

# ***FH SERIES MARKING HEAD***



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**operator's  
manual**

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# ***FH SERIES MARKING HEAD***

## **FH Series Marking Head Operator's Manual for Index and Tracker models**

Version 3.1

Released June 2004

Part number 900-17922-01



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## Warranty information

This is to certify that FH Series Marking Heads 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.

If, within one year from the date of purchase, any part of the FH Series Marking Head 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 FH Series Marking Head 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 FH Series Marking Head, 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.

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### Sales and Applications

SYNRAD's Regional Sales Managers work with customers to identify and develop the best CO<sub>2</sub> laser solution for a given application. Because they are familiar with you and your laser application, use them as a first point of contact when questions arise. Regional Sales Managers also serve as the liaison between you and our Applications Lab in processing material samples per your specifications. To speak to the Regional Sales Manager in your area, call SYNRAD at 1.800.SYNRAD1.

### Customer Service

For assistance with order or delivery status, service status, or to obtain a Return Authorization (RA) number, contact SYNRAD at 1.800.SYNRAD1 and ask to speak to a Customer Service representative.

### Technical Support

SYNRAD's Regional Sales Managers are able to answer many technical questions regarding the installation, use, troubleshooting, and maintenance of our products. In some cases, they may transfer your call to a Laser, Marking Head, or Software Support Specialist. You may also email questions to the Technical Support Group by sending your message to [support@synrad.com](mailto:support@synrad.com) or to [support@winmark.com](mailto:support@winmark.com).

### Reference materials

Your Regional Sales Manager can provide reference materials including Outline & Mounting drawings, Operator's Manuals, Technical Bulletins, and Application Newsletters. Most of these materials are also available directly from SYNRAD's web site at <http://www.synrad.com>.

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# laser safety

## Hazard information

Hazard information includes terms and symbols used in this manual or on the equipment to alert both operating and service personnel to the recommended precautions in the care, use, and handling of laser equipment.

## Terms

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

**⚠ Danger:** Hazards that could result in serious personal injury or death.

**⚠ Warning:** Hazards or unsafe practices that could result in serious personal injury or death.

**Caution:** Hazards or unsafe practices that could result in minor personal injury or product damage.

**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

Direct or diffuse laser radiation can inflict severe corneal injuries. Always wear eye protection when in the same area as an exposed laser beam. Eyewear protects against scattered energy and is not intended to protect against direct viewing of the beam or reflections from metallic surfaces. Protective eyewear that blocks 10.6  $\mu\text{m}$  CO<sub>2</sub> laser radiation is available from SYNRAD, Inc.

Enclose the beam path whenever possible. Direct or diffuse laser radiation can seriously burn human or animal tissue.

U.S. customers should refer to and follow the laser safety precautions in ANSI Z136.1-1993, *American National Standard for Safe Use of Lasers*. Procedures listed under the Standard include the appointment of a Laser Safety Officer, 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 refer to and follow the laser safety precautions in EN 60825-1, *Radiation Safety of Laser Products, Equipment Classification, Requirements, and User's Guide*.

# laser safety

## Hazard information

### **Warning**

possible  
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 Z136.1-1993, *American National Standard for 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.

### **Caution**

possible  
personal  
injury

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

## Other hazards

The following hazards would be typical for this product 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) generation of hazardous air contaminants that may be noxious, toxic, or even fatal.

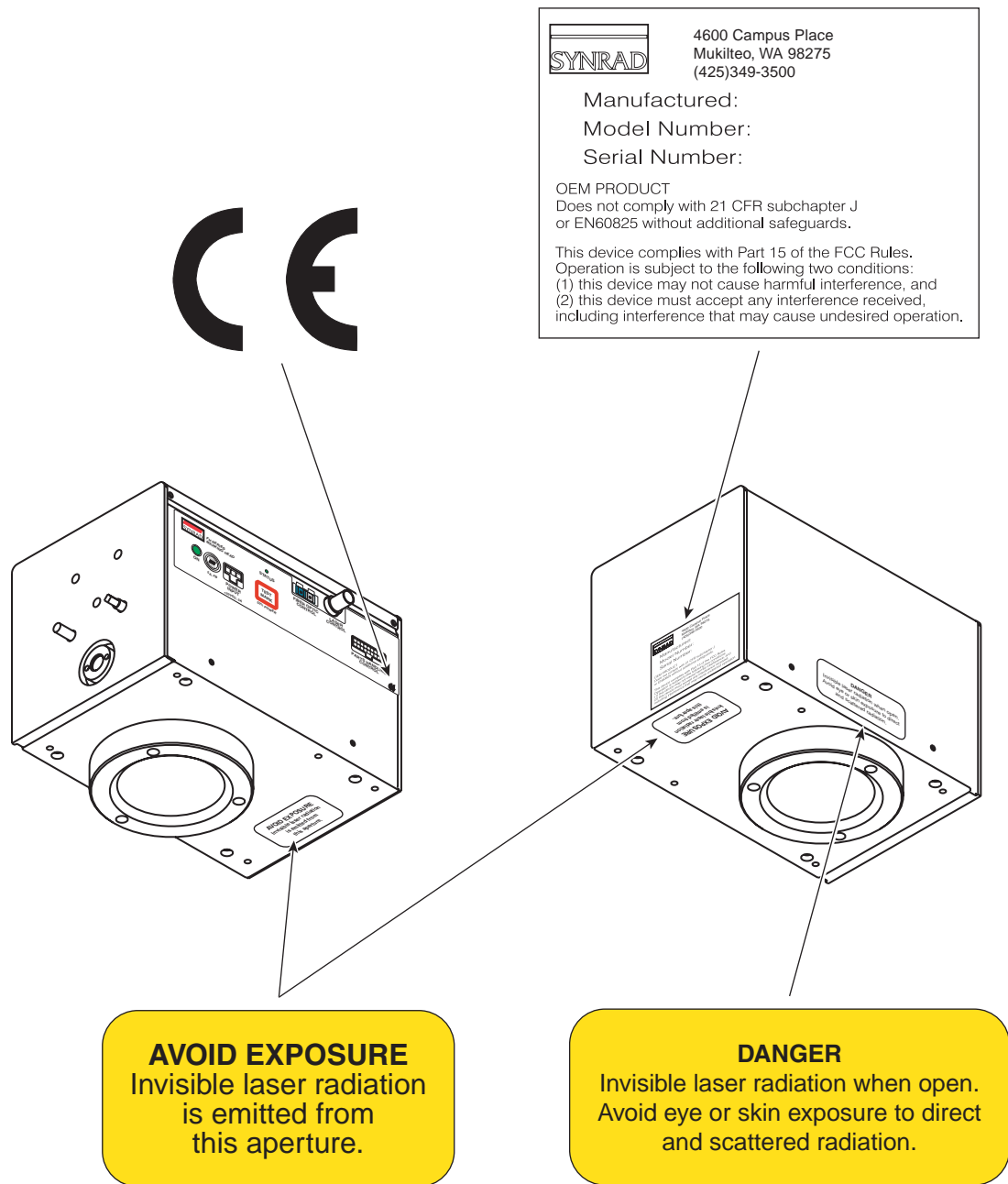
## Additional laser safety information

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 OEM's/System Integrators; (2) Laser Safety Standards for End Users including Class I Installations, Class IV 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) has an online Technical Manual located at: [http://www.osha-slc.gov/dts/osta/otm/otm\\_iii/otm\\_iii\\_6.html](http://www.osha-slc.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>.

# laser safety

## Label locations



**Figure 1** FH Marking Head hazard label and CE label locations

# laser safety

## Agency compliance

The *Agency compliance* section includes subsections:

- Center for Devices and Radiological Health (CDRH) requirements
- Federal Communications Commission (FCC) requirements
- European Union (EU) requirements

The FH Series Marking Head with its associated Fiber Link Controller Card has been tested and certified to comply with certain United States and European Union (EU) directives. These directives impose product performance requirements related to electromagnetic compatibility (EMC) and product safety characteristics for laser products. The associated directives and specific provisions to which the FH Series Marking Head must comply are identified and described in the following paragraphs.

## Center for Devices and Radiological Health (CDRH) requirements

Under the Radiation Control for Health and Safety Act of 1968, the U.S. Food and Drug Administration (FDA) issued a performance standard in the *Code of Federal Regulations* (CFR) for laser products. This performance standard (21 CFR, Part 1040.10) was developed to protect public health and safety by imposing requirements upon manufacturers of laser products to provide an indication of the presence of laser radiation, to provide the user with certain means to control radiation, and to assure that all personnel are adequately warned of potential hazards through the use of product labels and instructions.

SYNRAD's FH Series Marking Head is an OEM product intended for incorporation as a component of a laser marking system and as such does not comply with 21 CFR, Subchapter J without additional safeguards. Additional safeguards required to meet the standard depend on the system in which the FH Series Marking Head is to be incorporated. For instance, if the system is intended to be a Class 1 laser system, the OEM integrator will have to provide guarding to prevent laser emission in excess of the Accessible Emission Limits (AEL) for Class 1 devices. For incorporation in a Class IV laser system, the integrated system must include a beam attenuator, a keyswitch, a remote interlock, and other safety features as required under the standard.

## 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 in the frequency range above 9 kHz.

SYNRAD's FH Series Marking Head has been tested and found to comply by demonstrating performance characteristics that have met or exceeded the requirements of CFR 47, Chapter 1, Part 2, Subpart J.

With respect to instances of electromagnetic interference by other devices, SYNRAD defines marking variations to be an "acceptable loss of performance" as long as the following criteria are met: (1) there is no damage to the marking equipment or machinery into which it is integrated, (2) the marking variation does not cause a hazardous or unsafe condition, (3) the marking variation is apparent to the operator, and (4) normal operation is recovered after removal of the interfering signal.

# laser safety

## Agency compliance

### FCC information to the user

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### 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

The European Union's Electromagnetic Compatibility (EMC) Directive 89/336/EEC is the sole Directive developed to address electromagnetic interference (EMI) issues in electronic equipment. In particular, the Directive calls out documents that define the emission and immunity standards for specific product categories. For the FH Series Marking Head, the standard EN55011 defines the radiated RF emissions limit. The generic standard EN50082-1 defines immunity requirements published by the International Electrotechnical Commission (IEC). FH Series Marking Heads have demonstrated performance characteristics that have met or exceeded the requirements of EMC directive 89/336/EEC.

Operational requirements of the FH Series Marking Head are 30 VDC @ 3 amps (max). In accordance with Low Voltage Directive 73/23/EEC Article 1, the Low Voltage Directive would not apply to this family of devices. However, due to the considerable risks and hazards associated with the installation and operational use of this apparatus when incorporated with associated laser equipment, the manufacturer has provided appropriate product warning labels and instructions to the user regarding laser safety. Laser safety instructions and warnings are included in this manual.

The FH Series Marking Head is intended for incorporation as a component of a laser marking system. When incorporated as a part of a laser marking system, and dependent upon the user application and installation, additional warning labels and safety barriers may be required to protect the operator of the system. The final system and installation should be evaluated to meet the requirements of EN60825-1 under Low Voltage Directive 73/23/EEC.

SYNRAD, Inc. assumes no responsibility for the compliance of the system into which the FH Series Marking Head is integrated, other than to supply and/or recommend components and apparatus that are CE marked for compliance with applicable European Directives. FH Series Marking Head systems are intended for installation and use in laboratory or manufacturing facilities by trained personnel only.

In accordance with Machinery Directive, 89/392/EEC. Article 1, paragraph 4 and 5, the Machinery Directive does not apply to this device. In consideration of the incorporation of the FH Series Marking Head into devices that may fall under the definition of a "machine", SYNRAD, Inc. considers the application of the EMC Directive as sufficient evidence that the FH Series Marking Head product family will not compromise the compliance of the "machine" into which it is incorporated.

# laser safety

## Agency compliance

Table 1 contains a summary of EU performance requirements pertaining to the FH Series Marking Head.

**Table 1** European Union Directives

### Applicable Standards/Norms

89/336/EEC	Electromagnetic Compatibility
EN 55011:1991	Radiated and Conducted Emissions
EN 50082-2: 1995	Immunity
ENV 50140	RF Electromagnetic Fields
ENV 50204:1995	RF Electromagnetic Fields, Pulse Modulation
ENV 50141	RF Common Mode
EN 60950	Equipment Safety
EN 61000-4-2:1995	Electrostatic Discharge Immunity
EN 61000-4-4:1995	Electrical Fast Transient/Burst 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

FH Series Marking Heads have demonstrated performance characteristics that have met or exceeded the requirements of EMC Directive 89/336/EEC.

# laser safety

## Declaration of Conformity

### Declaration of Conformity


<b>Applicable EU Directive(s):</b>	89/336/EEC	Electromagnetic Compatibility
<b>Applicable Standards/Norms:</b>	EN 55011:1991	Radiated and Conducted Emissions, Class A, Group II
	EN 50082-2: 1995	Immunity
	ENV 50140	RF Electromagnetic Fields
	ENV 50204:1995	RF Electromagnetic Fields, Pulse Modulation
	ENV 50141	RF Common Mode
	EN 60950	Equipment Safety
	EN 61000-4-2:1995	Electrostatic Discharge Immunity
	EN 61000-4-4:1995	Electrical Fast Transient/Burst Immunity

**Manufacturer:** SYNRAD, Inc.  
4600 Campus Place  
Mukilteo, WA 98275

<b>Model Number</b>	<b>Serial Number (Compliant Unit)</b>	<b>Date of Compliance</b>
FH Marking Head	Beta 001	20 December 1999
FH Tracker Marking Head	Beta 001	20 December 1999

We, SYNRAD, Inc., hereby declare under our sole responsibility that the equipment specified above conforms to the above Directive(s) and Standard(s).

**Corporate Officer:**

  
\_\_\_\_\_  
Dave Clarke, President of SYNRAD  
20 December 1999  
\_\_\_\_\_  
Date

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# laser safety

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# getting started

Use information in this section to prepare your FH Series Marking Head for operation. The order of information presented in this section is the same as the order of tasks that you will need to perform. The best way to get the marking head ready for operation is to start at *Inventory* and work your way through *WinMark Pro Software*.

This section contains the following information:

- Inventory – describes all components shipped with your FH Series Marking Head.
- Introduction – describes the history of the FH Head.
- Mounting – explains marking head mounting requirements.
- Connecting – explains how to connect cables and install the Fiber Link Controller Card.
- WinMark Pro version 4 software – describes WinMark Pro software, which is used to create and mark laser graphics.

**Note:** If you are installing an FH Tracker Marking Head, please perform the tasks described in the “Getting Started” and “Operation” sections before proceeding to the “Tracker” section.

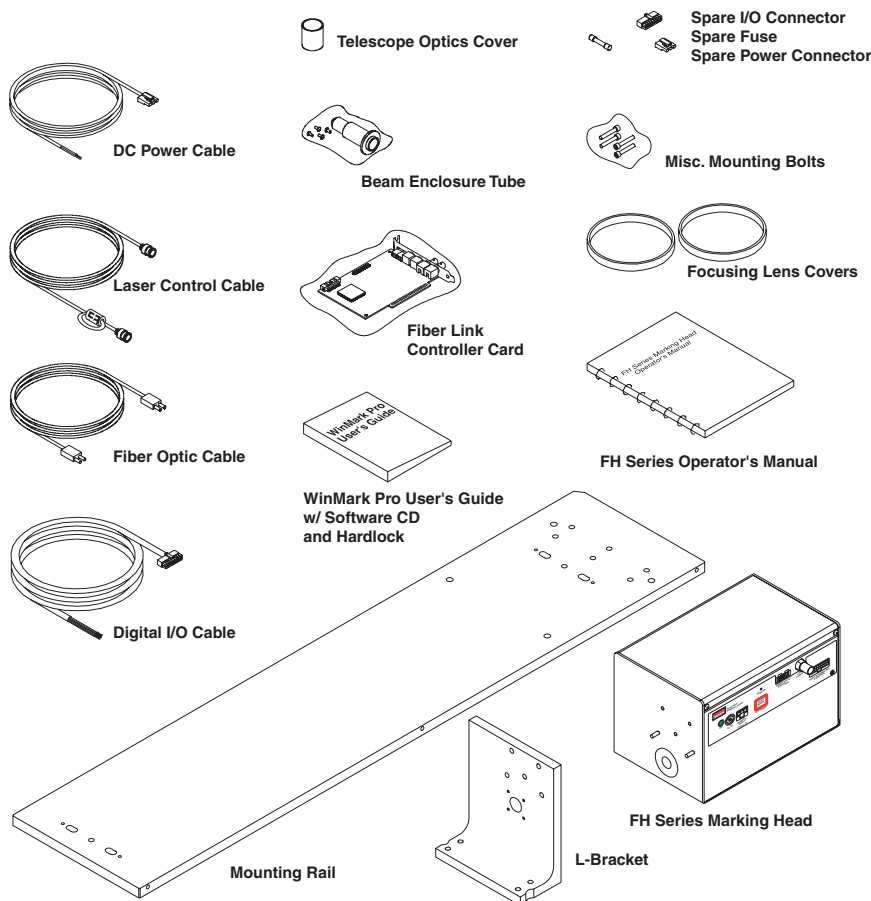
# getting started

## Inventory

The *Inventory* section includes subsections:

- FH Series Marking Head
- WinMark Pro software
- Fiber Link Controller Card
- L-bracket
- Mounting Rail
- Laser

Your FH Series Marking Head may have been purchased separately from the laser and mounting kit or may have been purchased as a component in a complete marking solution. The components in a typical marking package include a SYNRAD FH Series Marking Head, a Fiber Link Controller Card, a SYNRAD CO<sub>2</sub> laser, an L-bracket, and a Mounting Rail. If you ordered all the components listed above as a complete package, they are delivered factory aligned and only require the assembly of major components. If you ordered a SYNRAD 48 Series 10 W or 25 W air-cooled marking system, it is shipped completely assembled—ready to use out-of-the-box after making power and control connections. Figure 1-1 below illustrates all the components (except laser) shipped with a complete marking system.



**Figure 1-1** FH Series shipping box contents

# getting started

## Inventory

### FH Series Marking Head

**Table 1-1** Shipping box contents

<b>Shipping Box Contents</b>	<b>Qty</b>	<b>Shipping Box Contents</b>	<b>Qty</b>
SYNRAD FH Series Marking Head .....	1	Accessory Kit Contents (cont.)	
FH Series Operator's Manual .....	1	Digital I/O Cable .....	1
Fiber Optic Cable .....	1	Beam Enclosure Tube .....	1
Accessory Kit Contents		Spare 5 Ampere (A) Fuse .....	1
DC Power Cable .....	1	Spare Power Connector .....	1
Laser Control Cable .....	1	Spare Digital I/O Connector .....	1

### Contents description

A description of each item listed in Table 1-1 follows:

SYNRAD FH Series Marking Head – marks a variety of products and materials.

    Focusing Lens Cover – installed over focusing lens to prevent damage to optical surfaces.

    Telescope Optics Cover – installed over input beam expander to prevent damage to telescope optics.

*FH Series Marking Head Operator's Manual* – provides setup, operation, and maintenance information.

Fiber Optic Cable – electrically isolates your computer from the FH Marking Head while providing noise-free, two-way communication.

Accessory Kit Contents –

    DC Power Cable – supplies power to the FH Marking Head.

    Laser Control Cable – sends Command signals from the marking head to the laser.

    Digital I/O Cable – allows you to connect I/O field wiring directly to the FH Marking Head.

    Beam Enclosure Tube – encloses the beam path between the laser's output aperture and the marking head's input aperture.

    Spare 5 Ampere (A) Fuse – spare fuse for the FH Head.

    Spare Power Connector with Crimp Pins – allows you to build a custom length *DC Power* cable.

    Spare Digital I/O Connector with Crimp Pins – allows you to build a custom length I/O cable.

# getting started

## Inventory

### WinMark Pro software

\*The WinMark Pro software package includes:

WinMark Pro Laser Marking Software CD – allows you to easily create text and graphics, or import graphics files to be laser marked by the FH Series Marking Head. In addition to software, the WinMark Pro CD also contains outline and mounting drawings for SYNRAD products, Operator's Manuals, and Applications data.

*WinMark Pro User's Guide* – describes WinMark Pro's marking and object commands. Also covered are automation basics (when using WinMark Pro in conjunction with automated parts handling equipment) and ActiveMark technology, WinMark's implementation of ActiveX/OLE control.

WinMark Pro Hardlock – installs on your computer's printer port to prevent unauthorized use of WinMark Pro software.

### Fiber Link Controller Card

\*SYNRAD's Fiber Link Controller Card (FLCC) communicates with and allows remote computer control of the FH Series Marking Head. The FLCC requires one open PCI-bus slot in your IBM-compatible computer.

### L-bracket

\*The *L-bracket* serves to mount and position the FH Head in alignment with SYNRAD CO<sub>2</sub> lasers when used with the SYNRAD *Mounting Rail*.

### Mounting Rail

\*The *Mounting Rail* serves as a mounting base for the FH Marking Head and your SYNRAD laser

### Laser

\*SYNRAD lasers are available in powers ranging from 10–125 W for marking head applications. Models include the SYNRAD 48 Series of 10, 25, and 50 W lasers; Evolution™ Series 100 and 125 W lasers; and the new Firestar® Series of 20, 40, 60, 80, or 100 W lasers.

Evolution 100 and 125 W and Firestar t60/t80 lasers are shipped with a second box containing the external RF power supply and laser accessories.

\* when ordered

# getting started

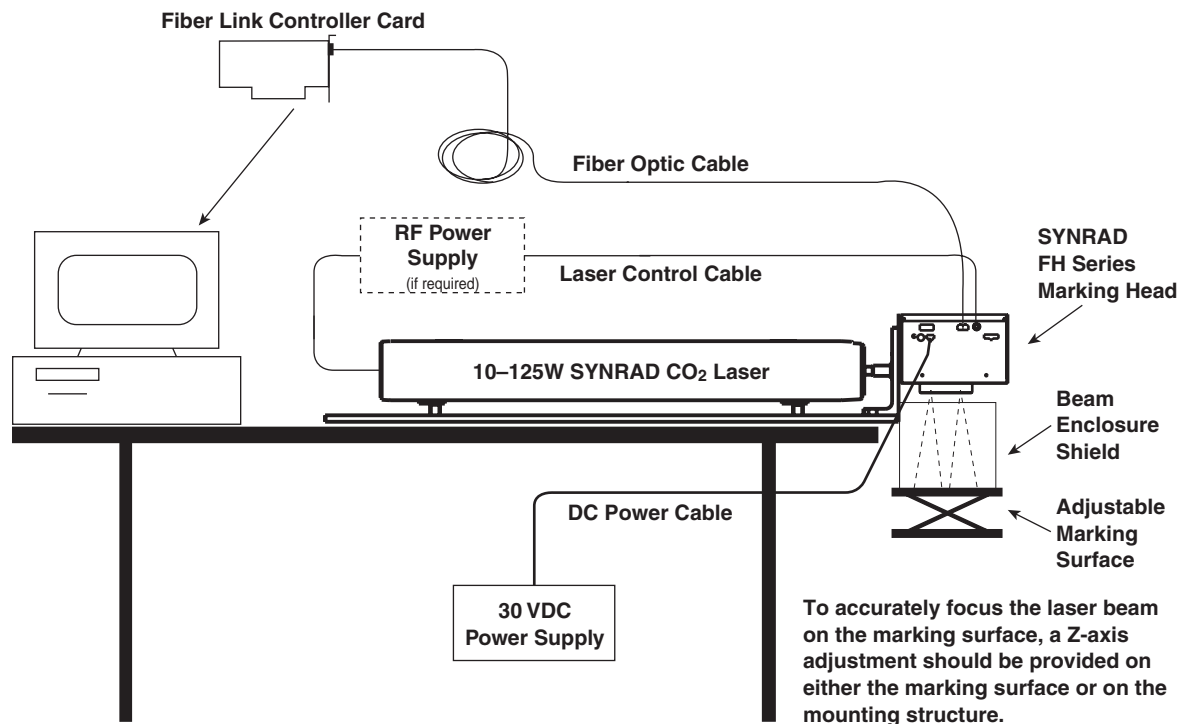
## Introduction

The FH Series Marking Head family is SYNRAD's third generation marking product, evolving from our years of experience with SH and DH Series Marking Heads currently being used in hundreds of applications at customer sites throughout the world. The FH Series Index Marking Head is designed to mark stationary parts in manual, indexed, or intermittent motion applications while the FH Tracker Marking Head is capable of marking moving parts "on-the-fly" at line speeds up to 200 feet per minute.

## Marking system components

A typical FH Index laser marking system is shown in Figure 1-2 and consists of the following components available from SYNRAD:

- SYNRAD FH Series Marking Head
  - Fiber Link Controller Card
  - SYNRAD CO<sub>2</sub> laser (10 W–25 W)
  - Marking head mounting kit
  - 30 VDC power supply
  - SYNRAD's WinMark Pro marking software
- You will need to supply the following items:
- IBM-compatible computer with an open PCI bus slot (see *WinMark Pro software* later in this section for system requirements)
  - Marking surface with an adjustable Z-axis
  - Beam enclosure shield



**Figure 1-2** Typical FH Series marking system

# getting started

## Mounting

The *Mounting* section includes subsections:

- Mounting guidelines
- Mounting Rail
- L-bracket
- FH Head
- Laser

## Mounting guidelines

Before mounting your FH Series Marking Head to the appropriate *Mounting Rail*, please ensure the following guidelines are met:

- The *Mounting Rail* must be securely positioned so that the marking surface is parallel to the bottom of the marking head housing.
- Position the marking head so that the lens to marking surface distance, the working distance, matches the distance specified in the final test report. A Z-axis adjustment for either the marking surface or the mounting platform is highly recommended.
- A beam enclosure shield should surround the beam path below the marking head and around the marking area wherever feasible.
- An *FH Field Alignment Kit*, SYNRAD part number 230-18176-01, is required for checking alignment if you are not mounting the FH Head to a SYNRAD *L-bracket/Mounting Rail* assembly.
- In addition to providing FH Head/laser alignment, the *L-bracket* available from SYNRAD serves as a heat sink. If you are not using the *L-bracket*, you must ensure that your metal mounting bracket is capable of sinking the excess heat (approximately 60 W) generated by the marking head.
- To prevent damage to your FH Series marking head when using a custom-built mounting bracket instead of the SYNRAD-supplied *L-bracket*, ensure that the 1/4–20 UNC mounting screws do not extend further than 0.30" (7.6 mm) into the FH head.
- Carefully review the *Alternate mounting configurations* and *Beam expansion/path length* sections in Appendix C before designing a non-standard mount for your FH Marking Head.

SYNRAD's integrated component design eliminates the need for FH Head alignment. To mount your FH Series Marking Head simply follow the steps listed in each section below.

## Mounting Rail

Refer to the appropriate mounting diagram in the "Technical Reference" section for the proper orientation of the bevel on the *Mounting Rail* and then securely fasten the *Mounting Rail* to a rigid structure. Appendix A provides information about a mounting stand that you can build.

# getting started

## Mounting

### L-bracket

The FH Head is positioned by dowel pins on the *L-bracket*, which in turn is dowel-pinned to the *Mounting Rail*. To mount the *L-bracket* to the *Mounting Rail*, perform the following steps:

- 1 Orient the *L-bracket* as shown in the appropriate mounting diagram, then place the bracket so that the dowel pins protruding from the bottom engage the dowel holes in the *Mounting Rail*.
- 2 Fasten the *L-bracket* to the *Mounting Rail* using four 1/4–20 × 3/4" socket head capscrews.

### FH Head

To mount your FH Head to the *L-bracket*, perform the following steps:

- 1 Remove the *Telescope Optics Cover* from the rear (beam input end) of the FH Head.
- 2 Place the FH Series Marking Head on the *L-bracket* so that the dowel pins protruding from the rear of the head engage the dowel holes in the *L-bracket*.
- 3 Install and tighten three 1/4–20 × 3/4" socket head capscrews through the *L-bracket* into the marking head housing.
- 4 Fasten the *Beam Enclosure Tube* to the *L-bracket* using four 8–32 × 1/4" button head socket screws.

### Laser

To mount the laser, perform the following steps:

**Note:** The laser's mounting feet are precisely aligned and shimmed at the factory to ensure alignment between the FH Series Marking Head and the *Mounting Rail*. Do not loosen or remove the mounting feet from the laser.

- 1 Orient the laser on the *Mounting Rail* with the output aperture facing the *L-bracket*.
- 2 Ease the laser forward against the *Beam Enclosure Tube* until the dowel pins on the mounting feet drop into the dowel pin holes drilled into the *Mounting Rail*. The screw holes on the ends of the feet should be positioned over the appropriate mounting holes as shown in the FH Head to laser mounting drawings in the "Technical Reference" section.
- 3 Install and tighten four capscrews to secure the laser to the *Mounting Rail*.
  - 48-1/48-2 lasers use 6–32 × 1" socket head capscrews (SHCS).
  - 48-5 lasers use 10–32 × 3/4" SHCS.
  - Evolution 100/125 lasers use 1/4–20 × 1" SHCS.
  - Firestar v20/v40 lasers use 1/4–20 × 7/8" SHCS.
  - Firestar t60/t80/t100 lasers use 1/4–20 × 1" SHCS.
  - Firestar f100 lasers use 1/4–20 × 2" SHCS.
- 4 Connect water, power, and control hookups to your laser according to instructions in the laser's *Operator's Manual*.

# getting started

## Connecting

The *Connecting* section includes subsections:

- DC Power cable
- Laser Control cable
- Digital I/O cable
- Fiber Link Controller Card (FLCC)

## DC Power cable

The FH Series Marking Head requires a +30 VDC, 3 A power supply for operation. To connect the *DC Power* cable between the DC power supply and the marking head, perform the following steps:

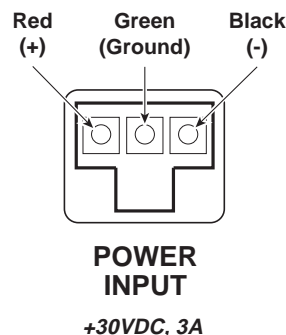
- 1 Verify that the DC power supply is disconnected from its power source.
- 2 Connect the 3-pin keyed connector on the end of the *DC Power* cable to the *Power Input* connector on the FH Head.
- 3 Attach the red wire of the power cable to the positive (+) terminal on the DC power supply.
- 4 Attach the black wire of the power cable to the negative (-) terminal on the DC power supply.
- 5 Attach the green wire of the power cable to earth ground.

**Note:** If you require a custom length *DC Power* cable, a spare connector with crimp pins for 18–24 AWG wire is included in the Accessory Kit. When wiring the spare connector, refer to Figure 1-3 below for the polarity of the FH Head's *Power Input* jack.

### Caution

possible  
equipment  
damage

The DC power supply voltage must be set to +30.0 VDC  $\pm$ 2.0 V. Damage to the FH Marking Head will result if the DC supply voltage drops below +28.0 VDC. Before connecting the *DC Power* cable, measure your DC supply's output voltage under load to ensure that it can provide +30 VDC.



**Figure 1-3** Power Input jack polarity

# getting started

## Connecting

### Laser Control cable

Install the *Laser Control* cable between the FH Series Marking Head and your laser according to its type.

**Important Note:** To aid electrical noise suppression, one end of the *Laser Control* cable is looped through a ferrite bead. This end of the cable should be connected to the FH Head.

#### Series 48-1, 48-2 laser:

Attach the end of the coaxial control cable with the ferrite bead to the *Laser Control* BNC connector on the FH Series Marking Head. Attach the other end of the cable to the control input, labeled *CTRL*, located on the rear of the laser.

#### Series 48-5 laser:

Attach the long “leg” of the “Y” coaxial control cable, the end with the ferrite bead, to the *Laser Control* BNC connector on the FH Series Marking Head. Attach the short “legs” of the cable to the control inputs, labeled *CTRL1* and *CTRL2*, located on the rear of the laser.

#### Evolution™ 100, 125 laser:

Attach the end of the coaxial control cable with the ferrite bead to the *Laser Control* BNC connector on the FH Series Marking Head. Attach the other end of the cable to the control input, labeled *Control In*, located on the front or rear panel of the RF-3000 RF power supply.

#### Firestar® v20, v40, f100 laser:

Attach the end of the coaxial control cable with the ferrite bead to the *Laser Control* BNC connector on the FH Marking Head. Attach the other end of the cable to the BNC connector on the *Quick Start Plug* (or customer-supplied DB15 connector) attached to the *User I/O* port on the rear panel of the laser.

#### Firestar® t60, t80, t100 laser:

Attach the end of the coaxial control cable with the ferrite bead to the *Laser Control* BNC connector on the FH Series Marking Head. Attach the other end of the cable to the BNC connector on the *Quick Start Plug* (or customer-supplied DB15 connector) attached to the *User I/O* port located on the rear panel of the RF power supply.

### Digital I/O cable

To install the *Digital I/O* cable (if connecting I/O signals to the head), perform the following steps:

- 1 Connect the 18-pin keyed connector on the end of the *Digital I/O* cable to the *Parts Handling Control* connector on the FH Series Marking Head.
- 2 Connect I/O cabling as required for your application. See *Marking automation* in the “Technical Reference” section for detailed information regarding I/O connections and electrical signals.

**Note:** If you require a custom length *Digital I/O* cable, a spare *Digital I/O* connector with crimp pins for 20–24 AWG wire is included in the Accessory Kit.

# getting started

## Connecting

### Fiber Link Controller Card

SYNRAD's Fiber Link Controller Card (FLCC) accepts instructions from WinMark Pro® laser marking software and communicates data to the FH Marking Head through a digital fiber optic cable. The Fiber Link Card is very sensitive to static electricity discharges. Because it is possible to damage the FLCC or your computer through improper handling, please follow the installation directions carefully.

These instructions cover installation of SYNRAD's PCI-bus Fiber Link Controller Card (FLCC) in IBM-compatible computers running Windows® 95, 98, NT4, 2000, or XP operating systems. Installation will vary slightly depending on the operating system and WinMark Pro version being used.

**Note:** WinMark Pro version 2.1.0.3468 and above supports either ISA- or PCI-bus FLCCs running on Windows 95/98 systems.

Version 4.0.0.3773 and above supports PCI-bus FLCCs running on Windows 98, NT4, 2000, or XP operating systems.

#### Caution

possible  
equipment  
damage

Static sensitive components on the Fiber Link Controller Card may be damaged if exposed to static electricity discharges. Always wear a static control wrist strap when handling the FLCC. If a static control wrist strap is not available, follow the instructions carefully to avoid damaging the card.

### Locate the FLCC device driver (WinMark Pro version 2.1 only)

**Note:** When installing WinMark Pro version 4.0.0.3773 or above, PCI Device Drivers are loaded during the WinMark Pro software installation. Proceed to the *Configure the FLCC* section.

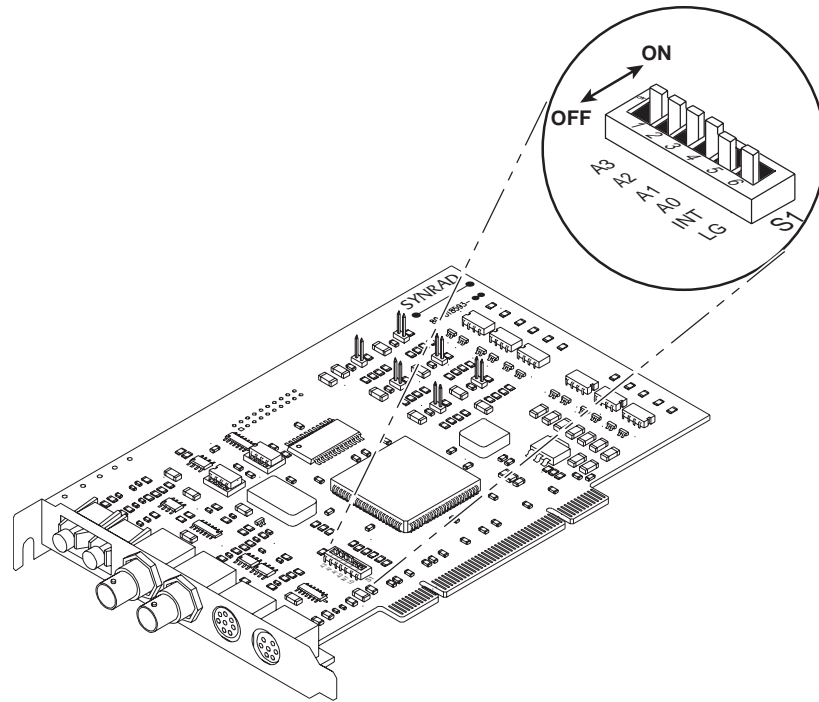
Locate the FLCC's PCI Device Driver files (Synmarkh.inf and Synmarkh.vxd) before continuing the installation. On the WinMark Pro CD, driver files are located in the same folder as the WinMark Pro installation file. Version 2-compatible PCI drivers are also available from the WinMark Pro web site at <http://www.winmark.com/download.htm>.

### Configure the FLCC

We recommend that you configure DIP switches before installation. Figure 1-4 shows factory default DIP switch settings.

# getting started

## Connecting



**Figure 1-4** PCI card DIP switch settings

Table 1-2 lists FLCC DIP switch functions.

**Table 1-2** DIP switch functions

DIP SW#	Label	Default Position	Switch Function
1	A3	ON	Card ID# MSB
2	A2	ON	
3	A1	ON	
4	A0	ON	Card ID# LSB
5	INT	OFF	Fast Acting Safety Interlock (FASI) – ON enables the FASI function; OFF disables the Interlock function. When the FASI Interlock is enabled, a high level input must be present on Input # 3 (IN3) for marking to proceed.
6	LG	OFF	Used only with DH Series Marking Heads.

Because the Windows Plug and Play feature, not the user, assigns the PCI address, address switches are not important. The card identification set by the Card ID# DIP switches will support future improvements to WinMark Pro. Card ID switches use negative logic – for example when SW1–SW4 are set to ON, the Card ID# = 0; when SW1–SW4 are set to OFF the Card ID# = 15. If SW1, SW2, and SW3 = OFF and SW4 = ON, then the Card ID# = 7.

# getting started

## Connecting

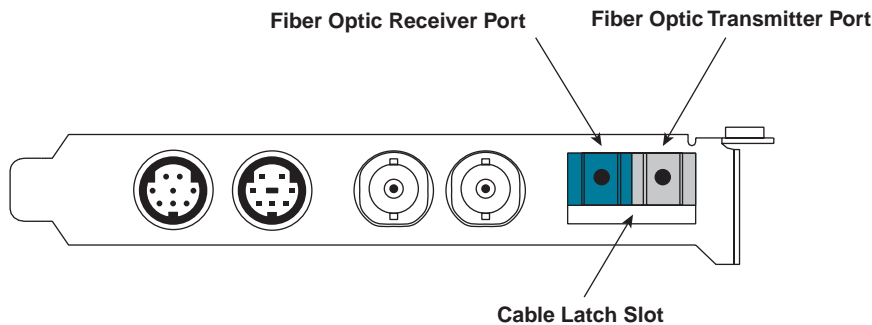
### Install the FLCC

To install the **PCI-bus FLCC**, perform the following steps:

- 1 Turn off your computer, but leave it plugged into a properly grounded outlet. Leaving the computer plugged in means that the computer chassis will remain grounded, enabling you to discharge harmful static electricity before handling sensitive electronic components.
- 2 Remove the computer's case or cover to expose the expansion slots. Locate an empty PCI bus slot (the PCI-bus FLCC will not physically fit in an ISA slot).
- 3 If there is a "space filler" metal bracket covering the PCI slot, then remove the bracket. Save the screw.
- 4 Make sure you are grounded before handling the FLCC. While grounded, install the FLCC in the PCI slot. The gold contact fingers on the card should slide into the mating PCI bus slot without using excessive force.
- 5 When the card is properly seated, use the screw removed in step 3 to secure the card to the computer chassis.
- 6 Reinstall the computer's case or cover.

### Connect the Fiber Optic cable

To install the *Fiber Optic* cable, refer to Figure 1-5 and perform the following steps:



**Figure 1-5** Fiber Link Controller Card connectors

- 1 With the back of the computer accessible, locate the *Fiber Optic Receiver/Transmitter* port on the FLCC.
- 2 Remove the rubber dust caps from the fiber optic ports.
- 3 Locate the *Fiber Optic* cable in the shipping box.
- 4 The end that attaches to the FLCC terminates into a single duplex connector. Insert the duplex connector into the *Fiber Optic Receiver/Transmitter* port on the FLCC. When properly connected, the latch on the connector should clip into the cable latch slot. You should not be able to remove the *Fiber Optic* cable without depressing the latch.

# getting started

## Connecting

**Note:** The fiber optic connection is the only connection necessary to control Fenix or FH Series Marking Heads; no other connections are made to the FLCC.

- 5 Connect the other end of the *Fiber Optic* cable to your marking head.

### Load the PCI card driver (WinMark Pro version 2.1 only)

**Note:** When installing WinMark Pro version 4.0.0.3773 or above, PCI Device Drivers are loaded during the WinMark Pro software installation. Proceed to *Verify the FLCC's functionality* section.

To load the Fiber Link Controller Card's PCI Device Driver, perform the following steps:

- 1 Turn on your computer. During start-up, the Windows *New Hardware* wizard will guide you through the necessary steps to install the PCI card's Device Driver.
- 2 Windows will display a *New Hardware Found* dialog box. Wait until the *Building Information Database* progress bar completes its task.
- 3 The *Add New Hardware Wizard* dialog box appears. The wizard searches for new drivers for the PCI card labeled "PCI Co-processor CPU". Click the **Next** button.
- 4 Click the radio button next to "Search for the best driver for your device" and then click **Next**.
- 5 Windows will search for new drivers on your hard drive and in any of the locations you select. Check "CD-ROM drive" or "specify a location" and uncheck all other choices. See Figure 1-6.



**Figure 1-6** Update Device Driver Wizard dialog box

- 6 Insert the WinMark Pro CD into the CD-ROM drive or specify a location on your hard drive and click **Next**.
- 7 Windows will locate the "Fenix/FH Laser Marking Device" driver. Click **Next** to continue.
- 8 The wizard notifies you that it has installed the driver required by the FLCC. Click **Finish**.
- 9 Allow your computer to complete the start-up process.

# getting started

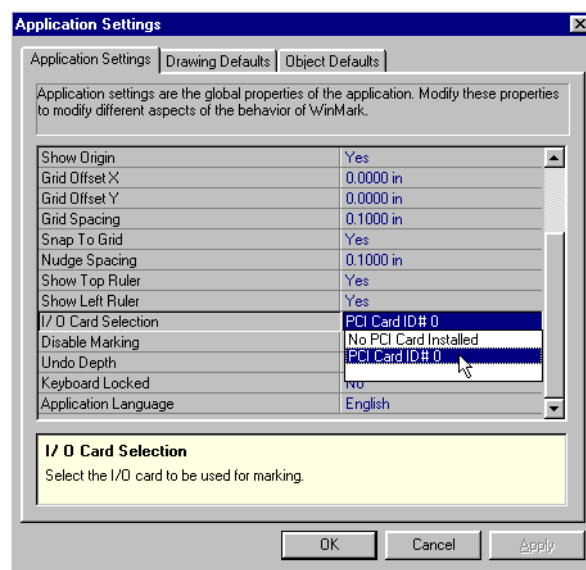
## Connecting

### Verify the FLCC installation

Follow the steps below to verify that the PCI card is properly installed.

- 1 Install WinMark Pro if you have not already done so.
- 2 Restart your computer (even if WinMark Pro is already installed). This forces Windows to load the newly installed PCI Device Driver.
- 3 Double-click the *Shortcut to WinMark Pro* icon on your desktop.
- 4 When WinMark Pro opens, click *Tools* on the *Menu* bar and then click *General Settings....* On the *Application Settings* tab, locate the *I/O Card Selection* property and verify that the PCI card is properly identified. See Figure 1-7. If an ISA-bus FLCC is also installed in your computer, you will need to select the newly installed PCI card from the drop-down list.

This completes the installation of your PCI-bus Fiber Link Controller Card.



**Figure 1-7** Application Settings tab

The connections you have just completed are sufficient for manual operation and testing of the FH Head. Refer to *Initial start-up* in the “Operation” section for startup procedures. After completing the WinMark Pro software installation, you can control all marking actions directly from your computer.

If you plan to interface the FH Series Marking Head with automated parts handling equipment, then read *Marking automation* in the “Technical Reference” section for detailed information regarding I/O connections and electrical signals.

# getting started

## WinMark Pro® version 4 software

The *WinMark Pro version 4.0 software* section includes subsections:

- System requirements
- Installation

WinMark Pro® allows you to laser mark professional graphics and text from your Microsoft® Windows® 98, NT4, 2000, or XP operating system. WinMark Pro's ActiveMark™ technology is capable of controlling every aspect of the marking process from incrementing serial numbers to controlling laser parameters to interfacing with parts handling equipment. New features found in WinMark Pro version 4.0 include:

- PCI-bus FLCC support
- Extended character sets for stroke fonts
- Vector-style 2D codes
- Imported objects now “exploded” and grouped
- Multiple language support
- On-line link to SYNRAD's Laser Marking FAQ

### System requirements

WinMark Pro version 4.0 requires a PCI-bus Fiber Link Controller Card (FLCC) to drive the FH Series marking head. In order to install and run WinMark Pro software, your Windows computer system must meet the following minimum requirements:

**Note:** WinMark Pro version 4 software is not compatible with Windows 95 and is not compatible with Windows 98 operating systems using an ISA-bus FLCC.

#### Windows 98

- 486DX, 66 MHz or faster (Pentium 90 MHz or faster recommended)
- 16-MB RAM (24 MB recommended)
- 20-MB available hard drive space
- One CD-ROM drive
- VGA or higher-resolution display adaptor (16- or 24-bit SVGA color monitor recommended)
- One open PCI-bus slot

#### Windows NT4

- Pentium-compatible CPU, 90 MHz or faster
- 16-MB RAM (32 MB recommended)
- 20-MB available hard drive space
- One CD-ROM drive
- VGA or higher-resolution display adaptor (16- or 24-bit SVGA color monitor recommended)
- One open PCI-bus slot

# getting started

## WinMark Pro® version 4 software

### Windows 2000

- Pentium-compatible CPU, 133 MHz or faster
- 64-MB RAM
- 20-MB available hard drive space
- One CD-ROM drive
- VGA or higher-resolution display adaptor (16- or 24-bit SVGA color monitor recommended)
- One open PCI-bus slot

### Windows XP

- Pentium-compatible CPU, 233 MHz or faster (300 MHz recommended)
- 64-MB RAM (128 MB recommended)
- 20-MB available hard disk space
- One CD-ROM drive
- SVGA or higher-resolution display adaptor (16- or 24-bit SVGA color monitor recommended)
- One open PCI-bus slot

## Installation

### Hardlock

A Hardlock on the printer port prevents unauthorized use of WinMark software. If the Hardlock is not installed, WinMark can still be opened and files can be created, but marking will not be enabled.

Install the Hardlock by performing the following steps:

- 1 Disconnect the printer cable from the back of your computer.
- 2 Connect the Hardlock to the printer port.
- 3 Connect the printer cable to the Hardlock.

### WinMark Pro®

To install WinMark Pro, follow the installation directions in the *WinMark Pro User's Guide*. The User's Guide also contains complete information for importing graphics as well as creating text and barcode images. In addition, the manual explains how to automate your marking process by configuring WinMark Pro to read from and write to parts handling I/O.

After you have installed WinMark software on your computer, continue on to the "Operation" section of this manual to perform initial start-up and testing of your FH Series Marking Head.

# operation

Use information in this section to familiarize yourself with FH Series Marking Head controls and indicators and to begin marking operation.

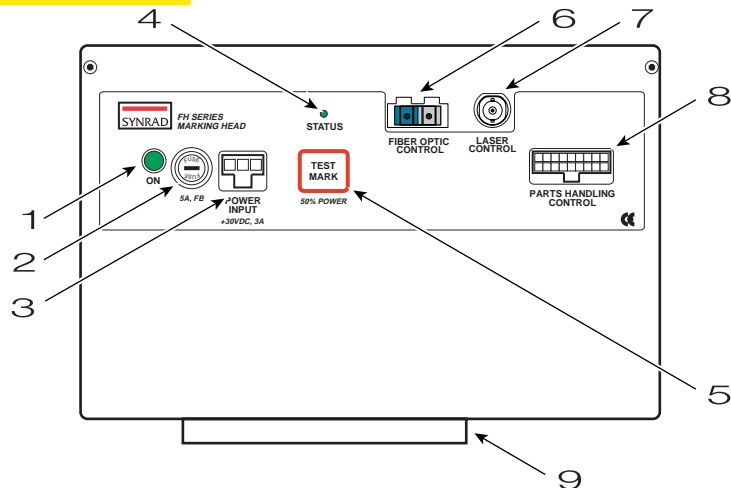
This section contains the following information:

- Controls and indicators – displays and describes FH Marking Head controls, indicators, and connections.
- Initial start-up – explains how to start the FH Head and verify proper operation.

# operation

## Controls and indicators

### Control panel



**Figure 2-1** Control panel

- 1 ON Indicator – illuminates green when 30 VDC is applied to the FH Marking Head.
  - 2 Fuse Holder – protects marking head circuitry with a 5 ampere, 125 V fast-blow fuse.
  - 3 Power Input Connector – receives 30 VDC from the DC power supply through the DC Power cable.
  - 4 Status Indicator – illuminates to indicate FH Head status. The indicator may be red during power-up, changing to green when the system is ready to mark. A fault condition is indicated if the lamp remains, or turns, red.
  - 5 Test Mark Pushbutton – press to mark a test pattern when the Status indicator is illuminated green. Test Mark power output is 50% of the laser’s rated output power with a marking speed of 40 inches per second (IPS).
  - 6 Fiber Optic Control Port – carries digital information via the Fiber Optic cable between the FH Head and the Fiber Link Controller Card (FLCC). The Fiber Optic cable provides noise immunity for the digitally-generated control signals.
  - 7 Laser Control BNC Connector – outputs 5 kHz tickle and 20 kHz PWM Command signals to the laser.
  - 8 Parts Handling Control Connector – provides four external inputs, IN0–IN3, and four external outputs, OUT4–OUT7, for signals to and from parts handling equipment through the Digital I/O cable. Each input or output has its own isolated ground, or return, line.
- Note:** When controlling the FH Series Marking Head with WinMark software, the only connections required are DC Power, Laser Control, and Fiber Optic cables. Parts Handling Control connections through the Digital I/O cable are typically used only when connecting the FH Head to automated parts handling equipment.
- 9 Focusing Lens Mount – focuses the laser beam onto the material to be marked. Each lens has a nominal working distance engraved on the bottom face of the lens mount. The actual working distance is noted on the final test report shipped with each FH Head.

# operation

## Initial start-up

# 2

The *Initial start-up* section includes subsections:

- Stand-alone operation
- Computer-controlled operation

## Stand-alone operation

To initially test your FH Series Marking Head, perform the following steps:

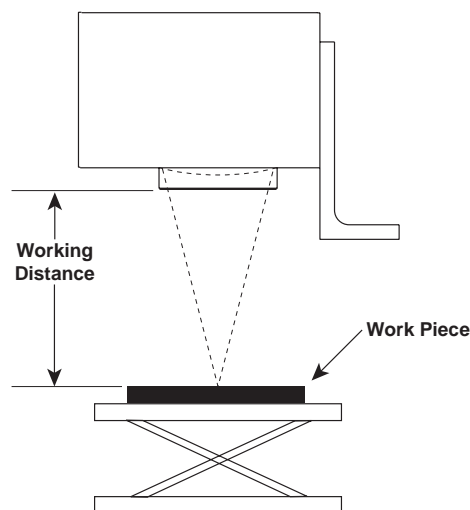
- 1 Remove the dust cap from the focusing lens.
- 2 Place the material to be marked (a sheet of anodized aluminum is ideal) on your marking surface in the field of the focusing lens.

### Caution

possible  
lens  
damage

Lens damage may result if the measuring device contacts the surface of the focusing lens.

- 3 Use a ruler marked in millimeters to set the working distance (Z-axis adjustment) from the bottom of the focusing lens mount to the surface of the part to be marked as shown in Figure 2-2. The nominal working distance is engraved on the bottom of the focusing lens mount. Because working distance is unique to each lens, consult the final test report shipped with your FH Head to determine the actual working distance of your lens. Refer to Table 4-1 in the “Technical Reference” section for FH focusing lens specifications.



**Figure 2-2** Working distance measurement

# operation

## Initial start-up

### **⚠ Danger**

serious  
personal  
injury

This product emits invisible infrared laser radiation at the 10.6  $\mu\text{m}$   $\text{CO}_2$  wavelength. 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.

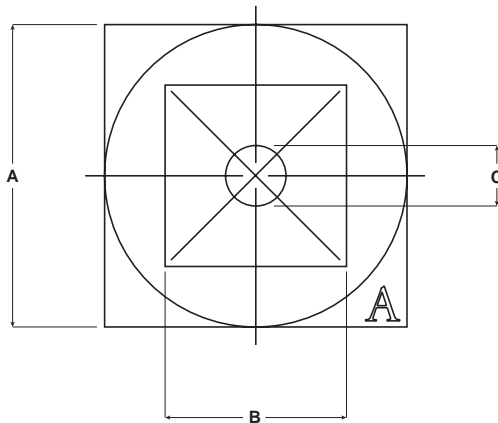
- 4 Ensure that all personnel in the area are wearing the appropriate protective eyewear and then apply power to the FH Head and the laser.
- 5 If your laser is equipped with a *Keyswitch*, turn it “On” (clockwise). The laser's green *PWR* indicator (Series 48 laser) or yellow *Ready* (Evolution™ or Firestar® laser) indicator illuminates and after a five-second delay the laser is ready to lase.

**Note:** During standby operation (*PWR* or *Ready* indicator on, but no PWM Command signal applied), 5 kHz “tickle” pulses sent from the head to the laser pre-ionize the gas to just below the lase threshold. These pulses allow the laser to respond almost instantaneously to Command signals from the marking head as the beam is switched off and on during marking.

- 6 Press the *Test Mark* pushbutton. The FH Head will mark a test pattern at a default speed of 40 inches per second (ips) using 50% of the laser's rated output power.

The test pattern, shown in Figure 2-3, locates the center of the marking field. Test pattern dimensions for each lens are provided in Table 2-1.

If the FH Head fails to mark properly, refer to *Troubleshooting* in the “Maintenance/Troubleshooting” section.



**Figure 2-3** Test pattern

# operation

## Initial start-up

**Table 2-1** Test pattern dimensions

Lens Size	Dim A	Dim B	Dim C
370 mm	90.0 mm	54.0 mm	18.0 mm
200 mm	50.0 mm	30.0 mm	10.0 mm
125 mm	32.0 mm	19.2 mm	6.4 mm
125HP*	30.0 mm	18.0 mm	6.0 mm
80 mm	12.5 mm	7.5 mm	2.5 mm

\* 125 mm lens for use with lasers 40 W and higher.

## Computer-controlled operation

Once you have verified that the FH Series Marking Head is working properly, the FLCC is installed, and WinMark Pro® software is loaded, perform the following steps to begin marking with your computer:

- 1 Refer to the *WinMark Pro User's Guide* and install the Hardlock.
- 2 Ensure that the lens size entered in WinMark is the same as the currently installed focusing lens:
  - a From the *Tools* menu in WinMark Pro, select *General Settings*...
  - b In the *Application Settings* dialog box, click the *Application Settings* tab.
  - c Click *Lens*, and then click the ellipsis (...).
  - d In the *Lens Selection* dialog box, select the lens currently installed on your FH Head.
- 3 From the *File* menu, open a *New* drawing.
- 4 Design a mark using WinMark or import a sample file from WinMark's *Samples* folder.

**Note:** If WinMark Pro senses that it is communicating with an FH Tracker Head, a new tab, *Tracking*, appears in the Property List. If so, then set *Track Marking Object* to *No* during this initial test.

### Caution

possible  
lens  
damage

Lens damage may result if the measuring device contacts the surface of the focusing lens.

- 5 Place the material to be marked in the field of the focusing lens.
- 6 Use a ruler marked in millimeters to set the proper Z-axis working distance from the bottom of the focusing lens mount to the surface of the part to be marked. Refer back to Figure 2-2.

# operation

## Initial start-up

### **Danger**

serious  
personal  
injury

This product emits invisible infrared laser radiation at the 10.6  $\mu\text{m}$   $\text{CO}_2$  wavelength. 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.

- 7 Apply power to the FH Head and the laser.
- 8 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are being followed, then command WinMark to mark.

**Note:** If the *Test Mark* pushbutton is pressed while WinMark Pro is marking a part, all or part of the mark may be lost. This can occur since the FH Marking Head accepts commands from both the *Test Mark* pushbutton on the control panel and WinMark Pro software. For safety reasons, if instructions arrive from both sources simultaneously, control panel inputs are programmed to take precedence.

**Note:** If the FH Head fails to mark properly under computer control, refer to *Troubleshooting* in the “Maintenance/Troubleshooting” section for information about the FLCC or check the *WinMark Pro User's Guide* for information regarding WinMark Pro settings.

Use information in this section to setup your FH Series Tracker Marking Head. The order of information presented in this section is the same as the order of tasks that you will need to perform. The best way to get Tracker ready for operation is to start at *Determining Line Speed* and work your way through *Marking*. You should have already completed the steps in the “Getting Started” and “Operation” sections of this manual.

This section contains the following information:

- Introduction – describes the FH Head’s Tracker feature.
- Determining line speed – explains how to determine line speed for your application.
- WinMark Pro software – describes WinMark’s Tracker features.
- Additional hardware – explains how to connect the rotary position encoder, part sensor, and DC power supply required for Tracker operation.
- Marking – explains the concepts behind Tracker’s dynamic marking and demonstrates how to optimize Tracker marks for speed and quality.

**Note:** If you are installing an FH Tracker Marking Head, please perform the tasks described in the “Getting Started” and “Operation” sections before proceeding to the “Tracker” section.

# tracker

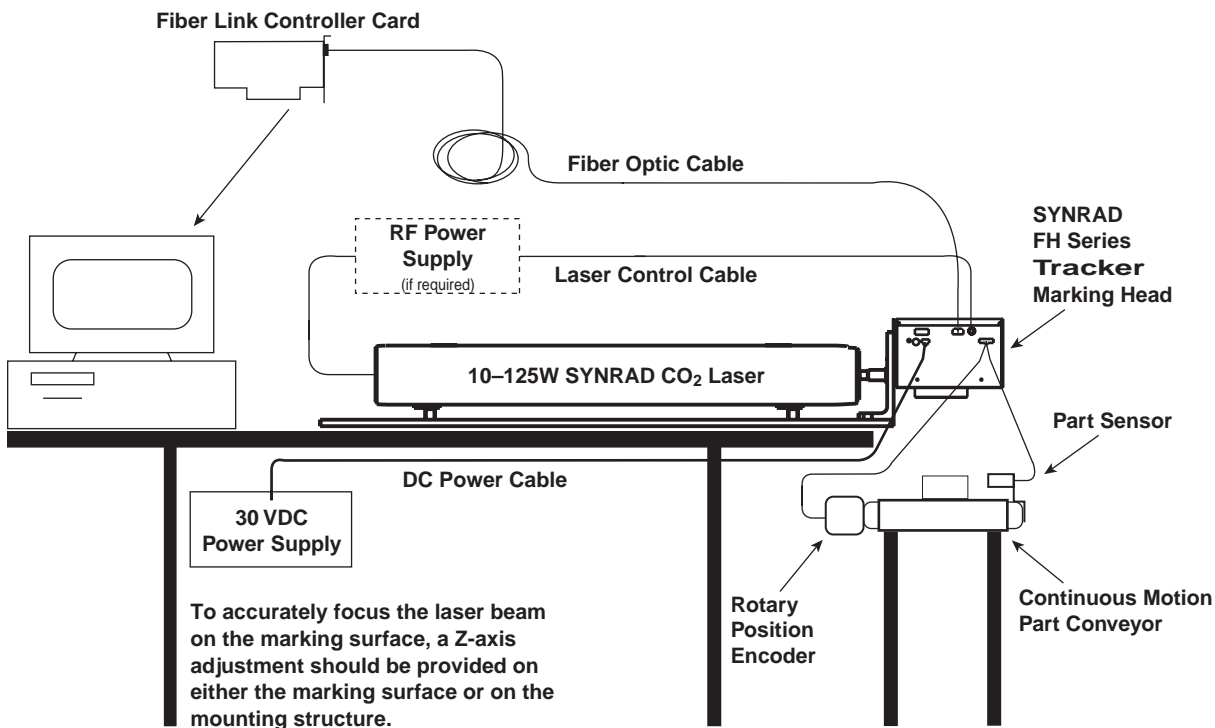
## Introduction

Unlike static laser marking systems that require parts to be at rest during marking, the FH Tracker is capable of marking parts “on-the-fly” as they move through the marking field at line speeds up to 200 feet per minute. Initial material samples should be tested by SYNRAD’s Applications Lab to determine the optimum power, speed, and lens size settings for your application. This testing will lead to an approximate figure for expected line speed; however, line speed is greatly affected by the type of mark you decide to create. The fastest marks are generally alphanumeric text marks such as serial numbers, date codes, lot numbers, etc., but even then changes in font type or font size may make a significant difference in actual performance.

## Tracker system components

A typical FH Tracker marking system is shown in Figure 3-1. In addition to the items listed under *Marking system components* in the “Getting Started” section, you will need to supply the following:

- Rotary position encoder
- Part sensor
- DC power supply for encoder and part sensor
- Part movement or conveyor system



**Figure 3-1** Typical FH Series Tracker marking system

# tracker

## Determining line speed

# 3

The *Determining line speed* section includes subsections:

- Definitions
- Tracker marking criteria
- Line speed formula
- Sample calculations

## Definitions

Before calculating the approximate line speed for an FH Tracker in a given application, several terms must be defined. To obtain the highest possible line speed and mark quality, please review these definitions carefully before designing your Tracking application.

### Mark

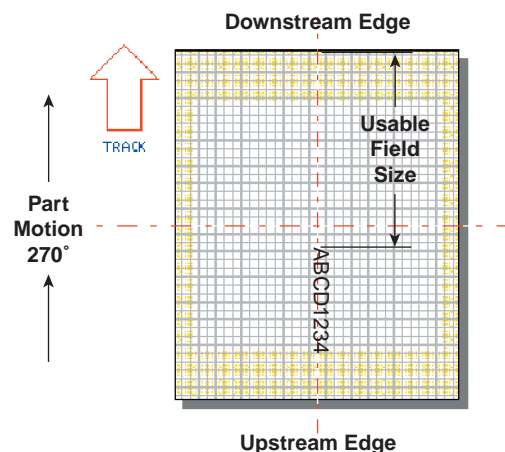
The *Mark* is the object, or collection of objects, defined by the bounding box when all marking objects are selected in your .mkh mark file.

### Marking Window

The *Marking Window* is best explained by visualizing WinMark Pro's *Drawing Canvas* superimposed on an actual part in the focal plane of the lens. The *Drawing Canvas* would exactly cover the maximum *Marking Window* for the selected lens. For example, with a 200 mm FH lens selected, the maximum *Marking Window* dimensions are 165 mm × 134 mm. When using a 125 mm FH lens, the *Marking Window* spans a 105.6 mm × 85.7 mm area.

### Usable Field Size

*Usable Field Size* is the distance, in millimeters, from the downstream edge of *Mark* placement in the *Marking Window* to the downstream edge of the *Marking Window* in the axis of part motion. Figure 3-2 illustrates *Usable Field Size*.



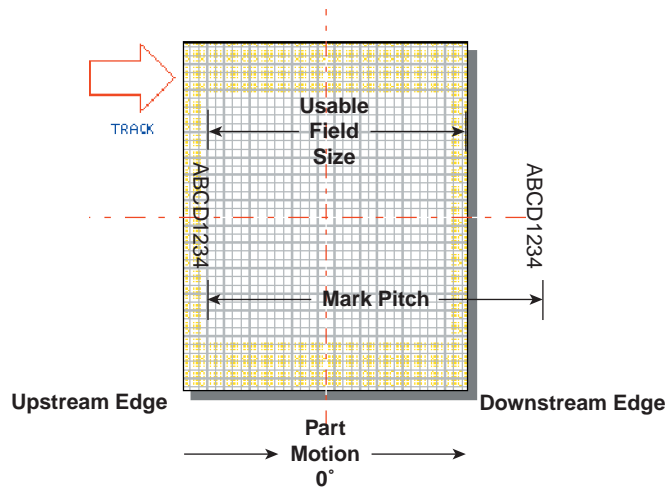
**Figure 3-2** Usable Field Size

# tracker

## Determining line speed

### Mark Pitch

*Mark Pitch* is the distance, in the axis of part motion, from the leading edge of the *Mark* on one part to the leading edge of the *Mark* on the following part. To achieve maximum line speed, *Mark Pitch* should be greater than the *Usable Field Size*. See Figure 3-3.



**Figure 3-3** Mark Pitch greater than Usable Field Size

### Cycle Time

The amount of time in seconds required to complete the *Mark* is the *Cycle Time*. Because cycle times for FH Index and Tracker Heads are the same, marks are first tested and optimized for speed and mark quality in Index mode.

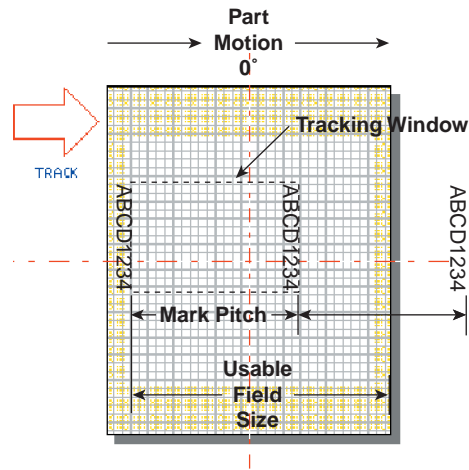
### Tracking Window

The *Tracking Window* is the fixed area beneath the Tracker Marking Head in which marking may be completed without error. The *Tracking Window* is defined as the smaller of either *Usable Field Size* or *Mark Pitch*.

For example, Figure 3-4 shows an application using a 200 mm lens with a 0° Motion Vector. The *Marking Window* dimension, in the direction of part motion, is 134 mm. Mark placement creates a *Usable Field Size* measuring 128 mm and part spacing creates a *Mark Pitch* measuring 90 mm. By definition, the *Tracking Window* is the smaller of *Usable Field Size*, which is 128 mm, or *Mark Pitch*, which measures 90 mm. In this case the actual *Tracking Window* is limited to 90 mm.

# tracker

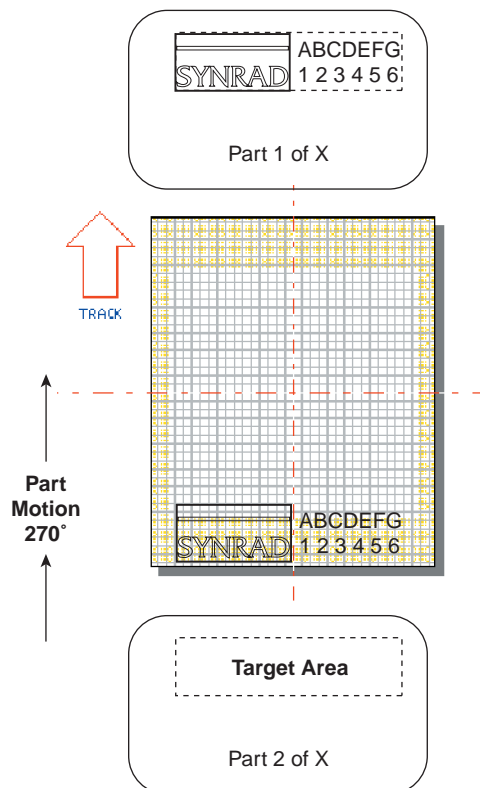
## Determining line speed



**Figure 3-4** Tracking Window

### Target Area

The *Target Area* is the area on the part, or array of parts, that will be lased with the *Mark* as parts move under the Tracker Head. See Figure 3-5.



**Figure 3-5** Target Area

# tracker

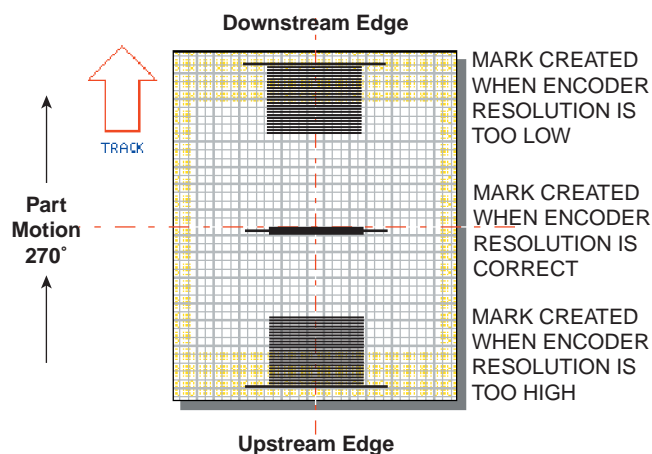
## Determining line speed

### Tracker marking criteria

- The entire *Target Area* of the part, or array of parts, to be marked must move completely within the *Tracking Window* before lasing will begin.
- Lasing must be completed on the part, or array of parts, before the *Target Area* of the next part, or array of parts, reaches the *Tracking Window*. If lasing is not complete before the *Target Area* of the next part reaches the *Tracking Window*, the next part, or array of parts, will not be marked and the mark log will display a “Line speed too fast – missed start” error.

Depending upon Sensor Distance and *Mark Pitch*, FH Tracker Heads can buffer up to 16 “start mark” signals. The number of start signals buffered by the head equals the number of parts that pass the part sensor before the first part enters the *Tracking Window*. Note that when a “Line speed too fast – missed start” error occurs, the buffer is reset to zero. In cases where more than one “start mark” signal is buffered, more than one piece will not be marked when the buffer resets.

- The part sensor should be positioned so that it does not trigger while the FH head is marking a part. See Figures 3-14 and 3-15.
- Encoder Resolution, encoder pulses per millimeter of conveyor motion, must be properly set to prevent mark distortion or marking outside the *Target Area*. See *Additional hardware* later in this section for details on calculating Encoder Resolution. After determining the correct value, open and run the *Linestack200.mkh* or *Linestack370.mkh* mark file to verify the calculated value (for 80 mm and 125 mm lenses, copy the linestack objects and paste into a *New* drawing created with the correct lens setting). If Encoder Resolution is correct, then short and long lines will appear as one long line as shown in Figure 3-6.

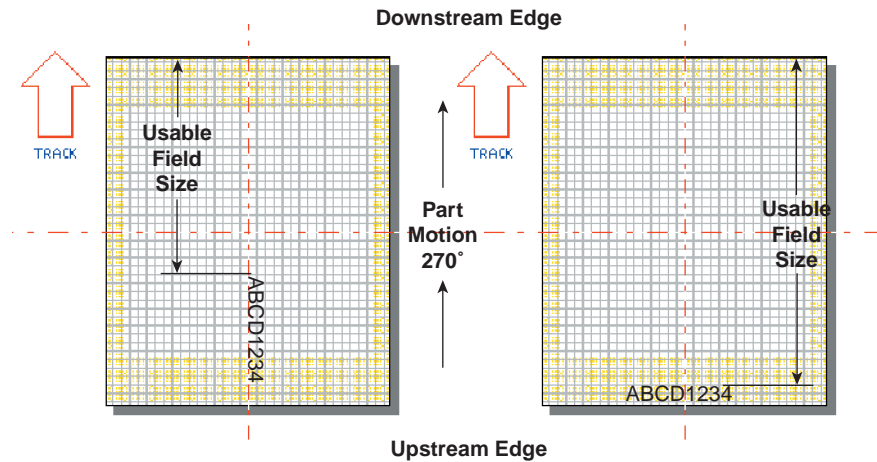


**Figure 3-6** Checking Encoder Resolution

If the long line is further downstream of the short lines in the direction of motion, then increase Encoder Resolution. If the long line is upstream of the short ones, decrease Encoder Resolution. Accuracy to the second decimal point may be required depending on the resolution of your encoder.

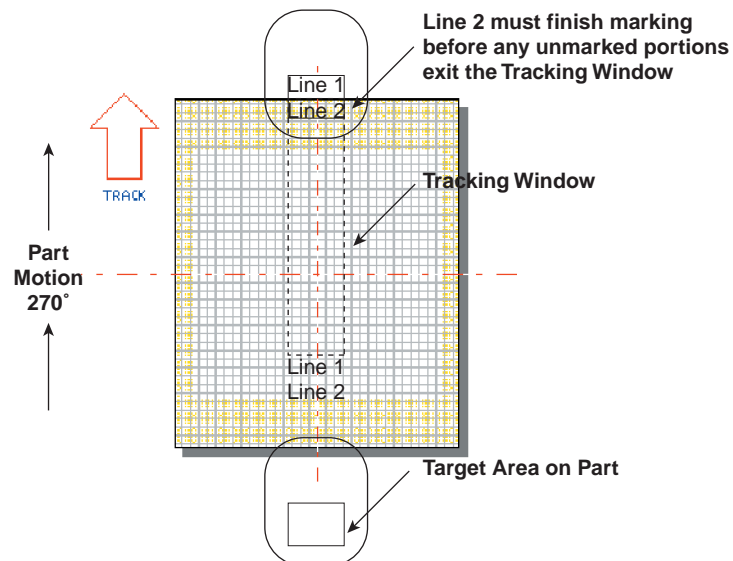
## Determining line speed

- Mark position and orientation make a substantial difference in Tracking speed because they change Usable Field Size. Maximum line speed is achieved when the Mark is positioned as close as possible to the upstream edge of the Marking Window. The entire Mark must be positioned on the Drawing Canvas so that it lies within the boundaries of the Marking Window. Figure 3-7 shows how the same text positioned differently can give two very different values for Usable Field Size.



**Figure 3-7** Usable Field Size comparisons

- Marked portions of the Target Area may move beyond the downstream edge of the Tracking Window as the mark is progressing; however, lasing is disabled when any unmarked microvectors move outside the Tracking Window. If this occurs, the mark may be missing or incomplete and the mark log will display a “Line speed too fast to finish” error. In Figure 3-8, “Line 2” will mark unless any unmarked portions of the text object move outside the Tracking Window.



**Figure 3-8** Maximum marking position in Tracking Window

# tracker

## Determining line speed

### Line speed formula

**Note:** Line speed calculations do not account for differences in computer speed or the time required for automation processes to complete their respective tasks between marks. These factors must be considered when determining the actual throughput of your production line. As with any factory automation proposal, proof-of-concept testing is highly recommended. The first step in achieving maximum line speed is to first optimize your mark file to meet mark speed and mark quality requirements for the specific material to be marked.

The formula below provides the approximate maximum line speed for a specific mark file using an FH Series Tracker Marking Head:

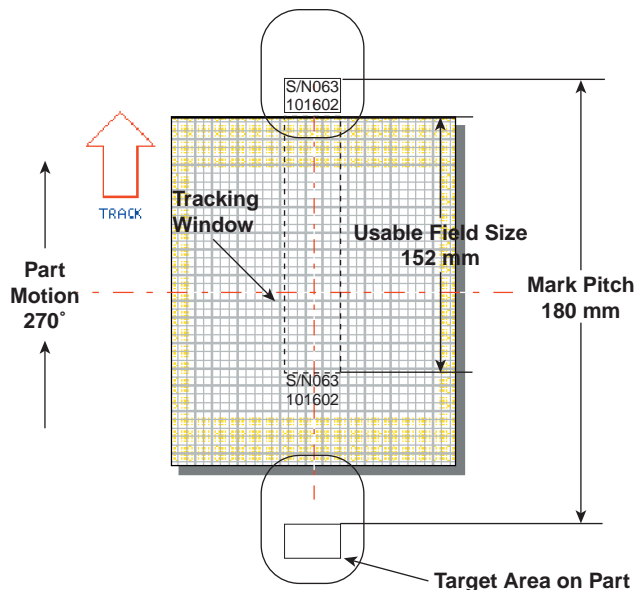
$$\text{Line Speed} = \text{Tracking Window} / \text{Cycle Time}$$

### Sample calculations

Sample calculation #1 and Sample calculation #2 guide you through the definitions described earlier so that the correct values for Tracking parameters can be determined and inserted into the Line Speed equation.

#### Sample calculation #1

Refer to Figure 3-9 and read through the following sample line speed calculation.



**Figure 3-9** Tracker line speed calculation # 1

The mark is being made by an FH Tracker using a 200 mm FH lens; maximum lens field dimensions are 165 mm × 134 mm. A Motion Vector of 270° is set in WinMark Pro on the *Tracking* tab due to the application's part motion requirements. Mark placement in the *Marking Window* is such that the *Usable Field Size* is 152 mm.

# tracker

## Determining line speed

The *Tracking Window* is defined as the smaller of either *Usable Field Size* or *Mark Pitch*. *Usable Field Size* is 152 mm and *Mark Pitch* is 180 mm, so the *Tracking Window* is 152 mm.

*Cycle Time* for the mark (optimized in Index marking mode) is 0.32 seconds.

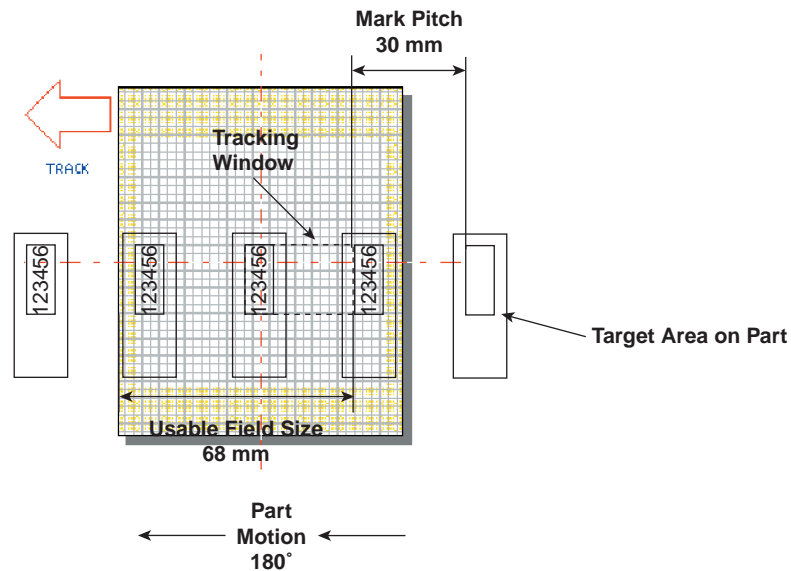
$$\text{Line Speed} = \text{Tracking Window} / \text{Cycle Time}$$

$$= 152 \text{ mm} / 0.32 \text{ sec}$$

$$\text{Line Speed} = 475 \text{ mm/sec} = 28.5 \text{ m/min} = 93.5 \text{ ft/min}$$

### Sample calculation #2

Refer to Figure 3-10 and the following sample line speed calculation.



**Figure 3-10** Tracker line speed calculation # 2

The mark is being made by an FH Tracker using a 125 mm FH lens. Maximum lens field dimensions are 105.6 mm × 85.7 mm. A Motion Vector of 180° is set in WinMark Pro on the *Tracking* tab due to the application's part motion requirements. *Usable Field Size* is 68 mm and *Mark Pitch* measures 30 mm. The *Tracking Window*, the smaller of either *Usable Field Size* or *Mark Pitch*, equals 30 mm.

*Cycle Time* for the mark is 0.20 seconds.

$$\text{Line Speed} = \text{Tracking Window} / \text{Cycle Time}$$

$$= 30 \text{ mm} / 0.20 \text{ sec}$$

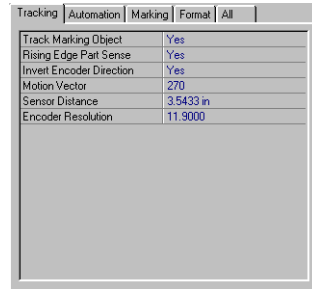
$$\text{Line Speed} = 150 \text{ mm/sec} = 9 \text{ m/min} = 29.5 \text{ ft/min}$$

# tracker

## WinMark Pro software

### Tracking tab

When WinMark Pro senses it is communicating with an FH Tracker it adds another tab to the Property List. This additional tab, *Tracking* (shown in Figure 3-11), contains the tracking properties described below.



Tracking	Automation	Marking	Format	All
Track Marking Object	Yes			
Rising Edge Part Sense	Yes			
Invert Encoder Direction	Yes			
Motion Vector	270			
Sensor Distance	3.5433 in			
Encoder Resolution	11.9000			

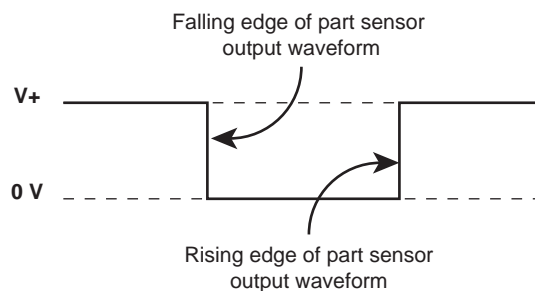
**Figure 3-11** Tracking tab

### Track Marking Object

Select *Yes* to track and mark moving parts with the Tracker feature. Choose *No* to mark stationary objects.

### Rising Edge Part Sense

Set Rising Edge Part Sense based on how the part sensor output should trigger the mark. Selecting *Yes* triggers marking on the rising edge of the sensor's output waveform while selecting *No* triggers marking on the falling edge of the signal. Figure 3-12 illustrates a typical waveform from a part sensor. For optimal results, Rising Edge Part Sense should always be set to *Yes*.



**Figure 3-12** Part sensor output waveform

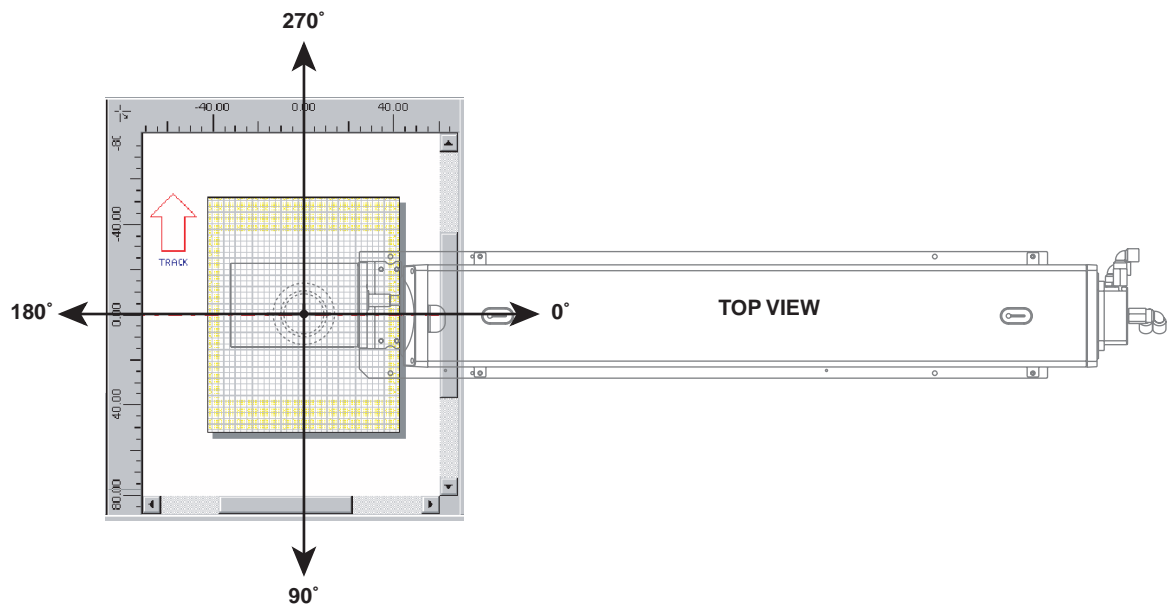
### Invert Encoder Direction

Invert Encoder Direction allows you to invert phasing of the encoder's quadrature output signal so that the actual direction of part movement through the marking field is correctly sensed as "forward". This feature eliminates the need to physically change input field wiring on the FH Head.

### Motion Vector

Set the direction of part movement through the marking field. When looking at WinMark's *Drawing Canvas* (shown in Figure 3-13), 0° is part movement towards the right, 90° is movement towards the bottom, 180° is towards the left, and 270° is part movement towards the top of the *Drawing Canvas*.

When Track Marking Object is Yes, a motion arrow displays to the left of the *Drawing Canvas* showing the direction of the currently entered Motion Vector.



**PART MOTION COORDINATE SYSTEM OF WINMARK DRAWING CANVAS RELATIVE TO FH TRACKER HEAD**

**Figure 3-13** Drawing Canvas coordinates relative to Tracker

**Note:** Part motions of either 90° or 270° provide the fastest line speeds because part movement is along the long axis of the marking field; 0° or 180° part movement will be slightly slower. Although non-cardinal motion vectors (like 70° or 125°) are supported by Tracker, it is simpler to setup and achieve expected results using the cardinal motion vectors of 0°, 90°, 180°, or 270°.

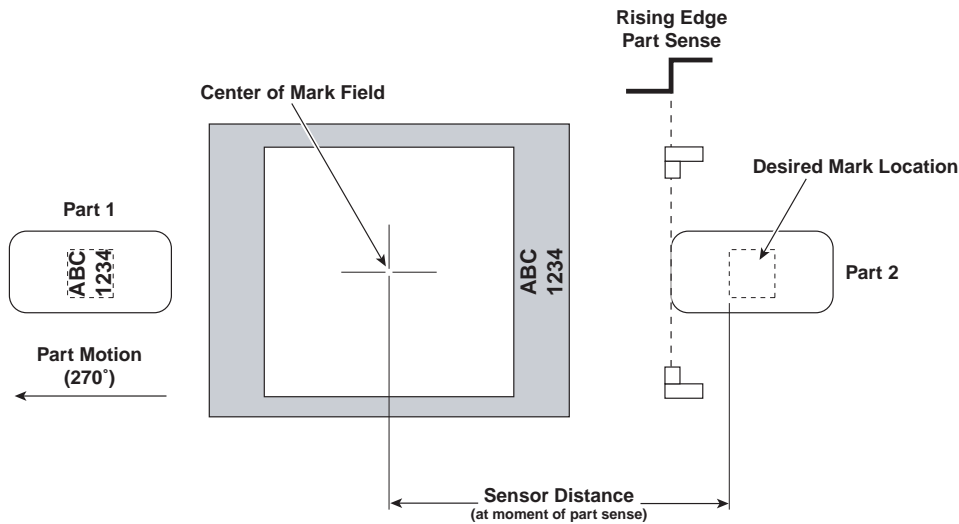
### Sensor Distance

The term, Sensor Distance, is not entirely accurate because the value entered is not related to the physical part sensor location but rather Sensor Distance is defined as *the distance, at the moment of part sense, from the center of the Marking Window to the leading edge of the desired mark location*. Unlike other marking methods that are time-based, Tracker uses a distance-based marking scheme. This is because at the moment a part is sensed (on the rising or falling edge of the part sense signal), the FH Tracker Head begins counting rotary encoder pulses. When the number of encoder pulses counted by the head equals the Sensor Distance (calculated by the Encoder Resolution), marking begins. Because Tracker calculates marking vectors based on encoder pulses (distance), Tracker can continue to accurately mark an object even when it stops once the *Target Area* has fully entered the *Tracking Window*.

## WinMark Pro software

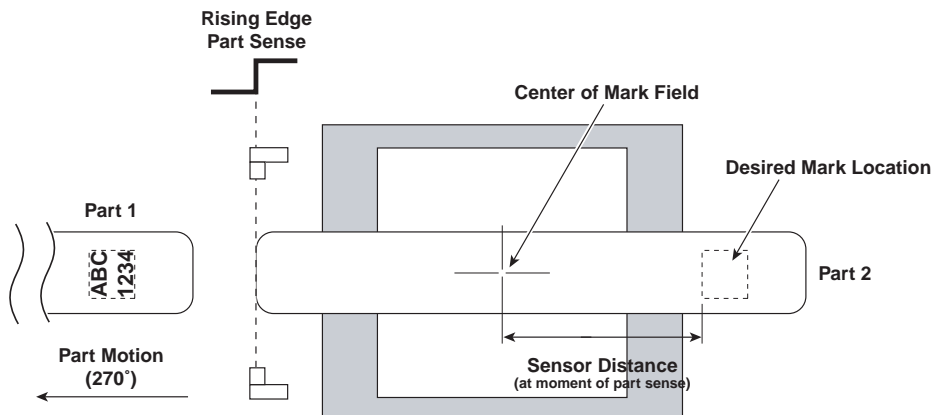
Units of measure for Sensor Distance are inches with a maximum value of 12.0 inches. Change Sensor Distance to move the location of the mark on the part in the axis of part motion. Moving the location of the mark object on the Drawing Canvas (in the axis of part motion) has no affect on part mark location.

Figure 3-14 illustrates the Sensor Distance concept. In this case the part sensor is placed upstream of the mark field (parts are sensed before they reach the center of the mark field) and the sensor is set to trigger on a rising edge transition.



**Figure 3-14** Upstream part sensor, rising edge trigger

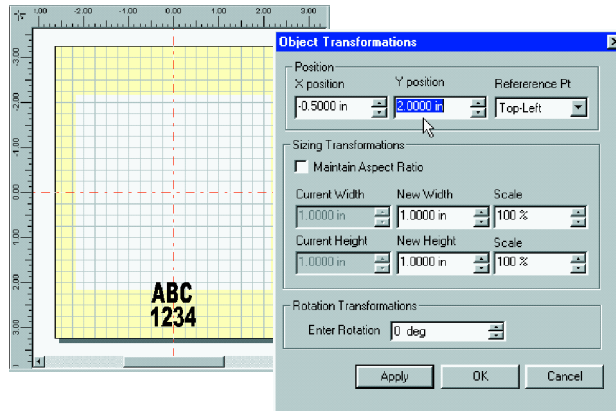
Figure 3-15 illustrates Sensor Distance when the part sensor is positioned downstream. Even though the leading edge of the part has traveled past the center of the mark field, the area where the part is to be marked must still be upstream of the centerline.



**Figure 3-15** Downstream part sensor

Maximum Tracker mark speeds are obtained when mark objects are positioned near the upstream edge of WinMark's *Drawing Canvas* and the Motion Vector (on the *Tracking* tab) is set to 90° or 270°, which takes advantage of the FH Head's rectangular marking field.

Each object to be marked has an X-Y “start mark” point, which is the starting beam position. Sensor Distance must be greater than the value of the X or Y “start mark” coordinate, which is normally the object's top left corner (unless the object has been rotated). When the Tracking Motion Vector is 90° or 270°, the Sensor Distance must be greater than the Y “start mark” coordinate. When the Motion Vector is 0° or 180° then Sensor Distance must be greater than the X “start mark” coordinate. If the Sensor Distance minus the mark position on the *Drawing Canvas* is less than or equal to zero, this means that the part will be past the point of marking before the specified Sensor Distance has been traveled. If this error occurs, move the part sensor further upstream. If line speed (cycle time) is not an issue, you can instead move the object's location on the *Drawing Canvas*. In Figure 3-16, the text object's top left coordinate value is X = -0.5, Y = 2.0 (inches). If the drawing's Motion Vector is 270°, then the Sensor Distance entered must be greater than 2.0 inches.



**Figure 3-16** X-Y “start mark” coordinates

Rotating an object changes the X-Y coordinates of its “start mark” point, which may require you to reposition the mark object on the *Drawing Canvas* or change Sensor Distance (move the part sensor). Depending upon the Motion Vector selected, rotating an object 180° may allow the object to be placed closer to the upstream edge of the *Drawing Canvas*, thus increasing overall line speed.

## Encoder Resolution

Encoder Resolution is the number of encoder pulses received per millimeter of distance traveled by the conveyor. Encoder Resolution units are fixed as pulses/mm even when WinMark is set to display measurement units in inches or centimeters.

# tracker

## Additional hardware

The *Additional hardware* section includes subsections:

- Rotary position encoder
- Part sensor
- DC power supply

FH Tracker Heads require several additional components to coordinate marking with part motion. These components include a part sensor (capacitive, inductive, optical, mechanical, etc.) for part position information, a rotary position encoder (with bidirectional or quadrature signal output) for determining line speed, and a DC power supply to power both the part sensor and rotary encoder. Although the components listed above are not provided with your FH Tracker, some or all of them may already exist in the equipment that performs your automated parts handling. Appendix B provides information on a *Tracker Motion Sensing Kit* for those customers who prefer to buy motion detection components from SYNRAD.

## Rotary position encoder

A rotary position encoder is required to send position information to the FH Tracker. If your parts handling equipment does not incorporate a rotary encoder that generates quadrature position signals, then you must add an encoder that produces a “bidirectional” or “quadrature” output signal, a two channel signal whose phase relationship distinguishes forward and reverse motion. Do not use an absolute position encoder. Table 3-1 lists electrical specifications for choosing a rotary encoder.

**Table 3-1** Rotary position encoder specifications

Function	Specifications
Code	Incremental
Pulses Per Revolution	User determined (see <i>Encoder setup</i> for sample calculations)
Input Voltage	15.0–40.0 VDC
Output Signal	Open collector (PNP or NPN) or open drain (P-channel or N-channel) Low level output voltage: –0.6–5.0 VDC (0 V typ.) High level output voltage: 15.0–40.0 VDC (24 V typ.) On-state current: 15 mA minimum Quadrature or bi-directional

## Encoder connection

Encoder outputs are connected directly to the FH Tracker’s *Parts Handling Connector*. Fiber Link Controller Card (FLCC) inputs can not be used for tracking functions.

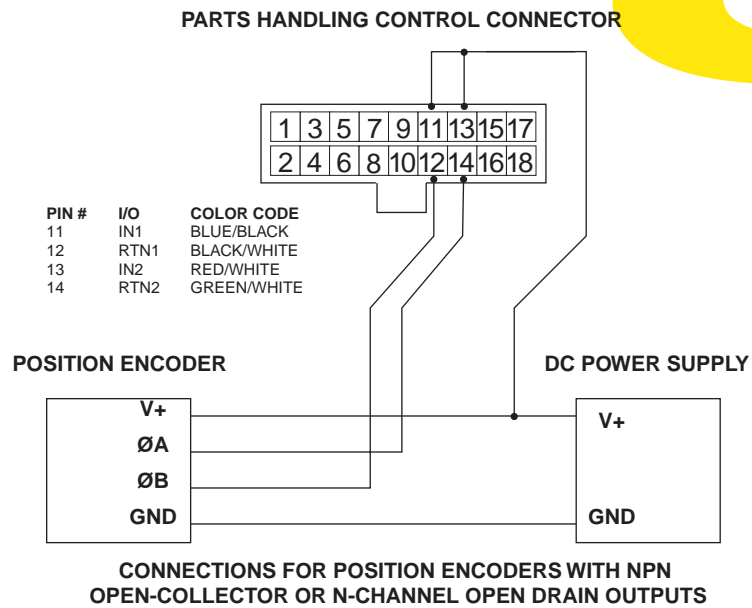
To connect the rotary position encoder, refer to the appropriate connection diagram. Use Figure 3-17 for NPN open collector or N-channel open drain encoders. Use Figure 3-18 for PNP or P-channel encoders.

**Note:** If using SYNRAD’s *Tracker Motion Sensing Kit*, connect the encoder’s five-pin DIN jack to the five-pin DIN plug on the end of Tracker’s *Parts Handling Control* cable. Plug the 18-pin *Parts Handling Control* connector into the *Parts Handling Control* port on the FH Head.

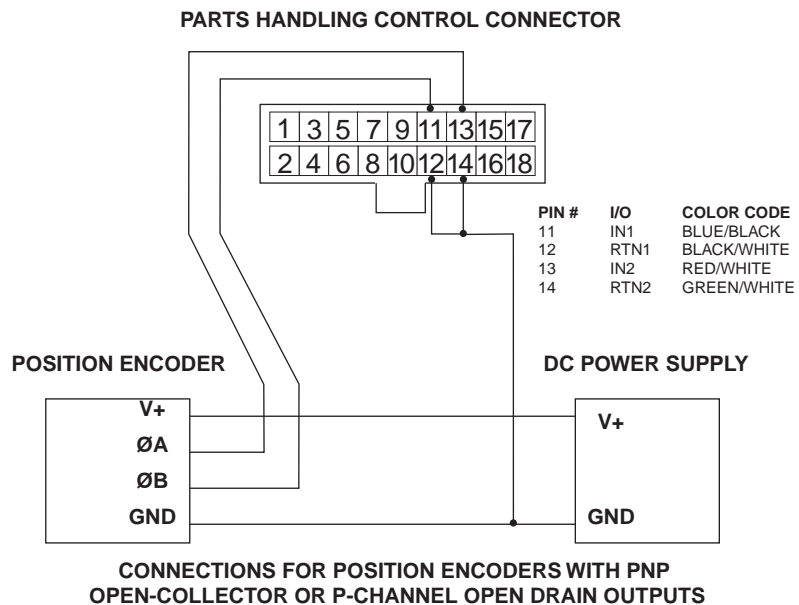
# tracker

## Additional hardware

# 3



**Figure 3-17** Wiring diagram for NPN or N-channel encoders



**Figure 3-18** Wiring diagram for PNP or P-channel encoders

Verify that field wiring is correct after encoder connections are completed. In the *WinMark* folder, open *DigScope.exe* and apply power to the encoder. If the encoder is properly connected, input #1 (IN1) and input #2 (IN2) should toggle as the position encoder rotates through its range of motion.

**Note:** To prevent I/O conflicts, *DigScope* and *WinMark Pro* should never be open at the same time. Always close one application before opening the other.

# tracker

## Additional hardware

### Encoder setup

Convert the encoder's "Pulses Per Revolution" (PPR) output to pulses per millimeter of motion by using the following equation:

$$\text{Encoder resolution (pulses per mm of motion)} = X (\text{pulses per rev}) \times Y (\text{coupling factor}) \times 1 \text{ m}/1000 \text{ mm}$$

Where: **X** is the number of encoder pulses per revolution (read from the encoder's data sheet),  
**Y** is the coupling factor; the number of encoder revolutions per meter of conveyor motion (calculated by the user). Multiply by 1 m/1000 mm (or divide by 1000 mm) to convert meters of motion to millimeters.

Example:

$$\begin{aligned} \text{Encoder resolution} &= X \times Y \times 1 \text{ m}/1000 \text{ mm} \\ &= 360 \text{ pulses/rev} \times 14.32 \text{ rev/m} \times 1 \text{ m}/1000 \text{ mm} \\ &= 5155.2 \text{ pulses/m} \times 1 \text{ m}/1000 \text{ mm} \end{aligned}$$

$$\text{Encoder resolution} = 5.1552 \text{ pulses per millimeter of conveyor motion}$$

An Encoder Resolution between 5–15 pulses per millimeter of conveyor motion provides adequate resolution for part conveyors that run smoothly at constant speeds. When marking very small objects or when part motion is variable, maintain mark quality by choosing an encoder with a higher PPR (pulses per revolution) output or increase the coupling factor so that the Encoder Resolution value is much larger.

Tracker's optically-isolated inputs have an electrical input frequency limitation of approximately 10 kHz. This means that the encoder's output (encoder pulses per revolution) and the coupling factor (encoder revolutions per meter of conveyor motion) should be chosen so that conveyor or line speed in mm/sec multiplied by the encoder's calculated pulses/mm of conveyor travel is less than 10,000. If line speed is set too fast, the message "Line speed too fast to finish" is displayed in the mark log file that appears on the right side of the Launcher (mark window) during a mark session.

Example:

The selected encoder provides 1000 pulses/rev and the coupling factor is determined to be 8 rev/m of motion. Using the equation above, the calculated encoder resolution is 8 pulses/mm of conveyor motion. The required line speed is 144 ft/min (732 mm/s). Multiplying the line speed of 732 mm/s by the encoder's 8 pulses/mm of travel gives an input frequency of 5.856 kHz, which is within Tracker's frequency limit of 10 kHz.

Enter the calculated number of pulses per millimeter of motion in the Encoder Resolution field on WinMark Pro's *Tracking* tab.

If necessary, fine-tune encoder resolution using one of the *linestackXX.mkh* sample files included in the *WinMark* folder. These files consist of an array of 20 identical lines stacked on top of each other. The last line marked is longer than the others and serves to indicate whether the actual encoder resolution is higher or lower than the currently entered Encoder Resolution.

# tracker

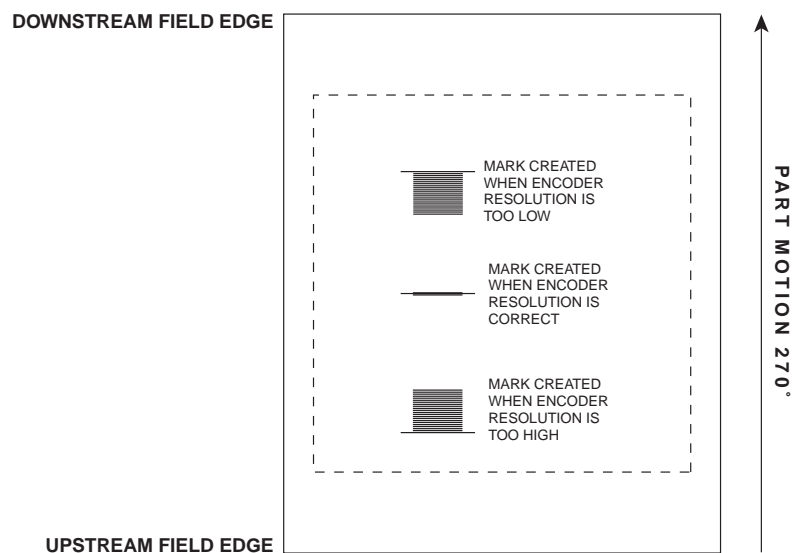
## Additional hardware

To fine tune encoder resolution, follow the steps below:

- 1 In the *WinMark* folder, locate and open the appropriate *linestackXX.mkh* file where *XX* matches the lens installed on your marking head. For example, if a 200 mm focusing lens is installed, choose *linestack200.mkh*.
- 2 Click the *Marking* tab and set an appropriate *Power* for your test substrate.

**Note:** Your test substrate should be at the same height as the part to be marked. Minor differences in Z-axis adjustment (working distance) will affect Tracker performance as the mark may be too faint. Changing the Z-axis also affects the optimum Encoder Resolution value.

- 3 Ensure that all personnel in the area are wearing the appropriate protective eyewear.
- 4 Mark the file at the required line speed.
- 5 Examine the mark produced and compare with the drawing in Figure 3-19 below.



**Figure 3-19** Linestack mark

- 6 When Encoder Resolution is set accurately, the lines will appear as one long line. If the longer line is further downstream of the shorter lines, then increase Encoder Resolution. If the longer line is upstream of the shorter lines, then decrease resolution. Accuracy to the second decimal point may be required depending upon the resolution of your particular encoder.

# tracker

## Additional hardware

### Part sensor

A part sensor is required to send part position information to the FH Tracker. Any number of capacitive, inductive, photoelectric, or mechanical sensors currently on the market can be used depending on the part's material composition. Table 3-2 lists electrical specifications for choosing a part sensor.

**Table 3-2** Part sensor specifications

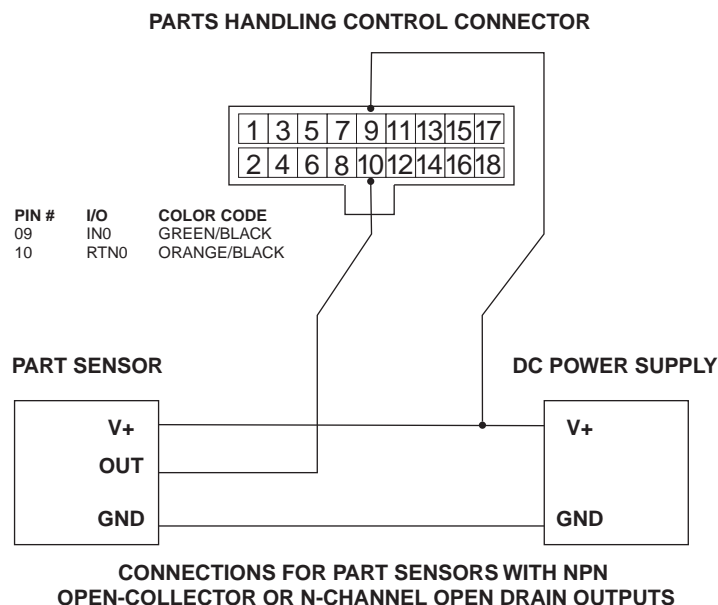
Function	Specifications
Input Voltage	15.0–40.0 VDC
Output Signal	Open collector (PNP or NPN), open drain (P-channel or N-channel), or mechanical limit switch Low level output voltage: –0.6–5.0 VDC (0 V typ.) High level output voltage: 15.0–40.0 VDC (24 V typ.) On-state current: 15 mA minimum

### Part sensor connection

The part sensor output is connected directly to the FH Tracker's *Parts Handling Connector*. Fiber Link Controller Card (FLCC) inputs can not be used for tracking functions.

To connect the part sensor, refer to the appropriate connection diagram. Use Figure 3-20 for NPN open collector or N-channel open drain sensors. Use Figure 3-21 for PNP or P-channel sensors.

**Note:** If using SYNRAD's *Tracker Motion Sensing Kit*, connect the sensor's four-pin DIN jack to the four-pin DIN plug on the end of Tracker's *Parts Handling Control* cable. Plug the 18-pin *Parts Handling Control* connector into the *Parts Handling Control* port on the FH Head.

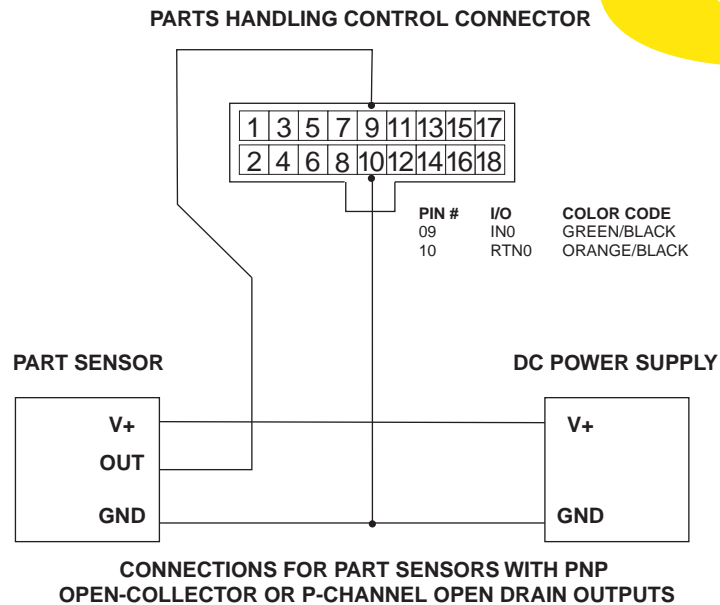


**Figure 3-20** Wiring diagram for NPN or N-channel sensors

# tracker

## Additional hardware

# 3



**Figure 3-21** Wiring diagram for PNP or P-channel sensors

Verify that field wiring is correct after all part sensor connections are complete. Locate and start Digital Scope (*DigScope.exe*) in the *WinMark* folder and then apply DC power to the sensor. If the part sensor is properly connected, input #0 (INO) should toggle when the part sensor activates.

**Note:** To prevent I/O conflicts, Digital Scope and WinMark Pro should never be open at the same time. Always close one application before opening the other.

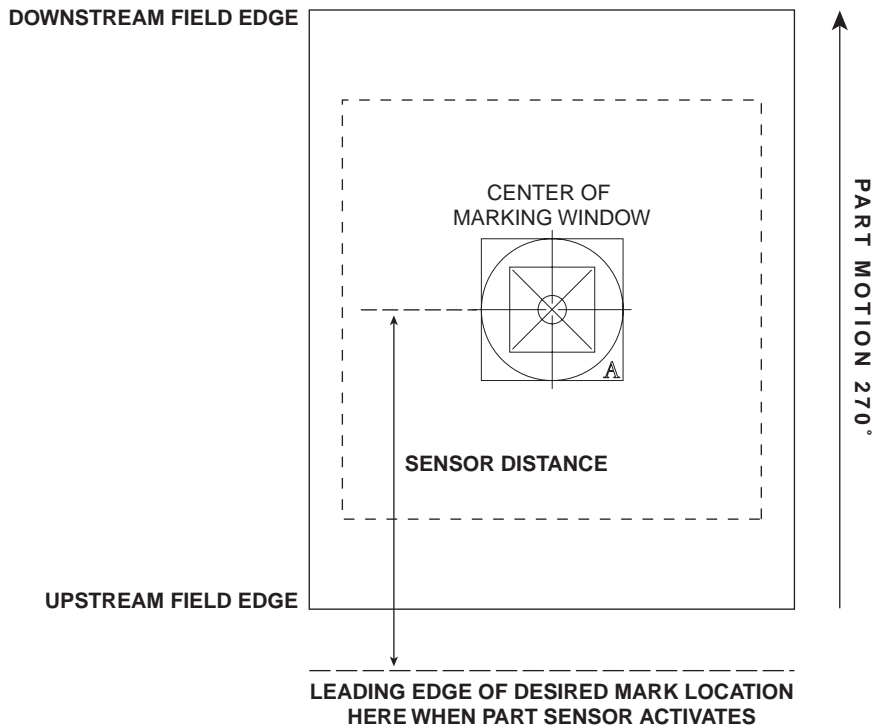
You may need to adjust the part sensor's optical sensitivity so that the sensor sends only a single output pulse for each individual part sense. Multiple part sense inputs for a single part causes the FH head to generate "Line speed too fast – missed start" errors. Mechanical or relay contact outputs may also provide part sense inputs, however the user must properly debounce the contacts to prevent multiple part sense inputs to the marking head.

# tracker

## Additional hardware

### Part sensor setup

Set part sensor parameters by referring to Figure 3-22 and following the steps below:



**Figure 3-22** Part sensor setup

- 1 If you are using a photoelectric sensor, follow the manufacturer's instructions on selecting either a Light or Dark activation mode.
- 2 On WinMark's *Tracking* tab, click on Rising Edge Part Sense and select Yes. Ensure that your part sensor is configured to generate a rising edge output pulse.
- 3 Center a sheet of cardboard, anodized aluminum, or a scrap part on the conveyor under the focusing lens and press the *Test Mark* pushbutton on the FH Tracker Head.
- 4 Close WinMark Pro and open Digital Scope. Trigger the part sensor with the part to be marked and verify that IN0 toggles as the sensor is activated.
- 5 Measure the distance (at the instant the part sensor activates) from the center of the marking field indicated by the test mark target to the leading edge of the desired mark location on the part.
- 6 Enter this number in the Sensor Distance field on WinMark's *Tracking* tab.

## DC power supply

A DC power supply is required to power the part sensor and position encoder.

### Power supply specs

Table 3-3 lists electrical specifications for choosing a DC power supply.

**Table 3-3** Power supply specifications

<b>Function</b>	<b>Specifications</b>
Input Voltage	User determined
Output Voltage	Select output voltage based on encoder and part sensor requirements within the range of 15.0–40.0 VDC

# tracker

## Marking

The *Marking* section includes subsections:

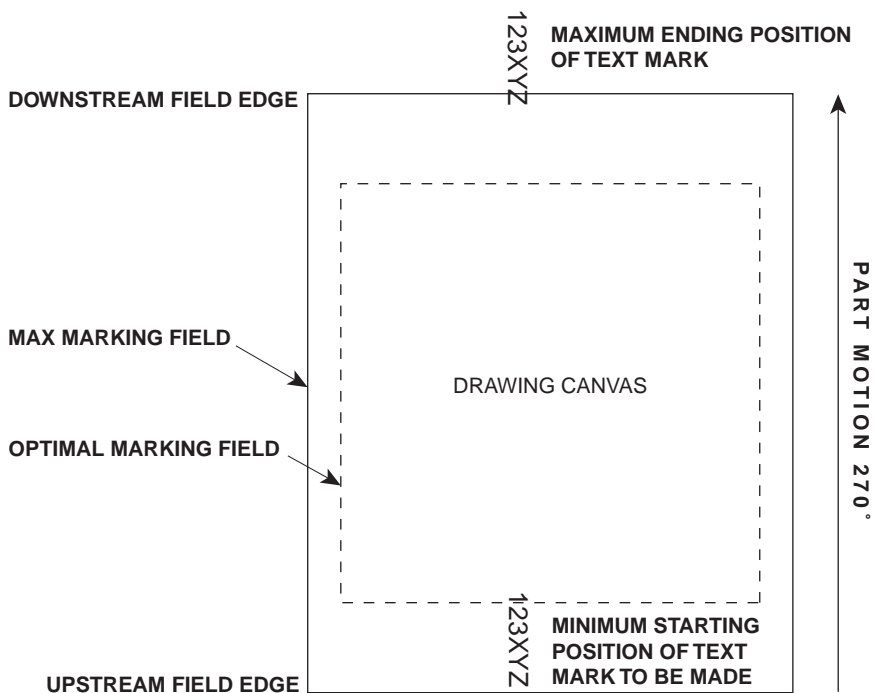
- Text
- Graphics
- Mark placement
- Optimization
- Summary

### Text

The best, and fastest, files to mark are those files containing only vector objects such as alphanumeric text using either a stroke font or an outlined TrueType font.

When marking a file containing just non-filled vector text (such as “123XYZ”), Tracker starts marking only when the *Target Area* encompassing “123XYZ” is fully within the *Tracking Window*. Marking can continue up until the moment the last portion of text to be marked (the last part of the “Z”) exits the *Tracking Window*. Figure 3-23 illustrates placement of the text to be marked on the *Drawing Canvas*.

WinMark Pro marks text from left to right, just as you enter it in the *Text Caption Editor* dialog box; all the characters in line 1, followed by all the characters in line 2, etc. (refer back to Figure 3-8). When marking two or more lines of text, the *Mark* must not exit the *Tracking Window* before the last character on the *last* line, not the last character on the *first* line, is completed.



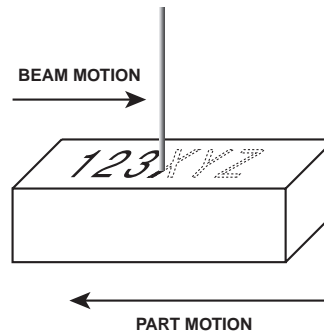
**Figure 3-23** Sample text mark

# tracker

## Marking

Because WinMark Pro marks text from left to right and top to bottom, use this feature to ensure that marking occurs at the fastest speed possible. To achieve optimum speeds, perform the following steps:

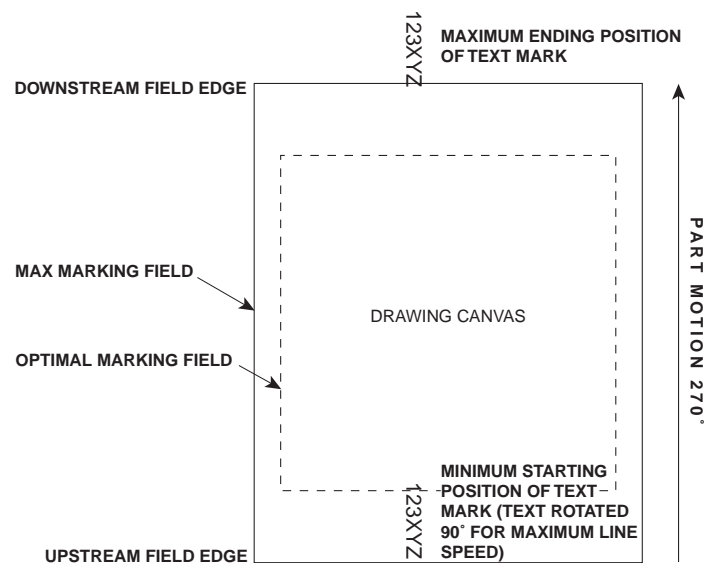
- 1 Orient either the text or the part to be marked as shown in Figure 3-24 so that the laser mark is made moving against, or counter to, the direction of part motion.



**Figure 3-24** Beam/mark motion

- 2 Position the mark on the *Drawing Canvas* so that the entire mark is placed near the upstream edge of the *Marking Window* (Figure 3-25).

**Note:** Because Sensor Distance must be greater than the X or Y “start mark” coordinate, you may need to move the physical placement of the part sensor to prevent an error when marking.



**Figure 3-25** Mark orientation

- 3 Begin marking at the desired speed. If line speed is set too fast, the message “Line speed too fast to finish” is displayed in the mark log (on the right side of the Launcher window). This error occurs when a *Target Area* containing any unmarked microvectors moves outside the *Tracking Window*.

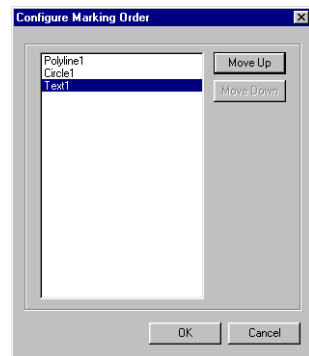
# tracker

## Marking 3 Graphics

The best graphics files to mark are simple drawings composed of unfilled vector-based artwork such as those created in drawing programs like AutoCAD®, Adobe® Illustrator®, CorelDRAW®, or Macromedia® Freehand™.

As with text objects, marking of graphic objects can continue up until the last portion of the object to be marked exits the *Tracking Window*. Be aware however, that starting points for objects such as circles and squares combined with the desired direction of part motion may not always allow the graphic to move outside the *Tracking Window* before marking is complete.

To optimize marking of files containing both text and graphics, set the mark order so that all graphic objects mark before any text objects. In WinMark, go to the *Objects* menu and click *Set Marking Order*. When the *Configure Marking Order* dialog box appears (Figure 3-26), arrange drawing objects as required.



**Figure 3-26** Configure Marking Order dialog box

**Note:** Bar codes, filled TrueType text, imported bitmap images, or other filled objects created in WinMark Pro are marked using a slower raster scanning method. These raster objects may not be appropriate for Tracker’s high-speed “on-the-fly” marking. Although 2D codes are also bitmap (raster scanned) objects, WinMark Pro versions 2.0.0.3087 and above support a “fast” spot-style 2D code. This “fast” code, created by marking very small unfilled vector circles, is a viable option for marking 2D codes with Tracker.

## Mark placement

To move the position of marking *along* the axis of part movement and achieve the highest potential line speed, position the mark near the upstream field edge of the *Marking Window* and then adjust *Sensor Distance* on WinMark’s *Tracking* tab to position the actual mark on the part.

To relocate the mark *across* the axis of part motion, select all mark objects on the *Drawing Canvas* and use your mouse or arrow keys to move the objects perpendicular to part motion.

**Note:** When positioning objects on the *Drawing Canvas*, never place any object beyond the edges of the maximum *Marking Window*.

## Optimization

### Tracking variables

There are several variables related to the *Tracking Window* that can be optimized to increase marking throughput:

- Lengthen *Usable Field Size* by reducing *Mark* size.
- Rotate the *Mark* (as shown in Figure 3-7).
- If the *Tracking Window* is smaller than *Usable Field Size*, increase the *Mark Pitch* so that it is equal to, or greater than, the *Usable Field Size*. If this is not possible then consider adding a second marking head so that each head marks every other part, which effectively doubles *Mark Pitch*.

### WinMark Pro property variables

Cycle times of mark files are usually optimized, even in Index applications, to obtain the highest throughput speeds. To increase Tracking line speeds, try the following:

- Increase Velocity and reduce Resolution.
- Increase Off Vector Velocity and reduce Off Vector Resolution.
- Use stroke text instead of TrueType fonts.
- When marking 2D codes, set 2D Barcode Bitmap (on the *Format* tab) to *No* and set Spot Marking Style (on the *Marking* tab) to *Yes*.
- Simplify line art.
- If possible, reduce the number of marking characters.
- Run WinMark Pro on a faster computer.

## Summary

Line speed calculations do not take into account the differences in computer speeds (for instance, if the mark's *Cycle Time* is optimized on a different computer system than the one running the actual marking application), or the time required for other automation processes (such as motion controllers or automation software) to complete their respective tasks between each mark. These factors must be accounted for when determining the actual throughput of your production line. As with any factory automation proposal, proof-of-concept testing is highly recommended.

# tracker 3

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# technical reference

Use information in this section as a technical reference for your FH Series Marking Head.

This section contains the following information:

- FH Head technical overview – briefly describes SYNRAD’s FH Series Marking Head technology.
- Upgrading firmware – describes how to upgrade the firmware in your FH Series Marking Head.
- Custom test mark feature – explains how to implement the custom test mark feature using your FH Head and WinMark Pro.
- Marking automation – explains how to interface the FH Head to parts handling equipment.
- Fiber Link Controller Card features – describes the FLCC’s Fast Acting Safety Interlock function and illustrates DIP switch settings.
- General specifications – lists FH Series Marking Head specifications.
- FH package outline drawing – illustrates FH Series Marking Head package outline and mounting dimensions.
- FH Head / Model 48-1/48-2 package outline drawings – illustrates package outline and mounting dimensions for an FH Head with a 10 or 25 W laser.
- FH Head / Model 48-5/Evolution 100 package outline drawing – illustrates package outline and mounting dimensions for an FH Head with a 50 or 100 W laser.
- FH Head / Evolution 125 package outline drawing – illustrates package outline and mounting dimensions for an FH Head with a 125 W laser.
- FH Head / Firestar v20 package outline drawing – illustrates package outline and mounting dimensions for an FH Head with a 20 W Firestar laser.
- FH Head / Firestar v40/t60/t80/f100 package outline drawing – illustrates package outline and mounting dimensions for an FH Head with a 40, 60, 80, or 100 W Firestar laser.
- FH Head / Model 48-1/48-2 mounting – illustrates an exploded assembly drawing for an FH Head with a 10 or 25 W laser.
- FH Head / Model 48-5/Evolution 100/125 mounting – illustrates an exploded assembly drawing for an FH Head with a 50, 100, or 125 W laser.
- FH Head / Firestar v20 mounting – illustrates an exploded assembly drawing for an FH Head with a 20 W Firestar laser.
- FH Head / Firestar v40/t60/t80/f100 mounting – illustrates an exploded assembly drawing for an FH Head with a 40, 60, 80, or 100 W Firestar laser.

# technical reference

## FH Head technical overview

The *FH Head technical overview* section includes subsections:

- Control circuitry
- Marking head
- Beam expansion
- Lens specifications

### Control circuitry

WinMark Pro software sends microvector command data to FH control circuitry through a digital fiber optic link. Once received by the control board, these software commands are interpreted by the CPU and sent to the proper control element. Although the tickle signal is sent at a 5 kHz clock rate, digital laser power commands are converted into a 20 kHz pulse width modulated (PWM) Command signal, which is then sent to the laser. Position commands are digitally corrected to compensate for the optical properties of the head and then converted to analog signals that drive the galvanometer scanners. Position control of the galvanometers is maintained by analog servo electronics to provide closed-loop feedback and control.

### Marking head

The purpose of the marking head is to position and focus the laser beam onto the marking surface. This process begins as the laser's output beam enters the head through an expansion telescope. After expansion, the beam is collimated and then deflected onto two lightweight X and Y mirrors mounted on separate high-speed galvanometer scanners. These mirrors position the beam and direct it out through a single-element focusing lens onto the mark surface. This focusing design, where the beam is focused after the steering optics, is called post-objective focus. The advantage of post-objective focus is that a flat-field lens can be used to achieve final focus, providing excellent mark quality since the focused spot is located in the same horizontal plane over the entire marking field.

### Beam expansion

Three distinct expansion ratios are available for FH Series Marking Heads. Depending upon the laser's beam diameter a 3X (48 Series and Firestar f100 lasers), 2.5X (Evolution lasers), or 5X (v20/v40/t60/t80 Firestars) expander telescope may be installed. Figure 4-1 shows the expander telescope location. The 2.5X expander is identified by a clear anodized coating over the aluminum housing, 3X expanders are black anodized, and 5X expander telescopes are red anodized (early 5X expanders were anodized black).

In facilities where multiple laser types are used, remember to check that the expander ratio matches the laser type before mounting the marking head to a laser. An expander/beam size mismatch may cause the beam to spill off the galvanometer mirrors causing loss of output power and possible damage to internal marking head components.

When using a 5X expander in a marking head with a 370 mm lens, please note that the lens must have a newer style, notched mount. This notch allows the longer 5X expander to clear the 370 mm lens mount. The newer lens mount is dowel-pinned so that it can only be mounted in an orientation that provides clearance for the 5X expander.

# technical reference

## FH Head technical overview

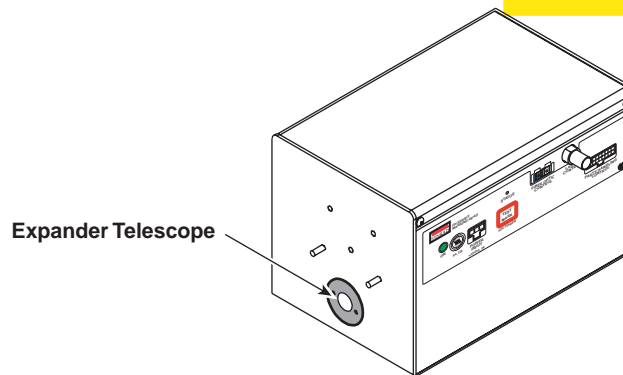


Figure 4-1 Expander telescope location

## Lens specifications

To accommodate customers who need a slightly larger marking field at the same working distance, FH Series lenses are able to mark images beyond the standard field specification. Table 4-1 lists nominal and maximum field sizes, working distance, focused spot size, and depth of field specifications for all FH lenses. This larger field can be seen in WinMark Pro where the center area of the *Drawing Canvas* denotes the nominal imageable area for the currently selected focusing lens. The outer border (shaded yellow) indicates the maximum marking field for that lens. Mark objects placed in the yellow shaded area, especially those objects placed near the outer corners, may exhibit a slight degradation in mark quality.

**Note:** See *Initial Start-up* and Figure 2-2 in the “Operation” section for information on setting the correct working distance for your focusing lens.

Table 4-1 FH lens specifications

Lens Focal Length	Nominal Field H x W, mm	Max. Field H x W, mm	Working Distance* typical, mm	Spot Size (1/e <sup>2</sup> ), μm	Depth of Field, mm
370 mm	198 × 198 (7.8" × 7.8")	241.0 × 297.0 (9.5" × 11.7")	350 ± 5 (13.78")	540 (0.021")	± 10 (±0.394")
200 mm	110 × 110 (4.3" × 4.3")	134.0 × 165.0 (5.3" × 6.5")	190 ± 3 (7.48")	290 (0.011")	± 2.5 (±0.098")
125 mm	74 × 74 (2.9" × 2.9")	85.7 × 105.6 (3.4" × 4.2")	128 ± 2 (5.04")	180 (0.007")	± 1.5 (±0.059")
125HP**	66 × 66 (2.6" × 2.6")	80.4 × 99 (3.2" × 3.9")	126 ± 2 (4.96")	180 (0.007")	± 1.5 (±0.059")
80 mm	27 × 27 (1.1" × 1.1")	33.5 × 41.2 (1.3" × 1.6")	74 ± 1 (2.91")	116 (0.005")	± 0.4 (±0.016")

\* for lenses with 19 mm (0.75") high lens mounts. The typical working distance is marked on each lens mount. Consult your marking head's final test report for the actual working distance.

\*\* 125 mm lens for use with lasers 40 W and higher.

# technical reference

## Upgrading firmware

The *Upgrading firmware* section includes subsections:

- Using WinMark Pro v4
- Using MarkLink.exe

The firmware in your FH Series Marking Head is designed to be field-upgradeable\*. Upgrade FH Series firmware using either WinMark Pro version 4 or by using *MarkLink.exe* as described below.

**Note:** If you decide to reverse the firmware upgrade for any reason, you can do so by pressing and holding the *Test Mark* pushbutton while applying power to the FH Series Marking Head. This causes the marking head to restart using the original factory-loaded firmware.

## Using WinMark Pro v4

To upgrade marking head firmware using WinMark Pro version 4, perform the following steps:

- 1 Ensure that the marking head is powered up and is connected to the marking computer.
- 2 Open WinMark Pro and check that the digital fiber optic link is communicating with the head. Click the *Help\About Synrad WinMark ...\Head Info* button to check marking head status. The correct Head Type, Lens, and Firmware version should be displayed. Continue with the update only if your firmware version is 7 or greater.
- 3 From the *Help* menu, click *About Synrad WinMark ...*, and press the **Update F/W** button. A dialog box opens asking you to initiate the firmware update. Press **OK**.
- 4 In the *Open* dialog box, select the desired “*Update\_××.asc*” firmware file, where ×× is the firmware version, and press **Open**.
- 5 After downloading the new firmware file, remove power from the marking head, wait a few seconds, and then power up the head to begin operation with the new firmware.

## Using MarkLink.exe

Prior to version 4, MarkLink was placed in the *WinMark* folder during installation. To upgrade marking head firmware using WinMark Pro v2.1.X or v3.1.X with ISA-bus FLCCs, perform the following steps:

- 1 Ensure that the marking head is powered up and is connected to the marking computer.
- 2 Open WinMark Pro and check that it is communicating with the head. Click the *Help\About Synrad WinMark ...\Head Info* button to check head status. The correct Head Type, Lens, and Firmware version should be displayed. Update firmware only if the version number is 7 or greater.
- 3 Close WinMark and use Windows Explorer to open *MarkLink.exe* in *C:\Program Files\WinMark*.
- 4 Start *MarkLink.exe* and choose the CODE DOWNLOAD option when the dialog box opens.
- 5 Click the *Open File* tool and select the correct upgrade file. Firmware upgrade files are formatted as “*Update\_××.asc*”, where ×× is the firmware version. MarkLink will download the selected file and indicate success.
- 6 Power down the head, wait a few seconds, and then reapply power to restart the new firmware. Open WinMark and click the **Head Info** button. It will display the upgraded firmware version.

\* FH Series Marking Heads running firmware version 7 or higher.

# technical reference

## Custom test mark feature



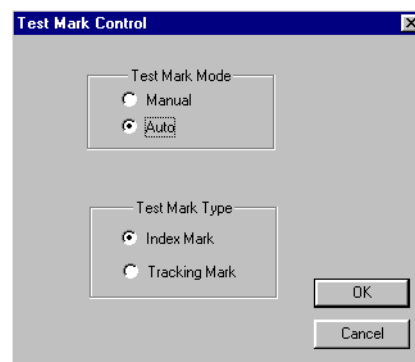
The *Custom test mark feature* section includes subsections:

- Overview
- Test Mark Control options
- Creating a custom test mark
- Setting Test Mark Control options
- Downloading a custom test mark file
- Custom test mark I/O

### Overview

Customers using FH Series Marking Heads (with firmware version 7 or higher) have the ability to download a custom test mark to their FH Index or Tracker Head. Like the standard test pattern shown in Figure 2-3 in the “Operation” section, a custom test mark loaded into the FH Head’s non-volatile memory is marked each time the *Test Mark* pushbutton is pressed. However, unlike the standard test pattern, the custom test mark command allows operators to: (1) create a custom mark file with specific object properties; (2) mark the custom test mark as an Index or Tracker mark; or (3) perform stand-alone Index or Tracker marking of the custom test mark without a computer connected to the FH Head.

Access the custom test mark command in WinMark Pro by clicking *Tools* and then click *Custom Test Mark...* The *Test Mark Control* dialog box (shown in Figure 4-2) opens.



**Figure 4-2** Test Mark Control dialog box

**Note:** If the FH Head is powered up and connected to your computer and *Custom Test Mark...* appears dimmed under the *Tools* menu, then under *Help*, click *About Synrad WinMark...* and then click **Head Info**. Custom test marking is supported when the head’s *Firmware* version is 7.0 or greater, WinMark Pro version 2.0.0.3019 or greater is used, and the Fiber Link Controller Card firmware is 6.0 or greater.

# technical reference

## Custom test mark feature

### Test Mark Control options

The custom test mark feature is controlled by selecting one of two *Test Mark Modes* and one of two *Test Mark Types*. Each control option is described below.

#### Test Mark Mode

*Test Mark Mode* determines how the custom test mark is initiated. The options, *Manual* and *Auto*, are described below.

##### Manual

In *Manual Test Mark Mode*, the custom test mark simply replaces the factory default test pattern in memory. In this mode, the custom test mark is always marked as a static (Index) mark, firing only when the *Test Mark* pushbutton on the FH Head is pressed.

##### Auto

In *Auto Test Mark Mode*, the custom test mark replaces the factory test pattern in memory. Depending upon the setting of *Test Mark Type*, the stored custom test mark fires as an Index or Tracker mark when an input signal is sensed on input #0 (IN0).

#### Test Mark Type

*Test Mark Type* determines whether the custom test mark is marked as an Index or Tracker mark. *Test Mark Type* options, *Index Mark* and *Tracking Mark*, are described below. If *Manual Test Mark Mode* is selected, then *Test Mark Type* options do not apply and appear dimmed.

##### Index Mark

If *Test Mark Mode* is set to *Auto* and *Test Mark Type* is set to *Index* then a static custom test mark fires when the *Test Mark* pushbutton on the FH Head is pressed or when the rising edge of an input signal is detected on input #0 (IN0). *Index Mark* provides the ability to load a custom test mark file, disconnect the fiber optic cable and computer, and then automatically mark an Index file each time input #0 (IN0) goes active.

##### Tracking Mark

If *Test Mark Mode* is set to *Auto* and *Test Mark Type* is set to *Tracking* then a tracking custom test mark fires when an input (part sensor) signal is detected on input #0 (IN0), after encoder pulses satisfy the required *Sensor Distance*. When the *Test Mark* pushbutton on the FH Head is pressed, Tracker makes a static (Index) mark. *Tracking Mark* provides the ability to load a custom test mark file, disconnect the fiber optic cable and computer, and then automatically mark a tracking file each time a part moves through the marking field.

**Note:** The *Tracking Mark* option appears dimmed when WinMark Pro senses it is communicating with an FH Index Marking Head.

# technical reference

## Custom test mark feature

### Creating a custom test mark

Use WinMark Pro to develop a custom test mark the same way you would create any other mark file for the appropriate Index or Tracker marking style. Create a drawing with properly positioned text or graphic objects and then set object properties such as Velocity, Power, Resolution, etc.

File size for custom test marks is limited by the FH Head's non-volatile memory. For example, the default test pattern (see Figure 2-3 in the "Operation" section) fills approximately half of the available memory. When a custom test mark file is too large to download, WinMark displays "The selected mark drawing does not fit in Test Mark Memory". If this happens, try the following options to reduce file size:

- A Reduce the Off Vector Resolution of mark objects in the drawing. Resolutions of 50–100 dpi are sufficient to obtain a quality mark.
- B Reduce the Resolution of mark objects. 300 dpi is adequate for most marking. For graphics with only horizontal or vertical straight lines (not diagonals), 100 dpi is sufficient.
- C Refine the mark. Use stroke text instead of TrueType fonts, mark fewer words, or simplify line art.

**Note:** Because it is a downloaded file stored in memory, a custom test mark file cannot perform serialization, real-time date and time stamp coding, Input/Output, or other automation functions as it could if run in WinMark Pro.

### Setting Test Mark Control options

Creation of a custom test mark can be done offline, but to set custom test mark options the FH Head must be connected and communicating to a computer running WinMark Pro.

To setup custom test mark options, perform the following steps:

- 1 Open or create the desired file to be downloaded as a custom test mark.
- 2 From the *Tools* menu, click Custom Test Mark.... The *Test Mark Control* dialog box (Figure 4-2) opens.

**Note:** If Index or Tracker *Auto Test Mark Mode* is currently enabled, then a dialog box appears indicating that auto test marking has been disabled. This prevents an input signal from commanding the FH Head to mark while a new custom test mark file is being downloaded to memory.

- 3 Under *Test Mark Mode*, click *Manual* or *Auto*.
- 4 If *Auto Test Mark Mode* is selected, then under *Test Mark Type* choose *Index Mark* or *Tracking Mark*. The *Tracking Mark* option appears dimmed if the marking head is an Index model.

The type of mark selected should match the current marking method (Index or Tracking). If the *Test Mark Type* choice is not compatible with the currently selected marking mode, a dialog box reminds you to turn Track Marking Object (on the *Tracking* tab) On or Off. After setting the desired marking mode, return to *Tools* and click Custom Test Mark... to reopen the *Test Mark Control* dialog box.

# technical reference

## Custom test mark feature

### Downloading a custom test mark file

- 1 Under *Tools*, click *Custom Test Mark...* and when the *Test Mark Control* dialog box opens, verify that the correct *Test Mark Mode* options are selected.

**Note:** The default *Test Mark Mode* is *Manual*. To enable *Auto Test Mark Mode* you must select the *Auto* option each time the *Test Mark Control* dialog box opens.

- 2 Click **OK** to download the currently active WinMark file to FH Head memory.
- 3 After file transfer is complete, a dialog box confirms a successful download.
- 4 If the data transmission fails, click **OK** to acknowledge the failure and then repeat Steps 1–3. If the custom test mark feature appears dimmed after a data transmission failure, then under *Help*, click *About Synrad WinMark...* and then click **Head Info**. After closing the dialog boxes, return to the *Tools* menu. The custom test mark command should be available.

The marking head can contain only one custom test mark at a time, but a new mark file can be downloaded at any time. A copy of the factory installed test pattern (*FactoryTestMark1.mkh*) is provided in the *Program Files\WinMark* folder so that the default test mark file can be reloaded into FH memory as required for lens testing or mark centering.

## Custom test mark I/O

It is possible for the FH Marking Head to set or clear FH outputs (OUT4–OUT7) when marking a custom test mark. This output capability is only available when using *SetDigitalState* commands in WinMark Pro's Event Builder. Event Builder functions are available during the following stages of the Automation loop:

On Before Mark Session – On Before Mark Piece – On After Mark Piece – On After Mark Session

Remember that in WinMark Pro's Automation loop, On Before Mark Session and On After Mark Session events run only once before/after a marking session while On Before Mark Piece and On After Mark Piece events run before/after each individual piece. In a custom test mark application however, each individual mark is considered a mark session meaning that On Before Mark Session / On After Mark Session events are run for each piece that is marked.

It is not possible for a custom test mark to perform non-Event Builder output functions (*Set Digital Before Session*, *Set Digital Before Mark*, or *Set Digital After Mark*) or to perform any type of input automation. Input signals are sensed in only three cases: (1) for the Fast Acting Safety Interlock (FASI) where input #3, IN3, must be active; (2) for Index marks where IN0, the part sensor input, is expected when *Test Mark Mode* is set to *Auto*; or (3) for Tracking where IN0 is the part sensor input and IN1/IN2 are position inputs from the rotary encoder.

### **Warning**

possible  
personal  
injury

Marking head or FLCC outputs may be set or cleared during a custom test mark download when the mark file contains Event Builder automation. The user must take steps to assure that this behavior does not compromise the integrity of the control system.

# technical reference

## Marking automation



The *Marking automation* section includes subsections:

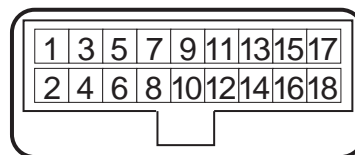
- Connecting to parts handling equipment
- Digital input circuitry
- Digital output circuitry

### Connecting to parts handling equipment

FH Series Marking Heads incorporate four input and four output circuits, each with a dedicated ground, that can be used to automate marking operation electronically in conjunction with WinMark Pro software.

A simple system utilizing FH Series Marking Head digital I/O and WinMark Pro to control marking might operate like this: A conveyor stops with a new part positioned under the marking head and then delivers a “start mark” signal to an FH input. WinMark Pro recognizes the input transition and marks the part. On completion of the mark, WinMark Pro commands the FH Head to activate an output signaling “mark complete”, which starts the conveyor again. After the “mark complete” signal, WinMark Pro waits for the next “start mark” signal. The digital I/O capability of SYNRAD’s FH Series Marking Head and the automation features of WinMark Pro enable this kind of process control.

Figure 4-3 shows the physical layout of the FH Head’s optically-isolated input/output terminals. Table 4-2 lists pin assignments for the FH Head’s *Parts Handling Control* connector.



**PARTS HANDLING CONTROL**

**Figure 4-3** Physical layout of Parts Handling Control connector

**Note:** If your installation requires the use of a *Digital I/O* cable longer than six feet in length, a spare 18-pin *Digital I/O* connector with crimp pins for 20–24 AWG wire is included in the Accessory Kit. When wiring the connector, refer to Figure 4-3 and Table 4-2 for the position and description of I/O connections.

# technical reference

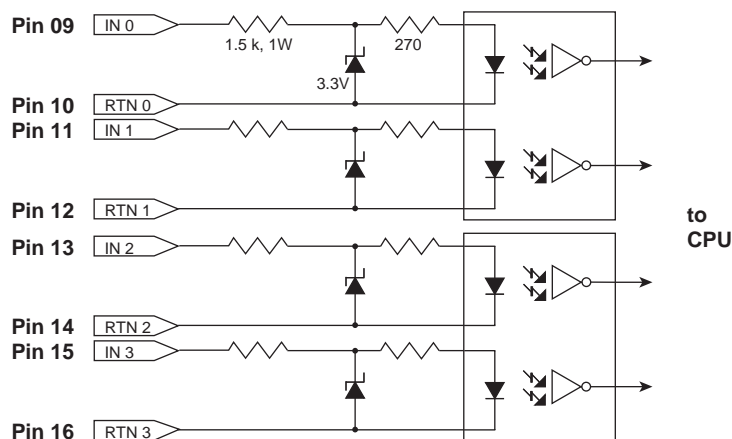
## Marking automation

**Table 4-2** Parts Handling Control connector pin assignments

Pin #	Signal	Wire Color
1	RTN4	Black
2	OUT4	White
3	OUT5	Red
4	RTN5	Green
5	RTN6	Orange
6	OUT6	Blue
7	OUT7	White/Black
8	RTN7	Red/Black
9	IN0	Green/Black
10	RTN0	Orange/Black
11	IN1	Blue/Black
12	RTN1	Black/White
13	IN2	Red/White
14	RTN2	Green/White
15	IN3	Blue/White
16	RTN3	Black/Red
17	DO NOT CONNECT	
18	DO NOT CONNECT	

## Digital input circuitry

Figure 4-4 shows the FH Head's optically-isolated input circuitry.



**Figure 4-4** Input circuit

# technical reference

## Marking automation

Table 4-3 provides electrical signal parameters for inputs sent to the FH Head.

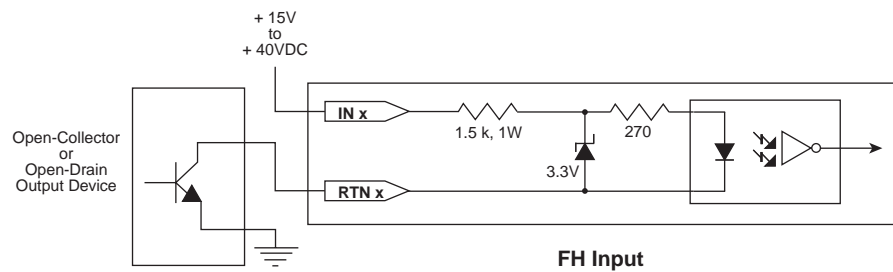
**Table 4-3** Input signal parameters

Input Parameter	Min	Typ	Max
$V_{IL}$ – Low level input voltage	-0.6 VDC	0.0 VDC	5.0 VDC
$V_{IH}$ – High level input voltage	15.0 VDC	24.0 VDC	40.0 VDC
$I_F$ – LED forward current			26 mA @ 40 VDC 15 mA @ 24 VDC

### Sample input circuits

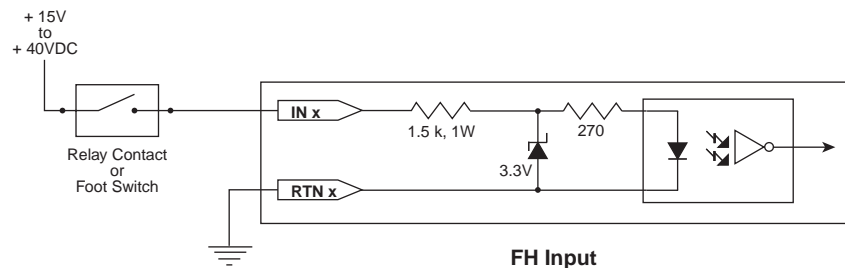
The FH Head's optically-isolated inputs can be used to start a marking operation or choose among multiple marks. When an external device sinks current through an input, WinMark Pro software senses a "1"; when no current flows through the input, WinMark Pro senses a "0".

FH inputs are designed to be compatible with standard industrial control circuit voltages and cannot be operated from 5 V TTL or CMOS logic signals. However FH inputs can be activated by a 5 V logic IC with an open collector or open drain output as shown in Figure 4-5.



**Figure 4-5** 5 V logic IC input

Another common requirement in marking applications is for an operator to initiate each mark operation by closing a foot-operated switch. Figure 4-6 illustrates a simple input circuit for using a foot switch or relay contact to send an input signal to the FH Head.



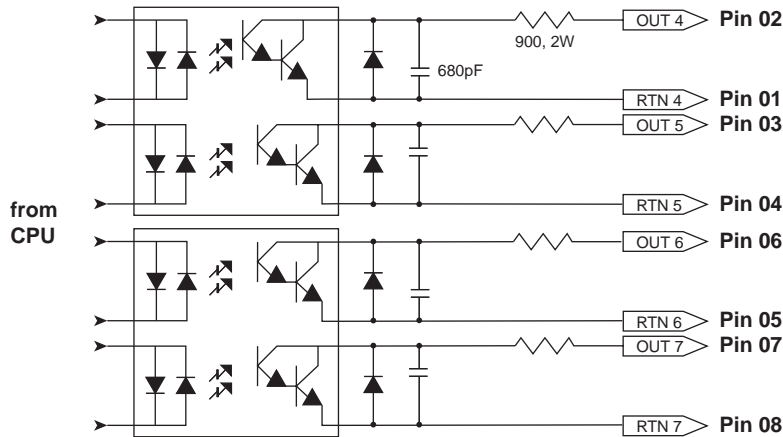
**Figure 4-6** Relay or foot switch input

# technical reference

## Marking automation

### Digital output circuitry

Digital outputs are designed to operate small relays or toggle inputs on parts handling equipment. Figure 4-7 shows the FH Head's optically-isolated output circuitry.



**Figure 4-7** Output circuit

Table 4-4 provides electrical signal parameters for FH outputs.

**Table 4-4** Output signal parameters

Output Parameter	Max
Sinking Current	40 mA
Darlington Breakdown Voltage	40 VDC
Darlington $V_{CE_{SAT}}$	1.0 VDC

### Sample output circuits

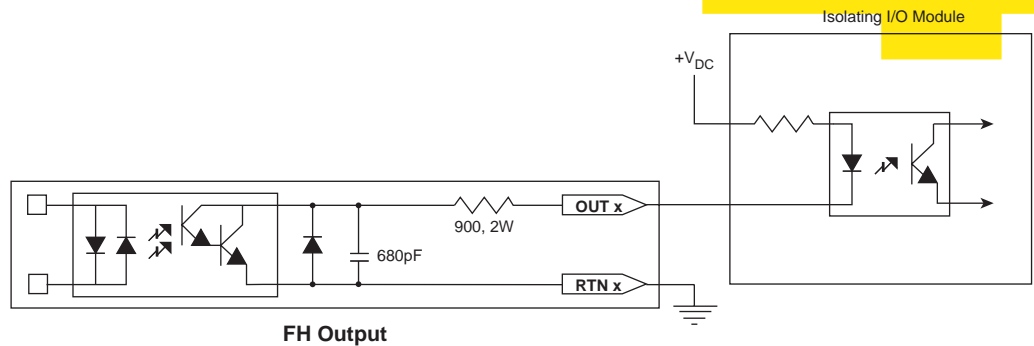
FH Head optically-isolated outputs can be used to create very flexible automated systems. Typically, one of these outputs will be used to indicate completion of a mark. Another might drive a warning light when the laser beam is active, or increment a parts counter. Several circuits for interfacing to FH outputs are shown on the following pages.

**Note:** When configuring your marking software, a “1” written to an output bit turns ON the output phototransistor. A “0” written to an output bit turns OFF the output phototransistor.

Figure 4-8 illustrates a simple output connection. In this configuration, the output is sinking current. When sizing  $V_{DC}$  remember to account for the voltage drop across the output's 900 ohm output resistor.

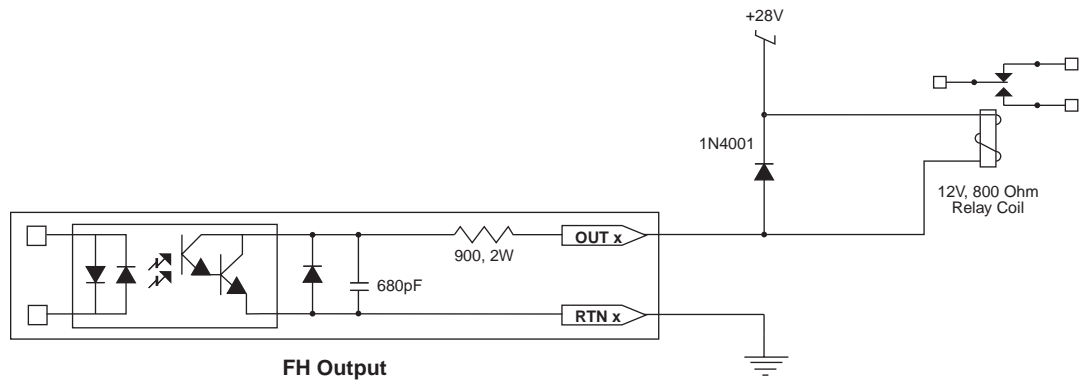
# technical reference

## Marking automation



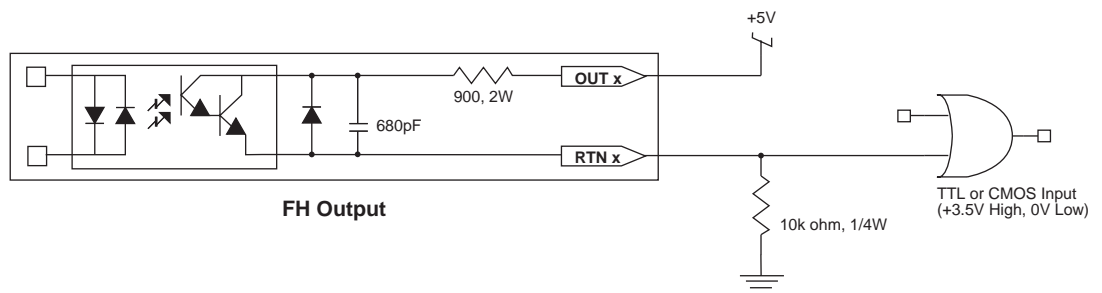
**Figure 4-8** Output to isolated I/O module

Figure 4-9 illustrates a simple driver for a small signal relay. When the output is ON, the relay is energized; the diode serves to clamp the inductive kick from the relay coil. Relay contacts can be used to drive higher current devices such as warning lights.



**Figure 4-9** Output to relay driver

Figure 4-10 illustrates a simple logic interface circuit. When the output is ON, the logic input is High.



**Figure 4-10** Output to TTL or CMOS logic interface

# technical reference

## FLCC features

The *FLCC features* section includes subsections:

- Fast Acting Safety Interlock (FASI)
- DIP switch settings

## Fast Acting Safety Interlock (FASI)

Many marking applications require a safety action to occur for each part that is marked. An example of this kind of action would be a machine that lowers a shield over a part prior to marking, then raises the shield to advance the part as soon as the mark is complete. SYNRAD lasers are equipped with a *Remote Interlock* feature that disables laser firing, typically when a switch on an access door or safety enclosure is opened. However in marking applications where a safety interlock is frequently cycled, the *Remote Interlock* creates an unacceptable delay. This delay occurs because after the interlock is closed the laser's *Keyswitch* or remote keyswitch must be cycled, which then invokes a built-in five-second delay prior to lasing. To address this issue, the FH Marking Head incorporates a Fast Acting Safety Interlock (FASI) function. The FASI function prevents the laser from firing unless a signal is present on FH input #3 (IN3). The FH Head responds to this rising signal transition in less than 1 ms. To enable the FASI feature, perform the following steps:

- 1 Set DIP switch #5 on the FLCC to the “On” position. Refer to Figure 4-11 for switch locations.
- 2 Configure WinMark's Wait Digital Before Piece command to wait for a “Set” state on input #3 (IN3) before marking begins. This synchronizes marking operations with the FASI safety feature.
- 3 Apply a signal in the range of 15–40 V (24 V typical) to FH input #3 (IN3).

When FASI is enabled, FH input #3 (IN3) must be active before the laser can fire (if the FASI feature is enabled and FH input #3 is inactive, no signal applied, then no marking will occur).

- 4 Command WinMark Pro to mark.

**Note:** Changes in the state of the FASI setting (DIP switch #5) are only sent to the FH Head when WinMark Pro is commanded to mark. If you change the switch setting (to enable or disable the FASI function) you must send a mark command from WinMark Pro so that the new switch state is written into FH memory.

When the FASI function is enabled, this interlock state is set in the FH Head's non-volatile memory and so does not depend on WinMark Pro software or even the computer to be running. This means that even manual firing of the laser using the *Test Mark* pushbutton requires an active signal on input #3 (IN3). Table 4-5 illustrates the relationship between DIP switch #5 and FH input #3 (IN3).

**Table 4-5** DIP switch / signal relationships

FLCC DIP SW 5	FH Marking Head Input # 3	Laser Status
Off	Inactive (Low)	Enabled
Off	Active (High)	Enabled
On	Inactive (Low)	Disabled
On	Active (High)	Enabled

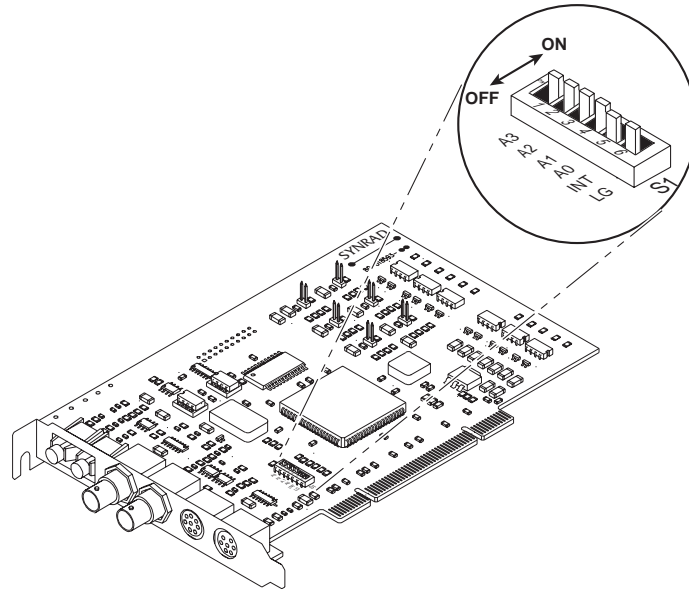
# technical reference

## FLCC features



### DIP switch settings

Figure 4-11 shows the factory default settings of the FLCC's DIP switches.



**Figure 4-11** DIP switch settings

Table 4-6 lists the PCI-bus Fiber Link Controller Card's (FLCC) DIP switch functions. Note that the Fast Acting Safety Interlock (FASI) feature is controlled by DIP switch #5 on PCI-bus FLCCs. Previous ISA-bus FLCCs used DIP switch #6 to control FASI. Because the Windows Plug and Play feature, not the user, assigns the PCI address, address switches are not important. The card identification, set by the Card ID# DIP switches, will support future improvements to WinMark Pro. Card ID switches use negative logic – for example when SW1–SW4 are set to ON, the Card ID# = 0; when SW1–SW4 are set to OFF the Card ID# = 15. If SW1, SW2, and SW3 = OFF and SW4 = ON, then the Card ID# = 7.

**Table 4-6** Factory DIP switch settings

DIP SW#	Label	Default Position	Switch Function
1	A3	ON	Card ID# MSB
2	A2	ON	
3	A1	ON	
4	A0	ON	Card ID# LSB
5	INT	OFF	Fast Acting Safety Interlock (FASI) – ON enables the FASI function; OFF disables the Interlock function. When the FASI Interlock is enabled, a high level input must be present on Input # 3 (IN3) for marking to proceed.
6	LG	OFF	Used only with DH Series Marking Heads.

# technical reference

## General specifications

**Table 4-7** FH Series Marking Head general specifications

Parameter	Marking Head Model Number FH-30-xxx <sup>1</sup>				
	370 mm	200 mm	125 mm	125 HP <sup>2</sup>	80 mm
<b>Lens Focal Length</b>	370 mm	200 mm	125 mm	125 HP <sup>2</sup>	80 mm
<b>Marking Specifications</b>					
Field Size, nominal, mm (in.)	198 × 198 (7.8 × 7.8)	110 × 110 (4.3 × 4.3)	74 × 74 (2.9 × 2.9)	66 × 66 (2.6 × 2.6)	27 × 27 (1.0 × 1.0)
Spot Size, 1/e <sup>2</sup> , μm (in.)	540 (0.021)	290 (0.011)	180 (0.007)	180 (0.007)	116 (0.005)
Working Distance <sup>3</sup> , typical, mm (in.)	350 ±5 (13.78)	190 ±3 (7.48)	128 ±2 (5.04)	126 ±2 (4.96)	74 ±1 (2.91)
Depth of Field, typical, mm (in.)	±10 (±0.394)	±2.5 (±0.098)	±1.5 (±0.059)	±1.5 (±0.059)	±0.4 (±0.016)
Incident Angle, degrees, max	19	16	11	10	5
Marking Speed <sup>4</sup> characters/sec, max	225	225	225	225	225
<b>Marking System Resolution</b>					
Position Accuracy, mm (in.)	0.05 (0.002)	0.03 (0.001)	0.02 (0.0007)	0.02 (0.0007)	0.01 (0.0004)
Position Resolution, μm (in.)	<15 (<0.0006)	<9 (<0.0004)	<6 (<0.0002)	<6 (<0.0002)	<3 (<0.0001)
Repeatability, mm (in.)	0.063 (0.0025)	0.038 (0.0015)	0.025 (0.0010)	0.025 (0.0010)	0.015 (0.0006)
Settling Time, small step - 1% of field, ms	<0.8	<0.8	<0.8	<0.8	<0.8
Orthogonality (any included angle of a square figure), degrees	90°00' ±20' max				
<b>Input Specifications</b>					
Input Power	30 VDC ±2.0 VDC @ 3 A max, 6 A inrush				
Heat Load, generated by head (W)	60 nominal, 90 max				
Continuous Beam Input Power, max (W)	125 mm lens–40, all other lenses–140				
<b>Environmental Specifications</b>					
Operating Temperature	0°C–40°C				
Humidity	0–95%, non-condensing				

# technical reference

## General specifications

Parameter	Marking Head Model
<b>Physical Specifications</b>	
Length	21.29 cm (8.38 in.)
Width	13.72 cm (5.40 in.)
Height	15.62 cm (6.15 in.)
Weight, max	4.54 kg (10 lbs)
<b>Mounting Kit Weights<sup>5</sup></b>	
10 W Mounting Kit w/ Fan Shroud	6.80 kg (15 lbs)
25 W Mounting Kit w/ Fan Shroud	9.98 kg (22 lbs)
10 W Mounting Kit (48-1)	5.44 kg (12 lbs)
20 W Mounting Kit (v20)	4.50 kg (10 lbs)
25 W Mounting Kit (48-2)	7.26 kg (16 lbs)
40 W Mounting Kit (v40)	6.80 kg (15 lbs)
50 W Mounting Kit (48-5)	8.16 kg (18 lbs)
60 W Mounting Kit (t60)	6.80 kg (15 lbs)
80 W Mounting Kit (t80)	6.80 kg (15 lbs)
100 W Mounting Kit (t100)	6.80 kg (15 lbs)
100 W Mounting Kit (Evolution 100)	8.16 kg (18 lbs)
100 W Mounting Kit (Firestar f100)	6.80 kg (15 lbs)
125 W Mounting Kit (Evolution 125)	9.07 kg (20 lbs)

\* Specifications subject to change without notice.

- 1 FH-30-xxx designates an FH Head with a 3X expander for 48-1/-2/-5 and Firestar f100 lasers. FH-25-xxx designates an FH Head with a 2.5X expander for Evolution 100/125 lasers. FH-50-xxx designates an FH Head with a 5X expander for Firestar v20/v40/t60/t80/t100 lasers.
- 2 125 mm lens for use with lasers 40 W and higher.
- 3 For lenses with 19 mm (0.75") high lens mounts. The typical focal length (working distance) is marked on each lens mount since the actual working distance may vary from lens to lens. For this reason, it is important to provide a Z-axis adjustment between the FH Series Marking Head and the marking surface. Consult your marking head's final test report for the actual measured working distance.
- 4 Based on a character height of ~3 mm, lens dependent.
- 5 Mounting kit consists of appropriate Mounting Rail and L-bracket. Laser and FH Head not included.

# technical reference

## FH package outline drawing

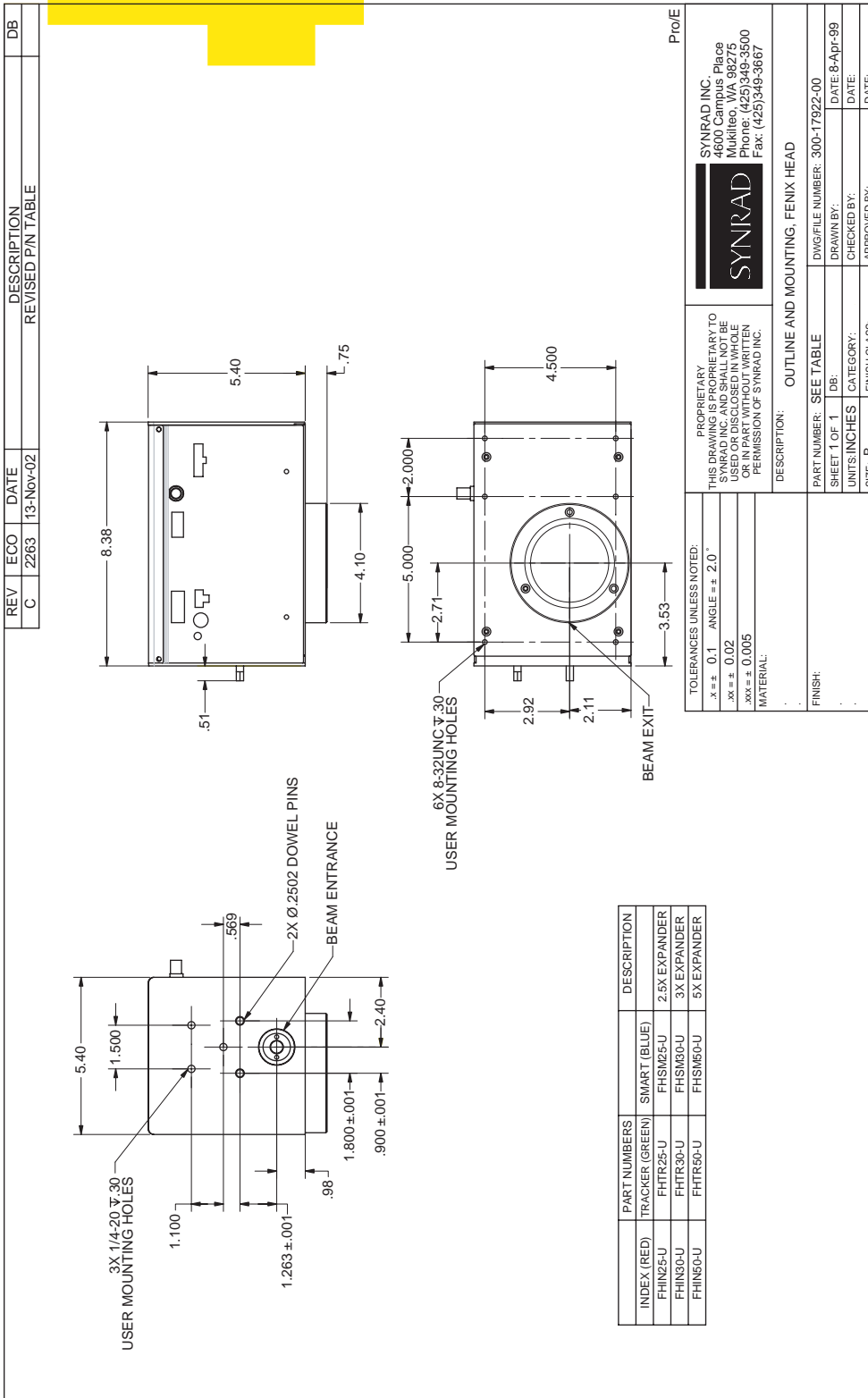


Figure 4-12 FH Marking Head package outline and mounting dimensions

# technical reference

## FH Head / Model 48-1/48-2 package outline drawings

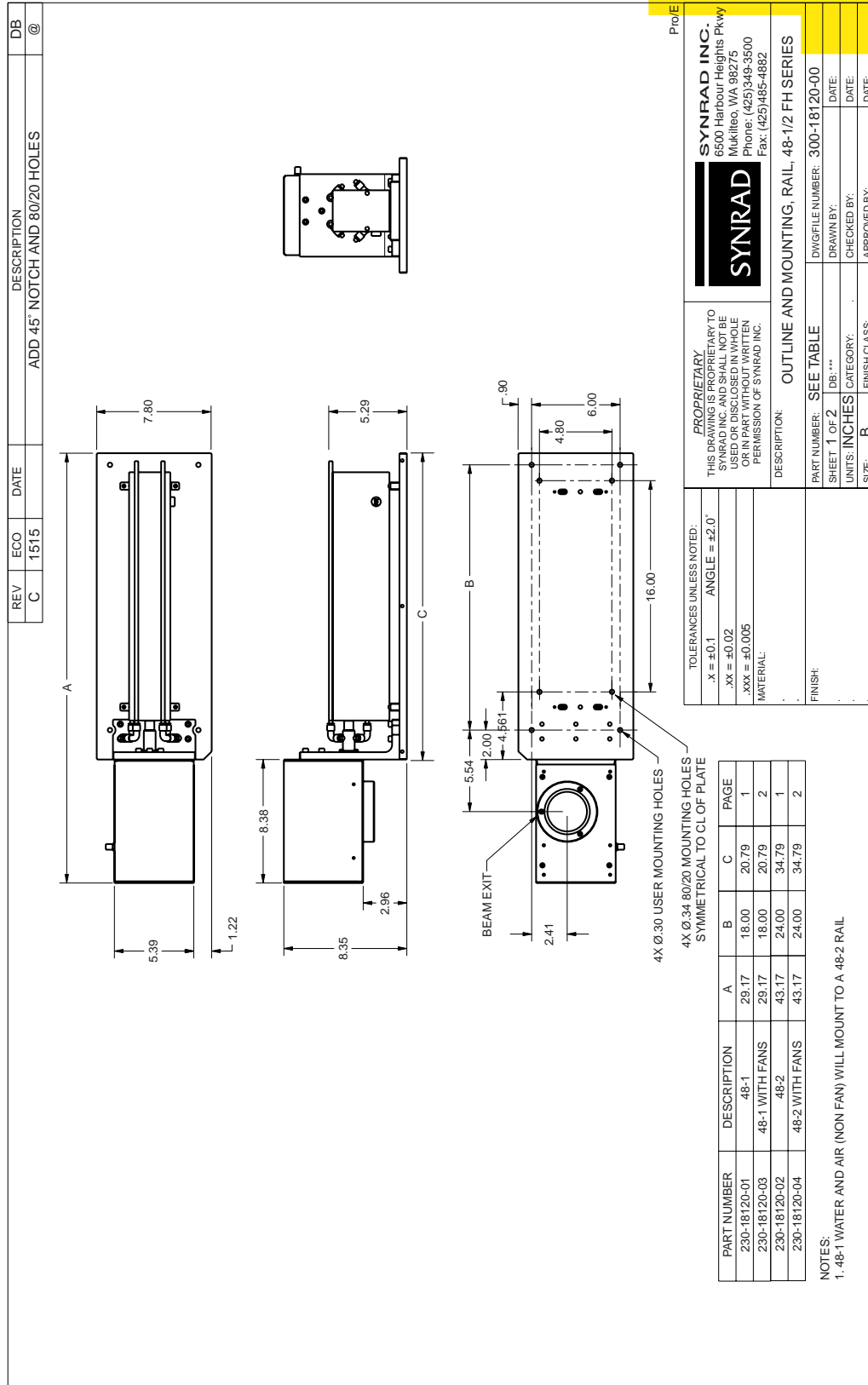


Figure 4-13 FH Head / Model 48-1/48-2 package outline and mounting dimensions

# technical reference

## FH Head / Model 48-1/48-2 package outline drawings

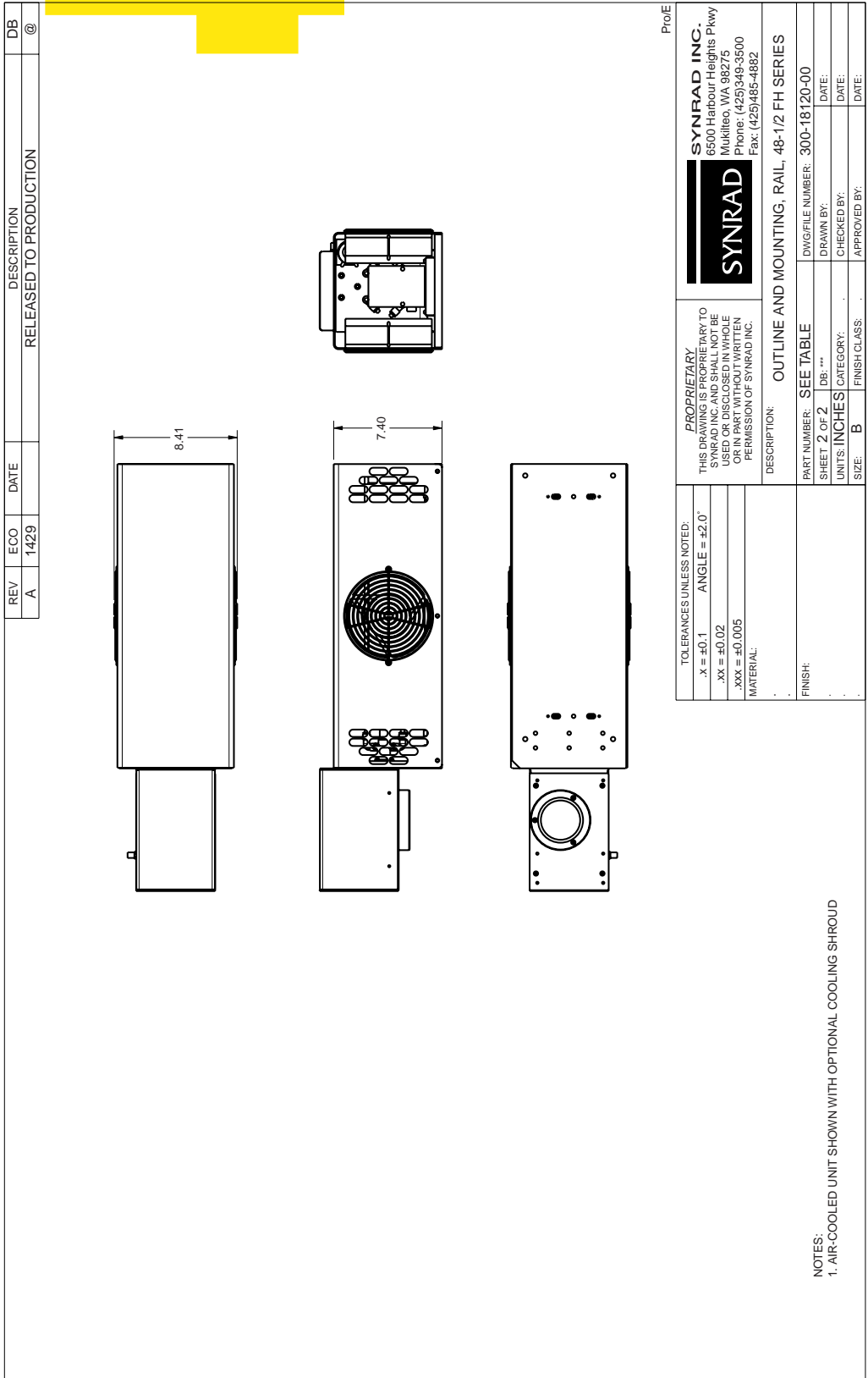


Figure 4-14 FH Head / Model 48-1/48-2 package outline and mounting dimensions

# technical reference

## FH Head / Model 48-5/Evolution 100 package outline drawing

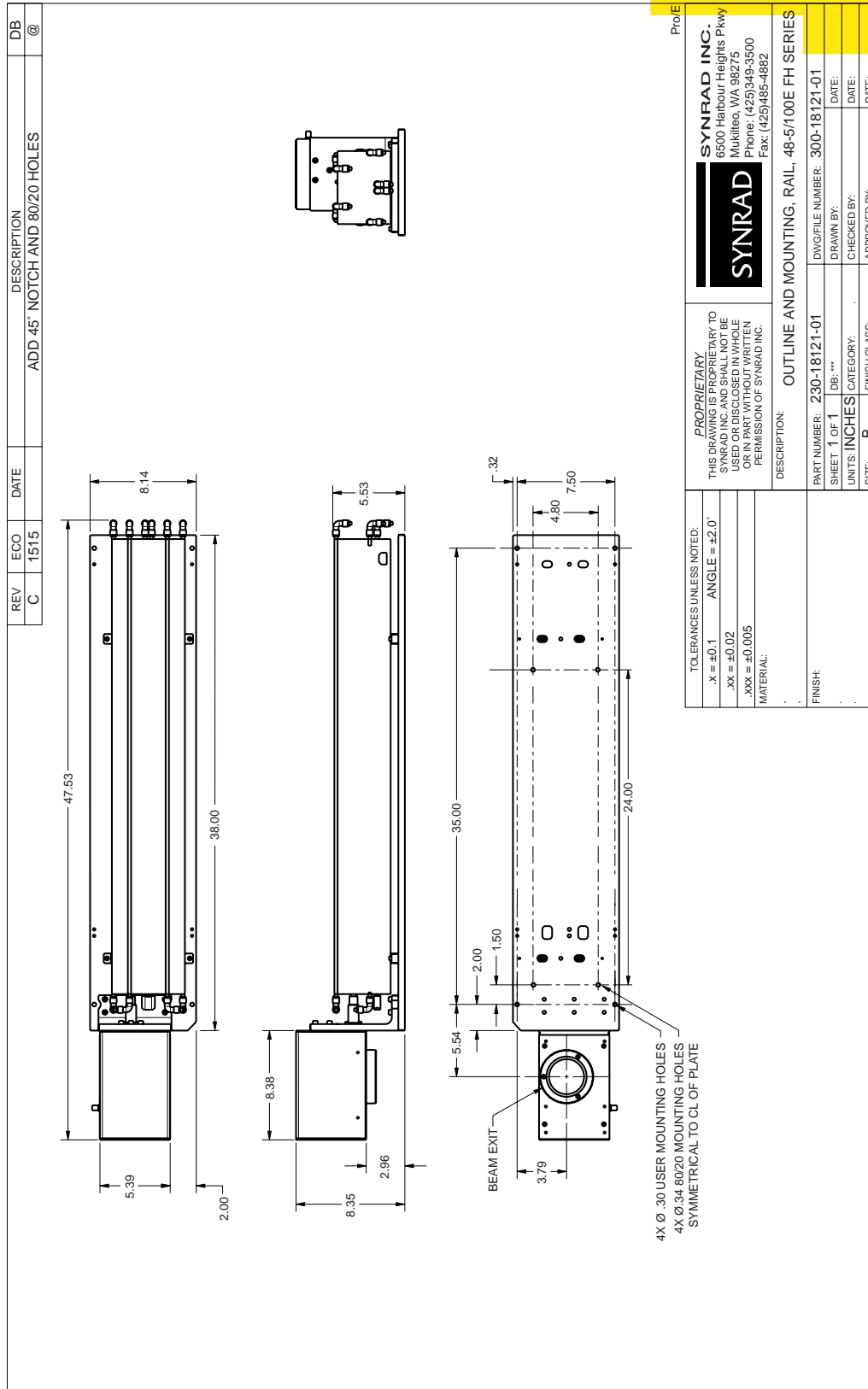


Figure 4-15 FH Head / Model 48-5/Evo 100 package outline and mounting dimensions

# technical reference

## FH Head / Evolution 125 package outline drawing

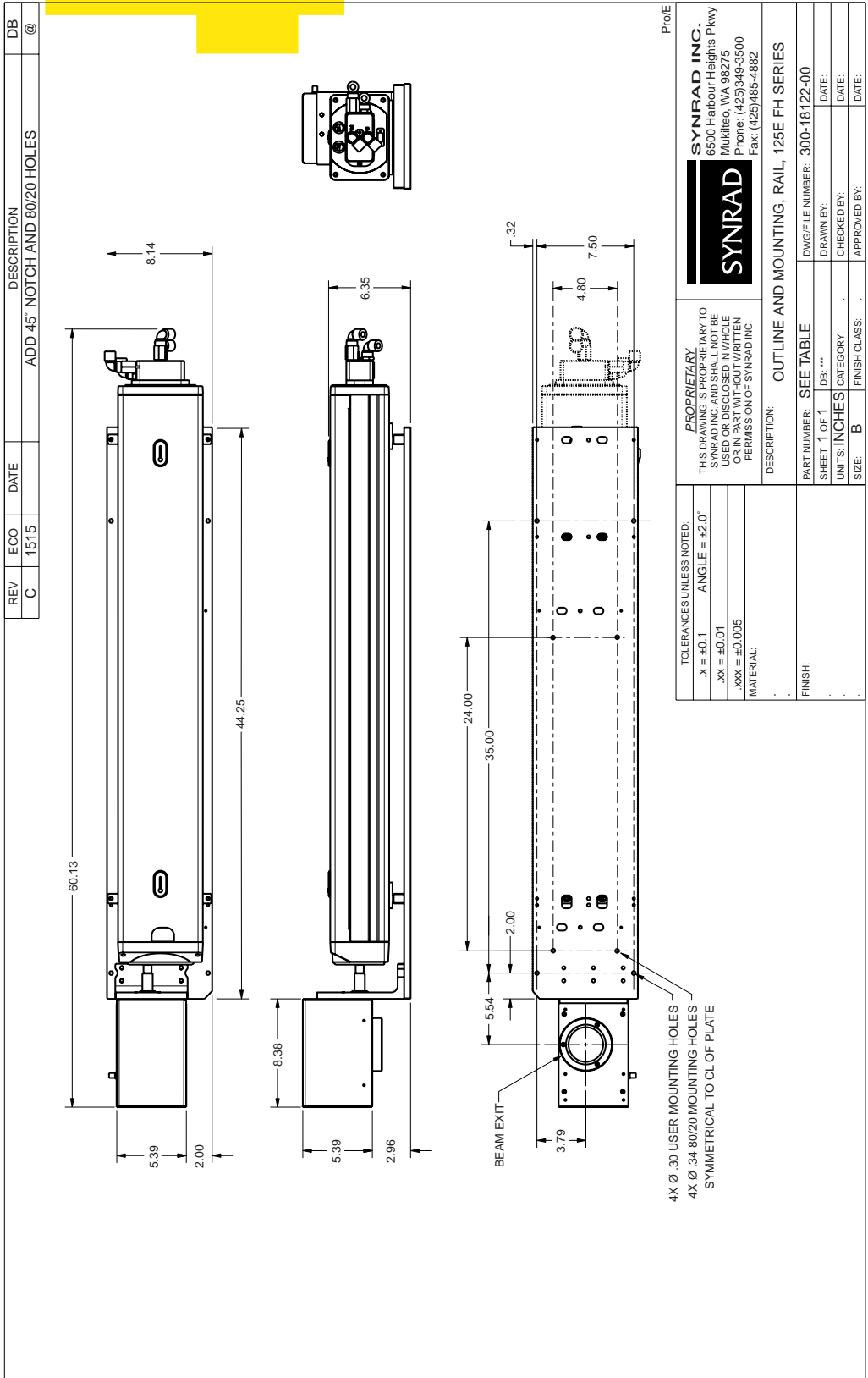


Figure 4-16 FH Head / Evolution 125 package outline and mounting dimensions

# technical reference

## FH Head / Firestar v20 package outline drawing

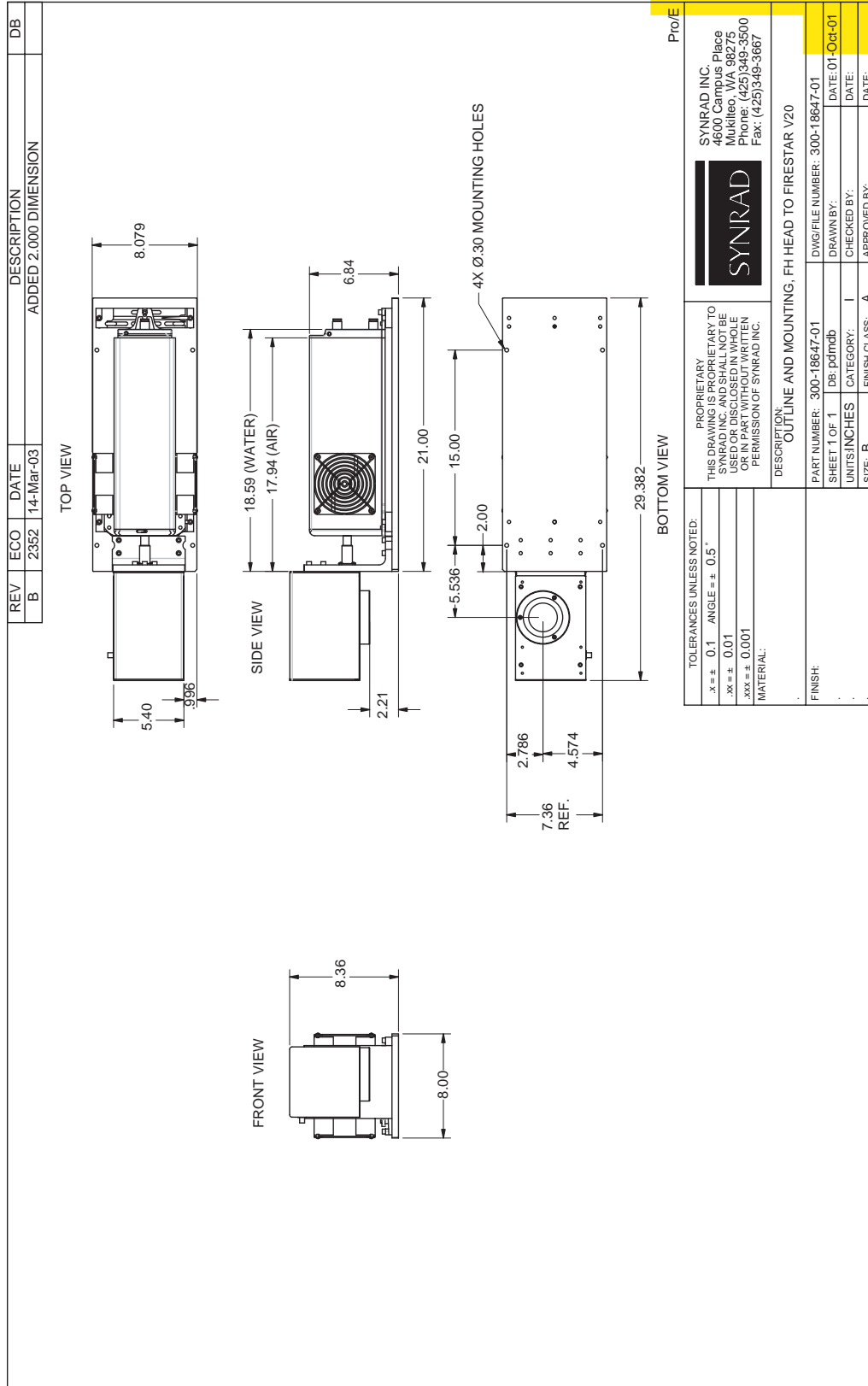


Figure 4-17 FH Head / Firestar v20 package outline and mounting dimensions

# technical reference

## FH Head / Firestar v40/t60/t80/f100 package outline drawing

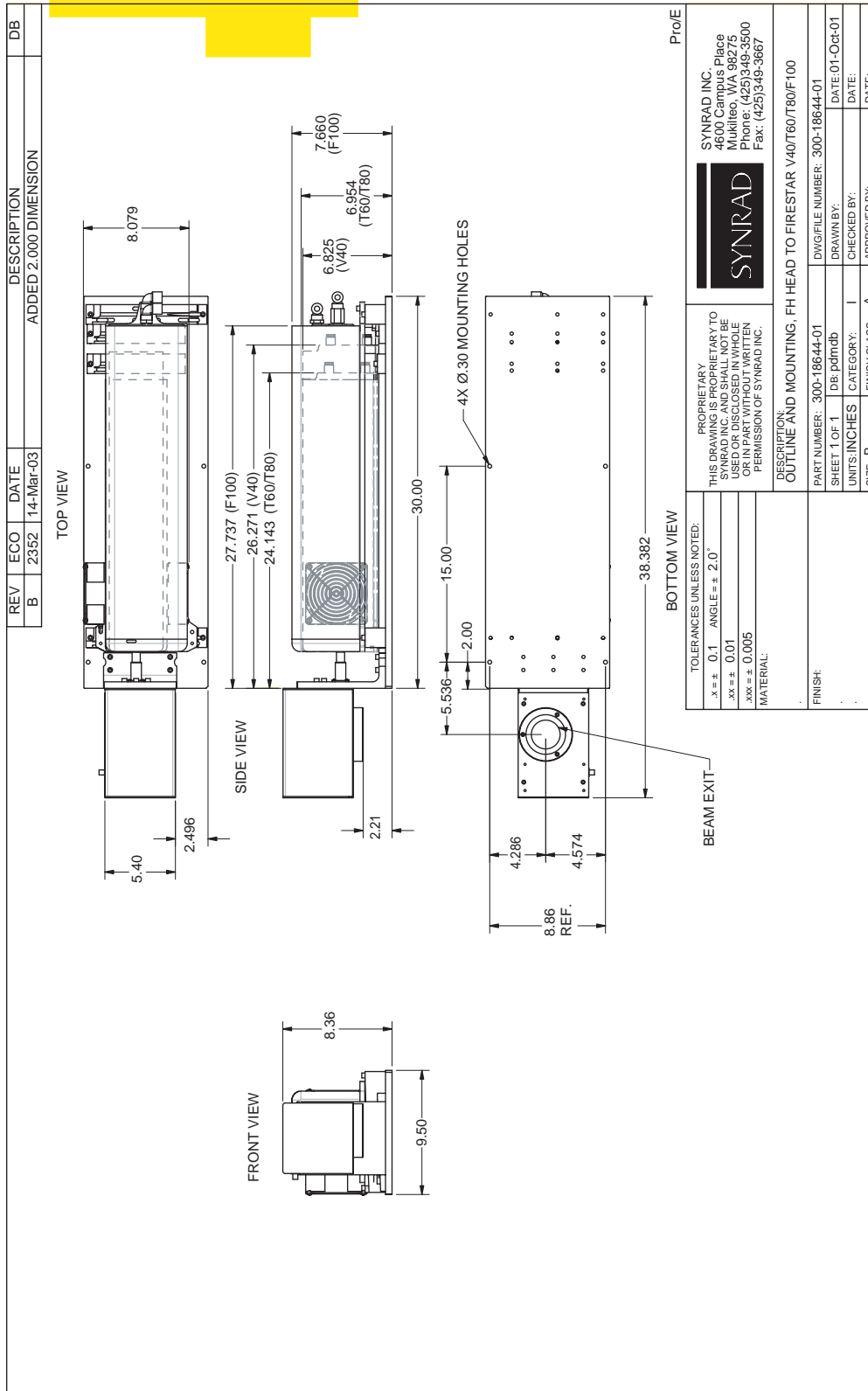


Figure 4-18 FH Head / Firestar v40/t60/t80/f100 package outline and mounting dimensions

# technical reference

## FH Head / Model 48-1/48-2 mounting

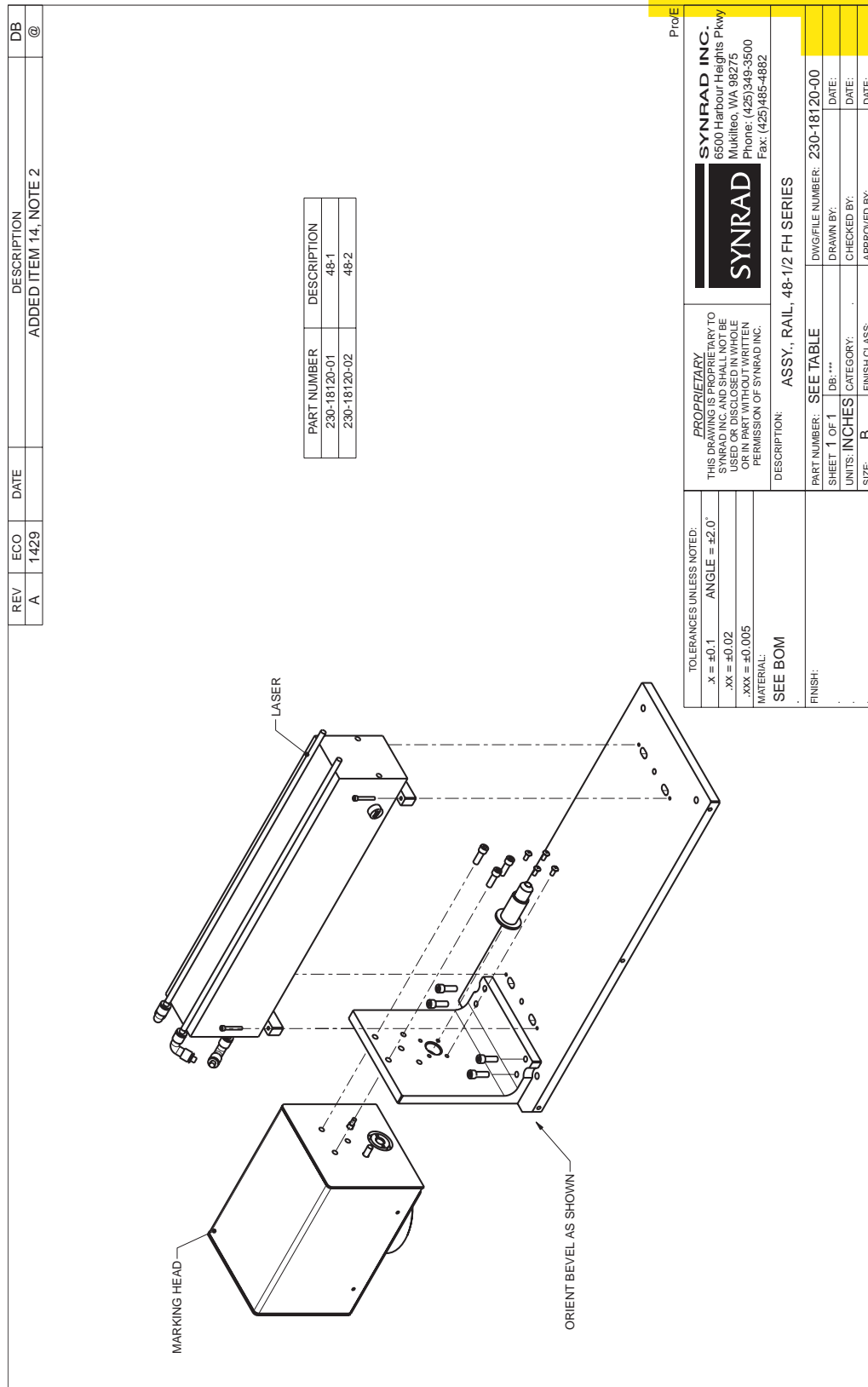


Figure 4-19 FH Head / Model 48-1/48-2 mounting drawing

# technical reference

## FH Head / Model 48-5/Evolution 100/125 mounting

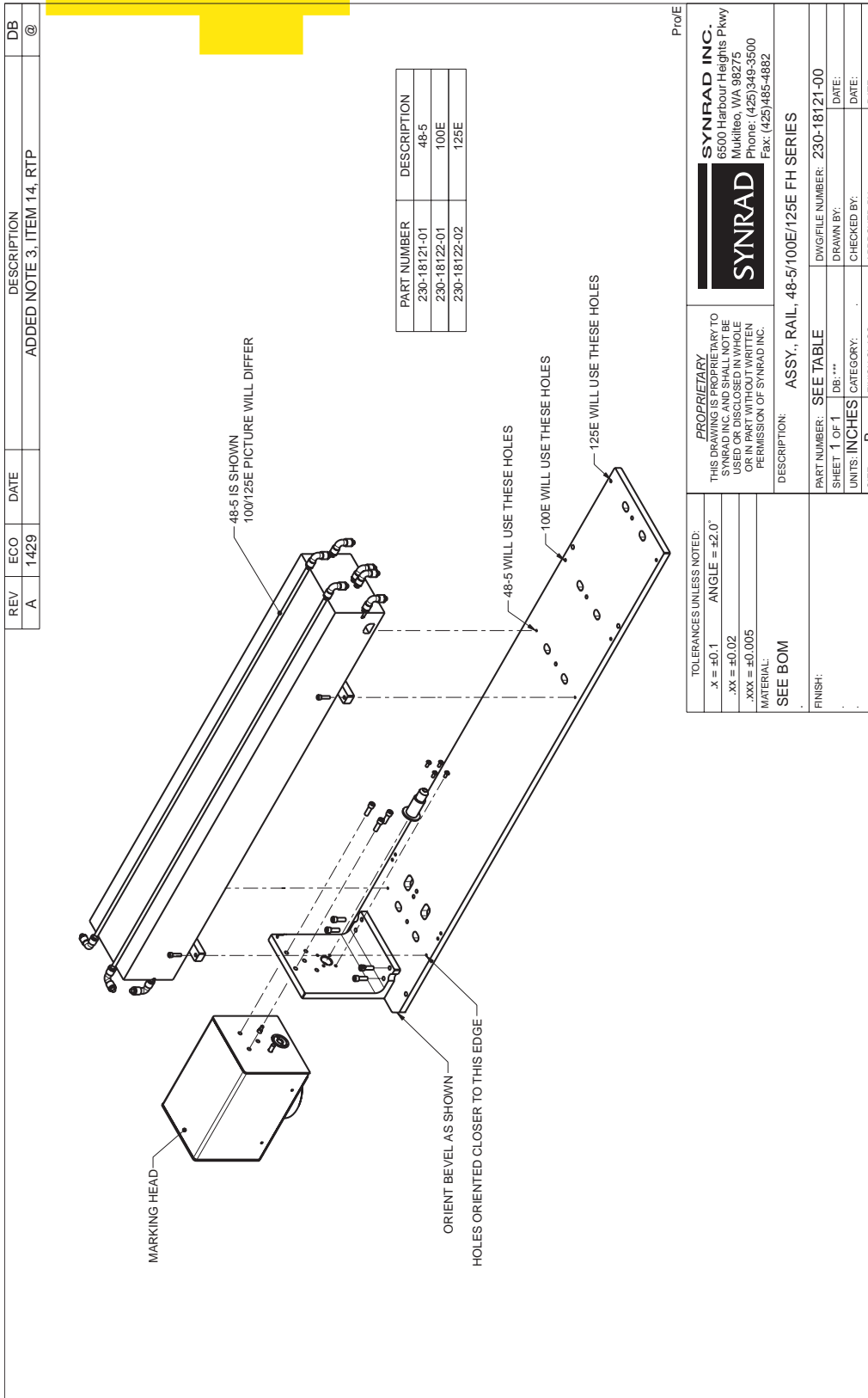


Figure 4-20 FH Head / Model 48-5/Evolution 100/125 mounting drawing

# technical reference

## FH Head / Firestar v20 mounting

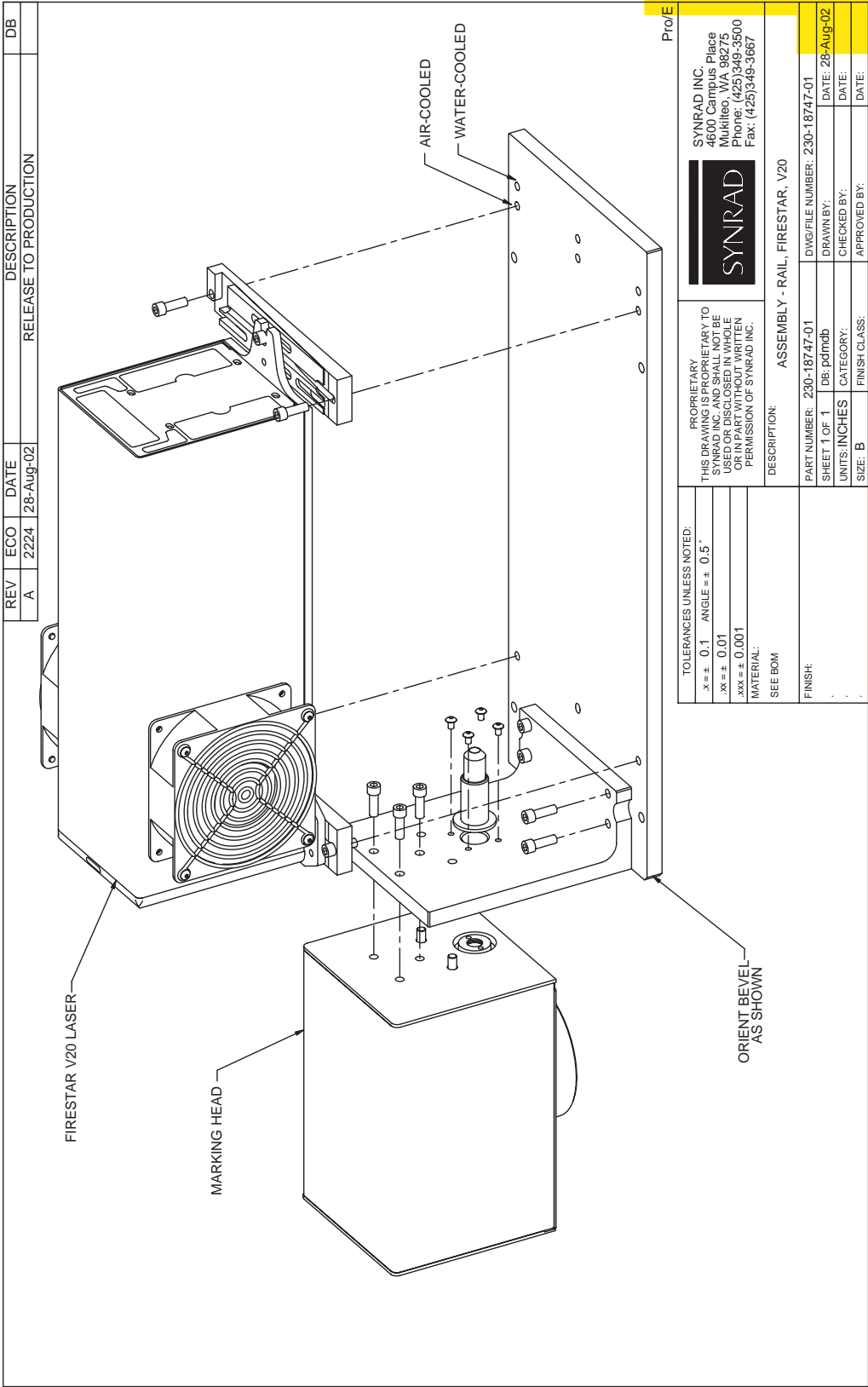


Figure 4-21 FH Head / Firestar v20 mounting drawing

# technical reference

## FH Head / Firestar v40/t60/t80/f100 mounting

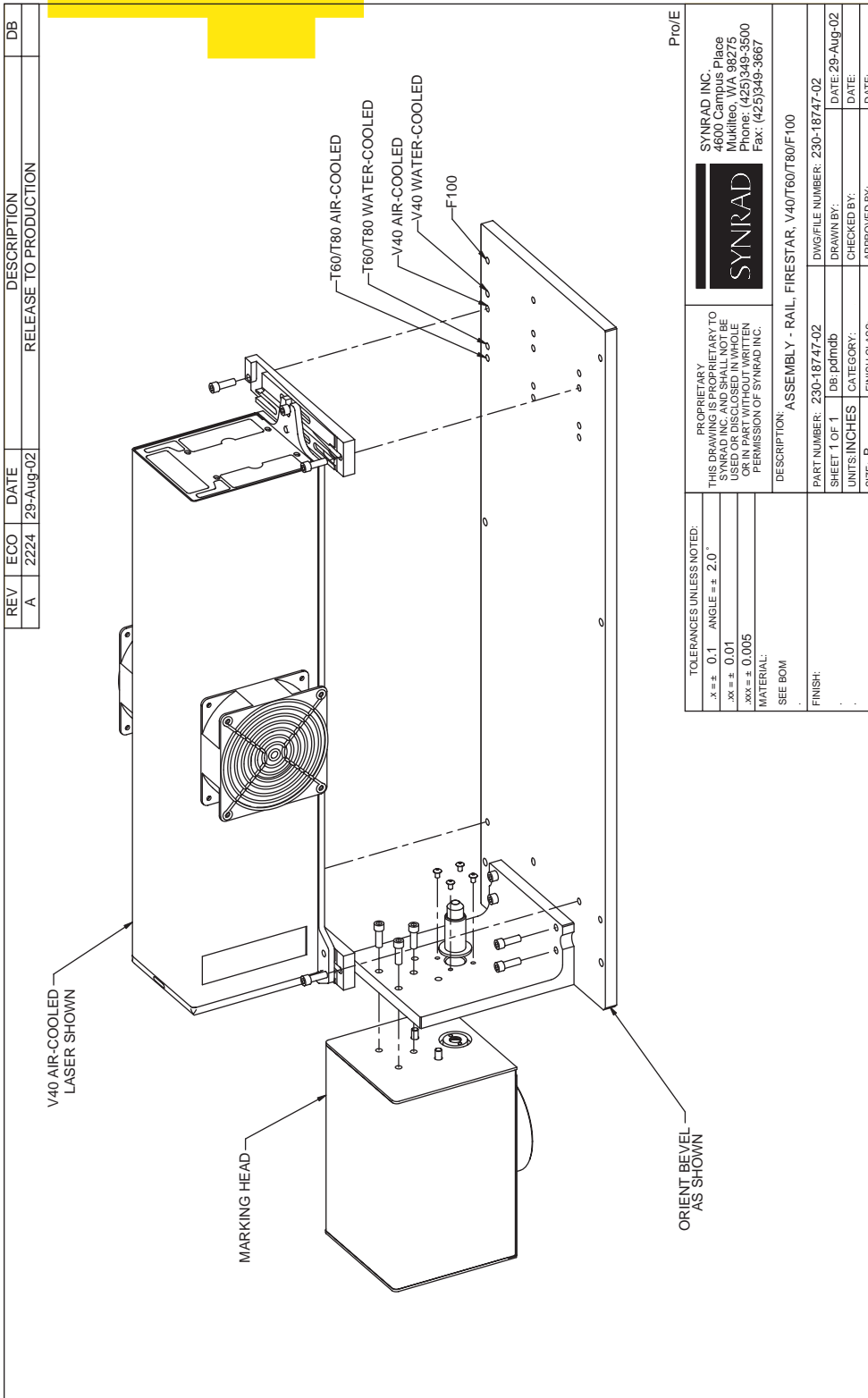


Figure 4-22 FH Head / Firestar v40/t60/t80/f100 mounting drawing

# **maintenance/ troubleshooting**

Use information in this section to perform maintenance and troubleshooting on the FH Series Marking Head.

This section contains the following information:

- Maintenance – explains typical maintenance procedures for the FH Marking Head.
- Troubleshooting – describes how to troubleshoot common problems.

# maintenance/ troubleshooting

## Maintenance

The *Maintenance* section includes subsections:

- Daily inspections
- Cleaning the focusing lens

### Daily inspections

Perform the following steps daily to keep your FH Head in optimum operating condition. Except for the procedures described below, no other service is required or should be attempted.

- 1 Shut off power to the laser and FH Head. Close the laser's shutter if it is equipped with one.

#### **Warning**

possible  
personal  
injury

Ensure that laser power is turned off before inspecting the lens surface. Invisible CO<sub>2</sub> laser radiation is emitted through the lens. Corneal damage or blindness may result from exposure to laser radiation.

- 2 Remove the dust cap from the focusing lens and visually inspect the exterior surface of the focusing lens for contaminants. If required, follow the cleaning instructions below.
- 3 Visually inspect the exterior of the marking head housing to ensure that all warning labels are present. Refer to *Label locations* in the “Laser Safety” section for label types and locations.

### Cleaning the focusing lens

Great care must be used when handling infrared optics since they are much more fragile than glass. For this reason, do not remove optics from their mounts. Carefully follow the cleaning procedures below using the materials listed in Table 5-1.

**Table 5-1** Required cleaning materials

Cleaning Material	Requirements
Finger cots or rubber gloves	Powder free
Air bulb	Clean air bulb
Ethyl alcohol	Spectroscopic or reagent grade
Acetone	Spectroscopic or reagent grade
Lens tissue	Optical quality
Cotton balls or cotton swabs	High-quality surgical cotton/high-quality paper-bodied

# maintenance/ troubleshooting

## Maintenance

### Passive cleaning

Passive cleaning of the focusing lens can be performed without removing the focusing lens from the marking head.

#### **Caution**

possible  
lens  
damage

Do not allow the nozzle of the air bulb to touch the lens surface. Any contact may damage the lens by scratching the surface.

Do not use compressed shop air to blow contamination from the lens. Compressed air contains significant amounts of water and oil that form absorbing films on the optical surface.

Remove loose contaminants from the focusing lens surface by holding a clean air bulb at an angle to the lens and blow a stream of air at a glancing angle across the lens surface. Repeat as necessary until all loose particulates are blown off the lens surface.

### Aggressive cleaning

Aggressive cleaning involves the use of solvents and requires the removal of the focusing lens from the marking head.

When handling or cleaning infrared optics, observe the following guidelines:

- Before beginning, read the entire cleaning process to ensure that all required materials are available.
- Use finger cots or rubber gloves to prevent contamination of the optics by dirt and skin oils.
- Always place optics on lens tissue for protection. Never place optics on hard or rough surfaces.
- It may be necessary to use a fluffed cotton swab instead of a cotton ball to uniformly clean the entire surface of small-diameter mounted optics.
- Before using cleaning agents, read Material Safety Data Sheets (MSDS) and observe all necessary safety precautions.

To remove dust, oily residues, and plastics buildup that have adhered to the surface of the focusing lens, perform the following steps:

- 1 Remove the three capscrews securing the focusing lens to the marking head. Do not remove the lens from its optical mount.
- 2 Perform the passive cleaning procedure discussed earlier to remove any loose contaminants from the optical surface. Repeat as necessary until all loose particles are removed.
- 3 Refer to Table 5-2 and select the appropriate cleaning solvent based on the type of contamination that exists on the surface of the lens.

# maintenance/ troubleshooting

## Maintenance

**Table 5-2** Cleaning solvent selection

Solvent Type	Classification	Application
Ethyl alcohol	Least aggressive	Initial dust cleaning
Acetone	Moderately aggressive	Oily residues Minor baked-on plastics

**Note:** If acetone is used as the cleaning solvent, a second follow-up cleaning of the optical surface using ethyl alcohol is required. Repeat Steps 4 through 7 using the ethyl alcohol.

4 Dampen a cotton ball or fluffed cotton swab with the selected cleaning agent.

### Caution

possible  
lens  
damage

Do not exert pressure on the surface of the optical lens during cleaning. The optical surface is easily scratched by dislodged contaminants.

5 Gently wipe the lens surface with the damp cotton beginning in the center of the optic and working outward in a spiral pattern. *Do not rub hard or apply pressure, especially when using a cotton swab.* Drag the cotton ball or swab without applying any downward pressure.

**Note:** Use a clean cotton ball or swab on each pass. The cotton will pickup and carry surface contaminants that may scratch the optical surface.

To prevent streaking during the final ethyl alcohol cleaning, drag the cotton slowly across the surface so that the cleaning liquid evaporates right behind the cotton.

6 It may be impossible to remove all traces of contaminants from the lens surface especially near the edges. Ensure that the only remaining residue is around the outer edges and not in the center of the lens.

7 Carefully examine the optical surface under a good light in front of a black background. Certain contaminants or damage such as metal splatter or pitting cannot be removed. In these cases the optic will require replacement.

8 Repeat Steps 4 through 7 as required, removing all possible contaminants and deposits.

9 Reinstall the focusing lens and replace the lens cap. If the cleaned optic will not be used immediately, wrap it in lens tissue and place in clean, dry storage.

# maintenance/ troubleshooting

## Troubleshooting

The *Troubleshooting* section includes subsections:

- FH Series Marking Head
- FH Series Tracker Marking Head
- Fiber Link Controller Card (FLCC)
- Automation I/O
- Laser Marking FAQ

## FH Series Marking Head

### Symptom:

- The *DC Power* cable is connected but the *ON* indicator is not illuminated.

### Possible Causes:

- DC voltage is not available from the DC power supply.

Ensure that the proper DC voltage (+30 VDC) is available under full-load conditions.

- The fuse has blown.

Turn the fuse holder cover counterclockwise and remove the fuse. Inspect or test the fuse, replacing as necessary with the correct 5 A, 125 V fast-blow fuse.

### Symptom:

- No marks or very light marks appear on the part.

### Possible Causes:

- The part is not positioned at the point of focus.

Locate the final test report shipped with your marking head to determine the actual working distance of the lens. Refer back to Figure 2-2, *Working distance measurement*, in the “Operation” section and then measure working distance from the bottom of the focusing lens mount to the surface of the part to be marked.

### Symptom:

- Mark quality deteriorates gradually over time and/or laser power must be increased to maintain quality.

# **maintenance/ troubleshooting**

## **Troubleshooting**

### **Possible Causes:**

- The focusing lens has become coated with marking debris or vapor.

Carefully inspect and clean the lens as described in *Maintenance* in the “Maintenance/Troubleshooting” section.

### **Symptom:**

- *ON* and *Status* indicators on the marking head are illuminated green, but there is no mark made when the *Test Mark* pushbutton is pressed.

### **Possible Causes:**

- The laser is not enabled.

Check that the laser’s *Ready* light is illuminated. On Series 48 and Evolution lasers, check that the *Lase* indicator is glowing dimly (tickle mode) and that it appears brighter (lasing mode) as the mark is made. On Firestar lasers, check that *RDY* (Ready) and *SHT* (Shutter) indicators are lit and that the *LASE* indicator illuminates as the mark is being made. Refer to your laser’s Operator’s Manual if indicators do not illuminate as described.

- The *Laser Control* cable is not connected between the laser and the marking head.

Refer to *Connecting* in the “Getting Started” section for information on connecting the *Laser Control* cable between the FH head and your particular laser.

- The Fast Acting Safety Interlock (FASI) feature on the Fiber Link Card has been enabled.

If the FASI feature has been enabled (DIP switch #5 on the Fiber Link Controller Card set to “On”), then a 15–40 V signal must be applied to input #3 (IN3) on the FH marking head before the laser will fire.

## **FH Series Tracker Marking Head**

### **Symptom:**

- Tracker does not track moving parts.

### **Possible Causes:**

- Tracking is not enabled.

Check that Track Marking Object in WinMark’s *Tracking* tab is set to *Yes*.

# maintenance/ troubleshooting

## Troubleshooting

- Encoder pulses are not being read by the FH Tracker Head.

Close WinMark Pro and open Digital Scope (*DigScope.exe*). Rotate the conveyor or position encoder and verify that input #1 (IN1) and input #2 (IN2) toggle as the encoder rotates.

- The part sensor signal is not being read by the FH Tracker Head.

Close WinMark Pro and open Digital Scope. Trigger the part sensor and verify that input #0 (IN0) toggles.

- Part movement is not being sensed in the proper direction.

Toggle Invert Encoder Direction in WinMark's *Tracking* tab.

### Symptom:

- Characters or graphics within the mark are distorted or missing.

### Possible Causes:

- The mark is not being completed within the marking field of the lens.

Ensure that the mark is positioned as close to the upstream edge of the *Drawing Canvas* as possible.

- Line speed is set too fast.

Lower line speed.

- The mark is being made too slowly for the required line speed.

Lower mark time by changing fonts, decreasing font size, or reducing line spacing. Simplify or eliminate graphic objects in the mark. Reduce graphic object size or resolution.

### Symptom:

- Tracker marks are skewed or distorted.

### Possible Causes:

- Encoder resolution is set improperly.

Load and mark the *linestack200.mkh* or *linestack370.mkh* file (located in the *WinMark* folder). Refer to *Rotary position encoder* in the "Tracker" section for instructions on how to fine-tune encoder resolution settings.

# maintenance/ troubleshooting

## Troubleshooting

- Line speed is set too fast.

Lower line speed.

- The actual part motion vector is different than the value entered as the Motion Vector in WinMark's *Tracking* tab.

Check that actual part motion under the marking head equals the entered Motion Vector value.

## Fiber Link Controller Card (FLCC)

### Symptom:

- A mark is made when the *Test Mark* pushbutton is pressed, but marking does not occur when commanded by WinMark Pro or WinMark Launcher.

### Possible Causes:

- The *Fiber Optic* cable between the FH Head and the FLCC is improperly connected.

To verify proper connection of the *Fiber Optic* cable, follow the steps below:

- 1 Make sure that both the FH Marking Head and your computer are turned on.

### **Warning**

possible  
personal  
injury

Do not stare directly into the red laser diode light emitted from the transmitter ports on the FLCC or from the marking head. The light is potentially intense enough to injure the eye with prolonged exposure.

- 2 Remove the duplex connector from the *Fiber Optic Receiver/Transmitter* port on the FLCC and verify that the card's gray (transmitter) port is emitting a visible red glow. The FLCC's fiber optic port is color-coded. The gray half transmits to the FH Marking Head. The blue half receives from the head.

**Note:** If there is no visible red glow from the transmitter port on the FLCC, shut down the computer and check the FLCC to ensure it is properly seated in the computer's PCI bus slot. Remember to follow the same static discharge precautions that you followed when installing the card. If the card still fails to function properly, contact SYNRAD, Inc. or a SYNRAD Authorized Distributor for assistance.

# maintenance/ troubleshooting

## Troubleshooting

- 3 Reconnect the duplex fiber optic connector to the FLCC. When properly connected, the latch on the connector should snap into the cable latch slot (see Figure 1-5 in the “Getting Started” section). You should not be able to remove the *Fiber Optic* cable without depressing the latch.
- 4 Disconnect the duplex fiber optic connector from the *Fiber Optic Control* port on the FH Head’s Control panel. The transmitter (TX) port on the FH Head should emit a visible red glow; if not, contact SYNRAD, Inc. or a SYNRAD Authorized Distributor for assistance.
- 5 Reconnect the duplex fiber optic connector to the *Fiber Optic Control* port so that the half that is emitting a visible red glow connects to the receiver (RX) port on the FH Head. When properly connected, the latch on the connector should snap into the cable latch slot. You should not be able to remove the *Fiber Optic* cable without depressing the latch.

- The FLCC has failed or has been damaged.

If you determine that the FLCC is not operating correctly, contact SYNRAD, Inc. or a SYNRAD Authorized Distributor for assistance.

## Automation I/O

### Symptom:

- The FH Head or WinMark Pro is not responding to automation inputs or the automation controller is not “seeing” FH Head/WinMark Pro outputs.

### Possible Causes:

- No Fiber Link Controller Card is selected.

In WinMark Pro, click the *Tools/General Settings.../Applications Settings* tab. Scroll down to I/O Card Selection and verify that a card is selected. If no card is shown on the drop-down list, verify that a fiber link card is installed in your computer, and then check that drivers for the PCI-bus FLCC are properly installed (refer to *Connecting* in the “Getting Started” section for information about installing PCI Device Driver files).

- I/O voltage levels are incorrect.

Review *Marking automation* in the “Technical Reference” section to verify that I/O signals are in the correct voltage range of 15–40 VDC.

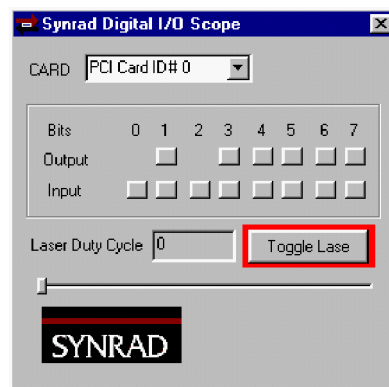
# maintenance/ troubleshooting

## Troubleshooting

- I/O wiring is not properly connected to the marking head.

Double-check field wiring to ensure that input/output signals are routed to the correct pins on the *Digital I/O* cable and that their respective return (ground) paths are wired to the proper pins.

Use Digital Scope (Figure 5-1) to verify proper I/O functionality between the marking head/FLCC and the automation controller. Digital Scope's input "buttons" pop-in as each individual input is activated (when the correct voltage level is applied). Press an output "button" to activate an output.



**Figure 5-1** Digital Scope window

**Note:** To prevent I/O conflicts, always close WinMark Pro or WinMark Launcher before opening Digital Scope. Close Digital Scope before operating the marking head membrane panel pushbuttons or before starting WinMark Pro or Launcher.

- The Fiber Link card is incorrectly addressed (ISA-bus FLCCs only).

Verify that any I/O address specified in WinMark Pro's Event Builder matches the current ISA card address.

## Laser Marking FAQ

Our *Laser Marking FAQ*, available for downloading or browsing from the WinMark Pro web site at <http://www.winmark.com>, answers many common marking questions in categories including *General troubleshooting*, *WinMark Pro automation*, *Tracking operation*, *ActiveX*, and others. The *Laser Marking FAQ* also includes links to various SYNRAD technical bulletins.

# appendix a

This appendix contains the following information:

- Mounting stand – illustrates one way to mount your FH marking system.
- Parts list – provides a list of parts to build an FH Series mounting stand.

# appendix a

## Mounting stand

The mounting stand illustrated in the drawings below is built from pre-cut aluminum T-slot material available under several trade names. Callout numbers in the illustrations refer to the item numbers listed in Tables A-1-A-3.

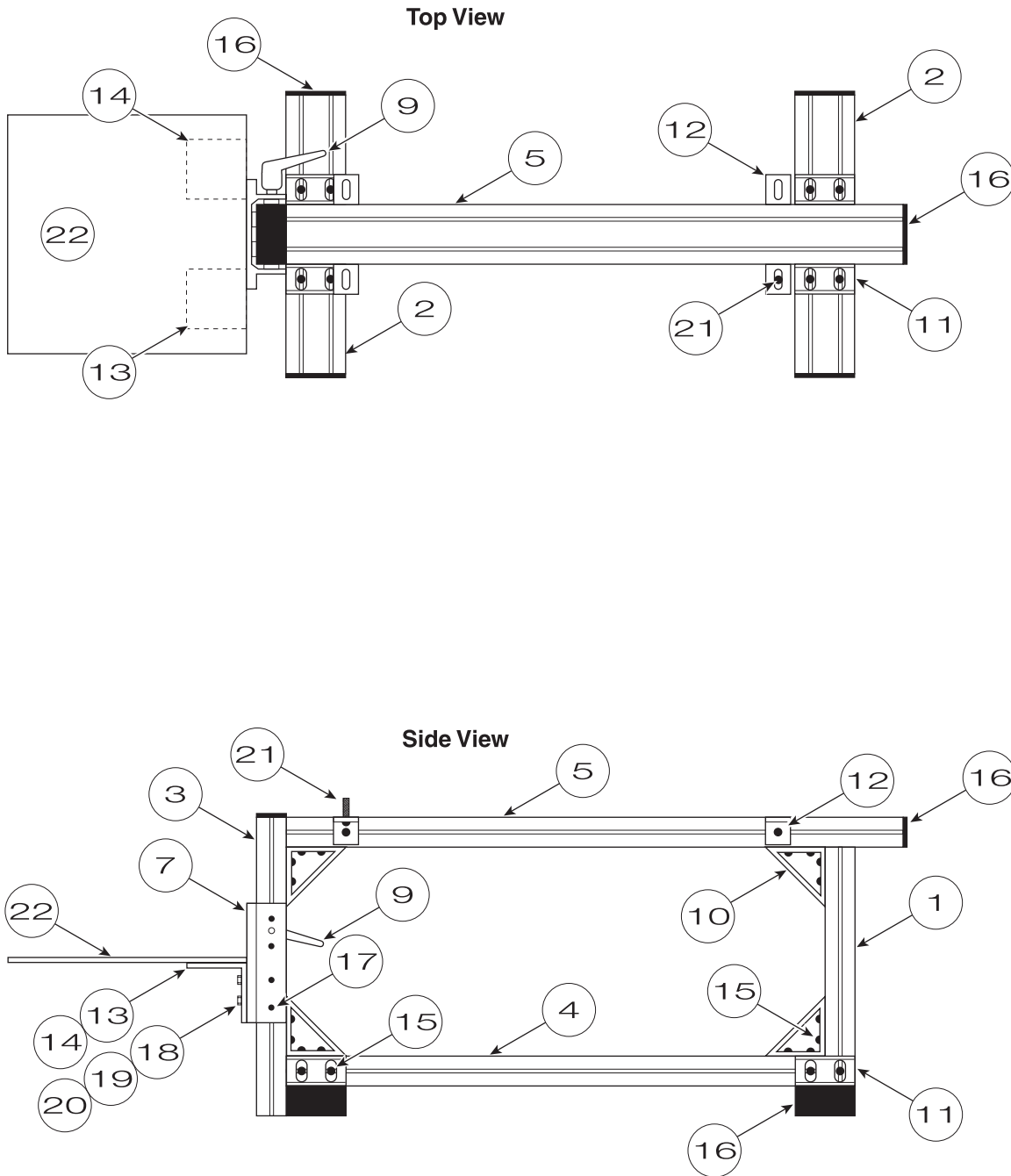


Figure A-1 Mounting stand

# appendix a

## Parts list

All components (and part numbers) necessary to build the mounting stand shown in Figure A-1 are listed in Tables A-1–A-3. Table A-1 lists part numbers for a “short” stand, meant for FH systems using 80 or 125 mm lenses. Table A-2 lists part numbers for a “medium” stand for systems using 80, 125, or 200 mm lenses. Table A-3 lists part number for a “tall” stand for systems using 80, 125, 200, or 370 mm lenses.

The component manufacturer, 80/20 Inc. can be contacted directly at:

80/20 Inc.  
1701 S. 400 E.  
Columbia City, IN 46725  
Tel: (219) 248-8030  
Fax: (219) 248-8029  
Web site: <http://www.8020.net>

**Table A-1** Parts list for short mounting stand (for 80–125 mm lenses)

Item #	Part #	Qty	Description	Cut to Length
1	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	7"
2	1530-Lite	2	Extrusion, 1.5" × 3.0", medium duty	14"
3	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	10"
4	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	27"
5	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	31"
6	7020	6	1530-Lite cut to length (cutting charge)	—
7	6834	1	15 Series Double Flange Linear Bearing with #7400 @ LR and LU	—
8	7400	2	Brake Mounting Kit (machine charge)	—
9	6800	1	15 Series Ratcheting L-Handle	—
10	4338	4	15 Series 8 Hole Inside Gusset Corner Brkt	—
11	4334	4	15 Series 4 Hole Inside Gusset Corner Brkt	—
12	4295	4	15 Series 2 Hole Slotted Inside Corner Brkt	—
13	4308	1	15 Series 6 Hole RH Inside Corner Brkt	—
14	4309	1	15 Series 6 Hole LH Inside Corner Brkt	—
15	3320	52	5/16-18 × 5/8" Flanged Button Head Socket Cap Screw and Economy T-Nut	—
16	2045	6	1530-Lite End Cap	—
17	3340	8	5/16-18 × 1/2" Flanged BHSCS	—
18	3118	4	5/16-18 × 1" BHSCS	—
19	3260	8	5/16" Washer	—
20	3214	8	5/15-18 Hex Nut	—
21	3123	4	5/16-18 × 1 1/4" SHCS	—

Item #22 is not available from 80/20 Inc. We recommend using a 12" × 12" × 1/4" anodized aluminum plate.

**Note:** 80/20 Inc. stocks a complete line of metric fasteners for those customers who require them.

# appendix a

## Parts list

**Table A-2** Parts list for medium mounting stand (for 80–200 mm lenses)

Item #	Part #	Qty	Description	Cut to Length
1	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	12"
2	1530-Lite	2	Extrusion, 1.5" × 3.0", medium duty	14"
3	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	15"
4	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	27"
5	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	31"
6	7020	6	1530-Lite cut to length (cutting charge)	—
7	6834	1	15 Series Double Flange Linear Bearing with #7400 @ LR and LU	—
8	7400	2	Brake Mounting Kit (machine charge)	—
9	6800	1	15 Series Ratcheting L-Handle	—
10	4338	4	15 Series 8 Hole Inside Gusset Corner Brkt	—
11	4334	4	15 Series 4 Hole Inside Gusset Corner Brkt	—
12	4295	4	15 Series 2 Hole Slotted Inside Corner Brkt	—
13	4308	1	15 Series 6 Hole RH Inside Corner Brkt	—
14	4309	1	15 Series 6 Hole LH Inside Corner Brkt	—
15	3320	52	5/16-18 × 5/8" Flanged Button Head Socket Cap Screw and Economy T-Nut	—
16	2045	6	1530-Lite End Cap	—
17	3340	8	5/16-18 × 1/2" Flanged BHSCS	—
18	3118	4	5/16-18 × 1" BHSCS	—
19	3260	8	5/16" Washer	—
20	3214	8	5/15-18 Hex Nut	—
21	3123	4	5/16-18 × 1 1/4" SHCS	—

Item #22 is not available from 80/20 Inc. We recommend using a 12" × 12" × 1/4" anodized aluminum plate.

**Note:** 80/20 Inc. stocks a complete line of metric fasteners for those customers who require them.

# appendix a

## Parts list

**Table A-3** Parts list for tall mounting stand (for 80–370 mm lenses)

Item #	Part #	Qty	Description	Cut to Length
1	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	19"
2	1530-Lite	2	Extrusion, 1.5" × 3.0", medium duty	14"
3	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	22"
4	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	27"
5	1530-Lite	1	Extrusion, 1.5" × 3.0", medium duty	31"
6	7020	6	1530-Lite cut to length (cutting charge)	—
7	6834	1	15 Series Double Flange Linear Bearing with #7400 @ LR and LU	—
8	7400	2	Brake Mounting Kit (machine charge)	—
9	6800	1	15 Series Ratcheting L-Handle	—
10	4338	4	15 Series 8 Hole Inside Gusset Corner Brkt	—
11	4334	4	15 Series 4 Hole Inside Gusset Corner Brkt	—
12	4295	4	15 Series 2 Hole Slotted Inside Corner Brkt	—
13	4308	1	15 Series 6 Hole RH Inside Corner Brkt	—
14	4309	1	15 Series 6 Hole LH Inside Corner Brkt	—
15	3320	52	5/16-18 × 5/8" Flanged Button Head Socket Cap Screw and Economy T-Nut	—
16	2045	6	1530-Lite End Cap	—
17	3340	8	5/16-18 × 1/2" Flanged BHSCS	—
18	3118	4	5/16-18 × 1" BHSCS	—
19	3260	8	5/16" Washer	—
20	3214	8	5/15-18 Hex Nut	—
21	3123	4	5/16-18 × 1 1/4" SHCS	—

Item #22 is not available from 80/20 Inc. We recommend using a 12" × 12" × 1/4" anodized aluminum plate.

**Note:** 80/20 Inc. stocks a complete line of metric fasteners for those customers who require them.

# appendix a



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# appendix b



This appendix contains the following information:

- FH Tracker Motion Sensing Kit – lists descriptions of items contained in the Tracker Motion Sensing Kit available from SYNRAD.
- Component suppliers – lists suppliers of items contained in the Tracker Motion Sensing Kit.

# appendix b

## FH Tracker Motion Sensing Kit

FH Tracker Heads require several additional components to coordinate marking on-the-fly with part motion. These components include a part sensor (capacitive, inductive, optical, mechanical, etc.) for part position information, a rotary position encoder (with bi-directional or quadrature signal output) for determining line speed, and a DC power supply to power both the part sensor and rotary encoder. Although these components are not provided with the FH Tracker, some or all of them may already exist as part of the equipment performing your automated parts handling. For those customers who prefer to buy motion detection components from a single source, SYNRAD offers the *Tracker Motion Sensing Kit* described in Table B-1 below.

**Table B-1** SYNRAD Tracker Motion Sensing Kit part numbers

Item Description	SYNRAD Part Number
Tracker Motion Sensing Kit w/ US power plug	250-18200-01
Tracker Motion Sensing Kit w/ UK power plug	250-18200-02
Tracker Motion Sensing Kit w/ European power plug	250-18200-03

Table B-2 lists components contained in the *Tracker Motion Sensing Kit*. Please note that kit components are **not** available separately from SYNRAD.

**Table B-2** SYNRAD Tracker Motion Sensing Kit contents

Item Name	Description / Notes
Rotary position encoder	1000 PPR, quadrature output Dynapar H22100011420H 5-pin DIN jack added by SYNRAD
Friction drive wheel (for encoder)	2-5/8" O.D. Stock Drive Products A6Z10-1342408
Optical part sensor (w/ reflective or thru-beam capability)	NAiS/Aromat UZF301 sensor NAiS/Aromat UZFTF8 fiber optic pair 4-pin DIN jack added by SYNRAD
Custom FH Tracker I/O cable	Standard FH I/O cable 5-pin DIN plug added by SYNRAD 4-pin DIN plug added by SYNRAD Power jack added by SYNRAD
Power supply (choose one by location)	120 VAC/24 VDC, North American power plug Condor D12-10-03-206IP  230 VAC/24 VDC, United Kingdom power plug Condor PSD-24750-230/BSI-206IP  230 VAC/24 VDC, European power plug Condor PSD-24750-230-206IP

# appendix b

## Component suppliers

SYNRAD has successfully used Dynapar H20 Series rotary position encoders available from:

Danaher Controls  
1675 Delany Road  
Gurnee, IL 60031-1282  
USA  
Phone: 1-800-873-8731 or 847-662-2666  
Fax: 847-662-6633

SYNRAD has successfully used NAI S UZF3 and UZC Series photoelectric sensors available from:

Aromat Corporation  
Phone: 1-800-228-2350  
Internet: <http://www.aromat.com>

# appendix b

# B

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# appendix c



This appendix contains the following information:

- Alternate mounting configurations – describes alternate methods of mounting the FH Series Marking Head in relation to the laser.
- Beam expansion/path length – briefly describes beam expansion characteristics of 48 Series, Evolution, and Firestar lasers and how those properties affect the beam path length and “remote” mounting of the FH Marking Head.

**Important Note:** Mounting the laser and FH Marking Head in non-standard configurations (without the SYNRAD-designed *L-bracket* and *Mounting Rail*) is a complex process and should only be attempted by personnel experienced in laser/optical alignments and knowledgeable about optical beam characteristics.

# appendix c

## Alternate mounting configurations

The *Alternate mounting configurations* section includes subsections:

- Mounting guidelines
- Standard mounting
- In-line mounting
- Offset mounting

Although SYNRAD recommends mounting the FH Series Marking Head and laser using our *L-bracket* and *Mounting Rail*, there are some applications where, due to production line or packaging constraints, this is not possible. Described below are several alternatives for mounting your marking head and laser.

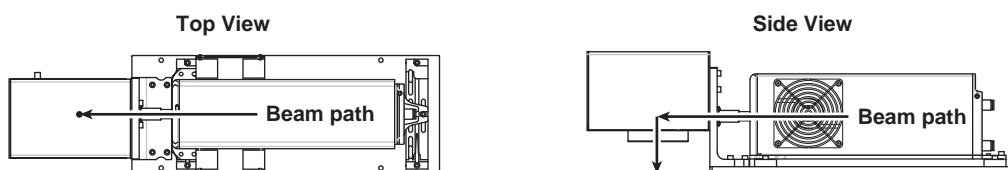
### Mounting guidelines

When mounting an FH Marking Head and laser using your own mounting components, follow the guidelines below to ensure optimum performance.

- The FH Head must be mounted so that marking surface is parallel to the bottom of the lens mount.
- The FH Head must be mounted to a bracket capable of sinking excess heat (approximately 60 W) generated by the marking head.
- In order to align the marking head to the laser, your mounting design must provide sufficient multi-axis adjustment for both the turning optic(s) and the FH Head.
- If you are not using a SYNRAD-supplied *L-bracket/Mounting Rail* assembly, an *FH Field Alignment Kit*, SYNRAD part number 230-18176-01, is required to ensure proper alignment and performance.
- If the total beam path (the distance between the front of the laser and the rear of the FH Head) exceeds four inches, please review the section on beam expansion and path length. The *Beam expansion/path length* section describes and illustrates path length and expander options for FH Marking Heads used in conjunction with SYNRAD 48 Series, Evolution, and Firestar lasers.

### Standard mounting

For reference purposes, the standard FH mounting configuration is shown in Figure C-1. Both marking head and laser are aligned horizontally and vertically but the marking head's beam exit is at a right-angle to the laser's beam exit.



Standard FH Marking Head/laser mounting  
using optional L-Bracket and Mounting Rail  
(Firestar v20 laser shown)

Figure C-1 Standard mounting

# appendix c

## Alternate mounting configurations

### In-line mounting

In-line mounting refers to an orientation where the beam exit of both the marking head and laser are in the same plane but the head is offset some distance in front of the laser (see Figure C-2). This type of mounting is common in a “space-saver” situation where the laser is mounted vertically instead of in the normal horizontal orientation.

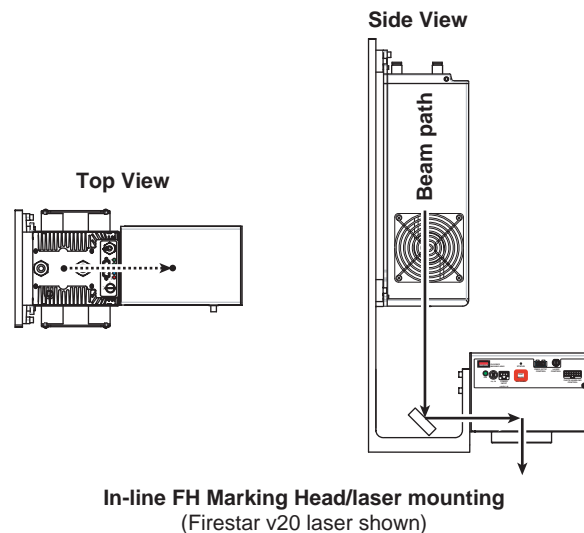


Figure C-2 In-line mounting

### Offset mounting

Offset mounting refers to an orientation where the beam exit of the marking head is offset some lateral distance from the laser’s beam exit centerline (see Figure C-3). This type of mounting is useful in situations where the laser must be offset from the marking head to prevent interference with the product flow or with other components in the manufacturing system.

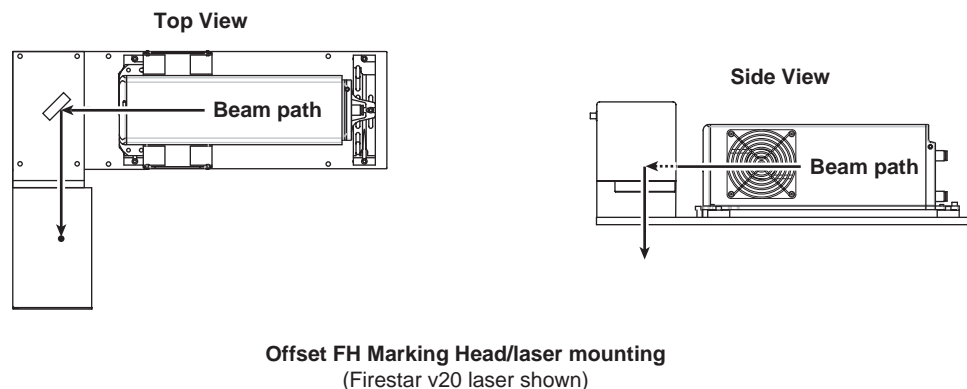


Figure C-3 Offset mounting

# appendix c

## Beam expansion/path length

Each SYNRAD laser family (48 Series, Evolution, and Firestar) has slightly different beam diameter and divergence values. When using a standard FH mounting scheme consisting of an *L-bracket* and *Mounting Rail*, beam expansion issues are taken into account by (1) the fixed mounting distance between the laser and the marking head and (2) the beam expander/telescope installed in the FH Head. The beam expander's expansion ratio is selected to match the laser's beam diameter and divergence characteristics so that beam diameter at the focusing optic is approximately 10–11 mm. For 48 Series and Firestar f-Series lasers with a beam diameter of 3.5 mm and a divergence of 4 milliradians (mrad), the expansion ratio is 3X; Evolution lasers (4 mm / 3.5 mrad) require a 2.5X expander; and Firestar v-Series/t-Series lasers (2 mm / 7 mrad) require a 5X expander.

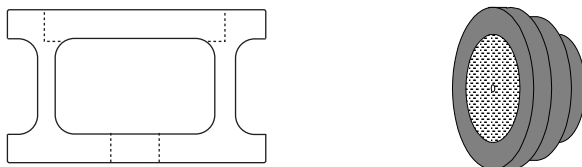
In situations where the FH Marking Head is mounted “remotely” on a non-standard mount, the beam path may not exceed certain distances as illustrated in Figures C-5–C-7, otherwise the laser beam will overflow the marking head's input aperture optic. Each illustration shows the maximum path length for a given laser family in two situations: (1) where the beam expander is mounted in the marking head (the standard expander location) and (2) in situations where the expander is mounted in a user-designed custom mount at the faceplate of the laser (custom expander location).

**Important Note:** Because the resulting optical beam path is much longer in a non-standard mounting scheme, the focal length (working distance) of the lens will differ from the distance measured during the marking head's final test evaluation. You should use the focal length indicated in the final test report as a starting point to determine the new working distance. Non-standard FH mounting also affects the focused spot size, causing the spot diameter to vary slightly from standard values. Because of this variation, the performance of your marking head will differ from results obtained during sample testing and will not meet the published specifications given in Table 4-1 and 4-7.

In addition, the longer beam path and resulting change in focal length will affect the overall field size of the lens. You may need to optimize WinMark Pro's Field Scale X and Field Scale Y values (on the *Marking* tab) to obtain the correct size when marking objects with critical dimensional values.

Although path length can be greatly increased by designing a custom expander mount attached to the laser faceplate, alignment of the FH Marking Head to the laser becomes much more complex. The user-designed custom expander must be mounted perfectly collinear to the laser beam and must allow adjustment in both axes so that the expander can be aligned with the beam. In addition, the expanded beam becomes difficult to view and center in the alignment target. Keep in mind that an *FH Field Alignment Kit*, SYNRAD part number 230-18176-01, is required in all instances where the FH Marking Head is not mounted to the standard *L-bracket/Mounting Rail* assembly and remember that mounting attachments for the laser, marking head, and any intermediate optics must allow for fine adjustment in all axes.

**Note:** The *FH Field Alignment Kit* (shown in Figure C-4) does not provide the ability to make actual hardware alignment adjustments. The kit only provides the means to determine the true beam path, thus indicating the direction in which hardware adjustments must be made.



**Figure C-4** Output alignment fixture and beam alignment tool

# appendix c

## Beam expansion/path length

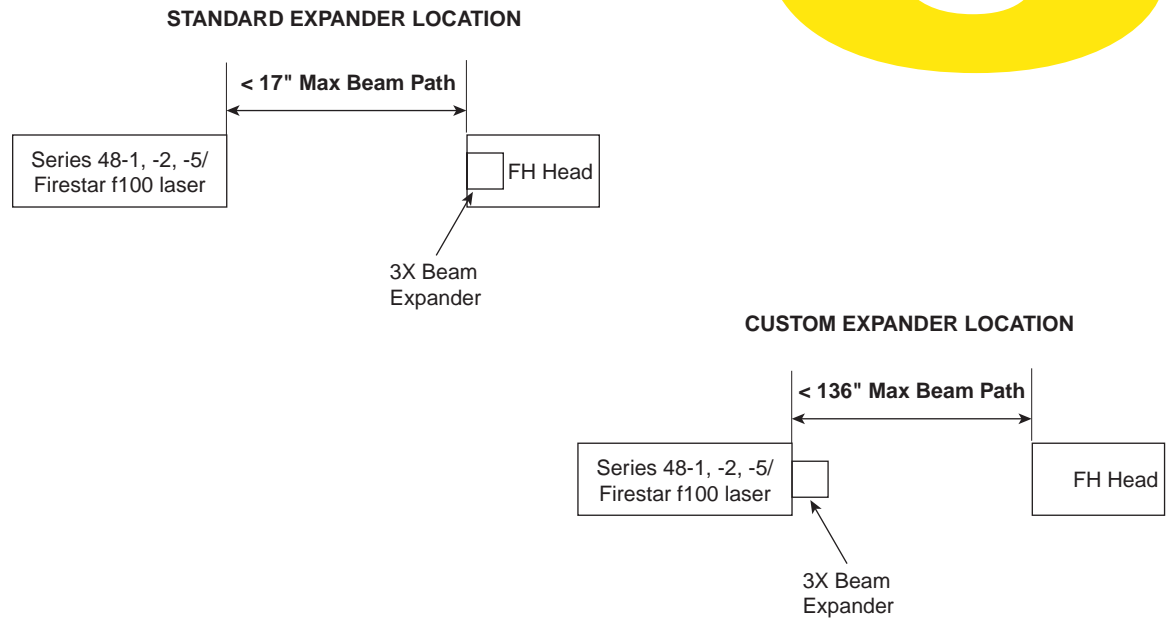


Figure C-5 Maximum 48 Series/f100 beam path

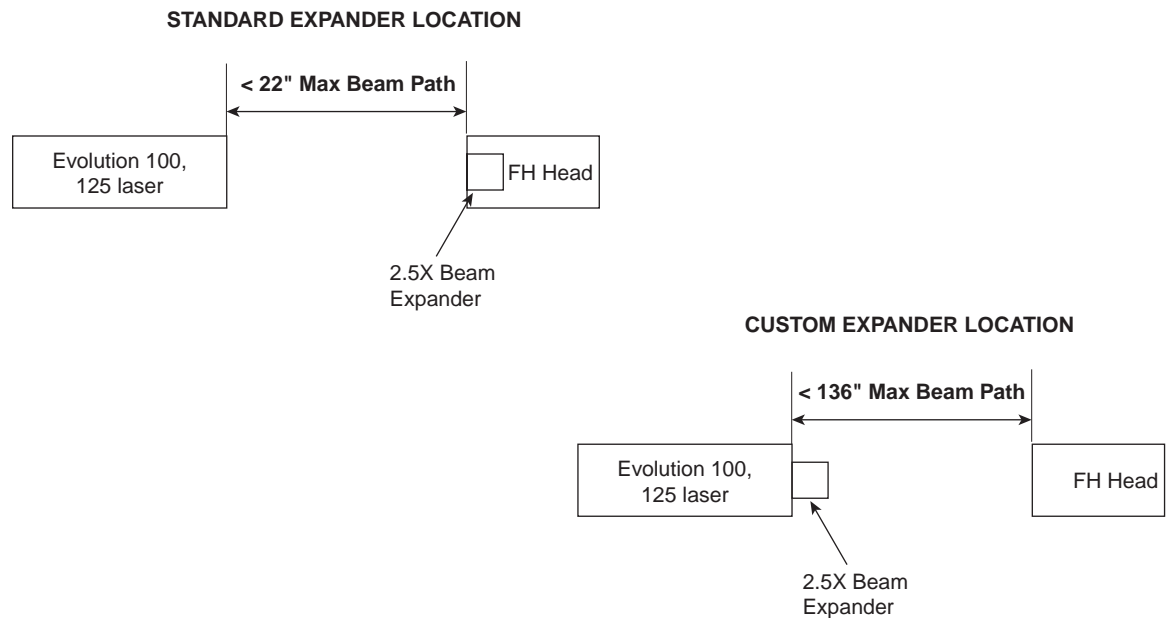
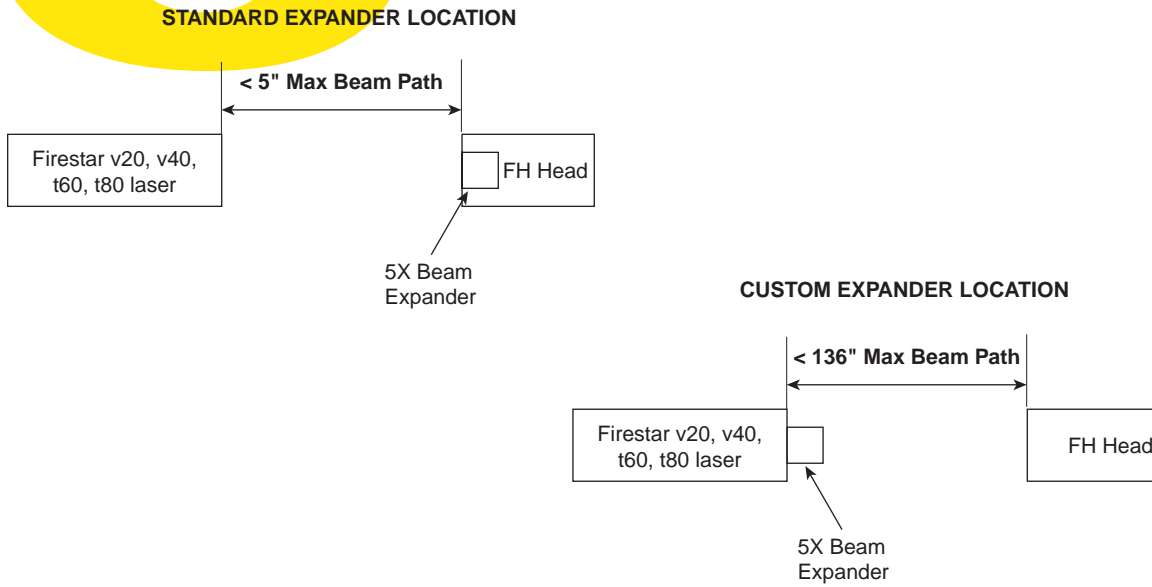


Figure C-6 Maximum Evolution beam path

# appendix c

## Beam expansion/path length



**Figure C-7** Maximum Firestar v20/v40/t60/t80 beam path

# appendix d

This appendix contains the following information:

- Power measurements – describes how to measure laser output power through an FH Series Marking Head.

# appendix d

## Power measurements

The *Power measurements* section includes subsections:

- Setup
- Input measurements
- Output measurements

This section describes how to measure laser output power through the FH Series Marking Head using a SYNRAD Power Wizard® power meter. Use this procedure to verify that the FH Head is properly aligned to the laser when it is mounted in a non-standard configuration (without using the SYNRAD designed *L-bracket* and *Mounting Rail*). Before beginning, read through the steps in the *Setup*, *Input measurements*, and *Output measurements* sections so that you understand the sequence and the purpose of each step.

### Caution

possible  
equipment  
damage

All power measurements must be taken on an unfocused beam. Never measure a focused laser beam at the point of focus. The Power Wizard power meter will be damaged.

## Setup

To prepare the marking head for power measurements, perform the following steps:

- 1 Remove the *Beam Enclosure Tube* located between the laser and the *L-bracket*.
- 2 Place a beam block or other absorbent material on the marking surface in the field of the focusing lens.
- 3 Verify that the factory-supplied test mark file is loaded into marking head memory. If necessary reload this file, *FactoryTestMark1.mkh*, into memory. See *Custom test mark feature* in the “Technical Reference” section for instructions.
- 4 Check that all personnel in the area are wearing the appropriate protective eyewear.
- 5 With power applied to the FH Head, press the *Test Mark* button to fire the test mark.  
This step centers the mirrors and marks a pattern to indicate the center of the marking field. As long as power remains applied to the FH Marking Head, the X-Y mirrors will remain centered on the marking surface.

**Note:** When WinMark Pro v4.0.0.4058 or higher is installed, Digital Scope automatically sends a command to center FH Series Marking Head mirrors when it is opened.

- 6 Ensure that WinMark Pro and WinMark Launcher are closed.

# appendix d

## Power measurements

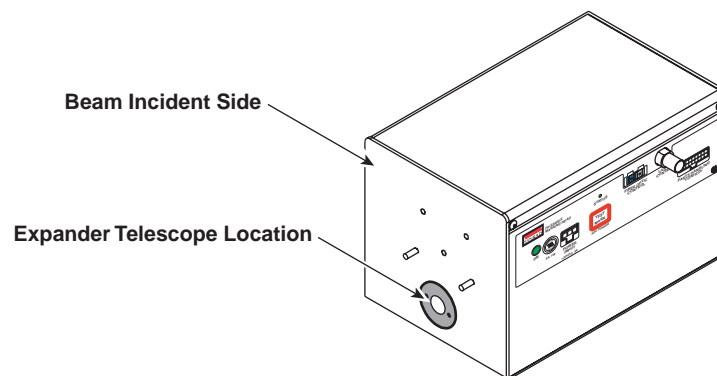
### Input measurements

Input power, measured just before the beam enters the marking head, provides a baseline of the actual output power from the laser at a specific duty cycle (power level). In cases where additional optics such as turning mirrors alter the beam path, we recommend taking power measurements before and after each optic to verify that all components are properly aligned to the beam path.

**Note:** The steps below describe the use of a SYNRAD Power Wizard® PW-250 power meter to measure laser output power. Refer to the *Power Wizard® PW-250 Operation Instructions* for detailed operating instructions. Ensure that you are using the correct Power Wizard for the laser power you are checking. The Power Wizard PW-2 has a measurement range of 10–1999 mW; the Power Wizard PW-250 has a range of 1–250 W.

To begin input power measurements, perform the following steps:

- 1 Ensure that all personnel in the area are wearing the appropriate protective eyewear.
- 2 Locate and open Digital Scope (*C:\Program Files\WinMark\DigScope.exe*). Use the slider to set the desired PWM power percentage in the *Laser Duty Cycle* box.
- 3 Ensure that all personnel are clear of the beam path and then press the **Toggle Lase** button.
- 4 Push and hold the Power Wizard's *Reset* button for 2–3 seconds.
- 5 Release the *Reset* button and quickly verify that the display reads 0.0 W ( $\pm 0.3$  W).
- 6 Immediately place the Power Wizard's target area in the beam path centered on, and close to, the FH Head's *Expander Telescope* (input aperture). See Figure D-1. Do not allow the Power Wizard to come in contact with the *Expander Telescope* as this may damage the expander's optical elements.



**Figure D-1** Input aperture location

- 7 Keep the unfocused beam centered on the Power Wizard's target area until you hear a series of beeps. This indicates the measurement cycle has ended. An automatic hold feature maintains the current reading for approximately 20 seconds or until the *Reset* button is pressed.
- 8 Press Digital Scope's **Toggle Lase** button to turn off the laser.
- 9 Repeat steps 3 through 8 two or three times to get a good average power reading.

# appendix d

## Power measurements

### Output measurements

Output power is measured at the focusing optic (output aperture) of the marking head. When comparing output power to input power measurements, make sure you set the same PWM power percentage as used in the *Input measurements* section above. Typical power loss through the FH Series Marking Head (measured output power versus measured input power) is less than 7%.

To begin output power measurements, perform the following steps:

- 1 Ensure that all personnel in the area are wearing the appropriate protective eyewear.
- 2 Open Digital Scope. Use the slider to set the desired PWM power percentage in the *Laser Duty Cycle* box.
- 3 Ensure that all personnel are clear of the beam path and then press the **Toggle Lase** button.
- 4 Push and hold the Power Wizard's *Reset* button for 2–3 seconds.
- 5 Release the *Reset* button and quickly verify that the display reads 0.0 W ( $\pm 0.3$  W).

#### Caution

possible  
equipment  
damage

All power measurements must be taken on an unfocused beam. Never measure a focused laser beam at the point of focus. The Power Wizard power meter will be damaged. Measure at a point on the beam several inches from the actual point of focus.

- 6 Immediately place the Power Wizard's target area in the output aperture's beam path centered on the *FactoryTestMark1.mkh* image marked earlier during the setup procedure.  
Hold the Power Wizard approximately one-half the distance from the bottom of the lens mount to the focal plane of the lens to ensure that the Power Wizard is in the path of a *defocused* beam.
- 7 Keep the unfocused beam centered on the Power Wizard's target area until you hear a series of beeps. This indicates the measurement cycle has ended. An automatic hold feature maintains the current reading for approximately 20 seconds or until the *Reset* button is pressed.
- 8 Press Digital Scope's **Toggle Lase** button to turn off the laser.
- 9 Repeat steps 3 through 8 two or three times to get a good average output power reading.

If power loss through the marking head seems too high, remove the focusing lens and take another set of output power measurements. If excessive power loss is seen when the focusing lens is installed, inspect the lens for contaminants. If required, carefully clean the lens as described in *Maintenance* in the "Maintenance/Troubleshooting" section.

If the FH Head is mounted in a non-standard configuration (without using the SYNRAD designed *L-bracket* and *Mounting Rail*), verify that alignment to the laser is correct.

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