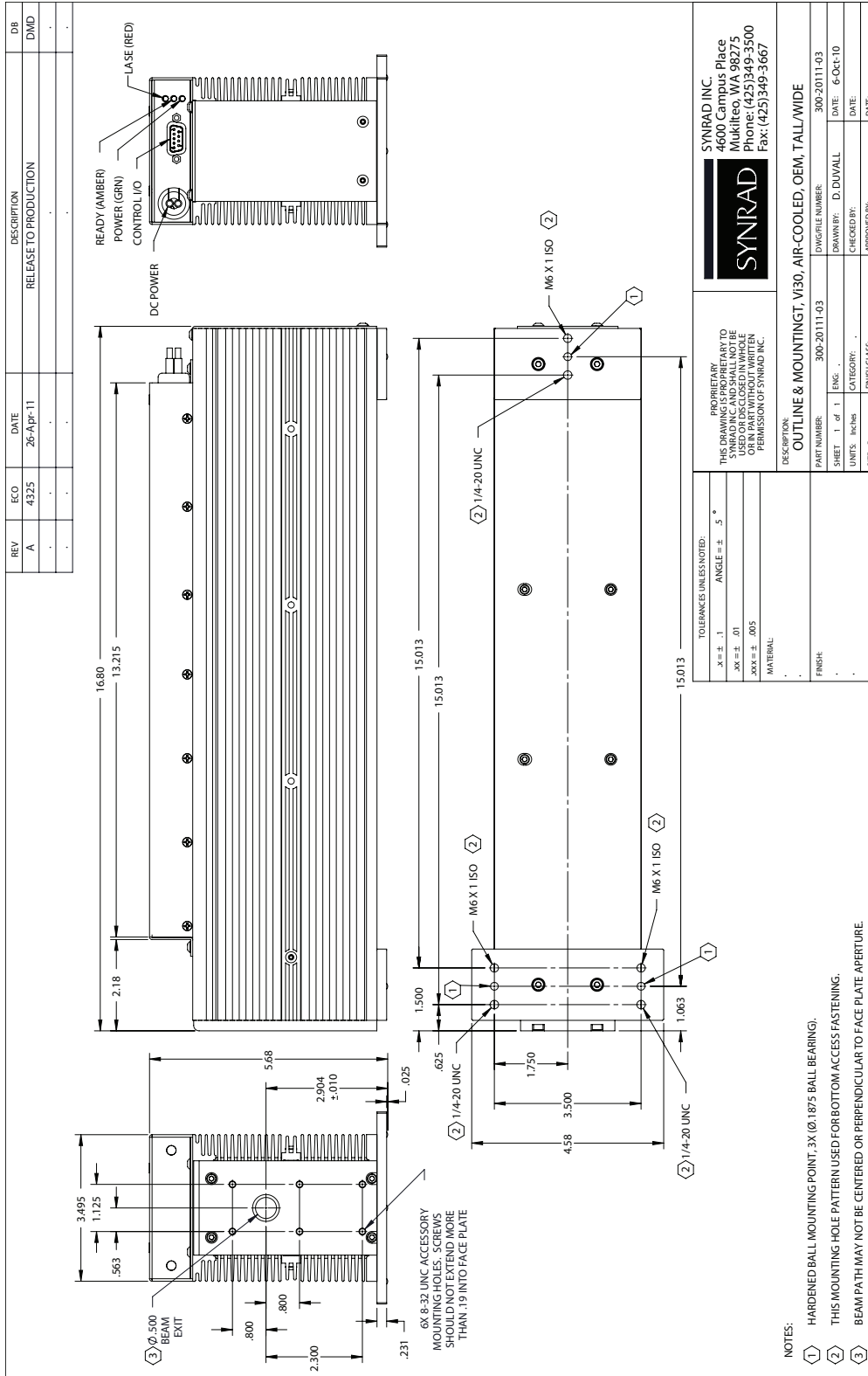


Figure 11 Firestar OEM vi30 package outline and mounting dimensions – with optional customer-installed ‘Tall/Wide’ mounting feet

Troubleshooting

This section is designed to help isolate Firestar OEM vi30 lasers problems to the board level only. Problems on circuit boards or the laser tube are not within the scope of this guide because they are not user-serviceable assemblies; do not attempt to repair them. Contact SYNRAD or a SYNRAD Authorized Distributor for repair or replacement information.

Danger
serious
personal
injury

This product emits *invisible* infrared laser radiation in the 10.6 μm CO₂ wavelength band. Direct or diffuse laser radiation can inflict severe corneal injuries and can seriously burn human or animal tissue. Service personnel troubleshooting Firestar lasers should be thoroughly trained in laser safety practices and electronic service techniques before attempting repairs.

Caution
possible
equipment
damage

Attempting repair of a SYNRAD Firestar laser without the express authorization of SYNRAD, Inc. will void the product warranty. If troubleshooting or service assistance is required, please contact the SYNRAD Service Department.

Status indications

Firestar OEM vi30 LED indicators, in conjunction with the DB-9 I/O outputs, provide status information to the user. Table 6 shows vi30 output signal and LED indicator states during normal and fault conditions.

Table 6 DB-9 I/O connector status signals

LED Indicator	LED Status		DB-9 Signal Name	DB-9 Signal Status	
	Normal	Fault		Normal	Fault
LASE (Red)	On	Off	Lase Indicator	High	Low
RDY (Yellow)	On	Off	Laser Ready	High	Low
RDY (Yellow)	On	Flashes	Overtemp Fault	Low	High
PWR (Green)	On	Flashes	DC Voltage Fault	Low	High

Error codes

Firestar OEM vi30 lasers have the ability to indicate various laser faults by flashing *RDY* and *PWR* indicators. For OEM vi30 lasers manufactured after October 1, 2011, certain faults are annunciated by the *PWR* LED blinking an error code, pausing 1/2 second, and then repeating the error code. This sequence continues until the fault is corrected and the laser is reset by cycling DC power. Table 7 on the following page lists error codes, the corresponding fault condition, and describes possible corrective actions.

Troubleshooting (cont.)

Table 7 Firestar vi30 error codes

LED	# of Blinks	Fault Condition	Corrective Action in Field
RDY	Off		
PWR	1 blink	Under-Voltage fault	Verify 48 VDC (measured at laser under load)
RDY	Off		
PWR	2 blinks	Over-Voltage fault	Verify 48 VDC (measured at laser under load)
RDY	Off		
PWR	3 blinks	DC Sense fault	Remove DC power, wait 30 seconds, and then re-apply power.
RDY	Continuous		
PWR	On	Over temperature fault ¹	Cool laser and then cycle DC power.
RDY	Continuous		
PWR	Continuous	PWM Sense fault	Remove DC power, wait 30 seconds, and then re-apply power.

¹ An over temperature fault is indicated if the Overtemp Fault output is high (+5 V). If the Overtemp Fault output is low, then a control board failure may have occurred.

Laser faults

When a fault occurs, vi30 status LEDs and output signals reflect faults as indicated in Table 6 or Table 7. Each Symptom listed below describes a particular fault while specific causes and solutions are described in the Possible Causes section.

Symptom:

- The RDY indicator is Off. The PWR LED is green and the LASE LED is Off. On the DB-9 I/O connector, all outputs (Lase Indicator, Laser Ready, DC Voltage Fault, and Overtemp Fault) are low (0 V).

Possible Causes:

- No Laser Enable input signal is present.

A +5 V Laser Enable signal must be applied between Pin 9 (*Laser Enable*) and Pin 8 (*GND*) on the DB-9 I/O connector to enable lasing.

Symptom:

- The RDY LED is flashing. The PWR LED is green and the LASE LED is Off. On the DB-9 I/O connector, Lase Indicator, Laser Ready, and DC Voltage Fault, outputs are low (0 V), but the Overtemp Fault output is high (+5 V).

Possible Causes:

- An over temperature fault exists.

Cool the OEM vi30's chassis temperature to below 60 °C and then cycle DC power to the laser.

Troubleshooting (cont.)

Symptom:

- The *RDY* indicator is flashing. The *PWR* LED is green and the *LASE* LED is Off. On the DB-9 I/O connector, all outputs (Lase Indicator, Laser Ready, DC Voltage Fault, and Overtemp Fault) are low (0 V).

Possible Causes:

- A control board failure has occurred.

Contact SYNRAD or a SYNRAD Authorized Distributor.

Warning
serious
personal
injury

On Firestar OEM vi30 OEM lasers, DC voltage faults are not latched. Clearing a DC voltage fault (under- or over-voltage) will restore normal operation and lasing is possible after the five-second delay provided that the Laser Enable input signal is high. Because exposure to 10.6 μm CO₂ laser radiation can inflict severe corneal injuries and seriously burn human tissue, the OEM or System Integrator must ensure that appropriate safeguards are in place to prevent unintended lasing.

Symptom:

- The *PWR* indicator blinks once, pauses 1/2 second and repeats. Both *RDY* and *LASE* LEDs are Off. On the DB-9 I/O connector, Lase Indicator, Laser Ready, and Overtemp Fault outputs are low (0 V), but the DC Voltage Fault output is high (+5 V).

Possible Causes:

- An under-voltage fault exists.

Check that the DC power supply is supplying +48 VDC under load and that its current capacity is 10 amperes or greater.

- An under-voltage condition exists (DC power supply is current-limiting) because PWM signals were applied before tube breakdown occurred.

On a cold start, verify that tickle pulses are being sent to the vi30 OEM laser for a period of five to ten seconds before a PWM signal is applied.

Symptom:

- The *PWR* indicator blinks twice, pauses 1/2 second and repeats. Both *RDY* and *LASE* LEDs are Off. On the DB-9 I/O connector, Lase Indicator, Laser Ready, and Overtemp Fault outputs are low (0 V), but the DC Voltage Fault output is high (+5 V).

Possible Causes:

- An over-voltage fault exists.

Check that the DC power supply is supplying +48 VDC under load.

Troubleshooting (cont.)

Symptom:

- The *PWR* indicator blinks three times, pauses 1/2 second and repeats. Both *RDY* and *LASE* LEDs are Off. On the DB-9 I/O connector, Lase Indicator, Laser Ready, and Overtemp Fault outputs are low (0 V), but the DC Voltage Fault output is high (+5 V).

Possible Causes:

- An DC Sense fault has occurred.

Remove DC power to the laser, wait 30 seconds, and then re-apply DC power. If the fault fails to clear, contact SYNRAD or a SYNRAD Authorized Distributor.

Symptom:

- Both *PWR* and *RDY* indicators are flashing. The *LASE* LED is Off. On the DB-9 I/O connector, all outputs (Lase Indicator, Laser Ready, DC Voltage Fault, and Overtemp Fault) are low (0 V).

Possible Causes:

- A PWM Sense fault has occurred.

Remove DC power from the laser, wait 30 seconds, and then re-apply DC power. If the fault fails to clear, contact SYNRAD or a SYNRAD Authorized Distributor.

DB-9 I/O connector

Symptom:

- The built-in +5 VDC, 250 mA voltage output on Pin 5, *DC Out*, has been accidentally shorted to ground.

Possible Causes:

- In the event that Pin 5, *DC Out*, is shorted to ground, the Firestar vi30 laser will not be damaged as the voltage regulator is protected by a current-limiting circuit.

Optics

Symptom:

- The laser appears to lose power over time; laser output power must be increased to maintain previous performance.

Possible Causes:

- Beam delivery optics are coated by vapor residue or debris.

 **Danger**
serious
personal
injury

Ensure that DC power to the laser is turned off and locked out before inspecting optical components in the beam path. *Invisible* CO₂ laser radiation is emitted through the lens. Corneal damage or blindness may result from exposure to laser radiation.

Troubleshooting (cont.)

Shut down the laser and carefully inspect each optic in the beam delivery path, including the laser's output coupler. Remember that optics are fragile and must be handled carefully. If the optic requires cleaning, then refer to the *Firestar v40 Operator's Manual* and use only recommended cleaning materials to prevent scratching delicate optical surfaces.

⚠ Caution
possible
personal
injury

A risk of exposure to toxic elements, like zinc selenide, may result when certain optical or beam delivery components are damaged. In the event of damage to laser, marking head, or beam delivery optics, contact SYNRAD, Inc. or the optics manufacturer for handling instructions.

If the focusing optic is pitted, it must be replaced immediately. Because of the extremely high power density of Firestar lasers, pits or debris on the lens may absorb enough energy from the focused beam to crack the lens. If this happens, other optics in the beam path may be contaminated or damaged as well.

When the application requires air (instead of nitrogen) as an assist gas, use breathing quality air available in cylinders from a welding supply company. Compressed shop air contains minute particles of oil and other contaminants that will damage optical surfaces and must be carefully filtered and dried before use as a purge or assist gas.

⚠ Warning
serious
personal
injury

The use of aerosol dusters containing difluoroethane causes “blooming”, a condition that **significantly** expands and scatters the laser beam. This beam expansion can effect mode quality and/or cause laser energy to extend beyond the confines of optical elements in the system, possibly damaging acrylic safety shielding. Do not use air dusters containing difluoroethane in any area adjacent to CO₂ laser systems because difluoroethane persists for long time periods over wide areas.

Caution
possible
equipment
damage

If you operate your laser or marking head in a dirty or dusty environment, contact SYNRAD about the risks of doing so and precautions you can take to increase the longevity of your laser, marking head, and associated optical components.