# FH FLYER MARKING HEAD


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# FH FLYER MARKING HEAD

## Marking System Operator's Manual

Version 3.4

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**Important Note:** This Operation Manual explains operation activities related to FH Flyer lasers. If you cannot operate the unit using the information described in this manual, contact SYNRAD® (+1.425.349.3500) or an authorized SYNRAD Distributor.

Lift the laser only by the mounting feet or baseplate. Do not lift or support the laser by its cooling fittings.

Please reference the Quick Start Guide for unpacking, mounting, and connecting.

Failure to properly package the laser using SYNRAD shipping box and foam/cardboard inserts as shown in Packaging Instructions may void the warranty. Customers may incur additional repair charges due to shipping damage caused by improper packaging.

Before beginning any maintenance or inspections of your FH Flyer laser, be sure to complete-ly disable the laser by disconnecting the DC Power cable (or cables) from the rear of the laser.

***Caution***
**Possible Equipment Damage**

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

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

***Warning***
**Serious personal injury**

**Remote interlock faults are not latched on OEM lasers. Clearing the fault condition re-enables the RDY indicator and the laser will fire immediately provided the SHT indicator is lit and a PWM Command signal is applied.**
**Because exposure to $CO_2$ laser radiation in the (9-11) µm range can inflict severe corneal injuries and seriously burn human tissue, the OEM or System Integrator must ensure that appropriate safeguards are in place to prevent unintended lasing.**

# Warranty information

This is to certify that FH Series Flyer 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 Flyer 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 Flyer 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 Flyer 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.

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| web: | www.synrad.com |
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# EU headquarters

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# getting started

# 1

Use information in this chapter to prepare your FH Series Flyer marking head for operation. The order of information presented in this section is the same as the order of tasks that you need to perform. The best way to get Flyer ready for operation is to start at Inventory and work your way through Configuration.

This chapter contains the following information:

- Introduction – explains the evolution of Flyer, illustrates the basic marking setup, and describes Flyer's marking and control features.
- Unpacking – provides important information about unpacking your FH Series Flyer marking head.
- Inventory – describes the components shipped with your FH Series Flyer marking head.
- Mounting – describes how to mount Flyer to your SYNRAD laser and associated components.
- Cooling – lists situations that may require you to externally cool your FH Flyer head.
- Connecting – explains how to connect power, control, communication, and I/O cabling.
- Configuration – explains how to setup and configure Flyer and WinMark Pro v6 for marking via USB or Ethernet connections.

Note: If you are installing an FH Series Flyer head to operate in Tracking mode, please perform the tasks described in the Getting Started and Operation chapters before proceeding to the Tracking chapter.

# getting started

## Introduction

The Introduction section includes subsections:

- Basic marking setup
- FH Flyer features
- Control modes

## Basic marking setup

The FH Flyer marking head is SYNRAD's third generation marking product that is evolved from years of experience with FH Index, Tracker, and Smart heads as well as our SH and DH Series marking heads many of which are still in use today at customer sites throughout the world. Flyer is capable of marking parts in stationary applications or can dynamically mark moving parts "on-the-fly" at line speeds in excess of 400 feet per minute. A typical stationary FH Flyer installation is shown in Figure 1-1:

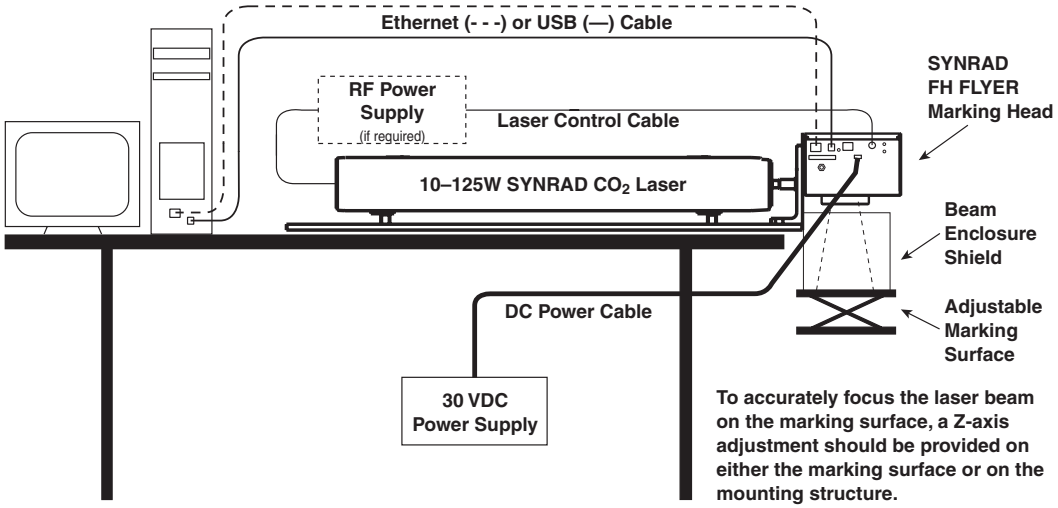


Figure 1-1 Typical FH Flyer static marking setup

The following components shown in Figure 1-1 are available from SYNRAD:

- SYNRAD FH Series Flyer marking head w/ SYNRAD $CO_2$ laser (10 W–125 W)
- FLMK mounting kit (Mounting Rail/L-bracket assembly)
- 30 VDC power supply
- SYNRAD's WinMark Pro v6 Laser Marking Software

You will need to supply the following items to complete the installation:

- A computer running Windows® 7, Vista, XP, or 2000 with two open USB ports
- Beam enclosure shield around the work area
- A marking surface with an adjustable Z-axis

# Introduction

## FH Flyer features

FH Series Flyer marking heads incorporate the latest DSP-based optical scanner technology that combines speed with precise position resolution. FH Flyer can achieve commanded mark velocities up to 300 inches per second (7,620 mm/s) across the field of a 370 mm focusing lens. This same technology allows Flyer to maintain a position resolution of less than 3 microns (<0.0001") across the field of an 80 mm lens. In conjunction with WinMark Pro v6 software, FH Flyer marking heads include the following features:

- Static (Index) and dynamic (Tracking) operation in a single marking head
- Maximum mark speeds up to 450 characters per second*
- Easily integrates with any SYNRAD $CO_2$ laser in the range of 10 W to 125 W
- Isolated USB communication port eliminates need for PC-based interface card
- Ethernet port provides access and control from remote server or network
- Modbus/IP protocol for interaction with PLCs or other MODBUS network devices
- Radial marking, around objects, and banner tracking, where mark length exceeds lens field dimensions
- Additional I/O points—8 inputs, 8 outputs, plus fully-isolated 15 VDC I/O power source
- New I/O voltage levels—5 V to 24 VDC—to accommodate industry standard interfaces
- Low pressure gas purge port reduces risk of contamination of internal
- CE compliant and meets WEEE/RoHS requirements

* Based on 3 mm high characters and a 200 mm lens

## Control modes

### WinMark control mode

When operating in WinMark control mode, WinMark Pro controls Flyer through a USB or Ethernet connection. WinMark Pro asserts normal control of marking operations—initiating a mark manually (using the Mark button or F1 key) or automatically (by an input signal) causes WinMark to stream vector data to the head where it is converted to microvector data and marked in real-time. Flyer responds by sending cycle time and mark progress data back to WinMark Pro where it is displayed in the Launcher window.

### Stand-alone mode

Stand-alone operation (or FH Smart emulation mode) means that mark files are downloaded to Flyer's Filestore before a mark session begins so it is not necessary to transmit vector data to Flyer during the mark. In stand-alone mode, Flyer can operate autonomously—communicating to automation equipment using discrete I/O signals—with no connection to the WinMark Pro computer. In situations where it is desirable to monitor mark session progress, a USB or Ethernet connection to WinMark Pro allows you to monitor cycle time and mark progress information.

### Stand-alone Master Control File mode

Stand-alone Master Control File operation is a specialized subset of stand-alone operation where Flyer loads a master file on boot-up. This Master Control File (MCF) is read once, only on boot-up, and configures Flyer to mark multiple files (previously stored in the Filestore or on a network share) in a user-controlled sequence determined by input bit status. If required, you can monitor cycle time and mark progress information from WinMark Pro through a USB or Ethernet connection.

# getting started

## Unpacking

The Unpacking section includes subsections:

- Incoming inspection
- Packaging guidelines

## Incoming inspection

Upon arrival, inspect all shipping containers for signs of damage. If you discover shipping damage, document the damage (photographically if possible), and then immediately notify the shipping carrier and SYNRAD, Inc. The shipping carrier is responsible for any damage that occurs during transportation from SYNRAD, Inc. to your receiving dock.

## Packaging guidelines

- To prevent equipment damage or loss of small components, use care when removing packaging materials.
- After unpacking, review the Inventory section and verify that all components are on hand.
- Save all shipping containers and packaging materials, including covers and plugs. Use these specialized packing materials when shipping the marking head to another location.
- When packaging a marking head for shipment, be sure to remove all accessory items not originally attached to the head.
- Place the red plastic expander cover over the input beam expander and place the red plastic lens cover over the focusing lens. These covers help prevent damage to expander and focusing optics.
- When shipping the head without a focusing lens attached, remove the anodized metal disc from inside the red plastic lens cover and fasten it over the lens opening using the three lens mounting screws. This keeps the optical scanner mirrors from being damaged.
- Refer to the Packaging instructions drawings in the Technical Reference chapter for details on packaging the Flyer head using SYNRAD-supplied shipping materials.

## Inventory

The Inventory section includes subsections:

- FH Flyer marking head
- FLMK mounting kit
- Laser

Your FH Series Flyer 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 the Flyer marking head, a SYNRAD $CO_2$ laser, a mounting rail, and an L-bracket. These components are designed so that when assembled as a package, the Flyer marking head is precisely aligned to the laser without the need for time-consuming alignment procedures. Figure 1-2 illustrates all the components (except laser) shipped with a complete marking package. If you ordered a SYNRAD 48 Series 10 W (FLMK-1A) or 25 W (FLMK-2A) fan-cooled marker, it is shipped completely assembled—ready to use out of the box after marking power and control connections.

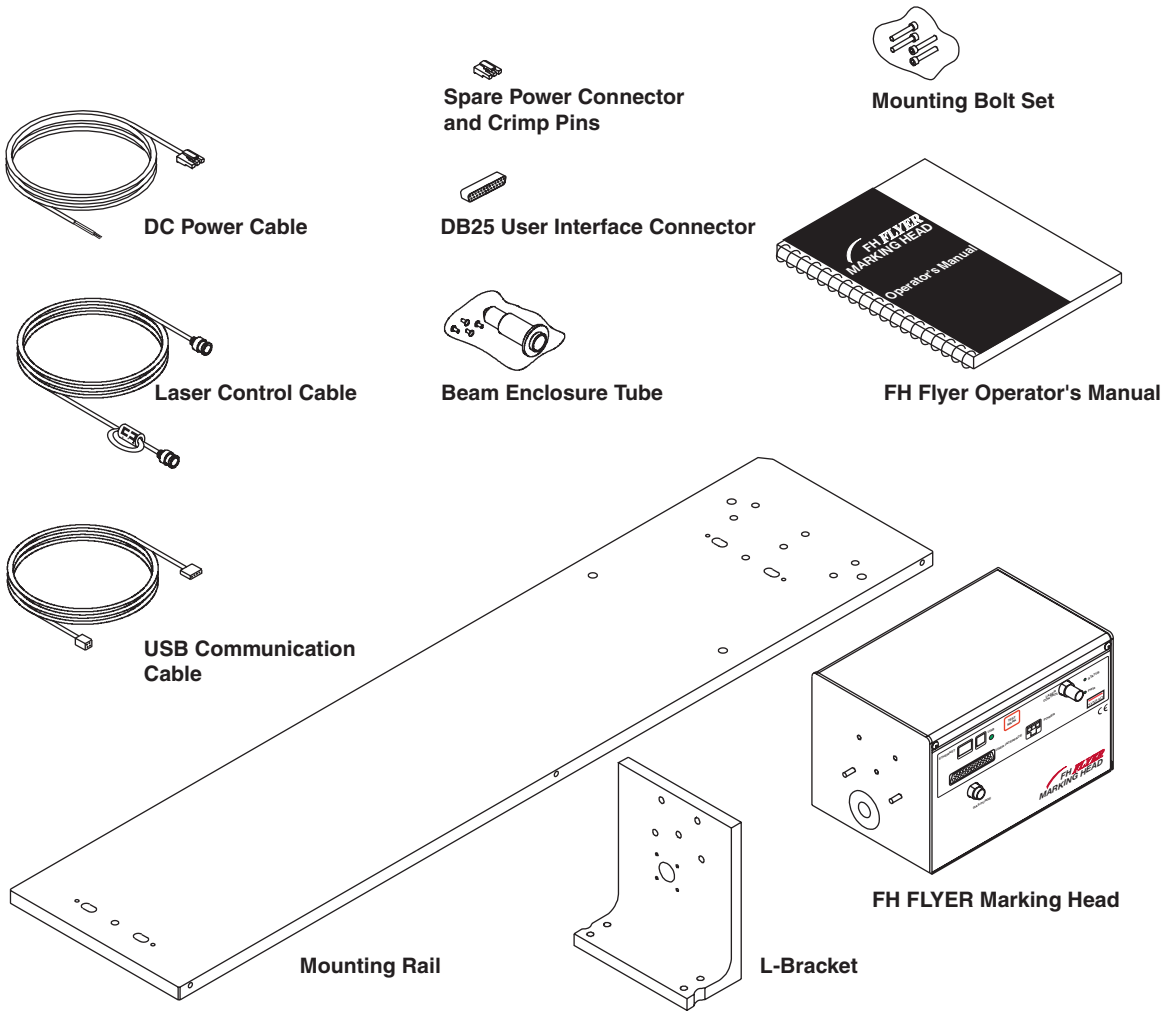


Figure 1-2 FH Flyer shipping kit contents

# getting started

## Inventory

### FH Flyer marking head

Table 1-1 Shipping kit contents

| Shipping Box Contents | Qty |
|---|---|
| SYNRAD FH Flyer Marking Head | 1 |
| FH Flyer Operator's Manual | 1 |
| DC Power Cable | 1 |
| Laser Control Cable | 1 |
| DB-25 User Interface Connector | 1 |
| USB Communication Cable | 1 |
| Spare Power Connector w/ Pins | 1 |
| Final Test Report (not shown) | 1 |

## Contents description

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

SYNRAD FH Flyer marking head – marks a variety of products and materials in Index or Tracking mode.

FH Flyer Operator's Manual – provides setup, operation, and maintenance information.

DC Power Cable – connects power from your 30 VDC power supply to the Flyer marking head.

Laser Control Cable – send PWM Command signals generated by Flyer to the laser.

DB-25 User Interface Connector – allows you to connect I/O field wiring directly to the Flyer head.

USB Communication Cable – completes the USB communications path between your computer and the Flyer head.

Spare Power Connector w/ Crimp Pins – allows you to fabricate a custom length DC Power cable.

Final Test Report (not shown) – contains data collected during the FH Flyer head's final pre-shipment tests including the actual measured working distance of the focusing lens.

# Inventory

## *FLMK mounting kit

Table 1-2 Mounting kit contents

| Mounting Kit Contents | Qty |
|---|---|
| Mounting Rail | 1 |
| L-Bracket | 1 |
| Beam Enclosure Tube | 1 |
| Mounting Bolt Package | 1 |

### Contents description

A description of each item listed in Table 1-2 follows:

Mounting Rail – serves as a mounting base for the FH Flyer head, L-bracket, and your SYNRAD laser.

L-bracket – serves as a mount for the Flyer head. When used in conjunction with the appropriate Mounting Rail and laser, the L-bracket maintains the precise alignment required between the head and laser.

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

Mounting Bolt Package – contains seven 1/4–20 × 3/4" socket head capscrews for fastening the L-bracket and Flyer head to the Mounting Rail.

## *Laser

SYNRAD sealed $CO_2$ lasers are available in powers ranging from 10–125 watts for marking head applications. Models appropriate for marking applications include 48 Series 10, 25 and 50 W lasers; Evolution™ Series 100 and 125 W lasers; and the new Firestar® Series 30, 40, 60, 70, 80, and 100 W lasers.

Evolution 100/125 W and Firestar t-Series laser shipments include a second box containing the external RF power supply and associated laser accessories.

* when ordered

# getting started

## Mounting

The Mounting section includes subsections:

- Mounting guidelines
- Mounting Rail
- L-bracket
- FH Flyer marking head
- Laser

## Mounting guidelines

Before mounting your FH Series Flyer marking head to the appropriate Mounting Rail, please ensure the following guidelines are met:

- When replacing an FH Index/Tracker head with FH Flyer, mount your Flyer head to a Flyer (clear anodized aluminum) L-bracket. If Flyer is mounted to a standard FH (black anodized) L-bracket, then the center of Flyer's beam exit is moved 2.54 mm (0.10") away from the center of the FH Index/Tracker mark field in the –X direction (to your right when facing Flyer's membrane panel).
- Mount the marking head so that the distance from the lens to the mark surface (the Working Distance) matches the distance specified in Flyer's Final Test Report. A Z-axis adjustment for either the marking surface or the mounting platform is highly recommended.
- Surround the beam path around the marking area with a beam enclosure shield to confine any reflected laser radiation.
- To prevent damage to your Flyer head when using a custom-built mounting bracket, verify that the 1/4–20 UNC mounting screws do not extend further than 0.30" (7.6 mm) into the Flyer head.
- Flyer's built-in heat sink includes four threaded holes for attaching a cooling fan. Allow room for fan clearance if there is a possibility that a cooling fan is required in your marking installation. See the Auxiliary cooling fan section for additional details.
- If you are designing a non-standard mounting configuration (without a SYNRAD Mounting Rail or L-bracket), carefully review the material in Appendix C before proceeding.

SYNRAD's integrated component design eliminates the need for Flyer-to-laser alignment. To mount your FH Series Flyer head simply follow the steps listed in each section below.

## Mounting Rail

Refer to Figure 1-3 and verify that the bevel machined on one edge of the Mounting Rail is properly oriented as shown in the drawing. Once the beveled edge is positioned as shown, securely fasten the Mounting Rail to a rigid structure. You must affix the Mounting Rail so that the bottom of the marking head housing is parallel to the part marking surface.

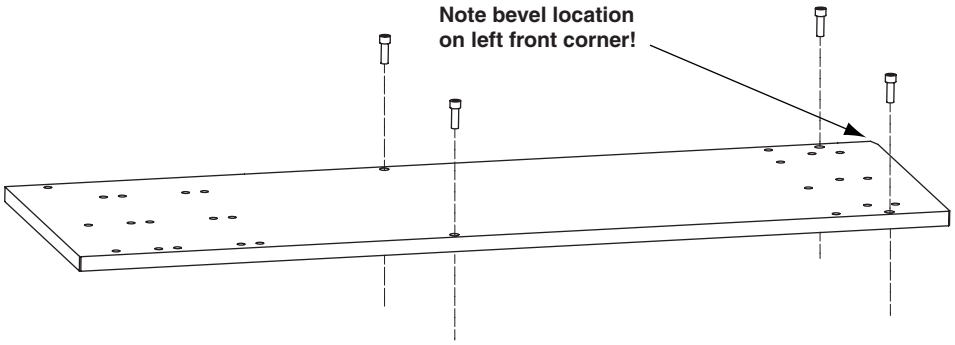


Figure 1-3 Installing the Mounting Rail

## L-bracket

Note: Mount your Flyer head to a Flyer (clear anodized) L-bracket. If Flyer is mounted to an existing FH (black anodized) L-bracket, the center of Flyer's beam exit is shifted 0.10" (2.54 mm) from the center of the FH Index/Tracker mark field in the –X direction (to your right when facing Flyer's membrane panel).

The FH Flyer 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, refer to Figure 1-4 and perform the following steps:

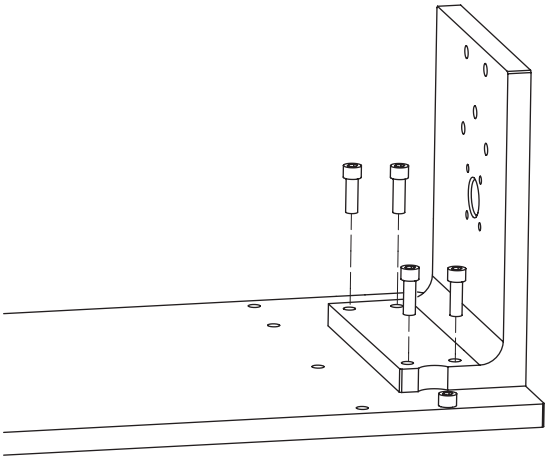

Figure 1-4 Mounting the L-bracket

1. Orient the L-bracket as shown and 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.

# Mounting

## FH Flyer marking head

To mount your FH Flyer marking head to the L-bracket, refer to Figure 1-5 and perform the following steps:

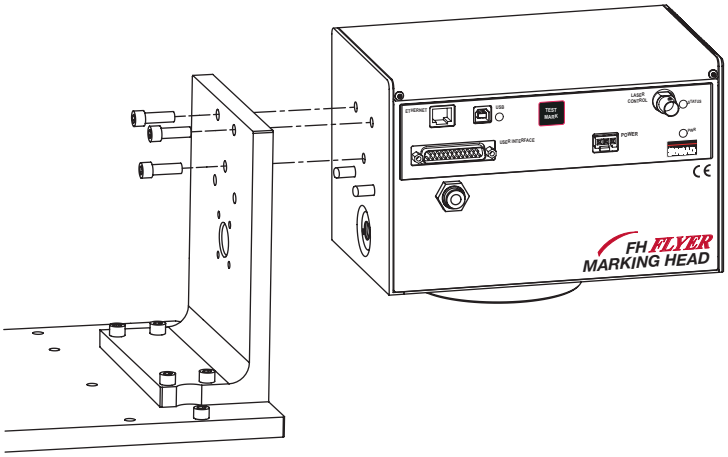


Figure 1-5 Mounting the Flyer head

1. Remove the telescope optics cover from the rear (beam input end) of the Flyer head.
2. Place the FH Flyer 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 Flyer head.
4. Fasten the Beam Enclosure Tube to the L-bracket using four 8–32 × 1/4" button head socket screws as shown in Figure 1-6. Tighten the screws just enough to hold the Beam Enclosure Tube in position; this allows the tube some flexibility to align with the bevel on the laser faceplate in the next step.

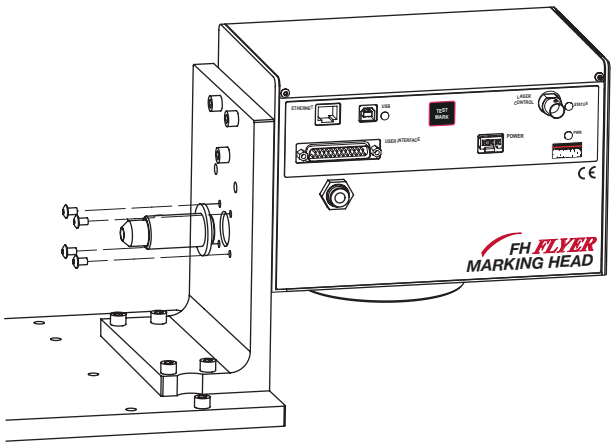


Figure 1-6 Installing the Beam Enclosure Tube

## Laser

To mount the laser, refer to Figure 1-7 and perform the following steps:

Note: The laser's mounting feet are precisely aligned at the factory to ensure alignment between the FH Flyer head and the Mounting Rail. Do not loosen, adjust, or remove the laser's mounting feet!

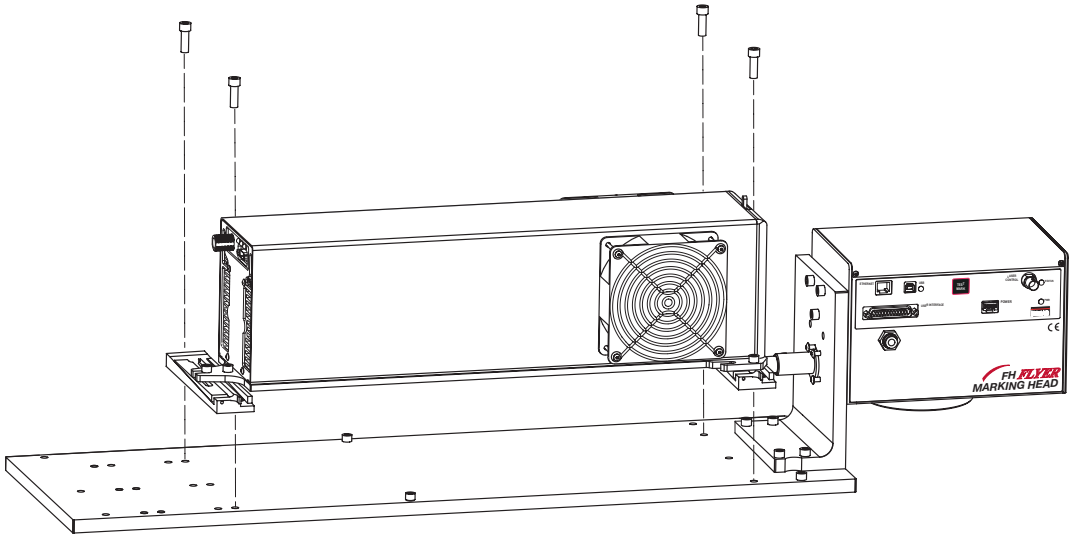


Figure 1-7 Mounting the laser

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 mounting diagrams in the Technical Reference chapter. A Firestar t60 laser is shown in Figure 1-7.
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 × 1 5/8", 1 3/4", or 2" SHCS (depending on mounting foot height).
4. Verify that the beveled end of the Beam Enclosure Tube is seated in the laser's beveled aperture opening and then tighten the four button socket screws that fasten the tube to the L-bracket.
5. Connect water, power, and control hookups according to instructions in the laser's Operator's Manual.

# getting started

## Cooling

If you are currently cooling your FH Series Index or Tracker marking head, you should continue to cool FH Flyer in the same manner. However, please note that Flyer's heat load is concentrated on the front end of the head—at the finned heat sink end instead of the L-bracket (input) end.

You must add external cooling if the following conditions exist: (1) the front heat sink has less than 1.0" (25.4 mm) of free air space between the head and any enclosure or surface, or (2) the head is oriented such that the front heat sink is pointing downward or in any other non-standard orientation, or (3) the calculated optical scanner temperatures are higher than 50 °C (see Appendix A).

Note: Appendix A contains a detailed discussion on factors that influence head temperature and an equation to calculate an approximate internal temperature for your marking situation. This section also provides information about mounting an external cooling fan or cooling ductwork to Flyer's heat sink.

You can monitor Flyer head temperature in real-time during operation in your facility. To do this, click the Help menu in WinMark Pro, and then click About Synrad WinMark… . The About Synrad WinMark… dialog box displays internal air temperature near power amplifier and CPU components along with a color-coded Status indicator. If the Status indicator turns from green to yellow (indicating air temperatures at or above 65 °C near the power amplifiers), then you should consider adding an external cooling fan. FH Flyer will stop marking—when the Status indicator turns from yellow to red—if ambient air temperature reaches 65 °C (measured near the CPU). If this happens, marking will halt and you must cool the head. Marking is not enabled until ambient CPU air temperature drops below 60 °C.

# Connecting

The Connecting section includes subsections:

- DC Power cable
- Laser Control cable
- USB Communication cable
- DB-25 User Interface connector
- Gas Purge port

## DC Power cable

FH Flyer requires a +30 VDC, 4-ampere power supply for operation. If the laser uses a +30 VDC power supply and has 120 watts of excess capacity, you can use the same supply to power Flyer. To connect the DC Power cable between Flyer and your 30 V source, refer to Figure 1-8 and perform the following steps:

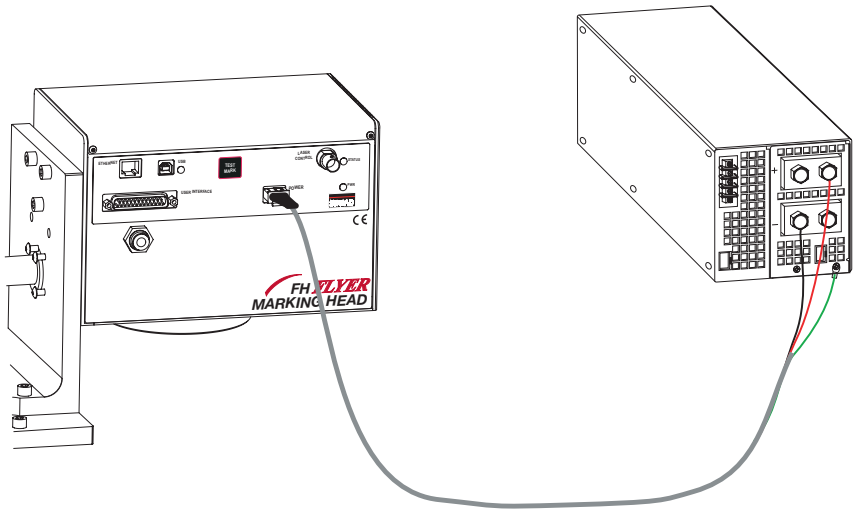


Figure 1-8 Connecting the DC Power cable

1. Locate the DC Power cable in the ship kit. It is manufactured with #18 AWG wire and measures 6 feet (1.8 m) long with a three-pin connector on one end and tinned conductors on the other.
2. Verify that the +30 VDC power supply is disconnected from its AC power source.
3. Connect the 3-pin connector on the end of the DC Power cable to the Power jack on the Flyer head.

| Caution<br>possible equipment damage | Do not attach or remove the DC Power cable while DC power to the FH Flyer head is energized. This "hot-plug" action causes arcing that will damage the connector pins and may damage Flyer circuitry.<br><br>Always switch AC power to the +30 VDC supply to energize or de-energize FH Flyer. |
|---|---|

## Connecting

4 Attach the DC Power cable's red wire to the positive (+) terminal on the +30 VDC power supply.

5 Attach the power cable's black wire to the negative (–) terminal on the DC supply.

6 Attach the power cable's green wire to earth ground.

| Caution<br>possible equipment damage | FH Flyer marking heads require a DC power supply voltage of +30.0 VDC ± 2.0 V. The Flyer head may not function properly 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. |
|---|---|

Note: If you require a custom length DC Power cable, a spare power connector with crimp pins for 18–24 AWG wire is included in the Accessory Kit. When wiring the spare connector, refer to Figure 1-9 below for the polarity of Flyer's Power jack (as seen when facing the Flyer head).

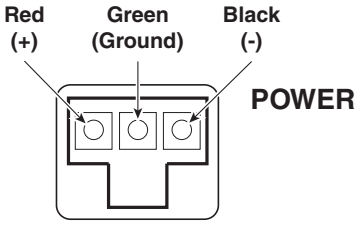


Figure 1-9 Polarity of Flyer's Power jack

## Laser Control cable

Locate the Laser Control cable in the ship kit. It is a 6 foot (1.8 m) long coaxial cable with male BNC connectors on each end. To aid electrical noise suppression, one end of the Laser Control cable is looped through a ferrite bead. Connect this end of the cable to the Flyer head (see Figure 1-10). Install the Laser Control cable between Flyer and your laser according to the laser types listed below.

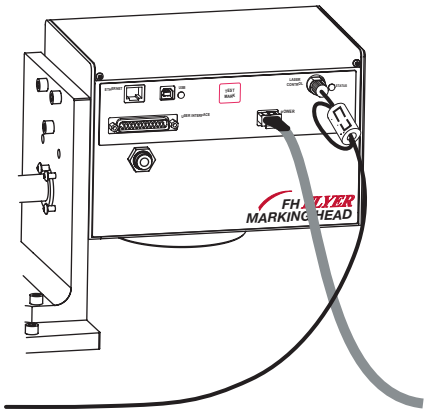

Figure 1-10 Connecting the Laser Control cable

# Connecting

## 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 side of the Flyer 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

Note: The Laser Control cable shipped with 48-5 dual-tube lasers is a 6 foot (1.8 m) long "Y" type cable with male BNC connectors on all three ends.

Attach the long "leg" of the "Y" coaxial control cable (the end with the ferrite bead) to the Laser Control BNC connector on the side of the Flyer head. Attach the short "legs" of the cable to the control inputs, labeled CTRL1 and CTRL2, located on the rear of the laser.

## Firestar® v30 laser

Attach the end of the coaxial control cable with the ferrite bead to the Laser Control BNC connector on the side of the Flyer head. Attach the other end of the cable to the BNC connector on the Quick Start Plug attached to the Interface A port located on the rear panel of the laser. If using a customer-supplied DB-9 connector, wire it so that Pin 1 (PWM Positive) is connected to the Laser Control cable's center conductor and Pin 6 (PWM Negative) is connected to the Laser Control cable's shielded outer conductor.

## Firestar® v40, f100, or ti-Series laser

Attach the end of the coaxial control cable with the ferrite bead to the Laser Control BNC connector on the side of the Flyer head. Attach the other end of the cable to the BNC connector on the Quick Start Plug attached to the User I/O port located on the rear panel of the laser. If using a customer-supplied DB-15 connector, wire it so that Pin 9 (PWM Input) is connected to the Laser Control cable's center conductor and Pin 1 (PWM Return) is connected to the Laser Control cable's shielded outer conductor.

## Firestar® t-Series laser

Attach the end of the coaxial control cable with the ferrite bead to the Laser Control BNC connector on the side of the Flyer head. Attach the other end of the cable to the BNC connector on the Quick Start Plug attached to the User I/O port located on the rear of the RF power supply. If using a customer-supplied DB-15 connector, wire it so that Pin 9 (PWM Input) is connected to the Laser Control cable's center conductor and Pin 1 (PWM Return) is connected to the Laser Control cable's shielded outer conductor.

## Evolution™ 100/125 laser

Attach the end of the coaxial control cable with the ferrite bead to the Laser Control BNC connector on the side of the Flyer 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.

# getting started

## Connecting

### USB Communication cable

Use the Universal Serial Bus (USB) cable to establish the initial communications link between Flyer and your Windows® development computer.

Important Note: Install WinMark Pro v6 before you connect Flyer to your computer's USB port and power it up. If WinMark Pro is not installed first, the Windows® operating system will arbitrarily assign a USB driver that is not compatible with Flyer's USB port protocols.

Important Note: After project development is complete, we highly recommend the use of Ethernet communications instead of USB in situations where you are operating in WinMark control mode during around-the-clock production because the Ethernet protocol is better designed to handle continuous data transfer between devices.

To connect the USB Communication cable, refer to Figure 1-11 and perform the following steps:

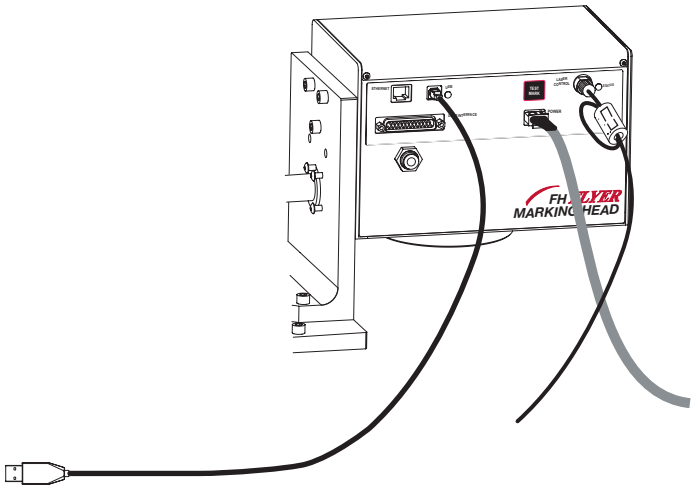

Figure 1-11 Connecting the USB Communication cable

1 Locate the USB Communication cable in the ship kit. This double-shielded cable is approximately six-feet (1.8 m) long with a USB "A" plug on one end and a USB "B" plug on the other.

Important Note: If you choose to provide your own USB cable, you must ensure that it is double-shielded. Do not use unshielded or single-shielded cables in industrial environments.

2 Plug the USB "A" connector (the flat rectangular end) into one of the USB "A" ports on your computer.

3 Plug the USB "B" connector (the square end) into the USB port on the side of the Flyer head as shown in Figure 1-11.

Note: When both USB and Ethernet cables are connected, the USB port takes precedence over the Ethernet port for control purposes.

## Connecting

The USB indicator next to the USB port on Flyer illuminates green when Flyer and the computer are both powered up and connected via the USB Communication cable. The LED turns red when WinMark Pro is communicating with Flyer.

It is not necessary to power down Flyer or your computer when connecting or disconnecting the USB Communication cable; the USB protocol allows the ability to "hot plug" USB devices.

## DB-25 User Interface connector

The DB-25 User Interface connector is only required when you are wiring input or output signals to the marking head. To install the DB-25 connector, perform the following steps:

1. Locate the DB-25 User Interface D-shell connector (female DB-25) in the ship kit.
2. Wire your I/O cabling to the DB-25 User Interface connector as required for your installation. FH Flyer's I/O interface provides eight inputs, eight outputs, and a 15 VDC, 400 mA isolated power supply. Refer to the Input/Output circuitry section in the Technical Reference chapter for detailed information about I/O connections and electrical specifications.

Important Note: In electrically noisy environments, use shielded, multi-conductor I/O cable as well as a shielded backshell when connecting field wiring to Flyer's DB-25 User Interface connector. To minimize ground loop noise, ground the cable shield at the user end only; the cable shield at the User Interface connector should be left floating.

3. After your field wiring is completed, connect the DB-25 User Interface connector to the 25-pin User Interface connection on the side of the Flyer head.

## Gas Purge port

A gas purge is highly recommended when operating the marking head in dirty or dusty environments. Purging the Flyer head creates a slight positive pressure inside the optical scanner housing that prevents vapor and debris from accumulating on internal optical surfaces.

To connect FH Flyer's low-pressure Gas Purge port, perform the steps described below:

1. Connect nitrogen or breathing-grade air to the Gas Purge port using 1/4-inch plastic tubing.
2. Push the tubing completely into the fitting and then pull the tubing lightly to ensure that it is locked into position.

Note: To disconnect gas purge tubing, first push and hold the tubing slightly into the fitting. Next, push the white fitting ring evenly towards the fitting and then pull the tubing free.

3. Set a purge pressure between 2–5 PSI. This setting provides just enough positive airflow to prevent dust or debris from entering the optical scanner/mirror area. If a flowmeter is available, set a flow rate of 30–60 standard cubic feet per hour (SCFH) at a pressure not to exceed 5 PSI.

When supplying gas to the Gas Purge port, use nitrogen or clean, dry air only; do not use any other gases for purging. See Table 1-3 for gas purity specifications.

## Connecting

Table 1-3 Gas purity specifications

| Purge Gas | Specification | |
|---|---|---|
| Nitrogen | High Purity Grade | 99.9500% purity or better |
| Air | Breathing Grade | 99.9996% purity or better |
| Air | Compressed | 99.9950% purity or better, water-free; oil filtered to 5 mg/m3 or better; particulate filtered to < 1.0 micron |

# WinMark Pro v6 configuration

The WinMark Pro v6 configuration section includes subsections:

- System requirements
- WinMark/Flyer configuration

See the WinMark Pro User Guide or v6 Release Notes for Hardlock and software installation instructions.

Important Note: Install WinMark Pro v6 before you connect Flyer to your computer's USB port and power it up. If WinMark Pro is not installed first, the Windows® operating system will arbitrarily assign a USB driver that is not compatible with Flyer's USB port protocols.

## System requirements

WinMark Pro v6 Laser Marking Software runs on Microsoft® Windows® 7, Vista, XP, and 2000 Operating Systems. WinMark Pro software has the following minimum installation and operating requirements:

- 16-MB RAM
- CD-ROM drive
- 30-MB of free hard drive space
- Two open USB ports

## WinMark/Flyer configuration

### Object Name

The label of the "Device" tab corresponds to the Object Name given to the Flyer head. Every Flyer is assigned a unique name based on the head's serial number in the form "Flyerxxxxxx"; where "xxxxxx" denotes the last six digits of the head's serial number. In facilities operating multiple Flyers, you can give each Flyer head a unique identity based on location or process. To edit the head's Object Name property, refer to Figure 1-12 and perform the following steps:

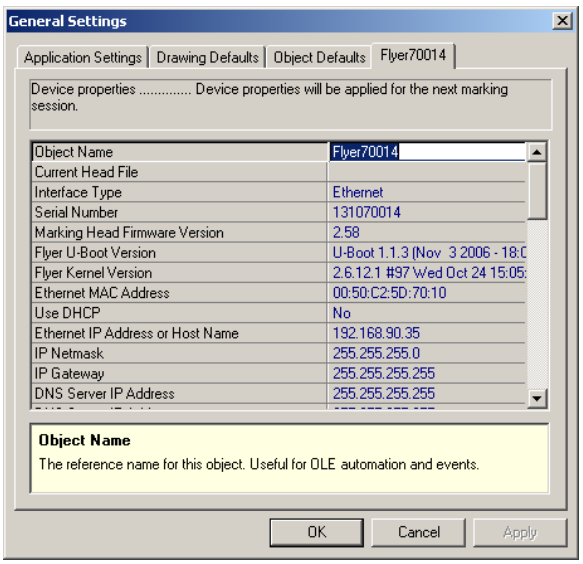


Figure 1-12 Creating a new Flyer device name

# getting started

## WinMark Pro v6 configuration

1 Power up Flyer and then open WinMark Pro.

2 On the Tools menu, select General Settings… .

3 Verify that the label on the "Device" tab, refers to the Flyer head you wish to rename.

If not, go to the Devices menu and from the drop-down menu, point to either Flyer Ethernet or Flyer USB to select the correct device from the list of recognized Flyer heads.

4 In the General Settings dialog, click the "Device" tab and then select Object Name.

Type in a descriptive name for the currently active Flyer head This new name is written into Flyer's non-volatile memory and will remain until overwritten by a new entry.

Note: An alternate method to access the "Device" tab is to right-click the Mark button.

In addition to Object Name, the "Device" tab provides other head-related setup and status properties including firmware version, IP addresses, lens selection, clearing mark, tracking parameters, and stand-alone settings.

## Mark file adjustments

Because Flyer's optical scanners exhibit a quicker response time than previous FH Series marking heads, you will need to adjust marking delays and Off Vector Velocity values in your existing mark files. Use the values listed in Table 1-4 as a starting point to obtain the best results. Some experimentation may be required to optimize mark quality. After a clean software install, the recommended property values will appear on the Marking tab when you open a New file.

Table 1-4 Recommended property values

| Property Name | Recommended Value |
|---|---|
| Pline Start Delay | 0 µs |
| Pline End Delay | 200 µs |
| Interseg Delay | 75 µs |
| Off Vector Delay | 250 µs |
| Off Vector Velocity | 200 in/sec |

The Configuration section includes subsections:

- Ethernet configuration via USB connection
- Ethernet configuration via peer-to-peer Ethernet connection
- Ethernet security
- Modbus I/P configuration

Important Note: After project development is complete, we highly recommend the use of Ethernet communications instead of USB in situations where you are operating in WinMark control mode during around-the-clock production because the Ethernet protocol is better designed to handle continuous data transfer between devices.

## Ethernet configuration via USB connection

Important Note: When both USB and Ethernet cables are connected, the USB port takes precedence over the Ethernet port for control purposes.

Before connecting Flyer to the Ethernet, you must first setup Flyer's Ethernet port. This procedure may require the assistance of your IT Department as Flyer's Ethernet settings are determined by your facility's network. To setup Flyer for the Ethernet using an isolated USB connection, perform the following steps:

1. Ensure that the proper Ethernet cable is connected between Flyer and the host computer. Your IT Department will determine if you require a straight-through or crossover cable. For additional cabling information, see the Ethernet port section in the Technical Reference chapter.
2. Connect the USB Communication cable between Flyer and the WinMark Pro host computer.
3. Power up Flyer and then open WinMark Pro v6. On the Tools menu, select General Settings… , and then click the "Device" tab.

Note: We do not recommend using Dynamic Host Configuration Protocol (DHCP). Under the DHCP scheme, Flyer's IP address and DNS name will change each time the head is turned off for a time period that exceeds the DHCP lease.

4. By default, the Use DHCP property is set to No. Contact your IT Department or Network Administrator for, and then enter, these property values: Ethernet IP Address or Host Name, IP Netmask, IP Gateway, and DNS Server IP Address. You may enter two different DNS server IP addresses.
5. If you are required to use DHCP, then set the Use DHCP property to Yes. When DHCP is enabled, Flyer automatically queries your DHCP server for a valid IP address and other network parameters.
6. Click OK and remove power from the Flyer head.
7. Disconnect the USB Communication cable from the head and re-apply DC power. Upon start-up, Flyer will communicate via the Ethernet using the protocol you have selected.

Note: If WinMark Pro does not connect to Flyer after boot-up, go to the Devices menu and click Connect To Ethernet Flyer. In the Select Ethernet IP Address dialog box, enter Flyer's Ethernet IP address (the value you entered for the Ethernet IP Address or Host Name property).

# getting started

## Ethernet configuration

### Ethernet configuration via peer-to-peer Ethernet connection

FH Flyer marking heads are now pre-configured at the factory to a fixed address of 192.168.100.100. This allows you to make a peer-to-peer Ethernet connection and eliminate the need for an isolated USB connection in order to configure Flyer's Ethernet network settings.

The procedure described below may require the assistance of your IT Department because your computer's Ethernet settings are determined by your facility's computer network. This procedure requires a connection to a computer with a static IP address that is not connected to a local network. To setup Flyer for the Ethernet using a peer-to-peer Ethernet connection, perform the steps in the following sections:

### Set your computer's static IP address

1. Disconnect the computer from your local network.
2. Turn off Dynamic Host Configuration Protocol (DHCP), if enabled, and create a static IP address for your computer.

Note: The exact steps may vary depending on your operating system.

a. From the Start menu, go to Settings and choose Network Connections.

b. Double-click on the appropriate Local Area Network (LAN).

c. Locate the LAN's Internet Protocol (TCP/IP) properties.

d. Select "Use the following IP address:" and enter the following information:

| | |
|---|---|
| IP Address: | 192.168.100.101 |
| Subnet Mask: | 255.255.255.0 |

e. Click OK to submit the changes.

### Connect to the Flyer marking head

1. Connect the Flyer head to your computer using an Ethernet crossover cable.
2. Power up the Flyer head and wait 30 seconds for the head to boot-up.
3. Open WinMark Pro and in the Devices menu, click Connect to Ethernet Flyer.
4. Enter Flyer's default Ethernet IP address, 192.168.100.100, in the dialog box and click OK.

### Configure Flyer's Ethernet network parameters

1. On the Tools menu, select General Settings… , and then click the "Device" tab.

Note: We do not recommend using Dynamic Host Configuration Protocol (DHCP). Under the DHCP scheme, Flyer's IP address and DNS name will change each time the head is turned off for a time period that exceeds the DHCP lease.

2 By default, the Use DHCP property is set to No. Contact your IT Department or Network Administrator for, and then enter, these property values: Ethernet IP Address or Host Name, IP Netmask, IP Gateway, and DNS Server IP Address. You may enter two different DNS server IP addresses.

3 If you are required to use DHCP, then set the Use DHCP property to Yes. When DHCP is enabled, Flyer automatically queries your DHCP server for a valid IP address and other network parameters.

4 Click OK and remove power from the Flyer head.

5 Reset your computer to its original Ethernet configuration.

6 Disconnect the Ethernet crossover cable from Flyer and connect the Ethernet cable required by your network—straight-through or crossover—as determined by your IT department.

7 Reapply DC power to Flyer. Upon start-up, Flyer will communicate via the Ethernet using the protocol you have selected.

Note: If WinMark Pro does not connect to Flyer after boot-up, go to the Devices menu and click Connect To Ethernet Flyer. In the Select Ethernet IP Address dialog box, enter Flyer's Ethernet IP address (the value you entered for the Ethernet IP Address or Host Name property).

## Ethernet security

The release of WinMark version 5.1.1, build 5942 and Flyer firmware 2.14 allow you to restrict the range of IP addresses that connect with the Flyer head. If there are no restrictions, Flyer will connect to any address; if one or more IP address ranges (up to ten ranges) are listed, Flyer will connect to devices within those ranges, but will refuse all other connections.

To setup Ethernet security, refer to Figure 1-13 and perform the following steps:

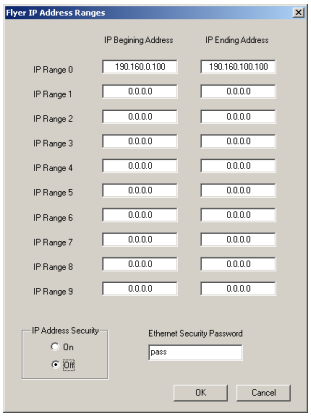


Figure 1-13 Flyer IP Address Ranges dialog

1 In WinMark Pro under the Tools menu, click Flyer IP Address Range.

2 Enter your user password. The default factory password is "pass" (without the quotes).

3 Once the Flyer IP Address Ranges dialog opens, enter a range of authorized IP addresses.

## Ethernet configuration

The beginning IP address should be "less than" the ending IP address. For example, 190.160.90.100 is considered less than 190.160.100.100. To allow access by only a single IP address, set the beginning IP address equal to the ending IP address. Clear a range of addresses by entering 0.0.0.0 for both beginning and ending addresses.

4. To enable the Ethernet security feature, click the "On" button in the IP Address Security section.
5. If you wish to change the Ethernet Security Password from the factory default, enter a new case-sensitive password.
6. Click OK when done with changes.

## Modbus I/P configuration

The SYNRAD external communications server (SynComm), available on FH Flyer marking heads and Fenix Flyer Laser Markers running firmware version 2.58 or above, provides the ability to transfer information over a network using the Modbus® protocol.

SynComm allows users to access various marking head functions via Flyer's Ethernet port using one of three different protocols: (1) Modbus/IP protocol for interaction with PLCs or other MODBUS network devices; (2) Modbus-Asynchronous protocol, a SYNRAD-modified Modbus protocol for peer-to-peer communications; and (3) SmartFH protocol, provided as legacy support for customers who have upgraded existing FH Smart systems to FH Flyer and wish to continue using custom programs written specifically for FH Smart marking heads.

Important Note: The SmartFH protocol is intended for legacy support only (for example, systems where Flyer is replacing an existing FH Smart marking head. For maximum flexibility, newly integrated systems incorporating FH Flyer marking heads should use Modbus/IP or Modbus-Asynchronous protocols.

Many of the features necessary for marking head control are performed through a user-defined function code that is part of the Modbus/IP protocol. In order to use SynComm within a Modbus/IP network, one of the user-defined function codes (65–72 and 100–110) must be available. The user-defined function code is set by the user in WinMark Pro using the Modbus User Function property on the "Device" (Flyerxxxxx) tab. The default value is 67 (0x43 hexadecimal).

For complete details on Modbus I/P, Modbus-Asynchronous, and SmartFH protocols, refer to WinMark Pro Application Note #5, located at http://www.winmark.com/products/winmark_ApplicationsNotes.html. This document describes all the information necessary to control an FH Flyer marking head using Modbus protocols including detailed descriptions of the SynComm/Modbus packet structure and all of the Flyer commands available through SynComm.

In addition, see http://winmark.com/products/winmark_activexsamples.html for sample Visual Basic and Visual C++ code illustrating how to easily incorporate Flyer's Modbus functionality into your custom marking application.

## SynComm Modbus I/P protocol guidelines

- The Flyer head MUST be set to operate in stand-alone mode (Standalone Marking property on "Device" tab set to "Yes").
- On the "Device" tab, set the Modbus User Function property to a decimal value in the range of 65–72 or 100–110. The default value is 67 (0x43 hex).

## Ethernet configuration

- On the "Device" tab, set the External Communications Server property to "Modbus".
- SynComm listens on the default Modbus port (502).
- Modbus is a big endian protocol (Modbus.h and Modbus.c contain endian conversion routines to aid in parsing data).
- Modbus is a request/reply (master/slave) protocol. FH Flyer is set to be a Modbus slave device (server).

Note: For customers who wish to write applications where the Flyer marking head is the only device on the network, use the SynComm Modbus-Asynchronous protocol. The Modbus-Asynchronous protocol provides additional features that are not part of the standard Modbus/IP protocol such as I/O events, log messages, and intermediate end of mark messages.

- All character strings must be null terminated (designated as "\0" in this document). String length routines do not include the null character as part of string length so you must account for this when parsing data.
- All file uploads and downloads to the Flyer Filestore are done through FTP via an FTP server on the marking head.

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# Laser Safety

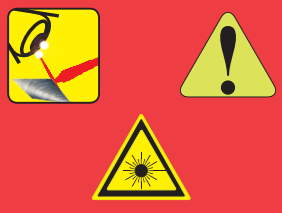
2

## Laser Safety Introduction

- Hazard Information – includes equipment label terms and hazards, please familiarize yourself with all definitions and their significance.
- General & Other Hazards – provides important information about the hazards and unsafe practices that could result in death, severe injury, or product damage.
- Disposal – information on your laser parts and/or components as they pertain to disposal.
- Additional Safety Information – describes how to find additional information about your laser.
- Compliance – explains in the subsections therein applicable and appropriate regulation information.

**Note:** Read the entire safety section. This will ensure you are familiar with the hazards and warnings prior to starting.

***Warning***
**Serious personal injury**



**This Class 4 $CO_2$ laser product emits invisible infrared laser radiation in the 9.3–10.6 µm wavelength band.**

**Because 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.**

# Laser Safety

## Hazard Information

Hazard information includes terms, symbols, and instructions 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 Class 4 laser equipment.

## Terms

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

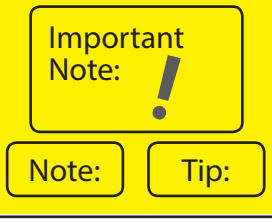
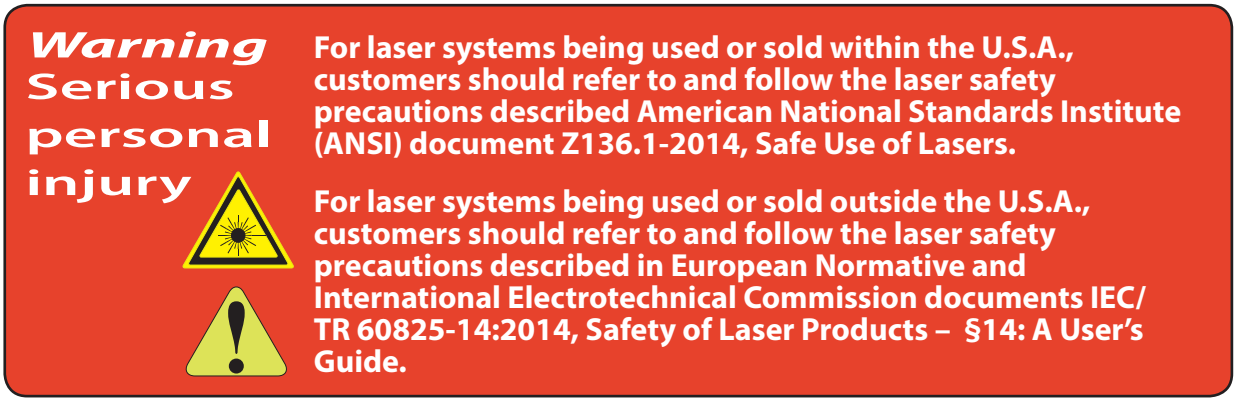
| Parameter | Description |
|---|---|
|  | WARNING: Potential & Imminent hazards which, if not avoided, could result in death or serious injury.<br><br>Alerts operator of serious dangers, hazardous radiation, hazardous voltages, vapor hazard, & reflective dangers. |
|  | DANGER: Hazards which, if not avoided, could result in minor or moderate injury.<br><br>Alerts operator of lifting dangers. |
|  | CAUTION: Potential hazards or unsafe practices which, if not avoided, may result in product damage.<br><br>Alerts operator of equipment dangers. |
|  | IMPORTANT NOTES & TIPS:<br><br>Content specific information and/or recommendations. |

Figure 2-1 Labeling terms and definitions.



# Laser Safety

## 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.

***Warning***
**Serious personal injury**

**Do not allow laser radiation to enter the eye by viewing direct or reflected laser energy.**

**$CO_2$ laser radiation can be reflected from metallic objects even though the surface is darkened. Direct or diffuse laser radiation can inflict severe corneal injuries leading to permanent eye damage or blindness. All personnel must wear eye protection suitable for $CO_2$ radiation, e.g. 9.3–10.6 µm when in the same area as an exposed laser beam.**

**Eye wear protects against scattered energy but is not intended to protect against direct viewing of the beam—never look directly into the laser output aperture or view scattered laser reflections from metallic surfaces.**

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

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

**Materials processing with a laser can generate air contaminants such as vapors, fumes, and/or particles that may be noxious, toxic, or even fatal. Safety Data Sheets (SDS) 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 Z136.1-2014, Safe Use of Lasers, §7.3.**

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

**The use of aerosol dusters containing difluoroethane causes "blooming", a condition that significantly expands and scatters the laser beam. This beam expansion can effect mode quality and/or cause laser energy to extend beyond the confines of optical elements in the system, possibly damaging acrylic safety shielding. Do not use air dusters containing difluoroethane in any area adjacent to $CO_2$ laser systems because difluoroethane persists for long time periods over wide areas.**

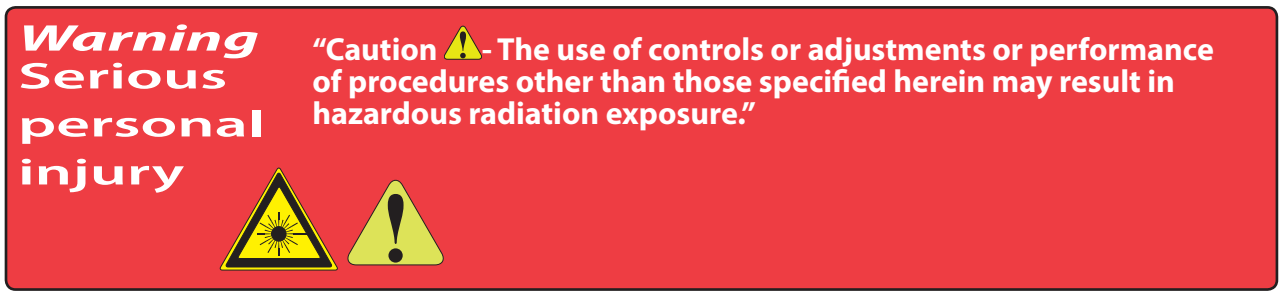
# Laser Safety

Laser should be installed and operated in manufacturing or laboratory facilities by trained personnel only. Due to the considerable risks and hazards associated with the installation and operational use of any equipment incorporating a laser, the operator must follow product warning labels and instructions to the user regarding laser safety. To prevent exposure to direct or scattered laser radiation, follow all safety precautions specified throughout this manual and exercise safe operating practices per ANSI Z136.1-2014, Safe Use of Lasers at all times when actively lasing.

Due to the specific properties of laser light, a unique set of safety hazards that differ from other light sources must be considered. Just like light, lasers can be reflected, refracted, diffracted or scattered.


Figure 2-2 Always wear safety glasses or protective goggles with side shields to reduce the risk of damage to the eyes when operating the laser.

A $CO_2$ laser is an intense energy source and will ignite most materials under the proper conditions. Never operate the laser in the presence of flammable or explosive materials, gases, liquids, or vapors.




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

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

# Laser Safety

## Disposal

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

## Other hazards

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

## Additional laser safety information

The SYNRAD web site https://www.synrad.com/resources/general_information/lasersafetyresources 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, (3) References and Sources, and (4) Assistance with Requirements.

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

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

## Laser label locations

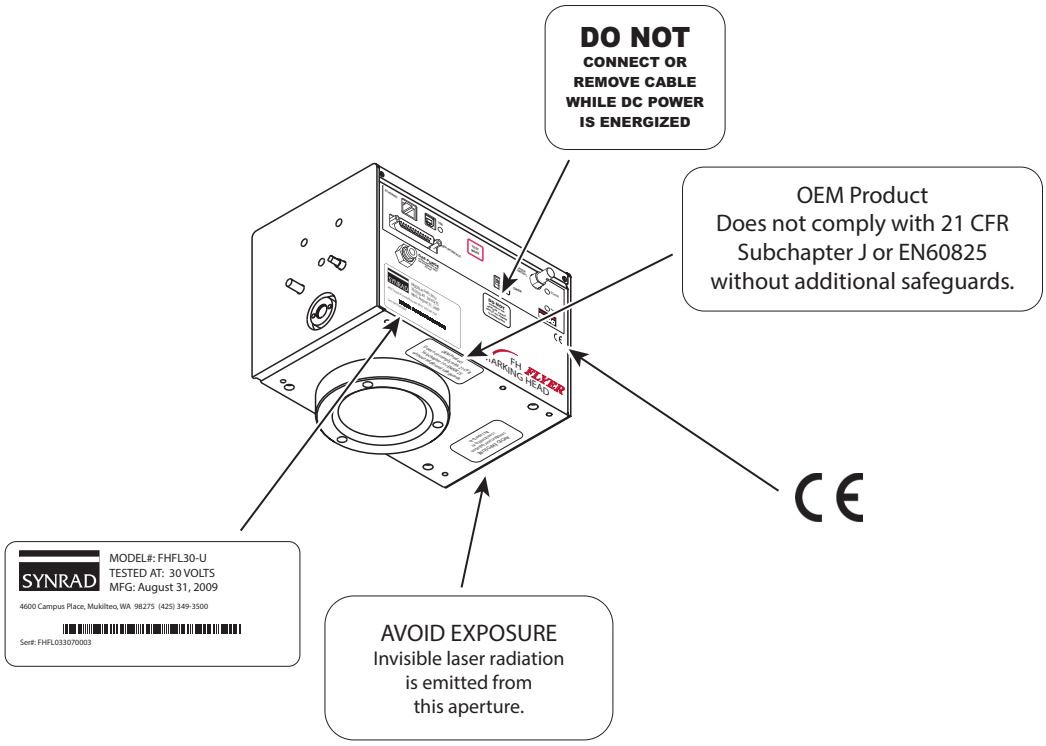



Figure 2-3 Hazard label locations.

# Agency compliance

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

SYNRAD® lasers are designed, tested, and certified to comply with certain United States (U.S.) and European Union (EU) regulations. These regulations impose product performance requirements related to electromagnetic compatibility (EMC) and product safety characteristics for industrial, scientific, and medical (ISM) equipment. The specific provisions to which systems containing laser lasers must comply are identified and described in the following paragraphs. Note that compliance to CDRH, FCC, and EU requirements depends in part on the laser version selected—Keyswitch or OEM.

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

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

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

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

Product features incorporated into the design of laser lasers to comply with CDRH requirements are integrated as panel controls or indicators, internal circuit elements, or input/output signal interfaces. Specifically, these features include a lase and laser ready indicators, remote interlock for power on/off, a laser aperture shutter switch, and a five-second delay between power on and lasing. Incorporation of certain features is dependent on the laser version (Keyswitch or OEM). See the following table for Class 4 safety features, indicating which features are available on laser lasers, the type and description of the feature, and if the feature is required by CDRH regulations.

## OEM models

Laser OEM lasers are OEM products intended for incorporation as components in laser processing systems. As supplied by SYNRAD, these lasers do not meet the requirements of 21 CFR, §§J without additional safeguards. In the U.S., the Buyer of these OEM laser components is solely responsible for the assurance that the laser processing system sold to an end user

components to ensure that they meet all applicable local laser safety requirements. In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above.

## 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 is to prevent harmful electromagnetic interference (EMI) from affecting authorized radio communication services. The FCC regulations that govern industrial, scientific, and medical (ISM) equipment are fully described in 47 CFR, §18, §§C.

SYNRAD® laser lasers have been tested and found to comply by demonstrating performance characteristics that have met or exceeded the requirements of 47 CFR, §18, Radiated and Conducted Emissions.

## FCC information to the user

**Note:** The following FCC information to the user is provided to comply with the requirements of 47 CFR, §18, §§213.

## Interference Potential

In our testing, SYNRAD has not discovered any significant electrical interference traceable to laser lasers.

## System Maintenance

Ensure that all exterior covers are properly fastened in position.

## Measures to Correct Interference

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

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

## FCC caution to the user

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

# Laser Safety

## European Union (EU) requirements

### RoHS compliance

SYNRAD® laser lasers meet the requirements of the European Parliament and Council Directive 2014/35/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment that establishes maximum concentration values for certain hazardous substances in electrical and electronic equipment.

## Laser safety standards

Under the Low Voltage Directive, 2014/35/EU, the European Norm (EN) document EN 60825-1:2014 was developed to provide laser safety guidance and includes clauses on Engineering Specifications, Labeling, Other Informational Requirements, Additional Requirements for Specific Laser Products, Classification, and Determination of the Accessible Emission Level. To develop a risk assessment plan/laser safety program for users, see IEC/TR 60825-14:2004 that includes clauses on Administrative Policies, Laser Radiation Hazards, Determining the MPE, Associated Hazards, Evaluating Risk, Control Measures, Maintenance of Safe Operation, Incident Reporting and Accident Investigation, and Medical Surveillance.

## OEM models

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

In cases where the Buyer is also the end-user of the OEM laser product, the Buyer/end-user must integrate the laser so that it complies with all applicable laser safety standards as set forth above. The following table, Class 4 safety features, summarizes laser product features, indicating the type and description of features and whether those features are required by European Union regulations.

## Electromagnetic interference standards

The European Union's Electromagnetic Compatibility (EMC) Directive, 2014/30/EU, is the sole Directive developed to address electromagnetic interference (EMI) issues in electronic equipment. In particular, the Directive calls out European Norm (EN) documents that define the emission and immunity standards for specific product categories. For lasers, EN 61000-6-4 defines radiated and conducted RF emission limits while EN 61000-6-2 defines immunity requirements for industrial environments.

# Laser Safety

SYNRAD® laser lasers have demonstrated performance characteristics that have met or exceeded the requirements of EMC Directive 2014/30/EU.

Table 2-1 Class 4 safety features.

| Feature | Location / Description | Required by: CDRH | Required by: EN60825-1 | Available on: OEM Laser |
|---|---|---|---|---|
| **Keyswitch**[1] | **Rear panel control** On/Off/Reset Keyswitch controls power to laser electronics. Key cannot be removed from switch in the "On" position. | **Yes** | **Yes** | **No** |
| **Shutter function** | **Laser control** Functions as a beam attenuator to disable RF driver/laser output when closed. | **Yes** | **Yes** | **Yes** |
| **Shutter indicator** | **Rear panel indicator (Blue)** Illuminates blue to indicate shutter is open. | **No** | **No** | **Yes** |
| **Ready indicator** | **Rear panel indicator (Yellow)** Indicates that laser has power applied and is capable of lasing. | **Yes** | **Yes** | **Yes** |
| **Lase indicator** | **Rear panel indicator (Red)** Indicates that is actively lasing. Lase LED illuminates when the duty cycle of the Command signal is long enough to produce laser output. | **No** | **No** | **Yes** |
| **Five second delay** | **circuit element** Disables RF driver/laser output for five seconds after Keyswitch is turned to "On" or remote reset/start pulse is applied when Keyswitch is in "On" position. | **Yes** | **No** | **Yes** |
| **Power fail lockout**[1] | **circuit element** Disables RF driver/laser output if input power is removed then later reapplied (AC power failure or remote interlock actuation) while Keyswitch is in "On" position. | **Yes** | **Yes** | **No** |
| **Remote Interlock** | **Rear panel connection** Disables RF driver/laser output when a remote interlock switch on an equipment door or panel is opened. | **Yes** | **Yes** | **Yes** |
| **Remote Interlock** | **Rear panel indicator (Green/Red)** Illuminates green when Remote Interlock circuitry is closed indicator Illuminates red when interlock circuitry is open. | **No** | **No** | **Yes** |
| **Over temperature** | **circuit element** Temperature shutdown occurs if temperature of the laser protection tube rises above safe operating limits. | **No** | **No** | **Yes** |
| **Temp indicator** | **Rear panel indicator (Green/Red)** Illuminates green when laser temperature is within operating limits, changing to red when thermal limits are exceeded. | **No** | **No** | **Yes** |
| **Warning labels** | **laser exterior** Labels attached to various external housing locations to warn personnel of potential laser hazards. | **Yes** | **Yes** | **Yes** |

1 Not available on laser OEM lasers

# Laser Safety

When integrating SYNRAD® laser OEM lasers, the Buyer and/or integrator of the end system is responsible for meeting all applicable Standards to obtain the CE mark. To aid this compliance process, SYNRAD testing program has demonstrated that laser lasers comply with the relevant requirements of Directive 2014/30/EU, the Electromagnetic Compatibility Directive, as summarized in the table below.

Table 2-2 European Union Directives.

| Applicable Standards / Norms | |
|---|---|
| 2004(2014)/108(30)/EU | Electromagnetic Compatibility Directive |
| 2014/35/EU | Low Voltage Directive |
| 2011/65/EU | RoHS Directive |
| EN 61010-1:2010 | Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements |
| EN 61000-6-4:2007 | Radiated Emissions Group 1, Class A |
| EN 61000-6-4:2007 | Conducted Emissions Group 1, Class A |
| EN 61000-6-2:2005 | Electrostatic Discharge Immunity |
| EN 61000-6-2:2005 | RF Electromagnetic Field Immunity |
| EN 61000-6-2:2005 | Electrical Fast Transient/Burst Immunity |
| EN 61000-6-2:2005 | Conducted RF Disturbances Immunity |

After a laser or laser processing system has met the requirements of all applicable EU Directives, the product can bear the official compliance mark of the European Union as a Declaration of Conformity.

# Declaration of Conformity

in accordance with ISO / IEC 17050-2:2004

We,

**Manufacturer's Name:** SYNRAD® A ©Novanta Company

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

Hereby declare under our sole responsibility that the following equipment:

**Product Name:** FH Flyer™ Marking Head

**Model Number:** FHFL25-U; FHFL30-U; FHFL50-U; FHFLU-U

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

**Applicable Directive(s):**

| | |
|---|---|
| 2014/30/EU | Electromagnetic Compatibility Directive |
| 2014/35/EU | Low Voltage Directive |
| 2011/65/EU | RoHS Directive |

**Applicable Standard(s):**

| | |
|---|---|
| EN 61000-6-4:2007/A1:2011 | Radiated Emissions, Group 1, Class A |
| EN 60950-1:2006/A12:2011 | Equipment Safety |
| EN 61000-6-2:2005/AC:2005 | Electrostatic Discharge Immunity & Radiated Frequency Immunity |
| EN 61000-4-6:2013/A1:2001 | Conducted Immunity |
| EN 61000-4-8:2009 | Magnetic Immunity |

*OEM FH Flyer Marking Head's do not comply with EN 60825-1:2014, *Safety of Laser Products*. Buyers of SYNRAD OEM products are solely responsible for meeting applicable Directives and Standards for CE compliance and marking.

**Corporate Officer:**

Tim Freni, Compliance Officer of SYNRAD

Date: Feb 26, 2019

**European Contact:**
Novanta Distribution (USD) GmbH
Parkring 57-59
85748 Garching bei München, Germany

CE

MADE IN THE U.S.A.
900-20976-12 Rev B

Figure 2-3 Declaration Document.

# operation

# 3

Use information in this chapter to familiarize yourself with Flyer's controls and indicators and to begin marking operation.

This chapter contains the following information:

- Controls and indicators – displays and describes FH Flyer marking head controls and indicators.
- Initial start-up – explains how to start FH Flyer and verify proper operation.

# operation

## Controls and indicators

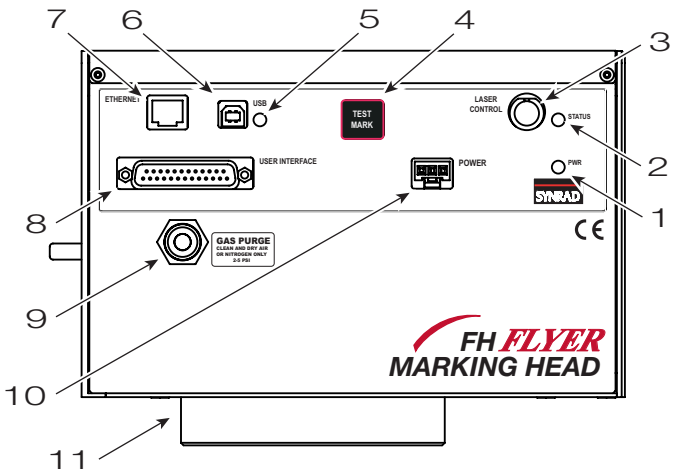



Figure 3-1 FH Flyer control panel

1 Pwr Indicator – illuminates green when +30 VDC is applied to Flyer.

2 Status Indicator – flashes green during normal boot-up, turning to solid green when Flyer is fully operational. The Status indicator flashes green at a faster rate during marking operations. Certain conditions cause the Status indicator to flash various green or red sequences. Refer to Troubleshooting in the Maintenance/Troubleshooting chapter for a table showing various indicator states.

3 Laser Control Connector – sends tickle and PWM Command signals to the laser.

4 Test Mark Pushbutton – marks a factory-installed test pattern (see Figure 2-3) using approximately 50% of the laser's rated output power at a marking velocity of 40 inches per second. The Test Mark button also fires any Custom Test Mark files loaded into memory and can reset stand-alone operation (see the Stand-alone Operation chapter for details).

5 USB Indicator – illuminates green when the FH Flyer and the computer are both powered up and connected via the USB Communication cable. The USB LED turns red when WinMark Pro is communicating with Flyer.

6 USB Port – provides a connection point for a USB interface between your computer and the Flyer head.

7 Ethernet Port – provides a connection point for an Ethernet network interface between your computer, server, or network and the Flyer head.

8 User Interface Connection – provides a male DB-25 connection to Flyer's eight inputs, eight outputs, and an isolated 15 VDC, 400 mA I/O power supply.

9 Gas Purge Port – provides a connection point for a customer-supplied purge gas. A low-pressure (2–5 PSI) gas purge creates a slight positive pressure inside the head, which lowers the risk of contamination of internal optical surfaces.

10 Power Connector – receives 30 VDC @ 4 Amps maximum from the DC power supply through the DC Power cable.

11 Focusing Lens – focuses the laser beam onto the marking surface. Each lens has a nominal working distance engraved on the bottom face of the lens mount. Refer to the Final Test Report shipped with your Flyer head for the actual measured working distance.

# Initial start-up

The Initial start-up section includes subsections:

- Test firing the laser
- Marking in WinMark control mode

## Test firing the laser

To test the setup of your FH Series Flyer marking head and laser after completing the connections described in the Getting Started chapter, perform the following steps:

1 Remove the red dust cap from Flyer's 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<br>possible equipment damage | Lens damage may occur if the measuring device contacts the surface of the focusing lens. Always measure the working distance from the bottom of the focusing lens mount. |
|---|---|

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 mark surface as shown in Figure 3-2. The nominal working distance is engraved on the bottom of the focusing lens mount. Because working distance is unique to each individual lens, consult the Final Test Report shipped with your FH Flyer head to determine the actual working distance of your lens. Refer to Table 6-1 in the Technical Reference chapter for FH Series focusing lens specifications.

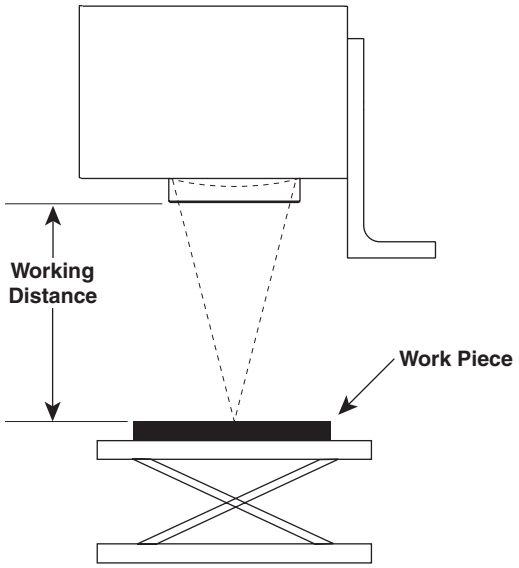



Figure 3-2 Working distance measurement

# operation

## Initial start-up

| ⚠ Danger<br>serious personal injury | This product emits invisible infrared laser radiation at the 10.6 µm $CO_2$ 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. $CO_2$ lasers emit an invisible beam that is capable of seriously burning human tissue.<br><br>Always be aware of the beam's path and always use a beam block while testing. |
|---|---|

| Caution<br>possible equipment damage | Do not attach or remove the DC Power cable while DC power to the FH Flyer head is energized. This "hot-plug" action causes arcing that will damage the connector pins and may damage Flyer circuitry.<br><br>Always switch AC power to the +30 VDC supply to energize or de-energize FH Flyer. |
|---|---|

| Caution<br>possible equipment damage | FH Flyer's operating system requires approximately 25–30 seconds to boot up. Repeatedly cycling power during the boot up sequence may cause corruption of Flyer's flash memory and operating system. |
|---|---|

4 Ensure that all personnel in the area are wearing the appropriate protective eyewear and then apply power to Flyer and the laser.

FH Flyer's operating system requires approximately 25–30 seconds to boot up. During this time, the Status lamp blinks green at a slow (2 Hz) rate. Flyer is operational when the Status LED illuminates solid green. Once Flyer is booted up and the optical scanners are activated, you may hear a high-frequency hiss from the head. This hiss is a normal result of sampling noise that is inherent in the DSP-based servo loop.

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 indicator (Evolution™ or Firestar® laser) illuminates and after a five-second delay the laser is ready to fire.

Note: During standby operation (PWR or Ready indicator on, but no Command signal applied), 5 kHz "tickle" pulses sent from Flyer 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 on and off during marking.

6 If you have a 10 W (FLMK-1A) or 25 W (FLMK-2A) fan-cooled marker, there is an adjustable rheostat inside the fan shroud. Increase cooling fan speed when operating at higher duty cycles or in locations with high ambient air temperatures.

| Caution<br>possible equipment damage | The default test pattern loaded in Test Mark memory fires the laser at 50% duty cycle when the Test Mark button is pressed. In the case of a 10-watt laser, this duty cycle corresponds to roughly 5–7 W, which is not enough power to mark anodized aluminum. If Flyer is connected to a 100-watt laser, the 50% duty cycle corresponds to 55–60 W and may ignite combustible materials. Before firing the Test Mark during initial testing, choose your marking substrate carefully based on the available laser power.<br><br>In all cases, use a beam block to prevent the beam from traveling beyond the intended work area. |
|---|---|

7 Press the Test Mark button. Flyer marks the test pattern at a power level determined by the 50% duty cycle of your laser using a default speed of 40 inches per second. The Status indicator flashes green at a fast (10 Hz) rate during marking operations.

The test pattern, shown in Figure 3-3, locates the center of the mark field to assist in part positioning. If the FH Flyer head fails to mark properly, refer to Troubleshooting in the Maintenance/Troubleshooting chapter.

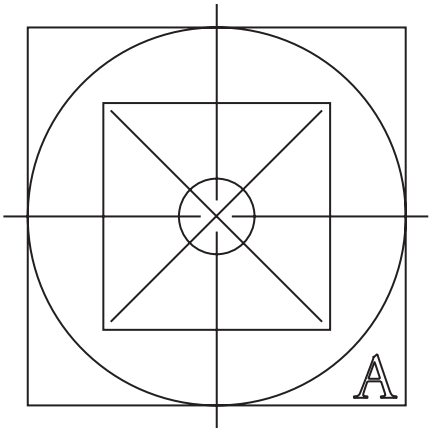



Figure 3-3 Test pattern

## Marking in WinMark control mode

Once you have verified that Flyer and the laser are connected and working properly, perform the following steps to test WinMark control of the Flyer head.

Important Note: When both USB and Ethernet cables are connected, the USB port takes precedence over the Ethernet port for control purposes.

### Verify Flyer/WinMark Pro communication

1 If you have not already done so, load WinMark Pro v6 onto your Windows® computer. Before installing WinMark, first verify that the Flyer head is powered down or that the USB cable is disconnected.

# operation

## Initial start-up

2 Power up the Flyer marking head and wait until the Status indicator is solid green.

| Caution<br>possible equipment damage | Do not attach or remove the DC Power cable while DC power to the FH Flyer head is energized. This "hot-plug" action causes arcing that will damage the connector pins and may damage Flyer circuitry.<br><br>Always switch AC power to the +30 VDC supply to energize or de-energize FH Flyer. |
|---|---|

3 Open WinMark and verify that the Mark button displays the name of the FH Flyer head you are operating (see Figure 3-4). If not, refer to Troubleshooting in the Maintenance/Troubleshooting chapter.

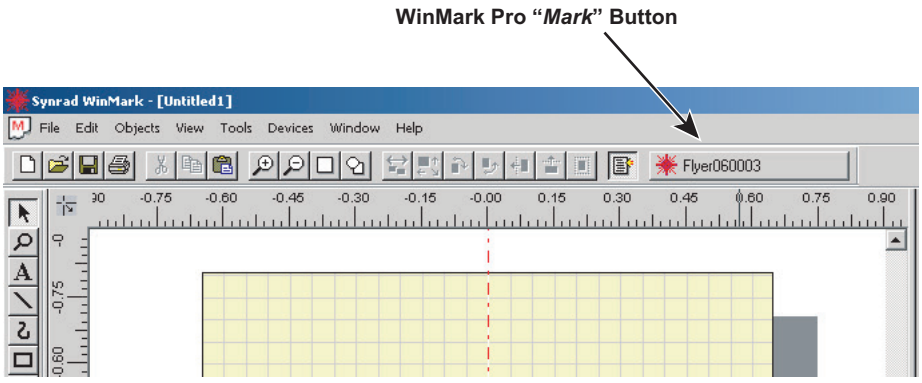



Figure 3-4 WinMark Pro's Mark button

## Create a mark file

1 Check 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 General Settings dialog box, click the "Device" tab.

c Click Lens and then click the arrow.

d In the drop-down list, select the lens currently installed on your FH Flyer head.

WinMark v6 automatically resizes the Drawing Canvas to fit the extents of the selected lens.

Note: An alternate method to access the "Device" tab is to right-click the Mark button.

2 Design and save your .mkh mark file using WinMark Pro's Drawing Editor.

## Lase the mark

1 Place a part in the field of the focusing lens.

## Initial start-up

| Caution<br>possible equipment damage | Lens damage may occur if the measuring device contacts the surface of the focusing lens. Always measure the working distance from the bottom of the focusing lens mount. |
|---|---|

2 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. Refer back to Figure 3-2.

3 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are in place.

| ⚠ Danger<br>serious personal injury | This product emits invisible infrared laser radiation at the 10.6 µm $CO_2$ 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. $CO_2$ lasers emit an invisible beam that is capable of seriously burning human tissue.<br><br>Always be aware of the beam's path and always use a beam block while testing. |
|---|---|

4 Click the Mark button, or select Mark from the File menu. After the Synrad WinMark (Launcher) dialog opens, click the Start-F1 button to begin marking.

| ⚠ Warning<br>serious personal injury | Pressing the F1 function key on the computer keyboard causes WinMark Pro to mark immediately without opening the Launcher dialog!<br><br>When using WinMark Pro, the F1 key is designated as a "quick mark" key meaning that the mark is lased immediately. To prevent injury, always ensure that all personnel in the area are wearing the appropriate protective eyewear and are physically clear of the mark area before starting a mark session. |
|---|---|

Note: When marking with FH Flyer in WinMark control mode (where the computer is sending mark data to Flyer in real-time through a USB or Ethernet connection), you must consider Ethernet latency issues when mark cycle times are very short (< 1 second) because the Ethernet protocol does not always transmit data in real-time. Occasionally, a latency period up to 200 milliseconds (ms) will occur between the time a 'start mark' signal is received and lasing begins. When this latency period becomes a significant portion of the cycle time, you should consider a USB communication connection or operate Flyer in stand-alone mode.

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# stand-alone operation

# 4

Use information in this chapter to configure your FH Series Flyer marking head to operate in "stand-alone" mode. In stand-alone mode, FH Flyer can operate independently of the marking computer.

This chapter contains the following information:

- Introduction– describes FH Flyer's control modes and lists supported mark functions.
- WinMark Pro/FH Flyer interface – illustrates the interface between WinMark Pro v6 and the FH Series Flyer head in stand-alone mode.
- Configuration – explains how to setup Flyer to operate in stand-alone marking mode.

# stand-alone operation

## Introduction

The Introduction section includes subsections:

- Stand-alone definitions
- Control modes
- Supported functions

## Stand-alone definitions

Download – A download action occurs when WinMark Pro sends data, typically a mark file, down to the Flyer marking head. Downloaded data can reside in Flyer's non-volatile flash memory or in RAM.

Filestore – FH Flyer's Filestore is the area in non-volatile flash memory where mark, data, and control files are stored. The Filestore has the capacity to hold 8-MB of data.

Network share – A network share is a location on a computer network where access permission is given to multiple users so they may work with common files. For a marking installation consisting of several FH Flyers, this scheme allows multiple Flyer heads to access common mark files in a central location.

Upload – An upload action occurs when FH Flyer sends a file, resident in the Filestore, up to a specified location on a computer or server.

## Control modes

FH Flyer marking heads, in conjunction with WinMark Pro, provides three types of operational control.

### WinMark control mode

When operating in WinMark control mode, WinMark Pro controls Flyer through a USB or Ethernet connection. WinMark Pro asserts normal control of marking operations—initiating a mark manually (using the Mark button or F1 key) or automatically (by an input signal) causes WinMark to stream vector data to the head where it is converted to microvector data and marked in real-time. Flyer responds by sending cycle time and mark progress data back to WinMark Pro where it is displayed in the Launcher window.

### Stand-alone mode

Stand-alone operation (or FH Smart emulation mode) means that mark files are downloaded to Flyer's Filestore before a mark session begins so it is not necessary to transmit vector data to Flyer during the mark. In stand-alone mode, Flyer can operate autonomously—communicating to automation equipment using discrete I/O signals—with no connection to the WinMark Pro computer. In situations where it is desirable to monitor mark session progress, a USB or Ethernet connection to WinMark Pro allows you to monitor cycle time and mark progress information. Except for starting/ending mark sessions and exiting stand-alone operation, WinMark has no other control functionality.

### Stand-alone Master Control File mode

Stand-alone Master Control File operation is a specialized subset of stand-alone operation where Flyer

# stand-alone operation

## Introduction

loads a master file on boot-up. This Master Control File (MCF) is read once, only on boot-up, and configures Flyer to mark multiple files (previously stored in the Filestore or on a network share) in a user-controlled sequence determined by input bit status. If required, you can monitor cycle time and mark progress information from WinMark Pro through a USB or Ethernet connection. Except for starting/ending mark sessions and exiting stand-alone operation, WinMark has no other control functionality.

## Supported functions

In stand-alone mode, Flyer supports many, but not all, of the functions available under WinMark control. Before developing mark files for stand-alone operation, refer to Table 4-1. It lists major categories of sup-ported features for Flyer stand-alone operation. Check the WinMark Pro web site at http://winmark.com/products/winmark_firmware.html for firmware updates that may add additional functionality.

Table 4-1 Stand-alone marking features

| Supported by Flyer Stand-alone Operation | Not Supported by Flyer Stand-alone Operation |
|---|---|
| Fonts:<br>WinMark Stroke (.syf)<br>TrueType® (.ttf) | Fonts:<br>OpenType® (.otf)<br>PostScript® (.pfb) |
| Auto Text functions:<br>Serial Number Text<br>Date Code Text (incl. custom date codes)<br>Disk File Text (Sequential)<br>Disk File Text (Fixed)<br>From Another Object | Auto Text functions:<br>Serial Port text (use Disk File Text)<br>User Entry Text |
| All Wait Digital/Set Digital automation stages | |
| All Event Builder stages using these commands:<br>AssignDate, DoPause<br>IncSerialNumber, MatchDigitalState<br>SetDigitalState, WaitDigitalState<br>ReadLineFromFile | The following Event Builder commands:<br>AskUserInput, CallDLLFunc<br>DoBeep, MarkingHeadOn<br>ReadyStatus<br>ReadFromSerialPort (use Disk File Text)<br>RestoreProperty, SaveProperty |
| 1D Barcodes<br>Code 128 – 5 subsets, Code 3 of 9<br>Extended Code 3 of 9, Interleaved Code 2 of 5 | All other WinMark Pro linear barcodes |
| All 2D Codes including UID/Composite codes | |
| All bitmap color reduction methods including Grayscale | |
| Radial marking | |
| Banner-style tracking | |
| No Cross property | |
| Spot Marking Style property | |

# stand-alone operation

## WinMark Pro/FH Flyer interface

The WinMark Pro/FH Flyer interface section includes subsections:

- Version requirements for stand-alone operation
- Stand-alone set-up
- Stand-alone Toolbar
- Filestore structure
- Fonts
- Configuring a network share

## Version requirements for stand-alone operation

FH Flyer marking heads are meant for use with WinMark Pro Laser Marking Software version v5 or v6. To verify the software build, open WinMark Pro, click the Help menu, and then choose About Synrad WinMark… . The About Synrad WinMark dialog displays the current software version and build number.

To get FH Flyer's firmware version, click Help and then choose About Synrad WinMark… . When the About Synrad WinMark dialog box opens, click the Head Info button to display the "Device" tab. Scroll down to the Marking Head Firmware Version property to view the current firmware version.

## Stand-alone set-up

When communicating with an FH Flyer marking head, enter stand-alone, or FH Smart emulation mode, from the "Device" tab (from the Tools menu, select General Settings… ). Scroll down to the Standalone Marking property, choose "Yes", and then click Apply. The stand-alone toolbar appears and Mark button color changes from red to blue. Click OK to exit the General Settings dialog.

To enter stand-alone Master Control File mode, enter stand-alone mode as described above and then locate Use Control File on the "Device" tab. Set the Use Control File property to "Yes". Click Apply and then click OK to save these settings. See the Configuration section later in this chapter for specific details about operating in stand-alone or stand-alone Master Control File mode.

Note: Although entry and exit from stand-alone mode is controlled from WinMark by the Standalone Marking property, stand-alone is a head-specific property and resides on the "Device" tab.

# stand-alone operation

## WinMark Pro/FH Flyer interface

### Stand-alone Toolbar

When WinMark Pro detects that an FH Flyer is connected and operating in stand-alone mode, several changes occur in WinMark's Drawing Editor. On the Mark button, the red laser starburst turns blue to indicate stand-alone operation is enabled. In addition, as shown in Figure 4-1, a toolbar consisting of four additional buttons appears to the right of the Mark button. These buttons are described below.

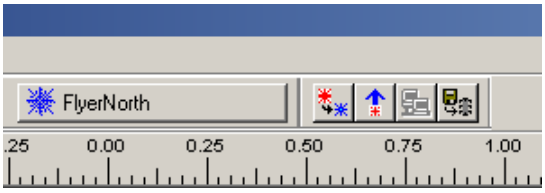


Figure 4-1 Stand-alone Toolbar

**⚠ Warning**
**serious personal injury**

Pressing the Mark Current File on Canvas button forces FH Flyer to begin marking immediately after the mark file is downloaded into RAM.

Before pressing the Mark Current File on Canvas button, ensure that all laser safety precautions described in this manual have been followed. To prevent injury, always ensure that all personnel in the area are wearing the appropriate protective eyewear and are physically clear of the mark area before starting a mark session.

### Mark Current File on Canvas

When a new file is created or opened on the Drawing Canvas, click the Mark Current File on Canvas button to save the file to FH Flyer's Filestore (to a default file named Canvas.mkh) and download the file to temporary storage (RAM), where the vector elements are converted to microvectors and immediately marked. This button is grayed out (inactive) when the Drawing Canvas is empty or when the file shown was loaded from Flyer's Filestore and has not been modified.

Important Note: This action overwrites the current Canvas.mkh file in the Filestore without warning.

Note: The WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

Tip: To view the filename of the mark file currently residing in RAM (the file that will be marked), hover your cursor over the Mark button.

# stand-alone operation

## WinMark Pro/FH Flyer interface

### Upload Current Mark File

Click the Upload Current Mark File button to upload the file currently stored in FH Flyer RAM to WinMark's Drawing Canvas. This process allows you to view and/or change file properties. If permanent modifications are made, you must resave the file to the Filestore.

### Open Network Mark File

When FH Flyer is configured for network sharing through the Ethernet port, use this button to open an .mkh mark file stored on a network server or drive. The Open Network Mark File button downloads the file to FH Flyer's temporary RAM for marking; however it does not save the file to the Filestore. This button is grayed out (inactive) if a network is not available.

### Save Current File to Filestore

Click the Save Current File to Filestore button to save the mark file displayed on the Drawing Canvas to the FH Flyer Filestore. You are prompted for a filename and can also specify a path, if one or more subfolders exist in the Filestore.

Note: The WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

## Filestore structure

FH Flyer's Filestore is a hierarchical file system in flash memory, similar to the file system on your computer. When Flyer is connected to your computer, you can view contents of the Filestore in the Flyer Files window and you have the ability to create, move, or delete files, subfolders, and folders. If the Filestore view is not shown when WinMark Pro connects to your FH Flyer head, click WinMark's View menu and then click Flyer Files.

When shipped, FH Flyer's Filestore contains only a single .dat file as shown in Figure 4-2. This particular file saves any custom date code formats that are predefined in mark files downloaded to the head.

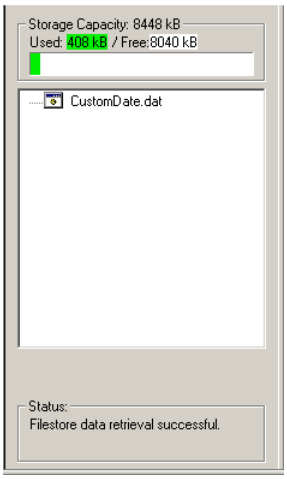


Figure 4-2 Initial stand-alone Flyer Files window

# stand-alone operation

## WinMark Pro/FH Flyer interface

Files added directly to the Filestore—those files not contained within a folder or subfolder—are said to reside in the root directory (similar to copying a file to the C:\ drive on a computer). You can create folders and subfolders as required to organize files required for your specific marking operation.

In stand-alone mode, double-clicking on a file in the Filestore loads it into Flyer RAM as the current mark file and also displays the mark file on WinMark Pro's Drawing Canvas.

A Storage Capacity message area, located at the top of the Flyer Files window, provides total file storage capacity in kilobytes (kB) and indicates filespace used and remaining free file storage space in Flyer memory.

A Status message area, located at the bottom of the window, provides information about the requested operation. When a Reformat File System or Reboot Flyer command is issued, the Status message indicates the state of the head. A "Filestore data retrieval successful" message after a format or reboot operation indicates the head is ready for operation.

As shown in Figure 4-3, an indicator appears in the Status message area during extended file operations as files are downloaded to, or uploaded from, the head. Allow Flyer to complete the requested file operation before proceeding.

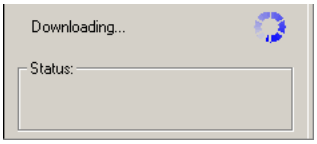


Figure 4-3 File operations indicator

### Valid file types

Although you can save any file type to the Flyer Filestore, Flyer recognizes only four file types for marking operations. These file types are: (1) mark files with an .mkh extension, (2) custom date code data files with a .dat extension, (3) TrueType® fonts with a .ttf extension, and (4) a master control file named "master.ctl". See Master Control File mode in the Configuration section for details on using a master control file.

### Saving files

When a file is open in WinMark's Drawing Editor on the Drawing Canvas, click the Save Current File to Filestore button, to save the currently active WinMark Pro mark file directly to the Filestore.

Important Note: When the Filestore contains a file with the same name as the file you are saving, the existing file in the Filestore is overwritten without warning.

Note: The WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Copying files

To copy an existing file within the Filestore, select the file and drag it to the appropriate folder or subfolder. Note that a plus (+) sign appears below the file to indicate it is being copied. Flyer's menu structure allows files with the same name as long as they are stored in a different folder or subfolder.

# stand-alone operation

## WinMark Pro/FH Flyer interface

You can also use your computer's "drag and drop" or "copy/paste" functionality to drop or paste previously created mark files, subfolders, or folders from your computer or server into the Filestore.

Although multiple files or folders can be selected and then dropped or pasted into the Flyer Filestore, you can only drag or copy individual files out of the Filestore onto your computer or server.

Important Note: When the Filestore contains a file with the same name as the file you are copying, the existing file in the Filestore is overwritten without warning.

Note: When copying files from a computer or server to the Flyer Filestore, the WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Moving files

To move an existing file within the Filestore, select the file, hold down the shift key, and drag the file to the appropriate folder or subfolder.

Important Note: When moving a file to a folder containing a file with the same name as the file you are moving, the existing file is overwritten without warning.

### Deleting files

To delete a file from the Filestore, right-click the file to select it and from the contextual menu, choose Delete File or press the Delete key on your computer's keyboard.

Important Note: The Flyer Filestore structure does not contain an "undo" feature! Make certain the file you plan to delete is no longer needed or is backed up on a computer or server.

### Adding folders

To create a folder, right-click inside the Flyer Files window and choose Make New Folder from the contextual menu. A new folder appears. To save the folder, enter a descriptive folder name. If the folder name is not changed from the default title "New Folder", no folder is created.

You can create folders that are nested inside of other folders by selecting an existing folder and then right-clicking Make New Folder.

You cannot move a folder from one location to another inside the Filestore.

### Deleting folders

To delete a folder from the Filestore, right-click the folder and choose Delete Folder from the contextual menu or press the Delete key on your computer's keyboard. The folder must be empty before deletion occurs. If not, a dialog box appears and reminds you to first delete or move files from the folder.

Figure 4-4 shows the Filestore (Flyer Files window) after several folders, subfolders, and mark files have been saved.

## WinMark Pro/FH Flyer interface

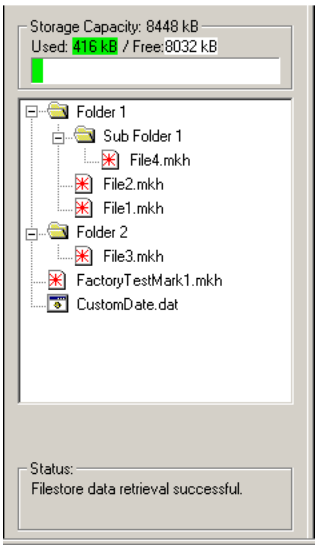


Figure 4-4 Filestore containing saved files and folders

## Right-click options

Right-clicking on a file, folder, or in the Filestore (Flyer Files window) brings up a contextual menu that allows you to perform other file-related operations.

### Right click on .mkh files

Right-clicking on an .mkh mark file provides the options shown in Figure 4-5 and described below:

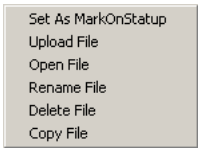


Figure 4-5 Contextual menu—.mkh mark files

#### Set As MarkOnStartup

Selecting this function changes two important properties in the FH Flyer head. First, it enables the Mark On Startup property so that FH Flyer begins marking as soon as power is applied and the head is booted up (stand-alone operation). Second, the mark file selected is the file that is marked on startup. You can also access this functionality (Mark On Startup and Startup Drawing properties) on the "Device" tab under Tools / General Settings… .

# stand-alone operation

## WinMark Pro/FH Flyer interface

### Upload File

Uploads the selected mark file from the FH Flyer Filestore to a computer location or server using the Save As dialog box.

### Open File

Opens the selected mark file in WinMark Pro's Drawing Editor and also loads the file into RAM as the current active file for marking.

### Rename File

Renames the selected mark file.

### Delete File

Deletes the selected mark file from the Filestore.

Important Note: You are not prompted to review this action. The file is deleted and is not recoverable.

### Copy File

Copies the selected mark file to the computer's Clipboard. You can then Paste this file into another folder in the Filestore or Paste it to a location on a computer or server.

## Right click on other files

Right-clicking on other file types provides the options shown in Figure 4-6 and described below:

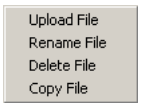


Figure 4-6 Contextual menu—other files

### Upload File

Uploads the selected file from the Flyer Filestore to a computer location or server using the Save As dialog box.

### Rename File

Renames the selected file.

### Delete File

Deletes the selected file from the Filestore.

Important Note: You are not prompted to review this action. The file is deleted and is not recoverable.

### Copy File

Copies the selected file to the computer's Clipboard. You can then Paste this file into another folder in the Filestore or Paste it to a location on a computer or server.

## Right click on folder

Right-clicking on a folder provides the options shown in Figure 4-7 and described below:

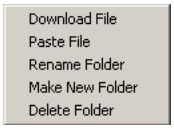


Figure 4-7 Contextual menu—folders

### Download File

Downloads a file from a computer or server to the selected folder in the Filestore using the Open dialog box. After the file is copied to the selected folder, the folder is opened and its contents are displayed.

Note: When copying files from a computer or server to Flyer's Filestore, the WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Paste File

Pastes a file from the computer's Clipboard to the selected folder in the Filestore. This choice is grayed out (inactive) if the computer's Clipboard does not contain a previously copied file.

Note: When copying files from a computer or server to the Flyer Filestore, the WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Rename Folder

Renames the selected folder.

# stand-alone operation

## WinMark Pro/FH Flyer interface

### Make New Folder

Creates a new subfolder within the selected folder. After creation, the subfolder is opened and its contents are displayed.

### Delete Folder

Deletes the selected folder from the Filestore. The folder must be empty before it can be deleted. If other files or folders are present, you are prompted to delete (or move) them before the selected folder can be deleted.

Important Note: You are not prompted to review this action. The folder is deleted (if empty) and is not recoverable.

## Right click in Filestore

Right-clicking in the Filestore (Flyer Files window) provides the options shown in Figure 4-8 and described below:

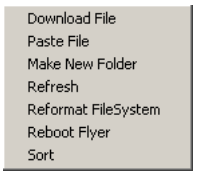


Figure 4-8 Contextual menu—Filestore

### Download File

Downloads a file from a computer or server to the root directory in the Filestore using the Open dialog box.

Note: When copying files from a computer or server to the FH Flyer Filestore, the WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Paste File

Pastes a file from the computer's Clipboard to the selected folder in the Filestore. This choice is grayed out (inactive) if the Clipboard does not contain a previously copied file.

Note: When copying files from a computer or server to the Flyer Filestore, the WinMark Pro Hardlock (USB or parallel port type) must be installed on the computer running WinMark before this operation is allowed to proceed.

### Make New Folder

Creates a new folder, or subfolder, within the Filestore.

## WinMark Pro/FH Flyer interface

### Refresh

Refreshes your view of files and folders within the Flyer Filestore.

### Reformat File System

Reformats (erases) all data—files and folders—in the Filestore. Before reformatting begins, a dialog warns that this is a permanent erasure and asks you to confirm (click OK) before proceeding. After reformatting the Filestore, which could take several minutes, the FH Flyer head performs a soft boot. Check the status message displayed at the bottom of the Flyer Files window for operational status before continuing file or marking operations.

### Reboot Flyer

Performs a soft boot of FH Flyer's operating system. This process will take 30 seconds to complete; check the status message displayed at the bottom of the Flyer Files window for operational status before continuing file or marking operations.

### Sort

Rearranges all Filestore files and folders alphabetically. Files contained within folders or subfolders are also sorted and listed alphabetically.

# Fonts

The release of Flyer firmware version 2.06 adds the ability to render TrueType® (.ttf) fonts in stand-alone mode and store those fonts in the Flyer Filestore or in a network share folder. To ensure the best marking performance, TrueType fonts are cached in Flyer RAM each time Flyer is powered up or rebooted. OpenType® (.otf) and PostScript® (.pfb) fonts cannot be used in stand-alone marking applications.

If the font specified in the mark file is not loaded in the cache, an error message is generated in the Main Message Log and the text object is marked using the Simple stroke font. For this reason, you should always test mark files before beginning a production run to ensure proper marking results.

## Loading font files into the Flyer Filestore

To load TrueType (.ttf) font files into the Flyer Filestore, perform the following steps:

1. Connect to your Flyer head using WinMark Pro.
2. Right click in the Filestore and choose Make New Folder from the contextual menu.
3. Name the new folder "Flyer Fonts" (without the quote symbols). The folder name is case-sensitive and must be entered exactly as shown.
4. Open Windows Explorer and navigate to the C:\WINDOWS\Fonts folder.
5. Highlight the font you wish to load into the Flyer Filestore.
6. From the Edit menu, click Copy.

# stand-alone operation

## WinMark Pro/FH Flyer interface

7 Go to WinMark Pro and right-click the Flyer Fonts folder.

8 From the contextual menu, click Paste File. The font file you selected is copied to the Flyer Fonts folder in the Flyer Filestore.

### Filestore fonts guidelines

- A maximum of 32 .ttf files can be stored in the Flyer Fonts folder.
- Load only the specific fonts required for your mark files. For example, the Arial® typeface family includes Regular Arial (Arial.ttf), Arial Italic (Ariali.ttf), Arial Bold (Arialbd.ttf), and Arial Bold Italic (Arialbi.ttf). These four files consume 1116 KB of memory. If your mark files use the Arial Bold font, load only the Arialbd.ttf font file because it requires less memory space (only 344 KB).
- When your mark file specifies "bold" or "italic", you cannot use WinMark Pro's Text Bold or Text Italics properties. You must copy the font's bold or italic typeface to the Filestore.
- The Filestore has a maximum capacity of 8 MB for all files. Some fonts like Arial Unicode MS and Batang® are too large to store in the Filestore and should be stored on a network share instead.
- There is no standard convention for naming TrueType fonts. You must carefully verify that the fonts used in your WinMark Pro .mkh mark files are the same as the fonts loaded into the Flyer Filestore.

## Loading font files onto a network share

To load TrueType (.ttf) font files into a folder on a network share, perform the following steps:

1 On your network share drive, create a new folder and name it "Flyer Fonts" (without the quote symbols). The folder name is case-sensitive and must be entered exactly as shown.

2 In Windows Explorer, navigate to the C:\WINDOWS\Fonts folder.

3 Highlight the font you wish to load into the Flyer Filestore.

4 From the Edit menu, click Copy.

5 Right-click the Flyer Fonts folder on your network share and choose Paste.

6 When you have finished adding fonts, you must refresh the Flyer font cache. To do this, right-click in the Flyer Filestore window and select Refresh from the contextual menu.

### Network share fonts guidelines

- 100 .ttf files, maximum, can be stored in the Flyer Fonts folder residing on a network share.
- After a font file is added or removed from the Flyer Fonts folder on the network share, you must refresh the Flyer font cache. To do this, right-click in the Flyer Filestore window and select Refresh from the contextual menu.

# stand-alone operation

## WinMark Pro/FH Flyer interface

- There is no standard convention for naming TrueType fonts. You must carefully verify that the fonts used in your WinMark Pro .mkh mark files are the same as the fonts loaded into the Flyer Fonts folder on the network share.

## Configuring a network share

When operating FH Flyer in stand-alone mode, you can store mark files, data files, and font files in the Flyer Filestore or you can store them in a share folder on a computer connected to your Ethernet network. Follow the steps described in the sections below to configure WinMark Pro and Flyer to look for files or fonts on a network share.

### Create a share folder

1. On your network computer, select an existing folder or create a new folder as the share folder.
2. Right-click the folder and choose Properties from the contextual menu.
3. In the folder Properties dialog, click the Sharing tab.
4. Click the Share this folder option button.
5. Click OK to accept this action and close the folder Properties dialog.

Note: In Window's Explorer, the folder icon changes to indicate the folder is now a shared folder.

### Setup Flyer's network share settings

1. Power up Flyer and allow it to boot-up.
2. Open WinMark Pro and go to the "Device" tab under Tools / General Settings… .
3. Scroll down the "Device" tab and locate the Share Name property.

   Enter the name of the share folder you created in the previous section.
4. For the Share Server property, enter the IP address of the computer on which the share folder resides.
5. Enter a Share Username. This must be a legitimate user from the list of users with access to the share folder on the network.
6. Enter a Share Password. This is the password used with the Share Username to gain access to the share folder on the network.
7. If the share folder should have "read-only" access, set the Share ReadOnly property to Yes.
8. Click Apply to save settings and then click OK to close the General Settings dialog.

When you re-open the General Settings dialog, the Network Share Available property (Yes or No) indicates whether Flyer is able to access the desired network share folder.

# stand-alone operation

## Configuration

The Configuration section includes subsections:

- Stand-alone development
- Stand-alone automation
- Stand-alone, Master Control File

Before proceeding with stand-alone configuration, you should have already tested FH Flyer operation in WinMark control mode as described by the Initial start-up section in the Operation chapter.

FH Flyer's stand-alone mode allows you to work manually (during project development, for example) and then move to a completely automated, "hands-off" method when Flyer is totally integrated into your automated marking system.

## Stand-alone development

### Hardware/software setup

1. Ensure that you have completed all the connections listed in the Getting Started chapter including USB or Ethernet connections. If using an Ethernet connection, refer to the Configuration section in the Getting Started chapter for information on setting Ethernet parameters.
2. Power up the FH Flyer head and allow 30 seconds for the operating system to boot.
3. Open WinMark Pro and go to the "Device" tab under Tools / General Settings… .
4. Locate the Standalone Marking property and set it to Yes.
5. Choose a Standalone Mark Log Level depending on the amount of information you want FH Flyer to report back to the computer—Normal is the default setting.
6. Verify that Use Control File and Mark On Startup properties are set to No.
7. Click Apply to save the new settings and then click OK to exit the General Settings dialog.

### Prepare to mark

1. Open an existing drawing to mark or click New on the File menu and create a mark file—a simple shape or text object will suffice for this test.
2. Place a part in the field of the focusing lens.

**Caution**
possible lens damage

Lens damage may occur if the measuring device contacts the surface of the focusing lens. Always measure the working distance from the bottom of the focusing lens mount.

## Configuration

3 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. Refer back to Figure 3-5 in the Operation chapter.

## Lase the mark

1 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are in place.

**⚠ Danger**
**serious personal injury**

This product emits invisible infrared laser radiation in the 10.6 µm $CO_2$ wavelength band. Since direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Do not allow the laser beam to contact a person. $CO_2$ lasers emit 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.

2 Press the Mark Current File on Canvas button. The mark file you created is downloaded to the FH Flyer head and the laser fires the mark immediately.

**⚠ Warning**
**serious personal injury**

Pressing the Mark Current File on Canvas button forces FH Flyer to begin marking immediately after the mark file is downloaded into RAM. Before pressing this button, ensure that all laser safety precautions described in this manual have been followed.

During the time that FH Flyer is actively marking, the Launcher window opens and displays mark progress and cycle time. In this "quick mark" mode, the Launcher window closes as soon as the mark is complete. To view cycle time information, click WinMark's Mark button to reopen the Launcher window.

Note: Launcher's Preview window is blank because WinMark Pro is not generating microvector data during the mark.

The file you downloaded to FH Flyer now resides in RAM and is also saved in the Filestore as Canvas.mkh. Press F1 on the computer keyboard or click Start-F1 in the Launcher window to lase another mark. You can hover your mouse pointer over the Mark button to verify the correct file is loaded into Flyer RAM.

An untitled file downloaded to Flyer will overwrite the current Canvas.mkh file. Save this file to the Filestore permanently by clicking WinMark's Save Current File to Filestore button or right-click the Canvas.mkh file in the Flyer Files window and choose Rename from the pop-up contextual menu. To archive this file to your computer or server, open WinMark Pro's File menu and select Save As… .

# stand-alone operation

## Configuration

### Stand-alone automation

When the Filestore contains at least one .mkh mark file, you can configure FH Flyer to automatically load a mark file and begin marking as soon as the head boots up. Typically the mark file will contain input/output (I/O) automation that, in conjunction with corresponding wiring on the User Interface connector, coordinates laser marking with automated parts handling equipment.

### Hardware/software setup

1 Ensure that you have completed all the connections listed in the Getting Started chapter including USB or Ethernet connections. If using an Ethernet connection, refer to the Configuration section in the Getting Started chapter for information on setting Ethernet parameters.

2 Verify that I/O field wiring on the User Interface connector matches the input and output states specified in the mark file on the Drawing object's Automation tab. For more information about Input/Output automation, refer to the WinMark Pro Laser Marking Software User Guide or our Laser Marking FAQ at http://www.winmark.com/Support/FAQs.html.

3 Verify that the mark file's Mark Count, on the Drawing's Marking tab, is set to zero (0) or a value that matches the number of parts you plan to mark.

Note: If Mark Count is one (1), then only one mark will occur each time the head is powered up.

4 After FH Flyer is booted-up up and operational, open WinMark Pro and go to the "Device" tab under Tools / General Settings… .

5 Locate the Standalone Marking property and set it to Yes.

6 Choose a Standalone Mark Log Level depending on the amount of information you want FH Flyer to report back to the computer—Normal is the default setting. Choose Verbose to display I/O progress at each stage of the automation loop.

7 Set the Mark On Startup property to Yes.

8 Click the Startup Drawing property and enter a path and filename for the desired mark file. This file must reside in the head's Filestore.

For example, if the startup file is named Test.mkh and resides in the root directory of the Filestore, enter "/Test.mkh" as the Startup Drawing. If this file is located in a folder named Startup File Folder, then enter "/Startup File Folder/Test.mkh" for the Startup Drawing path and filename. Type the case-sensitive path and filename without the quote ("") symbols.

9 Verify the Use Control File property is set to No.

10 Click Apply to save the new settings and then click OK to exit the General Settings dialog.

### Prepare to mark

1 Place a part in the field of the focusing lens.

# stand-alone operation

## Configuration

| Caution<br>possible lens damage | Lens damage may occur if the measuring device contacts the surface of the focusing lens. Always measure the working distance from the bottom of the focusing lens mount. |
|---|---|

2 Use a ruler marked in millimeters to verify the proper Z-axis working distance from the bottom of the focusing lens mount to the surface of the part. Refer back to Figure 3-5 in the Operation chapter.

### Lase the mark

1 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are in place.

| ⚠ Danger<br>serious personal injury | This product emits invisible infrared laser radiation in the 10.6 µm $CO_2$ wavelength band. Since direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Do not allow the laser beam to contact a person. $CO_2$ lasers emit an invisible laser beam that is capable of seriously burning human tissue.<br><br>Always be aware of the beam's path and always use a beam block while testing. |
|---|---|

2 Power down FH Flyer, then restart Flyer or reboot Flyer by right-clicking in the Filestore and choosing Reboot Flyer.

3 If your mark file automation is set-up following WinMark Pro's basic automation scheme, a mark is lased each time a 'start mark' signal is applied to Flyer input IN0.

When connected to the WinMark computer via USB or Ethernet during the time that FH Flyer is actively marking in stand-alone mode, click the Mark button to open the Launcher window and view piece count/cycle time information.

Note: Launcher's Preview window is blank because WinMark Pro is not generating microvector data during the mark.

Note: When the head is busy marking, it may not have sufficient time to initialize the Filestore view, so files stored in the Filestore may not appear in the Flyer Files window.

# stand-alone operation

## Configuration

### End a stand-alone mark session

1. To end a stand-alone mark session, first connect FH Flyer to the WinMark Pro computer via the USB or Ethernet port.
2. Click the Mark button to open the Launcher window.
3. Click the Stop Marking button in the Launcher window or press ESC on the WinMark computer's keyboard.

To start another automated mark session, press the F1 key on the WinMark computer's keyboard or click Start-F1 in the Launcher window.

To exit Flyer's automated stand-alone marking mode, go to the "Device" tab and set the Mark On Startup property to No. Click the Apply button to accept the change, and then click OK.

Note: If the Filestore does not appear when you switch operating modes, right-click in the Flyer Files window and choose Refresh from the contextual menu.

Note: In certain situations when Mark On Startup is enabled, Flyer may not exit stand-alone marking, depending on the configuration of mark file automation. If this occurs, power down Flyer, re-apply DC power, then press and hold the Test Mark button until Flyer has finished booting up. Alternatively, if you are communicating via Ethernet, you can access the Mark On Startup property through the Flyer web page. See Flyer web interface in the Technical Reference chapter for details.

## Stand-alone, Master Control File

In FH Flyer's stand-alone Master Control File mode, the head is configured to load a text file named master.ctl, which must be saved in the Filestore's root directory. This feature allows a single file, the Master Control File (MCF), to cause Flyer to load and mark two or more mark files based on the status of the User Interface digital inputs. For example, this feature allows a PLC or other type of automation controller to load and mark many different mark files using digital I/O without the need for a Windows-based user interface.

Important Note: Stand-alone Master Control File mode requires firmware version 2.02 or later.

## Overview

Stand-alone marking in Master Control File mode allows Flyer to mark multiple mark files in a single mark session using discrete digital inputs to control mark file selection. All this is accomplished in true stand-alone mode, without a Windows-based user interface.

Master Control File functionality provides the ability to:

- Load and mark individual .mkh mark files controlled entirely by discrete I/O from a Programmable Logic Controller (PLC), Programmable Automation Controller (PAC), or other automation device capable of interfacing with FH Flyer I/O circuits.
- Manage multiple mark files using a single text file (named "master.ctl") resident in the root directory of the Flyer Filestore.

# stand-alone operation

## Configuration

- Store mark files internally in FH Flyer's 8 MB flash memory or store files on a network share.
- Operate in either continuous mode, where FH Flyer reads input status and loads the appropriate file before every mark, or strobed mode, where Flyer marks the same file each time until a strobe input dictates that another file be loaded and marked.
- Mask one or more inputs (IN0–IN7) to exclude them from use as file selection or strobe inputs.
- Read 8-bit or 16-bit (multiplexed) inputs, which allows Flyer to individually select one of 65,535 possible mark files from a single Master Control File.
- Set an optional wait state that allows input voltages to settle before input status is scanned.

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Tip: By storing files on a network share, accessible over FH Flyer's Ethernet port, you could modify one mark file, using WinMark Pro, while another file is loaded and marked as directed by the Master Control File.

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Important Note: FH Flyer reads the Master Control File only at boot-up. Any changes to master.ctl including mark file names will not be recognized until the next time Flyer is rebooted or restarted.

## Hardware/software setup

1. Ensure that you have completed all the connections listed in the Getting Started chapter including USB or Ethernet connections. If using an Ethernet connection, refer to the Configuration section in the Getting Started chapter for information on setting Ethernet parameters.
2. Verify that I/O field wiring on Flyer's DB-25 User Interface connector matches the input and output states specified in the mark file on the Drawing object's Automation tab and in the Master Control File (master.ctl). For more information about Input/Output automation, refer to the WinMark Pro User Guide or see our Laser Marking FAQ at http://winmark.com/Support/FAQs.html.
3. Verify that all case-sensitive mark file names match those specified in the Master Control File and that the case-sensitive pathname points to the correct location on your computer, server, or in the FH Flyer Filestore.
4. After FH Flyer is booted up and operational, open WinMark Pro and go to the "Device" tab under Tools / General Settings… .
5. Locate the Standalone Marking property and set it to Yes.
6. Choose a Standalone Mark Log Level depending on the amount of information you want FH Flyer to report back to the computer—Normal is the default setting. Choose Verbose to display I/O progress at each stage of the automation loop.
7. Set the Mark On Startup property to Yes.
8. Set the Use Control File property to Yes.

# stand-alone operation

## Configuration

9 Click Startup Drawing and enter a path and filename for any mark file listed in the Master Control File (master.ctl).

Note: The file specified as the Startup Drawing is not the first file marked. In strobed mode (where Type=1), the first file marked is determined by the input state present after the Strobe input is recognized; in continuous mode (where Type=0), the first file marked is the file that matches the specified input state.

For example, if three files named "file1.mkh", "file2.mkh" and "file3.mkh" are listed in the Master Control File (master.ctl) and reside in the root directory of the Filestore, you may specify any of the three as the Startup Drawing. If you choose file1.mkh as the Startup Drawing, enter "/file1.mkh" for the Startup Drawing path and filename. Type the case-sensitive path and filename without the quote ("") symbols.

10 Click Apply to save the new settings and then click OK to exit the General Settings dialog.

## Prepare to mark

1 Place a part in the field of the focusing lens.

| Caution<br>possible lens damage | Lens damage may occur if the measuring device contacts the surface of the focusing lens. Always measure the working distance from the bottom of the focusing lens mount. |
|---|---|

2 Use a ruler marked in millimeters to verify the proper Z-axis working distance from the bottom of the focusing lens mount to the surface of the part. Refer back to Figure 3-5 in the Operation chapter.

## Lase the mark

1 Check that all safety precautions (safety glasses and shielding) are in place around the beam area.

| ⚠ Danger<br>serious personal injury | This product emits invisible infrared laser radiation in the 10.6 µm $CO_2$ wavelength band. Since direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Do not allow the laser beam to contact a person. $CO_2$ lasers emit an invisible laser beam that is capable of seriously burning human tissue.<br><br>Always be aware of the beam's path and always use a beam block while testing. |
|---|---|

# stand-alone operation

## Configuration

2 Power down Flyer and then remove the USB or Ethernet connection if desired.

Note: The Ethernet connection must be active if your mark files reside on a computer server instead of in Flyer's Filestore.

3 Restart the FH Flyer marking head and your automation control system.

4 FH Flyer begins marking immediately after boot-up as commanded by the User Interface digital inputs driven by your automation controller.

If connected to the WinMark computer via USB or Ethernet during the time that FH Flyer is actively marking in stand-alone Master Control File mode, you can click the Mark button, to open the Launcher window and view piece count/cycle time information.

Important Note: The information in the Launcher window is only current from the time you open the window to view mark activity. To view a complete mark history after the entire mark session is finished, go to WinMark Pro's Tools menu, click Get Flyer Head Logs and then choose Mark Log. The Mark Log text file is uploaded to the computer location you specify.

Note: When monitoring stand-alone MCF activity from WinMark Pro, the Launcher Preview window is disabled because WinMark Pro is not controlling microvector generation during the mark.

Note: When the head is busy marking, it may not have sufficient time to initialize the Filestore view, so files stored in the Filestore may not appear in the Flyer Files window.

## End a stand-alone MCF mark session

1 To end a stand-alone Master Control File mark session, first connect FH Flyer to the WinMark Pro computer via the USB or Ethernet port.

2 Click the Mark button to open the Launcher window.

3 Click the Stop Marking button in the Launcher window or press ESC on the computer's keyboard.

To start another automated mark session, press the F1 key on the WinMark computer's keyboard, click Start-F1 in the Launcher window, or reboot the Flyer head.

To exit Flyer's automated stand-alone marking mode, go to the "Device" tab and set the Mark On Startup property to No. Click the Apply button to accept the change, and then click OK.

Note: If the Filestore does not appear when you switch operating modes, right-click in the Flyer Files window and choose Refresh from the contextual menu.

Note: In certain situations when Mark On Startup is enabled, Flyer may not exit stand-alone marking, depending on the configuration of mark file automation. If this occurs, power down Flyer, re-apply DC power, then press and hold the Test Mark button until Flyer has finished booting up. Alternatively, if you are communicating via Ethernet, you can access the Mark On Startup property through the Flyer web page. See Flyer web interface in the Technical Reference chapter for details.

# stand-alone operation

## Configuration

### Master Control File (MCF) specification

This section describes how to create a Master Control File for a stand-alone FH Flyer application.

#### General information

- A Master Control File (MCF) is a simple text file created in a standard text editor and saved with the case-sensitive name "master.ctl".
- The MCF is not software. Flyer reads the file only once, on boot-up, and performs a continuous sequence of operations based on MCF keyword values and digital inputs.
- When the Use Control File property in WinMark Pro is set to Yes and a control file named master.ctl resides in the root directory of the FH Flyer Filestore, then that file is opened, analyzed, and written to RAM at the beginning of a mark session.
- If master.ctl does not exist or if FH Flyer finds an error in the file, then the head operates as if Use Control File is set to No.
- The Master Control File is opened at the beginning of a mark session and remains in memory until the beginning of the next mark session or until FH Flyer is powered down. Any changes made to master.ctl while the mark session is in progress will not become effective until the next mark session.
- When individual .mkh files specified within the MCF are opened, the Mark Count property in each mark file is ignored. The MCF protocol treats the Mark Count property in each file as if it is "1".
- All valid FH Flyer automation and Event Builder commands within individual .mkh files are processed in sequence just as in a standard mark session.
- Master Control Files cause Flyer to function in one of two ways—in a continuous mode or in a strobed mode.

  In continuous mode, each mark is made once within an individual mark session (the Piece Count shown in the Launcher window is always 1). On entry to continuous mode, the input state (8-bit or 16-bit multiplexed) is read and the corresponding mark file listed in the Master Control File (MCF) is marked once. At the end of the mark session, Flyer performs another input read and loads the corresponding mark file (either the same file or a different file) into memory for marking—this loop is performed continuously. If a valid match does not occur, then Flyer loops without marking until a valid mark file match occurs.

  In strobed mode, each mark file loaded into memory begins a new mark session, which could consist of a single mark or multiple marks using the same file (the Piece Count begins at 1 and increments if multiple marks are made from the same file. Piece Count resets to 1 if a new mark file is loaded into memory). On entry to strobed mode, Flyer monitors the specified strobe input and reads the input state when a strobe is detected. On a valid match, the corresponding mark file listed in the Master Control File is marked once. If another strobe input is detected after marking is complete, then Flyer performs another input read and loads the corresponding mark file into memory. If a valid strobe input does not occur, FH Flyer continues to mark the previous file loaded into memory.

# stand-alone operation

## Configuration

- The Master Control File can direct Flyer to read the state of all eight digital inputs or it can configure Flyer to read up to 16 bit states using a multiplexed scheme. FH Flyer inputs and their corresponding decimal and hexadecimal equivalents are shown below. For clarity, hexadecimal values are preceded with an "0x" prefix.

Lower byte (LSB):

| Input | IN7 | IN6 | IN5 | IN4 | IN3 | IN2 | IN1 | IN0 |
|---|---|---|---|---|---|---|---|---|
| Decimal value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Hex value | 0x80 | 0x40 | 0x20 | 0x10 | 0x08 | 0x04 | 0x02 | 0x01 |

Upper byte (MSB):

| Input | IN7 | IN6 | IN5 | IN4 | IN3 | IN2 | IN1 | IN0 |
|---|---|---|---|---|---|---|---|---|
| Decimal value | 32768 | 16384 | 8192 | 4096 | 2048 | 1024 | 512 | 256 |
| Hex value | 0x8000 | 0x4000 | 0x2000 | 0x1000 | 0x0800 | 0x0400 | 0x0200 | 0x0100 |

Example: When reading only one byte (eight bits) and the active input state is:

| Input | IN7 | IN6 | IN5 | IN4 | IN3 | IN2 | IN1 | IN0 |
|---|---|---|---|---|---|---|---|---|
| Input state | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

this corresponds to decimal 15 (8 + 4 + 2 + 1 =15) or hexadecimal 0x0F.

- The Master Control File can direct Flyer to set the state of all eight digital outputs. FH Flyer outputs and their corresponding decimal and hexadecimal equivalents are shown below. For clarity, hexadecimal values are preceded with an "0x" prefix.

| Output | OUT7 | OUT6 | OUT5 | OUT4 | OUT3 | OUT2 | OUT1 | OUT0 |
|---|---|---|---|---|---|---|---|---|
| Decimal value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Hex value | 0x80 | 0x40 | 0x20 | 0x10 | 0x08 | 0x04 | 0x02 | 0x01 |

Example: You need to set output OUT7 high (active) to indicate a particular condition. If OUT7 is the only active output, then this state corresponds to decimal 128 or hexadecimal 0x80.

| Output | OUT7 | OUT6 | OUT5 | OUT4 | OUT3 | OUT2 | OUT1 | OUT0 |
|---|---|---|---|---|---|---|---|---|
| Output state | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# stand-alone operation

## Configuration

### Bit masks

Several of Flyer's Master Control File (MCF) keywords allow masking of input or output bits to limit valid input or output states to a specific range. For example, the FileMask keyword causes Flyer to scan up to 16 input bits when looking for a valid mark file match. By using a FileMask value of 0x0F hex (15 decimal), you can narrow the valid input range down to the first four bits (inputs IN0–IN3).

### Input masks

An input mask is required for FileMask and Strobe keywords. For example, the Strobe keyword is used by the MCF strobed mode of operation to define the input state causing FH Flyer to perform another read of the inputs. The first argument is the mask value and the second argument is the required input state. The mask value forces Flyer to ignore any inputs outside of the mask boundary. This concept is illustrated below:

Input example # 1:

| Input # | IN7 | IN6 | IN5 | IN4 | IN3 | IN2 | IN1 | IN0 |
|---|---|---|---|---|---|---|---|---|
| Current input state (0x5F) | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| Strobe mask value (0x03) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Desired input state (0x01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Result of mask (0x03) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

In this case, the mask result, 0x03, does not match the desired input state (0x01) and the Strobe function will not occur. Flyer will continue to mark the previous mark file loaded into memory.

Input example # 2:

| Input # | IN7 | IN6 | IN5 | IN4 | IN3 | IN2 | IN1 | IN0 |
|---|---|---|---|---|---|---|---|---|
| Current input state (0x5D) | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| Strobe mask value (0x03) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Desired input state (0x01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Result of mask (0x01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

In example # 2, the mask result, 0x01, matches the desired input state (0x01). The Strobe function is valid, which instructs Flyer to end the current mark session, read the current input state, perform a file match and begin another mark session using a new mark file.

## Configuration

### Output masks

An output mask is required for SetDigitalInit, SetDigitalMatch, SetDigitalNoMatch, SetDigital16, and Error keywords. For example, the SetDigitalMatch keyword defines the output state to set when Flyer successfully matches an input state to a particular mark file. The first argument is a mask value and the second argument is the desired output state. The mask value prevents Flyer from changing any outputs that fall outside the mask boundary.

Output example # 1:

| Output # | OUT7 | OUT6 | OUT5 | OUT4 | OUT3 | OUT2 | OUT1 | OUT0 |
|---|---|---|---|---|---|---|---|---|
| Current output state (0x4F) | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| Output mask value (0x60) | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Desired output state (0x20) | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Result of mask (0x2F) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |

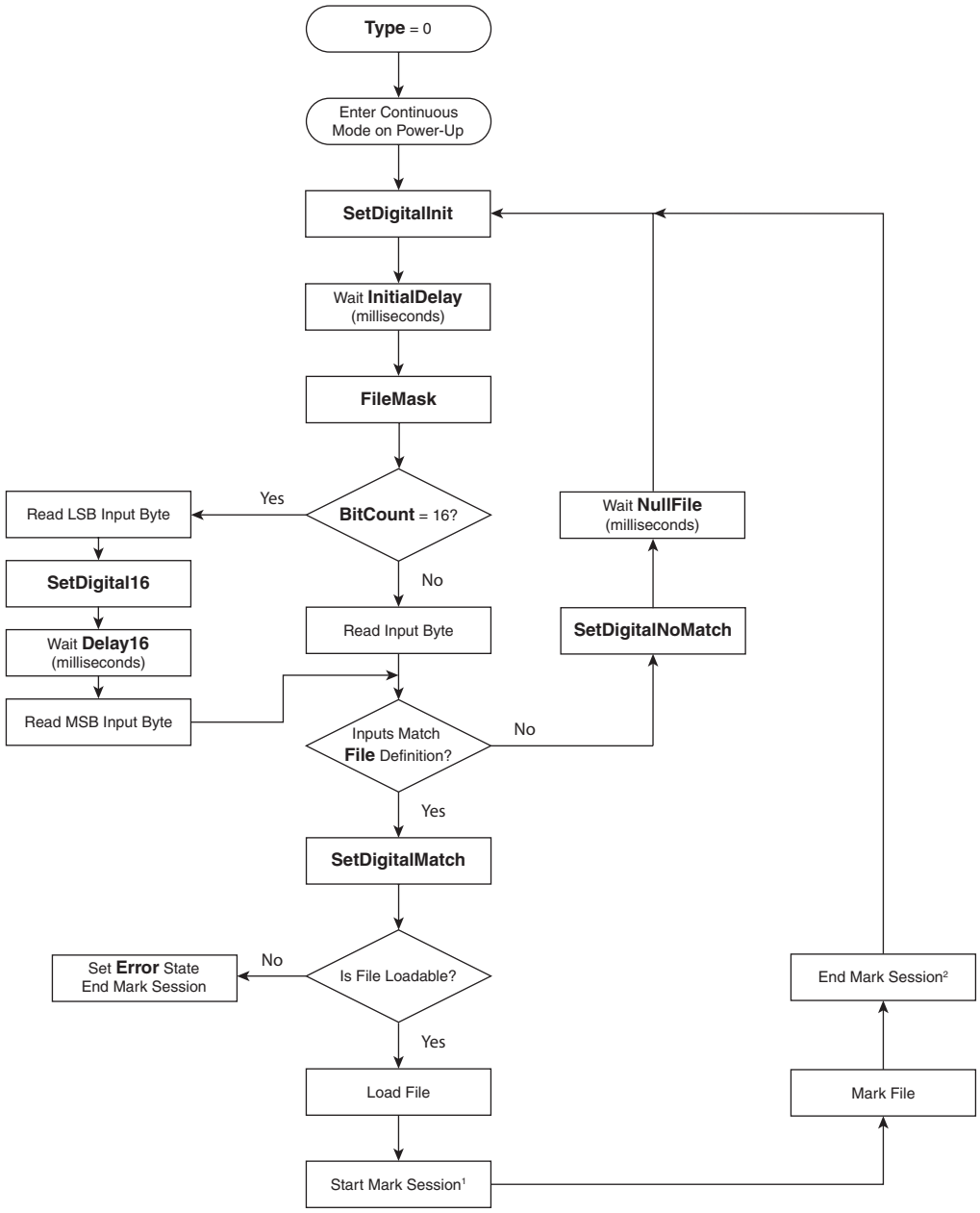
The mask value (0x60) means that only OUT5 and OUT6 will be changed, if necessary, to the desired output state. In this example, OUT5 is Set and OUT6 is Cleared to indicate that a file match was successful. Note that outputs OUT7, OUT4, and OUT3–OUT0 are unchanged because of the mask operation.

# stand-alone operation

## Configuration

### Master Control File flowcharts

Figure 4-9 displays a Master Control File flowchart for continuous mode, where Type=0.

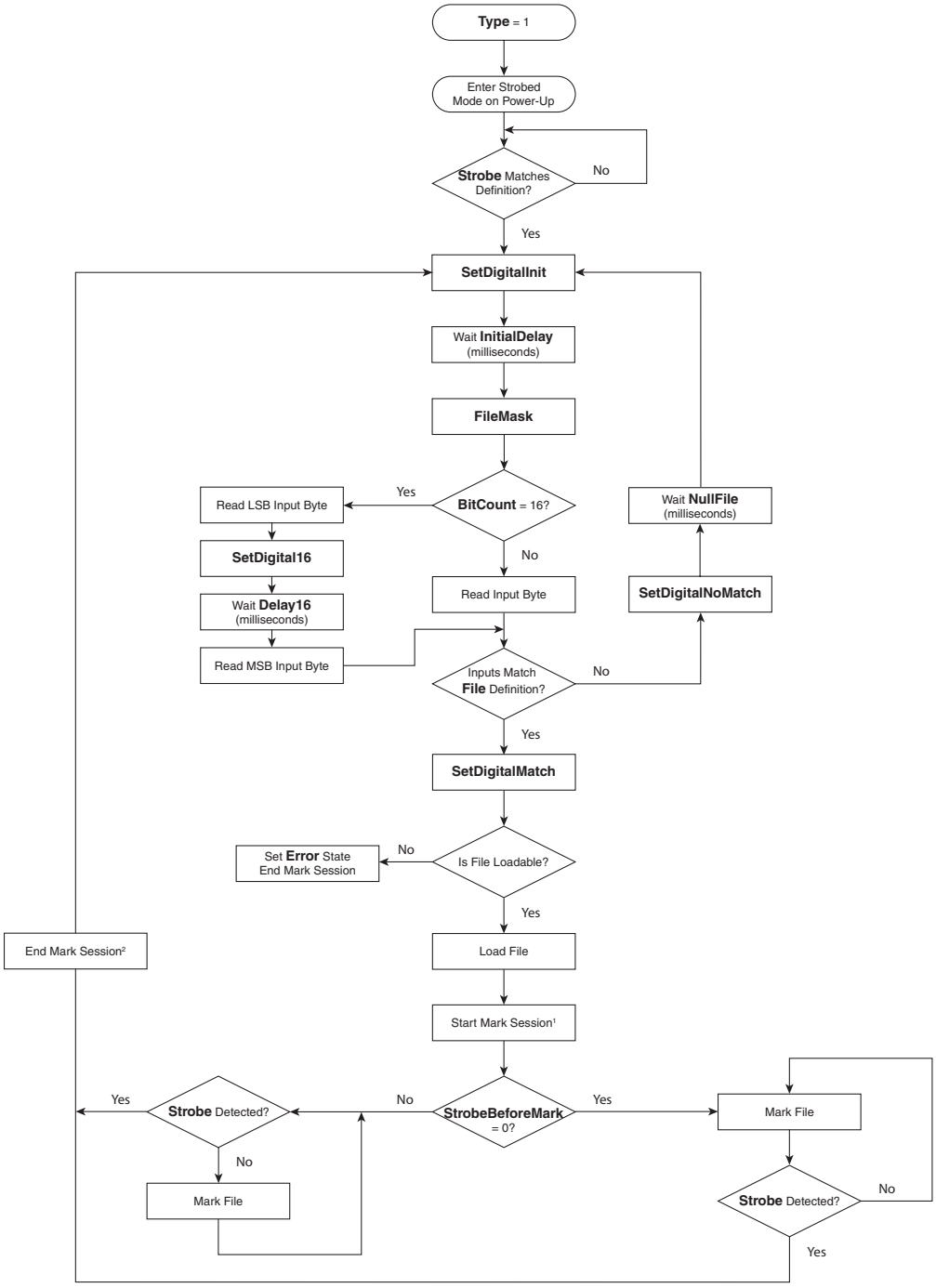



1 Start mark session and run On Before Mark Session automation (if any) in the mark file.

2 Run On After Mark Session automation (if any) in the mark file and end mark session.

Figure 4-9 Master Control File flowchart—continuous mode

Figure 4-10 shows a MCF flowchart for strobed mode, where Type=1.




1 Start mark session and run On Before Mark Session automation (if any) in the mark file.

2 Run On After Mark Session automation (if any) in the mark file and end mark session.

Figure 4-10 Master Control File flowchart—strobed mode

# stand-alone operation

## Configuration

### Master Control File syntax

The following items describe the syntax and rules for writing a Master Control File:

- Blank lines are ignored.
- Lines beginning with a "#" symbol are interpreted as comments and are ignored.
- Lines within the Master Control File (MCF) can be in any order—the Flyer head will parse the code and determine the necessary order of execution. We recommend using the sequence shown in our examples for consistency and ease of troubleshooting.
- The space character is reserved as a delimiter. Spaces in comment fields are acceptable, however commands like "File=0 /file0.mkh" cannot be written as "File = 0 / file0.mkh".
- Digital input/output (I/O) and bit masks can be expressed in either decimal or hexadecimal form. Hexadecimal values must be preceded by a "0x" prefix.

  For example, with eight inputs or eight outputs, the bit values could range from 0 to 255 decimal (0x00 to 0xFF hexadecimal).

  When 16 bits are used in a multiplexed method, the bit values could range from 0 to 65535 (0x0000 to 0xFFFF hexadecimal). The first byte read is the lower byte and the second byte read is the upper byte. For example, if the first byte, the LSB, is decimal 140 (bit 7, bit 4, and bit 3 on or active), the hexadecimal equivalent is 0x8C. If the second byte, the MSB, is 0 decimal (all bits off or inactive during the second byte read), the hex equivalent is 0x00. The byte order, first byte (LSB) and second byte (MSB) provides hex 0x008C, which is the equivalent of decimal 140.

- Delay values are expressed in milliseconds (ms) and are limited to a count of 10000 (10 seconds). Values greater than 10000 are ignored and the actual delay is set to 10000 ms.
- The format of a MCF code line is: Keyword=arg1 arg2 arg3… . Remember that the space character is a delimiter.

### MCF keywords and arguments

Below is a list of valid Master Control File keywords and arguments. The information explains if the keyword is required or optional and if the keyword is valid for all modes, only for continuous mode, or only for the strobed mode of operation.

Keyword: Type

Operation: Continuous, strobed

Required: Yes

Format: "Type=arg1" where arg1 is a single integer value.

Argument: A "0" value indicates continuous operation, where file input bits are read after every mark. A new (or the same) file is loaded and marked only on receipt of a valid input state. A "1" indicates strobed operation, where the currently loaded file is marked repeatedly until a valid strobe input causes Flyer to read file input bits and load another mark file.

## Configuration

Example: # specify strobed operation—continue to mark existing file until
# strobe input is active.
Type=1
# next step in Master Control File.

Keyword: Strobe

Operation: Strobed

Required: Yes

Format: "Strobe=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the input bits to read. Arg2 is the required input state that directs Flyer to perform another read of file input bits and compare the results to a list of valid mark files in the Master Control File.

Notes: The Strobe is a command to load another mark file into memory. When the specified input state matches the Strobe value, FH Flyer sets the output state specified by the optional SetDigitalInit keyword and then delays a minimum of InitialDelay (optional) milliseconds before performing a comparison of the inputs to determine the next file match. If a Strobe is not present, Flyer continues marking the file currently loaded into memory. FH Flyer does not constantly monitor the Strobe input. Flyer checks for a Strobe only before or after a mark as defined by the StrobeBeforeMark keyword.

Example: # Read state of inputs IN1 and IN0 and perform input read if input state is 01
# (if IN1 = 0 and IN0 = 1).
# IN1 = 2, IN0 = 1 so mask equals 3 decimal or 0x03 hex. The valid strobe
# input value is 1 decimal or 0x01 hex.
Strobe=0x03 0x01
# remember that a space is a data delimiter!
# next step in Master Control File.

Keyword: StrobeBeforeMark

Operation: Strobed

Required: No

Format: "StrobeBeforeMark=arg1" where arg1 is a single integer value.

Argument: A nonzero value forces Flyer to check the Strobe prior to marking the current Drawing. If StrobeBeforeMark is zero or undefined, Flyer evaluates the Strobe input after the mark is finished and all Drawing automation is complete.

Example: # check the Strobe input before marking the current file.
StrobeBeforeMark=1
# next step in Master Control File.

# stand-alone operation

## Configuration

Keyword: SetDigitalInit

Operation: Continuous, strobed

Required: No

Format: "SetDigitalInit=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the output bits to set or clear. Arg2 is the desired output state.

Notes: The SetDigitalInit command signals the automation controller that Flyer's next action is to read file input bits and perform a file match. When an IntitalDelay is specified, Flyer waits the InitialDelay value before reading input status.

Example:
```
# specify outputs OUT7 and OUT6 as the mask. OUT7 = 128 and OUT6 = 64,
# so mask value is 192 decimal or 0xC0 hex.
# The desired output state is OUT7 = 1 and OUT6 = 0, so the output
# value is 128 decimal or 0x80 hex.
SetDigitalInit =0xC0 0x80
# remember that a space is a data delimiter!
# next step in Master Control File.
```

Keyword: InitialDelay

Operation: Continuous, strobed

Required: No

Format: "InitialDelay=arg1" where arg1 is a single integer value.

Argument: InitialDelay forces Flyer to wait the InitialDelay value (in milliseconds) before reading the current state of the inputs. Delay values are expressed in milliseconds (ms) and are limited to 10000 (10 seconds). InitialDelay values greater than 10000 are ignored and the actual delay is set to 10000 ms.

Notes: Use InitialDelay after a Strobe or SetDigitalInit command to force Flyer to wait while inputs are switched to a valid file selection state. If an InitialDelay is not used, then Flyer immediately performs an input read and file match operation.

Example:
```
# enter a 15 millisecond delay while input status is reconfigured for a file match.
InitialDelay=15
# next step in Master Control File.
```

Keyword: FileMask

Operation: Continuous, strobed

Required: Yes

Format: "FileMask=arg1" where arg1 is a single decimal or hexadecimal value.

Argument: The FileMask indicates the range of valid inputs to use for file comparison and can accommodate up to 16 bits.

## Configuration

Example: # use a combination of the first four inputs (IN0–IN3) to select one of 15 different
# mark files, where IN3 = 8, IN2 = 4, IN1 = 2, and IN0 = 1. The FileMask value
# should be 15 decimal or 0x0F hex.
FileMask=0x0F
# next step in Master Control File.

Keyword: BitCount

Operation: Continuous, strobed

Required: No

Format: "BitCount=arg1" where arg1 is a single value—either "8" or "16".

Argument: The "8" for 8 bit or "16" for 16 bit, indicates the number of digital inputs to read. If BitCount is not specified, Flyer defaults to "8".

Notes: When BitCount is set to "16", then two additional keywords—SetDigital16 and Delay16—are valid keywords to use in the MCF.

Example: # there are more than 255 mark files (8 bits) to match, so we require a 16 bit input.
BitCount=16
# next step in Master Control File.

Keyword: SetDigital16

Operation: Continuous, strobed

Required: No

Format: "SetDigital16=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the output bits to set or clear. Arg2 is the desired output state.

Notes: When BitCount = 16, the SetDigital16 output command sets the specified output state after reading the first byte (LSB) and prior to reading the second byte (MSB). Use this output to signal that Flyer is ready to read the second input byte.

Example: # specify outputs OUT7 and OUT6 as the mask. OUT7 = 128 and OUT6 = 64,
# so mask value is 192 decimal or 0xC0 hex.
# The desired output state is OUT7 = 1 and OUT6 = 0, so the output
# value is 128 decimal or 0x80 hex.
SetDigital16=0xC0 0x80
# remember that a space is a data delimiter!
# next step in Master Control File.

Keyword: Delay16

Operation: Continuous, strobed

Required: No

Format: "Delay16=arg1" where arg1 is a single integer value.

# stand-alone operation

## Configuration

Argument: Delay16 forces Flyer to wait the Delay16 value (in milliseconds) after reading the first byte (LSB) and before reading the second byte (MSB) of a 16 bit input string. Delay values are expressed in milliseconds (ms) and are limited to 10000 (10 seconds). Delay16 values greater than 10000 are ignored and the actual delay is set to 10000 ms.

Notes: Use Delay16 after a SetDigital16 command to force Flyer to wait while inputs are switched to a valid file selection state between byte reads. If Delay16 is not used, then Flyer will immediately perform an input read and file match operation.

Example:
```
# enter a 10 millisecond delay while input status is reconfigured before
# Flyer reads the second (MSB) input byte.
Delay16=10
# next step in Master Control File.
```

Keyword: File

Operation: Continuous, strobed

Required: Yes

Format: "File=arg1 arg2" where arg1 is a decimal or hexadecimal value denoting the required input state and arg2 is a path/filename.

Argument: Arg1 is a single decimal or hexadecimal value that specifies the required input state match. Arg2 is a case sensitive path/filename for the mark file that Flyer will load on the specified input state match.

Example:
```
# path and filenames are case sensitive!!
File=1 /markfile1.mkh
# "/" symbol indicates that file resides in the Filestore's root directory.
File=2 /markfile2.mkh
File=3 /Folder1/markfile3.mkh
# markfile3 resides in Folder1 in the Filestore.
File=4 /Folder2/subfolder1/markfile4.mkh
File=5 /network/markfile5.mkh
File=6 /network/markfile6.mkh
# mark file 5 and mark file 6.mkh reside on a network share connected via
# FH Flyer's Ethernet port.
File=7 /markfile1.mkh
# A match to "1" or "7" marks the same file (markfile1.mkh) – this is OK!
# or File=0x01 /markfile1.mkh; File=0x02 /markfile2.mkh; etc.
# next step in Master Control File.
```

Keyword: SetDigitalMatch

Operation: Continuous, strobed

Required: No

Format: "SetDigitalMatch=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the output bits to set or clear. Arg2 is the desired output state.

## Configuration

Notes: The SetDigitalMatch command sets the desired output when Flyer has successfully matched the current input state to a particular mark file.

Example:
```
# specify outputs OUT5 and OUT4 as the mask. OUT5 = 32 and OUT4 = 16,
# so mask value is 48 decimal or 0x30 hex.
# The desired output state is OUT5 = 1 and OUT4 = 0, so the output
# value is 32 decimal or 0x20 hex.
SetDigitalMatch =0x30 0x20
# remember that a space is a data delimiter!
# next step in Master Control File.
```

Keyword: SetDigitalNoMatch

Operation: Continuous, strobed

Required: No

Format: "SetDigitalNoMatch=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the output bits to set or clear. Arg2 is the desired output state.

Notes: SetDigitalNoMatch sets the desired output when Flyer cannot match the current input state to a particular file. Flyer will then execute a NullFile delay if one is specified.

Example:
```
# specify outputs OUT5 and OUT4 as the mask. OUT5 = 32 and OUT4 = 16,
# so mask value is 48 decimal or 0x30 hex.
# The desired output state is OUT5 = 0 and OUT4 = 1, so the output
# value is 16 decimal or 0x10 hex.
SetDigitalNoMatch =0x30 0x10
# remember that a space is a data delimiter!
# next step in Master Control File.
```

Keyword: NullFile

Operation: Continuous, strobed

Required: No

Format: "NullFile=arg1" where arg1 is a single integer value.

Argument: NullFile forces Flyer to wait the specified value in milliseconds before reading the input state.

Notes: A NullFile delay occurs after the input state is read AND no mark file match is found. If the NullFile keyword is not defined in the Master Control File, Flyer immediately scans the input for a matching file. Delay values are expressed in milliseconds (ms) and are limited to 10000 (10 seconds). NullFile values greater than 10000 are ignored and the actual delay is set to 10000 ms.

Example:
```
# enter a 30 millisecond delay before input status is rescanned for a file match.
NullFile=30
# next step in Master Control File.
```

# stand-alone operation

## Configuration

Keyword: Error

Operation: Continuous, strobed

Required: No

Format: "Error=arg1 arg2" where the arguments consist of decimal or hexadecimal values.

Argument: Arg1 is a mask that defines the output bits to set or clear. Arg2 is the desired output state.

Notes: Error defines the output state that is set on an error condition just prior to the mark session ending. If the Error keyword is not defined in the Master Control File, Flyer ends the mark session with outputs remaining in their current state. Error conditions include: a corrupt Master Control File, an invalid mark file, or a nonexistent mark file—likely due to an incorrect path or filename specification.

Example:
```
# specify outputs OUT5 and OUT4 as the mask. OUT5 = 32 and OUT4 = 16,
# so mask value is 48 decimal or 0x30 hex.
# The desired output state on an error is OUT5 = 1 and OUT4 = 1, so the
# output value is 48 decimal or 0x30 hex.
Error =0x30 0x30
# remember that a space is a data delimiter!
# next step in Master Control File.
```

## Continuous MCF example

```
# Continuous Master Control File example.
# A new file (or the same file) is loaded into Flyer memory for each mark.
# Each mark begins and ends a distinct mark session.
# OnBeforeMarkSession and OnAfterMarkSession events occur before/after each mark.

Type=0

# the Strobe keyword is not required for continuous operation.

# Set output OUT7 to "1" and OUT6 to "0" to indicate that another input read/file match
# operation will begin after the InitialDelay command.

SetDigitalInit=0xC0 0x80

# Add a 5-millisecond (ms) delay to allow input states to transition and settle before read.

InitialDelay=5

# Add a NullFile command – if input states do not match a valid file, then wait 10 ms
# and check inputs again.

NullFile=10

# Add Error command keyword to set output state before mark session ends if
# error condition occurs. Set OUT7 to "0" and OUT6 to "1" on error.
```

```
Error=0xC0 0x40

# Set mask to specify inputs used for file selection. In this case, read inputs IN3 – IN0.

FileMask=0x0F

# Now for the mark files.
# With four inputs (IN3 – IN0) we can make 16 discrete matches; however, we will
# not use the 0 state where IN3 – IN0 are all "0" because this could indicate
# the inputs are disconnected or otherwise unavailable. We want to ensure that only
# an active input state causes lasing to occur.
# Remember path and filenames are case sensitive!!

File=1 /markfile1.mkh

# "/" symbol indicates that file resides in the Filestore's root directory.

File=2 /markfile2.mkh
File=3 /Folder1/markfile3.mkh

# markfile3 resides in Folder1 in the Filestore.

File=4 /Folder2/subfolder1/markfile4.mkh
File=5 /network/markfile5.mkh
File=6 /network/markfile6.mkh

# markfile5 and markfile6.mkh reside on a network share connected via
# FH Flyer's Ethernet port.

File=7 /markfile1.mkh

# A match to "1" or "7" marks the same file (markfile1.mkh) – this is OK!

# or File=0x01 /markfile1.mkh; File=0x02 /markfile2.mkh; etc.

File=8 /network/markfile7.mkh
File=9 /markfile8.mkh

# Because there are only nine valid matches, input states 0 and 10–15 will not match.
# These "no match" states are caught by the NullFile command keyword, so Flyer
# will loop without marking until a valid match occurs.

# End of file.
```

# stand-alone operation

## Configuration

### Strobed MCF example

```
# Strobed Master Control File example.
# Provides the option of (1) loading a new file into memory for each mark
# or (2) marking the existing file stored in memory multiple times.
# The detection of a Strobe input ends the current mark session and begins a new session.
# OnBeforeMarkSession and OnAfterMarkSession events occur before/after each mark session.
# If a Strobe is not detected, the currently loaded file in Flyer memory continues to mark. In this case,
# OnBeforeMarkSession and OnAfterMarkSession events are not applicable and do not occur.

Type=1

# For the Strobe, look at IN1/IN0 and match on an "01" state (IN1 = "0", IN0 = "1").

Strobe=0x03 0x01

# Set output OUT7 = "1" and OUT6 = "0" to indicate that another input read/file match
# operation will begin after the InitialDelay command.

SetDigitalInit=0xC0 0x80

# Add a 5-millisecond (ms) delay to allow input states to transition and settle before read.

InitialDelay=5

# Add a NullFile command – if input states do not match a valid file, then wait 10 ms
# and check inputs again.

NullFile=10

# Add Error command keyword to set output state before mark session ends if
# error condition occurs. Set OUT7 to "0" and OUT6 to "1" on error.

Error=0xC0 0x40

# Set mask to specify inputs used for file selection. In this case, read inputs IN3 – IN0.

FileMask=0x0F

# Now for the mark files.
# With four inputs (IN3 – IN0) we can make 16 discrete matches; however, we will
# not use the 0 state where IN3 – IN0 are all "0" because this could indicate
# the inputs are disconnected or otherwise unavailable. We want to ensure that only
# an active input state causes lasing to occur.
# Remember path and filenames are case sensitive!!
```

## Configuration

File=1 /markfile.mkh

# "/" symbol indicates that file resides in the Filestore's root directory.

File=2 /markfile2.mkh

File=3 /Folder1/markfile3.mkh

# markfile3 resides in Folder1 in the Filestore.

File=4 /Folder2/subfolder1/markfile4.mkh
File=5 /network/markfile5.mkh
File=6 /network/markfile6.mkh

# markfile and markfile6.mkh reside on a network share connected via
# FH Flyer's Ethernet port.

File=7 /markfile1.mkh

# A match to "1" or "7" marks the same file (markfile1.mkh) – this is OK!

# or File=0x01 /markfile1.mkh; File=0x02 /markfile2.mkh; etc.

File=8 /network/markfile7.mkh
File=9 /markfile8.mkh

# Because there are only nine valid matches, input states 0 and 10–15 will not match.
# These "no match" states are caught by the NullFile command keyword, so Flyer
# will loop without marking until a valid match occurs.

# End of file.

# stand-alone operation

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# tracking

# 5

Use information in this chapter to setup your FH Series Flyer marking head for tracking. 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 FH Flyer ready for tracking operation is to start at Introduction and work your way through Tracking optimization. You should have already completed the steps in the Getting Started and Operation chapters of this manual.

This chapter contains the following information:

- Introduction – describes the FH Flyer tracking function.
- Tracking definitions – explains the definitions and terminology for tracking.
- Tracking mark criteria – describes criteria for successful tracking operation.
- Tracking hardware – explains how to connect position encoder, part sensor, and DC power supply components for tracking operation.
- WinMark Pro tracking setup – describes how to setup WinMark Pro v6 for tracking.
- Determining line speed – illustrates how to determine line speed for your specific application.
- Tracking optimization – explains the concepts behind FH Flyer's dynamic Tracker marking and describes how to optimize tracking marks for speed and quality.

Important Note: Please review all sections in this chapter thoroughly before designing your FH Flyer Tracker system.

Note: If you are configuring an FH Series Flyer marking head to track, please perform the tasks described in the Getting Started and Operation chapter before proceeding with this section.

# tracking

## Introduction

Unlike static laser marking systems that require parts to be at rest during marking, the FH Flyer head in tracking mode is capable of marking parts "on-the-fly" as they move through the marking field at line speeds up to 400 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.

With the release of WinMark Pro v6.0 and Flyer firmware 2.68, FH Flyer marking heads have the ability to perform banner tracking—laser marking objects "on-the-fly" (like pipe or tubing) that require marks along a length much larger than the extents of the Drawing Canvas for a given focusing lens. See the WinMark Pro web site, at http://www.winmark.com/products/winmark_ApplicationsNotes.html, for an Application Note describing how to setup banner tracking.

## Tracking setup

A typical FH Flyer tracking setup is shown in Figure 5-1. In addition to the items listed under Marking setup in the Getting Started chapter, you will need to supply the following:

- Position encoder
- Part sensor
- DC power supply for encoder and part sensor
  (if not using Flyer's built-in +15 VDC, 400 mA power supply)
- Part movement or conveyor system

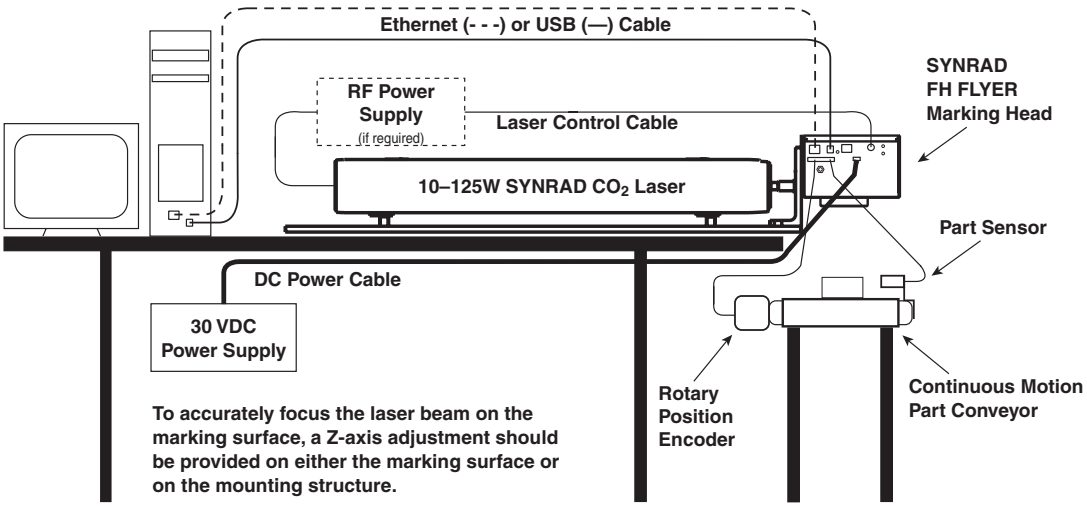


Figure 5-1 FH Flyer tracking setup

## Tracking definitions

Before calculating the approximate tracking line speed for Flyer marking heads 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 FH Flyer 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 WinMark Pro .mkh mark file.

### Marking Window

The Marking Window is best explained by visualizing an area the size of WinMark Pro's Drawing Canvas centered on the center point of the factory test mark 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 5-2 illustrates Usable Field Size.

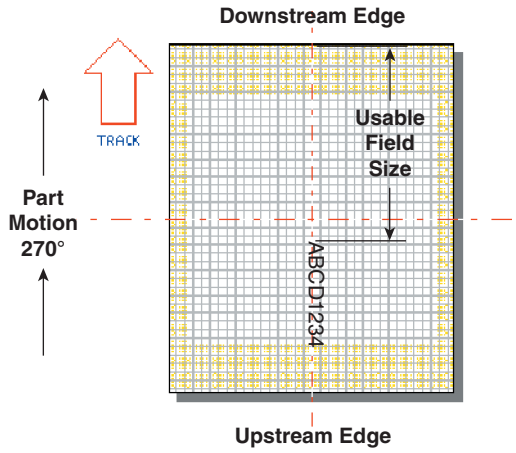


Figure 5-2 Usable Field Size

# Tracking definitions

## 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 5-3.

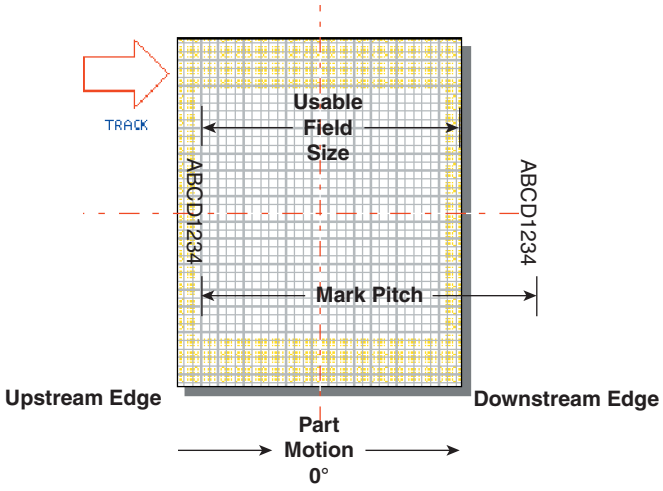


Figure 5-3 Mark Pitch greater than Usable Field Size

## Cycle Time

The amount of time in seconds required to complete the Mark is the Cycle Time.

## Tracking Window

The Tracking Window is the fixed area beneath the Flyer head where marking is completed without error. The Tracking Window is defined as the smaller of either Usable Field Size or Mark Pitch. Note that the Tracking Window is located within the Marking Window and can never exceed the extents of the Marking Window.

For example, Figure 5-4 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.

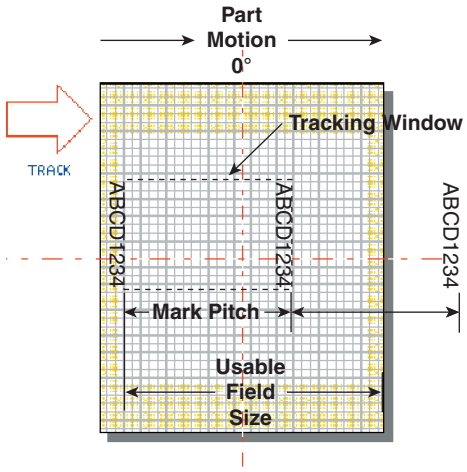


Figure 5-4 Tracking Window

## 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 underneath the FH Flyer head. See Figure 5-5.

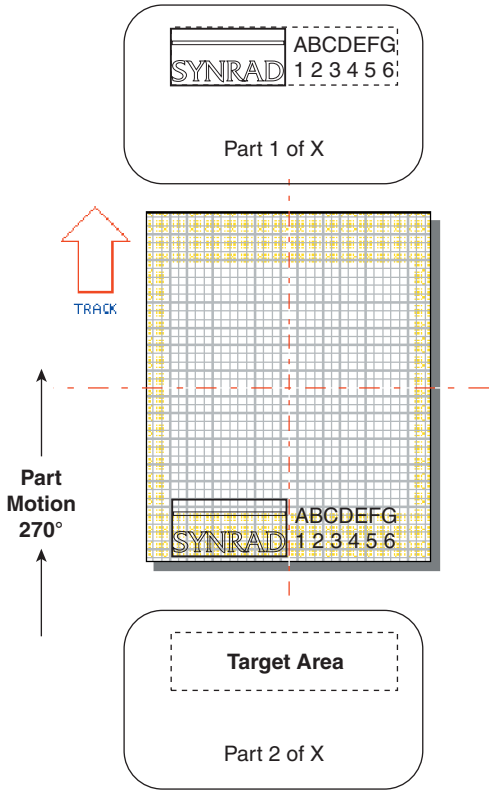


Figure 5-5 Target Area

# Tracking definitions

## Object Reference Point

The Object Reference Point is the X-Y coordinate of the Mark's top left corner (in the direction of part mo-tion) as viewed on WinMark's Drawing Canvas. See Figure 5-6.

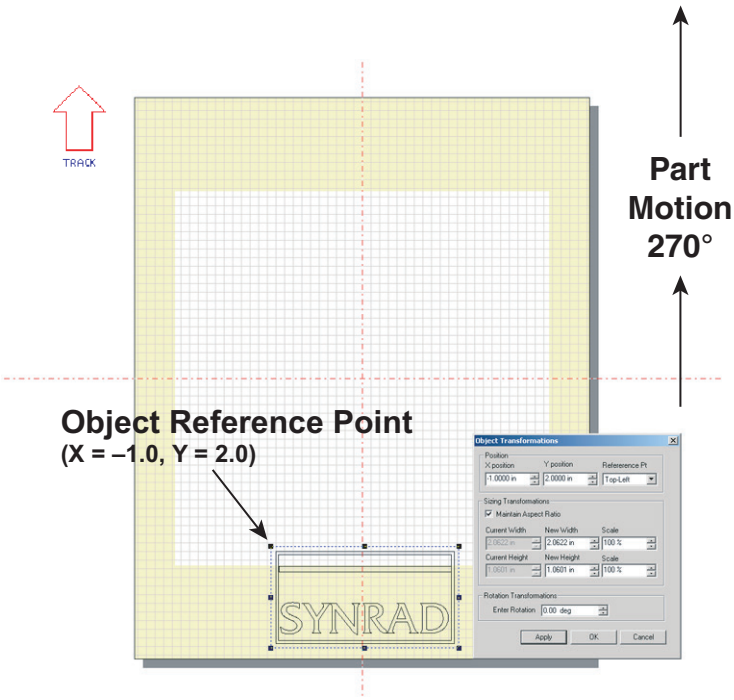


Figure 5-6 Object Reference Point

## Tracking mark 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, is not marked and the mark log displays a "Line speed too fast to finish - missed start" message. This error means that part sensor signals are occurring too rapidly because the line speed is moving too fast or parts are spaced too closely together.

  Depending upon Sensor Distance and Mark Pitch, Flyer heads in tracking mode can buffer up to 32 'start mark' signals. The number of 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 to finish - missed start" error occurs, the part on which the 'start mark' error occurred is not marked. Marking continues with the next part in the queue.

- Encoder Resolution, encoder pulses per millimeter of conveyor motion, must be properly set to prevent mark distortion or marking outside the Target Area. See Tracking hardware later in this chapter for details on calculating Encoder Resolution. After determining the correct value, open and run the Linestackxxx.mkh mark file (where xxx matches the focal length of the currently installed lens) to verify the calculated value. If you are tracking with a Motion Vector other than 270°, you must rotate the linestack file so that it is oriented properly. When Encoder Resolution is correct, then short and long lines will appear as one long line as shown in Figure 5-7.

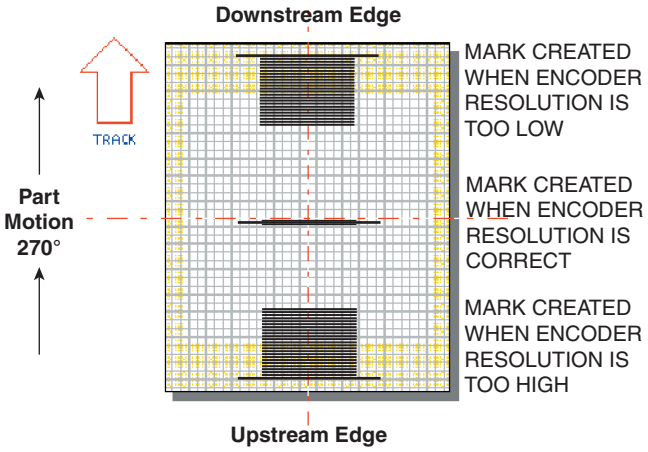


Figure 5-7 Checking Encoder Resolution

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 or third decimal point may be required depending on the resolution of your encoder.

Important Note: If your Flyer system is configured for Encoderless Tracking, the Encoder Resolution property is not valid. Instead use the Product Line Speed property to fine-tune tracking to actual part motion.

# Tracking mark criteria

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 WinMark Pro's Drawing Canvas so that it lies within the boundaries of the Marking Window. Figure 5-8 shows how the same text positioned differently can give two very different values for Usable Field Size.

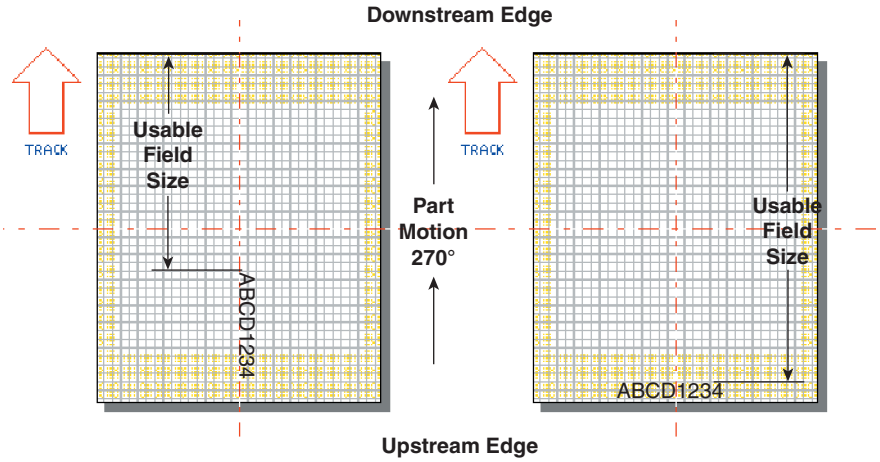


Figure 5-8 Usable Field Size comparisons

When the downstream edge of the Tracking Window coincides with the downstream edge of the Marking Window, then unmarked portions of the Target Area that move beyond the edge of the Tracking Window are not marked and lasing stops.

If part pitch constrains the downstream edge of the Tracking Window within the Marking Window, then lasing continues until unmarked portions of the Target Area move outside the Marking Window, however the next part in the queue is not marked. In either case, the mark log displays a "Too fast to finish" error. In Figure 5-9, "Line 2" will mark unless unmarked areas move outside the Marking Window.

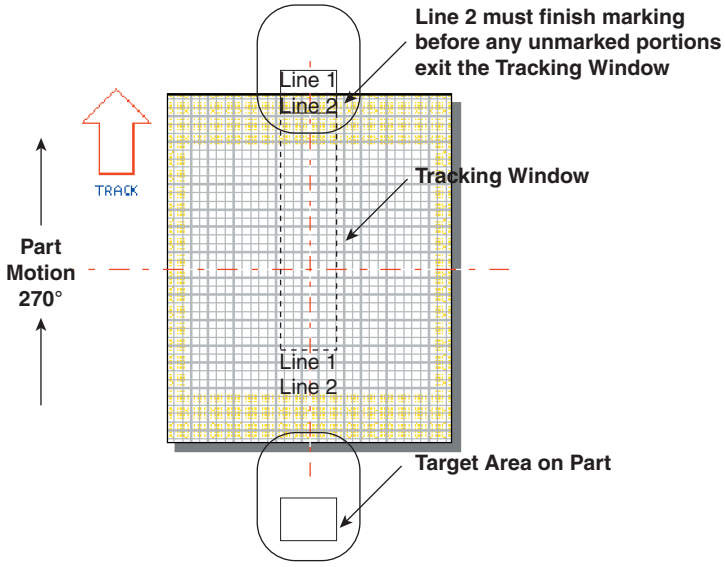


Figure 5-9 Maximum marking position in Tracking Window

# Tracking hardware

The Tracking hardware section includes subsections:

- Position encoder
- Part sensor
- DC power supply

Tracking with an FH Series Flyer marking head may 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 position encoder (typically a rotary encoder with a bidirectional or quadrature signal output) for determining line speed and direction, and a DC power supply to power both the part sensor and encoder. Although the components described above are not provided with your FH Flyer marking head, some or all of these components may already exist in the equipment that performs your automated parts handling.

Note: In constant velocity (constant line speed) applications, FH Flyer marking heads can track moving objects without an encoder using WinMark Pro's Encoderless and Product Line Speed properties. When a part sensor is not feasible, such as in continuous web processes, use WinMark's Internal Part Trigger and Part Pitch properties. Review the WinMark Pro tracking properties section for details.

## Position encoder

If the speed of your parts conveyor or web varies even slightly during the time that marking occurs, then you must add a position encoder to your parts handling setup. Choose either a bidirectional (quadrature) or unidirectional type. Unidirectional encoders send pulses to the Flyer head that synchronize marking as line speed varies. Quadrature encoders are preferred as they also maintain synchronization if parts slow, stop, or even reverse direction during the mark. Do not use an absolute position encoder. Table 5-1 lists electrical specifications for choosing a position encoder when connecting to Flyer's high-speed inputs IN1 and IN2.

Table 5-1 Position encoder specifications (for IN1/IN2)

| Function | Specifications |
|---|---|
| Code | Incremental |
| Pulses Per Revolution | User determined (see Encoder setup for sample calculations) |
| Input Voltage | User determined (+15.0 VDC if powered from Flyer's internal 15 V supply) |
| Output Signal | Open collector (PNP or NPN) or open drain (P-channel or N-channel)<br>Low level output voltage: –0.6 V to +1.7 VDC (0 V typ.)<br>High level output voltage: +5.0 V to 24.0 VDC<br>On-state current: 6 mA typical; 9 mA maximum at 5 VDC<br>22 mA typical; 32 mA maximum at 12 VDC<br>32 mA typical; 47 mA maximum at 15 VDC<br>62 mA typical; 90 mA maximum at 24 VDC<br>Quadrature or bidirectional output recommended<br>(FH Flyer heads will accept a unidirectional encoder input) |

# Tracking hardware

## Encoder connection

Encoder outputs are connected directly to FH Flyer's DB-25 User Interface connector. If you are using a unidirectional (single output) encoder, connect your wiring as shown for 'A' phase (øA) in the following diagrams.

To connect a position encoder, refer to the appropriate connection diagram. Figure 5-10 shows a customer-supplied power supply driving a current-sinking NPN open collector encoder. Figure 5-11 shows how to power the same type encoder from Flyer's built-in +15 VDC power supply. See Figure 5-12 or 5-13 when wiring current-sourcing PNP encoders.

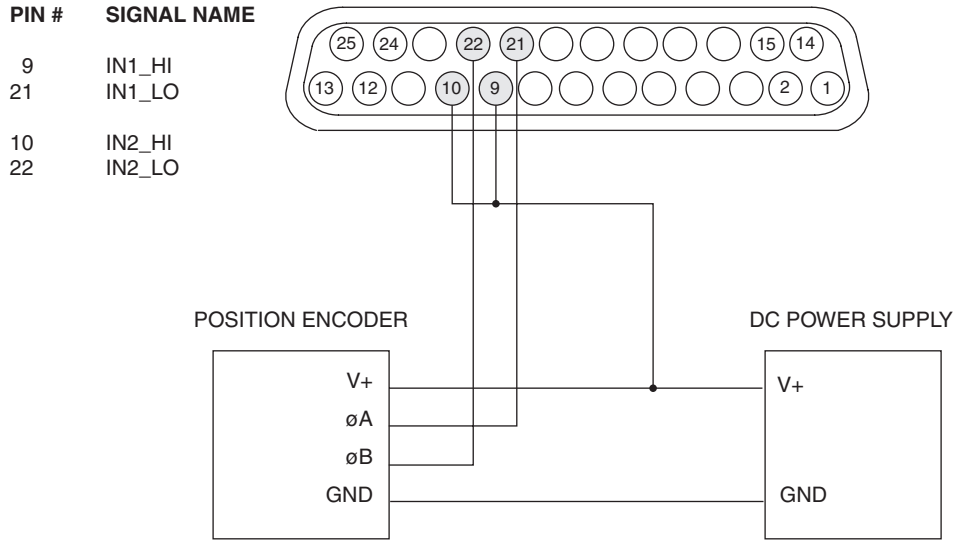


Figure 5-10 Wiring diagram for current-sinking (NPN open collector) encoders

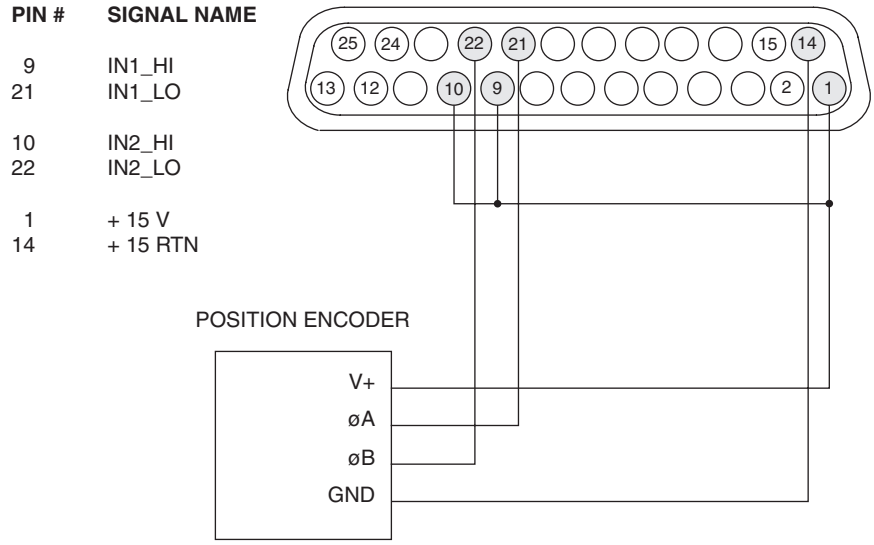


Figure 5-11 Wiring diagram for current-sinking (NPN open collector) encoders using Flyer's built-in power supply

Figure 5-12 shows a customer-supplied power supply driving a current-sourcing PNP open collector encod-er. Figure 5-13 shows how to power the same type of encoder from Flyer's built-in +15 VDC power supply.

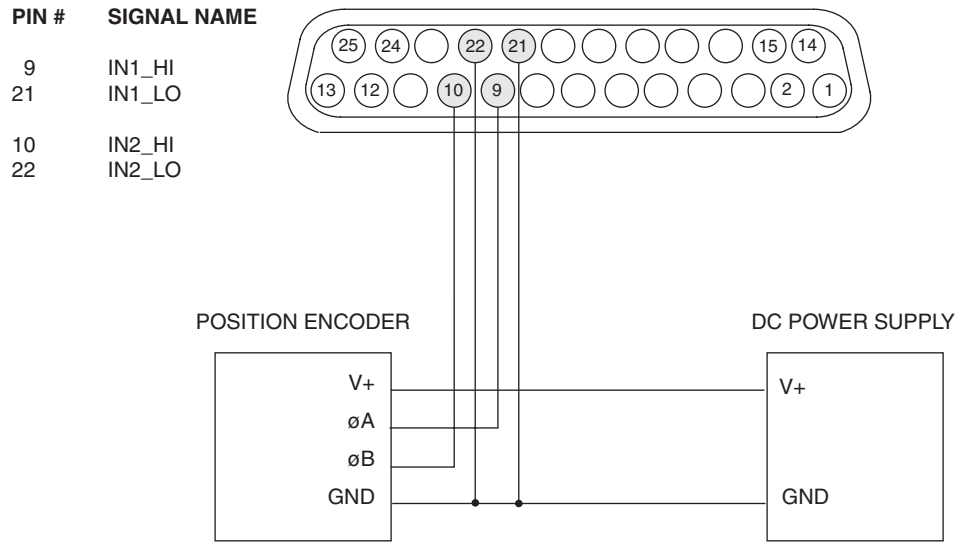


Figure 5-12 Wiring diagram for current-sourcing (PNP open collector) encoders

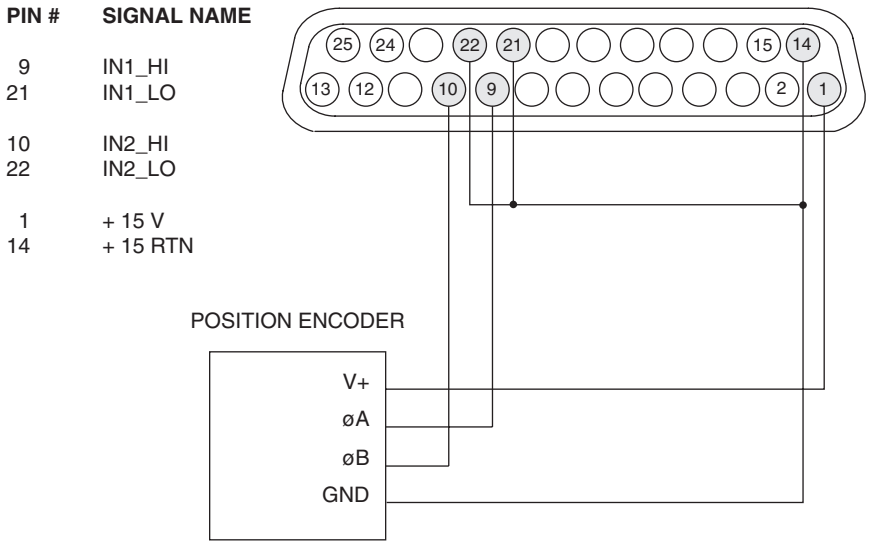


Figure 5-13 Wiring diagram for current-sourcing (PNP open collector) encoders using Flyer's built-in power supply

Verify that field wiring is correct after all encoder connections are complete using the Digital Scope application (DigScope.exe in the WinMark folder). If the encoder is properly connected, inputs IN1 and IN2 should toggle as the position encoder rotates through its range of motion.

# Tracking hardware

Note: WinMark Pro's Drawing Editor displays a motion arrow when tracking is enabled—Track Marking Object is Yes. The motion arrow points in the direction specified by the Motion Vector property (on the "Device" tab under Tools / General Settings…).

## Encoder setup

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

Encoder resolution (pulses per mm of motion) = X (pulses per rev) x Y (coupling factor) × 1 m/1000 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:

Encoder Resolution = X × Y × 1 m/1000 mm

= 800 pulses/rev × 14.32 rev/m × 1 m/1000 mm

= 11456.0 pulses/m × 1 m/1000 mm

Encoder Resolution = 11.456 pulses per millimeter of conveyor motion

An Encoder Resolution between 10–15 pulses per millimeter of conveyor motion should provide 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.

FH Flyer's optically-isolated high-speed inputs (IN1/IN2) have an input frequency limitation of 40 kHz. This means you should choose the encoder's output (encoder pulses per revolution) and the coupling factor (encoder revolutions per meter of conveyor motion) so that conveyor or line speed in mm/sec multiplied by the encoder's calculated pulses/mm of conveyor travel is less than 40,000 pulses/sec. Encoder pulses may be missed if the encoder output frequency exceeds 40 kHz.

Example:

The selected encoder outputs 3600 pulses/rev and the coupling factor is determined to be 8 rev/m of motion. Using the equation above, the calculated encoder resolution is 28.8 pulses/mm of conveyor motion. The required line speed is 144 ft/min (731.52 mm/s). Multiplying the line speed of 731.52 mm/s by the encoder's 28.8 pulses/mm of travel gives an input frequency of 21.067 kHz, which is within FH Flyer's input frequency limit of 40 kHz.

When you have finished your calculations, enter the calculated number of pulses per millimeter of motion for Encoder Resolution (Tools / General Settings... / "Device" tab / Encoder Resolution).

If necessary, fine-tune encoder resolution using the appropriate linestackxxx.mkh sample file included in the WinMark Pro software folder. This file consists of an array of 20 identical lines stacked on top 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.

To fine-tune encoder resolution, follow the steps below:

1 Go to the WinMark folder on your computer and open the appropriate linestackxxx.mkh file where xxx matches the lens installed on your marking head. For example, if a 200 mm focusing lens is installed, choose linestack200.mkh.

Note: If you are tracking with a Motion Vector other than 270°, you must rotate the appropriate linestackxxx.mkh file so that it is oriented correctly. For example, when tracking with a Motion Vector of 0° (from left to right across the Drawing Canvas), rotate the appropriate linestackxxx.mkh file 90° clockwise.

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 tracking performance as the mark may be too faint. Changing the Z-axis also affects the optimum Encoder Resolution value since the optical scanners are now moving through a longer or shorter arc.

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 it with the drawing in Figure 4-14 below.

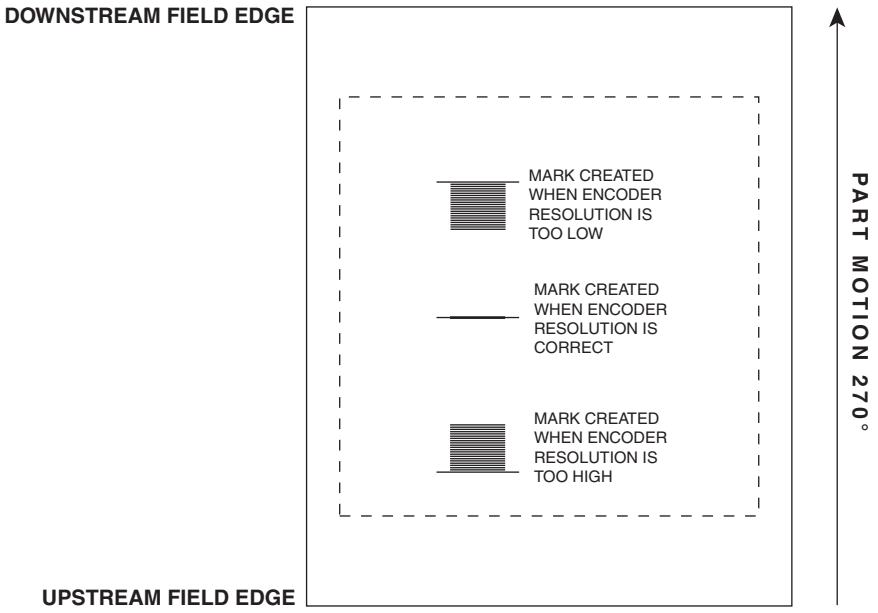


Figure 5-14 Linestack mark

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.

# Tracking hardware

## Part sensor

When tracking, a part sensor is required to send 'start mark' signals to the Flyer marking head on input IN0 (unless you enable the Internal Part Trigger property and specify a Part Pitch value). Any number of capacitive, inductive, photoelectric, or mechanical sensors currently on the market can be used depending on the part's material composition and your marking environment. Table 5-2 lists electrical specifications for choosing a part sensor.

Table 5-2 Part sensor specifications (for IN0)

| Function | Specifications |
|---|---|
| Input Voltage | User determined (+15.0 VDC if powered from Flyer's internal 15 V supply) |
| Output Signal | Open collector (PNP or NPN) or open drain (P-channel or N-channel)<br>or debounced mechanical limit switch<br>Low level output voltage: –1.0 V to +1.0 VDC (0 V typ.)<br>High level output voltage: +3.0 V to 24.0 VDC<br>On-state current: 6 mA typical; 9 mA maximum at 5 VDC<br>16 mA typical; 23 mA maximum at 12 VDC<br>20 mA typical; 29 mA maximum at 15 VDC<br>32 mA typical; 47 mA maximum at 24 VDC |

## Part sensor connection

The part sensor output is connected directly to input IN0 on FH Flyer's User Interface connector. To connect the part sensor, refer to the appropriate connection diagram. Figure 5-15 shows a customer-supplied power supply driving a current-sinking NPN open collector part sensor. Figure 5-16 shows how to power the same type sensor from Flyer's built-in +15 VDC power supply. See Figure 5-17 and 5-18 when wiring current-sourcing PNP open collector part sensors.

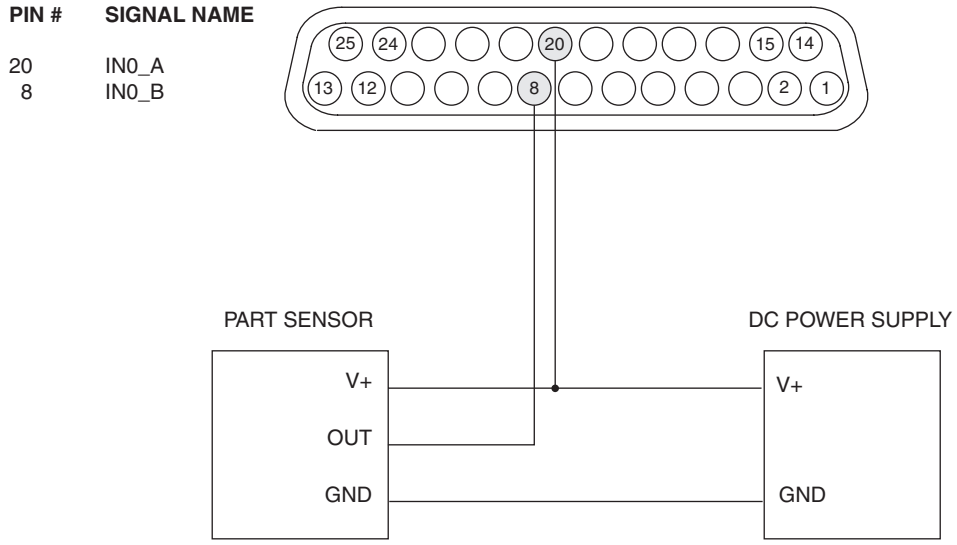


Figure 5-15 Wiring diagram for current-sinking (NPN open collector) part sensors

| PIN # | SIGNAL NAME |
|---|---|
| 20 | IN0_A |
| 8 | IN0_B |
| 1 | + 15 V |
| 14 | + 15 RTN |

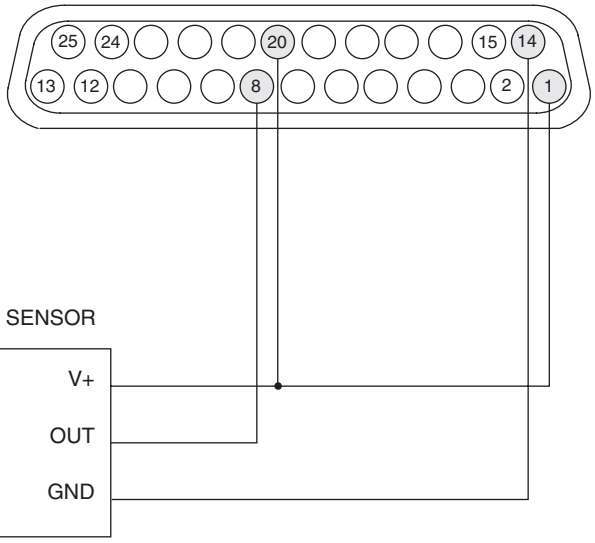


Figure 5-16 Wiring diagram for current-sinking (NPN open collector) part sensors using Flyer's built-in power supply

Figure 5-17 shows a customer-supplied power supply driving a current-sourcing PNP open collector part sensor. Figure 5-18 shows how to power the same type part sensor from Flyer's +15 VDC power supply.

| PIN # | SIGNAL NAME |
|---|---|
| 20 | IN0_A |
| 8 | IN0_B |

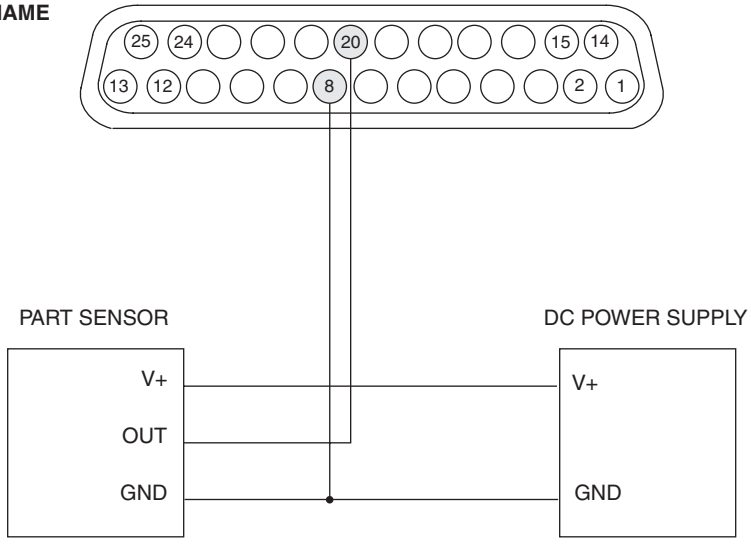


Figure 5-17 Wiring diagram for current-sourcing (PNP open collector) part sensors

# Tracking hardware

| PIN # | SIGNAL NAME |
|---|---|
| 20 | IN0_A |
| 8 | IN0_B |
| 1 | + 15 V |
| 14 | + 15 RTN |

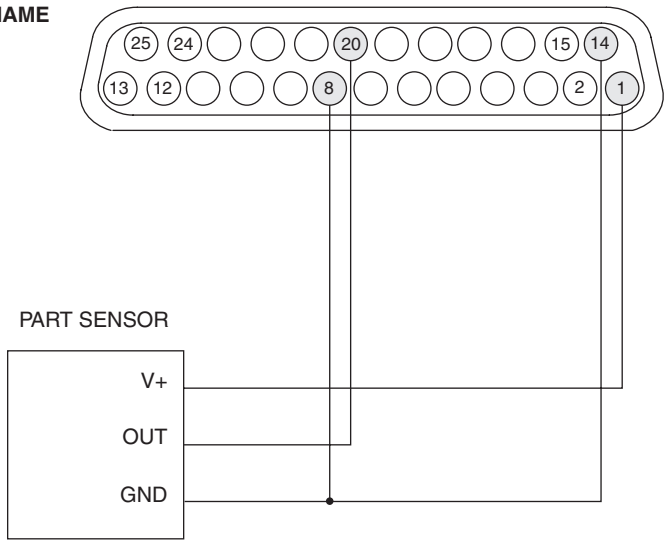


Figure 5-18 Wiring diagram for current-sourcing (PNP open collector) sensors using Flyer's built-in power supply

Verify that field wiring is correct after all part sensor connections are complete using the Digital Scope application (DigScope.exe in the WinMark folder). If the part sensor is properly connected, input IN0 should toggle when the part sensor activates.

## Part sensor setup

Set part sensor parameters by referring to Figure 5-19 and following the steps below:

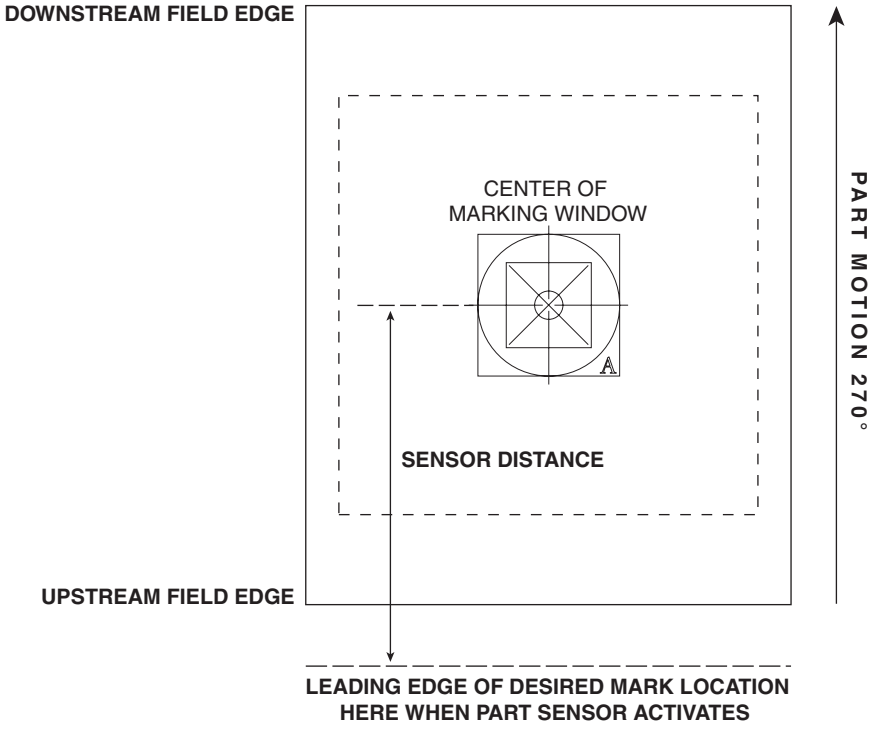


Figure 5-19 Part sensor setup

1. If required, adjust the part sensor's 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 marking head to generate "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.
2. In WinMark Pro, navigate to the Rising Edge Part Sense property and select Yes to set triggering on the sensor's rising edge or No to trigger on the falling edge. Ensure that your part sensor is configured to generate the correct rising or falling edge output pulse.
3. Center a sheet of anodized aluminum or a scrap production part on the conveyor under the focusing lens and press the Test Mark pushbutton on the marking head. This step locates the center of the Marking Window.
4. Mark the centerline of the test mark on a stationary point and then slowly jog the machine or conveyor (or move parts into position manually) until the part sensor is activated.
5. Measure the distance (at the instant the part sensor activates) from the centerline of the test mark (Marking Window) to the leading edge of the desired mark location on the part.
6. Enter this number (in the selected units of measure) for the Sensor Distance value in WinMark Pro.

# Tracking hardware

## DC power supply

The FH Flyer marking head incorporates an internal +15 VDC, 400 mA power supply output that can power a part sensor and position encoder as long as the combined current load does not exceed 400 mA. If your I/O components sink or source a total of more than 400 mA, you must provide an appropriately-sized DC power supply to power your I/O devices.

## Power supply specifications

Table 5-3 lists electrical specifications when choosing an external DC power supply to power your input/output circuits.

Table 5-3 Power supply specifications

| Function | Specifications |
|---|---|
| Input Voltage | User determined |
| Output Voltage | Select output voltage based on encoder and part sensor requirements within the range of +5.0–24.0 VDC |

## WinMark Pro tracking setup

WinMark Pro v6 contains a "Device" tab (labeled Flyer70014 in Figure 5-20). This tab contains head specific setup parameters and is located on the Tools menu under General Settings… (or right-click the Mark button in WinMark's Drawing Editor). In version 6, these tracking parameters are located on the "Device" tab because tracking parameters will vary slightly from head-to-head on production lines due to slight variations in encoder couplings, conveyor speeds, part sensor location, etc.

Note: The label of the "Device" tab corresponds to the "name" given to your Flyer head. Every Flyer head leaves the factory with a unique name based on the head's serial number—"Flyerxxxxxx"; where xxxxxx are the last six digits of the head's serial number. By using the Object Name property, you can rename your Flyer head to something meaningful to your facility such as its Ethernet IP address or a reference to its physical location such as "AssemblyLine3".

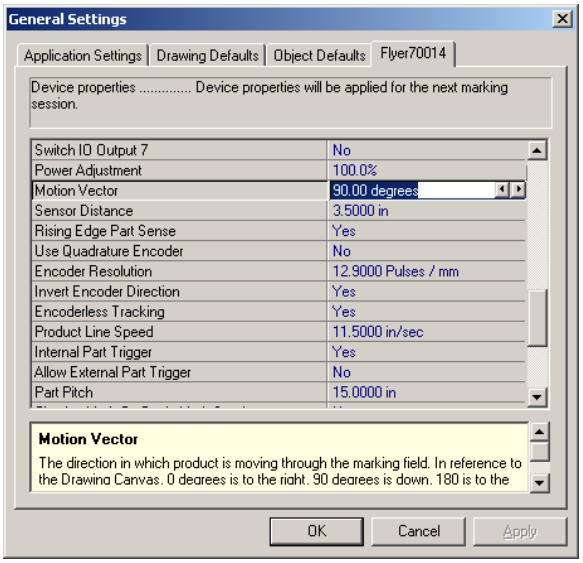


Figure 5-20 Tracking properties on "Flyer device" tab

To setup your FH Flyer marking head for tracking, make sure that your Flyer head is communicating with WinMark Pro v6 and then edit the tracking parameters described below.

### Motion Vector

Set the direction of part movement through the marking field. When looking at WinMark Pro's Drawing Canvas (shown in Figure 4-21), 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 the Track Marking Object property is Yes, a motion arrow displays to the left of the Drawing Canvas showing the direction of the currently entered Motion Vector.

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 is slightly slower due to the shorter mark area. WinMark Pro v6 and FH Flyer support Motion Vector values in 0.01° increments.

# WinMark Pro tracking setup

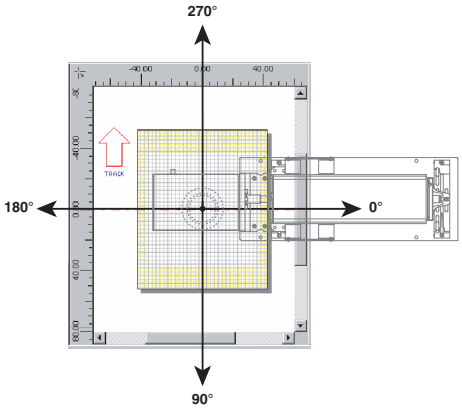


Figure 5-21 Drawing Canvas coordinates relative to FH Flyer

## 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 centerline of the Marking Window to the leading edge of the desired mark location on the part. Unlike other marking systems that are time-based, FH Flyer 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), FH Flyer begins counting encoder pulses. Marking begins when the number of encoder pulses counted by the head equals the Sensor Distance minus the distance from the center of the Marking Window to the Object Reference Point. Because FH Flyer calculates marking vectors based on encoder pulses (distance), Flyer's tracking algorithm can continue to accurately mark an object even when it stops or reverses direction, once the Target Area has fully entered the Tracking Window.

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 WinMark Pro's Drawing Canvas (in the axis of part motion) has no affect on part mark position. Figure 5-22 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.

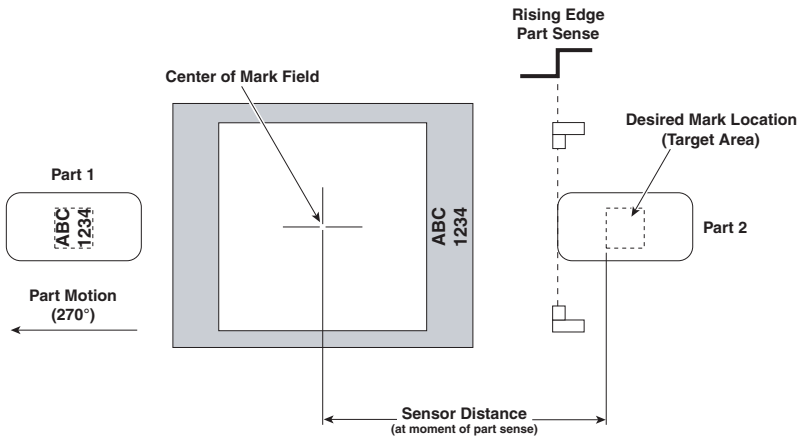


Figure 5-22 Upstream part sensor, rising edge trigger

Figure 5-23 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.

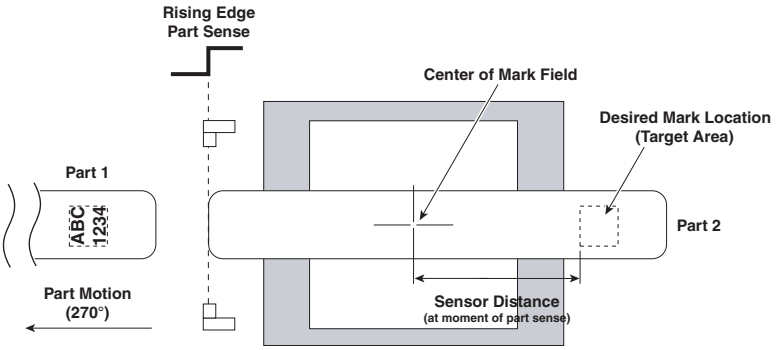


Figure 5-23 Downstream part sensor, rising edge trigger

Maximum tracking speeds are obtained when mark objects are positioned near the upstream edge of WinMark Pro's Drawing Canvas and the Motion Vector is set to 90° or 270°, which takes advantage of Flyer's rectangular marking field.

When positioning objects on the Drawing Canvas, remember that each marking object has an Object Reference Point, which is the object's top left corner (in the direction of part motion). The specified Sensor Distance must be greater than or equal to the absolute value of the X-position or Y-position reference point coordinate. When the tracking Motion Vector is 90° or 270°, Sensor Distance must be greater than or equal to the absolute value of the Y-position Object Reference Point. When the Motion Vector is 0° or 180°, Sensor Distance must be greater than or equal to the absolute value of the X-position coordinate.

If Sensor Distance minus the X- or Y-position Object Reference Point is less than zero, this means that the desired mark location is past the position of the Mark on the Drawing Canvas at the moment of part sense. To correct this "Invalid Sensor Distance" error, move the physical part sensor further upstream to increase Sensor Distance. If line speed (cycle time) is not an issue, you can instead move the object's location on the Drawing Canvas. In Figure 5-24, the text object's top left coordinate value is X = –0.5, Y = 2.0 (inches). If the Motion Vector is 270°, then Sensor Distance must be 2.0 inches or greater.

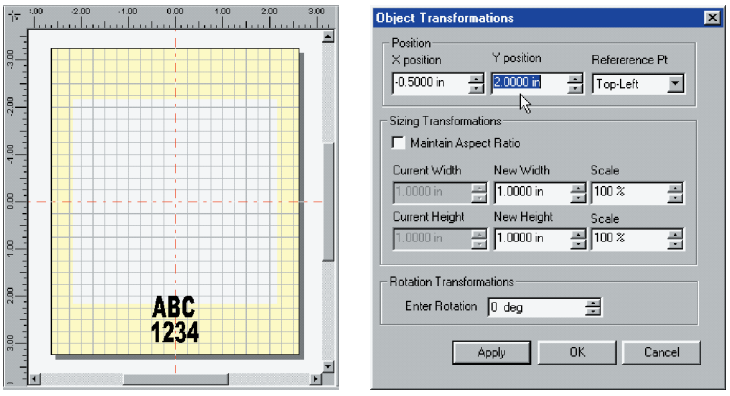


Figure 5-24 X-Y position Object Reference Point coordinates

# WinMark Pro tracking setup

Rotating an object also changes its 'start mark' position, which may require you to reposition the mark object on WinMark Pro's Drawing Canvas or change Sensor Distance (by moving 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 or change its 'start mark' position thus increasing overall line speed.

## Rising Edge Part Sense

Set Rising Edge Part Sense based on how the part sensor should trigger the mark. Select Yes to trigger marking on the rising edge of the sensor's output waveform. Choose No to trigger marking on the falling edge of the signal. Figure 5-25 illustrates typical part sensor waveforms.

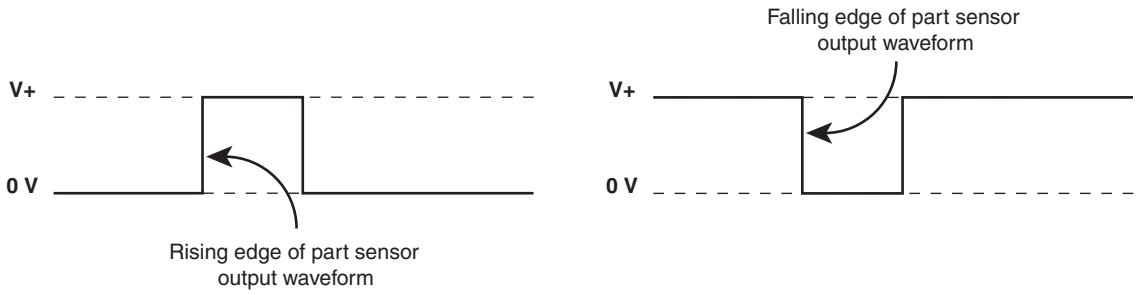


Figure 5-25 Part sensor output waveforms

## Use Quadrature Encoder

Select Yes when using a quadrature encoder where A and B input phases generate movement and directional information. Choose No if connected to a single-output position encoder (no directional information), which is appropriate only in applications where the part does not reverse direction during marking.

## 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 Pro is configured to display measurement units in inches or centimeters. See the Additional hardware section for information on determining the correct Encoder Resolution in your application.

## 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 to Flyer's User Interface connector.

## Encoderless Tracking

In constant velocity (line speed) applications, Encoderless Tracking allows Tracker part marking without using an external encoder. When Yes is selected, FH Flyer generates internal encoder pulses corresponding to the product velocity specified by the Product Line Speed property.

Important Note: Use the Encoderless Tracking property only in applications where line speed is tightly regulated. Any variation in product speed will result in poor quality marks.

# WinMark Pro tracking setup

## Product Line Speed

When Encoderless Tracking is enabled (set to Yes), enter a Product Line Speed value (in the selected units of measure) that is equal to conveyor or part velocity. Adjust Product Line Speed as required to fine-tune tracking to actual part movement.

## Internal Part Trigger

When operating FH Flyer in applications where it is not possible to sense individual pieces, for example in a continuous web process, use the Internal Part Trigger property to create an internal part sense signal. When Internal Part Trigger is enabled (set to Yes), FH Flyer generates an internal trigger signal at the distance interval specified by the Part Pitch property.

## Allow External Part Trigger

When Allow External Part Trigger is Yes, use an external signal on input IN0 to place a mark on a specific area of a web with the location of subsequent marks determined by the Part Pitch property. Set to No to ignore all signals on IN0. When Internal Part Trigger is No, this property is ignored.

The Allow External Part Trigger property will not delay the first mark beyond the point where the distance interval defined by Part Pitch is reached. Allow External Part Trigger is designed to allow exact placement of the first mark at any point before the specified Part Pitch distance is matched. Thereafter, marking is controlled by Internal Part Trigger signals based on the Part Pitch distance.

Important Note: When the Allow External Part Trigger property is set to Yes, a signal applied to input IN0 at any time will initiate a mark.

## Part Pitch

When Internal Part Trigger is enabled (set to Yes), enter a Part Pitch value in the selected units of measure. Part Pitch (or Mark Pitch)—defined as 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—determines where the Mark is placed on the product.

## Mark Count

(On the Drawing object's Marking tab)

In WinMark control mode, set Mark Count to '1' in situations where FH Flyer must track continuously (mark unlimited parts in a single mark session). To track continuously in Flyer Stand-alone mode, set the Mark Count property to '0'.

# Determining line speed

The Determining line speed section includes subsections:

- Line speed formula
- Sample calculations

## Line speed formula

Note: Line speed calculations do not account for 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 optimize your mark file to meet mark speed and mark quality requirements for the specific material to be marked.

The formula described below provides the approximate maximum line speed for a specific mark file using an FH Series Flyer marking head in tracking mode.

Line Speed = Tracking Window / 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 5-26 and read through the following sample line speed calculation.

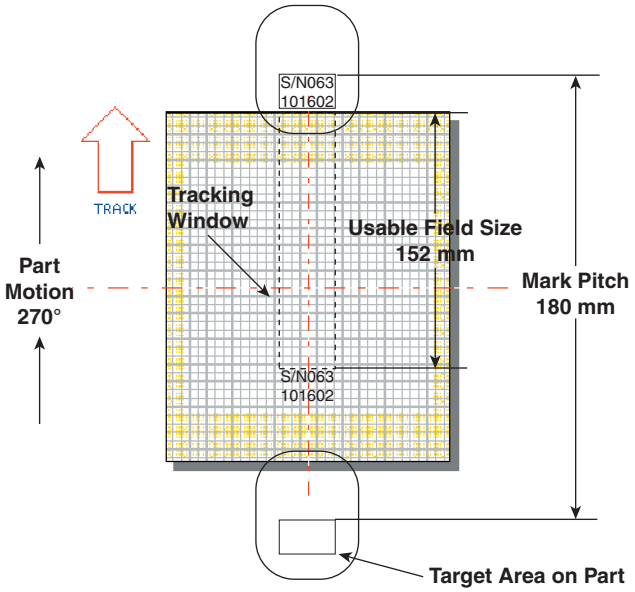


Figure 5-26 Tracker line speed calculation #1

## Determining line speed

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

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 static marking mode) is 0.32 seconds.

Line Speed = Tracking Window / Cycle Time

= 152 mm / 0.32 sec

Line Speed = 475 mm/sec = 28.5 m/min = 93.5 ft/min

## Sample calculation #2

Refer to Figure 5-27 and the following sample line speed calculation.

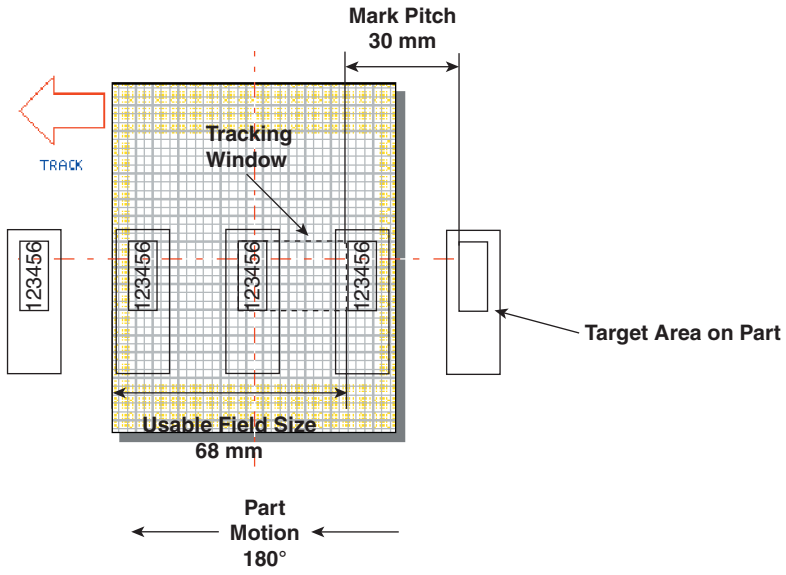


Figure 5-27 Tracker line speed calculation #2

The mark is being made by a Flyer head in tracking mode using a 125 mm FH lens. Maximum lens field dimensions are 105.6 mm × 85.7 mm. A Motion Vector of 180° is set 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.

Line Speed = Tracking Window / Cycle Time

= 30 mm / 0.20 sec

Line Speed = 150 mm/sec = 9 m/min = 29.5 ft/min

# Tracking optimization

The Tracking optimization section includes subsections:

- Text
- Graphics
- Mark placement
- Line speed optimization
- Summary

## Text

The best, and fastest, files to mark in a Flyer tracking application are those files containing only vector graphics and/or text objects created using WinMark Pro's built-in stroke fonts.

When marking a file containing non-filled stroke text (such as the "123XYZ" mark shown in Figure 5-28), FH Flyer starts marking when the Target Area encompassing "123XYZ" reaches the edge of 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 5-28 illustrates placement of the text to be marked on the Drawing Canvas.

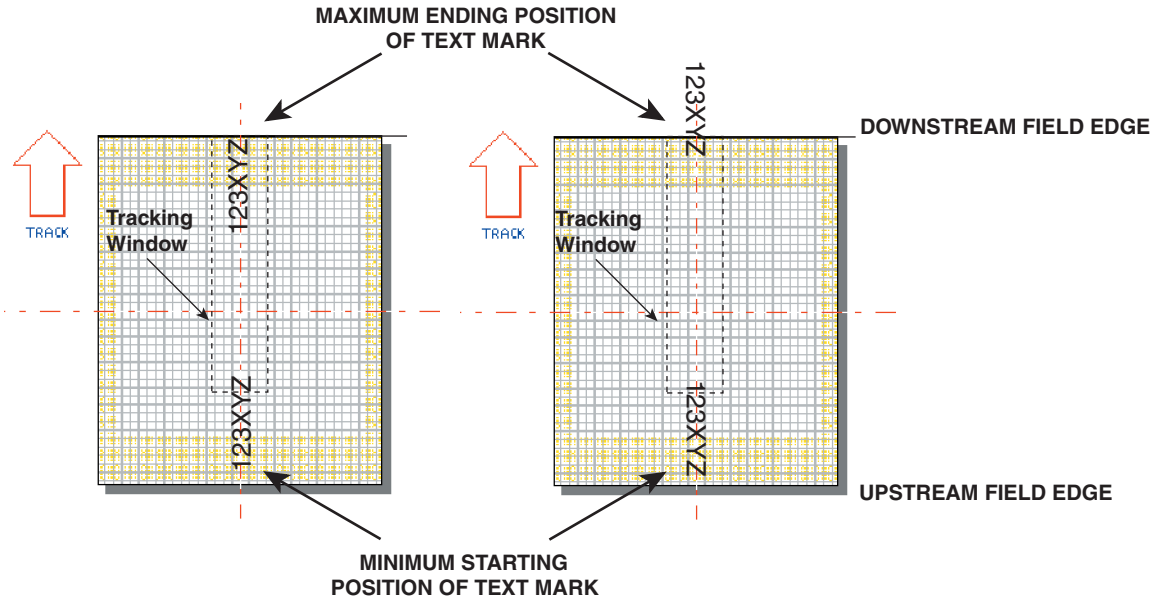


Figure 5-28 Sample text mark

Flyer marks text from left to right, just as you enter it in WinMark Pro's Text Caption Editor dialog box; all the characters in line 1, followed by all the characters in line 2, etc. (refer back to Figure 5-9). 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.

## Tracking optimization

Because FH Flyer marks text characters from left to right and top line to bottom line, proper orientation of the Mark on the Drawing Canvas will maximize the area available for marking. To achieve optimum line speeds, perform the following steps:

1 Orient either the text or the part to be marked as shown in Figure 5-29 so that the laser mark is made moving against, or counter to, the direction of part motion.

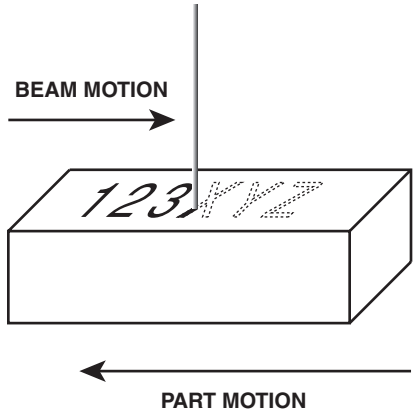


Figure 4-29 Beam/mark motion

2 In WinMark Pro, position the Mark on the Drawing Canvas so that the entire mark is placed near the upstream edge of the Marking Window (refer back to Figure 4-28).

Note: Because Sensor Distance must be greater than, or equal to, the absolute value of the X-position or Y-position Object Reference Point, you may need to move the physical placement of the part sensor to prevent an "Invalid Sensor Distance" error when marking.

3 Begin marking at the desired speed. If line speed is set too fast, a "Line speed too fast to finish" error message 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. To prevent a "Line speed too fast to finish" error, reduce line speed or decrease cycle time.

## 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, you can continue to mark graphic objects 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 remain inside the Tracking Window before marking is complete.

To optimize mark files containing both text and graphic objects, set the mark order so that all graphic objects mark before any text objects. In WinMark Pro, go to the Objects menu and click Set Marking Order. When the Configure Marking Order dialog box appears (Figure 5-30), arrange drawing objects as required.

# Tracking optimization

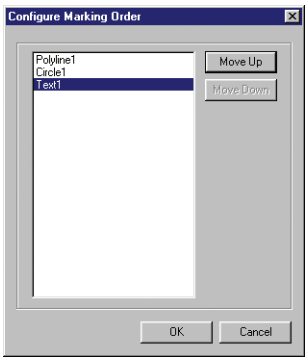


Figure 5-30 Configure Marking Order dialog box

## Mark placement

To achieve the highest potential line speed, position the mark near the upstream field edge of the Marking Window and then adjust Sensor Distance to position the actual mark on the part.

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

## Line speed 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 back in Figures 5-28 and 5-29).
- 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 object property variables

- Increase mark Velocity.
- Increase Off Vector Velocity.
- Reduce Resolution of raster-filled (bitmap) objects.
- Use one of WinMark Pro's built-in stroke fonts instead of TrueType® fonts.
- If possible, reduce the number of marking characters.
- When marking small 2D codes, set the 2D Barcode Bitmap property (located on the Format tab) to No. This forces WinMark Pro to mark vector circles instead of raster-filling cells.
- Simplify line art.

# Tracking optimization

## Summary

In tracking applications, line speed calculations do not take into account 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.

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# technical reference

# 6

Use information in this chapter as a technical reference for your FH Flyer marking head.

This chapter contains the following information:

- FH Flyer technical overview –describes SYNRAD's FH Flyer technology.
- Input/Output circuitry – explains Flyer's Input/Output (I/O) capability and provides basic I/O connection diagrams.
- USB port – describes Flyer's USB interface.
- Ethernet port – describes Flyer's Ethernet interface.
- Fast Acting Safety Interlock – describes Flyer's Fast Acting Safety Interlock feature.
- Flyer web interface – explains details about Flyer's Internet interface.
- Firmware upgrades – describes how to upgrade Flyer's operating code.
- Clearing mark – describes how WinMark Pro's clearing mark feature may prolong optical scanner lifetime.
- Over-temperature warning – describes FH Flyer's over-temperature warning feature.
- Custom test mark feature – explains how to implement the custom test mark feature using WinMark Pro v6 and your FH Flyer marking head.
- General specifications – lists FH Series Flyer marking head specifications.
- FH Flyer package outline drawing – illustrates FH Series Flyer marking head package outline and mounting dimensions.
- Flyer/Model 48-1/48-2 package outline drawings – illustrates package outline and mounting dimensions for Flyer with 48-1 (10 W) and 48-2 (25 W) lasers.
- Flyer/Model 48-5 package outline drawing – illustrates package outline and mounting dimensions for Flyer with a 48-5 (50 W) laser.
- Flyer/Firestar v30 package outline drawing – illustrates package outline and mounting dimensions for Flyer with a Firestar v30 (30 W) laser.
- Flyer/Firestar v40 package outline drawing – illustrates package outline and mounting dimensions for Flyer with a Firestar v40 (40 W) laser.
- Flyer/Firestar t70i package outline drawing – illustrates package outline and mounting dimensions for Flyer with a Firestar t70i (70 W) laser.

- Flyer/Firestar t-Series package outline drawing – illustrates package outline and mounting dimensions for Flyer with Firestar t-Series (60 W, 80 W, or 100 W) lasers.
- Flyer/Firestar f100 package outline drawing – illustrates package outline and mounting dimensions for Flyer with a Firestar f100 (100 W) laser.
- Flyer/Evolution 100 package outline drawing – illustrates package outline and mounting dimensions for Flyer with an Evolution 100 (100 W) laser.
- Flyer/Evolution 125 package outline drawing – illustrates package outline and mounting dimensions for Flyer with an Evolution 125 (125 W) laser.
- Flyer/Model 48-1/48-2 mounting – illustrates an exploded assembly drawing for Flyer with a 48-1 (10 W) or 48-2 (25 W) laser.
- Flyer/Model 48-5/Evolution 100/125 mounting – illustrates an exploded assembly drawing for Flyer with a 48-5 (50W), Evolution 100 (100 W), or Evolution 125 (125 W) laser.
- Flyer/Firestar v30 mounting – illustrates an exploded assembly drawing for Flyer with a Firestar v30 (30 W) laser.
- Flyer/Firestar v40/t-Series/f100 mounting – illustrates an exploded assembly drawing for Flyer with a Firestar v40 (40 W), Firestar t70i (70 W), Firestar t-Series (60, 80, or 100 W) or Firestar f100 (100 W) laser.

# technical reference

- FH Flyer packaging instructions – illustrates how to package an FH Flyer marking head for shipment using SYNRAD-supplied packaging materials.
- FLMK-1A packaging instructions – illustrates how to package an FH Flyer/48-1 fan-cooled marker for shipment using SYNRAD-supplied packaging materials.
- FLMK-2A packaging instructions – illustrates how to package an FH Flyer/48-2 fan-cooled marker for shipment using SYNRAD-supplied packaging materials.

## FH Flyer technical overview

The FH Series Flyer technical overview section includes subsections:

- Marking head
- Beam expansion
- Lens specifications

### 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 directed onto two lightweight X and Y mirrors mounted on separate high-speed optical 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.

WinMark Pro laser marking software sends vector data and laser power commands to FH Flyer through a USB or Ethernet connection where the processor on Flyer's control board converts vector data to microvector commands. These microvector commands, as well as the corresponding laser power commands, are sent to the Digital Signal Processor (DSP) on the control board. The DSP, which implements the servo loop that controls the position of the optical scanners, generates the correct timing between the microvector commands to insure the commanded marking speed and marking delays. The DSP also generates laser power commands and routes them to laser control circuitry on the control board in order to synchronize laser firing with movement of the optical scanners. This laser control circuitry generates a fixed 5 kHz tickle signal that maintains plasma ionization in the laser tube when the laser is commanded off and generates a variable Pulse Width Modulated (PWM) laser control signal that is user-adjustable (in WinMark Pro v6) within a frequency range of 1–50 kHz when the laser is commanded to fire.

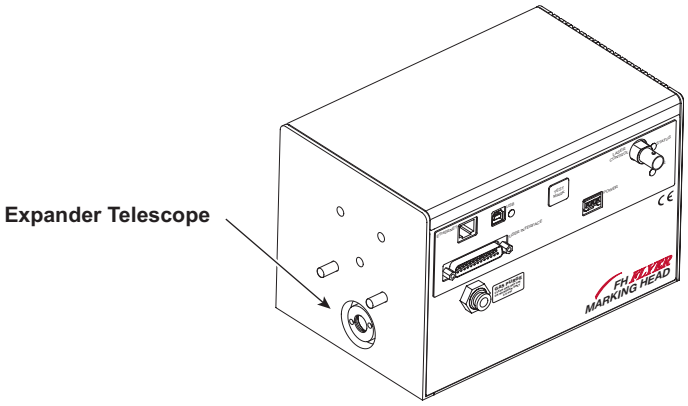
Note: FH Flyer's operating system requires approximately 25–30 seconds to boot up. Repeatedly cycling power during boot up may cause corruption of Flyer's flash memory and operating system.

### Beam expansion

Three distinct expansion ratios are available for FH Flyer marking heads. Depending upon the laser's beam diameter a 3X (48 Series and Firestar f100 lasers), 2.5X (Evolution lasers), or 5X (Firestar v-Series and t-Series lasers) expander telescope may be installed. Figure 6-1 shows the expander telescope location. You can identify FH expanders by their anodized color-coding—2.5X expanders are silver (clear anodized coat-ing over an aluminum housing), 3X expanders are black , and 5X expander telescopes are red.

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 optical scanner mirrors causing loss of output power and possible damage to internal marking head components.

Note: FLA370 lenses for FH Flyer heads have a notched mounting ring to provide clearance for 5X expanders. The 370-mm lens mount is dowel-pinned so it mounts in an orientation that provides clearance for heads fitted with the longer 5X expander.

# FH Flyer technical overview

Figure 6-1 Expander telescope location

## Lens specifications

The nominal (or standard) mark field for FH Series lenses is a square; however, to accommodate customers who require a slightly larger marking area at the same working distance, our FH Series lenses provide an extended rectangular mark area beyond the standard field specification. In WinMark Pro, the white center area on the Drawing Canvas denotes the nominal (standard) marking area for the currently installed focusing lens. The outer border (shaded yellow) indicates the maximum marking field for that lens. Note that mark objects placed in the yellow shaded area, especially those objects placed near the corners, may exhibit a slight degradation in mark quality. Table 5-1 lists nominal and maximum field sizes, working distance, focused spot size, and depth of field specifications for all FH Flyer lenses.

Note: See Initial start-up and Figure 3-2 in the Operation chapter for information on setting the correct working distance for your focusing lens.

Table 6-1 FH lens specifications

| Lens Focal Length | Nominal Field H × W, mm | Max. Field H × W, mm | Working Distance* typical, mm | Spot Size (1/e2), µm | Depth of Field, mm |
|---|---|---|---|---|---|
| 370 mm | 198 × 198<br>(7.8" × 7.8") | 241.0 × 297.0<br>(9.5" × 11.7") | 350 ± 5<br>(13.78") | 540<br>(0.021") | ±10<br>(±0.394") |
| 200 mm | 110 × 110<br>(4.3" × 4.3") | 134.0 × 165.0<br>(5.3" × 6.5") | 190 ± 3<br>(7.48") | 290<br>(0.011") | ±2.5<br>(±0.098") |
| 125 mm | 74 × 74 | 85.7 × 105.6 | 128 ± 2 | 180 | ±1.5 |

| | | | | | |
|---|---|---|---|---|---|
| | (2.9" × 2.9") | (3.4" × 4.2") | (5.04") | (0.007") | (±0.059") |
| 125HP** | 66 × 66<br>(2.6" × 2.6") | 80.4 × 99<br>(3.2" × 3.9") | 125 ± 2<br>(4.92") | 180<br>(0.007") | ±1.5<br>(±0.059") |
| 80 mm | 27 × 27<br>(1.1" × 1.1") | 33.5 × 41.2<br>(1.3" × 1.6") | 74 ± 1<br>(2.91") | 116<br>(0.005") | ±0.4<br>(±0.016") |

* The typical working distance is marked on each lens mount. Consult your marking head's Final Test Report for the actual working distance.

** High-power 125 mm lens for use with lasers 40 W and higher.

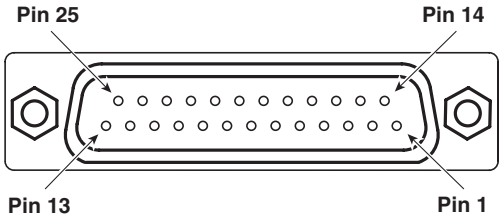
# Input/Output circuitry

The Input/Output circuitry section includes subsections:

- User Interface overview
- Internal +15 VDC supply
- Digital input circuitry
- Digital output circuitry
- FH Index/Tracker to Flyer conversion
- FH Smart to Flyer conversion

## User Interface overview

Flyer's DB-25 User Interface connection provides an isolated +15 VDC, 400 mA internal supply for powering externally-connected I/O devices; two high-speed optoisolated inputs; six bipolar optoisolated inputs; and eight bipolar optoisolated outputs that allow you to automate your marking operation. The male DB-25 User Interface connection requires a matching DB-25 female connector in order to attach external I/O devices to Flyer. A female DB-25 connector is included in the Flyer ship kit for this purpose.




**USER INTERFACE**

A simple parts handling system utilizing FH Flyer I/O 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

**Caution**
**possible equipment damage**

The pin assignments on Flyer's DB-25 User Interface connection are NOT compatible with FH Smart's DB-25 Parts Handling Control connection. If you are integrating an FH Flyer head into an existing FH Smart marking system, you must revise any I/O field wiring connected to Flyer's DB-25 connection. Failure to do so may damage Flyer's internal circuitry and/or any external devices connected to the I/O wiring harness.

a Flyer input. Flyer recognizes this input transition, sets an output bit to indicate the laser is on, and then marks the part. After the mark is complete, Flyer clears an output bit signaling the conveyor to start and run until another part is in place. Flyer then waits until another 'start mark' signal is received. The digital I/O capability of SYNRAD's FH Flyer marking head enables this kind of automated process control. Refer to the WinMark Pro Laser Marking Software User Guide or our Laser Marking FAQ on the WinMark web site (http://www.winmark.com) for details on configuring a basic automation sequence.

Figure 6-2 shows the physical layout of FH Flyer's User Interface connection.

Figure 6-2 Physical layout of Flyer's User Interface connection

## Input/Output circuitry

Table 6-2 lists pin assignments for Flyer's DB-25 User Interface connection. See the connection notes below for important information about A/B and HI/LO connection points.

Table 6-2 User Interface pin assignments

| DB-25 Pin # | Signal Name | Signal Description |
|---|---|---|
| 1 | + 15 V | Internal +15 VDC, 400 mA I/O power supply |
| 2 | OUT2–OUT7_B | *B connection point for OUT2 through OUT7 |
| 3 | OUT6_A | *A connection point for OUT6 |
| 4 | OUT4_A | *A connection point for OUT4 |
| 5 | OUT2_A | *A connection point for OUT2 |
| 6 | OUT1_A | *A connection point for OUT1 |
| 7 | OUT0_A | *A connection point for OUT0 |
| 8 | IN0_B | *B connection point for IN0 |
| 9 | IN1_HI | **High (+V) connection point for IN1 |
| 10 | IN2_HI | **High (+V) connection point for IN2 |
| 11 | IN4_A | *A connection point for IN4 |
| 12 | IN6_A | *A connection point for IN6 |
| 13 | IN3–IN7_B | *B connection point for IN3 through IN7 |
| 14 | + 15 RTN | Return point for internal 15 VDC supply |
| 15 | OUT7_A | *A connection point for OUT7 |
| 16 | OUT5_A | *A connection point for OUT5 |
| 17 | OUT3_A | *A connection point for OUT3 |
| 18 | OUT1_B | *B connection point for OUT1 |
| 19 | OUT0_B | *B connection point for OUT0 |
| 20 | IN0_A | *A connection point for IN0 |
| 21 | IN1_LO | **Low (–V) connection point for IN1 |

| | | |
|---|---|---|
| 22 | IN2_LO | **Low (–V) connection point for IN2 |
| 23 | IN3_A | *A connection point for IN3 |
| 24 | IN5_A | *A connection point for IN5 |
| 25 | IN7_A | *A connection point for IN7 |

* Bipolar inputs and outputs are not polarity sensitive—you can connect "A" and "B" connection points to either the low side (– VDC or return) or high side (+ VDC) of your I/O circuit.

** High-speed (encoder) inputs IN1 and IN2 are polarity sensitive. Connect the high, or positive, side (+ VDC) to the HI connection point. Connect the low, or return, side (– VDC) to the LO connection point.

# Input/Output circuitry

## Internal +15 VDC supply

An internal 15-volt (+15 VDC, 400 mA) isolated power supply is available to drive FH Flyer inputs or outputs in lieu of a customer-supplied power source. When powering input/output devices or tracking components such as part sensor and position encoder hardware, remember that the total current demand of these devices cannot exceed 400 mA. Table 6-3 summarizes +15 VDC pin assignments.

Table 6-3 +15 VDC pin assignments

| DB-25 Pin # | Signal Name | Signal Description |
|---|---|---|
| 1 | + 15 V | Internal +15 VDC, 400 mA I/O power supply |
| 14 | + 15 RTN | Return point for internal 15 VDC supply |

## Digital input circuitry

FH Flyer provides eight optoisolated inputs, IN0–IN7, for connecting to external input devices including part sensors, position encoders, relays, and Programmable Logic Controller (PLC) DC output modules. Table 6-4 summarizes input pin assignments.

Table 6-4 Input pin assignments

| DB-25 Pin # | Signal Name | Signal Description | Typical Use |
|---|---|---|---|
| 20 | IN0_A | *A connection point for IN0 | Part sense signal |
| 8 | IN0_B | *B connection point for IN0 | |
| 9 | IN1_HI | **High (+V) connection point for IN1 | High-speed input |
| 21 | IN1_LO | **Low (–V) connection point for IN1 | |
| 10 | IN2_HI | **High (+V) connection point for IN2 | High-speed input |
| 22 | IN2_LO | **Low (–V) connection point for IN2 | |
| 23 | IN3_A | *A connection point for IN3 | Any |
| 11 | IN4_A | *A connection point for IN4 | Any |

| | | | |
|---|---|---|---|
| 24 | IN5_A | *A connection point for IN5 | Any |

**Caution**
**possible equipment damage**

The voltage level for FH Flyer inputs is between 5V and 24 VDC. Note that this range differs from the input voltage range of previous FH Series marking heads. If your existing equipment interface uses voltages above 24.0 VDC, you must adapt your circuit or components to a voltage level between 5 V–24 VDC.

| | | | |
|---|---|---|---|
| 12 | IN6_A | *A connection point for IN6 | Any |
| 25 | IN7_A | *A connection point for IN7 | Any |
| 13 | IN3–IN7_B | *B connection point for IN3 through IN7 | |

* Bipolar inputs are not polarity sensitive—you can connect "A" and "B" connection points to either the low side (– VDC or return) or high side (+ VDC) of your I/O circuit.

** High-speed (encoder) inputs IN1 and IN2 are polarity sensitive. Connect the high, or positive, side (+ VDC) to the HI connection point. Connect the low, or return, side (– VDC) to the LO connection point.

# Input/Output circuitry

Inputs IN1 and IN2 are high-speed optoisolated inputs with a maximum input frequency of 40 kHz and are the required inputs when connecting a position encoder for tracking purposes. These inputs are unipolar where IN1_HI and IN2_HI always connect to the high (+V) side of the input circuit while IN1_LO and IN2_LO provide the corresponding isolated low side return. IN1/IN2 inputs are protected by 100 mA self-resetting fuses. Refer to Table 6-5 for IN1/IN2 input specifications. When driving Flyer's high-speed encoder inputs, IN1 and IN2, your signal device must be capable of providing the maximum current value shown in Table 6-5 at the appropriate input voltage.

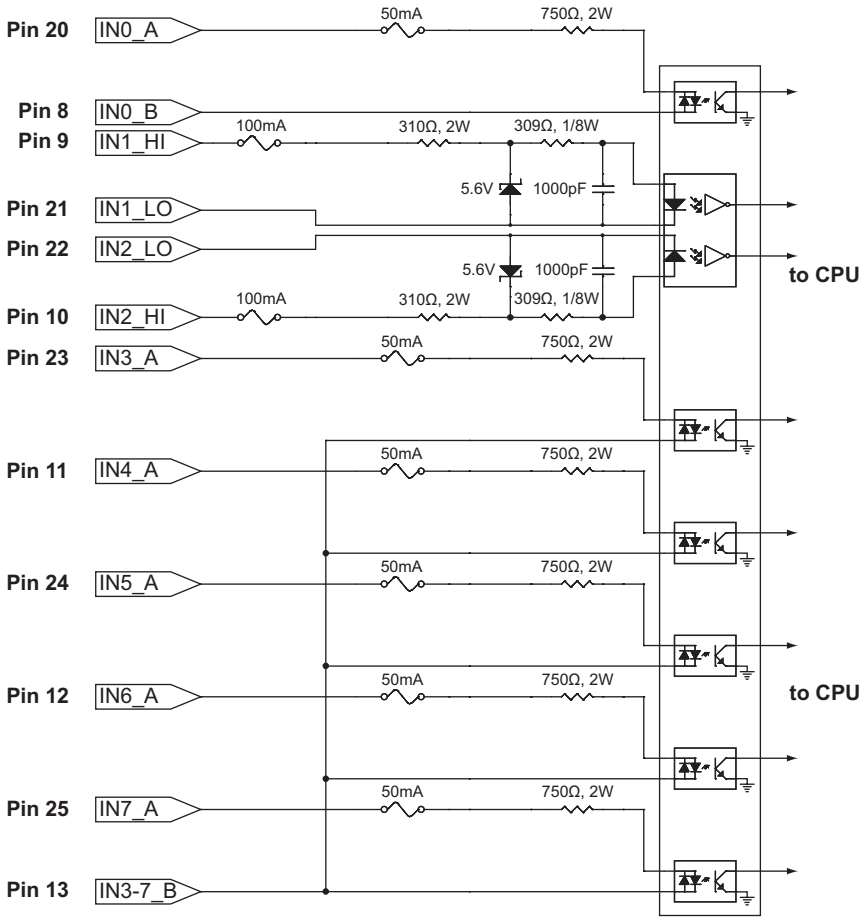
Table 6-5 Flyer high-speed input signal parameters—IN1/IN2

| Voltage In (VDC) | | Current In (mA) | | | | | | | | Frequency |
|---|---|---|---|---|---|---|---|---|---|---|
| Logic Low | Logic High | @5V | | @12V | | @15V | | @24V | | max (kHz) |
| | | Nom | Max | Nom | Max | Nom | Max | Nom | Max | |
| –0.6 to +1.7 | +5.0 to 24.0 | 6 | 9 | 22 | 32 | 32 | 47 | 62 | 90 | 40 |

The other six bipolar optoisolated inputs, IN0 and IN3–IN7, have a maximum input frequency of 1 kHz. Input IN0, which normally serves as the part sensor or 'start mark' input, has an isolated return line. Inputs IN3 through IN7 share a common return line that allows the user to configure either high-side switching on all five inputs or low-side switching on all five inputs. Inputs IN0 and IN3–IN7 are protected by 50 mA self-resetting fuses. Refer to Table 6-6 for IN0 and IN3–IN7 input specifications. When driving FH Flyer inputs IN0 and IN3 through IN7, your signal device must be capable of providing the maximum current value shown in Table 6-6 at the appropriate input voltage.

Table 6-6 Flyer input signal parameters—IN0, IN3–IN7

| Voltage In (VDC) | | Current In (mA) | | | | | | | | Frequency |
|---|---|---|---|---|---|---|---|---|---|---|
| Logic Low | Logic High | @5V | | @12V | | @15V | | @24V | | max (kHz) |
| | | Nom | Max | Nom | Max | Nom | Max | Nom | Max | |




## Input field wiring notes

- In electrically noisy environments, we recommend using shielded multi-conductor I/O cable as well as a shielded backshell when connecting field wiring to Flyer's DB-25 User Interface connector.
- To minimize ground loop noise, ground the cable shield at the signal source only. The cable shield at the User Interface connector must be left floating unless you are using Flyer's +15 VDC auxiliary power output as the I/O signal source.

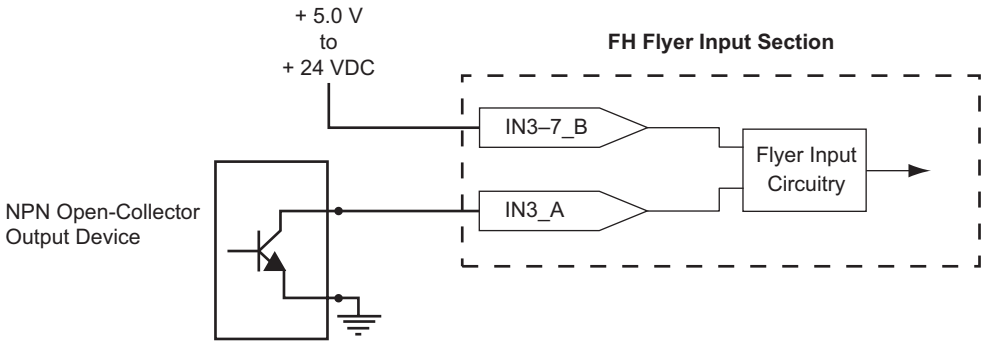
## Input/Output circuitry

Figure 6-3 illustrates an equivalent circuit diagram of FH Flyer's optically-isolated input circuitry.

Figure 6-3 FH Flyer's equivalent input circuit

## Sample input circuits

Flyer's optically-isolated inputs are used to start the mark sequence or perform other functions based on




signals from external devices. When an external device sinks or sources current through an input, FH Flyer senses a high-level state (1); when no current flows through the input, Flyer senses a low-level state (0). FH Flyer inputs are designed for compatibility with standard industrial control circuit voltages in the range from 5 V to 24 VDC. See Table 6-7 for a listing of possible input signal configurations.

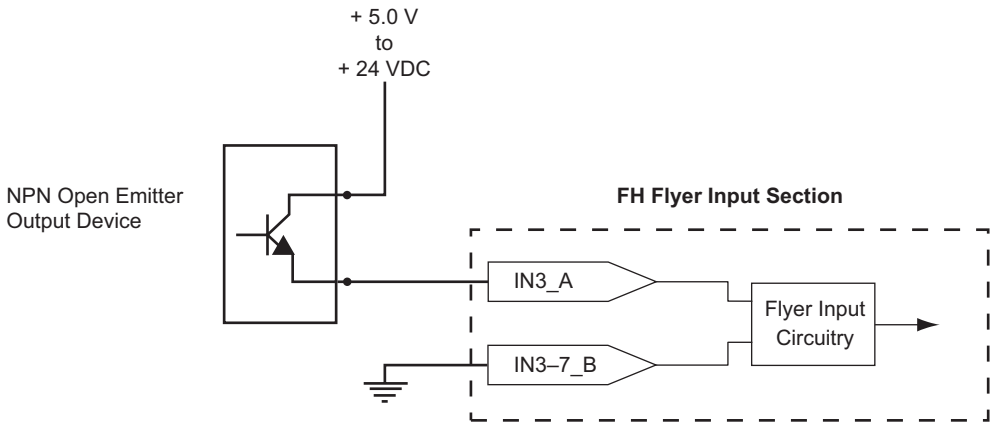
### From sinking NPN open collector device

Figure 6-4 illustrates one method of activating a Flyer input from an NPN open collector logic device that is sinking current.

# Input/Output circuitry

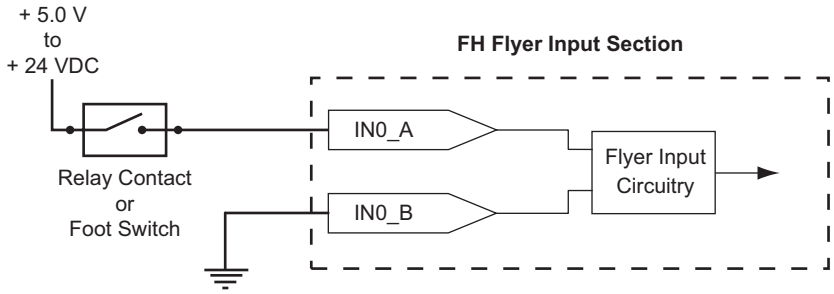
Figure 6-4 Activating Flyer input with a current sinking device

For example, to drive Flyer inputs from a PLC using an NPN open collector output module in




a current sinking configuration, connect the voltage source to IN3–7_B (the common return for inputs IN3_A through IN7_A) and connect each PLC output to Flyer inputs IN3_A through IN7_A as required. This allows the PLC's output module to independently activate Flyer inputs by pulling individual inputs to ground. In Figure 6-4, Flyer input IN3 is activated when input IN3_A is pulled to ground by the corresponding PLC output. See Table 6-7 for a listing of possible input signal configurations.

## From sourcing NPN open emitter



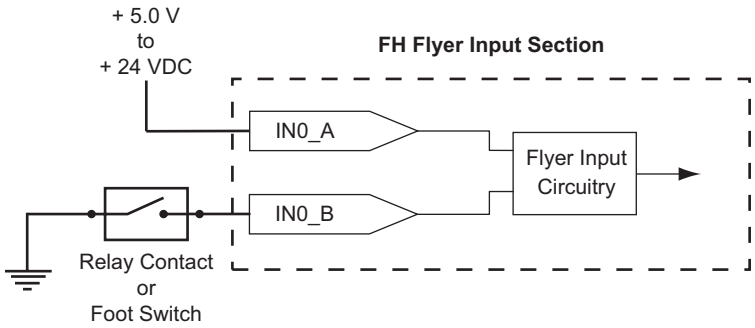

## device

Figure 6-5 illustrates a circuit for activating a Flyer input from an NPN open emitter logic device that is sourcing current.

Figure 6-5 Activating Flyer input with a current sourcing device

## From switch or relay contact

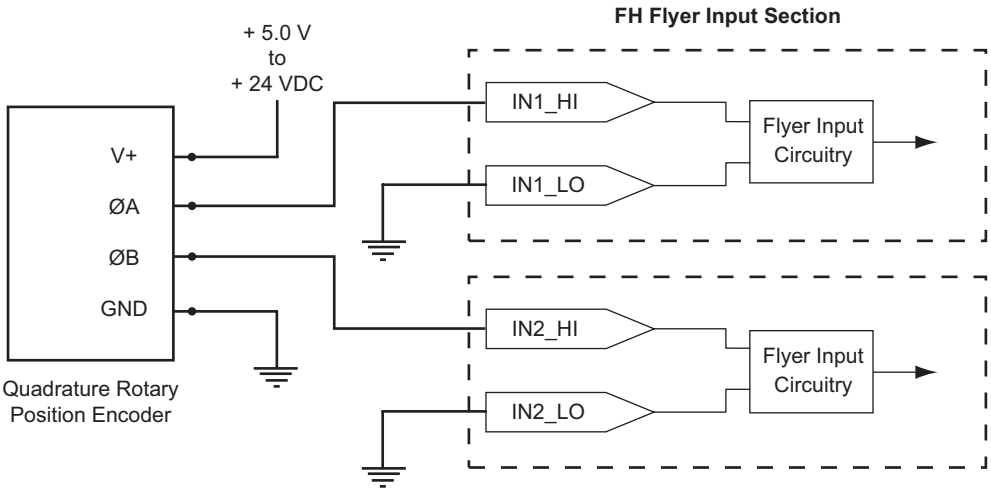
Another common requirement in marking applications is for an operator to initiate each mark operation by closing a foot-operated switch. Figure 6-6 illustrates a simple current sourcing cir-cuit for using a foot switch or relay contact to send an input signal to the Flyer marking head.




# Input/Output circuitry

Figure 6-6 Driving Flyer from current sourcing switch or relay device

For example, to use a foot switch or relay contact wired in a current sourcing configuration to initiate marking, connect your voltage source to one side of the Normally Open (NO) contact and connect the other side of the NO contact to IN0_A. Connect IN0_B back to the power supply's return connection to complete the circuit. Because IN0 is a bipolar input you could




instead connect the output of the foot switch to IN0_B and ground IN0_A depending on your wiring scheme. See Table 6-7 for a listing of possible input signal configurations.

Figure 6-7 illustrates the same foot switch or relay contact device connected in a current sink-ing configuration.

Figure 6-7 Driving Flyer from current sinking switch or relay device

# Input/Output circuitry

## From high-speed encoder input

In tracking applications, connect Flyer's high-speed inputs IN1 and IN2 to your position encoder. These two inputs can accept input frequencies up to 40 kHz. Figure 6-8 illustrates a circuit for connecting position encoder outputs to the FH Flyer marking head.

Figure 6-8 Driving Flyer from high-speed encoder input

Important Note: Remember that inputs IN1 and IN2 are unipolar. IN1_HI (Pin 9) and IN2_HI (Pin 10) must connect to the high (V+) side of the input signal while IN1_LO and IN2_LO must connect to the low or return side of the signal.

Input/Output circuitry

Table 6-7 lists possible ways you can connect Flyer inputs to your automation control circuits. For example, IN0 (typically the 'start mark' signal) is a bipolar input—you can connect IN0_A to the circuit' s high
(+V) side and IN0_B to the low side (return or power supply common) or you can connect IN0_B to the circuit's high side and IN0_A to the low side.

High-speed inputs IN1/IN2 must always be wired so that IN1_HI and IN2_HI are connected to the high (+V) side while IN1_LO and IN2_LO are always wired to the low side (return or power supply common).

Inputs IN3 through IN7 all share a common return line, IN3–IN7_B. If any of these inputs (IN3_A–IN7_A) is wired to the high (+V) side, then all other inputs must be wired to the circuit's high side. If your wiring scheme has the common return line, IN3–IN7_B, wired to the high side, then all inputs, IN3_A–IN7_A, must be wired to the circuit's low side (return or power supply common).

Table 6-7 Possible input signal configurations for FH Flyer

| Input High Side | Input Low Side |
|---|---|
| IN0_A | IN0_B |
| IN0_B | IN0_A |
| IN1_HI | IN1_LO |
| IN2_HI | IN2_LO |
| IN3_A[1] | IN3–7_B |
| IN4_A[1] | IN3–7_B |
| IN5_A[1] | IN3–7_B |
| IN6_A[1] | IN3–7_B |

| IN7_A[1] | IN3–7_B |
|---|---|
| IN3–7_B | IN3_A[2] |
| IN3–7_B | IN4_A[2] |
| IN3–7_B | IN5_A[2] |
| IN3–7_B | IN6_A[2] |
| IN3–7_B | IN7_A[2] |

1 If any input IN3 through IN7 is wired to the high side, then all inputs, IN3 through IN7, must be tied high because they share a common return line.

2 If any input IN3 through IN7 is wired to the low side, then all inputs, IN3 through IN7, must be tied low because they share a common return line.

# Input/Output circuitry

## Digital output circuitry

FH Flyer provides eight bipolar optoisolated outputs, OUT0–OUT7, for operating low-current relays or Programmable Logic Controller (PLC) DC input modules or other parts handling automation devices. Two outputs, OUT0 and OUT1, have isolated return pins that allow them to function independently as high-side (current sourcing) or low-side (current sinking) switches. The remaining six outputs, OUT2–OUT7, share a common return line that allows the user to configure all six outputs as either high-side switches or low-side switches. Table 6-8 summarizes output pin assignments while Table 6-9 shows output signal specifications. FH Flyer outputs are able to sink or source 30 mA maximum.

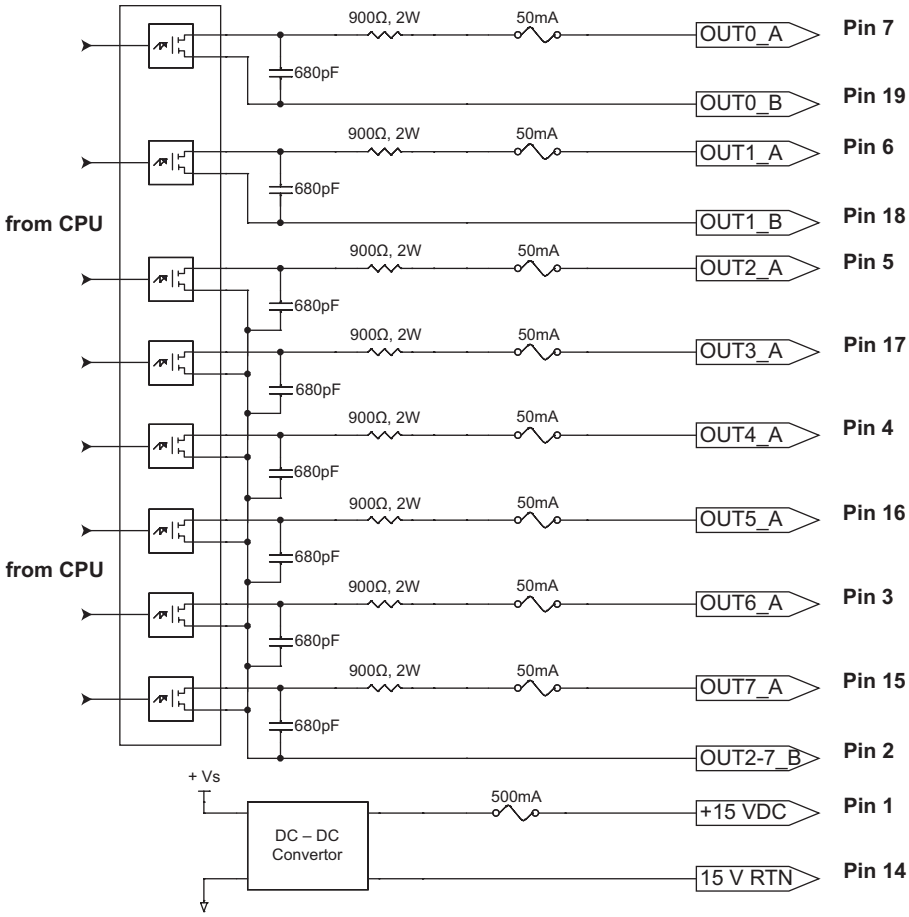
Table 6-8 Output pin assignments

| DB-25 Pin # | Signal Name | Signal Description | Typical Use |
|---|---|---|---|
| 7 | OUT0_A | *A connection point for OUT0 | Any |
| 19 | OUT0_B | *B connection point for OUT0 | |
| 6 | OUT1_A | *A connection point for OUT1 | Any |
| 18 | OUT1_B | *B connection point for OUT1 | |
| 5 | OUT2_A | **A connection point for OUT2 | Any |
| 17 | OUT3_A | **A connection point for OUT3 | Any |
| 4 | OUT4_A | **A connection point for OUT4 | Any |
| 16 | OUT5_A | **A connection point for OUT5 | Any |
| 3 | OUT6_A | **A connection point for OUT6 | Any |
| 15 | OUT7_A | **A connection point for OUT7 | Any |
| 2 | OUT2–OUT7_B | **B connection point for OUT2 through OUT7 | |

* Bipolar outputs are not polarity sensitive—you can connect "A" and "B" connection points to either the low side (– VDC or return) or high side (+ VDC) of your I/O circuit.

** Bipolar outputs are not polarity sensitive—you can connect "A" and "B" connection points to either the low side (– VDC or return) or high side (+ VDC) of your I/O circuit; however, OUT2–OUT7 share a common return point so outputs OUT2–OUT7 must all connect to either the low side (– VDC or return) or high side (+ VDC) — they cannot be mixed.

Table 6-9 FH Flyer output signal parameters

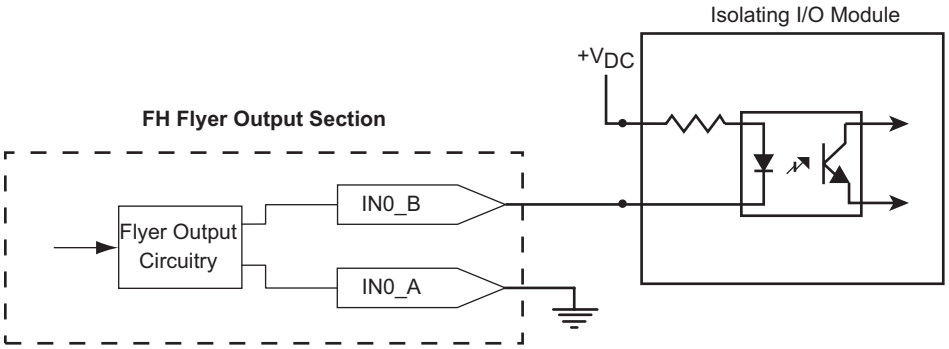
| Output Parameter | Specification |
|---|---|
|  | |
| Sinking/Sourcing Current, max. | 30 mA |
| Load Voltage, max. | 26 VDC |
| Output Impedance (On state) | ~900 Ohms |
| Turn-On Time, max. | 3.0 ms |
| Turn-Off Time, max. | 0.2 ms |
| Off State Leakage Current, max. | 1.0 µA |

## Input/Output circuitry

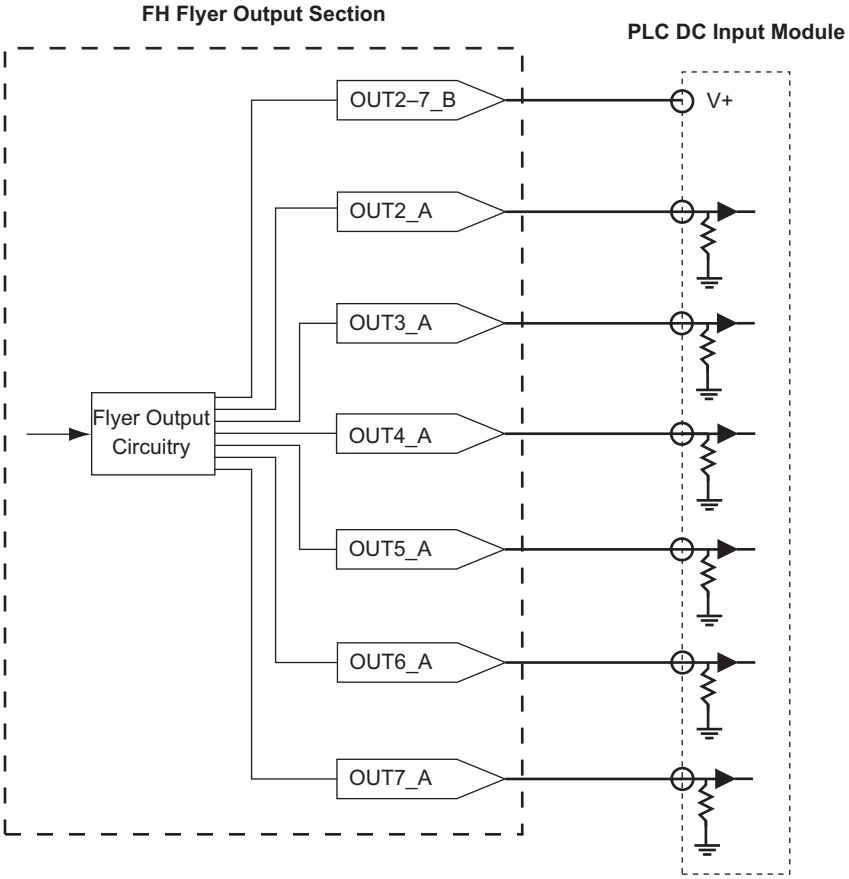
Figure 6-9 illustrates an equivalent circuit diagram of FH Flyer's optically-isolated output circuitry.

Figure 6-9 FH Flyer's equivalent output circuit

## Sample output circuits




FH Flyer's optically-isolated outputs are used to create flexible automated systems. Typically, one of these outputs is 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 Flyer outputs are shown on the following pages. FH Flyer outputs are designed for compatibility with standard industrial control circuit voltages in the range from 5 V to 24 VDC. Because Flyer outputs OUT0–OUT7 are bipolar, the circuits shown below can connect to either the "A" or "B" input connection. See Table 6-10 for a listing of possible output signal configurations.




### To isolated I/O module

Figure 6-10 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 Flyer's 900-ohm output resistance. See Table 6-10 for a listing of possible output signal configurations.

## Input/Output circuitry

Figure 6-10 Flyer output to isolated I/O module

### To PLC or logic interface

Figure 6-11 illustrates Flyer's bipolar outputs connected to a PLC DC input module. When the Flyer output is ON, it sources current and drives the PLC logic input to a logic high state. See Table 6-10 for a listing of possible output signal configurations.

Figure 6-11 Flyer output to PLC input module

## Input/Output circuitry

Table 6-10 lists possible ways you can connect Flyer outputs to your automation control circuits. Outputs OUT0 and OUT1 are bipolar outputs with isolated return lines. For example, if OUT0_A is wired to the circuit's high (+V) side, then wire OUT0_B to the low (return) side or you can connect OUT0_B to the high side and connect OUT0_A to the low side.

Outputs OUT2 through OUT7 share a common return line, OUT2–OUT7_B. When wiring your external circuit, the common return line, OUT2–OUT7_B is always connected to either the supply's high (V+) side or the supply's low (return). The "A" side of the outputs, OUT×_A, are always tied to the load.

For example, refer back to Figure 5-11. The common return line, OUT2–OUT7_B, is tied to the PLC's V+ high (V+) side. OUT2_A through OUT7_A are tied to the high side of the load and the other side of the load is returned back to the I/O power supply's return or common.

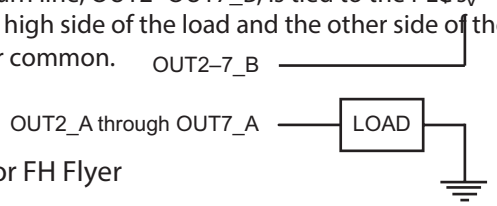
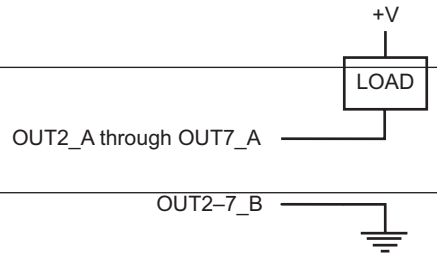



Table 6-10 Possible output signal configurations for FH Flyer

| Output High Side | Output Low Side |
|---|---|
| OUT0_A | OUT0_B |
| OUT0_B | OUT0_A |
| OUT1_A | OUT1_B |
| OUT1_B | OUT1_A |
| OUT2_A[1] | OUT2–7_B |
| OUT3_A[1] | OUT2–7_B |
| OUT4_A[1] | OUT2–7_B |
| OUT5_A[1] | OUT2–7_B |
| OUT6_A[1] | OUT2–7_B |
| OUT7_A[1, 2] | OUT2–7_B |



| | |
|---|---|
| OUT2–7_B | OUT2_A[3] |
| OUT2–7_B | OUT3_A[3] |
| OUT2–7_B | OUT4_A[3] |
| OUT2–7_B | OUT5_A[3] |
| OUT2–7_B | OUT6_A[3] |
| OUT2–7_B | OUT7_A[2, 3] |

1 If any output OUT2_A through OUT7_A is wired to the load's high side, then all outputs, OUT2_A through OUT7_A, must be wired high because they share a common return line.

2 When WinMark Pro's Switch IO Output 7 property is set to Yes, output OUT7 is inhibited from operating as a standard output. Output OUT7 will not activate when commanded by standard WinMark Pro automation or Digital Scope. See the Over-temperature warning section later in this chapter for details.

3 If any output OUT2_A through OUT7_A is wired to the load's low side, then all outputs, OUT2_A through OUT7_A, must be wired low because they share a common return line.

# Input/Output circuitry

## FH Index/Tracker to Flyer conversion

In order to retrofit a Flyer head into an existing FH Index or Tracker application, you must make changes to your physical field wiring. Refer to input circuit and output circuit conversion sections for specific details. Table 6-11 lists pin to pin connections for converting the Index/Tracker dual inline 18-pin connector to Flyer's DB-25 User Interface connector.

Important Note: The voltage level for FH Flyer inputs is between 5 V and 24 VDC. This range differs from the input voltage range of previous FH Series marking heads. If your existing equipment interface uses voltages above 24.0 VDC, you must adapt your circuit or components to a voltage level between 5 V–24 VDC.

Table 6-11 FH Index/Tracker to FH Flyer I/O conversion

| FH Index/Tracker I/O Connector | | Flyer DB-25 I/O Connector | | |
|---|---|---|---|---|
| Pin # | Wire Color | Function | Pin # | Function |
| 1 | Black | RTN4 | *2 | OUT2–7_B |
| 2 | White | OUT4 | 4 | OUT4_A |
| 3 | Red | OUT5 | 16 | OUT5_A |
| 4 | Green | RTN5 | *2 | OUT2–7_B |
| 5 | Orange | RTN6 | *2 | OUT2–7_B |
| 6 | Blue | OUT6 | 3 | OUT6_A |
| 7 | White/Black | OUT7 | 15 | OUT7_A |
| 8 | Red/Black | RTN7 | *2 | OUT2–7_B |

| | | | | |
|---|---|---|---|---|
| 9 | Green/Black | IN0 | 20 | IN0_A |
| 10 | Orange/Black | RTN0 | 8 | IN0_B |
| 11 | Blue/Black | IN1 | 9 | IN1_HI |
| 12 | Black/White | RTN1 | 21 | IN1_LO |
| 13 | Red/White | IN2 | 10 | IN2_HI |
| 14 | Green/White | RTN2 | 22 | IN2_LO |
| 15 | Blue/White | IN3 | 23 | IN3_A |
| 16 | Black/Red | RTN3 | 13 | IN3–IN7_B |
| 17 | — — | NC | | |
| 18 | — — | NC | | |

* On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. This wiring scheme assumes that RTN4–RTN7 are all tied to the I/O supply's DC common or return side (FH outputs are sinking current).

# Input/Output circuitry

## Input circuit conversion

Table 6-12 shows pin to pin connections for converting existing Index/Tracker input signals to Flyer's DB-25 User Interface connector.

Table 6-12 Index/Tracker input conversion

| FH Index/Tracker I/O Connector | | Flyer DB-25 I/O Connector | | |
|---|---|---|---|---|
| Pin # | Wire Color | Function | Pin # | Function |
| 9 | Green/Black | IN0 | 20 | IN0_A |
| 10 | Orange/Black | RTN0 | 8 | IN0_B |
| 11 | Blue/Black | IN1 | 9 | IN1_HI |
| 12 | Black/White | RTN1 | 21 | IN1_LO |
| 13 | Red/White | IN2 | 10 | IN2_HI |
| 14 | Green/White | RTN2 | 22 | IN2_LO |
| 15 | Blue/White | IN3 | 23 | IN3_A |
| 16 | Black/Red | RTN3 | 13 | IN3–IN7_B |

## Output circuit conversion

Tables 6-13 and 6-14 show pin to pin connections for converting existing Index/Tracker output signals to Flyer's DB-25 User Interface connector. Use Table 6-13 when all return lines (RTN4–RTN7) are connected to the I/O circuit's DC common or return (FH outputs function as low-side switches and are sinking cur-rent). Refer to Table 6-14 when all output lines (OUT4–OUT7) are connected to the I/O circuit's DC voltage supply (V+) (FH outputs function as high-side switches and are sourcing current).

Table 6-13 Index/Tracker output conversion—all RTN lines grounded (sinking current)

| FH Index/Tracker I/O Connector | | Flyer DB-25 I/O Connector | | |
|---|---|---|---|---|
| Pin # | Wire Color | Function | Pin # | Function |
| 1 | Black | RTN4 | *2 | OUT2–7_B |
| 2 | White | OUT4 | 4 | OUT4_A |
| 3 | Red | OUT5 | 16 | OUT5_A |
| 4 | Green | RTN5 | *2 | OUT2–7_B |
| 5 | Orange | RTN6 | *2 | OUT2–7_B |
| 6 | Blue | OUT6 | 3 | OUT6_A |
| 7 | White/Black | OUT7 | 15 | OUT7_A |
| 8 | Red/Black | RTN7 | *2 | OUT2–7_B |

* On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. This wiring scheme assumes that RTN4–RTN7 are all tied to the I/O supply's DC common or return side (FH outputs are sinking current).

## Input/Output circuitry

Use Table 6-14 when all output lines (OUT4–OUT7) are connected to the I/O circuit's DC voltage supply (V+).

Table 6-14 Index/Tracker output conversion—all OUT lines tied to V+ (sourcing current)

| FH Index/Tracker I/O Connector | | Flyer DB-25 I/O Connector | | |
|---|---|---|---|---|
| Pin # | Wire Color | Function | Pin # | Function |
| 1 | Black | RTN4 | 4 | OUT4_A |
| 2 | White | OUT4 | *2 | OUT2–7_B |
| 3 | Red | OUT5 | *2 | OUT2–7_B |
| 4 | Green | RTN5 | 16 | OUT5_A |
| 5 | Orange | RTN6 | 3 | OUT6_A |
| 6 | Blue | OUT6 | *2 | OUT2–7_B |
| 7 | White/Black | OUT7 | *2 | OUT2–7_B |
| 8 | Red/Black | RTN7 | 15 | OUT7_A |

* On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. This wiring scheme assumes that OUT4–OUT7 are all tied to the I/O supply's positive DC (V+) voltage (FH outputs are sourcing current).

If your existing FH Index/Tracker outputs are mixed, for example—one or more outputs are tied to the high side (V+) AND one or more outputs are tied to the low side (return or I/O supply's DC common)—the following wiring options are available to you:

| Caution<br>possible equipment damage | The pin assignments on Flyer's DB-25 User Interface connection are NOT compatible with FH Smart's DB-25 Parts Handling Control connection. If you are integrating an FH Flyer head into an existing FH Smart marking system, you must revise any I/O field wiring connected to Flyer's DB-25 connection. Failure to do so may damage Flyer's internal circuitry and/or any external devices connected to the I/O wiring harness. |
|---|---|

A Flyer supports two bipolar outputs—OUT0 and OUT1. If one or two of your existing FH Index/Tracker outputs are wired to the high (V+) side—sourcing current—and the other three or two outputs are wired to the low (return) side—sinking current—then wire those one or two outputs to Flyer outputs OUT0 and OUT1 and wire the other outputs as shown in Table 6-13.

If one or two of your existing FH Index/Tracker outputs are wired to the low (return) side—sinking current—and the other three or two outputs are wired to the high (V+) side—sourcing current—then wire those one or two outputs to Flyer outputs OUT0 and OUT1 and wire the other outputs as shown in Table 6-14.

B Re-wire your output circuit(s) so that all outputs are tied high and share a common return OR wire your circuit so that all outputs are tied low and share a common return.

Refer back to Table 6-10 for a list of possible output signal configurations. See Table 6-8 for a list of all output signals and their corresponding DB-25 pin numbers on Flyer's User Interface connector.



## FH Smart to Flyer conversion

In order to retrofit a Flyer head into an existing FH Smart application, you must make changes to your physical field wiring. Refer to input circuit and output circuit conversion sections for specific details. Table 6-15 on the following page lists pin to pin connections for converting the FH Smart DB-25 Parts Handling Control connector to Flyer's DB-25 User Interface connector.

Important Note: The voltage level for FH Flyer inputs is between 5 V and 24 VDC. This range differs from the input voltage range of previous FH Series marking heads. If your existing equipment interface uses voltages above 24.0 VDC, you must adapt your circuit or components to a voltage level between 5 V–24 VDC.

## Input/Output circuitry

Table 6-15 FH Smart to FH Flyer I/O conversion

| FH Smart I/O Connector | | Flyer DB-25 I/O Connector | |
|---|---|---|---|
| Pin # | Function | Pin # | Function |
| 1 | + 15 V | 1 | + 15 V |
| 2 | IN7 | 25 | IN7_A |
| 3 | IN6 | 12 | IN6_A |
| 4 | IN5 | 24 | IN5_A |
| 5 | IN4 | 11 | IN4_A |
| 6 | IN3 | 23 | IN3_A |
| 7 | IN2 | 10 | IN2_HI |
| 8 | IN1 | 9 | IN1_HI |
| 9 | IN0 | 20 | IN0_A |
| 10 | OUT6/OUT7 RTN | **2 | OUT2–OUT7_B |
| 11 | OUT5 | 16 | OUT5_A |
| 12 | OUT4 | 4 | OUT4_A |
| 13 | DO NOT CONNECT | — | — — |
| 14 | + 15 RTN / IN7 RTN* | 14 | + 15 V RTN* |
| 15 | IN6 RTN | 13 | IN3–IN7_B |
| 16 | IN5 RTN | 13 | IN3–IN7_B |

| | | | |
|---|---|---|---|
| 17 | IN4 RTN | 13 | IN3–IN7_B |
| 18 | IN3 RTN | 13 | IN3–IN7_B |
| 19 | IN2 RTN | 22 | IN2_LO |
| 20 | IN1 RTN | 21 | IN1_LO |
| 21 | IN0 RTN | 8 | IN0_B |
| 22 | OUT7 | 15 | OUT7_A |
| 23 | OUT6 | 3 | OUT6_A |
| 24 | OUT4/OUT5 RTN | **2 | OUT2–OUT7_B |
| 25 | DO NOT CONNECT | — | — — |

* If your existing FH Smart head has the return (common) from input IN7 (IN7 RTN) wired to Pin 14, you must move this input return connection to Pin 13, IN3–IN7_B, on the FH Flyer marking head.

** On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. This wiring scheme assumes that OUT4/OUT5 RTN and OUT6/OUT7 RTN are all tied to the I/O supply's DC common or return side (FH Smart outputs are sinking current).

# Input/Output circuitry

## Input circuit conversion

Table 6-16 shows pin to pin connections for converting existing FH Smart input signals to Flyer's DB-25 User Interface connector.

Table 6-16 FH Smart input conversion

| FH Smart I/O Connector | | Flyer DB-25 I/O Connector | |
|---|---|---|---|
| Pin # | Function | Pin # | Function |
| 2 | IN7 | 25 | IN7_A |
| 3 | IN6 | 12 | IN6_A |
| 4 | IN5 | 24 | IN5_A |
| 5 | IN4 | 11 | IN4_A |
| 6 | IN3 | 23 | IN3_A |
| 7 | IN2 | 10 | IN2_HI |

| | | | |
|---|---|---|---|
| 8 | IN1 | 9 | IN1_HI |
| 9 | IN0 | 20 | IN0_A |
| 14 | IN7 RTN* | 13 | IN3–IN7_B |
| 15 | IN6 RTN | 13 | IN3–IN7_B |
| 16 | IN5 RTN | 13 | IN3–IN7_B |
| 17 | IN4 RTN | 13 | IN3–IN7_B |
| 18 | IN3 RTN | 13 | IN3–IN7_B |
| 19 | IN2 RTN | 22 | IN2_LO |
| 20 | IN1 RTN | 21 | IN1_LO |
| 21 | IN0 RTN | 8 | IN0_B |

* If your existing FH Smart head has the return (common) from input IN7 (IN7 RTN) wired to Pin 14, you must move this input return connection to Pin 13, IN3–IN7_B, on the FH Flyer marking head.

# Input/Output circuitry

## Output circuit conversion

Tables 6-17 and 6-18 show pin to pin connections for converting existing Index/Tracker output signals to Flyer's DB-25 User Interface connector. Use Table 6-17 when all return lines (RTN4–RTN7) are connected to the I/O circuit's DC common or return (FH outputs function as low-side switches and are sinking cur-rent). Refer to Table 6-18 when all output lines (OUT4–OUT7) are connected to the I/O circuit's DC voltage supply (V+) (FH outputs function as high-side switches and are sourcing current).

Table 6-17 FH Smart output conversion—all RTN lines grounded (sinking current)

| FH Smart I/O Connector | | Flyer DB-25 I/O Connector | |
|---|---|---|---|
| Pin # | Function | Pin # | Function |
| 10 | OUT6/OUT7 RTN | *2 | OUT2–OUT7_B |
| 11 | OUT5 | 16 | OUT5_A |
| 12 | OUT4 | 4 | OUT4_A |
| 22 | OUT7 | 15 | OUT7_A |
| 23 | OUT6 | 3 | OUT6_A |
| 24 | OUT4/OUT5 RTN | *2 | OUT2–OUT7_B |

* On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. This wiring scheme assumes that OUT4/OUT5 RTN and OUT6/OUT7 RTN are both tied to the I/O supply's DC common or return side (FH Smart outputs are sinking current).

Use Table 6-18 when all output lines (OUT4–OUT7) are connected to the I/O circuit's DC voltage supply (V+).

Table 6-18 FH Smart output conversion—all OUT lines tied to V+ (sourcing current)

| FH Smart I/O Connector Pin # | Function | Flyer DB-25 I/O Connector Pin # | Function |
|---|---|---|---|
| 10 | OUT6/OUT7 RTN | 3 | OUT6_A |
| 12 | OUT4 | *2 | OUT2–OUT7_B |
| 23 | OUT6 | *2 | OUT2–OUT7_B |
| 24 | OUT4/OUT5 RTN | 4 | OUT4_A |

* On the Flyer DB-25 User Interface connector, outputs OUT2–OUT7 share a common return—OUT2–7_B on Pin 2. Because FH Smart OUT4/OUT5 and OUT6/OUT7 share common returns, only two outputs (OUT4 and OUT6) can be used in this current sourcing configuration. This wiring scheme assumes that FH Smart outputs OUT4–OUT7 are all tied to the I/O supply's positive DC (V+) voltage (FH Smart outputs are sourcing current).

If four or more outputs are required in a current sourcing arrangement (FH Flyer offers a total of eight outputs—two with isolated return lines, the other six share a common return), then rewire your Smart output circuitry to take advantage of this functionality. Refer back to Table 6-10 for a list of possible output signal configurations.

# USB port

The USB port section includes subsections:

- USB connections
- Electrical isolation/electrical noise

## USB connections

FH Series Flyer marking heads incorporate an isolated USB (Universal Serial Bus) connection between the host and the head. This connection provides communication between WinMark Pro and the Flyer head when marking, testing, or when configuring Flyer's Ethernet port. Flyer heads support USB V2.0 Full Speed connections with a data bandwidth of 12 million bits per second (Mbps). It is not necessary to power down Flyer or your computer when connecting or disconnecting the cable; USB protocol allows the ability to "hot" plug and unplug.

The Flyer ship kit includes a six-foot (1.8 m) long USB Communication cable. If a longer USB cable is required, SYNRAD highly recommends buying a USB extension cable. Please note that the USB specification does not permit an overall USB cable length longer than 16.4 feet (5.0 m). When supplying your own USB cable, please ensure that it is double-shielded. This prevents electrical noise in industrial environments from interfering with communications between your computer and the Flyer head.

Important Note: Before installing or upgrading WinMark Pro software, first disconnect DC power or unplug the USB cable from the Flyer head. This ensures that the Windows OS will load and install the latest Flyer USB driver.

## Electrical isolation/electrical noise

In situations where two AC powered devices are connected via an electrical connection, such as a USB cable, a large difference in the ground potential (voltage) can develop between these devices. For example, when the DC power supply for an FH Flyer marking head is powered from a different AC circuit than the circuit powering the personal computer or controller, the USB Communication cable can complete a ground loop that may damage the USB port in the marking head or in the computer or controller, render-

ing the USB port unusable.

FH Flyer heads, with serial numbers FHFLxxx100042 or higher, contain built-in isolated USB circuitry. Optical USB isolation provides protection from any ground loop voltage differentials that may exist and reduces the possibility that electromagnetic interference may disrupt communication between Flyer and its control device.

In industrial environments with excessive electrical noise problems, the USB protocol is susceptible to interference from radiated and conducted emission in excess of permissible EU standards. If your application requires the use of a USB connection in electrically-noisy environments, SYNRAD recommends installing an isolation device like the Icron® USB Rover™ 200 Isolated USB Hub. The USB Rover 200 provides immunity to ground loops by converting USB data into optical signals that are transmitted down a 32.8 foot (10 m) fiber optic cable and back into digital data at the other end. This optically isolated USB connection may improve immunity to electrical interference if you expose only the optical cable portion to potential interference AND minimize or shield the rest of the USB cable from the interfering environment.

See SYNRAD Technical Bulletin #13 (available from the SYNRAD web site at http://www.synrad.com/Manuals/tech_bulletins.htm) for further information about operating FH Flyer in electrically-noisy environments.

# Ethernet port

The Ethernet port section includes subsections:

- Ethernet overview
- Ethernet port LEDs
- Ethernet/Flyer cabling

## Ethernet overview

FH Series Flyer marking heads incorporate an Ethernet connection for communication between the host and the head. This connection provides a communication link between WinMark Pro and the Flyer head when marking or testing in real-time. Flyer heads support Ethernet 10/100 Base-T Fast Ethernet connections with a data bandwidth of 10/100 million bits per second (Mbps). See Configuration in the Getting Started chapter for information on Ethernet configuration via a USB or peer-to-peer Ethernet connection.

Note: When marking with FH Flyer in tethered mode (where the computer is sending mark data to Flyer in real-time through a USB or Ethernet connection), you must consider Ethernet latency issues when mark cycle times are very short (< 1 second) because the Ethernet protocol does not always transmit data in real-time. Occasionally, a latency period up to 200 milliseconds (ms) will occur between the time a 'start mark' signal is received and lasing begins. When this latency period becomes a significant portion of the cycle time, you should consider an isolated USB connection or operate Flyer in stand-alone mode.

## Ethernet port LEDs

Flyers Ethernet port contains two built-in miniature LEDs. The yellow LED is either Off, which indicates no Ethernet activity (or no connection), or is Blinking, which indicates there is Ethernet activity. The green LED is either Off, when there is no active WinMark Pro communication, or is On to indicate an open WinMark Pro session.

## Ethernet/Flyer cabling

In most cases, you can purchase an Ethernet patch cable or crossover cable in the correct length for your application. The type of computer network used in your facility will determine which type of cable is required—if in doubt contact your company's Network Administrator. If you require a longer cable than is commercially available or prefer to build your own custom length cable, then refer to the Tables and Fig-ures below. Table 6-19 and Figure 6-12 provide details for a straight-thru Ethernet cable while Table 6-20 and Figure 6-13 describe a crossover Ethernet cable.

## Ethernet wiring notes

- Use male RJ45 connectors on both ends of the Ethernet cable.
- Use Category 5 (CAT5 or CAT5e) Ethernet cable.
- Each twisted cable pair must be kept as a pair. TX+ / TX– must be a pair; RX+ / RX– must be another pair; etc.
- Pair 1 (the blue pair) connects to pins 4 & 5; pair 2 (orange pair) connects to pins 1 & 2; pair 3 (green pair) connects to pins 3 & 6; and pair 4 (brown pair) connects to pins 7 & 8.
- Color codes are referenced to the pin numbers and names on the host interface.

## Ethernet port

Table 6-19 provides pin assignments for straight-thru Ethernet cable.

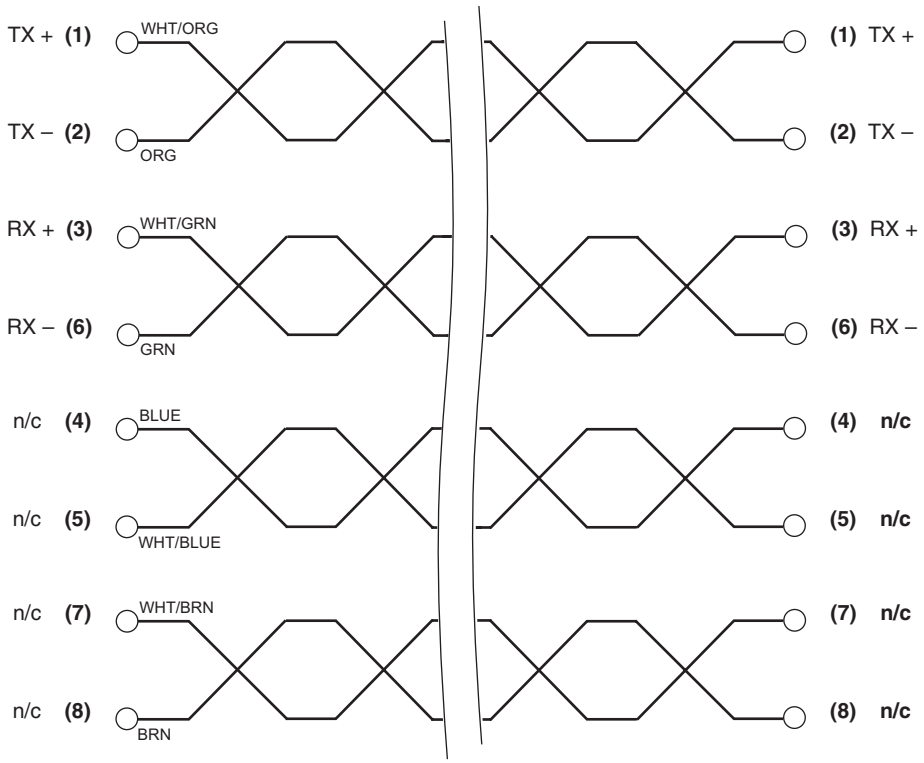



Table 6-19 Ethernet pin assignments—straight-thru connection

| Name | RJ45 Pin # | Cable Color | RJ45 Pin # | Name |
|---|---|---|---|---|
| TX+ | 1 | White/Orange | 1 | TX+ |
| TX– | 2 | Orange | 2 | TX– |
| RX+ | 3 | White/Green | 3 | RX+ |
| n/c | 4 | Blue | 4 | n/c |
| n/c | 5 | White/Blue | 5 | n/c |
| RX– | 6 | Green | 6 | RX– |
| n/c | 7 | White/Brown | 7 | n/c |
| n/c | 8 | Brown | 8 | n/c |

n/c — not connected

Figure 6-12 shows the physical wiring for a straight-thru Ethernet cable.

Figure 6-12 Physical wiring—straight-thru Ethernet connection

# Ethernet port

Table 6-20 provides pin assignments for wiring a crossover Ethernet cable.

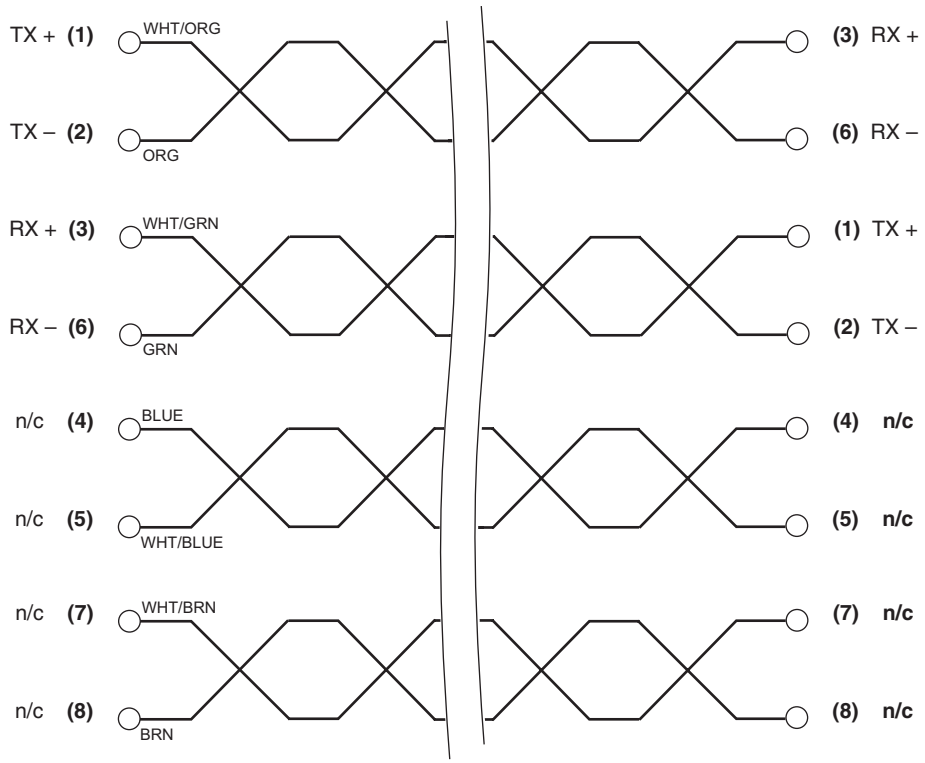



Table 6-20 Ethernet pin assignments—crossover connection

| Name | RJ45 Pin # | Cable Color | RJ45 Pin # | Name |
|---|---|---|---|---|
| TX+ | 1 | White/Orange | 3 | RX+ |
| TX– | 2 | Orange | 6 | RX– |
| RX+ | 3 | White/Green | 1 | TX+ |
| n/c | 4 | Blue | 4 | n/c |
| n/c | 5 | White/Blue | 5 | n/c |
| RX– | 6 | Green | 2 | TX– |
| n/c | 7 | White/Brown | 7 | n/c |
| n/c | 8 | Brown | 8 | n/c |

n/c — not connected

Figure 6-13 shows the physical wiring for crossover Ethernet cable.

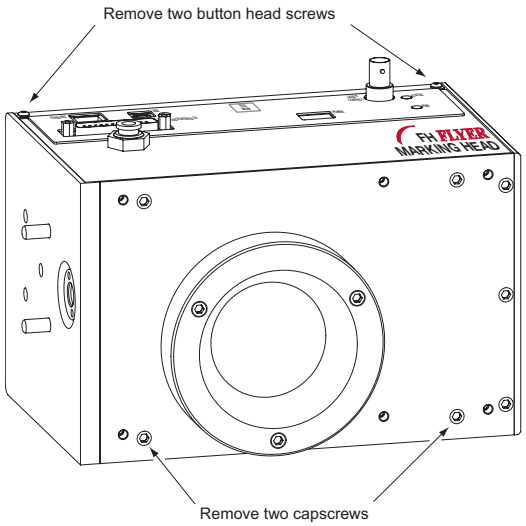
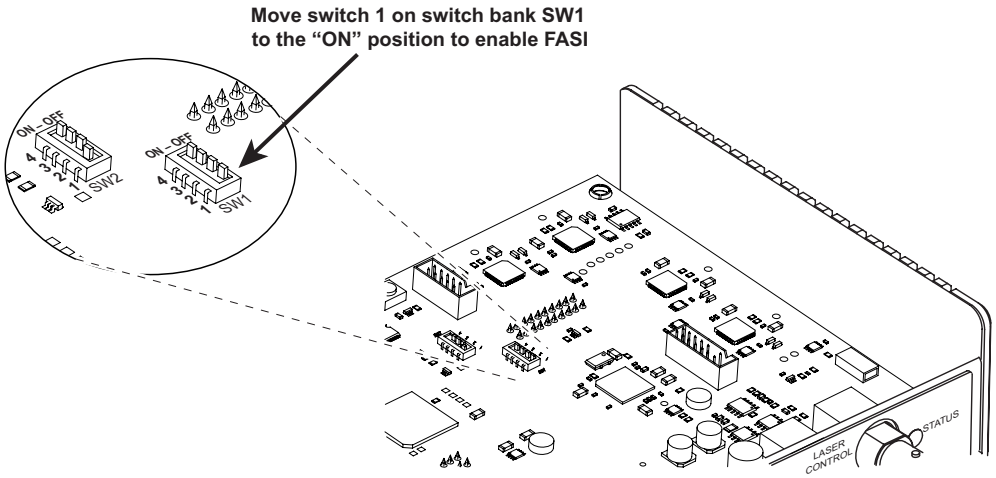



Figure 6-13 Physical wiring—crossover Ethernet connection

## Fast Acting Safety Interlock

Many marking applications require a safety action to occur for each part that is marked. An example of this action is a machine that lowers a shield over a part prior to marking, and 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 safety switch on an access door or enclosure is opened. However in marking applications where a safety interlock is frequently cycled, the Remote Interlock may create an unacceptable delay. This delay occurs because closing the interlock (and cycling the Keyswitch, or remote keyswitch, on Keyswitch-equipped lasers) invokes a built-in five-second delay prior to lasing.

To address this issue, FH Flyer marking heads incorporate a Fast Acting Safety Interlock (FASI) function. The FASI function prevents Flyer from generating a PWM Command signal unless an active input is pres-




ent on input IN3. When an enable signal is applied, FH Flyer responds to the rising edge transition in less than 1 millisecond (ms).

Important Note: The Fast Acting Safety Interlock (FASI) function does NOT disable the laser. FASI only prevents FH Flyer from sending PWM Command signals to the laser. Flyer still sends tickle pulses (1 µs @ 5 kHz) out the Laser Control port in order to maintain plasma ionization inside the laser.

To enable Flyer's FASI feature, refer to Figure 6-14 and perform the following steps:

Figure 6-14 Opening Flyer to enable FASI

1 Remove DC power from the Flyer head or disconnect the DC Power cable.

2 Refer to Figure 6-14 and withdraw two button head Allen screws and two Allen head capscrews at the locations shown to remove Flyer's upper cover.

3 Ground yourself by keeping one hand in constant contact with Flyer's lower metal cover.

4 Locate the DIP switch bank labeled SW1 on the CPU board (see Figure 6-15) and move switch # 1 to the "ON" position.

# Fast Acting Safety Interlock

Figure 6-15 Flyer DIP switch locations

5 All other switches must remain at their default settings as listed on Table 5-21 below.

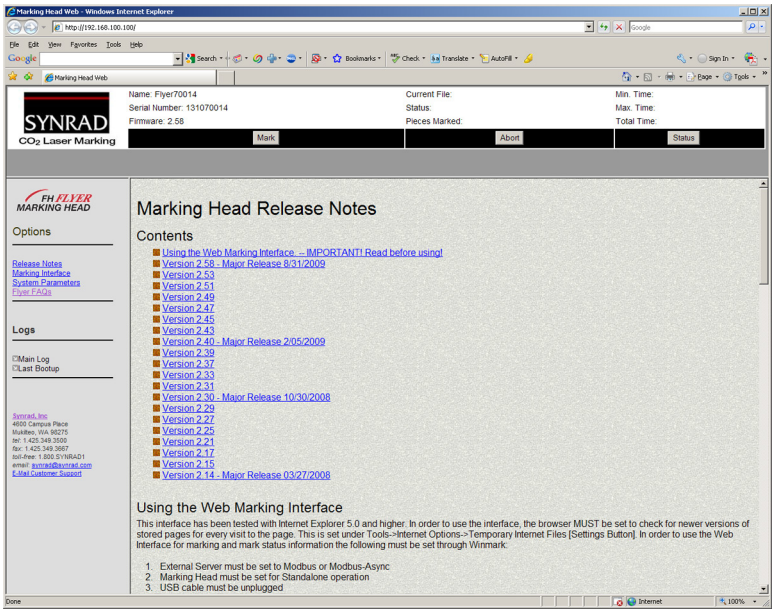
6 Replace Flyer's upper cover and tighten the screws removed in Step 2.

7 Open your mark files and configure WinMark's Wait Digital Before Piece automation command to wait for a "Set" state on input IN3 before marking begins. This step synchronizes marking operations with the FASI safety feature.

8 To begin lasing with FASI enabled, apply a 5–24 VDC signal to Flyer input IN3.

When FASI is enabled, IN3 must be active before Flyer sends PWM Command signals to the laser. If the FASI feature is enabled but IN3 is inactive (no current flow), then no marking will occur. In FASI mode, even manual firing of the laser using the Test Mark pushbutton requires an active input signal on IN3.

Note: Flyer's Status LED turns red and blinks rapidly if FASI is enabled and marking is commanded, but




IN3 is not active.

Table 6-21 Factory DIP switch assignments

| DIP SW # | SW # | Default Setting | Notes |
|---|---|---|---|
| SW1 | 1 | OFF | Switch ON to enable FASI |
| SW1 | 2 | OFF | must remain OFF |
| SW1 | 3 | OFF | must remain OFF |
| SW1 | 4 | OFF | must remain OFF |
| | | | |
| SW2 | 1 | ON | must remain ON |
| SW2 | 2 | OFF | |
| SW2 | 3 | OFF | |
| SW2 | 4 | OFF | must remain OFF |

## Flyer web interface

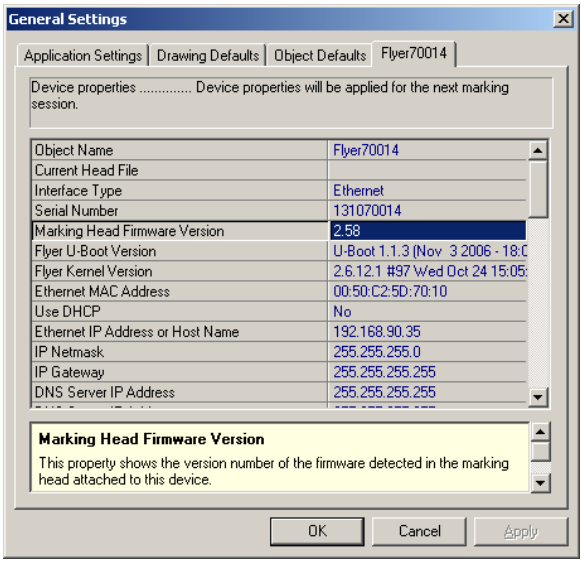
FH Flyer marking heads offer a web-based Internet interface that allows you to access read-only information including log files, firmware release notes, and head configuration data using a standard web browser as shown in Figure 6-16.

Figure 6-16 Flyer's Internet interface page

To access Flyer's interface page, ensure Flyer's Ethernet connection is established and then perform the following steps:

1. Determine the IP address of your Flyer marking head if it differs from the factory default address of 192.168.100.100.
2. On your computer, open the web browser.
3. At the prompt, type "http://192.168.100.100" (without the quotes) and press Enter. Use your own specific IP address if it differs from the factory default.

From the Marking Head Web page, you can start (Mark) and stop (Abort) a stand-alone mark session as well as check Flyer status. The Options section provides links to Release Notes (including information on using Flyer's web interface), Marking Interface, System Parameters, and Flyer FAQs. The Logs section links




directly to Flyer's Main and Last Bootup logs.

Note: In certain situations when Mark On Startup is enabled, Flyer may not exit stand-alone marking, depending on the configuration of mark file automation. If this occurs, click the Marking Interface or System Parameters link on the Marking Head Web page. Locate and click on the Mark On Startup link (highlighted in green). Notice that the property value changes from 'Yes' to 'No'. Close the web page, reboot Flyer, and launch WinMark Pro to make mark file adjustments as required.

# Firmware upgrades

FH Flyer's flash memory contains the operating code—firmware—that controls the marking head. As improvements or changes are made to the firmware by SYNRAD Engineers, these firmware updates are posted to the WinMark Pro web site (see FH Series Resources at http://www.winmark.com).

To perform a firmware upgrade, perform the following steps:

1. Power up the FH Flyer head and then open WinMark Pro v6.

2 From the Help menu, select About Synrad WinMark… .

3 In the About Synrad WinMark dialog box, click the Head Info button.

4 In the General Settings dialog, on the Device tab, check the firmware version shown for the Marking Head Firmware Version property (see Figure 5-17). Click OK when done.

Figure 6-17 Checking Flyer's firmware version

5 In the About Synrad WinMark dialog, press the Update F/W button and from the Marking Head Firmware Update dialog, click Update.

6 In the Open dialog, navigate to the location of the latest firmware update (Update_x-xx.fhz) file. By default, a copy is placed in the C:\Program Files\WinMark folder during the WinMark installation.

If the Update_x-xx.fhz file is newer than the current Flyer firmware, then select the file and click Open to continue with the upgrade; otherwise click Cancel.

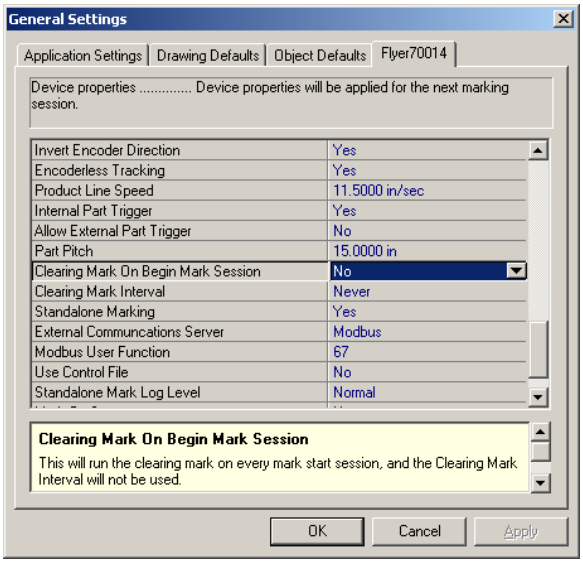
7 A dialog box displays Flyer's current firmware version and the upgrade version. Click Yes to proceed with the upgrade.

8 Read the Update message and click OK. Do not attempt to operate the head until it has rebooted!

9 After Flyer reboots (the Status LED briefly flashes off and then back on), repeat Steps 2 through 4 to verify the new firmware version in the head.

## Clearing mark

When optical scanners are used in applications that involve long durations of high frequency, small angle movements, the ball bearings used in their construction are subject to degradation over time. This occurs because the balls in the ball bearings do not rotate a complete revolution around the bearing raceway




when executing small angle moves. Instead, the balls rock back and forth in a narrow area, pressing lubricant out from between each ball and the raceway, which causes narrow notches to wear in the race under

the ball bearings. Over a period of years, this rocking action may lead to issues where marks suddenly appear to shift (as the balls jump in and out of the wear grooves in the raceway) and ultimately this problem requires optical scanner replacement.

As a preventive maintenance measure, our WinMark Pro laser marking software contains a software feature to benefit this small segment of customers whose marking processes involve long durations of high frequency, small angle movements (where the overall mark is smaller than 10% of the nominal mark field). This feature, called a 'clearing mark', serves two purposes: first, it redistributes lubricant along the bearing raceway, and two, it repositions ball bearings around the bearing, which, over time, helps to achieve a continuous and evenly worn raceway.

When used from the initial start-up of your FH Series Flyer marking head as a preventive maintenance measure, implementation of the clearing mark is the best possible method for increasing service life since optical scanner bearings are the only part of a marking head that wear out with use.

To enable this preventive maintenance feature, perform the following steps:

Note: The clearing mark is a non-lasing operation. The laser does not fire during this sequence.

1 In WinMark Pro, click the Tools menu and then click General Settings… . When the Application Settings dialog opens, click the Application Settings tab.

2 Scroll down to the Clearing Mark On Begin Mark Session and Clearing Mark Interval properties. See Figure 6-18.

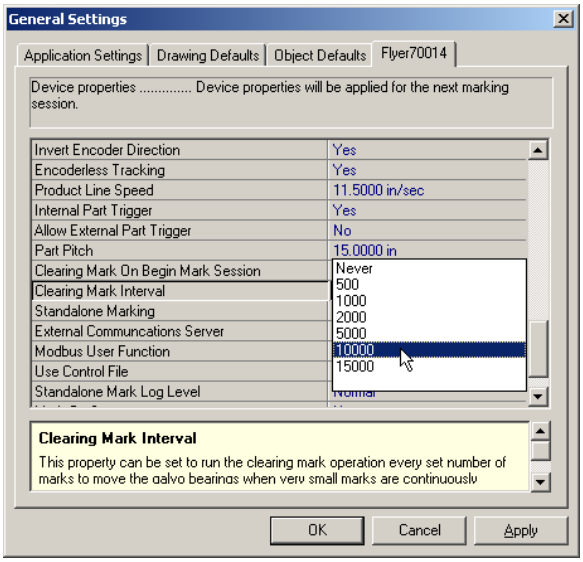



Figure 6-18 Clearing Mark properties

## Clearing mark

3 In most applications, a clearing mark is not necessary. Set Clearing Mark On Begin Mark Session

to No and set Clearing Mark Interval to Never. This is WinMark Pro's default setting.

4 If your application requires a clearing mark, there are two choices: (1) perform the instructions described in Step 4A to initiate the clearing mark at the start of each mark session OR (2) follow Step 4B to insert a clearing mark after a specific number of marks has occurred in one or more mark sessions.

A Initiate a clearing mark at the beginning of each mark session.

Set Clearing Mark On Begin Mark Session to Yes. This enables a clearing mark sequence at the beginning of each mark session—every time a mark session opens in WinMark Pro or WinMark Launcher.

OR

B Initiate a clearing mark after a specific number of marks have occurred.

Set Clearing Mark On Begin Mark Session to No, and then select a Clearing Mark Interval other than Never. This initiates a clearing mark sequence after the specified number of marks has occurred, even across multiple mark sessions. Choose a Clearing Mark Interval based on your needs. SYNRAD recommends an interval of once every 10,000 marks. See Figure 6-19.

Figure 6-19 Clearing Mark Interval

Note: To perform clearing marks in a Tracking application, set Clearing Mark On Begin Mark Session to Yes so that a clearing mark sequence occurs at the beginning of each mark session. The Clearing Mark Interval is disabled in Tracking mode.

## Over-temperature warning

In addition to monitoring FH Flyer head temperature visually using WinMark Pro, FH Flyer marking heads have the ability to generate an output signal when the marking head reaches a preset temperature limit.

You can monitor Flyer marking head temperature in real-time using our WinMark Pro laser marking software. To do this in WinMark Pro, click the Help menu and then click About Synrad WinMark… . The About Synrad WinMark… dialog box displays internal air temperature near power amplifier and CPU components along with a color-coded Status indicator. If the Status indicator, normally green, turns yellow (indicating power amp air temperatures at or above 65 °C), then you should consider cooling the environment in which the Flyer head is operating. FH Flyer will stop marking if the CPU's ambient air temperature reaches 65 °C (when the Status indicator turns red). If this happens, marking will halt and you must cool the Flyer head. Marking is not enabled again until ambient CPU air temperature drops below 60 °C.

Note: Real-time air temperature measurements at power amplifier and CPU locations inside Flyer have been correlated with optical scanner air temperatures after extensive testing. A measured air temperature of 65 °C at the CPU indicates that air temperatures surrounding the optical scanners are approaching their maximum temperature limit of 50 °C.

When enabled, FH Flyer's over-temperature warning function provides a signal on OUT7_A of the DB-25 User Interface connector. This output signal serves to alert an automation controller or maintenance per-

sonnel that additional cooling may be required in order to continue marking operation.

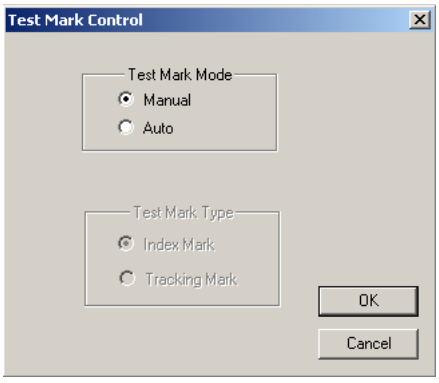
Important Note: When the Switch IO Output 7 property is set to Yes, output OUT7 is inhibited from operating as a standard output. Output OUT7 will not activate when commanded by standard WinMark Pro automation or Digital Scope.

In order to setup Fenix Flyer's over-temperature warning output, perform the following steps:

1. In WinMark Pro, click the Tools menu, click General Settings… , and then click the "Device" tab.
2. Scroll down the property list until you find the Switch IO Output 7 property.
3. Click the Switch IO Output 7 property and click the arrow button on the right-hand side to display the drop-down list.
4. In the drop-down list, choose Yes. When the Switch IO Output 7 property is Yes, output OUT7 activates to indicate that power amp air temperatures are at or above 65 °C and additional cooling is required.

   The activation of output OUT7_A occurs when the color-coded Status indicator in the About Synrad WinMark… dialog box transitions from green to yellow, which indicates power amp air temperatures are at or above 65 °C.

5. Wire OUT7_A and OUT2–OUT7_B on the DB-25 User Interface connector so that when activated, OUT7_A provides an input to an automation controller or signals maintenance personnel that additional cooling may be required. Refer to the Input/output circuitry section earlier in this chapter for information on wiring input devices to FH Flyer outputs.




# 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

FH Flyer customers have the ability to download a custom test mark to the Flyer head. Like the standard test pattern shown in Figure 3-3 in the Operation chapter, a custom test mark downloaded into Flyer's non-volatile memory is marked each time the Test Mark pushbutton is pressed. However, unlike the standard test pattern, the custom test mark feature allows operators to create a custom mark file with specific object properties and then perform Index marking of the custom test mark without a computer connected to the Flyer 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 6-20) opens.

Figure 6-20 Test Mark Control dialog box

## 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 is pressed.

#### Auto

In Auto Test Mark Mode, the custom test mark replaces the factory test pattern in memory. The stored custom test mark fires as a static mark when an input signal is sensed on input 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 Mark then a static custom test mark fires when the Test Mark pushbutton is pressed or when an input signal is detected on input IN0. Index Mark provides the ability to load a custom test mark file, disconnect the USB or Ethernet cable and computer, and then automatically mark an Index file each time input IN0 goes active.

#### Tracking Mark

FH Flyer does not support a Tracking custom test mark. The Tracking Mark option appears dimmed when the Tracking feature is unavailable. See the Stand-alone Operation chapter for instructions on how to setup Flyer to perform stand-alone Tracker marking.

## Creating a custom test mark

Use WinMark Pro v6 to develop a custom test mark the same way you would create any other mark file. 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 Flyer's non-volatile memory space. For example, the default test pattern (Figure 3-3 in the Operation chapter) fills approximately 4% of 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 Refine the mark. Use stroke text instead of TrueType® fonts, mark fewer words, or simplify line art.

C Reduce the physical size of the image. This reduces the number of microvectors stored in memory.

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 directly from WinMark Pro or in Flyer's stand-alone operating mode.

# Custom test mark feature

## Setting Test Mark Control options

Creation of a custom test mark can be done offline, but to set custom test mark options, the Flyer head must be connected to and communicating with to a computer running WinMark Pro v6.

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 opens (refer back to Figure 5-20).

Note: If your Flyer head is already programmed with an Index Auto Test Mark, then a dialog box appears indicating that auto test marking is disabled. This prevents an input signal from commanding FH Flyer 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. The Tracking Mark option is dimmed (unavailable) for FH Flyer heads.

## 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 Flyer memory.

3 After file transfer is complete, a dialog box confirms a successful download.

FH Flyer memory 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 memory as required for lens testing or mark centering.

## Custom test mark I/O

### Inputs

FH Flyer can read inputs (IN0–IN7) during a custom test mark. This input capability is available when using any Wait Digital command on the Drawing's Automation tab or when using MatchDigitalState and WaitDigitalState Event Builder commands during On Before Mark Session, On Before Mark Piece, On After Mark Piece, and On After Mark Session stages of the automation loop. The On Abort Session event is not a valid custom test mark state.

## Custom test mark feature

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.

By design, input IN0 is considered the 'start mark' input. When the Test Mark Mode is Auto, this input is expected to be "Set" in the Wait Digital Before Piece command on the Drawing's Automation tab or in a WaitDigitalState Event Builder command in On Before Mark Session or On Before Mark Piece stages of the automation loop. Note; however, that subsequent marks will not fire until the state of IN0 transitions from active to inactive during or after the previous mark.

The IN0 input state need not be specified on the Automation tab when Test Mark Mode is set to Manual because pressing the Test Mark button initiates a mark session.

Important Note: When the Fast Acting Safety Interlock (FASI) is enabled, input IN3 must be active in order for the laser to fire during a mark. To ensure that the custom test mark does not begin until FASI is enabled, you should always specify that IN3 in the Wait Digital Before Piece command be "Set" before the automation loop can continue.

## Outputs

FH Flyer is able to set or clear outputs (OUT0–OUT7) when marking a custom test mark. This output capability is available when using any Set Digital commands on the Drawing's Automation tab or when using SetDigitalState Event Builder commands during On Before Mark Session, On Before Mark Piece, On After Mark Piece, and On After Mark Session stages of the automation loop. The On Abort Session event is not a valid custom test mark state.

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.

# General specifications

Table 6-22 FH Series Flyer marking head specifications

| Parameter | Marking Head Model Number: FHFLxx-xxx[1] | | | | |
|---|---|---|---|---|---|
| Lens Focal Length | 370 mm | 200 mm | 125 mm | 125 HP[2] | 80 mm |
| Marking Specifications | | | | | |
| Field Size, nominal, mm<br>(in.) | 198 × 198<br>(7.8 × 7.8) | 110 × 110<br>(4.3 × 4.3) | 74 × 74<br>(2.9 × 2.9) | 66 × 66<br>(2.6 × 2.6) | 27 × 27<br>(1.0 × 1.0) |
| Spot Size, 1/e², µm<br>(in.) | 540<br>(0.021) | 290<br>(0.011) | 180<br>(0.007) | 180<br>(0.007) | 116<br>(0.005) |
| Working Distance[3], typical, mm<br>(in.) | 350 ±5<br>(13.78) | 190 ±3<br>(7.48) | 128 ±2<br>(5.04) | 125 ±2<br>(4.92) | 74 ±1<br>(2.91) |
| Depth of Field, typical, mm<br>(in.) | ±10<br>(±0.394) | ±2.5<br>(±0.098) | ±1.5<br>(±0.059) | ±1.5<br>(±0.059) | ±0.4<br>(±0.016) |
| Incident Angle, degrees, max | 19 | 16 | 11 | 10 | 5 |
| Marking Speed[4]<br>characters/sec, max | 450 | 450 | 450 | 450 | 450 |

| Marking System Resolution | | | | | |
|---|---|---|---|---|---|
| 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, µs | ≤440 | ≤440 | ≤440 | ≤440 | ≤440 |
| Orthogonality (any included angle of a square figure), degrees | 90°00' ±20' max | | | | |

| Input Specifications | |
|---|---|
| Input Power | 30 VDC ±2.0 VDC @ 4 A, 8 A peak |
| Heat Load, generated by head (W) | 90 nominal, 120 max |
| Continuous Beam Input Power, max (W) | 125 mm lens – 40, all other lenses – 140 |

* Specifications subject to change without notice.

1 FHFL30-xxx designates an FH Flyer head with a 3X (black) expander for 48-1/-2/-5 and Firestar f100 lasers. FHFL25-xxx designates an FH Flyer with a 2.5X (silver) expander for Evolution 100/125 lasers. FHFL50-xxx designates a Flyer head with a 5X (red) expander for Firestar v-Series and t-Series lasers. The "xxx" denotes a 370, 200, 125, or 80 mm lens or "U" for unfocused (no lens included).

2 High-power 125 mm lens for use with lasers 40 W and higher.

3 The typical focal length (working distance) is marked on each lens mount. Because the actual working distance may vary from lens to lens, it is important to provide a Z-axis adjustment between the FH Flyer marking head and the marking surface. Consult your marking head's Final Test Report for the actual measured working distance.

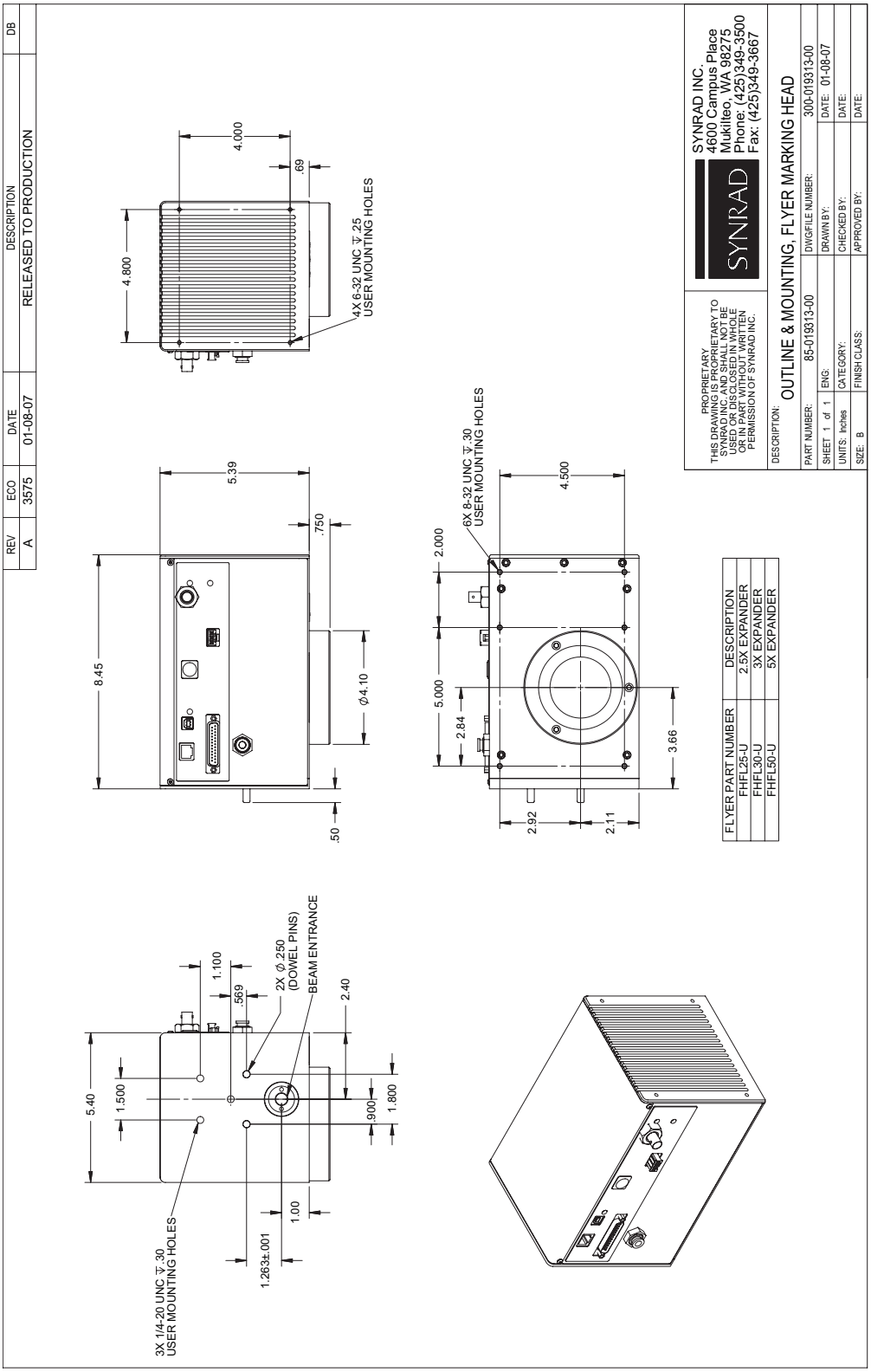
4 Based on a character height of ~3 mm and a 200 mm focusing lens.

## General specifications

| Parameter | | |
|---|---|---|
| Environmental Specifications | | |
| Operating Temperature | 0 °C to 40 °C | |
| Humidity | 0–95%, non-condensing | |
| Physical Specifications | | |
| Length | 21.46 cm | (8.45 in.) |
| Width | 13.72 cm | (5.40 in.) |
| Height | 13.69 cm | (5.39 in.) |
| Height, including lens | 15.60 cm | (6.14 in.) |
| Weight, max | 4.35 kg | (9.6 lbs) |

Mounting Kit Weights[5]

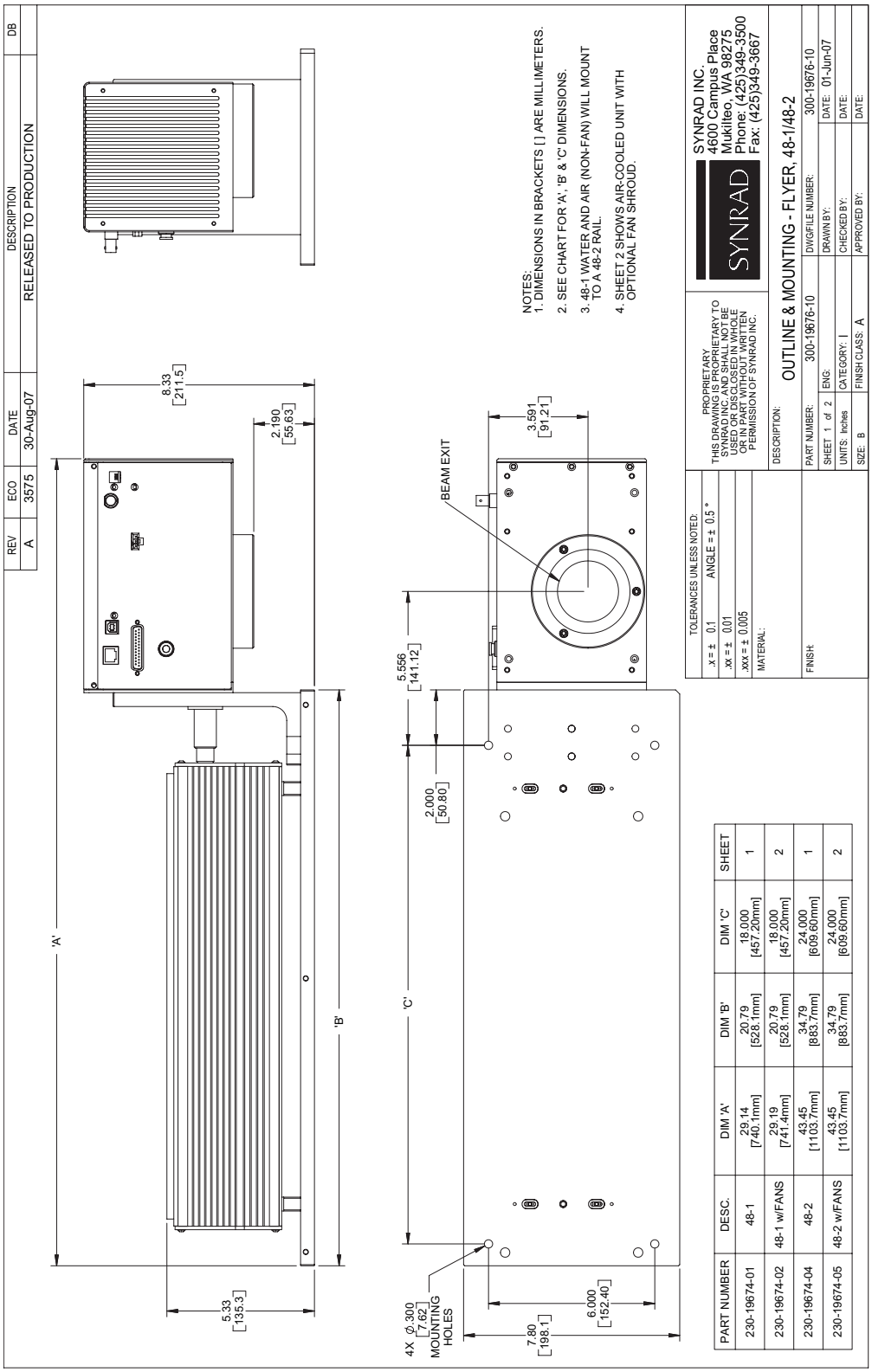
10 W Mounting Kit (48-1) 5.44 kg (12 lbs)




10 W Mounting Kit w/ Fan Shroud 6.80 kg (15 lbs)

25 W Mounting Kit (48-2) 7.26 kg (16 lbs)

25 W Mounting Kit w/ Fan Shroud 9.98 kg (22 lbs)

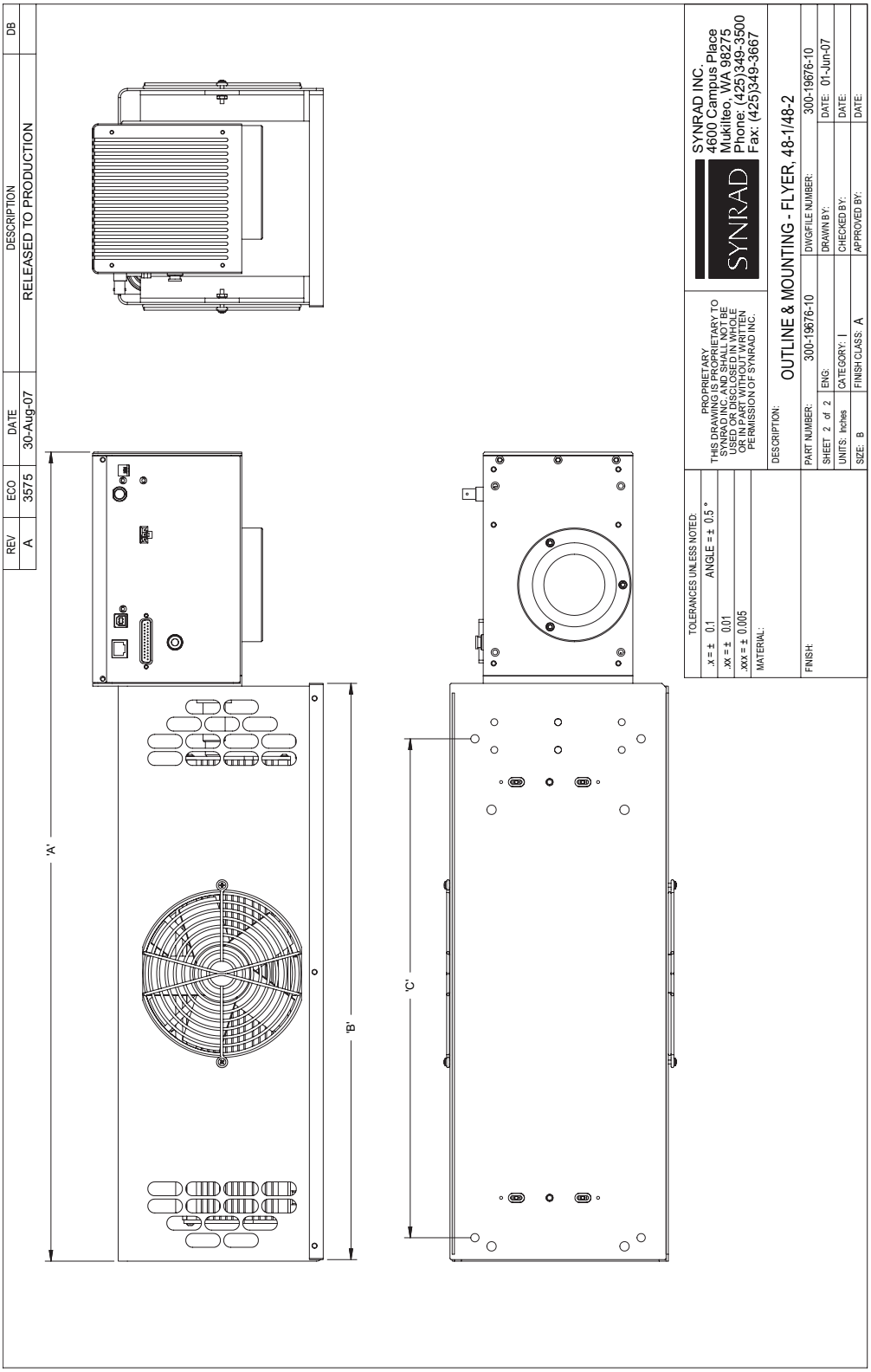



| PART NUMBER | DESC. | DIM 'A' | DIM 'B' | DIM 'C' | SHEET |
|---|---|---|---|---|---|
| 230-19674-01 | 48-1 | 29.14 [740.1mm] | 20.79 [528.1mm] | 18.000 [457.20mm] | 1 |
| 230-19674-02 | 48-1 w/FANS | 29.19 [741.4mm] | 20.79 [528.1mm] | 18.000 [457.20mm] | 2 |
| 230-19674-04 | 48-2 | 43.45 [1103.7mm] | 34.79 [883.7mm] | 24.000 [609.60mm] | 1 |
| 230-19674-05 | 48-2 w/FANS | 43.45 [1103.7mm] | 34.79 [883.7mm] | 24.000 [609.60mm] | 2 |

30 W Mounting Kit (v30) 4.50 kg (10 lbs)

40 W Mounting Kit (v40) 6.80 kg (15 lbs)

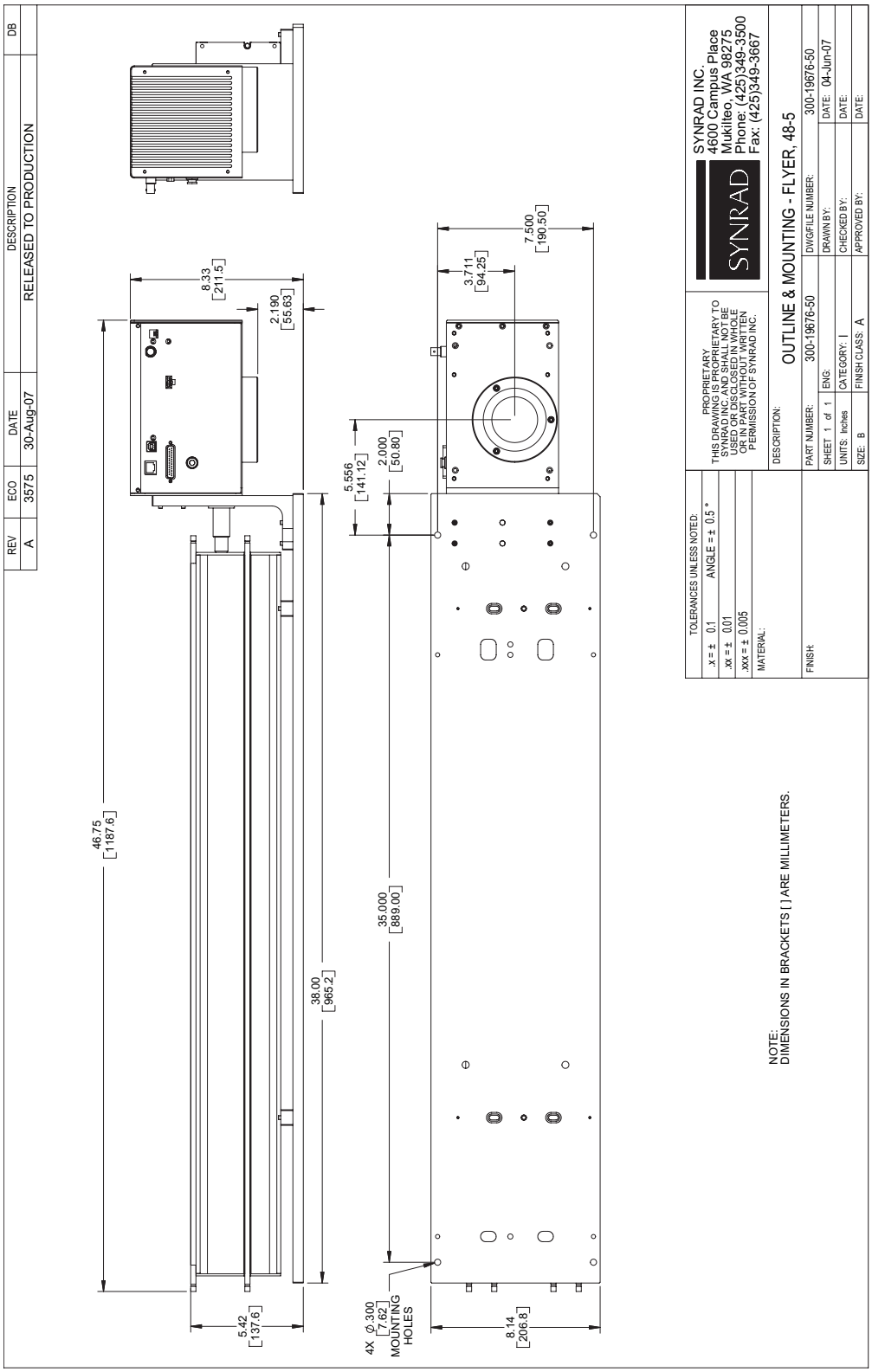
50 W Mounting Kit (48-5) 8.16 kg (18 lbs)




60 W Mounting Kit (t60) 6.80 kg (15 lbs)

70 W Mounting Kit (t70i) 6.80 kg (15 lbs)

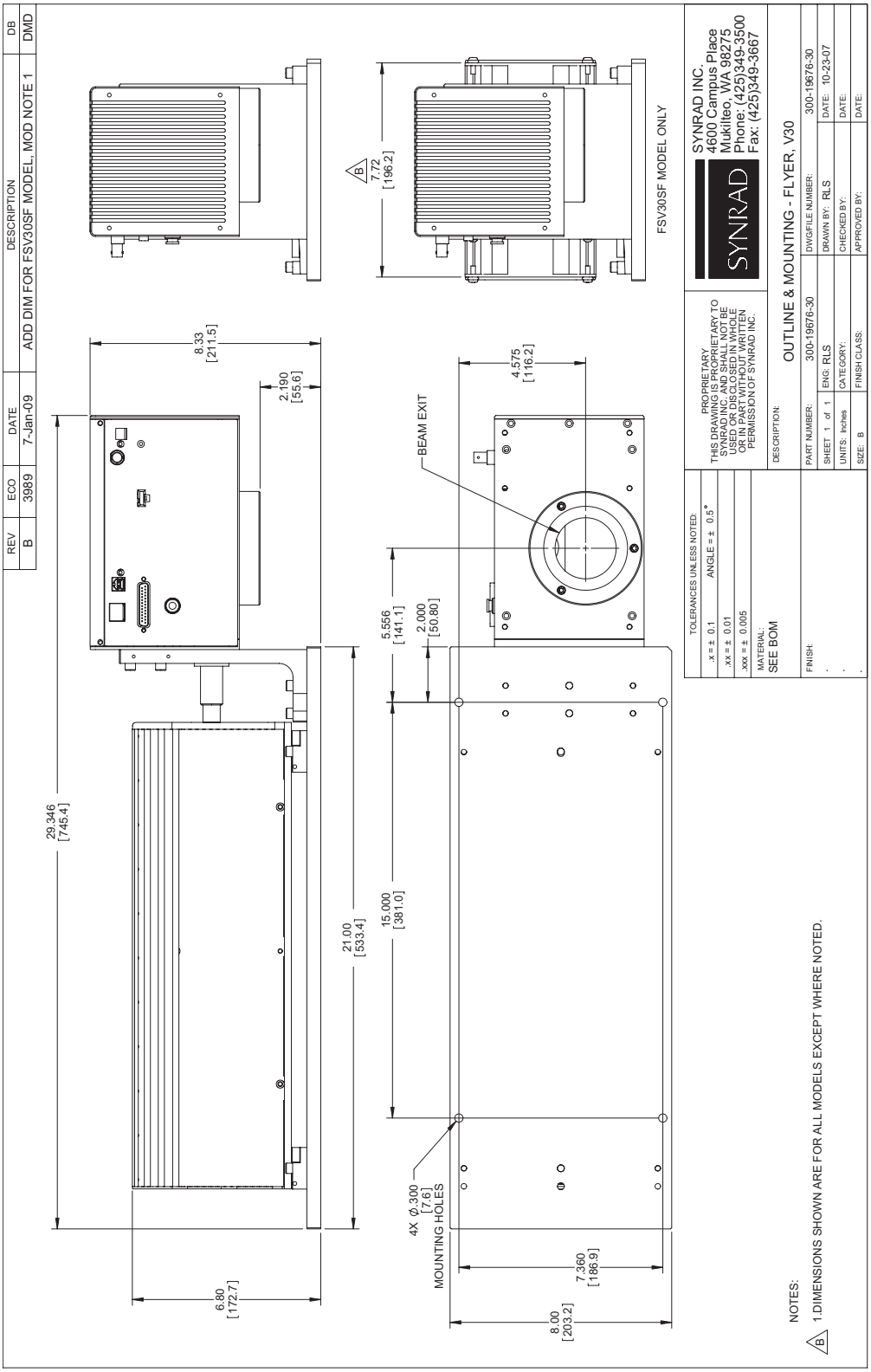
80 W Mounting Kit (t80) 6.80 kg (15 lbs)




100 W Mounting Kit (t100) 6.80 kg (15 lbs)

100 W Mounting Kit (Evolution 100) 8.16 kg (18 lbs)

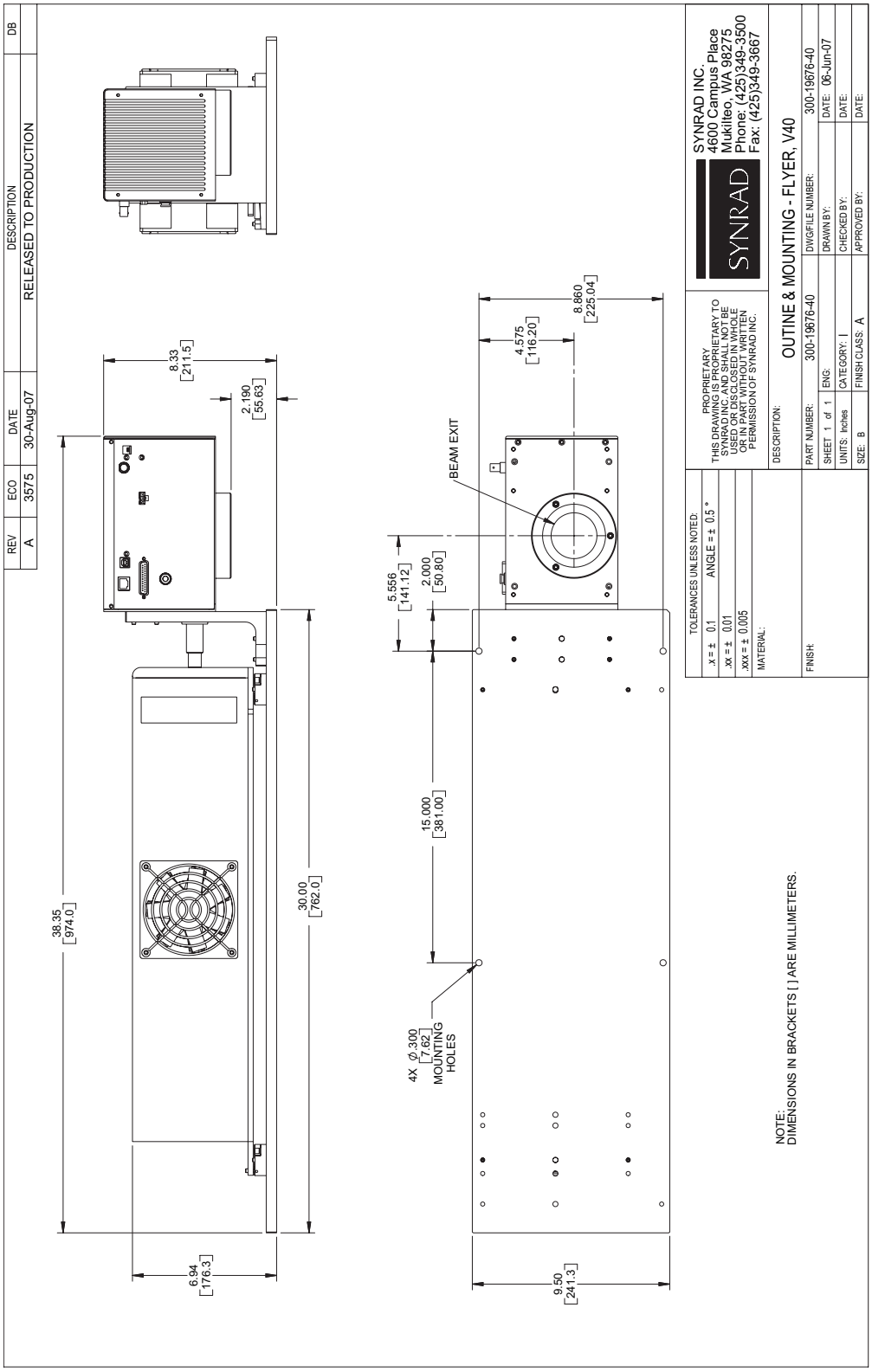
100 W Mounting Kit (Firestar f100) 6.80 kg (15 lbs)




125 W Mounting Kit (Evolution 125) 9.07 kg (20 lbs)

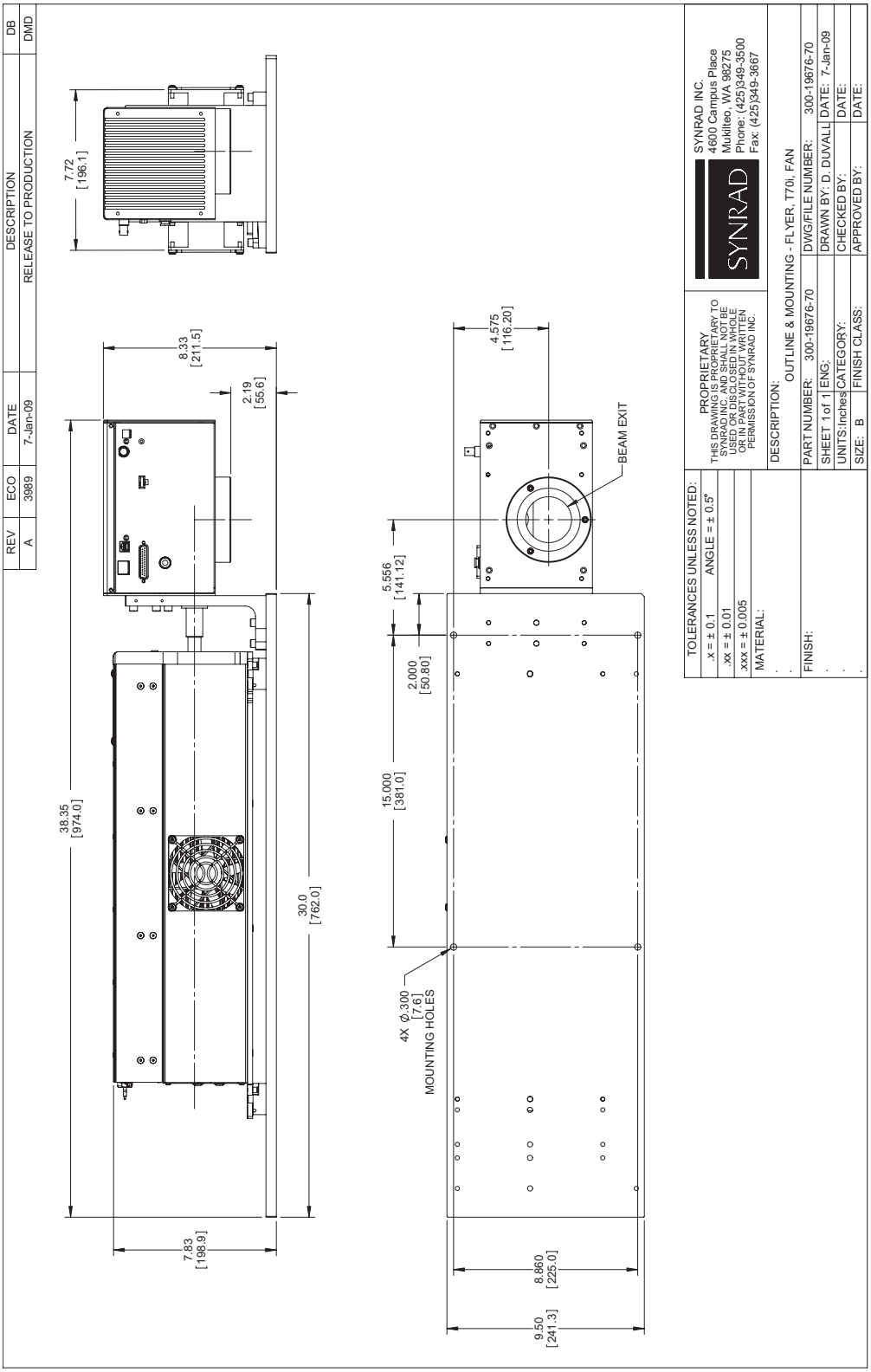
* Specifications subject to change without notice.

5 Mounting kit consists of appropriate Mounting Rail, L-bracket, Beam Enclosure Tube, and fasteners. Laser and FH Flyer head not included.




## FH Flyer package outline drawing

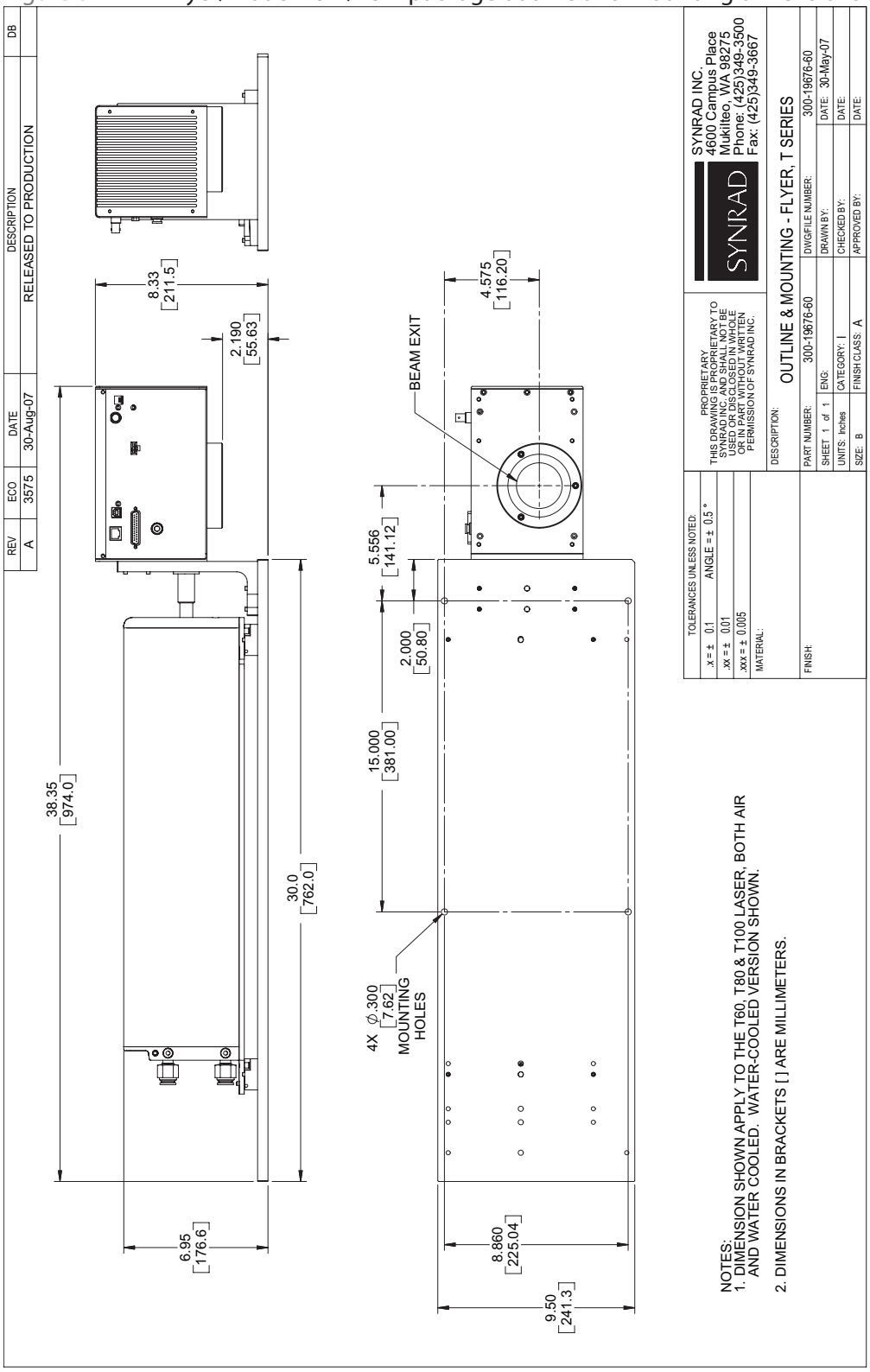
Figure 6-21 FH Flyer marking head package outline and mounting dimensions




FH Flyer/Model 48-1/48-2

## package outline drawings

Figure 6-22 FH Flyer/Model 48-1/48-2 package outline and mounting dimensions




Sheet 1 of 2

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

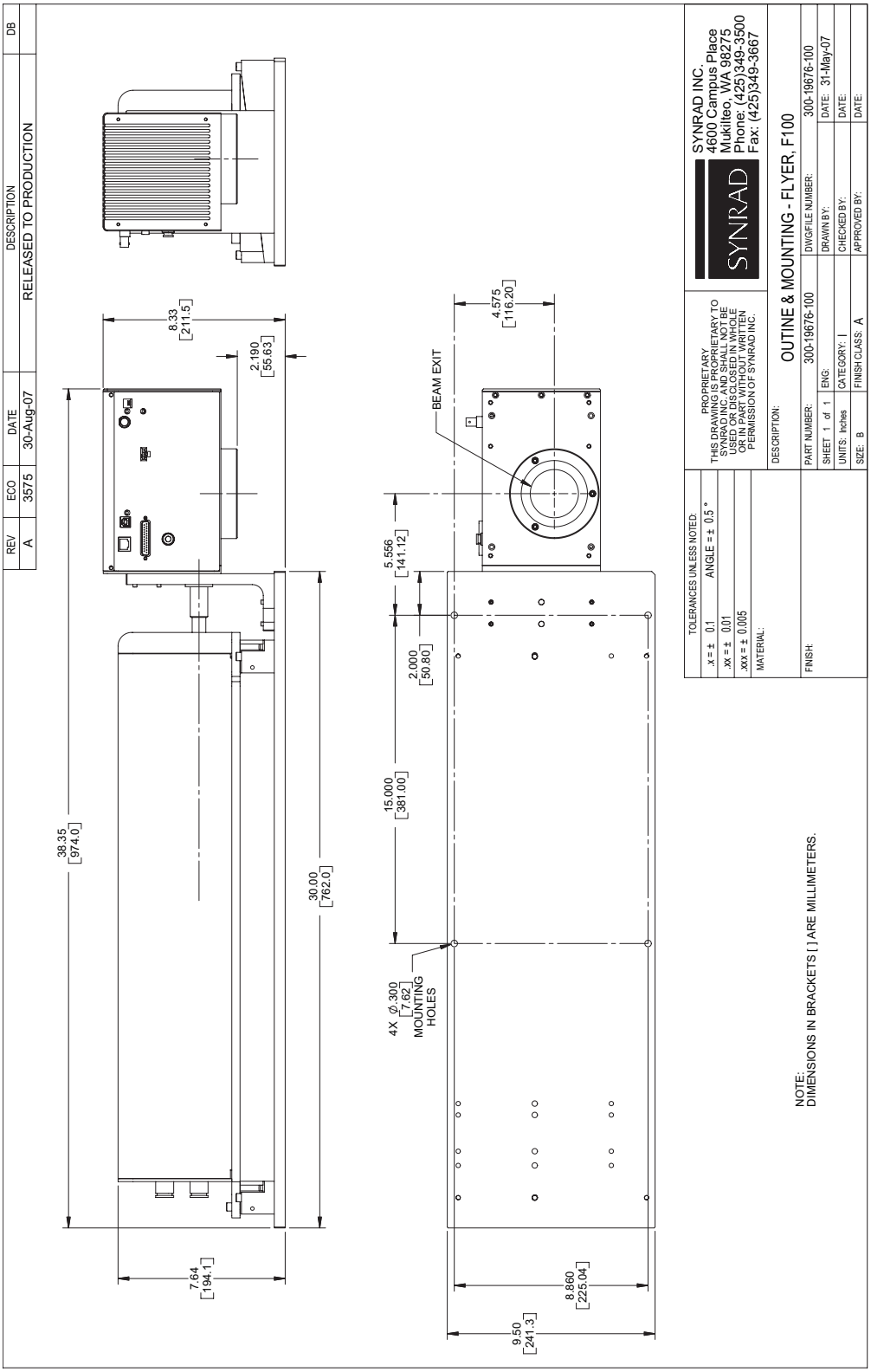



Figure 6-23 FH Flyer/Model 48-1/48-2 package outline and mounting dimensions Sheet 2 of 2

# FH Flyer/Model 48-5 package outline drawing

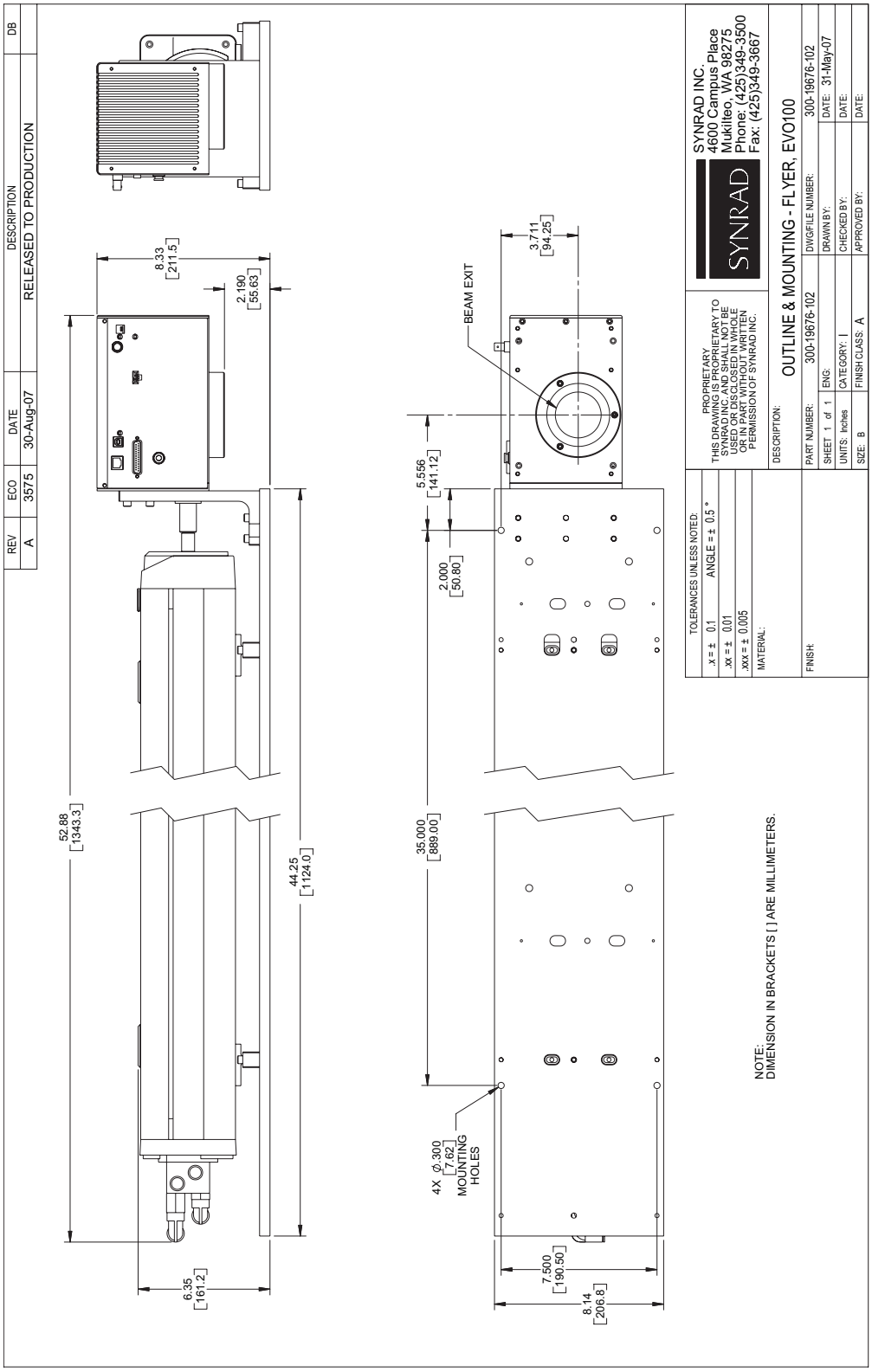



Figure 6-24 FH Flyer/Model 48-5 package outline and mounting dimensions

# FH Flyer/Firestar v30 package outline drawing

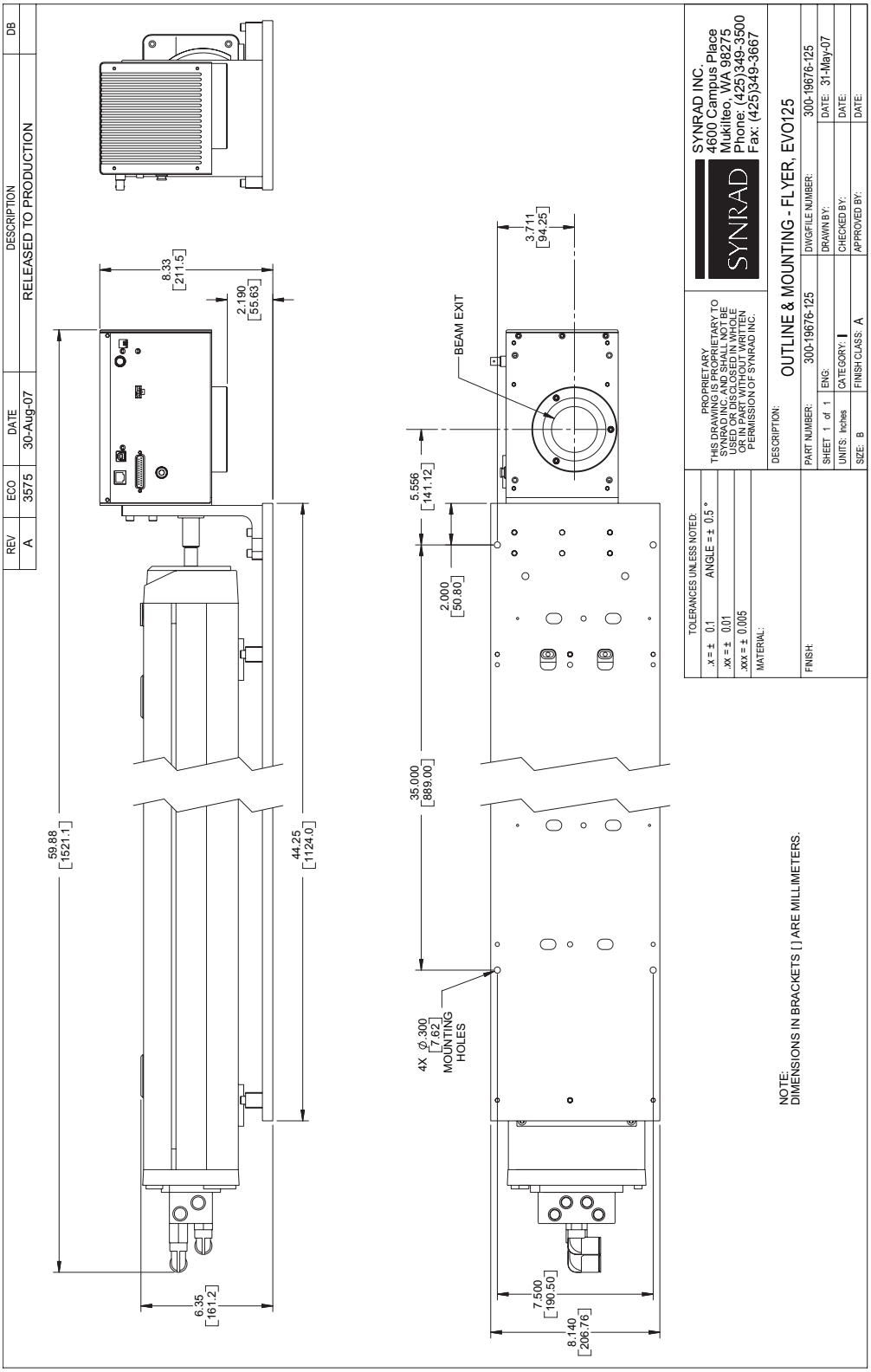



Figure 6-25 FH Flyer/Firestar v30 package outline and mounting dimensions

# FH Flyer/Firestar v40 package outline drawing

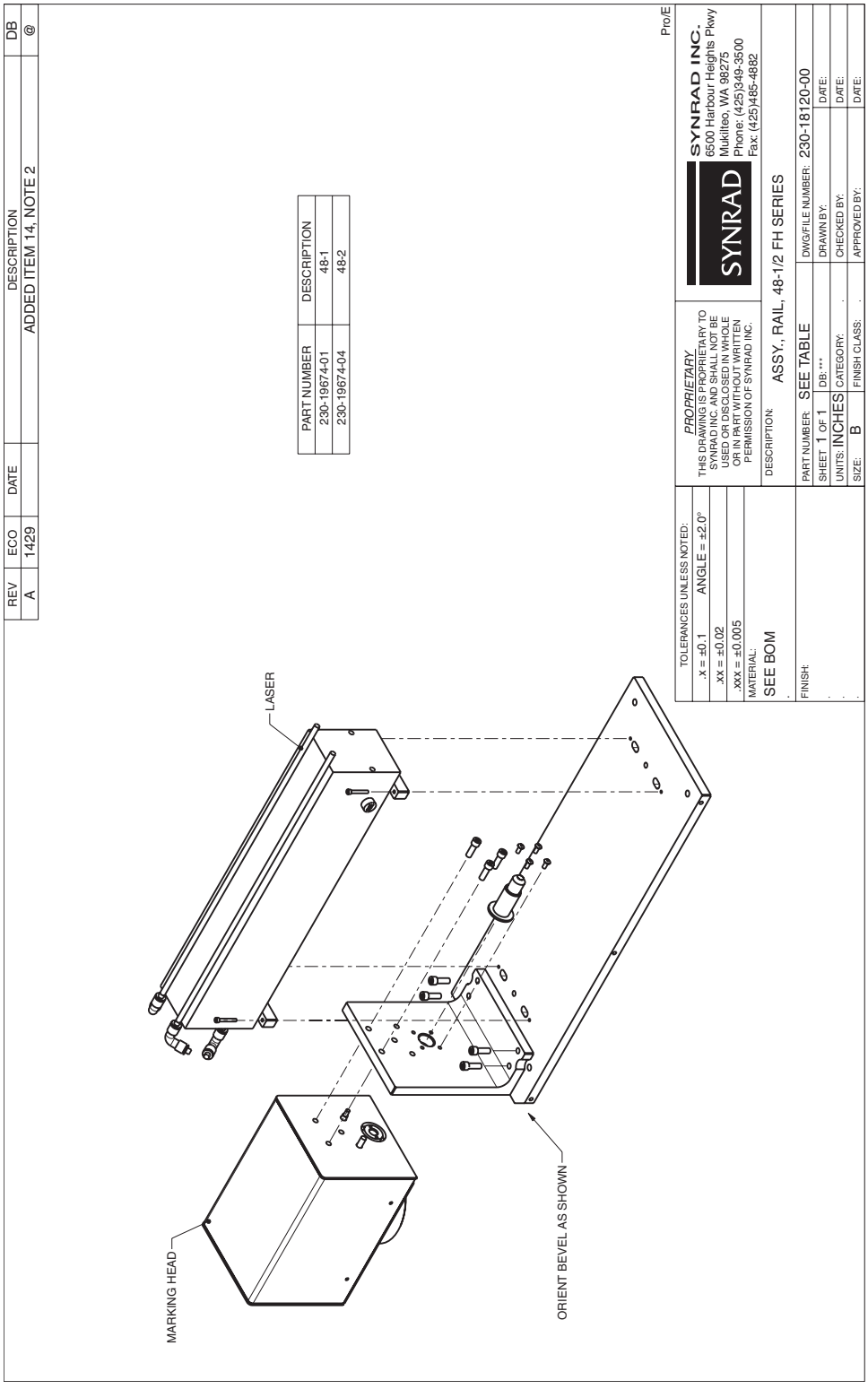



Figure 6-26 FH Flyer/Firestar v40 package outline and mounting dimensions

# FH Flyer/Firestar t70i package outline drawing

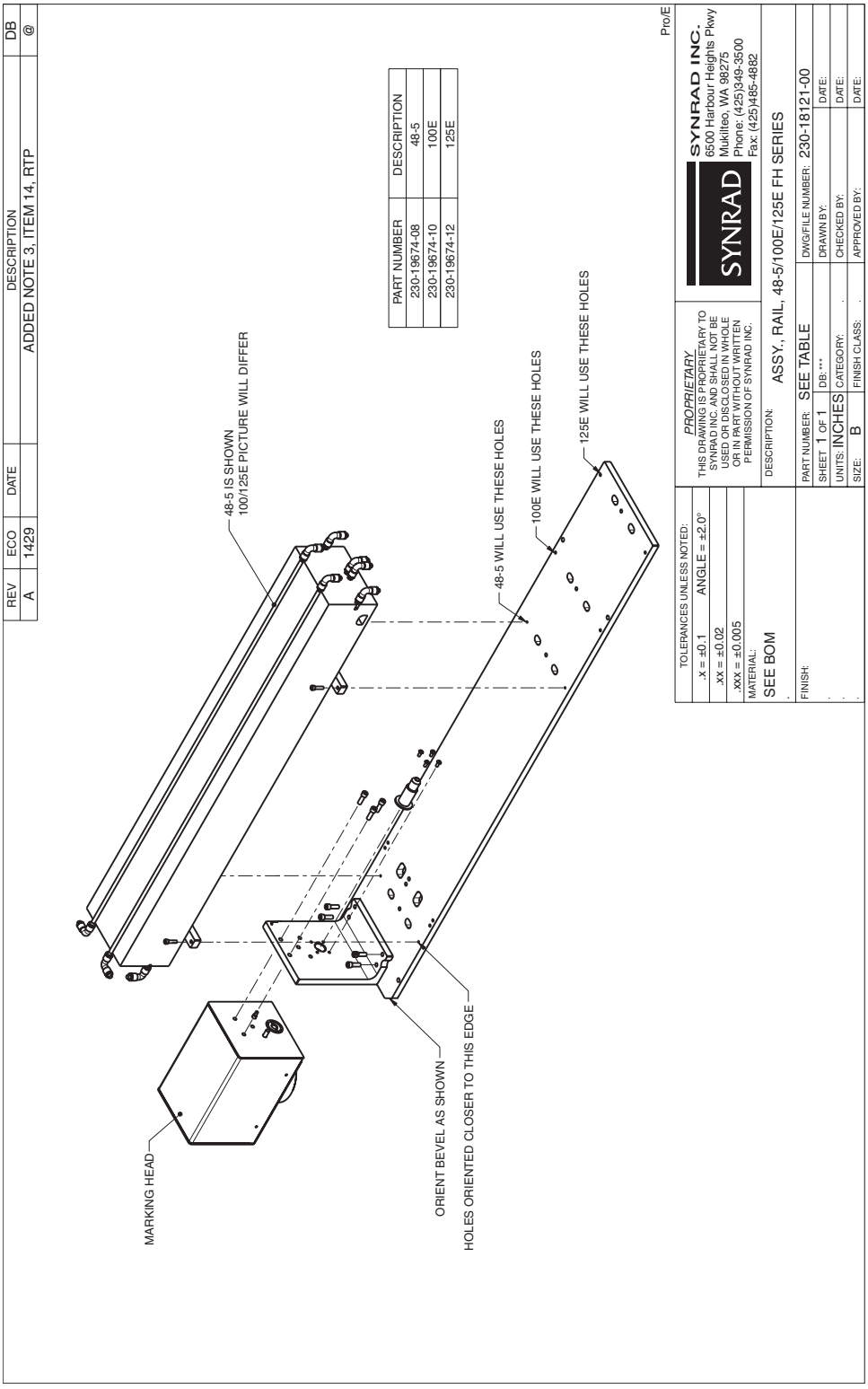
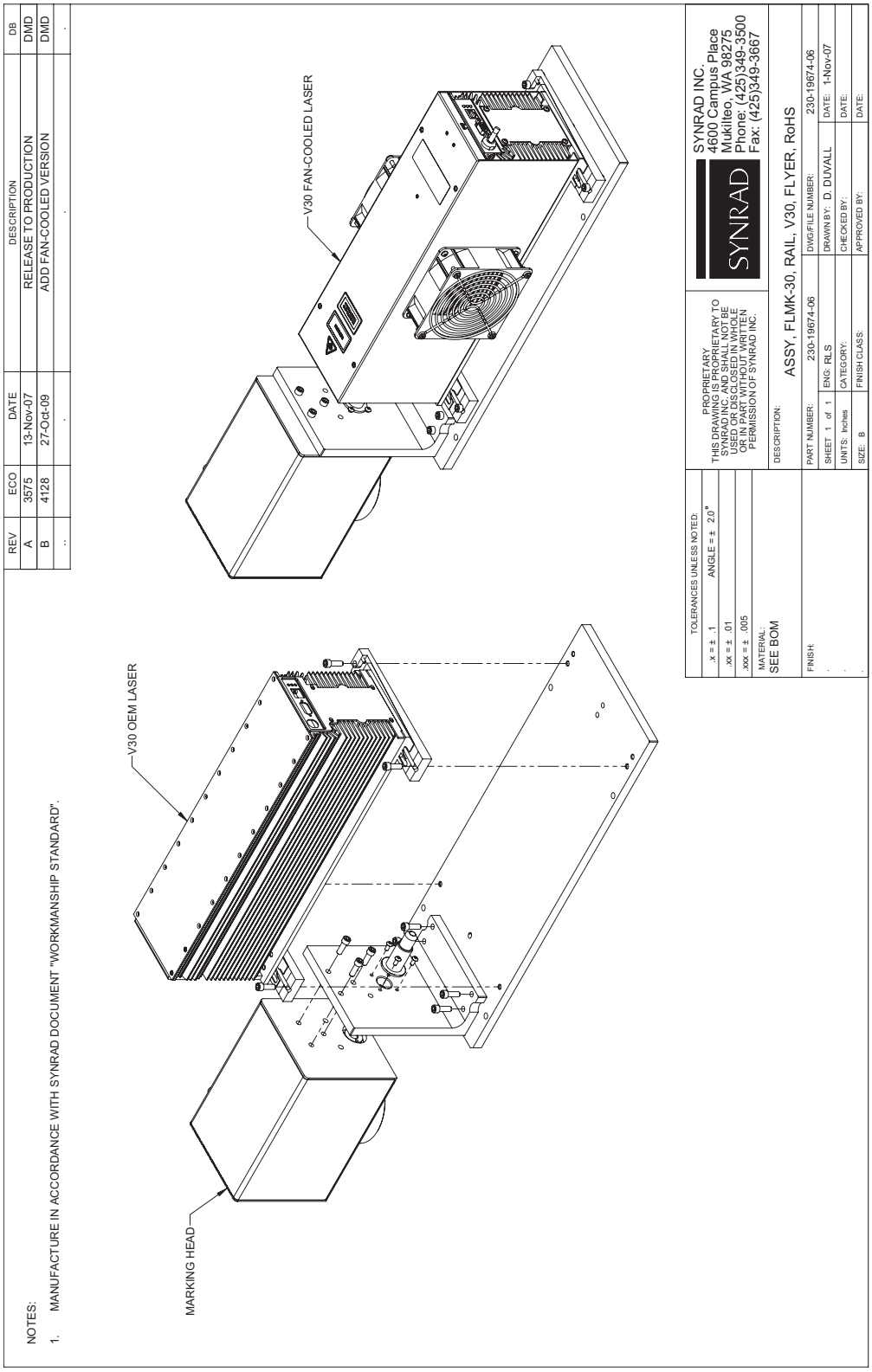
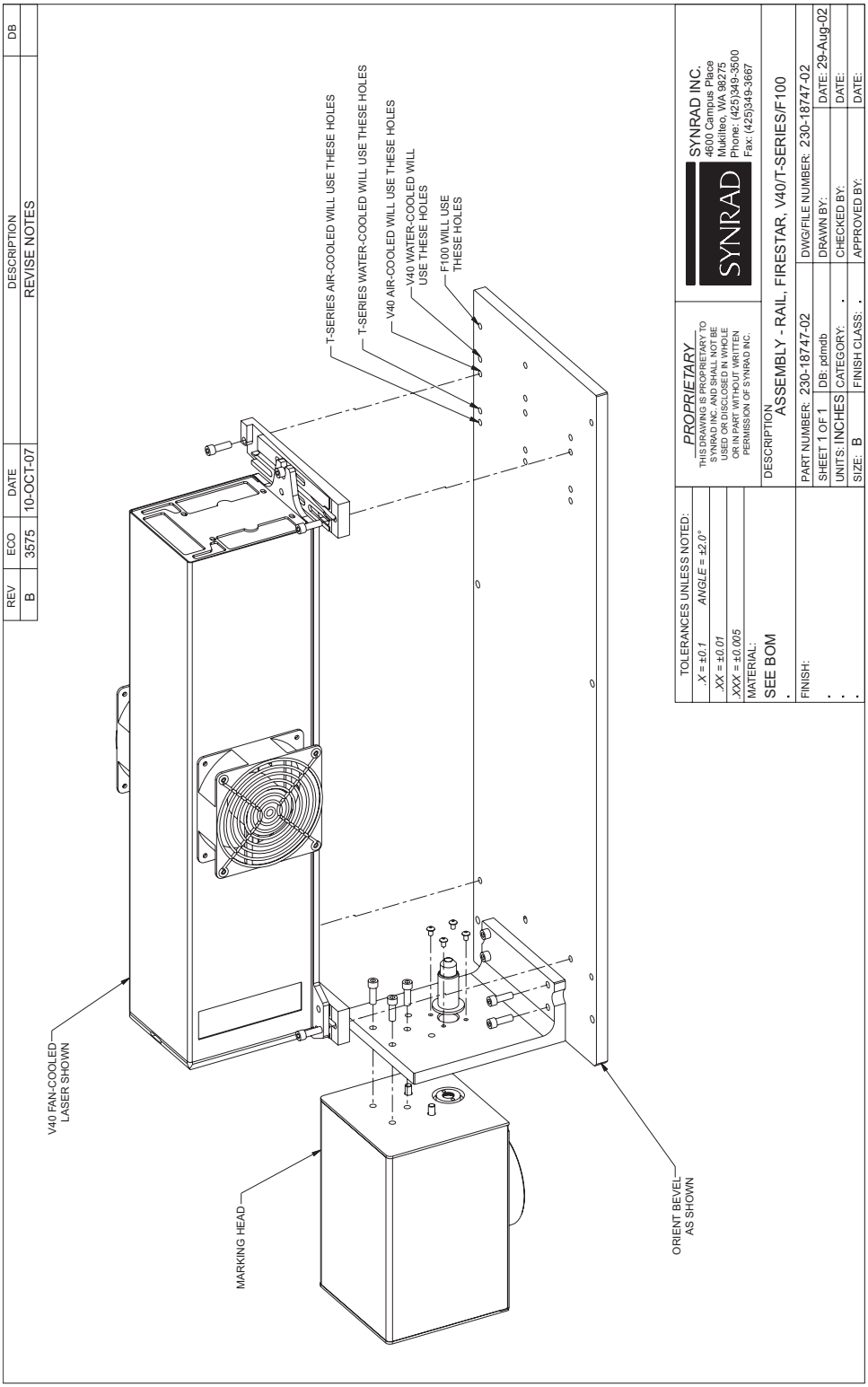



Figure 6-27 FH Flyer/Firestar t70i package outline and mounting dimensions




## outline drawing

Figure 6-28 FH Flyer/Firestar t-Series package outline and mounting dimensions




# FH Flyer/Firestar f100 package

## outline drawing

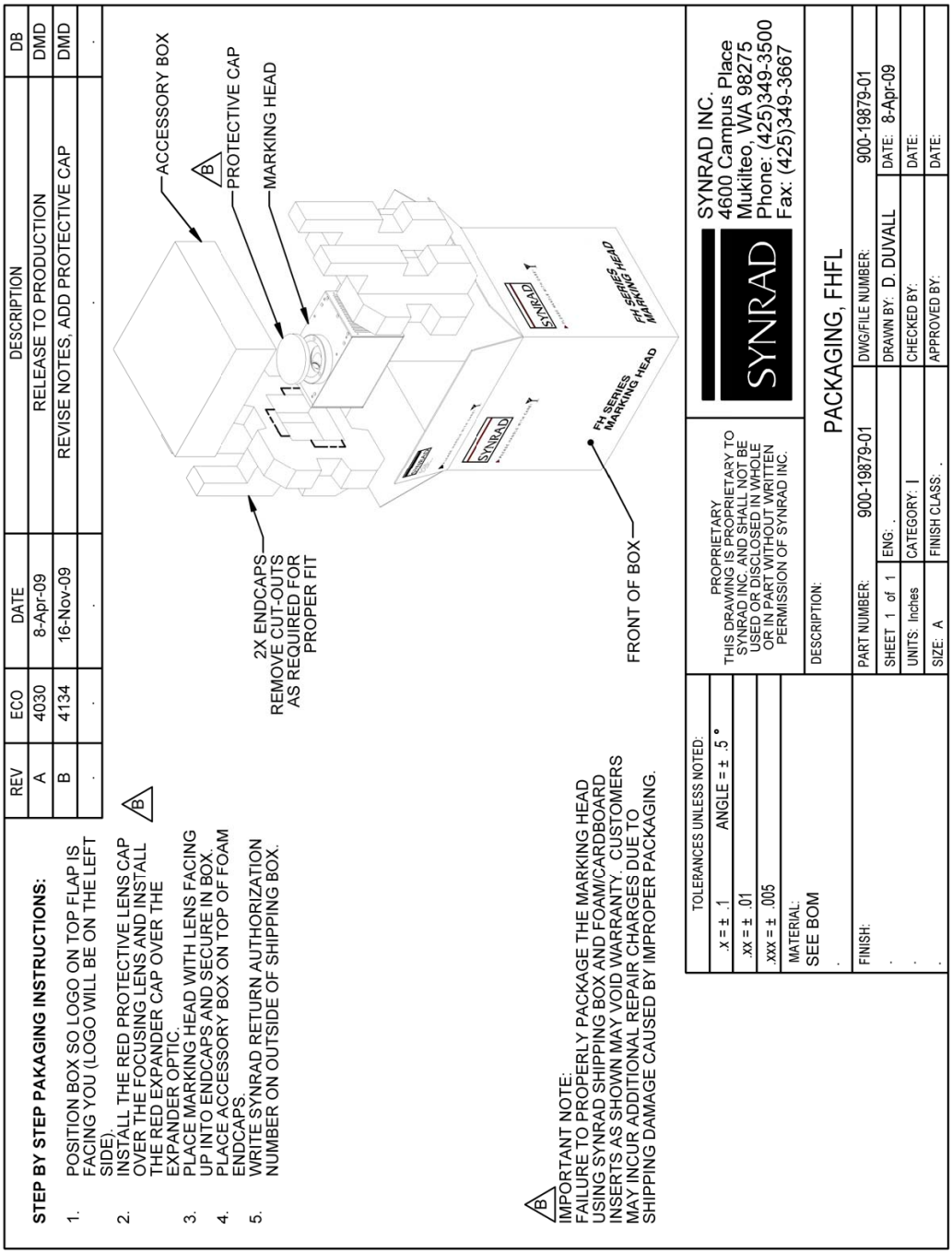
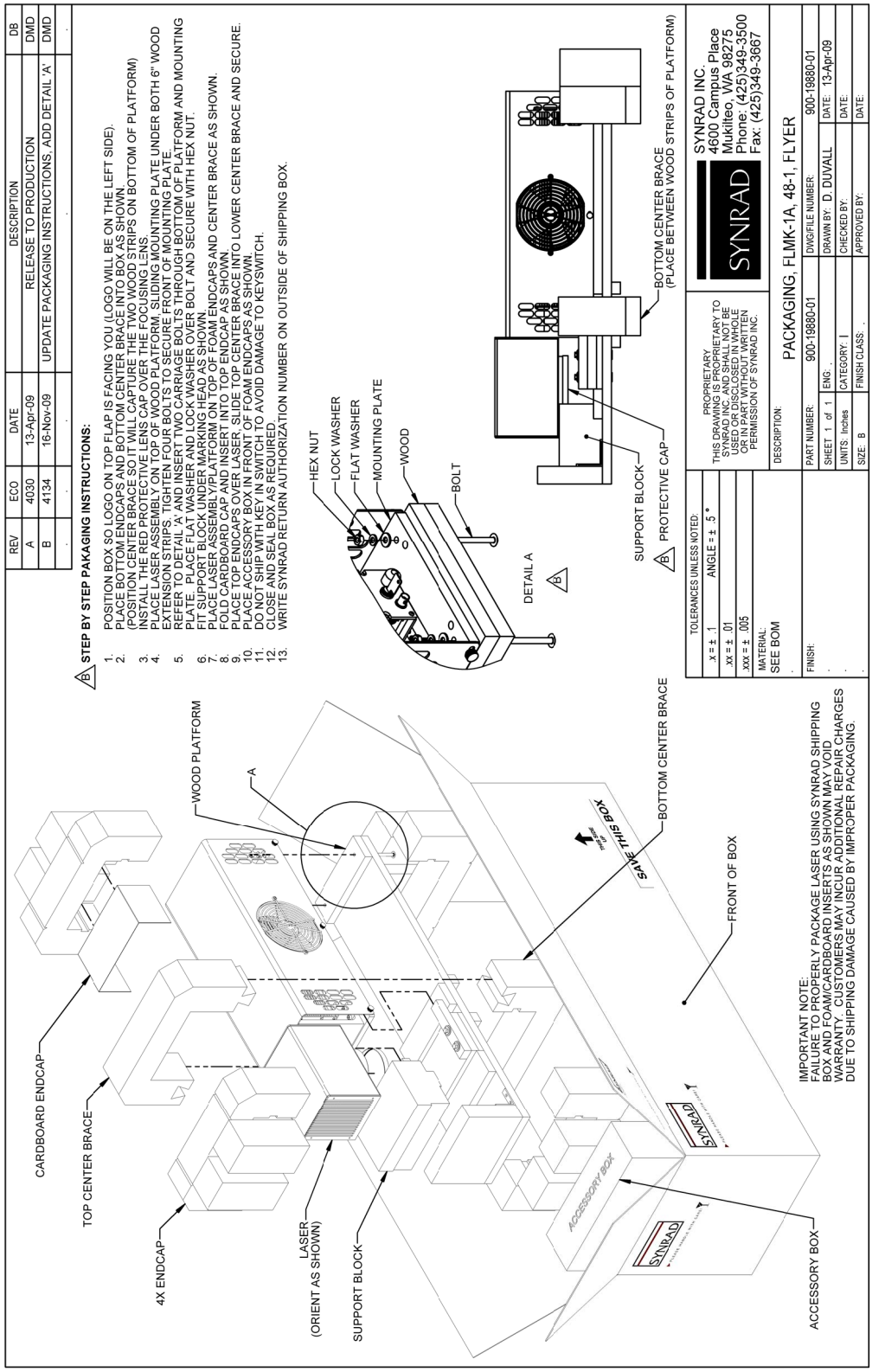


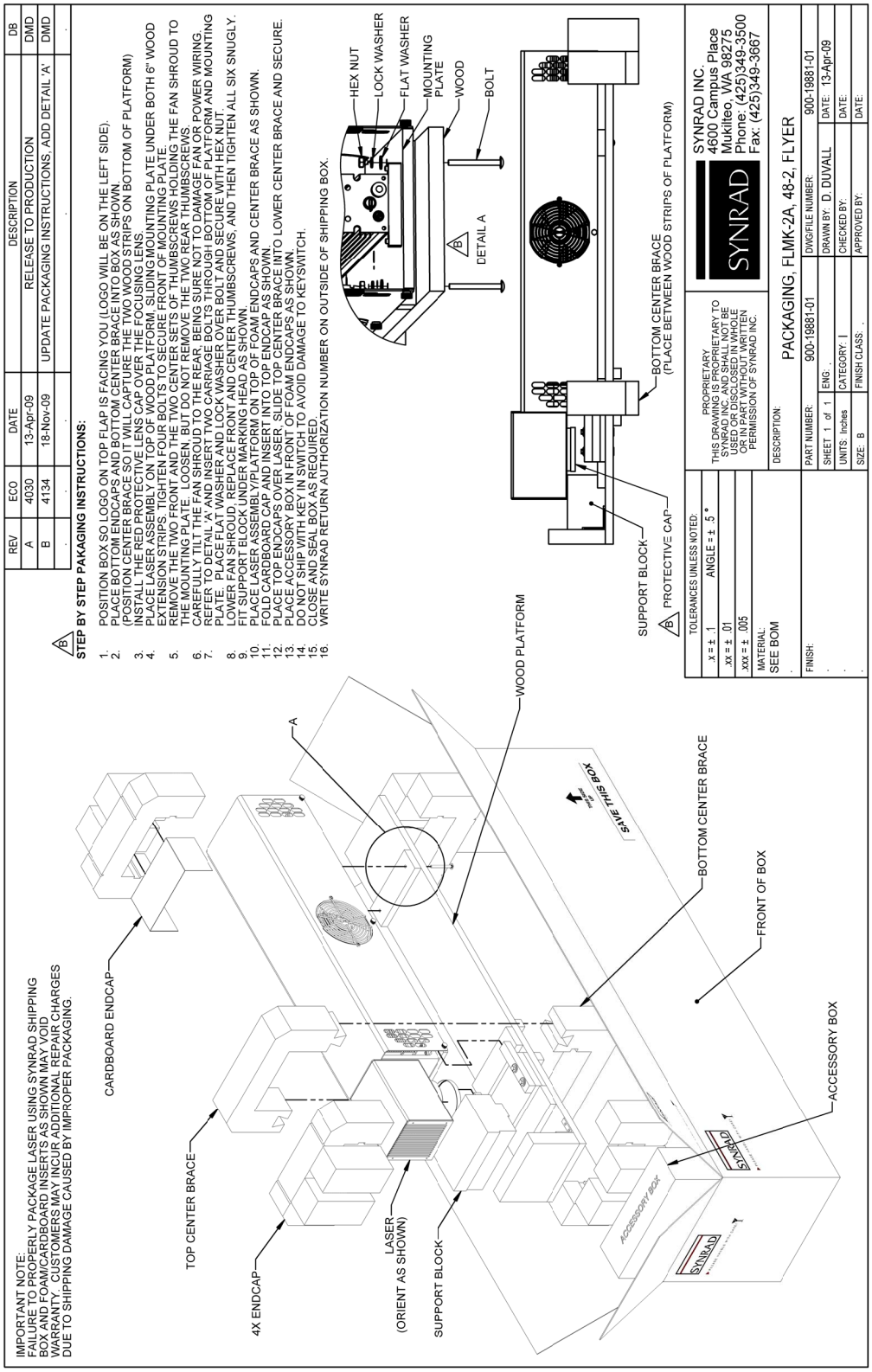

Figure 6-29 FH Flyer/Firestar f100 package outline and mounting dimensions

# FH Flyer/Evolution 100 package




outline drawing

Figure 6-30 FH Flyer/Evo 100 package outline and mounting dimensions




## FH Flyer/Evolution 125 package

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# maintenance/ troubleshooting

# 7

Use information in this chapter to perform maintenance and troubleshooting on the FH Series Flyer marking head.

This chapter contains the following information:

- Maintenance – explains typical maintenance procedures for the FH Series Flyer marking head.
- Troubleshooting – describes how to troubleshoot common marking head problems.

# Maintenance

The Maintenance section includes subsections:

- Daily inspections
- Storage/shipping
- Lens mount removal/replacement
- Cleaning optics

## Daily inspections

Perform the following steps daily to keep your FH Flyer marking 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 Flyer head. Close the laser's shutter if it is equipped with one.

| ⚠ Danger<br>serious personal injury | Ensure that DC power to the laser is turned off and locked out before inspecting optical components in the beam path. Invisible $CO_2$ laser radiation is emitted from the laser. Corneal damage or blindness may result from exposure to laser radiation. |
|---|---|

2 Visually inspect exterior surfaces of optical components for contamination. If required, follow the cleaning instructions below.

| ⚠ Caution<br>possible personal injury | A risk of exposure to toxic elements, like zinc selenide, may result when certain optical or beam delivery components are damaged. In the event of damage to laser, marking head, or beam delivery optics, contact SYNRAD, Inc. or the optics manufacturer for handling instructions. |
|---|---|

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 chapter for label types and locations.

4 When cooling FH Flyer using an externally-mounted fan or ducted ventilation system, check the fan, Flyer's finned heatsink, and/or ductwork for dirt or debris build-up and clean as required.

# maintenance/ troubleshooting

## Maintenance

### Storage/shipping

When preparing an FH Flyer head for storage or shipping, place dust caps over expander telescope and focusing optics. Place a cap over Flyer's Gas Purge port to prevent debris from entering the gas purge path. If possible, repackage the head in its original SYNRAD shipping container to lessen the chance of damage.

### Lens mount removal/replacement

For best results, remove the focusing lens assembly before cleaning. This allows you to work comfortably and inspect the lens under good lighting.

The 80 mm, 125 mm, 125HP, and 200 mm FLA lenses used on FH Flyer marking heads are held in place by three cap screws. Older FLA lenses, and all FLA 370 mm lenses, include a dowel pin that indexes the lens to a specific orientation relative to the head.

To remove FH Flyer's focusing lens for inspection and cleaning, perform the following steps:

1. Shut off and lock out all power to the laser and marking head. You must verify that the laser is OFF before proceeding with lens removal and inspection!
2. While holding the one-piece lens mount assembly in place, remove the three 8–32 × 3/8" Allen cap screws securing the focusing lens to the marking head (see Figure 7-1).

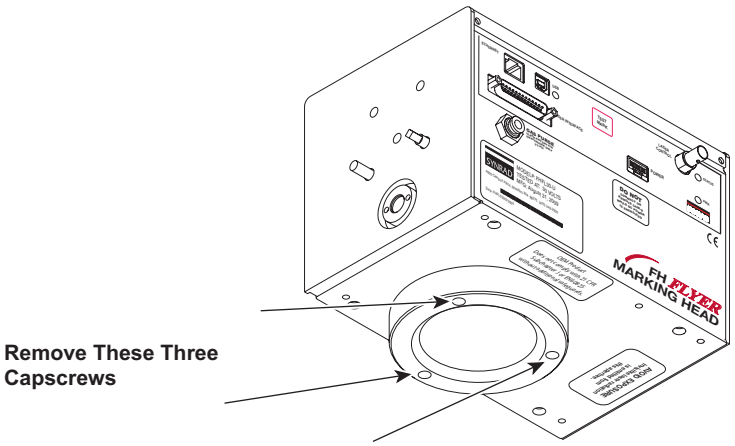


Figure 7-1 Lens mounting screw locations

3. Carefully pull the lens mount away from the marking head and place it on a sheet of lens tissue for inspection.

Important Note: Do not disassemble the lens assembly or attempt to remove the focusing lens from its mount.

# maintenance/ troubleshooting

## Maintenance

To replace the FH Flyer focusing lens, perform the following steps:

1 If the focusing lens assembly has a dowel pin on its inside face, refer to Figure 7-2 and position the lens mount so that the dowel pin lines up with the non-threaded dowel pin hole in Flyer's bottom plate.

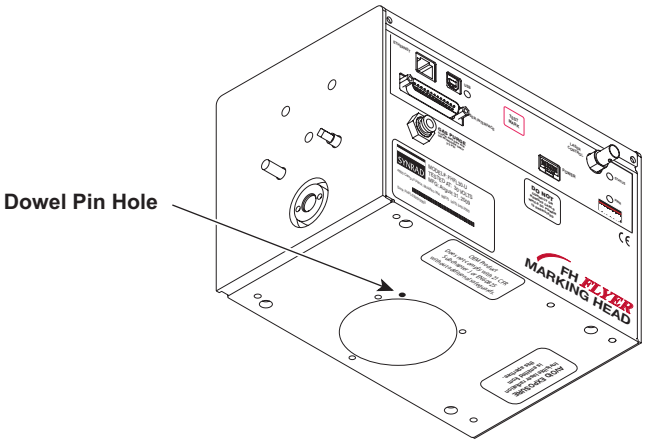


Figure 7-2 Lens mount dowel pin location

2 Insert the dowel pin into the dowel pin hole, then rotate the lens slightly as required so the screw holes align with the threaded holes in Flyer's bottom plate.

If the lens mount does not have a dowel pin, simply line up the screw holes in the lens mount with the threaded holes in Flyer's bottom plate.

3 Hold the lens in position, then insert and loosely fasten the three 8–32 × 3/8" Allen cap screws.

4 While carefully tightening the three cap screws, inspect the lens mount assembly around its circumference and verify that the lens mount fits flush against the bottom plate.

Note: If the lens mount assembly does not fit flush against the bottom plate, remove the lens and recheck the alignment and fit of the dowel pin.

# maintenance/ troubleshooting

## Maintenance

### Cleaning optics

Debris or contaminants on the focusing lens may affect laser processing, leading to damage or failure of the lens or marking head. Carefully follow the steps below to inspect and clean optical components. Before beginning the cleaning process, read this section thoroughly to ensure that cleaning materials listed in Table 7-1 are available and that each step is completely understood.

Important Note: Exercise great care when handling infrared optics; they are much more fragile than common glass materials. Optical surfaces and coatings are easily damaged by rough handling and improper cleaning methods.

Table 7-1 Required cleaning materials

| Cleaning Material | Purity 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 wipe (preferred) | Optical (cleanroom) quality |
| Cotton balls or cotton swabs | High-quality surgical cotton/high-quality paper-bodied |

### Lens cleaning guidelines

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

- Wear rubber or latex finger cots or rubber gloves (powder-free) to prevent contamination of optical surfaces by dirt and skin oils.
- Never handle optics with tools; always use gloved hands or fingers.
- Hold optics by the outer edge; never touch the coated surface.
- 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 or cotton ball instead of a lens wipe 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 Shut off and lock out all power to the laser and marking head. You must verify that the laser is OFF before proceeding with the optical inspection and cleaning!

2 Remove the focusing lens as described in the Lens mount removal/replacement section above.

**Caution**
**possible lens damage**

Do not allow the nozzle of the air bulb to touch the optical surface. Any contact may damage the optic by scratching coatings on the optical surface.

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

Do not exert pressure on the surface of the optic during cleaning. Optical surfaces and coatings are easily scratched by dislodged contaminants.

Use a new wipe on each pass as contaminants picked up by the wipe may scratch the optical surface.

3 Remove loose contaminants from the focusing lens 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.

4 Refer to Table 7-2 and select the appropriate cleaning solvent based on the type of contamination that exists on the surface of the lens.

Table 7-2 Cleaning solvent selection

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

5 Dampen a lens wipe with the selected cleaning agent.

Note: If acetone is used as the cleaning solvent, a second follow-up cleaning of the optical surface using ethyl alcohol is required to remove any acetone residue.

6 Gently, and without applying pressure, wipe the damp lens wipe across the optic surface in a single pass. Do not rub or apply pressure, especially when using a cotton swab. Drag the wipe without applying any downward pressure.

Note: Use a clean lens wipe on each pass. The wipe will pick up and carry surface contaminants that may scratch the optical surfaces or coatings.

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

## Maintenance

7 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.

8 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.

9 Repeat Steps 5 through 8 as required, removing all possible contaminants and deposits.

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

# Troubleshooting

The Troubleshooting section includes subsections:

- Indicator LEDs
- FH Series Flyer marking head
- Stand-alone mode
- Tracking mode
- Automation I/O
- Laser Marking FAQ

## Indicator LEDs

FH Flyer has several LEDs that indicate operational status or fault conditions. LEDs may change color and/or blink at a slow (2 Hz) or fast (10 Hz) rate depending on the state of the Flyer head. Each LED and its corresponding status indications are described in detail below.

### Pwr LED

The Pwr LED illuminates green when +30 VDC is applied to the Power connector. The LED is off when no power is available.

### Status LED

The Status LED can indicate several different operational states as described in Table 7-3.

Table 7-3 Status LED indications

| Status LED State | Operational Status of Flyer |
|---|---|
| Off | No power applied to Flyer (or failure of control electronics). |
| During Boot-Up: | |
| Green – Slow Blink (2 Hz) | Flyer's boot sequence is proceeding normally (allow 25–30 seconds). |
| Red – Slow Blink (2 Hz) | Flyer in alternate boot mode. Contact SYNRAD Technical Support. |
| Red – Fast Blink (10 Hz) | Alternate boot successful; ready to download update or repair file system. |
| After Boot-Up: | |
| Green – Solid | Normal boot sequence successful; ready to perform marking operations. |
| Green – Fast Blink (10 Hz) | Marking in progress. |
| Red – Fast Blink (10 Hz) | The FASI feature is enabled, but no FASI signal is detected on input IN3. Apply a valid input signal on IN3 to enable marking. |
| Red – Slow Blink (2 Hz) | A scanner fault is detected. Contact SYNRAD Technical Support. |
| Red – Solid | A fatal fault has occurred. Contact SYNRAD Technical Support. |

## Troubleshooting

### USB LED

The USB LED indicates the operational states described in Table 7-4.

Table 7-4 USB LED indications

| USB LED State | USB Status |
|---|---|
| Off | No power applied to Flyer or USB cable disconnected |
| Green – Solid | Flyer powered up and connected to active computer |
| Red – Solid | Flyer communicating with WinMark Pro |

### Ethernet LEDs

Ethernet LEDs (located in the lower corners of the RJ45 Ethernet connector) indicate the following Ether-net status (see Table 7-5).

Table 7-5 Ethernet LED indications

| Ethernet LED State | Ethernet Status |
|---|---|
| Yellow – Off | No Ethernet activity or Ethernet cable disconnected |
| Yellow – Blinking | Ethernet activity; physical network connection OK |
| Green – Off | Flyer not connected to WinMark Pro session |
| Green – On | Flyer connected to an active WinMark Pro session |

## FH Series Flyer marking head

Symptom:

- The DC Power cable is connected, but the Pwr indicator is not illuminated.

Possible Causes:

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

Ensure that the proper DC voltage (+30 VDC ±2.0 V @ 4 A) is available under full-load conditions.

Symptom:

- The Flyer head exhibits a high-frequency hiss after boot-up when the Status LED turns solid green.

Possible Causes:

- This is normal operation for Flyer.

# Troubleshooting

After boot-up, when the optical scanners are activated, you may hear a high-frequency hiss from Flyer. This hiss is a normal result of sampling noise inherent in Flyer's DSP-based servo loop.

### Symptom:

- Power (+30 VDC) has just been applied to the head, the Pwr LED is green; however, more than 30 seconds has elapsed and the Status indicator is still blinking green at a slow (2 Hz) rate.

### Possible Causes:

- Flyer's OS or flash memory is corrupted.

A fault exists that prevents Flyer's Operating System from booting. This fault condition may be field repairable. Contact SYNRAD Technical Support for instructions on how to proceed.

### Symptom:

- Power (+30 VDC) has just been applied to the head, the Pwr LED is green, but the Status indicator is blinking red at a slow (2 Hz) rate.

### Possible Causes:

- Flyer is in alternate boot mode because it has failed to fully boot-up five times in a row.

Allow the alternate boot sequence to continue. If the Status lamp starts blinking red at a fast (10 Hz) rate, then the alternate boot mode was successful. Contact SYNRAD Technical Support for instructions on how to proceed.

### Symptom:

- Power was applied to the head, the Pwr LED is green, however the Status indicator was blinking red at a slow (2 Hz) rate and is now blinking red at a fast (10 Hz) rate.

### Possible Causes:

- Flyer's OS has completed an alternate boot sequence.

A fault exists that prevents Flyer's Operating System from booting normally. This fault condition may be field repairable. Contact SYNRAD Technical Support for instructions on how to proceed.

### Symptom:

- Flyer booted up normally (Pwr and Status LED's are solid green) and a mark session was in progress when the Status indicator began flashing red at a fast (10 Hz) rate and the laser quit firing.

### Possible Causes:

- Flyer received a 'start mark' signal; however, the Fast Acting Safety Interlock (FASI) feature is enabled and a high level (5 V–24 VDC) signal was not detected on input IN3.

# maintenance/ troubleshooting

## Troubleshooting

When FASI is enabled, a FASI signal to enable lasing must be connected to input IN3. If not, Flyer will not send PWM Commands signals to fire the laser and the Status LED starts blinking red at a fast rate. If IN3 goes low while marking a piece then the mark is not completed.

### Symptom:

- Flyer boots up normally (Pwr and Status LED's are solid green), but after the servos are initialized, the Status indicator begins flashing red at a slow (2 Hz) rate and marking is halted.

### Possible Causes:

- Flyer detected a fault in the optical scanner system.

Remove power, wait 30 seconds, and then reapply power. If the fault re-occurs after the servos are initialized, then contact SYNRAD Technical Support.

### Symptom:

- The Status indicator is red.

### Possible Causes:

- If the Status LED is solid red, not blinking, this indicates a fatal, non-recoverable, fault has occurred.

Remove power, wait 30 seconds, and reapply power. If the fault re-occurs, contact SYNRAD Technical Support.

- A solid red, not blinking, Status LED may indicate that the field reprogramming procedure was attempted, but DIP switch # 4 on switchbank SW2 was not switched back to the OFF position.

Refer back to Service Bulletin #08 and complete or restart the reprogramming procedure. If the fault re-occurs, contact SYNRAD Technical Support.

### Symptom:

- WinMark Pro v6 is installed, Flyer is powered up, Pwr and Status LED's are green and the USB Communication cable is connected between FH Flyer and the computer, but WinMark Pro v6 does not "see" the FH Flyer marking head. The "Search for heads again" option does not locate the head, forcing WinMark Pro v6 to open in demo mode with the Mark button grayed out.

### Possible Causes:

- FH Flyer's USB device driver is not installed.

In the Windows® Control Panel, open the Add Hardware Wizard and follow the instructions to scan for new Devices and install the appropriate Device Drivers. If this fails, restart your computer and/or reinstall WinMark Pro v6 Laser Marking Software. The first two screen shots in Figure 7-3 show that a hardware device exists, but a corresponding driver is not installed. The screen shot on the right shows the Flyer Laser Marking Device is properly installed and functioning.

# Troubleshooting

Important Note: Before installing or upgrading WinMark Pro software, first disconnect DC power or unplug the USB cable from the Flyer head. This ensures that the Windows OS will load and install the latest Flyer USB driver.

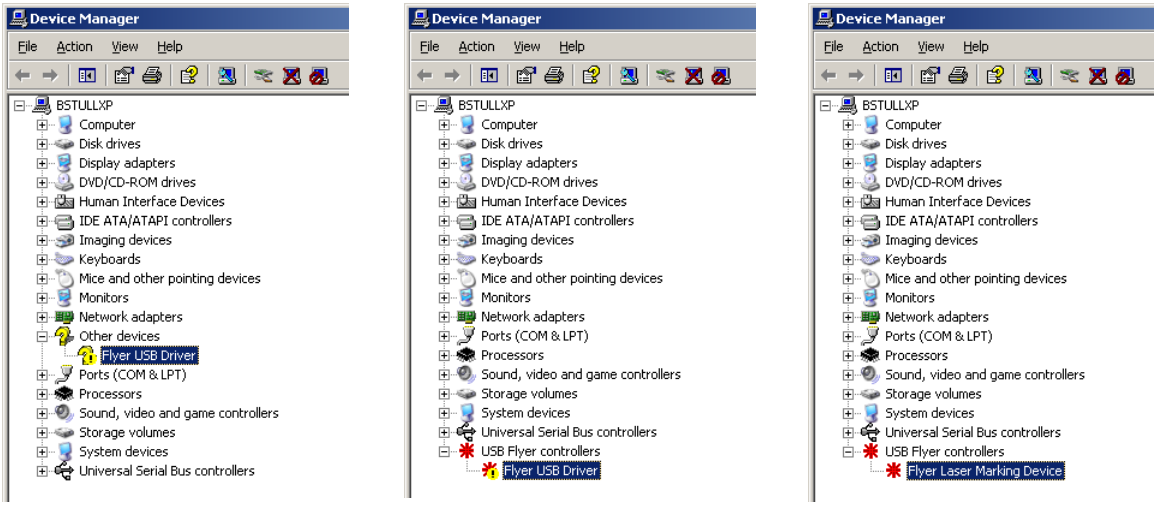


Figure 7-3 Windows Device Driver displays

## Symptom:

- Flyer and WinMark Pro v6 are connected via USB, WinMark is open, and Flyer is powered up (Status light is green), but the Mark button is grayed out and does not indicate an active device.

## Possible Causes:

- Communications between Flyer and WinMark Pro are not synchronized.

In WinMark Pro, under the Devices menu, chose Flyer USB and select the appropriate Flyer device. If a Flyer device is not available or the selection is grayed out, close and then re-open WinMark Pro while the Flyer head is powered up. This forces WinMark Pro to re-initialize communications with Flyer. If communication is not established after this step, then close WinMark, reboot your computer, power down the Flyer head, wait 30 seconds, and then reapply power. When Flyer's Status LED illuminates green, open WinMark Pro.

## Symptom:

- Flyer and WinMark Pro are connected via USB, WinMark is open, and Flyer is powered up (the Status light is green), but the Mark button (on the "Device" tab) displays "Device ID 0" and does not indicate an active Flyer device.

## Possible Causes:

- Communication between Flyer and WinMark Pro is not synchronized and WinMark has recognized, and defaulted to, a Fiber Link Controller Card (FLCC) previously installed in the marking computer.

# maintenance/ troubleshooting

## Troubleshooting

Close and then re-open WinMark Pro while the Flyer head is powered up. This forces WinMark Pro to re-initialize communications with Flyer. If communication is not established after this step, then close WinMark, power down the Flyer head, wait 30 seconds, and then reapply power. When Flyer's Status LED illuminates green, open WinMark Pro.

### Symptom:

- The laser mark produced by FH Flyer is much larger or much smaller than the image drawn on the WinMark Pro Drawing Canvas.

### Possible Causes:

- The lens size specified in WinMark Pro does not match the lens installed on Flyer.

Check that the lens specified in WinMark Pro matches the lens currently installed on Flyer. In WinMark, go to the Tools menu, select General Settings… , and then click the "Device" tab. Check the Lens property to ensure the chosen lens is from the FH/Flyer list.

### 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 focusing lens. Refer back to Figure 3-2, Working distance measurement, in the Operation chapter and then measure working distance from the bottom of the focusing lens mount to the surface of the part to be marked. Adjust the Z-axis of the mounting platform or the marking surface as required to obtain the cor-rect working distance.

### Symptom:

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

### 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 chapter.

### Symptom:

- Pwr and Status indicators on the marking head are illuminated green, but no mark is made when the Test Mark pushbutton is pressed or when marking is commanded through WinMark Pro.

# Troubleshooting

## 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 chapter for information on connecting the Laser Control cable between Flyer and your particular laser.

- The Fast Acting Safety Interlock (FASI) feature is enabled.

When the FASI feature is enabled (If the FASI Enable property on the "Device" tab under Tools / General Settings… is Yes), then you must apply a 5 V–24 VDC signal on Flyer input IN3 to fire the laser.

## Symptom:

- FH Flyer is not marking properly or there are indications of operational faults within the head.

## Possible Causes:

- Flyer has, or is experiencing, one or more fault or error conditions.

Before contacting SYNRAD Technical Support, download and review Flyer's Error Logs. To do this, go to the Tools menu in WinMark Pro, highlight Get Flyer Head Logs, and select Main Message Log. WinMark prompts you for a location in which to save the .log file (the default is the WinMark installation folder – C:\Program Files\WinMark). After the file is saved to your hard drive, it opens to display a recent history of Flyer operation.

# Stand-alone mode

## Symptom:

- Flyer is waiting for an input during a stand-alone mark session. Pwr and Status indicators are illuminated green, but the head will not connect and communicate to WinMark Pro through Ethernet or USB connections.

## Possible Causes:

- Flyer will not connect to Ethernet or USB ports while waiting for an input during a stand-alone mark session.

Disconnect power from the head and then attach the appropriate Ethernet or USB connection between Flyer and your computer. Re-apply power to Flyer. When the head boots up, it will re-establish communication with the computer before beginning the stand-alone mark session.

# Troubleshooting

## Tracking mode

### Symptom:

- FH Flyer does not track moving parts.

### Possible Causes:

- Tracking is not enabled.

In WinMark Pro v6, check that Track Marking Object (on the Drawing object's Marking tab) is Yes.

- Encoder pulses are not being read by the FH Flyer head.

Close WinMark Pro and open Digital Scope (DigScope.exe). Rotate the conveyor or position encoder and verify that input IN1 and input IN2 toggle as the encoder rotates through its range of motion.

- The part sensor signal is not being read by the FH Flyer head.

Close WinMark Pro and open Digital Scope (DigScope.exe). Trigger the part sensor and verify that input IN0 toggles as the part sensor activates.

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

In WinMark Pro, toggle the Invert Encoder Direction property on the "Device" tab under Tools / General Settings… .

- A physical part sensor is not installed.

Enable the Internal Part Trigger property (on the "Device" tab under Tools / General Settings…) and then enter a Part Pitch value.

- A position encoder is not installed.

Enable Encoderless Tracking (on the "Device" tab under Tools / General Settings…) and then enter a Product Line Speed value equal to conveyor or part velocity.

### Symptom:

- Characters or graphics within the mark are missing.

### Possible Causes:

- The mark is not being completed within the extents of the Tracking Window.

Open the mark file in WinMark Pro and ensure that the mark is positioned as close to the upstream edge of the Drawing Canvas as possible.

# Troubleshooting

- Line speed is set too fast.

Lower line speed.

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

Open the mark file in WinMark Pro and do the following: (1) shorten mark time by changing fonts, decreasing font size, or reducing line spacing; (2) simplify or eliminate graphic objects in the mark; or (3) reduce graphic object size or resolution.

### Symptom:

- Tracking marks are skewed or distorted.

### Possible Causes:

- The Encoder Resolution value is set improperly.

Load and mark the appropriate linestackxxx.mkh file (located in the WinMark software folder). Refer to Tracking hardware - position encoder in the Tracking chapter for instructions on how to fine-tune encoder resolution settings.

- The Product Line Speed value is set improperly.

If Encoderless Tracking is specified, check that Product Line Speed (on the "Device" tab under Tools / General Settings…) is equal to conveyor or part velocity. Adjust Product Line Speed as required to fine-tune tracking to actual part motion.

- Line speed is set too fast.

Lower line speed.

- The actual part motion vector is different from the value entered as the Motion Vector.

Check that actual part motion under the marking head equals the entered Motion Vector (on the "Device" tab under Tools / General Settings…). WinMark Pro v6 and FH Flyer support Motion Vector values in 0.01° increments.

# Automation I/O

### Symptom:

- FH Flyer is not responding to automation inputs or the automation controller is not "seeing" Flyer outputs.

### Possible Causes:

- I/O voltage levels are incorrect.

# maintenance/ troubleshooting

## Troubleshooting

Review the Input/output circuitry section in the Technical Reference chapter to verify that I/O signals are in the correct voltage range of 5 V to 24 VDC. Use a voltmeter to measure your I/O signals while they are connected to Flyer's DB-25 User Interface connector.

Note: Flyer's input/output voltage range is different from previous FH heads (Index/Tracker/Smart) where the allowable voltage range was 15 V–40 VDC. Flyer I/O voltages must be in the range of 5 V–24 VDC.

- 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 User Interface connector and that their respective return (ground) paths are wired to the proper pins. Refer to Input/output circuitry in the Technical Reference chapter for information about connecting signals to/from Flyer. This section also contains information about converting an existing FH Index or Tracker system for Flyer-compatibility.

Important Note: Flyer's DB-25 User Interface connector pinout does not match the pinout on the FH Smart DB-25 Parts Handling Control connector.

Use Digital Scope (DigScope.exe), shown in Figure 7-4, to verify proper I/O functionality between FH Flyer and the automation controller. Digital Scope's input "buttons" pop-in as an input is activated (when the correct voltage level is applied). Press an output "button" to activate an output.

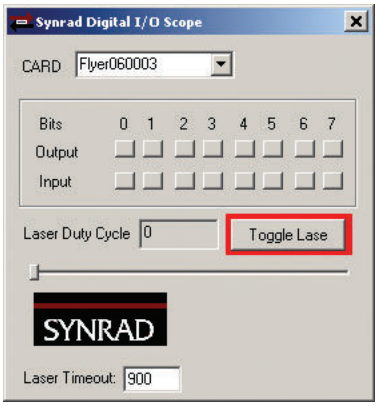


Figure 7-4 Digital Scope window

## 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.

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# appendix a

# A

This appendix contains the following information:

- Cooling – explains how to determine when operating conditions and the type of marking application indicate a need for auxiliary cooling of your FH Flyer marking head.

# appendix a

## Cooling

The Cooling section includes subsections:

- Cooling FH Flyer
- Heat load factors
- Calculating heat load
- Mounting an auxiliary cooling fan

## Cooling FH Flyer

If you are currently cooling your FH Series Index or Tracker marking head, you should continue to cool FH Flyer in the same manner. However, please note that Flyer's heat load is concentrated on the front end of the head—at the finned heat sink end, not the L-bracket (input) end.

You must add external cooling if any of the following conditions exist: (1) the heat sink has less than 1.0" (25.4 mm) of free air space between the head and any enclosure or surface, (2) the head is oriented such that the heat sink is pointing downward or in any other non-standard orientation, or (3) Flyer's calculated maximum internal temperature at the optical scanners is higher than 50 °C.

You can monitor Flyer head temperature in real-time using our WinMark Pro laser marking software. To do this in WinMark Pro, click the Help menu and then click About Synrad WinMark… . The About Synrad WinMark… dialog box displays internal air temperature near power amplifier and CPU components along with a color-coded Status indicator. If the Status indicator, normally green, turns yellow (indicating power amp air temperatures at or above 65 °C), then you should consider adding an external cooling fan. FH Flyer will stop marking if the CPU's ambient air temperature reaches 65 °C (when the Status indicator turns red). If this happens, marking will halt and you must cool the head. Marking is not enabled again until ambient CPU air temperature drops below 60 °C.

Note: Real-time air temperature measurements at power amplifier and CPU locations inside Flyer have been correlated with optical scanner air temperatures after extensive testing. A measured air temperature of 65 °C at the CPU indicates that air temperatures surrounding the optical scanners are approaching their maximum temperature limit of 50 °C.

## Heat load factors

Several factors influence the internal temperature of the marking head including external ambient air temperature, airflow, marking speed, off-vector speed, mark object type and size, mark duty cycle, and head mounting orientation. Each item is described in detail below. An understanding of the factors that affect heat load and head performance will assist you in optimizing your integrated FH Flyer marking system for best performance and long service life.

### External ambient air temperature

Ambient air temperature refers to the air temperature in the immediate vicinity of the Flyer head. If the marking head is installed inside an industrial-type processing machine, then the machine's shielding and covers, along with drive motors and other heat-generating components, may raise the ambient temperature inside the machine to a point well above the ambient air temperature of the room where the machine is placed. Flyer's environmental specifications (see Table 5-18) for operating temperature is within the range of 0 °C to 40 °C in a non-condensing environment—where the combination of air temperature and humidity are above the dew point (the point at which condensation forms).

# appendix a

## Cooling

### Airflow

Just as your car's engine temperature rises when stationary, Flyer's internal air temperature rises when the head is exposed to still air. Even modest airflow over the heat sink significantly reduces maximum temperatures inside the head. If in doubt, install a small fan or ductwork to direct cooling air over the heat sink.

### Marking speed (Velocity)

In general, fast optical scanner speeds generate more heat than slow marking velocities.

### Off-vector speed (Off Vector Velocity)

Off Vector Velocity is the commanded speed for the optical scanners when making off-vector (non marking) moves. Fast off-vector moves generate more heat, but help minimize cycle times.

### Mark object type

Internal temperatures become higher when marking stroke text and other vector-type objects. This occurs because both optical scanners are usually making significant moves throughout their range of motion. Raster objects, such as bitmaps or linear bar codes, generate less heat since one optical scanner moves small steps compared to the other scanner.

### Mark object size

Although not intuitive, marking small objects generates more internal heat than marking large objects. This happens because the optical scanners execute acceleration/deceleration commands more often.

### Mark duty cycle

To calculate the duty cycle of a marking application, divide mark cycle time by the time measured from the beginning of one 'start mark' input to the next 'start mark' input. For example, if the cycle time to mark one part is 0.80 seconds and there are 1.60 seconds between 'start mark' signals, then the mark duty cycle is 50%. The affects of mark duty cycle on heating are fairly linear—a 50% mark duty cycle will generate twice the heat of a 25% duty cycle.

### Head mounting orientation

The standard mounting orientation for a marking system is to place the laser/head assembly in a horizontal plane with the focusing lens pointed downward. Any other non-standard mounting configuration should include some means of cooling Flyer's heat sink.

# appendix a

## Cooling

### Calculating heat load

The purpose of calculating Flyer's internal heat load is to determine if a specific marking application requires auxiliary cooling. The goal is to prevent the temperature of Flyer's XY optical scanners from rising above 50 °C.

The equation used for this Heat Load calculation is:

$$T_{INT} = T_{AMB} + 14\ °C + (T_{GRAPH} \times DC_{MARK})$$

where: $T_{INT}$ = Internal optical scanner temperature (in °C)

$T_{AMB}$ = Ambient temperature (in °C)

$T_{GRAPH}$ = Temperature rise due to mark parameters (in °C)

$DC_{MARK}$ = Duty cycle of mark (Cycle time/time between successive 'start mark' inputs)

Note: This equation assumes "worst-case" conditions for mark object type (text), off-vector speed (maximum), and airflow (none) in order to approximate the maximum temperature rise sustained by Flyer's optical scanners.

To calculate Flyer's maximum internal temperature for a specific marking application, perform the steps listed in the following sections:

### Calculate the $T_{GRAPH}$ Temperature Rise

1 Determine the focusing lens used in this marking application.

Example – your application uses a 125 mm focusing lens, so enter a Lens Size of 125 mm.

**Lens Size equals _____ mm.**

2 From your mark file, determine the smallest dimension (in either the X- or Y-axis) of the object you are marking.

Example – your mark object, as shown in WinMark Pro's Object Transformations dialog, has a New Width dimension of 0.476" and a New Height dimension of 0.080". The Minimum Dimension X or Y is 0.08 inches.

**Minimum Dimension X or Y equals _____ inches.**

3 With the Minimum Dimension obtained in Step 2, use Table A-1 to locate the appropriate temperature curve (A, B, C, or D). To do this, find your lens in the Lens Size column and follow across to the column containing the Minimum Dimension from Step 2.

# appendix a

## Cooling

Table A-1 Temperature curve selection based on lens size and minimum object size

| | Temperature Curve | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Lens Size | Min. Dimension, inches | | | |
| 80 mm | ≥ 0.30 | 0.29 – 0.16 | 0.15 – 0.08 | ≤ 0.07 |
| 125 mm | ≥ 0.47 | 0.46 – 0.25 | 0.24 – 0.13 | ≤ 0.12 |
| 200 mm | ≥ 0.74 | 0.73 – 0.39 | 0.38 – 0.20 | ≤ 0.19 |
| 370 mm | ≥ 1.37 | 1.36 – 0.73 | 0.72 – 0.37 | ≤ 0.36 |

Example – for our example lens size of 125 mm, follow the 125 mm row across until you find a column containing a minimum dimension of 0.08". This is less than 0.12 inches, so Temperature Curve D is the appropriate curve for this marking application.

**The appropriate Temperature Curve is _____.**

4 Determine the scale factor for the focusing lens used in this marking application from Table A-2 below.

Table A-2 Focusing lens scale factors

| Lens | Scale Factor |
|---|---|
| FLA 80 mm | 2.466 |
| FLA 125 mm | 1.570 |
| FLA 200 mm | 1.000 |
| FLA 370 mm | 0.540 |

Example – in our series of examples, the Lens Size is 125 mm, so the Scale Factor is 1.570.

**Scale Factor equals _____.**

5 Determine the mark velocity (in inches per second—IPS) used in this marking application.

**Marking Velocity equals _____ IPS.**

6 Multiply the object's Marking Velocity from Step 5 by the Scale Factor of the lens to obtain the Normalized Marking Velocity.

Example – the Marking Velocity from Step 5 is 45 IPS and our Scale Factor is 1.570, so the Normalized Marking Velocity is 70.65 IPS. You may round this value up to 71 IPS.

**Normalized Marking Velocity equals _____ IPS.**

# appendix a

## Cooling

7 Use Figure A-1 to determine the $T_{GRAPH}$ temperature rise due to the application's mark parameters.

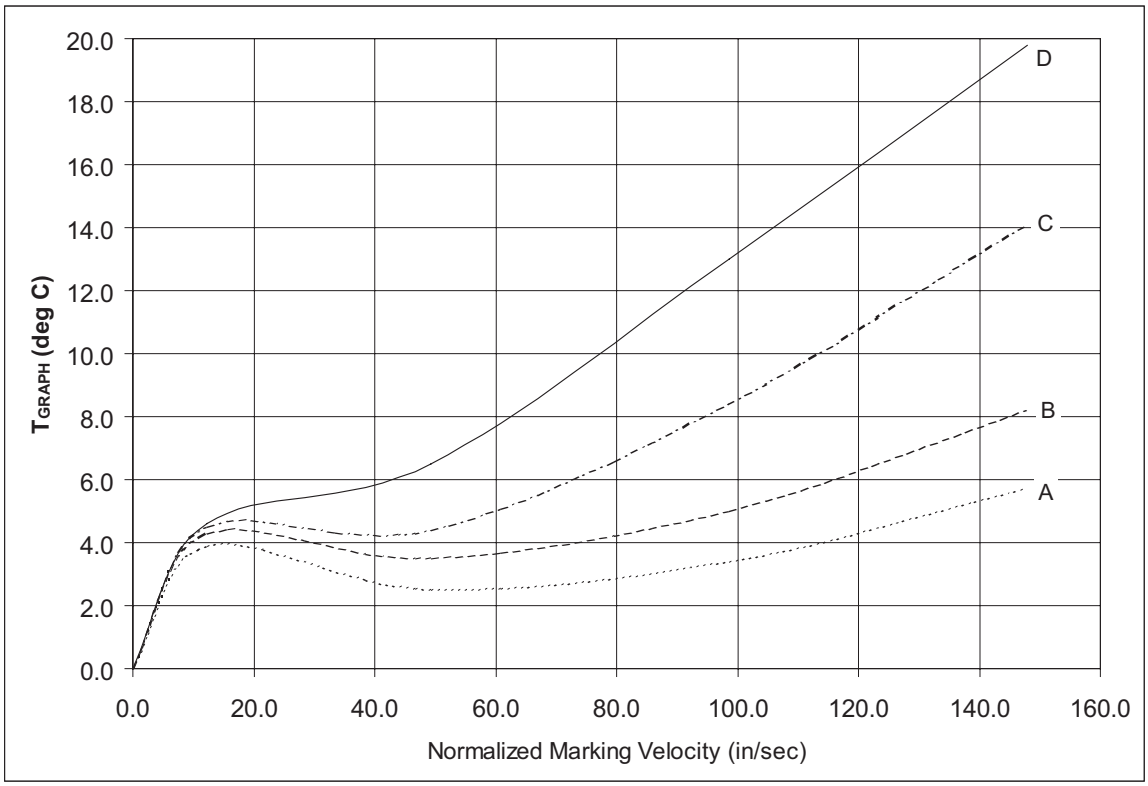



Figure A-1 Graph of heat rise based on normalized mark velocity by temperature curve

Example – locate the approximate position of 71 in/sec on the Normalized Marking Velocity axis and follow this point up to where it intersects Temperature Curve D. Now read across to determine the $T_{GRAPH}$ Temperature Rise in °C. In our example, this value is around 9 °C.

**$T_{GRAPH}$ Temperature Rise equals _____ °C.**

## Determine the other Heat Load variables

1 Enter the ambient temperature (in °C) of the location where Flyer is operating.

Note: Be sure to use the maximum air temperature that could be attained in the area where the machine is installed during the hottest time of the year.

Example – the location where the Flyer head is installed never rises above an ambient temperature of 86 °F, which converts to a $T_{AMB}$ Value of 30 °C.

**$T_{AMB}$ Value (in °C) is _____ .**

2 Determine the duty cycle of the mark. To do this, divide mark cycle time (in seconds) by the number of seconds between successive 'start mark' signals.

Example – the cycle time of the mark is 0.75 seconds and there are 1.25 seconds between 'start mark' signals. 0.75 / 1.25 equals a $DC_{MARK}$ Duty Cycle of 0.6.

**$DC_{MARK}$ Duty cycle is _____ .**

## Solve the Heat Load equation

Flyer's Heat Load equation is:

$$T_{INT} = T_{AMB} + 14\ °C + (T_{GRAPH} \times DC_{MARK})$$

Enter the values you have determined for $T_{AMB}$, $T_{GRAPH}$, and $DC_{MARK}$. Solve for $T_{INT}$, which is the maximum internal temperature that Flyer will reach. Using the values shown in our examples, we can solve the Heat Load equation to determine the maximum internal temperature. Our example values are:

$T_{AMB} = 30\ °C$;

$T_{GRAPH} = 9\ °C$;

$DC_{MARK} = 0.6$.

$$T_{INT} = T_{AMB} + 14\ °C + (T_{GRAPH} \times DC_{MARK})$$

$$T_{INT} = 30 + 14 + (9 \times 0.6)$$

$$T_{INT} = 30 + 14 + (5.4)$$

$$T_{INT} = 49.4\ °C.$$

Our example calculated temperature is below 50 °C, which is the maximum internal temperature that Flyer should reach, so no external cooling is required in this case. Remember that this Heat Load calculation is based on "worse-case" parameters including still air temperatures—even a small amount of airflow over Flyer's heat sink will reduce the maximum internal air temperature significantly.

# appendix a

## Cooling

### Mounting an auxiliary cooling fan

Use information in this section to mount an external cooling fan or cooling ductwork if you have determined that additional external cooling is required because (1) Flyer's heat sink has less than 1.0" (25.4 mm) of free air space between the head and any enclosure or surface, (2) Flyer is oriented such that the heat sink is pointing downward or in any other non-standard orientation, or (3) Flyer's calculated internal maximum temperature is higher than 50 °C.

Tests have shown that adding a cooling fan to provide airflow over Flyer's heat sink can reduce internal temperatures by 10 °C in demanding marking applications. Choose a cooling fan with an airflow rating of at least 50–100 cubic feet per minute (CFM). For best results, mount the cooling fan or cooling ductwork at an angle of approximately 15° to the heat sink so that airflow is directed slightly upward. The natural tendency of heat to rise will assist in the heat removal process. See the example drawing in Figure A-2.

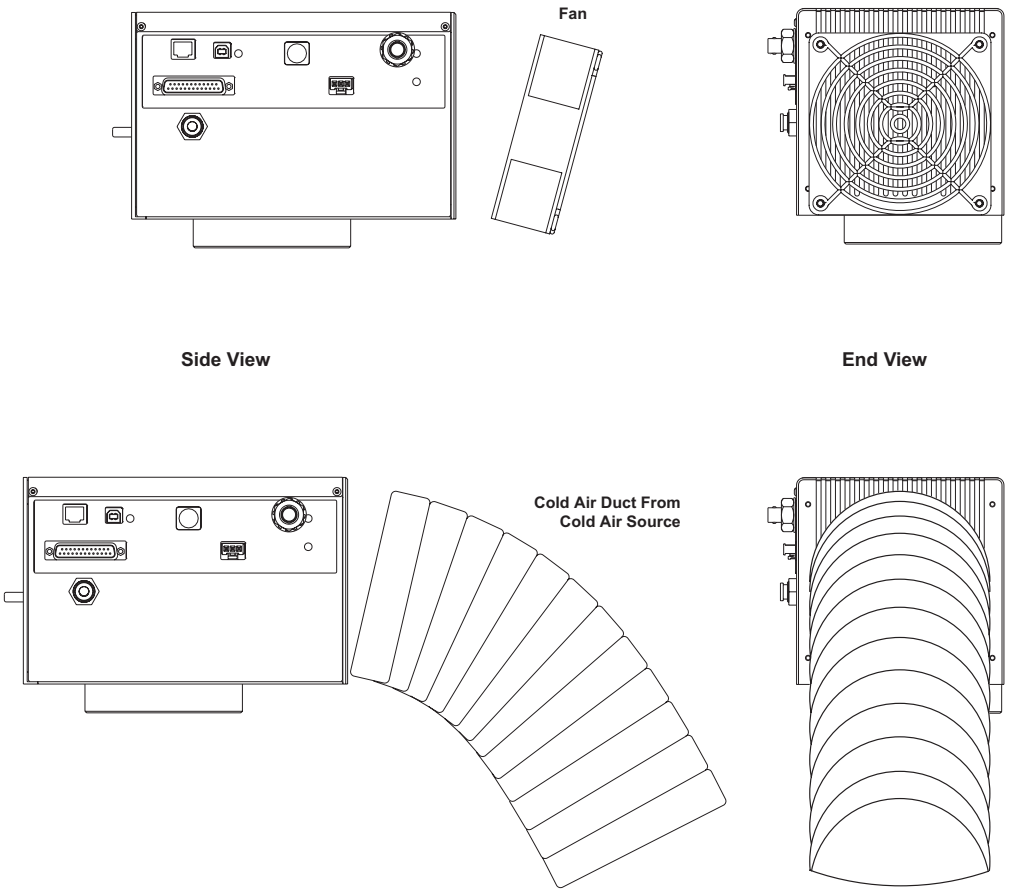



Figure A-2 Mounting cooling fan or ductwork to Flyer

Before mounting a cooling fan or ductwork, refer to Figure 5-20 in the Technical Reference chapter for a diagram showing dimensions of the four user-accessible mounting holes in Flyer's heat sink. The mounting holes are tapped for standard 6–32 UNC screws with a maximum depth of 0.25" (6.35 mm).

# appendix b

# B

This appendix contains the following information:

- Power measurements – describes how to measure laser output power through an FH Series Flyer marking head.

# appendix b

## Power measurements

The Power measurements section includes subsections:

- Setup
- Input measurements
- Output measurements

This Appendix describes how to measure laser power through the FH Flyer marking head using a SYNRAD Power Wizard® power meter. Use this procedure to verify that Flyer is properly aligned to the laser when it is mounted without using the SYNRAD designed L-bracket and Mounting Rail or to verify that the laser is performing properly. 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<br>possible equipment damage | Take all power measurements on an unfocused beam. Never measure a focused laser beam at the point of focus. Damage to the Power Wizard power meter will result. |
|---|---|

## Setup

To prepare the marking head for power measurements, perform the following steps to ensure the optical scanners are centered in the mark field:

1. Place a beam block on the marking surface in the field of the focusing lens. This prevents the beam from traveling beyond the work area during power measurements.
2. Remove the Beam Enclosure Tube from between the L-bracket and the laser.
3. Power down the FH Flyer head and then connect your computer to the marking head via USB or Ethernet.
4. On your computer, open the Digital Scope executable (DigScope.exe).
5. Power up the Flyer head. Cycling power to the head ensures that the optical scanner mirrors are centered in the mark field.

## 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. The Power Wizard PW-250 has an operational range of 1–250 W.

# appendix b

## Power measurements

**⚠ Danger**
**serious personal injury**

This product emits invisible infrared laser radiation at the 10.6 µm $CO_2$ 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.

To begin input power measurements, perform the following steps:

1. Ensure that all personnel in the area are wearing the appropriate protective eyewear.
2. In Digital Scope, use the slider to set the desired PWM power percentage, which appears 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 (±0.3 W).
6. Immediately place the Power Wizard's target area in the beam path centered on, and close to, Flyer's Expander Telescope (input aperture). See Figure B-1. Do not allow the Power Wizard to contact the Expander Telescope as this may damage the expander's optical elements.

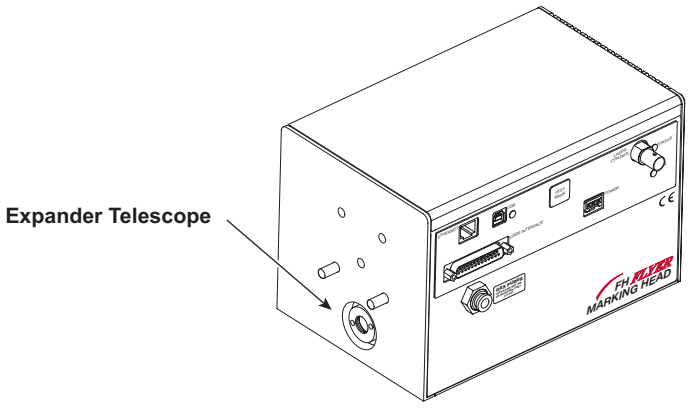



Figure B-1 Input aperture location

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. When measuring power levels above 100 watts, give the Power Wizard time to cool between measurements.

# appendix b

## Power measurements

### Output measurements

Measure output power 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 an FH Series marking head (measured output power versus measured input power) is approximately 7%.

To begin output power measurements, perform the following steps:

| ⚠ Danger<br>serious personal injury | This product emits invisible infrared laser radiation at the 10.6 µm $CO_2$ 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.<br><br>Always be aware of the beam's path and always use a beam block while testing. |
|---|---|

1. Ensure that all personnel in the area are wearing the appropriate protective eyewear.
2. Open Digital Scope and use the slider to set the desired PWM power percentage, which appears 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 (±0.3 W).
6. Immediately place the Power Wizard's target area in the center of the focusing optic's beam path.

   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 Toggle Lase 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 exceeds approximately 7%, remove the focusing lens and take another set of output power measurements. Excessive power loss through the focusing lens may indicate that the lens is dirty. Inspect the lens for contaminants and, if required, carefully clean the lens as described in Maintenance in the Maintenance/Troubleshooting chapter.

If the FH Flyer marking 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. Ensure that the beam is located in the center of both input and output optics.

# appendix c

C

This appendix contains the following information:

- Alternate mounting configurations – describes alternate methods of mounting the FH Series Flyer 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 Flyer marking head.

Important Note: Mounting the laser and FH Series Flyer marking head in non-standard configurations (without the SYNRAD-designed L-bracket and Mounting Rail) is a complex process and should be attempted only by personnel with experience and knowledge in optical beam characteristics and laser/optical alignment.

# 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 marking head and laser using our Flyer L-bracket and Mounting Rail, there are some applications where, due to production line or packaging constraints, this is not possible. Several alternatives for mounting your marking head and laser are described below.

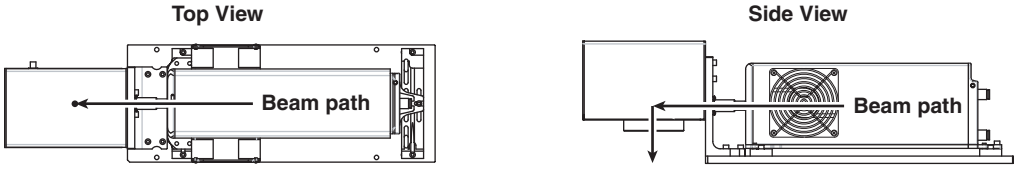
## Mounting guidelines

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

- When replacing an FH Index/Tracker head with FH Flyer on a non-standard mounting bracket, the center of Flyer's beam exit is moved 2.54 mm (0.10") away from the center of the FH Index/Tracker mark field in the –X direction (to your right when facing Flyer's membrane panel).
- Mount FH Flyer so that your marking surface is parallel to the bottom of the focusing lens mount.
- Build in a Z-axis adjustment for either the marking surface or the mounting platform.
- To prevent damage to your Flyer head when using a custom-built mounting bracket, verify that the 1/4–20 UNC mounting screws to not extend further than 0.30" (7.6 mm) into the Flyer 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.
- Allow room for fan clearance if a cooling fan is required in your FH Flyer installation.
- 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.

## Standard mounting

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




**Standard FH Marking Head/laser mounting using optional L-Bracket and Mounting Rail**

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.

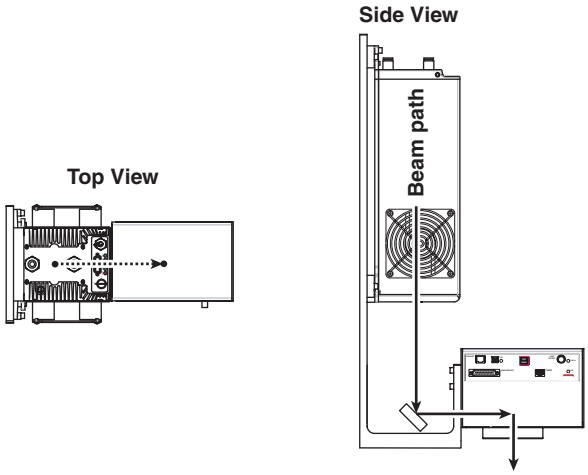



Figure C-2 In-line mounting

### 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.

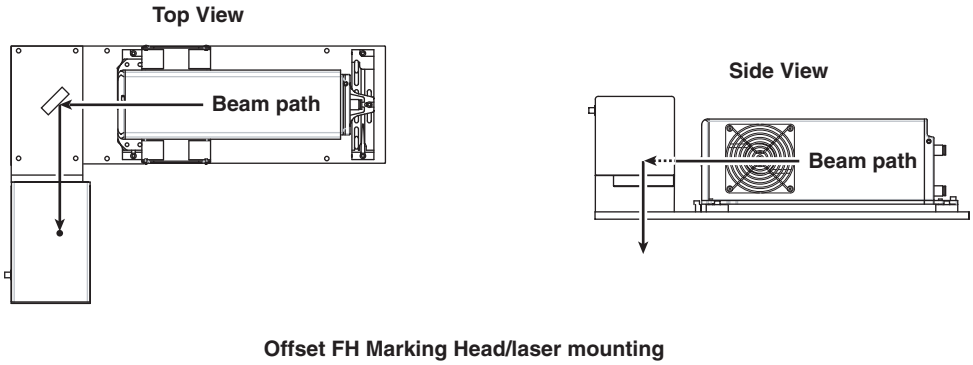



Figure C-3 Offset mounting

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## Beam expansion/path length

Each SYNRAD laser family (48 Series, Evolution, and Firestar) has slightly different beam diameter and divergence values. The standard FH mounting scheme, consisting of our L-bracket and Mounting Rail, takes these issues 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 f100 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 and t-Series lasers (2 mm / 7 mrad) require a 5X expander.

In situations where the FH Flyer 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 input aperture optic, potentially damaging the head. 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 working distance of the lens will differ from the distance measured during the marking head's final test evaluation. You should use the value indicated in the marking head's 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 Tables 5-1 and 5-22.

In addition, the longer beam path and resulting change in focal length affects the overall field size of the lens. You may need to optimize FieldScaleX and FieldScaleY values to obtain the correct dimensions when marking objects with critical 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.

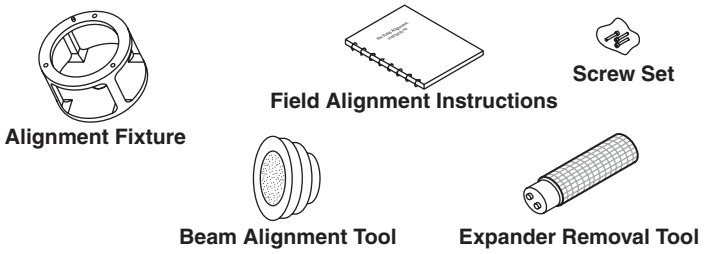


Figure C-4 FH Field Alignment Kit

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## Beam expansion/path length

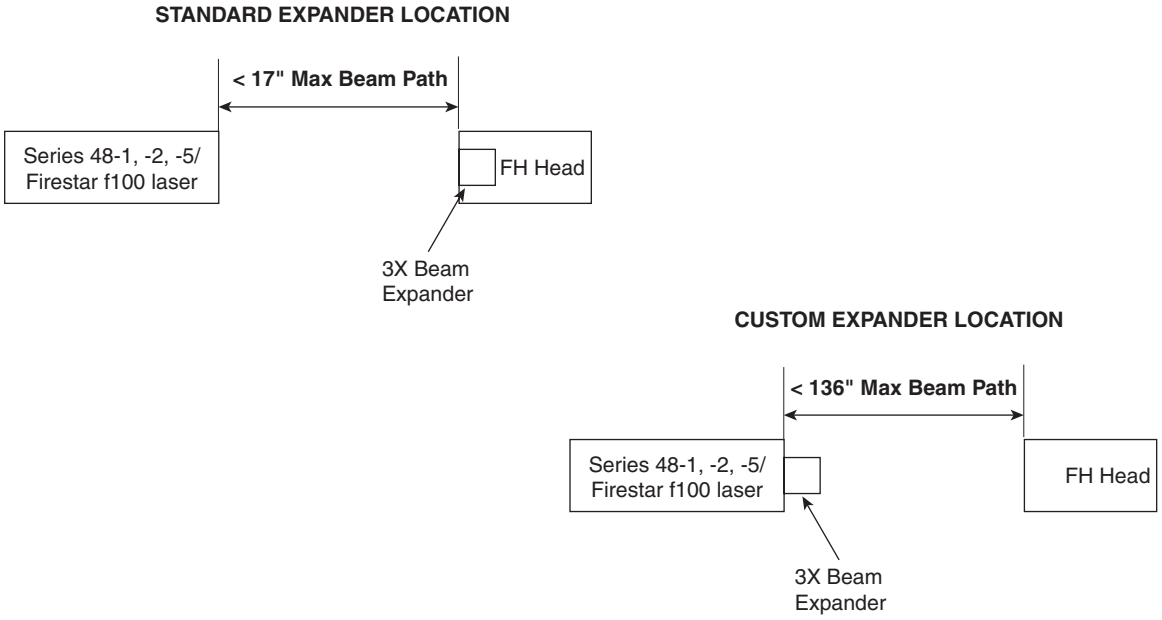


Figure C-5 Maximum 48 Series/f100 beam path

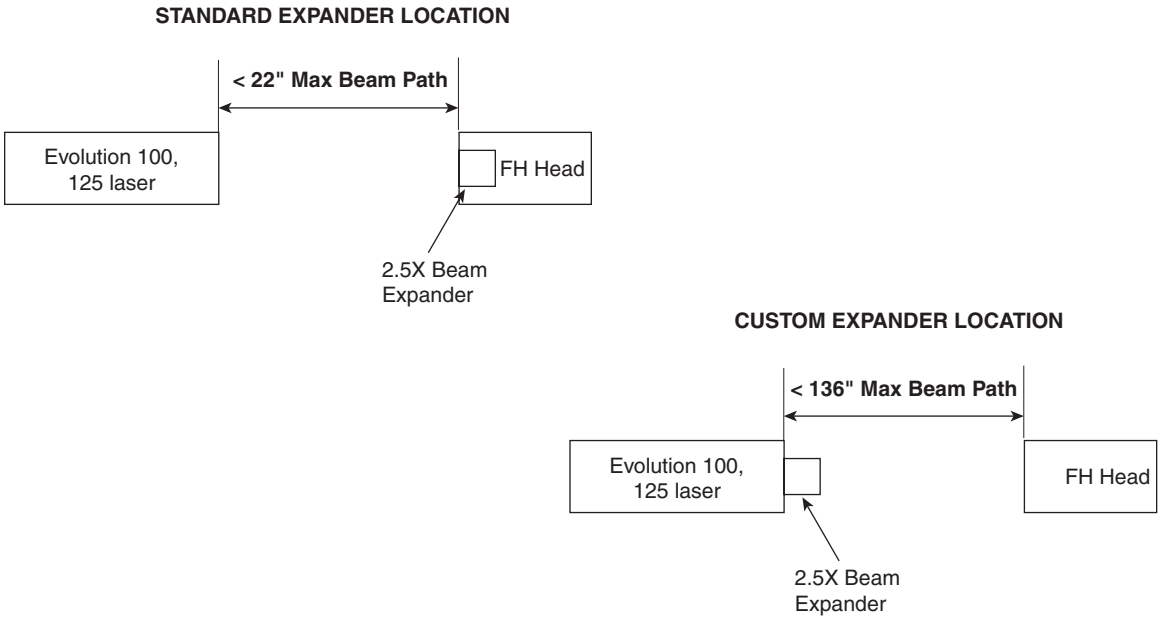


Figure C-6 Maximum Evolution beam path

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## Beam expansion/path length

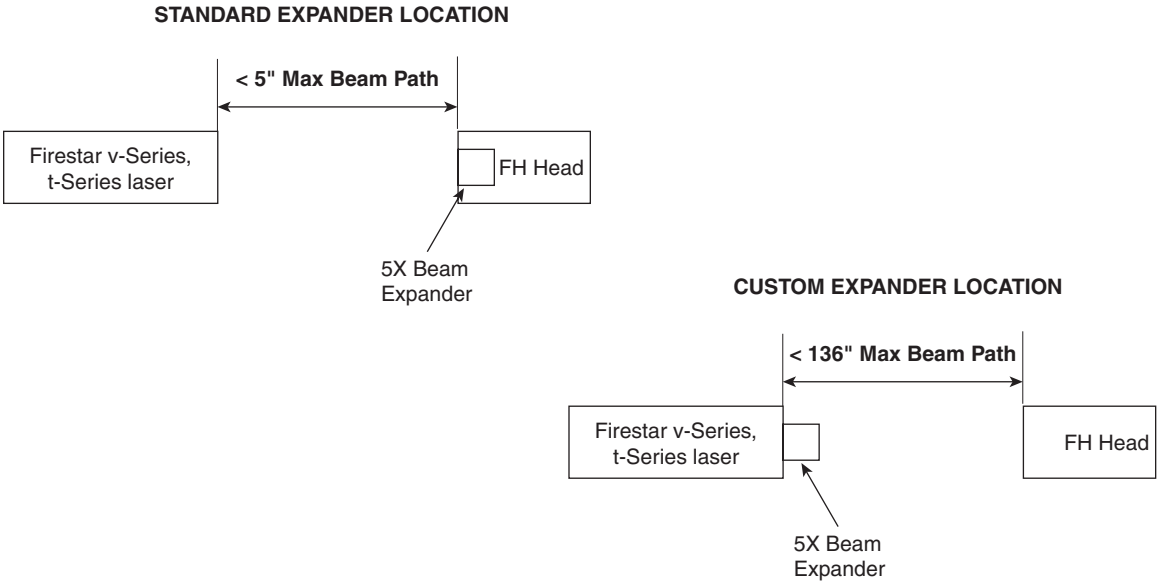


Figure C-7 Maximum Firestar v-Series/t-Series beam path

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## Symbols



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