

FLYER TM **3D** **MARKING HEAD**

Flyer 3D Head
Operator's
Manual



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Marking System
Operator's Manual

Version 1.4

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Table of contents

Warranty Information 1

Operating system license information	10
GNU General Public License	11
GNU Lesser General Public License.....	14
The FreeType Project License.....	19
Headquarters.....	21
European headquarters	21

Laser Safety 2

Laser Safety Chapter Information:.....	23
Information.....	24
Terms.....	25
General hazards	25
Other hazards	26
Disposal	26
Additional laser safety information	26
Center for Devices and Radiological Health (CDRH) requirements.....	28
Federal Communications Commission (FCC) requirements.....	28

Introduction 3

Basic system setup.....	33
Software configuration	34
Hardware set-up	34
User Interface connector.....	40
Gas Purge port.....	41
System requirements.....	42
WinMark/Flyer 3D Head configuration.....	42
Changing Flyer 3D Head's IP address.....	44
Resetting Flyer 3D Head's IP address.....	45
Ethernet security	46
MODBUS TCP/IP configuration	47

Operation 4

Flyer 3D rear control panel.....	50
Flyer 3D bottom panel.....	51
Lase a mark.....	55
Marking operation	56
Determine the operating method	56
Begin marking	57

Stand Alone Operation 5

Stand-alone definitions.....	58
Stand-alone control.....	58
Supported functions	58
Stand-alone set-up	60
Stand-alone Toolbar	60
Filestore structure	62
TrueType fonts.....	69
Configuring a network share	70
File creation/testing	72
Stand-alone configuration.....	75

Table of contents

Technical Reference 6

Flyer 3D Head.....	80
Beam expansion	80
Mark field specifications	81
User Interface overview	82
Internal +15 VDC supply	84
Digital input circuitry	84
Sample input circuits	86
From sinking NPN open-collector device.....	86
From sourcing NPN open-emitter device.....	87
From switch or relay contact.....	88
From high-speed encoder output.....	89
From Firestar/Pulstar laser output.....	89
Digital output circuitry	90
Sample output circuits	92
To isolated I/O module	93
To PLC or logic interface	93
Ethernet overview	95
Ethernet port LEDs.....	95
Ethernet/Flyer cabling.....	95
Ethernet wiring notes	95
Packaging.....	117

Maintenance & Troubleshooting 7

Daily inspections	119
Storage/shipping.....	120
Output window removal/replacement	120
Cleaning window optics & guidelines	121
Flyer 3D marking head	125
Communications	129
Stand-alone mode	130
Tracking mode.....	131
Indicator LEDs.....	133
Power LED	133
Status LED	133
Automation I/O	133
Laser Marking FAQ	135

Table of contents

Appendix

Appendix A	
Power measurements	137
Setup.....	137
Appendix B	
Interface properties.....	141
Current Head File.....	142
IP Gateway	143
Set-up & Working Distance	144
Field Width.....	144
Field Height	144
FASi Enable	145
Tracking properties.....	145
Motion Vector	146
Sensor Distance	147
Product Line Speed	148
Clearing Mark On Begin Mark Session.....	149
Modbus User Function	150
Enable Marking Head Ready Output (Output 6).....	151
Appendix C Overview	152
Starting/ending a MCF session	153
Master Control File specifications	154
Appendix C	
Overview	153
Starting/ending a MCF session	154
Start a MCF mark session.....	154
End a MCF mark session	155
Master Control File specifications	155
General information	156
Master Control File flowcharts.....	160
Master Control File Flowcharts (Continued.)	162
Continuous MCF example.....	168
Strobed MCF example	170
Appendix D	
Introduction	174
Tracking definitions.....	175
Tracking mark criteria	179
Tracking hardware	181
Encoder setup.....	184
WinMark Pro tracking properties	189
Determining line speed	194
Tracking optimization.....	195
Appendix E	
Banner tracking definitions	200
Banner tracking mark criteria	200
Banner tracking hardware.....	201
WinMark Pro banner tracking properties	201
Mark file banner tracking setup	205
Determining line speed	206
Banner tracking optimization	206

Table of contents

Appendix

Appendix F	
Radial marking methodology	209
Equipment setup	209
WinMark Pro/Flyer 3D setup	210

Index (List of Figures & Tables)

Figure 2-1 Flyer 3D hazard label locations.	26
Table 2-1 European Union Directives	29
Figure 2-2 European compliance mark.	29
Figure 2-3 Declaration of Conformity.	30
Figure 3-1 Typical Flyer 3D Head marking setup.	32
Figure 3-2 Working distance measurement see Operation Section.	33
Table 3-1 Field size options	34
Figure 3-3 Flyer 3D Head's mark field orientation.	35
Figure 3-4 Local Area Connection Properties dialog.	37
Figure 3-5 Internet Protocol (TCP/IPv4) Properties dialog.	38
Figure 3-6 Flyer 3D DB-25 User Interface connection	39
Table 3-2 Purge gas specifications	40
Figure 3-7 Creating a new Flyer 3D Head device name	41
Figure 3-8 Flyer 3D Head's IP Address Ranges dialog	45
Figure 4-1 Flyer 3D rear panel control and indicator locations.	49
Figure 4-2 Flyer 3D bottom panel component locations	50
Figure 4-3 WinMark Pro's Mark button.	52
Figure 4-4 Diode pointer On/Off button	53
Figure 4-5 Factory Test Mark pattern	53
Table 5-1 Stand-alone marking features	59
Figure 5-1 Stand-alone Toolbar.	60
Figure 5-2 Initial Stand-alone Flyer 3D Head Files window	62
Figure 5-3 File operations indicator	63
Figure 5-4 Filestore.	65
Figure 5-5 Contextual menu—.mkh mark files.	65
Figure 5-6 Contextual menu—folders.	66
Figure 5-7 Contextual menu—other files	66
Figure 5-8 Contextual menu—Filestore	67
Figure 6-1 Physical layout of Flyer 3D Head's User Interface connection.	81
Table 7-1 User Interface pin assignments	82
Table 7-2 +15 VDC pin assignments	83
Table 7-3 Input pin assignments	83
Table 7-4 Flyer 3D Head high-speed input signal parameters—IN1/IN2	84
Table 7-5 Flyer 3D Head input signal parameters—IN0, IN3–IN7	84
Figure 6-2 Flyer 3D Head's equivalent input circuit.	85
Figure 6-3 Activating Flyer 3D Head input with a current sinking device.	86
Figure 6-4 Activating Flyer 3D Head input with a current sourcing device.	86

Table of contents

Index (List of Figures & Tables Continued)

Figure 6-5 Driving Flyer 3D Head from current sourcing switch or relay device.....	87
Figure 6-6 Driving Flyer 3D Head from current sinking switch or relay device.	87
Figure 6-7 Driving Flyer 3D Head from high-speed encoder output.	88
Figure 6-8 Enabling Flyer 3D Head from Firestar/Pulstar laser outputs.....	88
Table 7-6 Possible input signal configurations for Flyer 3D Head.	89
Table 7-7 Output pin assignments.....	90
Table 7-8 Flyer 3D Head output signal parameters.....	90
Figure 6-9 Flyer 3D Head's equivalent output circuit.	91
Figure 6-10 Flyer 3D Head output to isolated I/O module.	92
Figure 6-11 Flyer 3D Head output to PLC input module.	92
Table 7-9 Possible output signal configurations for Flyer 3D Head	93
Table 7-10 Ethernet pin assignments—straight-thru connection.	95
Figure 6-12 Physical wiring—straight-thru Ethernet connection.	95
Table 7-11 Ethernet pin assignments—crossover connection.....	96
Figure 6-13 Physical wiring—crossover Ethernet connection.....	96
Figure 6-14 Opening Flyer 3D Head to enable FASL.....	97
Figure 6-15 Flyer 3D Head DIP switch S2 location.....	98
Table 7-15 Factory DIP switch assignments.....	98
Figure 6-16 Flyer 3D Head's Internet interface page.	99
Figure 6-17 Clearing Mark properties.	101
Figure 6-18 Clearing Mark Interval.....	102
Table 7-12 Flyer 3D Head specifications.	104
Figure 6-19 Flyer 3D Head outline and mounting dimensions.	105
Figure 6-20 Flyer 3D Head outline and mounting dimensions.	106
Figure 6-21 Flyer 3D Head outline and mounting dimensions.	107
Figure 6-22 Flyer 3D Head v30 fan-cooled outline and mounting dimensions.	108
Figure 6-23 Flyer 3D Head v40 fan-cooled outline and mounting dimensions.	109
Figure 6-24 Flyer 3D Head v40 fan-cooled outline and mounting dimensions.	110
Figure 6-25 Flyer 3D Head ti-Series fan-cooled outline and mounting dimensions. ..	111
Figure 6-26 Flyer 3D Head f201 fan-cooled outline and mounting dimensions.	112
Figure 6-27 Flyer 3D Head i401 outline and mounting dimensions.....	113
Figure 6-28 Flyer 3D Head p100 fan-cooled outline and mounting dimensions.	114
Figure 6-29 Flyer 3D Head p250 fan-cooled outline and mounting dimensions.	115
Figure 6-30 Flyer 3D Head packaging instructions.....	116
Figure 7-1 Output window mounting screw locations.	119
Table 7-1 Required cleaning materials.	120
Table 7-2 Cleaning solvent selection.....	122
Table 7-3 Laser status control LED indications.	123
Table 7-4 Ethernet LED indications.....	124
Figure 7-2 Digital Scope window	134
Figure A-1 Input aperture location.	137
Figure B-1 Flyer tab – Interface properties.....	140
Figure B-2 Flyer tab – Set-up properties.....	143
Figure B-3 Flyer tab – Tracking properties.....	145
Figure B-4 Flyer tab – Maintenance, stand-alone, and I/O properties.	147
Figure C-1 Master Control File flowchart-continuous mode.....	159
Figure D-1 Flyer 3D Head tracking setup.....	174
Figure D-2 Usable Field Size.	175
Figure D-3 Mark Pitch greater than Usable Field Size.	175
Figure D-4 Tracking Window.	176
Figure D-5 Target Area.....	177
Figure D-6 Object Reference Point.....	177

Table of contents

Index (List of Figures & Tables Continued)

Figure D-7 Checking Encoder Resolution.....	178
Figure D-8 Usable Field Size comparisons.	179
Figure D-9 Maximum marking position in Tracking Window.....	179
Table D-1 Position encoder specifications (for IN1/IN2).....	180
Figure D-10 Wiring diagram for current-sinking encoders.	181
Figure D-11 Wiring diagram for current-sinking encoders using built- in PS.	181
Figure D-12 Wiring diagram for current-sourcing encoders.....	182
Figure D-13 Wiring diagram for current-sourcing encoders using built-in PS.	182
Figure D-14 Linestack mark.....	184
Table D-2 Part sensor specifications (for IN0).....	185
Figure D-15 Wiring diagram for current-sinking part sensors.	185
Figure D-16 Wiring diagram for current-sinking part sensors using built-in PS.....	186
Figure D-17 Wiring diagram for current-sourcing part sensors.....	186
Figure D-18 Wiring diagram for current-sourcing sensors using built-in PS.	187
Figure D-19 Part sensor setup.....	187
Table D-3 Power supply specifications.	188
Figure D-20 Tracking properties on the Flyer 3D tab.	189
Figure D-21 Drawing Canvas coordinates relative to Flyer 3D.....	190
Figure D-22 X-Y position Object Reference Point coordinates.	190
Figure D-23 Part sensor output waveforms.....	191
Figure D-24 Flyer 3D Head tracking line speed calculation #1.....	193
Figure D-25 Flyer 3D Head tracking line speed calculation #2.....	194
Figure D-26 Sample text mark.....	195
Figure D-27 Beam/mark motion.....	195
Figure D-28 Configure Marking Order dialog box.....	196
Figure E-1 Tracking properties on Flyer 3D tab.	200
Figure E-2 Drawing Canvas coordinates relative to the Flyer 3D Head.	201
Figure E-3 Mark file for fine-tuning Banner Tracking Angle Adjustment.....	202
Figure E-4 Banner mark location on Drawing Canvas.....	203
Figure E-5 Illustration of lines showing gaps/overlaps between Banner Windows.	205
Figure E-6 Illustration of line showing “stair steps” between Banner Windows.....	206
Figure F-1 Rotary stepper mechanism positioned under Flyer 3D Head.....	209
Figure F-2 Configure the Part Moving Input property.....	210
Figure F-3 Configure the Step Command Output property.	210
Figure F-4 WinMark Pro Automation Flowchart.....	211
Figure F-5 Radial marking state diagram.....	212

Introduction Summary

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This Operation Manual explains operation activities related to Pulstar p250 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 p250 laser, be sure to completely 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 CO₂ 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.

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This is to certify that Flyer 3D Marking Heads are guaranteed by SYNRAD to be free of all defects in materials and workmanship for a period of one year from the date of shipment. This warranty does not apply to any defect caused by negligence, misuse (including environmental factors), accident, alteration, or improper maintenance. We request you examine each shipment within 10 days of receipt and inform Synrad of any shortage or damage. If no discrepancies are reported, Synrad shall assume the shipment was delivered complete and defect-free.

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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 CO₂ 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

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

Figure 2-1 Labeling terms and definitions.

Warning

Serious personal injury

For laser systems being used or sold within the U.S.A., customers should refer to and follow the laser safety precautions described American National Standards Institute (ANSI) document Z136.1-2014, Safe Use of Lasers.

For laser systems being used or sold outside the U.S.A., customers should refer to and follow the laser safety precautions described in European Normative and International Electrotechnical Commission documents IEC/ TR 60825-14:2014, Safety of Laser Products – §14: A User's Guide.

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.

CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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.

Warning
Serious
personal
injury

"Caution ⚠ - The use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure."



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

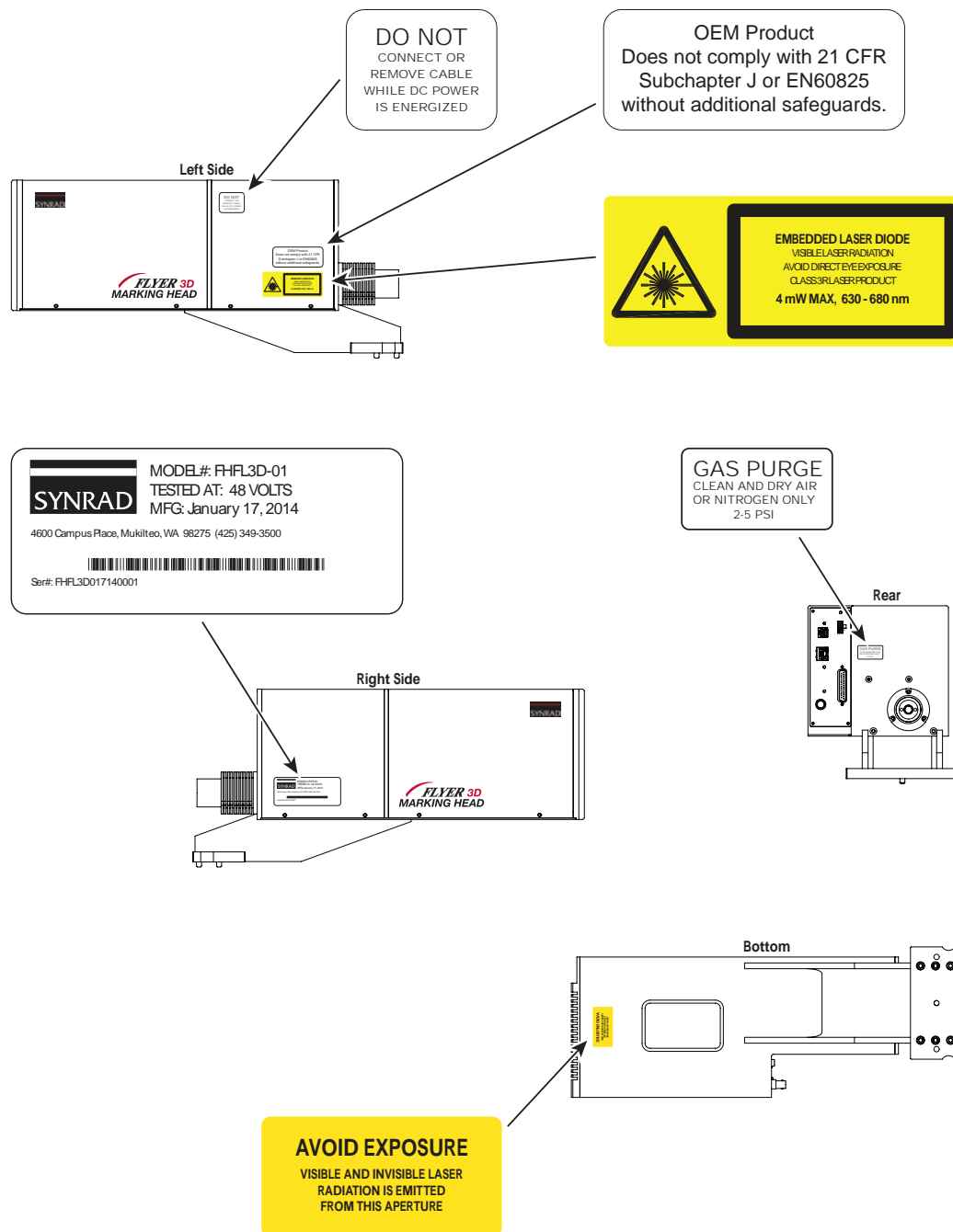


Figure 2-3 Hazard label locations.

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 2015/863/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.

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:		Available on: OEM Laser
		CDRH	EN60825-1	
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

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
2015/863/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:

Flyer 3D Marking Head

Model Number:

95-021351-01; 95-021351-02; 95-021351-03; 95-021351-04;
95-021351-05; 95-021351-06

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

Applicable Directive(s):

2014/30/EU

Electromagnetic Compatibility Directive

2015/863/EU

RoHS Directive

Applicable Standard(s):

EN 60950-1:2006

Information Technology Equipment Safety

EN 61000-3-2:2014

Radiated Emissions, Group 1, Class A

EN 61000-3-3:2013

Voltage Fluctuations and Flicker Emissions

EN 61000-6-4:2007 + A1

Conducted, Telecom Conducted, and Radiated Emissions, Group 1, Class A

EN 61000-6-2:2005 + C1

Electrostatic Discharge Immunity

EN 61000-6-2:2005 + C1

Radiated Immunity

EN 61000-6-2:2005 + C1

Electrical Fast Transient/Burst Immunity

EN 61000-6-2:2005 + C1

Surge Immunity

EN 61000-6-2:2005 + C1

Conducted Immunity

EN 61000-6-2:2005 + C1

Voltage Dips and Interrupts Immunity

*OEM lasers do not comply with EN 60825-1:2014, *Safety of Laser Products*. Buyers of OEM laser products are solely responsible for meeting applicable Directives and Standards for CE compliance and marking.

Corporate Officer:



Tim Freni, Quality Manager of SYNRAD

European Contact:

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

Dated: 7/19/19

CE

MADE IN THE U.S.A.
900-20976-06 Rev E

Figure 2-4 Declaration Document.

SYNRAD® Flyer 3D Operator's Manual Version 1.4
34

Introduction

Basic System Setup

3

Please refer to the Quick Start Guide to prepare your Flyer 3D Head for operation. The order of information presented within the Quick Start Guide is the same as the order of tasks that you need to perform. This chapter was designed to be used with the Quick Start Guide. The best way to get Flyer 3D Head ready for operation is to start at Unpacking and work your way through Ethernet configuration as the Quick Start Guide will show you. The Quick Start Guide can be downloaded from our website.

Please reference the Quick Start Guide, this chapter contains information to be used with this guide:

- Introduction & Basic System Setup– The Quick Start guide Illustrates the basic system setup, highlights important information about unpacking your Flyer 3D Head and lists the system components shipped with Flyer 3D Head, feel free to use it in conjunction with this section.
- Mounting – Please see the Quick Start Guide.
- Connecting – explains how to connect power, control, communication, and I/O cabling to Flyer 3D Head.
- WinMark Pro v7 configuration – describes how to setup WinMark Pro and Flyer 3D Head for operation.

Note: If you are installing a Flyer 3D Head to operate in Tracking mode, please perform the tasks described in the Operation chapter before proceeding to Appendix E for Tracking setup information.

Introduction

The Introduction section includes subsections:

- Basic system setup
- Control methods & testing

Basic system setup

A typical stationary Flyer 3D Head installation is shown in the figure below:

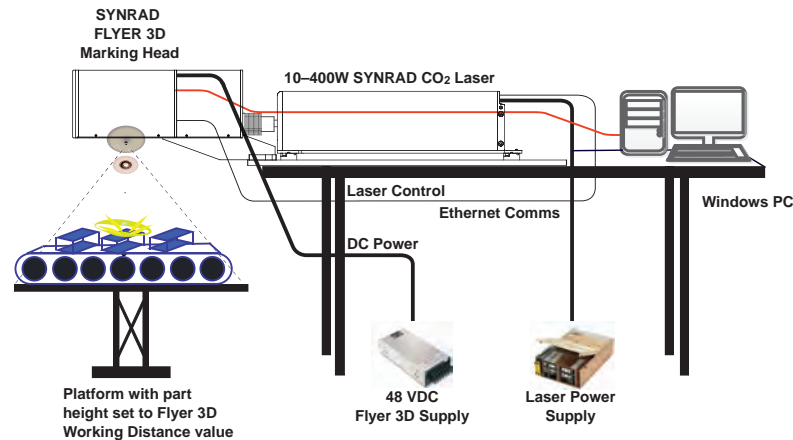


Figure 3-1 Typical Flyer 3D Head marking setup.

Note: In addition to the Quick Start Guide, you can also refer to the system installation guide shipped with the laser. Both guides can also be downloaded from our website.

The following components shown in the above figure are part of the integrated Flyer 3D marking system:

- SYNRAD Flyer 3D Head w/ SYNRAD CO₂ laser (10 W–400 W).
- Mounting Rail.
- 48 VDC Flyer 3D Head power supply (as required).
- 30 VDC, 48 VDC, or 96 VDC laser power supply (laser dependent).
- WinMark Pro Laser Marking Software.

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

- A computer running Windows® 7-10 with:
- One open Ethernet port for Flyer 3D Head communication.
- Beam enclosure shield around the work area (not shown).
- A marking surface and/or fixturing for part positioning.

Introduction

Mark Field Configuration

- Software configuration & Hardware set-up.
- Field Size off-set.
- Connecting.

Software configuration

Because the Flyer 3D Head system is configured at the factory with a fixed mark field, no software setup is required. The Working Distance property (on the Tools/General Settings... /"Flyer" tab) is preset to match the field size specified when the system was ordered. Field Width and Field Height values are read-only properties that reflect the fixed mark field dimensions.

Important Note: Flyer 3D Head is driven by advanced algorithms that compensate for barrel and pin-cushion effects common to three-axis heads. This unique design eliminates the need for correction tables and user calibration to achieve accurate large-area flat-field marks.

Hardware set-up

- 1 Place the material or part to be marked (a sheet of anodized aluminum is ideal) on your marking surface centered underneath Flyer 3D Head's output aperture.
- 2 Consult the Final Test Report shipped with your Flyer 3D Head (or in WinMark Pro, look on the Tools/General Settings... /"Flyer" tab) and locate the Working Distance value.
- 3 Use a ruler marked in millimeters or a precision distance gauge to set the working distance from the bottom surface of the Flyer 3D Head to the mark surface as shown in the following figure.

Important Note: Do not allow any measuring device or object to contact the protective window! Scratches or pits may damage the optical surface enough to affect mark quality.

Tip: Create a distance gauge (from an acrylic, wood, or aluminum rod), by precisely measuring and cutting the rod to the working distance length specified on the head's Final Test report.

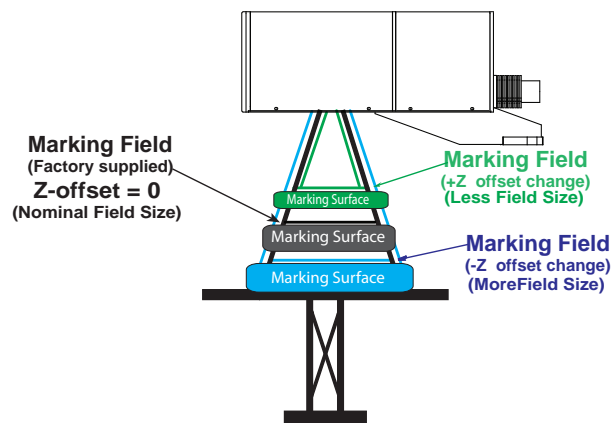


Figure 3-2 Working distance measurement see Operation Section.

Introduction

Setup

Flyer 3D Field Size Options

Field Size - Width x Height		Working Distance		Spot Size (μm)		Range of Z Axis Offset and Field Sizes (mm)			
mm	inches	mm	inches	M2 = 1.0	M2 = 1.2	Max + Z	Field Size	Max - Z	Field Size
269 x 227	10.6 x 8.9	268	10.55	165	181	7	264 x 233	17	285 x 240
280 x 238	11.0 x 9.4	282	11.10	173	190	10	272 x 231	21	299 x 253
302 x 258	11.9 x 10.1	310	12.20	188	206	15	290 x 247	26	325 x 277
347 x 304	13.7 x 12.0	374	14.72	223	245	25	327 x 287	42	383 x 335
400 x 350	15.7 x 13.8	434	17.09	257	282	37	370 x 324	61	452 x 395
454 x 400	17.9 x 15.7	506	19.92	297	325	52	411 x 363	86	525 x 464
508 x 451	20.0 x 17.8	576	22.67	336	368	72	449 x 399	118	605 x 538
561 x 501	22.1 x 19.7	644	25.35	374	410	92	486 x 435	157	689 x 616
607 x 544	23.9 x 21.4	703	27.68	407	446	120	510 x 457	205	773 x 694
673 x 607	26.5 x 23.9	790	31.10	455	499	155	549 x 495	265	888 x 800
792 x 718	31.2 x 28.3	942	37.09	540	592	200	632 x 573	400	1113 x 1010
914 x 833	36.0 x 32.8	1101	43.35	628	688	280	691 x 630	650	1434 x 1307
1084 x 993	42.7 x 39.1	1320	51.97	750	822	750	489 x 448	1018	1894 x 1735

* Calculated at 1/e²; center of field. Spot size may increase up to 10% at far edges of mark field.

Table 3-1 Field size options.

Introduction

Mounting

Please refer to the Quick Start Guide for Flyer 3D Head located on our website.

Note: SYNRAD integrated system design eliminates the need for Flyer 3D-to-laser alignment. To mount your Flyer 3D Head, simply follow the steps outlined in the quick start guide.

The Canvas

Please familiarize yourself with the following figure and reference the Quick Start Guide:

- When positioning Flyer 3D Head in your marking system, be aware that Flyer 3D Head's mark field (WinMark Pro's Drawing Canvas as seen in the following) is oriented in a horizontal (landscape) view, instead of the vertical (portrait) view as used by our FH Flyer Heads.

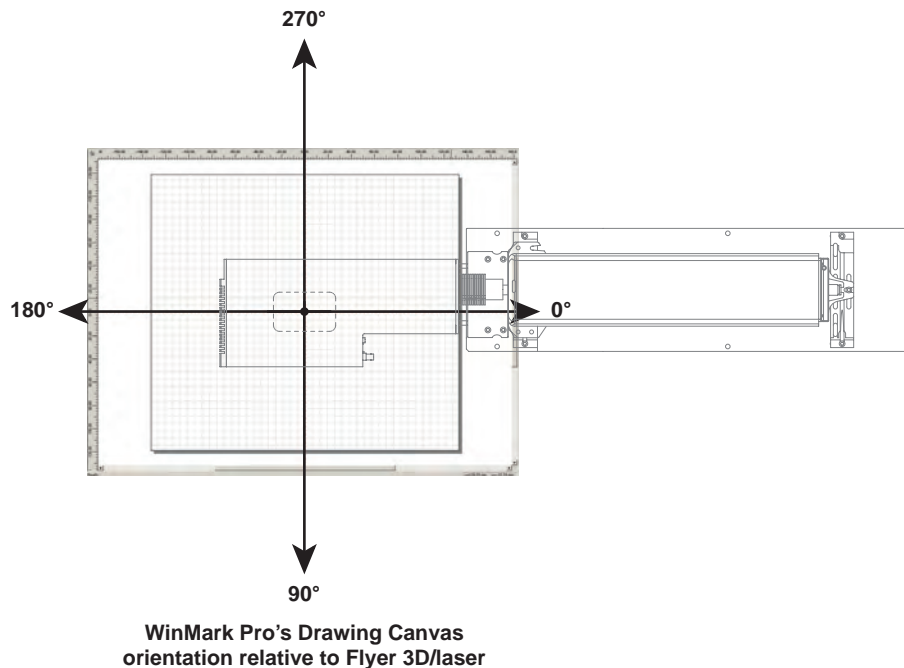


Figure 3-3 Flyer 3D Head's mark field orientation.

- Mount the Flyer 3D Head so the working distance, measured from the bottom of the Flyer 3D Head's housing to the top of the marking surface (see the prior figure), matches the distance specified in Flyer 3D Head's Final Test Report.
- Surround the beam path around the marking area with a beam enclosure shield to confine any reflected laser radiation.
- Flyer 3D Head's built-in heat sink includes an attached cooling fan. Allow at least 57.2 mm.
(2.25") of unobstructed fan clearance between the outside edge of the fan housing and any mounting surface or enclosure.

Introduction

Mounting

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



Do not attach or remove the DC Power cable when the DC power to the Flyer 3D Head is energized. This “hot-plug” action causes arcing that will damage the connector pins and may damage Flyer 3D Head’s circuitry.

Always switch AC power to the +48 VDC supply to energize or de-energize the Flyer 3D Head.

Flyer 3D marking heads require a DC supply voltage of $+48.0\text{ V} \pm 2.0$. The Flyer 3D Head may not function properly if the DC supply voltage drops below +46.0 VDC. If you fabricate a longer cable, be sure to account for additional voltage drop. Monitor 48 V at head to verify minimum voltage drop.

When lowering Flyer 3D Head into position, be sure the path enclosure assembly does not contact or damage the laser’s output window or faceplate.

Note: Please refer to the Quick Start Guide for information about mounting the ‘path enclosure tube’ to the laser faceplate on to the mounting block.

Introduction

Connecting

To setup Flyer 3D Head for the Ethernet using a peer-to-peer Ethernet connection, perform these steps:

Set your computer's static IP address

Note: The exact steps may vary depending on your operating system. The description below applies to a Windows 7 operating system (OS).

- 1 Remove the WinMark computer from the local network by unplugging network cables.
- 2 In the Windows Control Panel, double-click Network and Sharing Center.
- 3 In the Network and Sharing Center dialog, click the Local Area Connection option.
- 4 In the Local Area Connection Status dialog, click the Properties button.
- 5 In the Local Area Connection Properties dialog (below) select Internet Protocol Version 4 (TCP/IPv4) and click the Properties button.

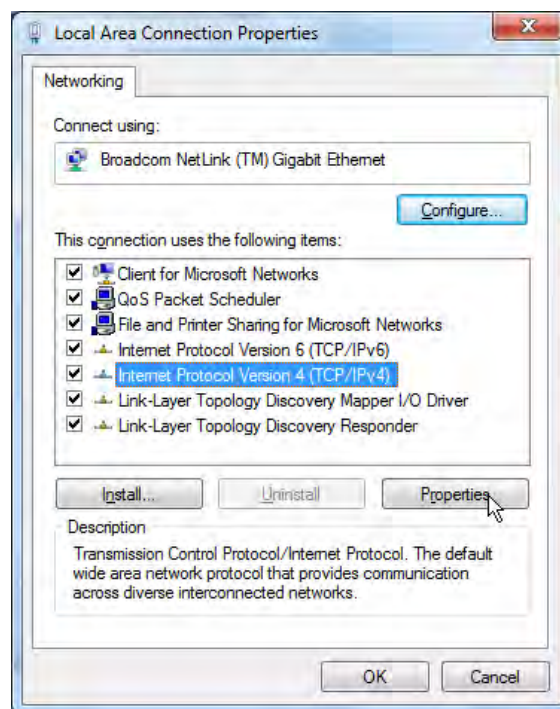


Figure 3-4 Local Area Connection Properties dialog.

- 6 When the Internet Protocol Version 4 (TCP/IPv4) Properties dialog opens, first write down your current settings so they can be restored later. Then select "Use the following IP address:" and enter the following information is also shown in the following figure:

IP Address: 192.168.100.101
Subnet Mask: 255.255.255.0

Introduction

Connecting

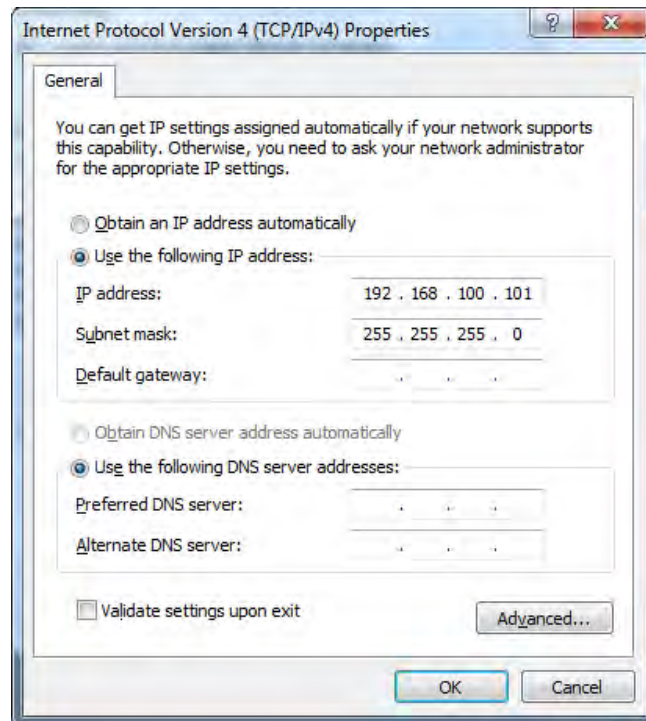


Figure 3-5 Internet Protocol (TCP/IPv4) Properties dialog.

- 7 Click OK to submit the changes.

Connect to the Flyer 3D Head

- 1 Connect Flyer 3D Head to your computer using an Ethernet crossover cable.
- 2 Power up the Flyer 3D Head marking head and wait approximately 30 seconds for it to boot-up.
- 3 Open WinMark Pro and perform either Step A or Step B:
 - a When WinMark's Device Simulation dialog opens, click "Enter IP Address for Flyer 3D Head", click in the text box and type 192.168.100.100, and then click OK.
 - b If WinMark Pro launches, go to the Devices menu and select Connect to Ethernet Flyer 3D Head. In the Select Ethernet Flyer IP Address dialog, click in the text box and type 192.168.100.100, and then click OK.

For Ethernet related information, see Ethernet configuration later in this chapter for information about connecting to a network and setting up Ethernet security. To set-up a network share folder, see the WinMark Pro/Flyer 3D Head interface section in the Stand-alone operation chapter and review the Flyer 3D Head's web interface section in the Technical Reference chapter for details on accessing Flyer 3D Head's web page.

Important Note: The Ethernet cable included in the ship kit is a shielded crossover-type cable. If your application requires a straight-through (patch) cable or you supply your own crossover cable, be sure the Ethernet cable is an industrially-shielded CAT 5e or CAT 6 cable.

Introduction

Connecting

User Interface connector

The User Interface connection is only required when you are wiring input or output automation signals to Flyer 3D Head. To install the DB-25 connector, refer to the figure below and perform the following steps:

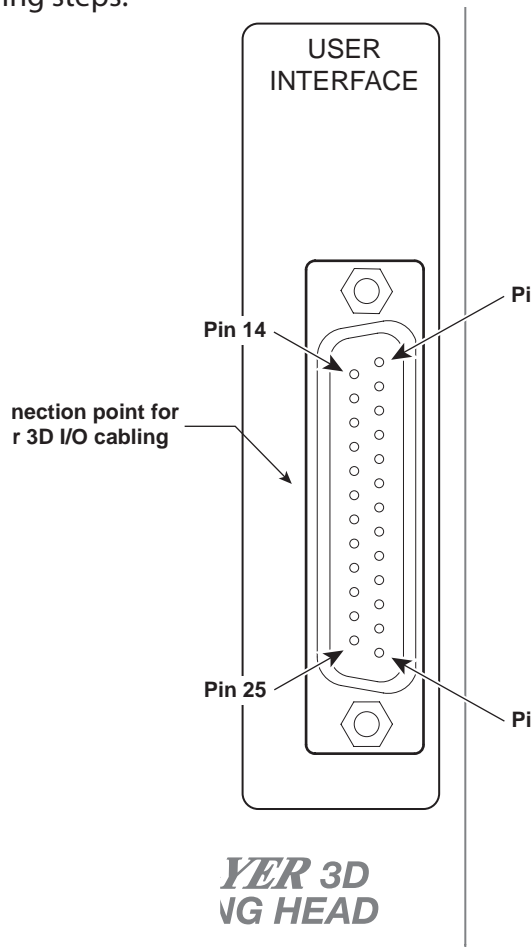


Figure 3-6 Flyer 3D Head DB-25 User Interface connection.

- 1 Locate the DB-25 connector (female DB-25) in the ship kit.
- 2 Wire I/O cabling to the DB-25 User Interface connector as required for your installation. Flyer 3D Head's I/O interface provides eight optoisolated inputs, eight optoisolated 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 the 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 connector to the 25-pin User Interface connection on the rear panel of the Flyer 3D Head.

Introduction

Connecting

Gas Purge port

A gas purge is highly recommended when operating Flyer 3D Head, especially if the output window is not installed. Purging the head creates positive pressure that prevents dirt and debris from accumulating on optical surfaces inside the Flyer 3D Head's housing. See the QSG located on our website for more.

To connect the Flyer 3D Head's Gas Purge port, perform the following steps:

- 1 Connect a section of 1/4-inch tubing between your nitrogen or breathing-grade air source and the Gas Purge port on the rear of the Flyer 3D Head's housing.

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

- 2 Set a purge pressure between 13.8–34.5 kPa (2–5 PSI). This provides just enough positive airflow to prevent dust from entering the Flyer 3D Head. If a flowmeter is available, set a flow rate of 0.85–1.7 m³/hr (30–60 SCFH, Standard Cubic Feet per Hour) at a pressure not to exceed 34.5 kPa (5 PSI).

The Flyer 3D Head's Gas Purge port must be connected to a source of nitrogen or clean, dry air only; do not use any other gases for purging. Purge gas specifications are listed in the table below.

Table 3-2 Purge gas specifications.

Purge Gas	Specification
Nitrogen	High Purity Grade $\geq 99.9500\%$ purity; filtered to ISO Class 1 particulate level
Air	Breathing Grade $\geq 99.9996\%$ purity; filtered to ISO Class 1 particulate level
Air	Compressed Instrument-grade air filtered and dried to ISO 8573-1:2010 Class 1, 2, 1 (≤ 10 1.0–5.0 μm particles/m ³ ; ≤ -40 °F dew point; ≤ 0.01 mg/m ³ oil vapor)

Caution

Possible

Equipment

Damage



Do not exceed a gas purge pressure of 34.5 kPa (5 PSI). Excessive pressure may damage the purge assembly or other internal laser components.

Do not use argon as a purge gas. Use only nitrogen or clean, dry air as described in the table above.

Do not attach or remove the DC Power cable when the DC power to the Flyer 3D Head is energized. This “hot-plug” action causes arcing that will damage the connector pins and may damage Flyer 3D Head's circuitry.

Always switch AC power to the +48 VDC supply to energize or de-energize the Flyer 3D Head.

Flyer 3D marking heads require a DC supply voltage of $+48.0 \text{ V} \pm 2.0$. The Flyer 3D Head may not function properly if the DC supply voltage drops below +46.0 VDC. If you fabricate a longer cable, be sure to account for additional voltage drop. Monitor 48 V at head to verify minimum voltage drop.

Introduction

WinMark Pro v7

The WinMark Pro v7 configuration section includes subsections:

- System requirements.
- WinMark/Flyer 3D Head configuration.

See the WinMark Pro User Guide or v7 Release Notes for Hardlock and software installation instructions.

System requirements

WinMark Pro software has the following minimum installation and operating requirements:

- 16-MB RAM
- 75-MB of free hard drive space
- CD-ROM drive

WinMark/Flyer 3D Head configuration

Object Name

The label of the Flyer 3D tab corresponds to the Object Name given to the Flyer 3D Head. Every Flyer 3D Head 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 Flyer/Flyer 3D heads, you can give each Flyer 3D Head a unique identity based on location or process. To edit the head's Object Name property, refer to the figure below and perform the following steps:

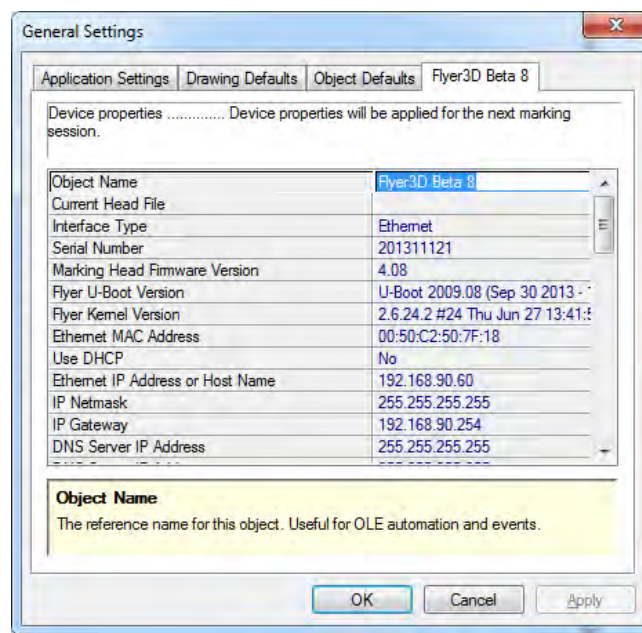


Figure 3-7 Creating a new Flyer 3D Head device name.

Introduction

WinMark Pro v7

- 1 Power up Flyer 3D Head and then open WinMark Pro.
- 2 On the Tools menu, select General Settings.
- 3 Verify that the label on the Flyer 3D tab, refers to the Flyer 3D Head you wish to re name.

If not, go to the Flyer 3D Head menu and from the drop-down menu, point to Flyer3D Head's Ethernet and select the correct device from the list of recognized Flyer/Flyer 3D heads.

- 4 In the General Settings dialog, click the Flyer 3D tab and then select Object Name.

Type in a descriptive name for the currently active Flyer 3D Head This new name is written into Flyer 3D Head's non-volatile memory and will remain until overwritten by a new entry.

Note: An alternate method to access the Flyer 3D tab is to right-click the Mark button.

In addition to Object Name, the Flyer 3D tab provides other head-related setup and status properties including firmware version, IP addresses, clearing mark, tracking parameters, and Stand-alone settings.

Introduction

Ethernet

The Ethernet configuration section includes subsections:

- Changing Flyer 3D Head's IP address.
- Resetting Flyer 3D Head's IP address.
- Ethernet security.
- MODBUS TCP/IP configuration.

Changing Flyer 3D Head's IP address

You can change Flyer 3D Head's Ethernet IP address as required to conform to your facilities network numbering convention. To change Flyer 3D Head's factory-default IP address, perform the following steps:

Important Note: We do not recommend using Dynamic Host Configuration Protocol (DHCP) with Flyer 3D marking heads. Under the DHCP scheme, Flyer 3D Head's IP address and DNS name will change each time the head is turned off for a time period that exceeds the DHCP lease. By default, Flyer 3D Head's Use DHCP property is set to No at the factory.

Note: The following procedure may require the assistance of your IT Department to ensure Flyer 3D Head's Ethernet settings are unique and not in use by another device on your facility's network.

- 1 Establish a connection between the Flyer 3D marking head and the WinMark computer as described in the Connecting section.
- 2 Open WinMark Pro and go to the Flyer 3D tab under Tools / General Settings.
- 3 Scroll down the Flyer 3D tab and enter values for the following properties:

Ethernet IP Address or Host Name
IP Netmask
IP Gateway

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

- 4 Click OK to apply the new settings and then remove power from the Flyer 3D Head.
- 5 If necessary, reset your computer to its original Ethernet/local network configuration.
- 6 Disconnect the Ethernet crossover cable from Flyer 3D Head and connect the Ethernet cable required by the local network—straight-through or crossover—as determined by your IT department.
- 7 Reapply DC power to Flyer 3D Head and wait approximately 30 seconds for the head to boot-up.

Introduction

Ethernet

- 8 Open WinMark Pro and perform either Step A or Step B:
 - a When the Device Simulation dialog opens, click “Enter IP Address for Flyer 3D Head” and type the value you entered for Ethernet IP Address or Host Name. Click OK.
 - b If WinMark Pro launches, go to the Devices menu and select Connect to Ethernet Flyer. In the Select Ethernet Flyer IP Address dialog, type the value you entered for Ethernet IP Address or Host Name and then click OK.

Resetting Flyer 3D Head’s IP address

In situations where Flyer 3D Head’s IP address was changed and is now unknown, perform the following steps to reset the Flyer 3D Head to its default IP address and re-establish communication:

- 1 Remove DC power from the Flyer 3D Head or disconnect the DC Power cable.
- 2 Refer to Figure 4-14 in the Technical Reference chapter and remove the four 6–32 × 1/4” button head Allen screws at the locations shown to remove Flyer 3D Head’s main cover.
- 3 Ground yourself with an anti-static wrist strap or keep one hand in constant contact with Flyer 3D Head’s metal chassis.
- 4 Locate the DIP switch bank labeled S1 on the CPU board (see the Technical Reference chapter) and move switch # 4 to the “ON” position.
- 5 Apply power to the head and allow 15–20 seconds for the operating system to boot up.
- 6 Open WinMark Pro and connect using Flyer 3D Head’s default IP address of 192.168.100.100.
- 7 To change the IP address back to a setting compatible with your facility’s network, perform Step 2 and Step 3 in the previous section, Changing Flyer 3D Head’s IP address.
- 8 Click OK to apply the new settings and then remove power from the Flyer 3D Head.

Introduction

Ethernet

- 9 Locate switch bank S1 and set switch # 4 back to the “OFF” position.
- 10 Replace Flyer 3D Head’s main cover and replace the button head screws removed in Step 2.

Ethernet security

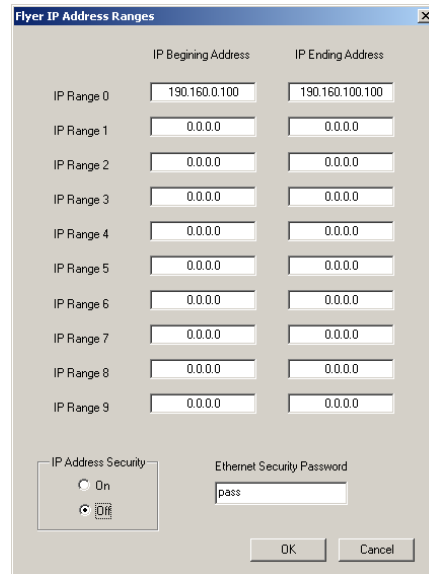


Figure 3-8 Flyer 3D Head’s IP Address Ranges dialog.

WinMark allows you to restrict the range of IP addresses that connect with Flyer 3D Head marking heads. If there are no restrictions, Flyer 3D Head’s will connect to any Ethernet address. Entering one or more IP address ranges (up to ten) allows Flyer 3D Head to communicate only to devices within those ranges and prevents all other connections. To setup Ethernet security, refer to the figure above and perform the following steps:

- 1 In WinMark Pro under the Tools menu, click Flyer 3D Head IP Address Range.
- 2 Enter your user password. The default factory password is “pass” (without the quotes).
- 3 Once the Flyer 3D Head IP Address Ranges dialog opens, enter a range of authorized IP addresses.

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.

Introduction

Ethernet

- 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 TCP/IP configuration

The MODBUS® protocol is handled within the Flyer 3D Head by an external communications server called SynComm. SynComm allows users to access various marking head functions via Flyer 3D Head's Ethernet port using one of two protocols. The first is a Modbus TCP/IP protocol for interaction with PLCs or other MODBUS network devices and the second is a SYNRAD-modified Modbus protocol, called Modbus-Asynchronous protocol, for peer-to-peer communications when a Flyer 3D Head is the only device on the network.

There are two options for implementing Modbus TCP/IP on Flyer 3D Heads. The first option is a basic set of register-based commands using Modbus function codes 3, 4, 6, and 16 that are supported by many Programmable Logic Controllers (PLCs). The second option is an extended set of commands using a Modbus user-defined function code in the range of 65–72 or 100–110. This extended (user-defined) command set includes advanced Filestore and head management options, but is less widely supported by PLC manufacturers.

For complete details on Modbus TCP/IP and Modbus-Asynchronous protocols, refer to WinMark Pro Application Note #05, located at http://www.winmark.com/products/winmark_ApplicationsNotes.html. This document contains all the information necessary to control a Flyer 3D Head using register-based or user-defined Modbus protocols.

In addition, see http://winmark.com/products/winmark_activexsamples.html for sample Visual Basic and Visual C++ code illustrating how to easily incorporate Flyer 3D Head's Modbus functionality into your custom marking application.

SynComm Modbus TCP/IP protocol guidelines

- The Flyer 3D Head marking head must be set to operate in Stand-alone mode (set the Stand-alone Marking property on the Flyer 3D tab to "Yes").
- For register-based Modbus operation, the Modbus User Function property (in WinMark Pro on the Flyer 3D tab) is not used—it can be left at its default value of 67 (0x43 hexadecimal).
- For user-defined Modbus operation, set the Modbus User Function property (on the Flyer 3D tab) to a decimal value in the range of 65–72 or 100–110. The default value is 67 (0x43 hex).
- If supported by your PLC, you can use a mix of register-based and user-defined commands. If this is the case, the Modbus User Function must be set to a decimal value in the range of 65–72 or 100–110. The default value is 67 (0x43 hex).
- For either register-based or user-defined operation, set the External Communications Server property (on the Flyer 3D tab) to "Modbus".

Introduction

Ethernet

- The SynComm external communications server listens on the default Modbus port (502).

- Modbus is a big endian protocol. In our Modbus VB example code posted at: http://www.winmark.com/products/winmark_activexsamples.html, Modbus.h and Modbus.c contain endian conversion routines to aid in parsing data.

- Modbus is a client/server (or command/response) protocol. The Modbus enabled PLC or computer is the client (that commands) while Flyer 3D Head acts as a server (that responds).

Note: For customers who wish to write applications where a Flyer 3D 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 TCP/IP protocol like unsolicited responses from Flyer 3D Head for I/O events, log messages, and intermediate end of mark messages.

- All character strings must be null terminated.
- Modbus limits message elements (16-bit words) to a maximum of 120 (or 240 bytes).
- Because the Flyer 3D Head is operating in Stand-alone mode, filenames must be preceded by the forward slash (/) character. For example, a file named Test.mkh becomes /Test.mkh.
- WinMark Pro, WinMark Launcher, and DigiScope applications must be closed after Flyer 3D Head is configured for Modbus/Modbus Async operation.
- In Modbus user-defined operation, all file uploads and downloads to the Flyer 3D Head's Filestore are done through FTP via an FTP server on the marking head.

Operation

4

Use information in this chapter to familiarize yourself with Flyer 3D's controls and indicators and to begin marking operation.

This chapter contains the following information:

- Controls and indicators – illustrates and describes Flyer 3D controls and indicators.
- Initial start-up – explains how to start-up Flyer 3D and verify proper operation.

Operation

Controls and Indicators

The Controls and indicators section includes subsections:

- Flyer 3D rear control panel.
- Flyer 3D bottom panel.

Flyer 3D rear control panel

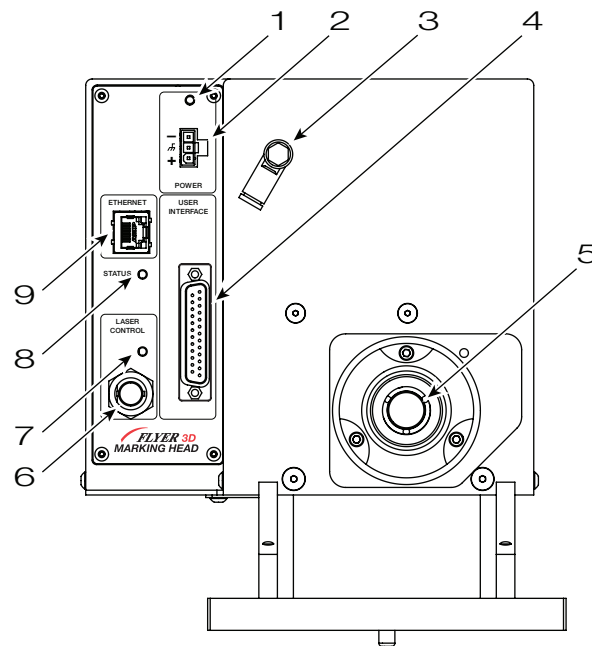


Figure 4-1 Flyer 3D rear panel control and indicator locations.

- 1 Power Indicator – illuminates green when +48 VDC is applied to the Flyer 3D Head.
- 2 Power Connector – receives 48 VDC @ 7.5 Amps maximum from the DC power supply.
- 3 Gas Purge Port – provides a low pressure nitrogen or clean, dry air connection to prevent dust and vapor from damaging electronic and optical components inside the Flyer 3D Head.
- 4 User Interface Connection – provides a male DB-25 connection to Flyer’s eight optoisolated inputs, eight optoisolated outputs, and an isolated 15 VDC, 400 mA I/O power supply.
- 5 Input aperture – provides an input path for the laser beam through a beam expander matched to the laser ordered with your Flyer 3D marking system. The aperture is equipped with cooling connections when shipped with f201, i401, or p250 lasers.
- 6 Laser Control Connector – sends tickle and PWM Command signals to the laser.
- 7 Laser Indicator – illuminates dim red to indicate tickle pulses are being sent to the laser. The LED becomes brighter when PWM Command signals are sent to the laser. LED intensity (apparent brightness) increases as PWM duty cycle increases.

Operation

Controls and Indicators

- 8 Status Indicator – flashes green during normal boot-up, turning to solid green when Flyer 3D is fully operational. Certain conditions cause the Status indicator to flash various green or red sequences. Refer to Troubleshooting Section in the Maintenance/Troubleshooting chapter for a table showing indicator states.
- 9 Ethernet Port – provides the connection point for an Ethernet network between your computer, server, or network and the Flyer 3D head.

Flyer 3D bottom panel

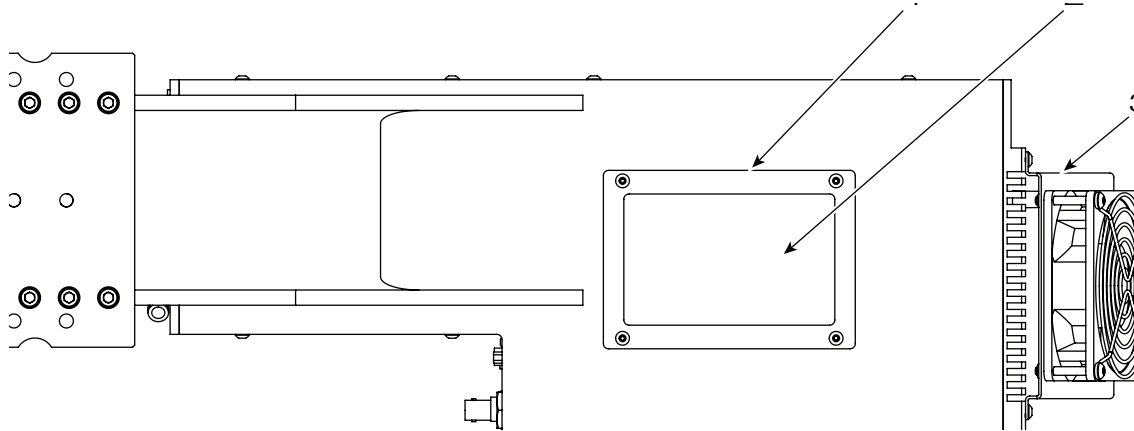


Figure 4-2 Flyer 3D bottom panel component locations.

- 1 Output window – a 3 mm-thick zinc selenide window protects internal optics from processing and environmental dirt, dust, fumes, and vapors.
- 2 Output aperture – provides the output beam exit to the work surface.
- 3 Cooling fan/heat sink surface – a factory-installed cooling fan and specially designed heat sink surface act together to cool Flyer 3D.

Operation

Initial Start-up

The Initial start-up section includes subsections:

- Test firing (WinMark control mode).
- Marking operation.
- Marking field configuration (see the Hardware Setup section in the Getting Started Chapter).

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



Flyer 3D's operating system requires approximately 15–20 seconds to boot up. Repeatedly cycling power during the boot up sequence may cause corruption of Flyer 3D's flash memory and operating system.

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



This product is designed to emit invisible infrared laser radiation from a Class 4 laser in the 9.3–10.6 μm CO₂ wavelength band.

This product emits visible laser radiation from a Class 3R laser in the 630–680 nm 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. CO₂ lasers emit an invisible beam that is capable of seriously burning human tissue.

Always be aware of the beam path and always use a beam block while testing or operating this product.

Operation

Initial Start-up

Test firing (WinMark control mode)

Verify Flyer 3D/WinMark Pro communication

- 1 If you have not already done so, load WinMark Pro v7 onto your Windows® computer.
- 2 Remove the dust covers from Flyer 3D's input and output apertures (or protective window).
- 3 Ensure that all personnel in the area are wearing the appropriate protective eyewear and then apply power to the Flyer 3D head and the laser. The head's Power indicator will illuminate green.
- 4 Wait until Flyer 3D has booted up (when the Status indicator turns solid green).

Flyer's operating system requires approximately 15–20 seconds to boot up. Flyer is operational when the Status LED illuminates solid green and the Lase indicator illuminates a dim red color.

Note: If the Flyer 3D system is shipped with a Pulstar (pulsed) laser, Flyer 3D tickle generation is disabled and the Lase indicator will not illuminate until PWM pulses are sent to the laser.

- 5 Open WinMark Pro and verify the Mark button displays the name of the Flyer 3D head you are operating (see the figure below). The head is disconnected or unavailable if the head name is grayed out.

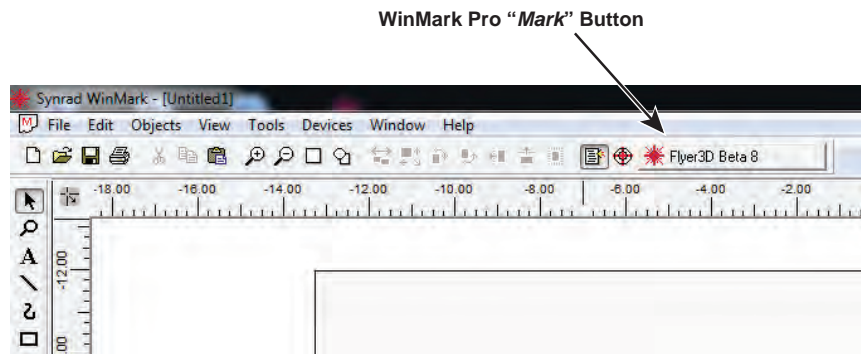


Figure 4-3 WinMark Pro's Mark button.

Operation

Initial Start-up

Diode pointer operation

The Flyer 3D marking head includes a built-in visible diode pointer that is useful for locating the center of the mark field or “tracing” the mark on the part surface prior to actual lasing.

Important Note: Lasing cannot occur while the diode pointer is activated.

- 1 To trace a mark, add mark objects to a blank Drawing Canvas or open an existing .mkh mark file. For convenience, a test mark file (FactoryTestMark1.mkh) is located in the C:\Program Files\WinMark folder.
- 2 Click the Diode Pointer button (Below figure), or select Diode Pointer from the File menu.

The diode pointer turns on and automatically moves to the center of the mark field and the SYNRAD WinMark (Launcher) dialog opens.

When the diode pointer is activated, the Diode Pointer button appears as seen in the figure below. Because laser marking is disabled, the red laser starburst icon does not appear on the Mark button.

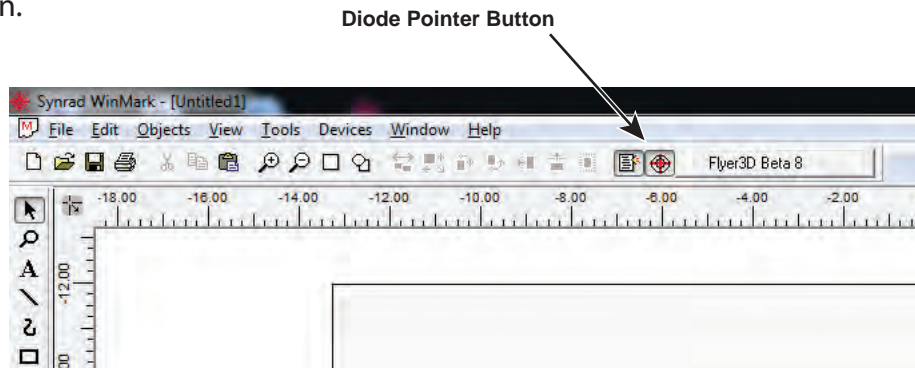


Figure 4-4 Diode pointer On/Off button.

- 3 Press F1 or click the Start-F1 button. The visible diode pointer beam will trace the mark path including off-vector (laser off) moves. When complete, the visible beam remains at its last commanded position, it does not return to center.

If you opened the factory test mark file, the visible beam will trace the path shown in the figure below.

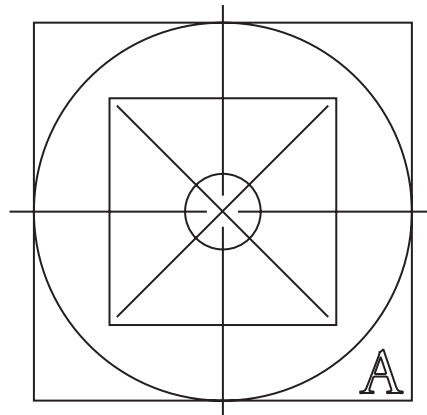


Figure 4-5 Factory Test Mark pattern.

Operation

Initial Start-up

- 4 Click the Diode Pointer button, or select Diode Pointer from the File menu, to turn the diode pointer off and enable lasing.

Lase a mark

- 1 Place the material or part to be marked in position on the marking surface at the proper working distance.
- 2 Assure a beam block is in place to prevent the laser beam from traveling beyond the work area, an anodized aluminum plate is ideal. The beam block should be slightly larger than the mark field.

Note: Flyer 3D's mark field is oriented in a horizontal (landscape) view, not a vertical (portrait) view, (the WinMark Pro Drawing Canvas as seen in the preceding figure).

- 3 In WinMark Pro, create a new mark file, open an existing .mkh file, or use the "FactoryTest Mark1.mkh" file.

Important Note: Default settings for the test mark file include a power level determined by the 50% duty cycle of your laser and a mark speed of 40 inches per second. To prevent overburning, you should adjust these settings as required depending on your laser's output power and marking sub-

**Warning
Serious
personal
injury**



Pressing the F1 function key on the computer keyboard causes WinMark Pro to mark immediately without opening the Launcher dialog!

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 eyewear and are physically clear of the mark area before beginning a mark session.

strate.

- 4 Check that all safety precautions discussed earlier such as safety glasses for personnel and shielding around the beam area are in place.
- 5 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.

The Lase indicator on the Flyer 3D Head becomes brighter as PWM Command signals are sent to the laser during marking.

If the Flyer 3D Head fails to mark properly, refer to Troubleshooting Section in the Maintenance/Troubleshooting chapter.

Operation

Initial Start-up

Note: When the optical scanners are activated on boot up, they are automatically positioned in the center of the mark field. After any marking is performed, the scan mirrors remain at the end of mark location; they do not return to the center point of the mark field.

Marking operation

Marking operation is the same as with previous FH Series marking heads. Open existing WinMark Pro .mkh mark files or create new mark files. The polylines comprising each mark object are marked in the plane of the Drawing Canvas at the specified working distance.

Important Note: Backup existing mark files before opening them in WinMark Pro v7. If an existing file is inadvertently saved in the latest v7 build format, it cannot be opened by earlier WinMark builds.

Determine the operating method

- 1 To operate Flyer 3D using a method other than WinMark control, refer to the following sources for information on Flyer 3D's many control methods:

Chapter 3, Stand-alone operation, to setup stand-alone control or access a network share.

Chapter 4, Technical reference, to use hard-wired I/O between Flyer and your automation controller.

Appendix C, Master Control File, for information on creating a Master Control File scheme.

Appendix D, Tracking, for a description of the tracking (on-the-fly part marking) function.

WinMark Pro Application Note # 5 for controlling Flyer 3D via Ethernet MODBUS[®] TCP/IP.

Open/create a mark file

- 1 Open an existing WinMark Pro .mkh mark file or create a new drawing and set drawing/object automation, marking, and format parameters to suit your needs.

**Warning
Serious
personal
injury**



This product emits invisible infrared laser radiation from a Class 4 laser in the 9.3 – 10.6 μm CO₂ 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. CO₂ lasers emit an invisible beam that is capable of seriously burning human tissue.

Always be aware of the beam path and always use a beam block while testing or operating this product.

Operation

Initial Start-up

Tip: When using file automation, test the file under WinMark control first before running in Stand-alone mode or with a .NET or ActiveX application.

Begin marking

- 1 Place the material or part to be marked in position on the marking surface at the proper working distance.
- 2 Check that a beam block ,an anodized aluminum plate is ideal, is in place to prevent the laser beam from traveling beyond the work area. The beam block should be slightly larger than the mark field.
- 3 Ensure that all safety precautions discussed earlier such as safety glasses for personnel and shielding around the beam area are in place.
- 4 Verify that Flyer 3D Head is configured for the desired operating method—WinMark control mode, Stand-alone control mode, or automation mode.
- 5 Enable marking. This step will vary depending on the control method you are using. In WinMark control mode, click the Mark button, or select Mark from the File menu. After the SYNRAD WinMark (Launcher) dialog opens, click the Start-F1 button to immediately begin marking.

Stand-alone Operation

5

Use information in this chapter to configure your Flyer 3D Head to operate in “Stand-alone” mode. In Stand-alone mode, Flyer 3D Head can operate independently of the marking computer.

This chapter contains the following information:

- Introduction– describes Flyer 3D Head’s control methods and lists supported mark functions.
- WinMark Pro/Flyer 3D Head interface – illustrates the interface between WinMark Pro v7 and the Flyer 3D Head in Stand-alone mode.
- Stand-alone process development – explains how to configure and test Flyer 3D Head to operate in Stand-alone marking mode.

Stand-alone Operation

Introduction

The Introduction section includes subsections:

- Stand-alone definitions.
- Stand-alone control.
- 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 – 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 32-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 Flyer heads, this scheme allows multiple heads to access common mark files from a central location.

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

Stand-alone control

In Stand-alone operation, mark files are downloaded to Flyer's Filestore before a mark session begins so it is not necessary for the WinMark computer to transmit vector data during the mark. In Stand-alone mode, Flyer can operate autonomously—communicating to automation equipment using discrete I/O signals or Modbus TCP/IP—with no connection to the WinMark Pro computer. In situations where it is desirable to monitor mark session progress, an Ethernet connection to a computer running 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.

Master Control File (MCF) operation is a specialized subset of Stand-alone operation where Flyer loads a master file on boot-up. The Master Control File configures Flyer to mark multiple files by providing a means to command the head to load a particular MKH file and/or input bit pattern in a user-controlled sequence determined by input bit status. See Appendix D for complete details on MCF configuration and operation.

Supported functions

In Stand-alone mode, Flyer supports many, but not all, of the functions available using WinMark control. Before developing mark files for Stand-alone operation, refer to the table in the prior chapters. It lists major categories of supported features for Flyer Stand-alone operation. Check the WinMark Pro web site at https://www.synrad.com/products/marketing_heads_software/winmark-sw for firmware updates that may add additional functionality.

Stand-alone Operation

Introduction

Table 5-1 Stand-alone marking features.

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

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

The WinMark Pro/Flyer 3D interface section includes subsections:

- Stand-alone set-up
- Stand-alone Toolbar
- Filestore structure
- TrueType fonts
- Configuring a network share

Stand-alone set-up

When communicating with a Flyer marking head, enter Stand-alone mode from the Flyer 3D 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.

Note: Entry and exit from Stand-alone mode is controlled from WinMark Pro using the Standalone Marking property; however, Stand-alone operation is a head-specific property and resides on the Flyer 3D tab.

Stand-alone Toolbar

When WinMark Pro detects that a Flyer head 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 the figure below, a Stand-alone Toolbar consisting of four additional buttons appears to the right of the Mark button. These buttons are described below.

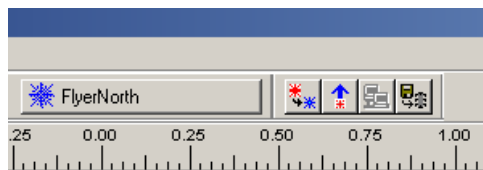


Figure 5-1 Stand-alone Toolbar.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

Warning Serious personal injury



Pressing the Mark Current File on Canvas button forces Flyer 3D 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 file is created or opened on the Drawing Canvas, click the Mark Current File on Canvas button to download the file to Flyer's temporary 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 uploaded from Flyer's Filestore and was not modified. To save the current mark file to the Filestore, use the Save Current File to Filestore button otherwise the file, and any changes, will be lost if Flyer is powered down.

Note: The WinMark Pro Hardlock must be installed on the computer running WinMark before this operation is allowed to proceed.

Tip: To view the filenames of the mark file currently residing in RAM (the file that will be marked in Stand-alone mode), hover your cursor over the Mark button or right-click the Mark button to view the Current Head File property on the Flyer 3D tab.



Upload Current Mark File

Click the Upload Current Mark File button to upload the file currently stored in 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 re-save the file to the Filestore.



Open Network Mark File

When 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 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 Flyer Filestore. You are prompted for a filename and can also specify a path, if one or more sub-folders exist in the Filestore.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

Important Note: This operation does not load the file into RAM for marking. To load the file for marking (and display the mark file on WinMark Pro's Drawing Canvas), double-click the filename in the Filestore after the download is complete.

Note: The WinMark Pro Hardlock must be installed on the computer running WinMark before this operation is allowed to proceed.

Filestore structure

Flyer's Filestore is a hierarchical file system in flash memory (32-MB), similar to the file system on your computer. When Flyer is connected to the WinMark 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 the Flyer head, click WinMark's View menu and then click Flyer Files.

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.

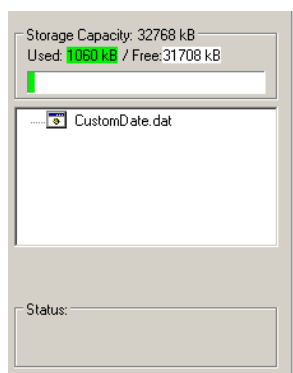


Figure 5-2 Initial Stand-alone Flyer Files window.

A Storage Capacity message, located at the top of the Flyer Files window (Figure above), 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 the following figure, 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.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

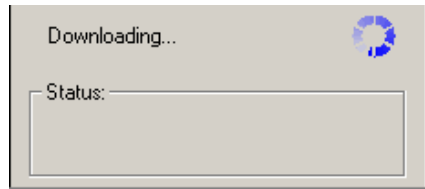


Figure 5-3 File operations indicator.

Pathname conventions

When mark (.MKH) or text (.TXT) files are stored in the Flyer Filestore, the Windows® marking computer, or a network share, the format of the pathname to this file differs depending on whether the file will be accessed by a Windows operating system or by the Flyer head (that uses a Linux OS).

Windows OS

To access files using WinMark Pro or a .NET or ActiveX application running on a Windows PC, pathnames must be typed using a backslash (\) character. For example, \MarkFile1.mkh or C:\MarkFileFolder\TextFile.txt.

Linux OS

To access files using the Flyer head operating in Stand-alone mode, pathnames must be typed using a forward slash (/) character. For example, /network/MarkFileFolder/TextFile.txt or /MarkFile1.mkh.

Valid file types

Although you can save any file to the Flyer Filestore, only five file types are used for marking operations: (1) mark files with a .mkh extension, (2) custom date code data files with a .dat extension, (3) TrueType® fonts with a .ttf extension, (4) text files with a .txt extension, and (5) a master control file named "master.ctl". See Appendix D 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 must be installed on the computer running WinMark before this operation is allowed to proceed.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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.

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 to 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 Hard lock 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 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 nested inside of other folders by selecting an existing folder and then right-clicking Make New Folder; however, you cannot move a folder from one location to another inside the Filestore.

The following figure shows the Flyer Filestore (Flyer Files window) after several folders, subfolders, and mark files have been saved.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

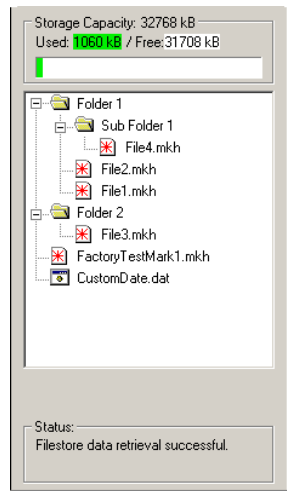


Figure 5-4 Filestore containing saved files and folders.

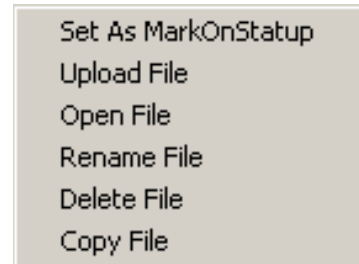


Figure 5-5 Contextual menu—.mkh mark files.

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.

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 the figure above and described below:

Set As MarkOnStartup

Selecting this function changes two important properties in the Flyer marking head. First, it enables the **Mark On Startup** property so that 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 **Mark on Setup** and **Startup Drawing** property functionality on the Flyer 3D tab under **Tools>General Settings**.

Upload File

Uploads the selected mark file from the 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.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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 folder

Right-clicking on a folder provides the options shown in the figure below and described below:

Right-click on other file types

Right-clicking on other file types provides the options shown in the following figure and described below:

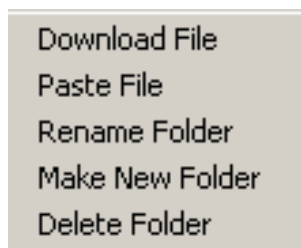


Figure 5-6 Contextual menu—folders.

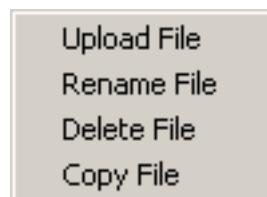


Figure 5-7 Contextual menu—other files.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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 the contents are displayed.

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

Rename Folder

Renames the selected folder.

Make New Folder

Creates a new sub-folder within the selected folder. After creation, the sub-folder is opened and the 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 the figure below:

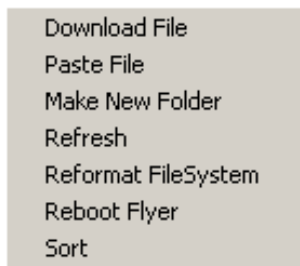


Figure 5-8 Contextual menu—Filestore.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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 Flyer Filestore, the WinMark Pro Hardlock 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 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.

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 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 Flyer's operating system. This process may take up to 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 sub-folders are also sorted and listed alphabetically.

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

TrueType fonts

Flyer marking heads have the ability to render TrueType® (.ttf) fonts in Stand-alone mode and store those fonts in the Filestore or in a network share folder. To ensure the best marking performance, TrueType fonts are cached in 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 the 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 Filestore.
- 6 From the Edit menu, click Copy.
- 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.
- 9 When you have finished adding (or removing) 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.

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

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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.
- 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.
- The Filestore has a maximum capacity of 32 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.

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 network share Flyer Fonts folder.
- 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 (or removing) 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.
- 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 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

Stand-alone Operation

WinMark Pro/Flyer 3D Interface

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 Flyer 3D tab under Tools>General Settings.
- 3 Scroll down the Flyer 3D tab and locate the Share Name property.

Enter the name of the share folder you created in the previous section. For example, if the path to the folder is "H:\Mark Files\Flyer Share", enter "Flyer Share" (without the quotes) as the Share Name.

- 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

WinMark Pro/Flyer 3D Interface

The Stand-alone process development section includes subsections:

- File creation/testing
- Stand-alone configuration

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

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.

File creation/testing

Stand-alone file creation

Important Note: Before operating the Flyer head in a fully automated mode, be sure to test any mark files with I/O automation in WinMark control mode as described below.

- 1 In WinMark Pro, open an existing drawing or click New on the File menu and create a mark file containing the objects you wish to mark.

Depending on the application, this may also include setting up text or barcode automation. See the WinMark Pro User Guide for details.

- 2 Using WinMark, configure Flyer inputs and outputs to communicate with the automation system at each step in the mark process as required. Save the .mkh file and close WinMark Pro when done.

Stand-alone Operation

Stand-alone Process Development

Warning 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.

Before testing I/O wiring between Flyer and your automated system, ensure that toggling I/O states will not inadvertently cycle the machine or fire the laser. In situations where the laser is powered up and automation machinery is active, verify that all personnel in the area are wearing protective eyewear and that all operating safeguards are in place around the machine.

- 3 Verify that I/O field wiring on Flyer's 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 https://www.synrad.com/products/marketing_heads_software/winmark-sw
- 4 Power up the Flyer marking head and allow 30 seconds for the head to boot-up.
- 5 Open the Digital Scope application. Use the output "buttons" to Set or Clear the corresponding Flyer output(s) and verify these states are recognized by your automation controller. Next, verify the input "buttons" change state when activated by the automation controller.
- 6 Close Digital Scope after verifying proper I/O functionality.

Stand-alone file testing

Software setup

- 1 Ensure that you have completed all the connections listed in the Getting Started chapter including the Ethernet Connection Section.
- 2 Power up the Flyer head and allow 30 seconds for the operating system to boot-up.
- 3 Open WinMark Pro and go to the Flyer 3D tab under Tools>General Settings.
- 4 Locate the Standalone Marking property and set it to Yes.

Stand-alone Operation

Stand-alone Process Development

- 5 Choose a Standalone Mark Log Level depending on the amount of information you want Flyer to report back to the computer—Normal is the default setting. Choose Verbose to display each I/O step in the mark file automation.
- 6 Verify that Use Control File and Mark On Startup properties are set to No.
- 7 Click Apply to save the settings and then click OK to exit the General Settings dialog.

Use the mark

- 1 Open the automation mark file you created earlier.
- 2 Place a part in the field of the focusing lens at the point of focus.
- 3 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are in place.

Warning Serious personal injury



Pressing the Mark Current File on Canvas button forces Flyer 3D 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 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.

- 4 Press the Mark Current File on the Canvas button. The mark file you created is downloaded to Flyer RAM and the laser fires the mark immediately.

Note: If the mark file contains automation, like a ‘start mark’ input, progression through the mark session is determined by your automated parts handling equipment.

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

- 5 As required, adjust the automation sequence in the mark file and on your automation controller until you achieve the desired control and “communication” between the Flyer marking head and your controller.

Stand-alone Operation

Stand-alone Process Development

The downloaded file is temporarily stored in Flyer RAM (until overwritten or power is removed). Press F1 on the computer keyboard or click Start-F1 in the Launcher window to load another mark. You can hover your mouse pointer over the Mark button or right-click the Mark button to view the Current Head File property on the Flyer 3D tab to verify the file currently loaded into Flyer RAM.

To save this file to the Filestore permanently, click WinMark's Save Current File to Filestore button. To archive this file to your computer or server, open WinMark Pro's File menu and select Save As.

Stand-alone configuration

When the Filestore contains at least one .mkh mark file, you can configure 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.

Software setup

- 1 Ensure that you have completed all the connections listed in the Getting Started chapter including Ethernet connections.
- 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 Flyer is booted-up and operational, open WinMark Pro and go to the Flyer 3D tab under Tools>General Settings.
- 5 Locate the Standalone Marking property and set it to Yes.
- 6 If a computer will be connected to monitor mark progress, choose a Standalone Mark Log Level depending on the amount of information you want the Flyer 3D Head to report back.
- 7 Set the Mark On Startup property to Yes.

Stand-alone Operation

Stand-alone Process Development

- 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 or on a network share.

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. Flyer's Linux OS requires you to specify pathnames using forward slash (/) characters instead of backslash (\) characters.

- 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.

Lase the mark

- 1 Place a part in the field of the focusing lens at the point of focus.
- 2 Check that all safety precautions discussed earlier such as safety glasses and shielding around the beam area are in place.
- 3 Power down Flyer, then re-apply power or reboot the head by right-clicking in the Filestore and choosing Reboot Flyer.
- 4 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 a WinMark computer during the time that 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.

While Flyer is marking, there may not be 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 mark session

- 1 To end a Stand-alone mark session, first connect Flyer to the WinMark Pro computer via the Ethernet port.
- 2 Click the blue (Stand-alone) 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.

Stand-alone Operation

Stand-alone Process Development

Note: In an automated system, you can configure input IN7, using WinMark Pro's Enable Abort Input (Input 7) property, to halt a mark session when activated by a PLC or automation controller.

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 Flyer 3D 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.

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, set-up an Ethernet connection and access the Mark On Startup property through the Flyer web page. See Flyer web interface in the Technical Reference chapter for details.

Master Control File (MCF) operation is a specialized subset of Stand-alone operation where the Flyer 3D Head loads a master file on boot-up. This feature allows a single file, the Master Control File, to configure Flyer to load and mark two or more mark files (previously stored in the Filestore or on a network share) in a user-controlled sequence based on the status of the head's User Interface digital inputs. See Appendix D for complete details on MCF configuration and operation.

Technical Reference

6

Use information in this chapter as a technical reference for your Flyer 3D marking head. This chapter contains the following information:

- Flyer 3D technical overview: Describes SYNRAD Flyer 3D technology.
- Input/Output circuitry: Explains Flyer's Input/Output (I/O) capability.
- 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 clearing marks may prolong optical scanner lifetime.
- Over-temperature warning: Describes Flyer's over-temperature warning feature.
- General specifications: Lists Flyer 3D marking head specifications.
- Flyer 3D package outline drawing: Illustrates Flyer 3D marking head package outline and mounting dimensions.
- Flyer 3D/Series 48-1 fan-cooled package outline drawing: Illustrates outline and mounting dimensions with a 48-1 laser.
- Flyer 3D/Firestar v30 fan-cooled package outline drawing: Illustrates outline and mounting dimensions with a v30 laser.
- Flyer 3D/Firestar v40 fan-cooled package outline drawing: Illustrates package outline and mounting dimensions with a v40 laser.
- Flyer 3D/Firestar ti-Series water-cooled package outline drawing: Illustrates package outline and mounting dimensions with ti60, ti80 and ti100 water-cooled lasers.
- Flyer 3D/Firestar ti-Series fan-cooled package outline drawing: Illustrates packaging outline and mounting dimensions with ti60/ti80 fan-cooled and t100 fan-cooled lasers.
- Flyer 3D/Firestar f201 package outline drawing: Illustrates packaging and mounting dimensions for Flyer 3D with a f201 laser.
- Flyer 3D/Firestar i401 package outline drawing: Illustrates packaging and mounting dimensions for Flyer 3D with a i401 laser.
- Flyer 3D/Pulstar p100 package outline drawing: Illustrates packaging and mounting dimensions for Flyer 3D with a p100 laser.
- Flyer 3D/Pulstar p250 package outline drawing: Illustrates packaging and mounting dimensions for Flyer 3D with a p250 laser.
- Flyer 3D Head packaging instructions: Illustrates how to package a Flyer 3D marking head for shipment using SYNRAD-supplied packaging materials.

Technical Reference

Flyer 3D Technical Overview

The Flyer 3D Head technical overview section includes subsections:

- Flyer 3D Head.
- Beam expansion.
- Mark field specifications.

Flyer 3D 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 passes through an expander optic—mounted inside Flyer 3D Head's input aperture (< 200 W lasers) or mounted to the laser face-plate (> 200 W lasers)—where it is expanded and collimated to a diameter of 9.0 mm. After entering the head, the beam is directed through a dynamic Z-axis objective lens controlled by a high-speed galvanometer and then onto two lightweight 30 mm X and Y mirrors mounted on separate high-speed optical galvanometers.

The linear motion of the precision-guided Z-axis objective lens is driven by advanced algorithms that compensate for barrel and pincushion effects common to three-axis heads. This unique design allows the Flyer 3D Head to maintain focus dynamically throughout the mark field without the need for correction tables or lengthy user calibration procedures. From the Z-axis optic, the XY galvanometers and mirrors precisely position the beam and direct it out through the output aperture where it reaches its exact point of focus at the intersection with the mark surface.

WinMark Pro Laser Marking Software sends vector data and laser power commands to the Flyer 3D Head through an Ethernet connection where a processor on Flyer 3D Head'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 all three 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. Control board circuitry generates a fixed 1 μ s, 5 kHz tickle signal that maintains plasma ionization in the laser tube when the laser is commanded off and then generates a variable Pulse Width Modulated (PWM) laser control signal that is user-adjustable (in WinMark Pro v7) within a frequency range of 1–50 kHz when the laser is commanded to fire.

Note: Flyer 3D Head's operating system requires approximately 15–20 seconds to boot up. Repeatedly cycling power during boot up may cause corruption of the head's flash memory and operating system.

Beam expansion

The Flyer 3D marking system includes a beam expander matched to the laser ordered as part of the system. If that laser is later replaced with different SYNRAD laser model (for example, in a facility where multiple laser types are used), verify the expander ratio matches the laser model before operating the marking head. An expander/beam diameter mismatch may cause loss of output power and possible damage or overheating of Flyer 3D Head's input aperture. Flyer 3D Head's maximum input beam diameter is 9.0 mm.

A precision aperture ring inside Flyer 3D Head's input aperture housing is designed to clip all energy outside of the expanded beam's 1/e² point. Eliminating excess laser energy outside of the 1/e² point enhances beam quality while reducing excessive heat input that adds no value—processing speed or quality—to the laser manufacturing process. Because of the aperture, you will see a power loss of approximately 10 – 20% through the Flyer 3D Head compared to power measurements made at the laser output.

Technical Reference

Flyer 3D Technical Overview

Mark field specifications

The actual mark field for Flyer 3D Head is slightly longer in the X-axis as shown back in Figure 1-3. This orientation is horizontal (a landscape view) instead of the vertical (portrait view) used by FH Flyer marking heads.

See the table in the first chapter of this manual for available nominal and actual field sizes, focused spot sizes, and required working distances for our Flyer 3D Head. Refer to the Final Test Report shipped with each Flyer 3D head for the field size set for your head at the factory.

Technical Reference

Input/ Output Circuitry

The Input/Output circuitry section includes subsections:

- User Interface overview
- Internal +15 VDC supply
- Digital input circuitry
- Digital output circuitry

User Interface overview

Important Note: Flyer 3D Head inputs and outputs (I/O) are not intended for use as general purpose I/O. Instead, they were designed to communicate with the control system before or after, but not during, the actual marking process. In applications where external devices must be monitored and controlled while lasing is in progress, we recommend using an automation controller or discrete I/O modules to perform this function.

The digital I/O capability of SYNRAD Flyer 3D marking head combined with WinMark Pro Laser Marking software provides an easy method for automating process control. Refer to the WinMark Pro Laser Marking Software User Guide or our Laser Marking FAQ https://www.synrad.com/products/marketing_heads_software/winmark-sw for details on configuring a basic automation sequence.

Flyer 3D Head'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 figure below shows the physical layout of Flyer 3D Head's User Interface connection.

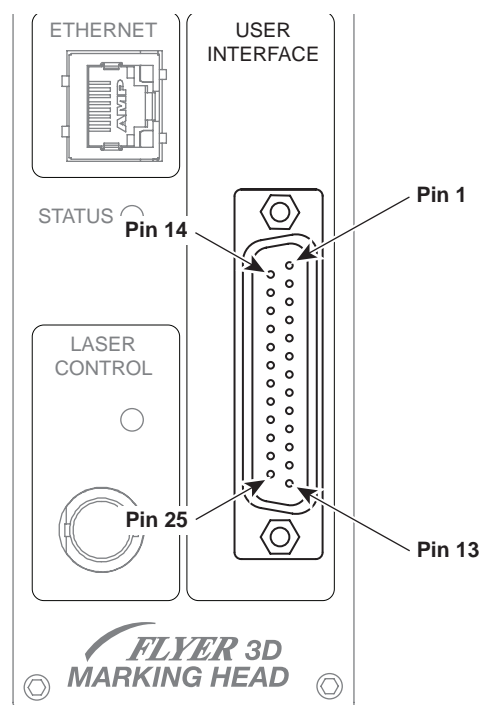


Figure 6-1 Physical layout of Flyer 3D Head's User Interface connection.

Technical Reference

Input/ Output Circuitry

Table below lists pin assignments for Flyer 3D Head's DB-25 User Interface connection. See the connection notes below for important information about A/B and HI/LO connection points.

Table 6-1 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.

Technical Reference

Input/ Output Circuitry

Internal +15 VDC supply

An internal 15-volt (+15 VDC, 400 mA) isolated power supply is available to drive Flyer 3D Head 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 6-2 summarizes +15 VDC pin assignments.

Table 6-2 +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

The Flyer 3D Head 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 below summarizes input pin assignments.

Table 6-3 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
12	IN6_A	*A connection point for IN6	Any
25	IN7_A	*A connection point for IN7	Any/see Note 1
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.

Note 1: When set to Yes, WinMark Pro’s Enable Abort Input (Input 7) property halts the current mark session when a voltage is applied to input IN7_A. When set to No, IN7_A functions as a normal automation input. See the WinMark Pro User Guide for details.

Technical Reference

Input/ Output Circuitry

Inputs IN1 and IN2 are high-speed optoisolated inputs with a maximum input frequency of 40 kHz and must be used 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 below for IN1/IN2 input specifications. When driving Flyer 3D Head'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 6-4 Flyer 3D Head high-speed input signal parameters—IN1/IN2.

Voltage In (VDC)				Current In (mA)				Frequency		
Logic Low	Logic High	@5V		@12V		@15V		@24V		max (kHz)
(OFF State)	(ON State)	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 the table below for IN0 and IN3–IN7 input specifications. When driving Flyer 3D Head 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 6-5 Flyer 3D Head input signal parameters—IN0, IN3–IN7.

Voltage In (VDC)				Current In (mA)				Frequency		
Logic Low	Logic High	@5V		@12V		@15V		@24V		max (kHz)
(OFF State)	(ON State)	Nom	Max	Nom	Max	Nom	Max	Nom	Max	
-1.0 to +1.0	3.0 to 24.0	6	9	16	23	20	29	32	47	1

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 3D Head'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 3D Head's +15 VDC auxiliary power output as the I/O signal source.

Technical Reference

Input/ Output Circuitry

The figure below illustrates an equivalent circuit diagram of Flyer 3D Head's optically-isolated input circuitry.

FLYER 3D USER INTERFACE

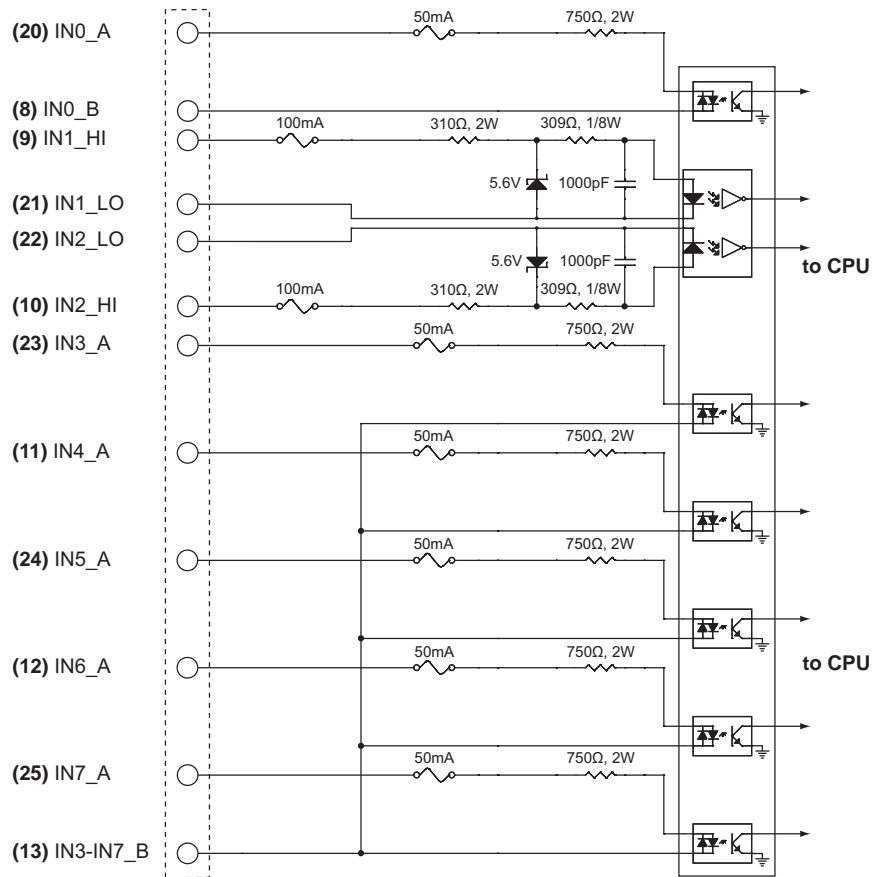


Figure 6-2 Flyer 3D Head's equivalent input circuit.

Sample input circuits

Flyer 3D Head'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, Flyer 3D Head senses a high-level state (1); when no current flows through the input, the Flyer 3D Head senses a low-level state (0). Flyer 3D Head inputs are designed for compatibility with standard industrial control circuit voltages in the range from 5 V to 24 VDC. See the following table for a listing of possible input signal configurations.

From sinking NPN open-collector device

To drive Flyer 3D Head inputs from a PLC using an NPN open-collector output module in a current sinking configuration as shown in the following figure, 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 3D Head inputs IN3_A through IN7_A as required. This allows the PLC's output module to independently activate Flyer 3D Head inputs by pulling individual inputs to ground.

Technical Reference

Input/ Output Circuitry

In the following figure, Flyer 3D Head input IN3 is activated when input IN3_A is pulled to ground by the corresponding PLC output. See the following table for a listing of possible input signal configurations.

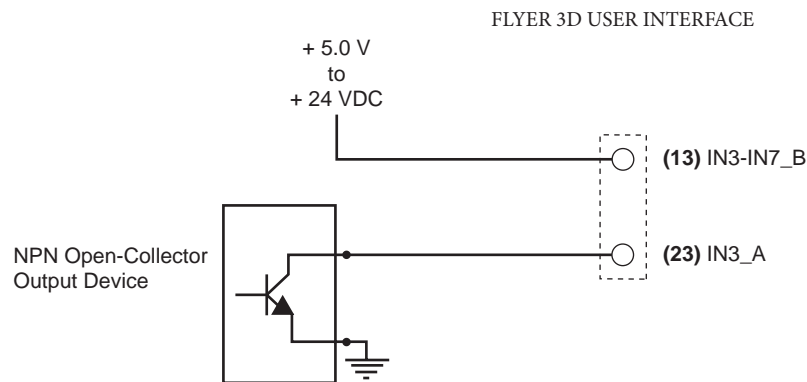


Figure 6-3 Activating Flyer 3D Head input with a current sinking device.

From sourcing NPN open-emitter device

The following figure illustrates a circuit for activating a Flyer 3D Head input from an NPN open-emitter logic device that is sourcing current.

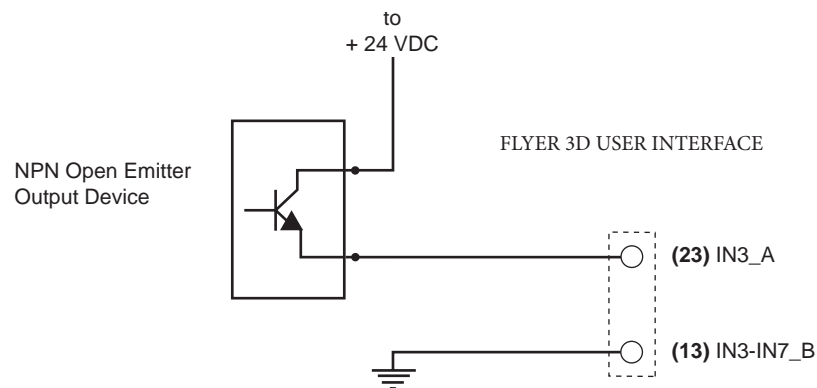


Figure 6-4 Activating Flyer 3D Head input with a current sourcing device.

Technical Reference

Input/ Output Circuitry

From switch or relay contact

A common requirement in marking applications is for an operator to initiate each mark operation by closing a foot-operated switch. The figure below illustrates a simple current sourcing circuit for using a foot switch or relay contact to send an input signal to the Flyer 3D Head marking head.

In this configuration, 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 6-6 for a listing of possible input signal configurations.

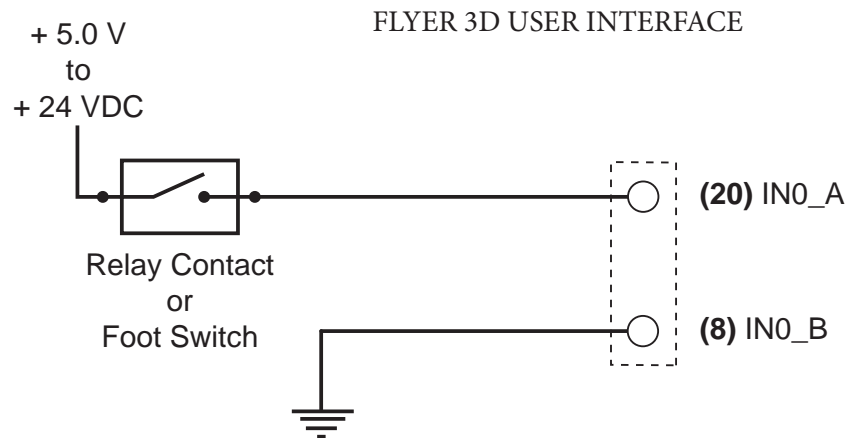


Figure 6-5 Driving Flyer 3D Head from current sourcing switch or relay device.

The figure below illustrates the same foot switch or relay contact device connected in a current sinking configuration.

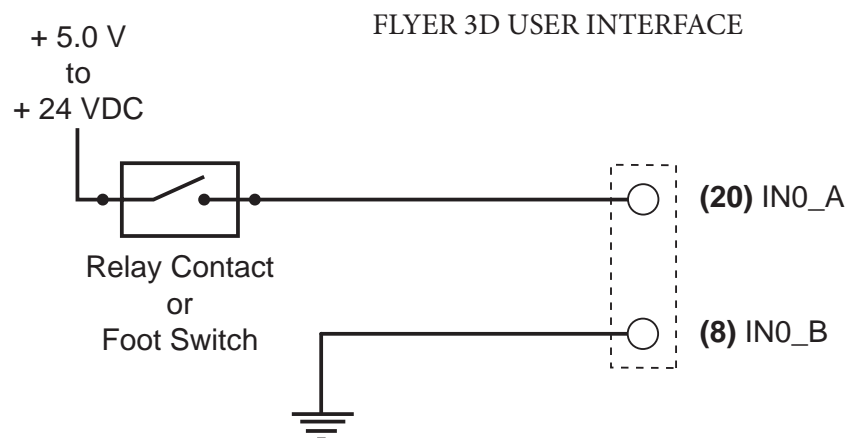


Figure 6-6 Driving Flyer 3D Head from current sinking switch or relay device.

Technical Reference

Input/ Output Circuitry

From high-speed encoder output

In tracking applications, connect Flyer 3D Head 's high-speed inputs IN1 and IN2 to your position encoder. These two inputs can accept input frequencies up to 40 kHz. The figure below illustrates a circuit for connecting position encoder outputs to the Flyer 3D Head marking head.

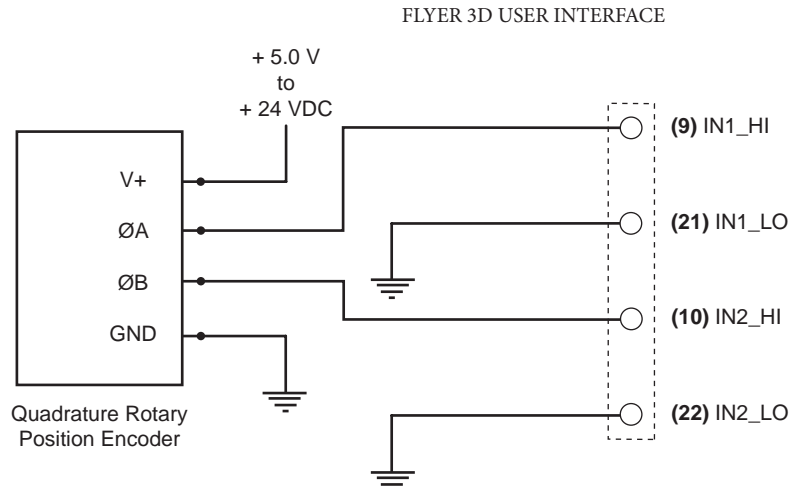


Figure 6-7 Driving Flyer 3D Head from high-speed encoder output.

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.

From Firestar/Pulstar laser output

When Flyer 3D Head is integrated with Firestar/Pulstar lasers equipped with a DB-15 User I/O port, you can ensure the laser is in a "ready" state before lasing. Connect the circuit shown in the figure below and configure the mark file to verify Flyer 3D Head inputs IN4 and IN5 are active (when Laser Ready and Shutter Open outputs are Closed) in the Wait Digital Before Piece automation step.

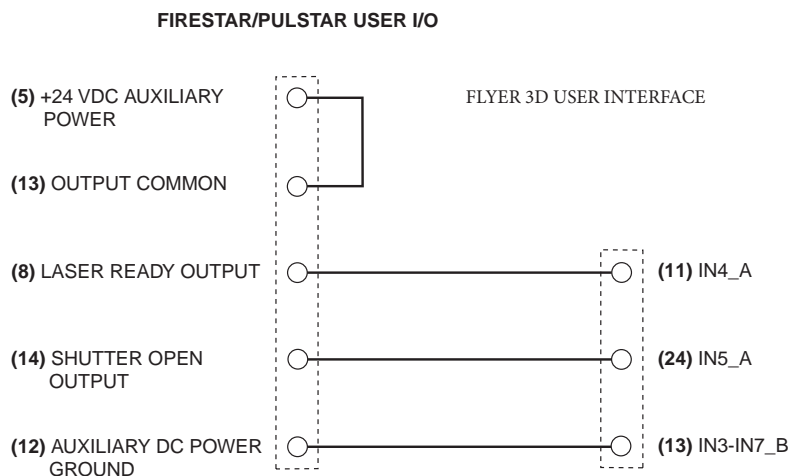


Figure 6-8 Enabling Flyer 3D Head from Firestar/Pulstar laser outputs.

Technical Reference

Input/ Output Circuitry

The following table lists possible ways you can connect Flyer 3D Head 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 6-6 Possible input signal configurations for Flyer 3D Head.

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.

Digital output circuitry

The Flyer 3D Head provides eight bipolar optoisolated outputs for operating low-current relays, PLC DC input modules, or other automation devices. Two outputs, OUT0 and OUT1, have isolated returns 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 as either high-side switches or low-side

Technical Reference

Input/ Output Circuitry

switches. The table below summarizes output pin assignments while Table 6-8 shows output signal specifications. Flyer 3D Head outputs are able to sink or source 30 mA maximum.

Table 6-7 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/see Note 1
15	OUT7_A	**A connection point for OUT7	Any/see Note 2
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.

Note 1: When set to Yes, WinMark’s Enable Marking Head Ready Output (Output 6) property activates OUT6_A when Flyer 3D Head is fully booted up. When set to No, OUT6_A functions as a normal automation output. See the WinMark Pro User Guide for details.

Note 2: When WinMark’s Switch IO Output 7 property is set to Yes, OUT7_A acts as an over-temperature warning output. When set to No, OUT7_A functions as a normal automation output. See page 5-35 or the WinMark Pro User Guide for details.

Table 6-8 Flyer 3D Head 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 μ A

The following figure illustrates an equivalent circuit diagram of Flyer 3D Head’s optically-isolated output circuitry.

Technical Reference

Input/ Output Circuitry

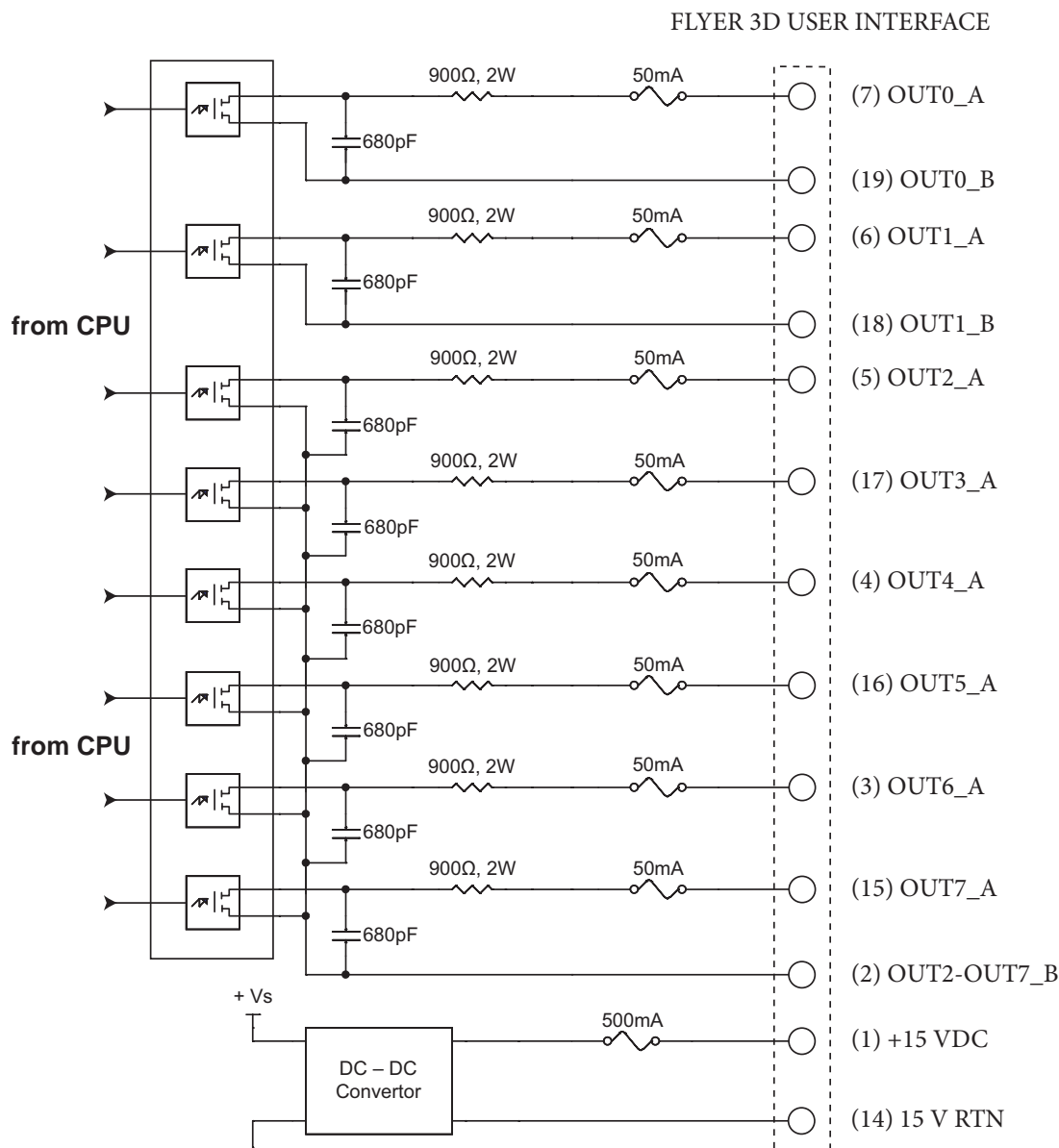


Figure 6-9 Flyer 3D Head's equivalent output circuit.

Sample output circuits

Flyer 3D Head'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 3D Head outputs are shown on the following pages. Flyer 3D Head outputs are designed for compatibility with standard industrial control circuit voltages in the range from 5 V to 24 VDC. Because outputs OUT0–OUT7 are bipolar, the circuits shown below can connect to either the "A" or "B" input connection. See Table 6-9 for a listing of possible output signal configurations.

Technical Reference

Input/ Output Circuitry

To isolated I/O module

The figure below illustrates a simple output connection. In this configuration, the output is sinking current. When sizing VDC remember to account for the voltage drop across Flyer 3D Head's 900-ohm output resistance. See the prior table for a listing of possible output signal configurations.

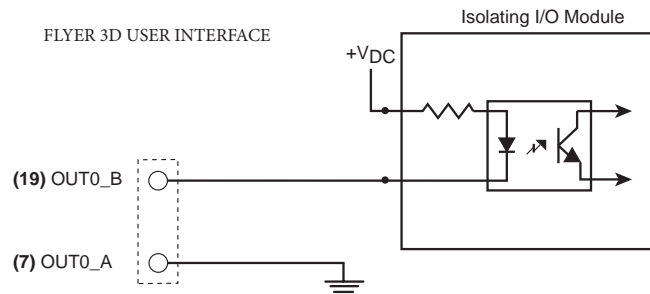


Figure 6-10 Flyer 3D Head output to isolated I/O module.

To PLC or logic interface

The figure below illustrates Flyer 3D Head's bipolar outputs connected to a PLC's DC input module. When the Flyer 3D Head output is ON, it sources current and drives the PLC logic input to a logic high state. See the following table for a listing of possible output signal configurations.

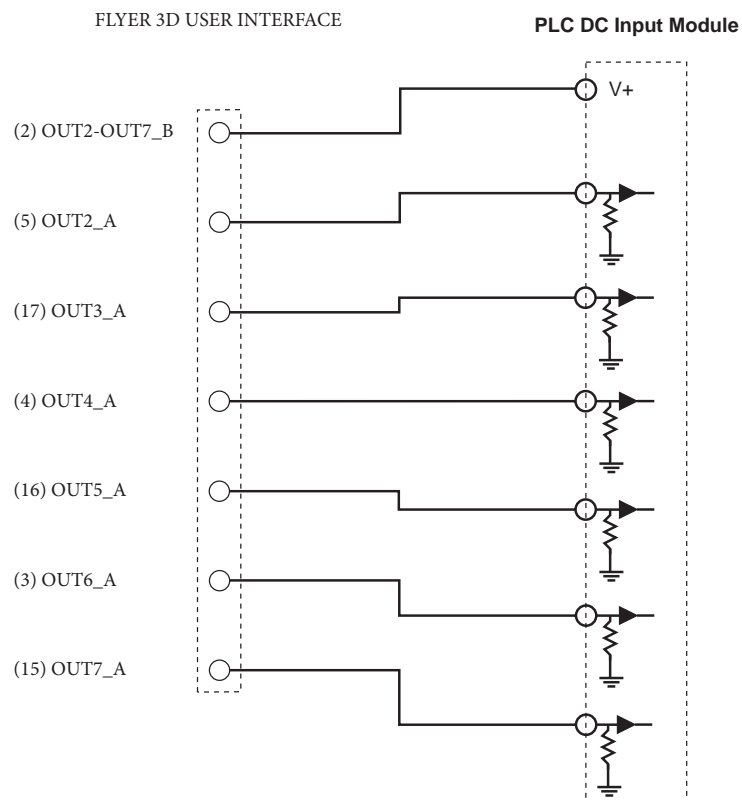


Figure 6-11 Flyer 3D Head output to PLC input module.

Technical Reference

Input/ Output Circuitry

The table below lists possible ways you can connect Flyer 3D Head 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, OUTx_A, are always tied to the load.

For example, refer back to the prior figure. The common return line, OUT2–OUT7_B, is tied to the PLC's 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 6-9 Possible output signal configurations for Flyer 3D Head .

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	OUT2–7_B	
OUT7_A	OUT2–7_B	
OUT2–7_B	OUT2_A	
OUT2–7_B	OUT3_A	
OUT2–7_B	OUT4_A	
OUT2–7_B	OUT5_A	
OUT2–7_B	OUT6_A	
OUT2–7_B	OUT7_A	

- 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.

Technical Reference

Ethernet Port

The Ethernet port section includes subsections:

- Ethernet overview.
- Ethernet port LEDs.
- Ethernet/Flyer cabling.

Ethernet overview

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 Flyer 3D Head when marking or testing in real-time. Flyer 3D Heads support Ethernet 10/100 Base-T Fast Ethernet connections with a data bandwidth of 10/100 million bits per second (Mbps). See Ethernet Configuration in the Getting Started chapter for information on Ethernet configuration via a peer-to-peer Ethernet.

Ethernet port LEDs

Flyer 3D Head's 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 Figures below. The following table provide details for a straight-thru Ethernet cable while the prior table 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.

Technical Reference

Ethernet Port

The table provides pin assignments for straight-thru Ethernet cable.

Table 6-10 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 below shows the physical wiring for a straight-thru Ethernet cable.

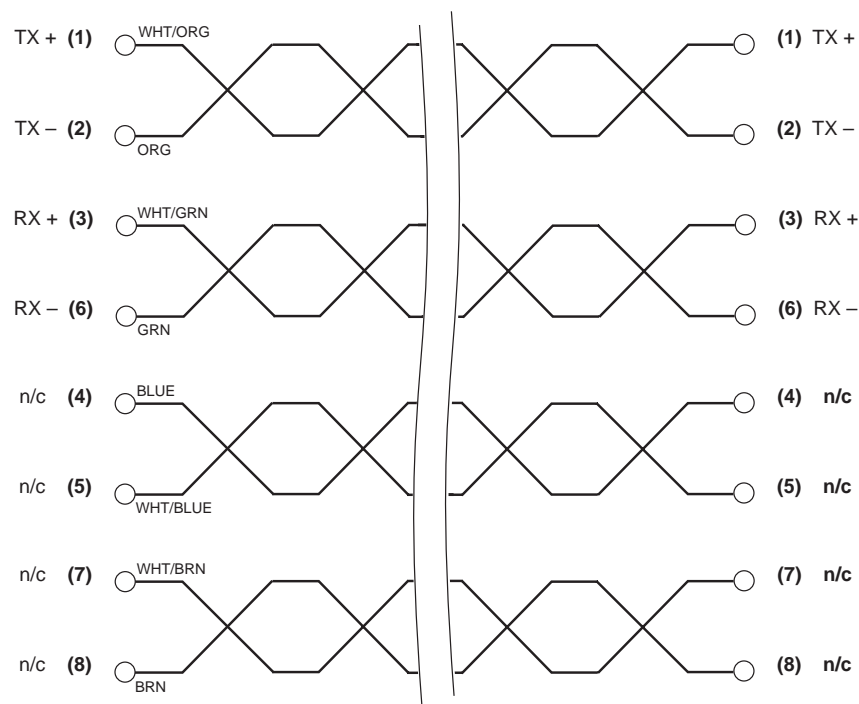


Figure 6-12 Physical wiring—straight-thru Ethernet connection.

Technical Reference

Input/ Output Circuitry

Table below provides pin assignments for wiring a crossover Ethernet cable.

Table 6-11 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 below shows the physical wiring for crossover Ethernet cable.

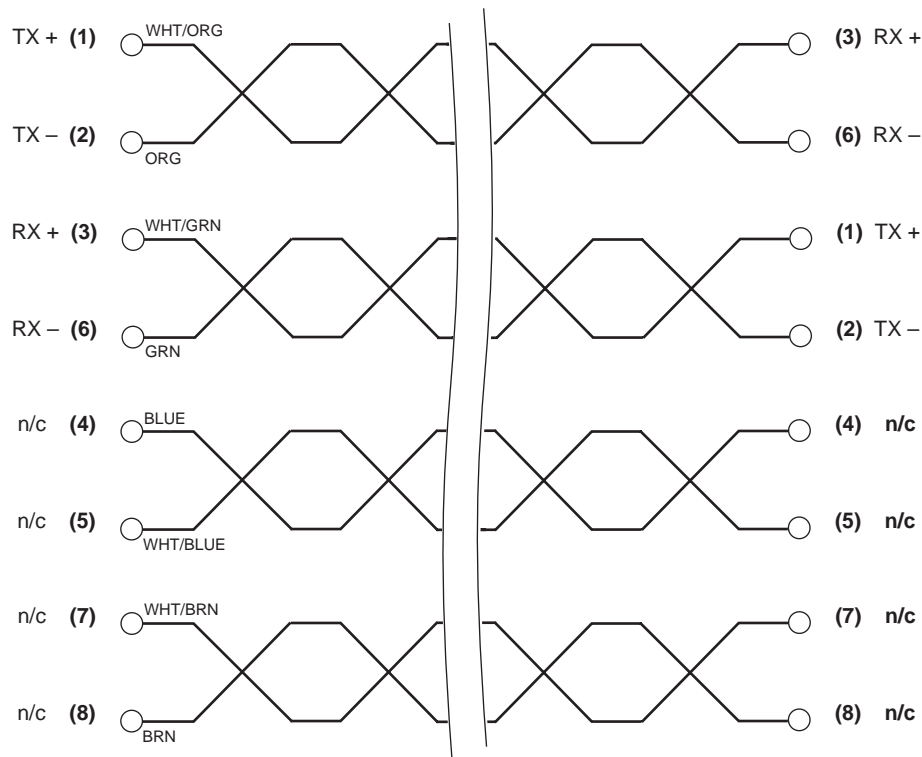


Figure 6-13 Physical wiring—crossover Ethernet connection.

Technical Reference

Fast Acting Safety Interlock

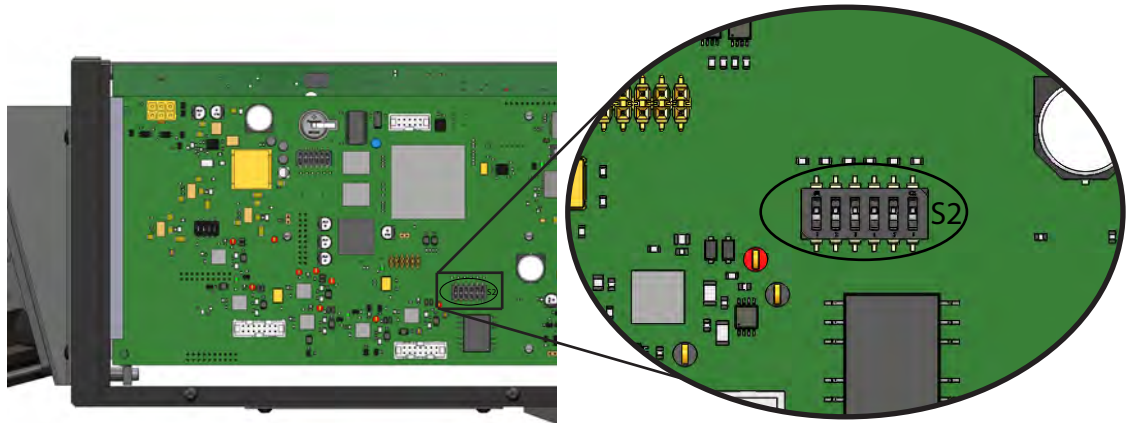


Figure 6-15 Flyer 3D Head DIP switch S2 location.

- 5 All other switches must remain at their default settings as listed on the table below.
- 6 Replace Flyer 3D Head's main cover and replace the button head screws removed in Step 2.
- 7 In each mark file, configure WinMark's Wait Digital Before Piece automation command to wait for a "Set" state on input IN3. This step synchronizes the 'start mark' input with the FASI safety feature.
- 8 To begin lasing with FASI enabled, apply a 5–24 VDC signal to Flyer 3D Head input IN3.

When FASI is enabled, IN3 must be active before Flyer 3D Head 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. Partial marks will occur if IN3 goes inactive (or active) while marking is in progress.

Note: Flyer 3D Head's Status LED turns red and blinks rapidly if FASI is enabled and marking is commanded, but IN3 is not active.

Table 6-15 Factory DIP switch assignments.

DIP #	SW #	Default Setting	Notes
S1	1	ON	must remain ON
S1	2	ON	must remain ON
S1	3	OFF	must remain OFF
S1	4	OFF	switch ON to set default IP Address
S1	5	OFF	must remain OFF
S1	6	OFF	reserved
S2	1	OFF	switch ON to enable FASI
S2	2	OFF	ON= Gate out OFF= PWM
S2	3	OFF*	*tickle disable; set ON only for Pulstar lasers
S2	4	OFF	ON= Diode pointer disable
S2	5	OFF	reserved
S2	6	OFF	reserved

Technical Reference

Flyer Web Interface

Flyer 3D Heads provide 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 the figure below.

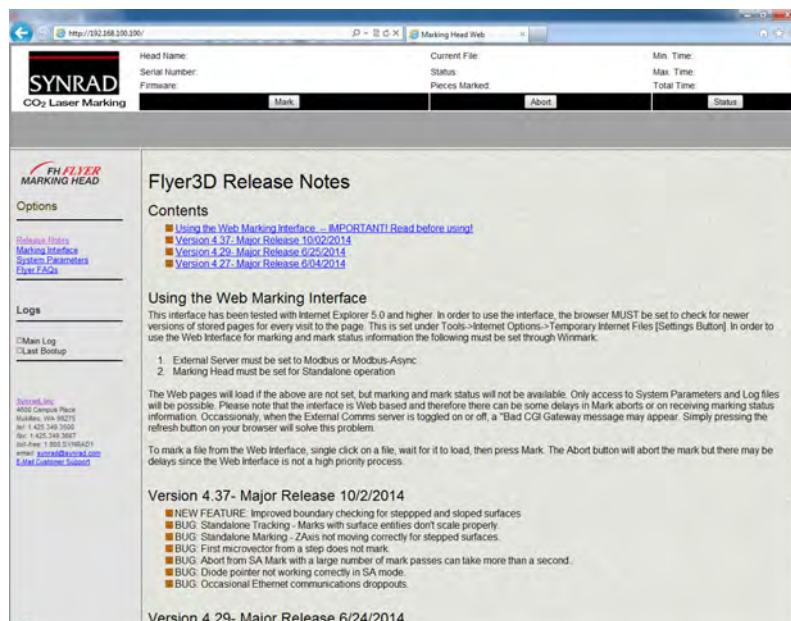


Figure 6-16 Flyer 3D Head's Internet interface page.

To access Flyer 3D Head 's interface page, ensure Flyer 3D Head '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.

The Options section of the web page provides links to Release Notes (including information on using Flyer 3D Head 's web interface), Marking Interface, System Parameters, and Flyer 3D Head FAQs. The Logs section links directly to Flyer 3D Head 's Main and Last Bootup logs. When operating Flyer 3D Head in Stand-alone mode, you can start (Mark) and stop (Abort) a mark session as well as check Flyer 3D Head status. To enable Mark, Abort, and Status button functionality, first set the External Communications Server property (on the Flyer 3D tab) to Modbus or Modbus-Async.

Note: In certain situations when Mark On Startup is enabled, Flyer 3D Head 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 3D Head, and launch WinMark Pro to make mark file adjustments as required.

Technical Reference

Over Temp Warning

Flyer 3D Head's flash memory contains the operating code—firmware—that controls the 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 upgrade (or downgrade) Flyer firmware, perform the following steps:

- 1 Power up the Flyer 3D Head and then open WinMark Pro v7.0 (or above).
- 2 From the Help menu, select Upgrade Flyer Firmware.
- 3 In the Open dialog, navigate to the location on your computer where the latest firmware update (Update_x-xx.mhz) is archived. By default, the firmware version released with WinMark is copied to the C:\Program Files\WinMark folder during the WinMark installation.

Note: Flyer 3D firmware files end with a .mhz extension.

- 4 Select the firmware file and click Open to continue with the upgrade; otherwise click Cancel.
- 5 A dialog box displays upgrade progress. Do not attempt to operate the head until it has rebooted!
- 6 After Flyer 3D Head reboots, the Status LED becomes solid green to indicate the head is operational again.

Technical Reference

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, WinMark Pro Laser Marking Software contains a 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 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 the figure below.

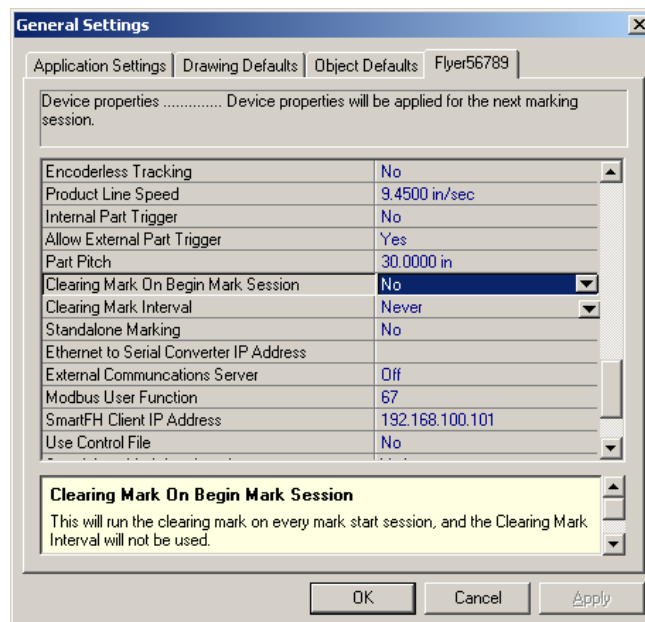


Figure 6-17 Clearing Mark properties.

Technical Reference

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 the figure below.

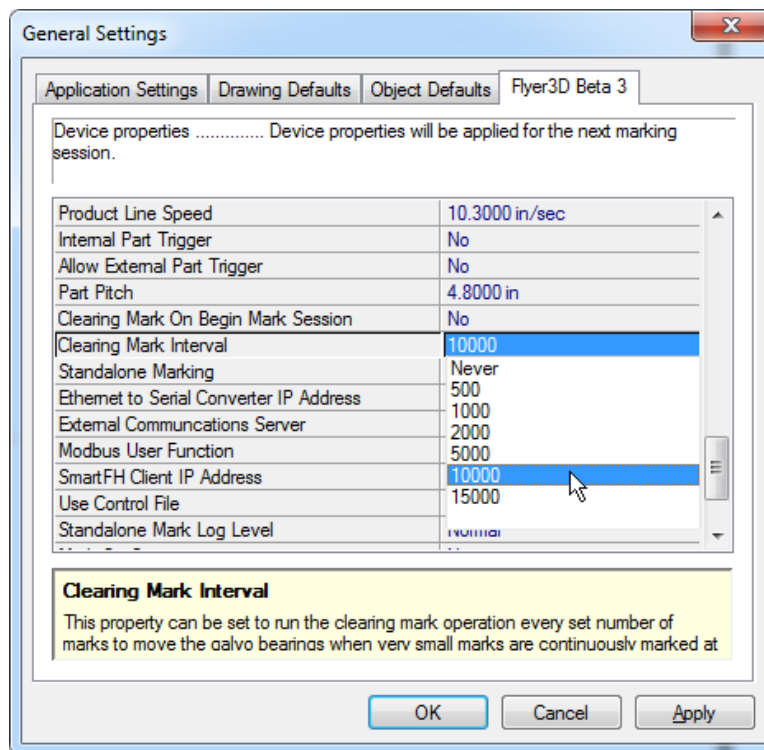


Figure 6-18 Clearing Mark Interval.

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 property is disabled in Tracking mode.

Technical Reference

Over Temp Warning

In addition to monitoring Flyer 3D Head temperature visually using WinMark Pro, Flyer marking heads have the ability to generate an output signal when the head reaches a preset temperature limit.

You can monitor Flyer 3D 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 3D Head is operating. Flyer 3D Head 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 3D Head. Marking is not enabled again until ambient CPU air temperature drops below 60 °C. When enabled, Flyer 3D Head'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 personnel 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 Flyer 3D Head's over-temperature warning output, perform the following steps:

- 1 In WinMark Pro, click the Tools menu, click General Settings, and then click the Flyer 3D 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 Flyer 3D Head outputs.

Technical Reference

Specifications

Table 6-12 Flyer 3D Head specifications.

Flyer 3D Marking Head Parameters*

Mark Field Specifications

Field Size Range, mm⁽¹⁾ 269 mm × 227 mm to 1084 mm × 993 mm

Spot Size Range, M² = 1.0, μm^(1,2) 165 μm to 750 μm

Spot Size Range, M² = 1.2, μm^(1,2) 181 μm to 822 μm

Working Distance Range, mm⁽¹⁾ 268 mm to 1320 mm

Marking Speed, mm/sec 7620 mm/sec (300"/s)

Resolution Specifications

Position Resolution, % 0.002% of minimum mark field dimension

Settling Time, μs <560 μs

Optical Specifications

Input Beam Power, continuous, W 500 W

Input Beam Wavelength, μm 10.2 μm – 10.8 μm

Input Specifications

Input Voltage, V 48 VDC ±0.5 V

Input Current, A 6.7 A, 20 A peak

Heat Load, W 320 W nominal, 400 W max.

Environmental Specifications

Operating Temperature Range, °C 0 °C to 40 °C

Humidity Range, % 0% – 95%, non-condensing

Physical Specifications⁽³⁾

-01/-03 Head

-02 Head

Length, mm (in) 557.7 mm (21.96 in.) 579.7 mm (22.82 in.)

Width, mm (in) 190.6 mm (7.51 in.) 190.6 mm (7.51 in.)

Height, mm (in) 218.8 mm (8.62 in.) 280.5 mm (11.05 in.)

Weight, kg (lb) 9.7 kg (21.45 lbs) 9.7 kg (21.45 lbs)

* Specifications subject to change without notice.

1 See Table 6-1 for a complete list of values.

2 Calculated at 1/e²; center of mark field. Spot size may increase up to 10% at far edges of mark field.

3 -01 is standard mount with air-cooled aperture; -02 is p100 mount with water-cooled aperture; -03 is standard mount with water-cooled aperture.

Technical Reference

Flyer 3D Outline Drawings

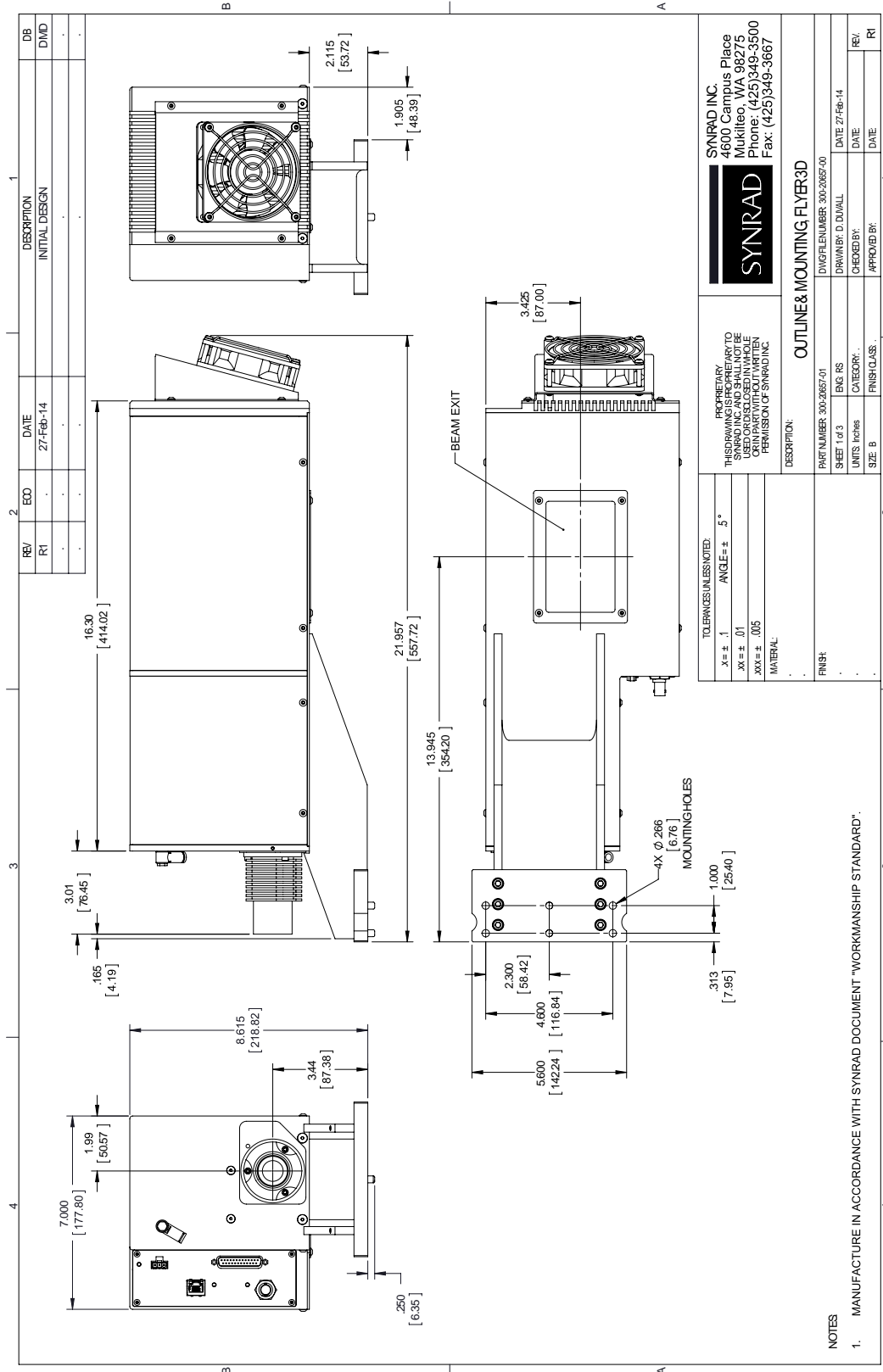


Figure 6-19 Flyer 3D Head outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

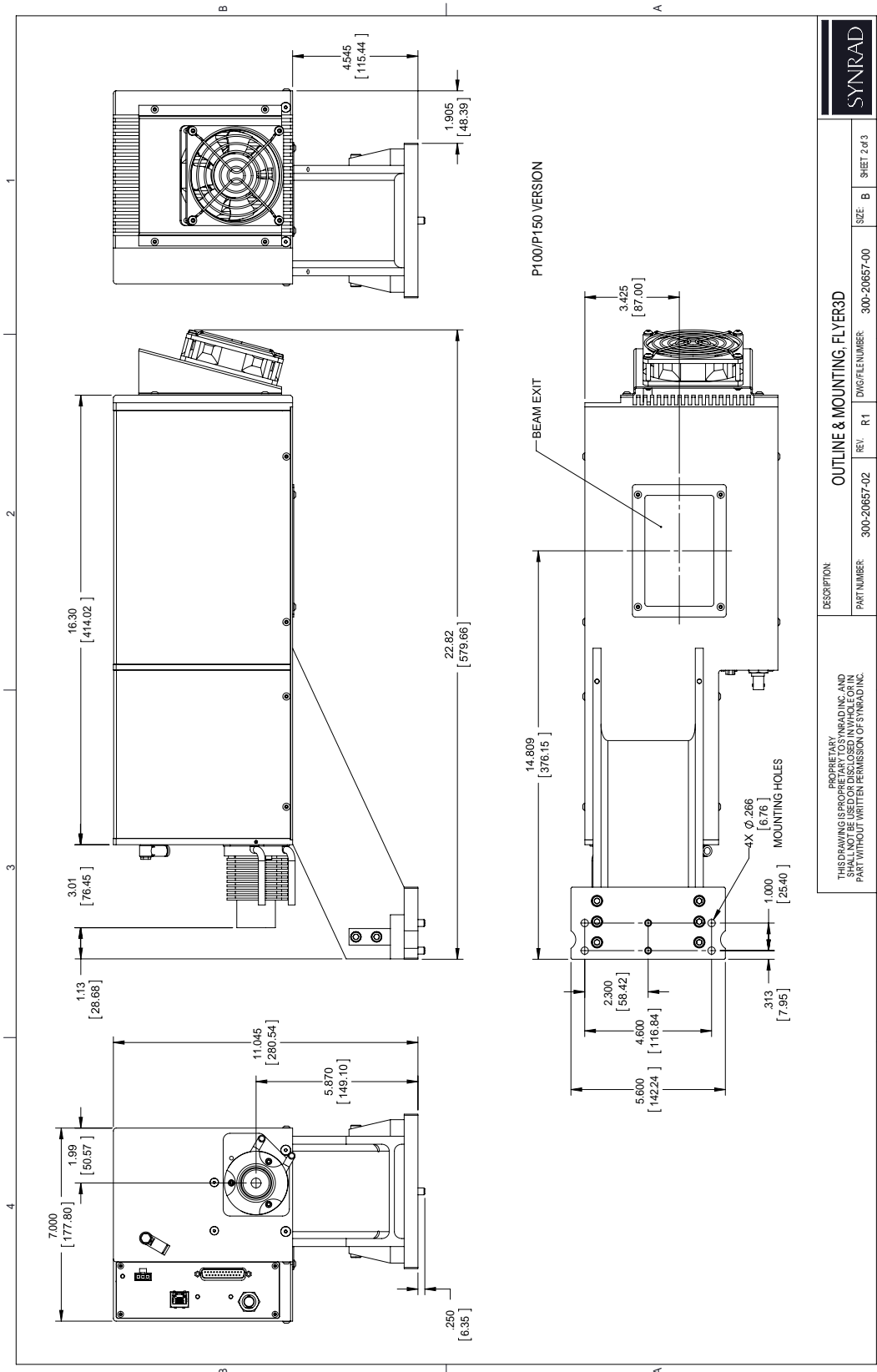


Figure 6-20 Flyer 3D Head outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

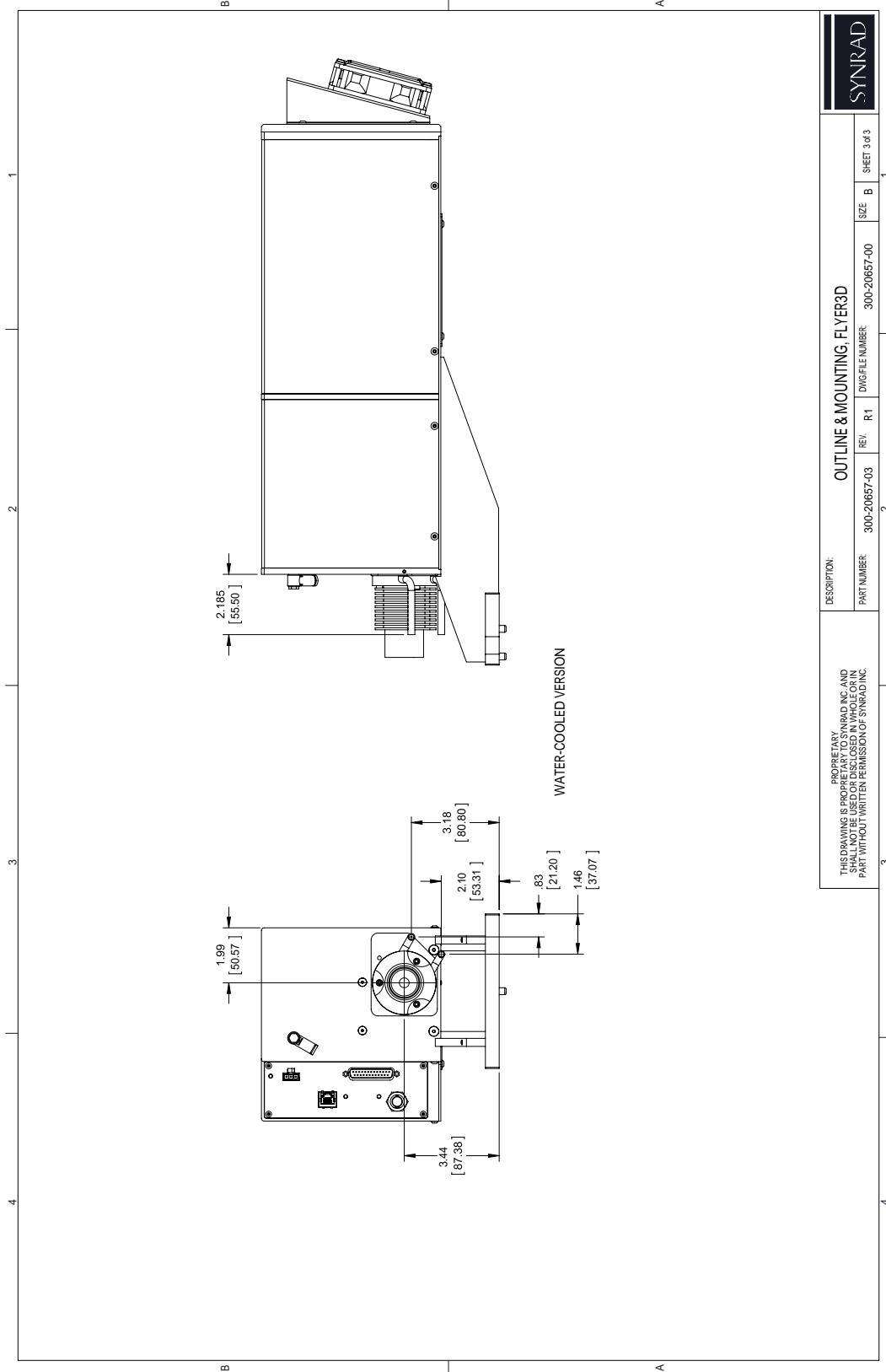


Figure 6-21 Flyer 3D Head outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

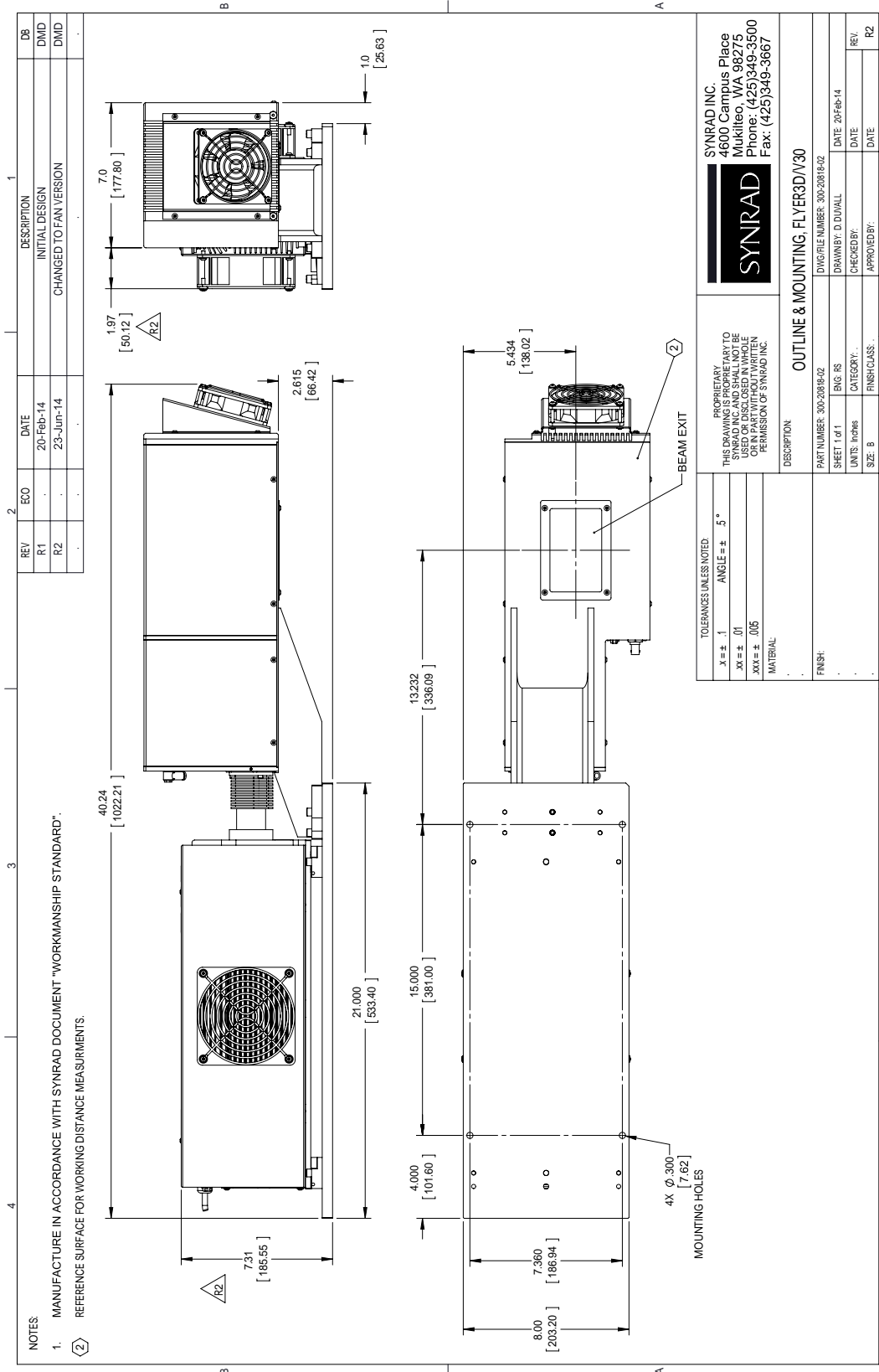


Figure 6-22 Flyer 3D Head v30 fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

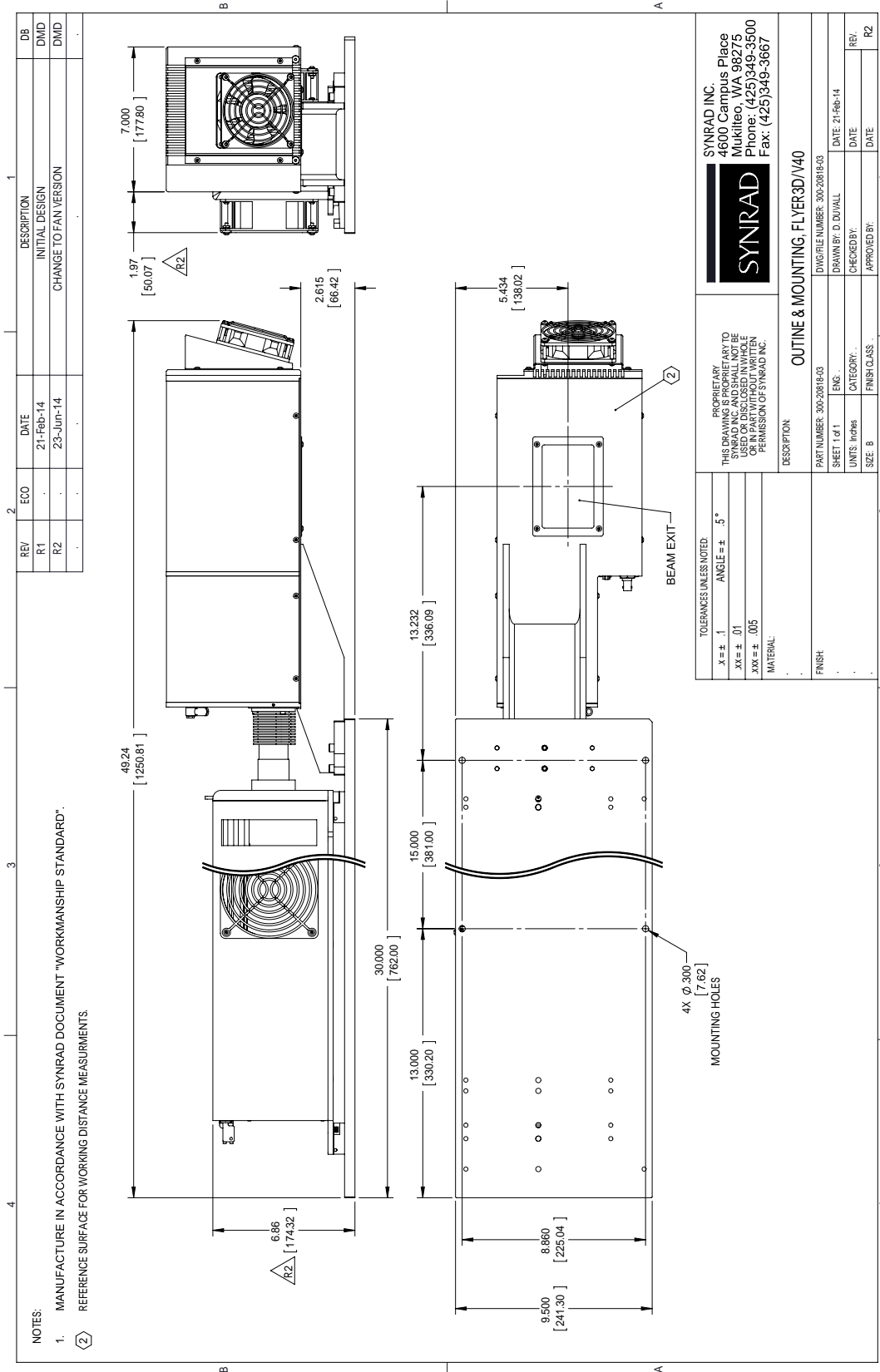


Figure 6-23 Flyer 3D Head v40 fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

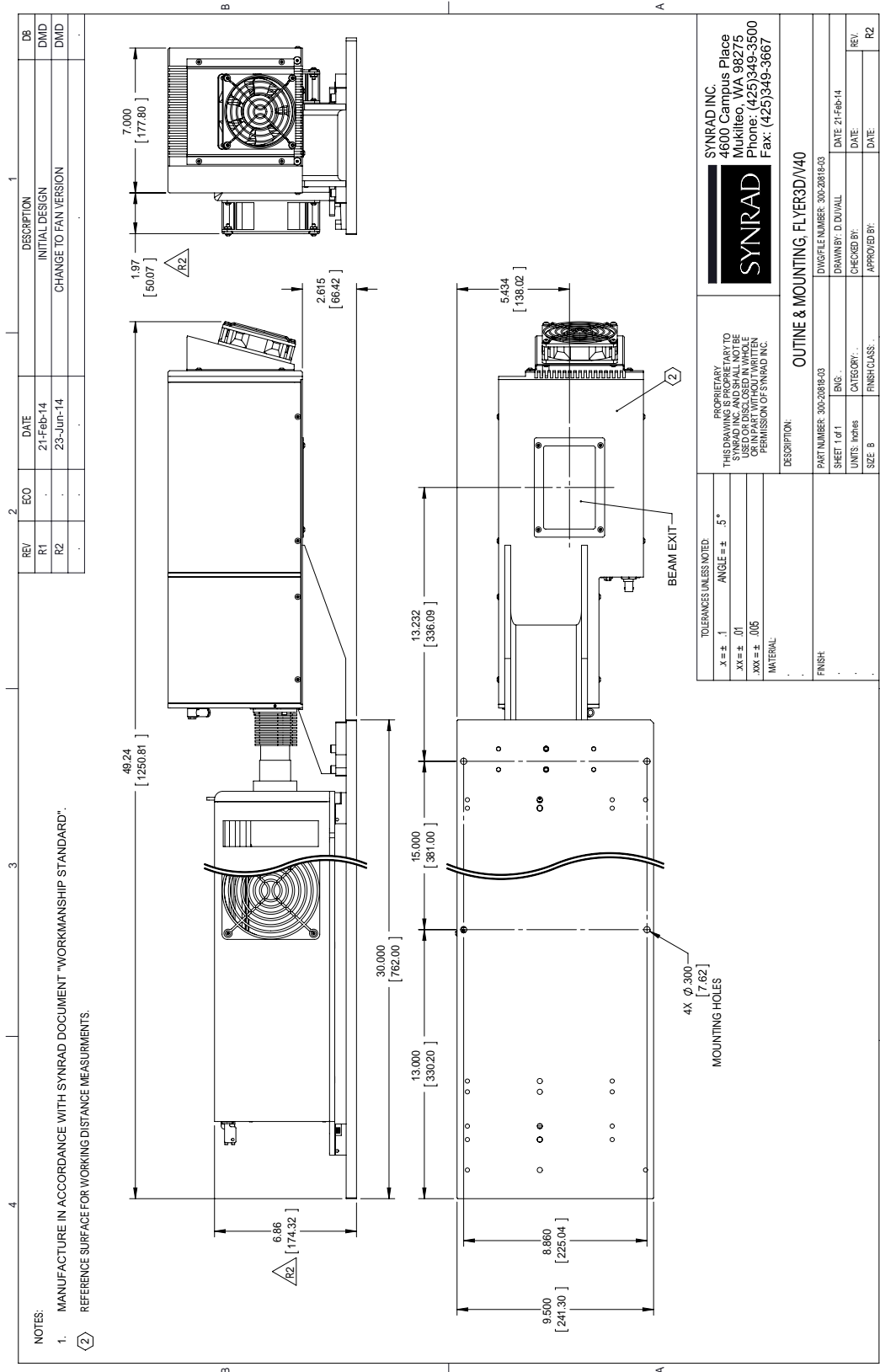


Figure 6-24 Flyer 3D Head v40 fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

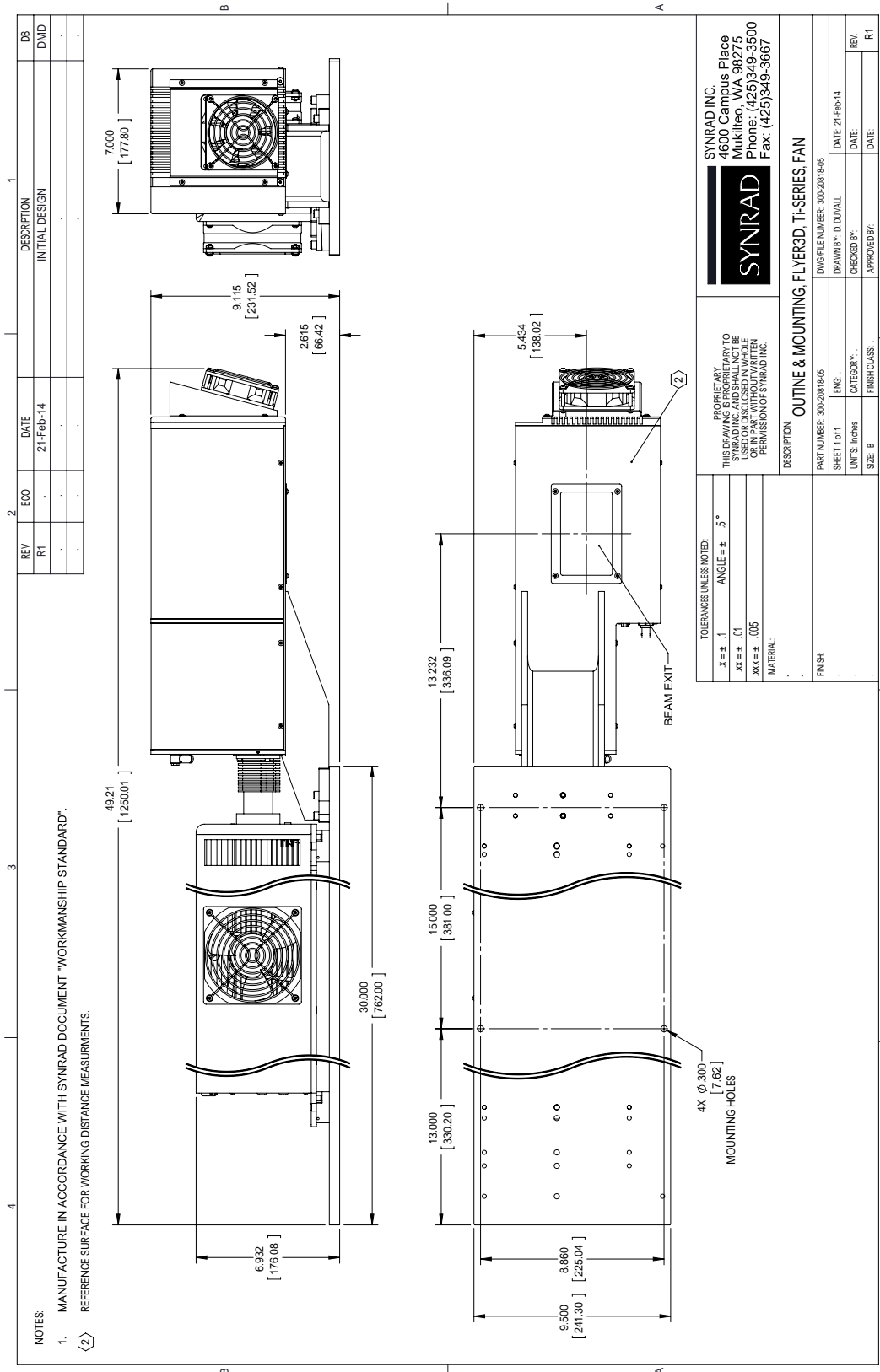


Figure 6-25 Flyer 3D Head ti-Series fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

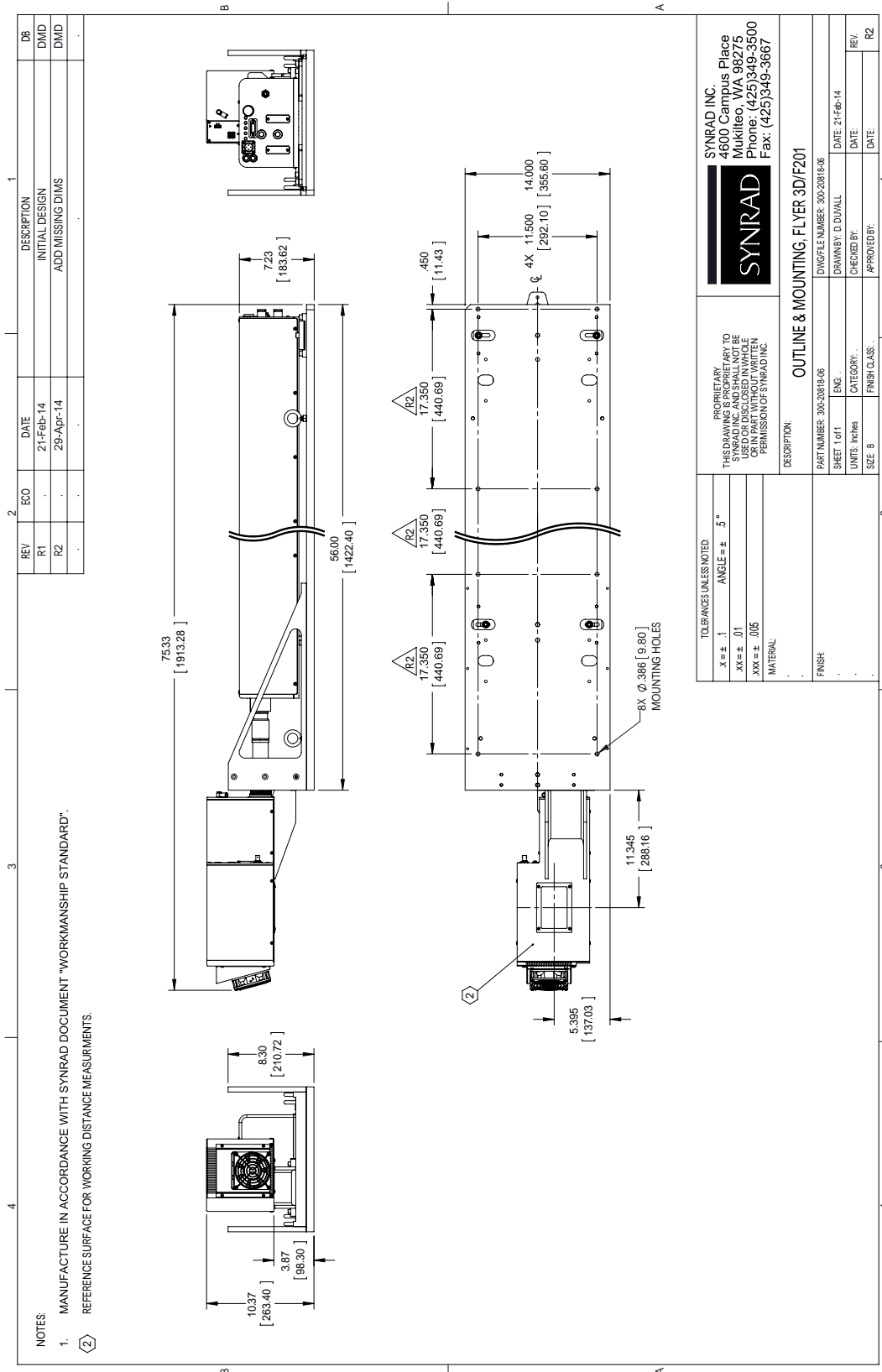


Figure 6-26 Flyer 3D Head f201 fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

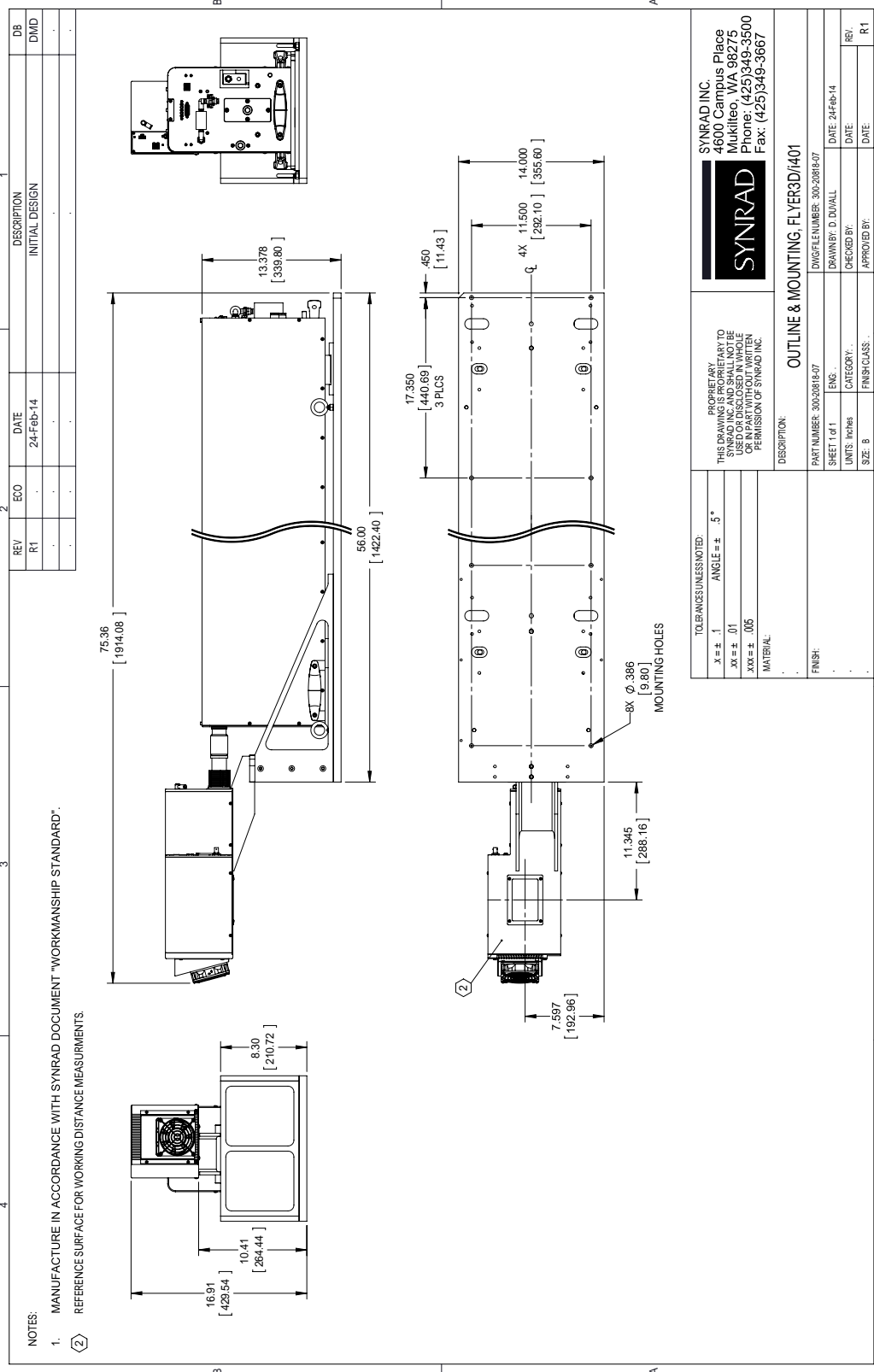


Figure 6-27 Flyer 3D Head i401 outline and mounting dimensions.

Technical Reference

Flyer 3D Outline Drawings

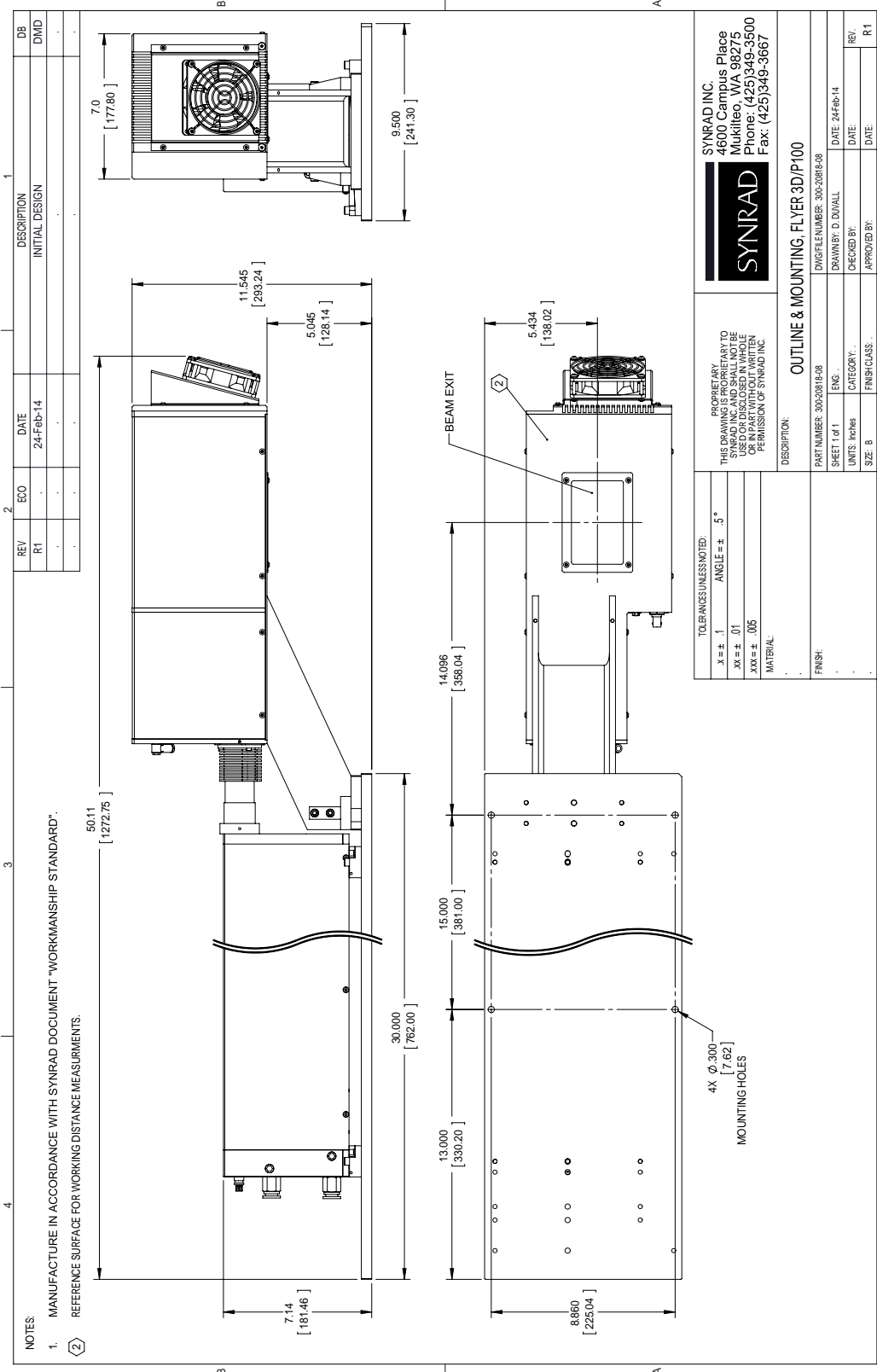


Figure 6-28 Flyer 3D Head p100 fan-cooled outline and mounting dimensions.

Flyer 3D Outline Drawings

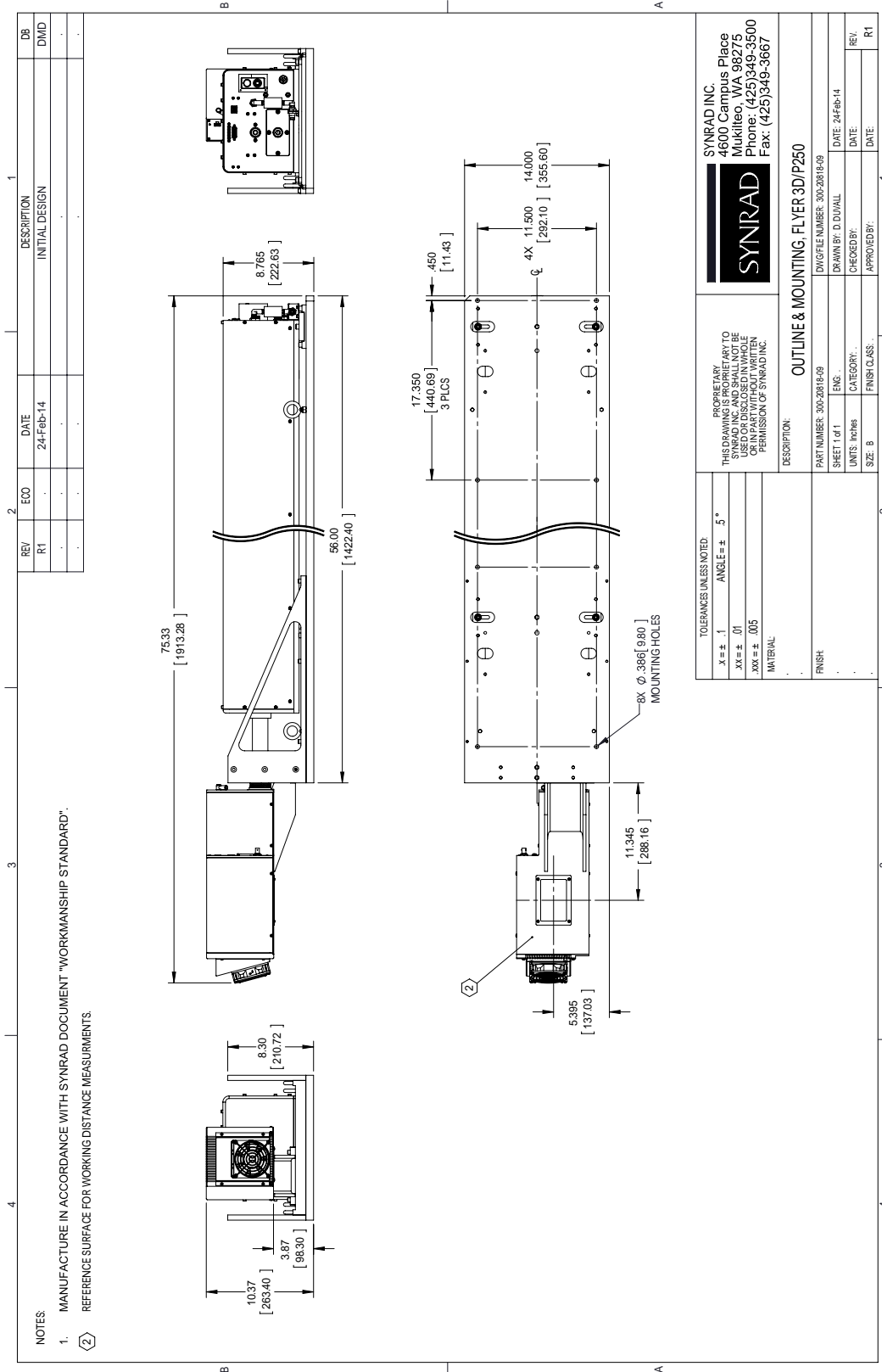


Figure 6-29 Flyer 3D Head p250 fan-cooled outline and mounting dimensions.

Technical Reference

Flyer 3D Package Instructions

Packaging

The following figure depicts the Flyer 3D Marking Head packaging. Save the packaging it was specifically designed to prevent damage.



Handle the Flyer 3D Marking Head to/from the shipping box as shown here.



Don't forget the components stow conveniently under the marking head.



Place the Flyer 3D Marking Head on a flat surface to remove the protective foam packaging.

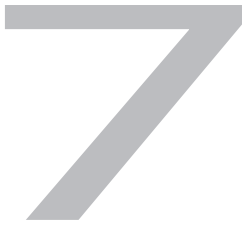


Seat/unseat the Flyer 3D Marking Head when packaging/un-packaging.

Figure 6-30 Flyer 3D Head packaging instructions.

Maintenance/ Troubleshooting

Maintenance



Use information in this chapter to perform maintenance and troubleshooting on the Flyer 3D Head.

This chapter contains the following information:

- Maintenance – explains typical maintenance procedures for the Flyer 3D Head.
- Troubleshooting – describes how to troubleshoot common Flyer 3D Head problems.

Maintenance/ Troubleshooting

Maintenance

The Maintenance section includes subsections:

- Daily inspections.
- Storage/shipping.
- Output window removal/replacement.
- Cleaning input expander/output window optics.

Daily inspections

Perform the following steps daily to keep your Flyer 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 Flyer head. Close the laser's shutter if it is equipped with one.
- 2 Visually inspect exterior surfaces of optical components for contamination. If required, follow the cleaning instructions in the Cleaning optics section.
- 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 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.

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



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

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, or the optics manufacturer for handling instructions.

Maintenance/ Troubleshooting

Maintenance

Storage/shipping

When preparing an Flyer 3D head for storage or shipping, place dust caps over expander telescope and seal the output aperture. If possible, repackage the head in its original SYNRAD shipping container to lessen the chance of damage.

Output window removal/replacement

The 3 mm-thick zinc selenide (ZnSe) output window protects internal optics from processing and environmental dirt, dust, fumes, and vapors. The use of the output window also increases the effectiveness of Flyer 3D's gas purge system.

If it becomes necessary to replace the output window, perform the following steps:

- 1 Shut off and lock out all power to the laser and marking head. You must verify the laser is OFF before proceeding with the output window replacement!
- 2 While holding the output window in place, remove the four 6-32 \times 1/4" button head Allen screws securing the window frame and window to Flyer 3D's bottom panel as shown in the figure below.

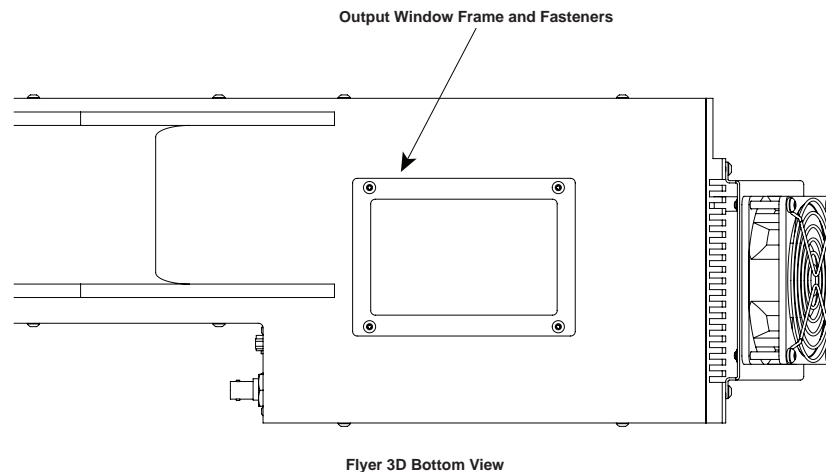


Figure 7-1 Output window mounting screw locations.

- 3 Carefully pull the window frame and output window away from the marking head. If the output window is damaged or unusable, place it in a sealed plastic bag and properly dispose of as hazardous waste. Save the window frame for reuse when installing the replacement output window.

Maintenance/ Troubleshooting

Maintenance

- 4 To replace the output window, position the it over the output aperture in Flyer 3D's bottom plate.
- 5 While holding it in position, place the window frame over the window, then insert and loosely fasten the four 6–32 × 1/4" button head screws.
- 6 Carefully tighten the four screws snugly, but do not overtighten.

Cleaning input expander/output window optics

Debris or contaminants on the input beam expander or protective output window optics may affect laser processing quality or damage these optics. In particular, the input expander can fail catastrophically due to excessive power absorption if it suffers physical damage or it coated with processing or environmental debris or vapors.

Important Note: To not attempt to clean the galvanometer mirrors inside the Flyer 3D head! The mirrors surfaces are easily scratched while excessive force may cause mirror breakage or galvanometer damage.

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 the table below are available and that each step is completely understood.

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
Latex gloves or finger cots	Powder free
Air bulb	Clean air bulb
Ethyl or isopropyl alcohol	Spectroscopic or reagent grade
Acetone	Spectroscopic or reagent grade
Distilled white vinegar	6% acetic acid content
Lens wipe (preferred)	Optical (cleanroom) quality
Cotton balls or cotton swabs	High-quality surgical cotton/high-quality paper-bodied

Maintenance/ Troubleshooting

Maintenance

Optic cleaning guidelines

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

- Wear latex gloves or finger cots (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 Safety Data Sheets (SDS) and observe all necessary safety precautions.

Optics cleaning procedure

To remove dust, oily residues, and plastics buildup that have adhered to the surface of the input beam expander and/or output window, 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 It is not necessary to remove the input beam expander or output window; both components can be cleaned in place.

Warning Serious personal injury



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.

Maintenance/ Troubleshooting

Maintenance

- 3 Remove loose contaminants from the optical surface by holding a clean air bulb at an angle to the optic and blow a stream of air at a glancing angle across the optical surface. Repeat as necessary.
- 4 Refer to the table below and select the appropriate cleaning solvent based on the type of contamination that exists on the surface of the optic.

Table 7-2 Cleaning solvent selection.

Solvent Type	Classification	Application
Ethyl or isopropyl alcohol	Least aggressive	Smudges, fingerprints
Acetone	Moderately aggressive	Oily residues
Distilled white vinegar (6%)	Most aggressive	Baked-on debris

- 5 Dampen a lens wipe with the selected cleaning agent. When cleaning the small diameter input expander optic, use a fluffed cotton swab instead.

Note: If distilled vinegar is used as the cleaning solvent, a second follow-up cleaning of the optic using acetone is required to remove any vinegar residue to prevent coating damage. Then, follow the acetone with a final cleaning using alcohol.

- 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. Carefully drag the wipe or swab without applying any downward pressure.

Important Note: Use a clean lens wipe or swab on each pass. The wipe, or swab, will pick up and carry surface contaminants that may scratch optical surfaces or coatings.

To prevent streaking during the final alcohol cleaning, lightly drag the lens wipe or swab slowly across the surface so that the cleaning liquid evaporates right behind the wipe.

The goal is to eliminate any trace of contaminants or cleaning solution. Any residue left on the optical surface can potentially cause localized heating that may lead to optics damage up to and including catastrophic optics failure.

- 7 It may be impossible to remove all traces of contaminants from the lens surface especially near the edges of small diameter mounted optics (like the input beam expander). 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.

Maintenance/ Troubleshooting

Maintenance

- 9 Repeat Steps 5 through 8 as required, removing all possible contaminants and deposits. Be sure the final cleaning pass is made using alcohol.
- 10 Verify that all traces of cleaning solution have evaporated from the optical surface and that no traces of cleaning residue remain. **Laser Control LED**

The Laser Control LED illuminates green when PWM Command signal pulses are being sent from the Flyer 3D Head to the laser. This provides a visual indication that a mark is in progress and the laser is being commanded to fire.

Laser Control LED

The Laser Control LED illuminates green when PWM Command signal pulses are being sent from the Flyer 3D head to the laser. This provides a visual indication that a mark is in progress and the laser is being commanded to fire.

Ethernet LEDs

Ethernet LEDs (located in the lower corners of the RJ45 Ethernet connector) indicate the following Ethernet status (see the table below).

Table 7-3 Laser status control LED indications.

Status LED State	Operational Status of Flyer 3D
Off	No power applied (or failure of control electronics).
During Boot-Up:	
Green– Slow Blink (2 Hz)	Boot sequence is proceeding normally (allow 25–30 seconds).
Red– Slow Blink (2 Hz)	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)	A mark session is 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.

Maintenance/ Troubleshooting

Troubleshooting

Table 7-4 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

Flyer 3D marking head

Symptom:

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

Possible Causes:

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

Ensure that the proper DC power (+48 VDC \pm 0.5 V @ 8 A nominal, 20 A peak) is available under full-load conditions.

Symptom:

- Flyer 3D Head exhibits a high-frequency hiss after boot-up when the Status LED turns solid green.

Possible Causes:

- This is normal operation for Flyer 3D marking heads.

After boot-up, when the optical scanners are activated, you may hear a high-frequency hiss from the head. This hiss is a normal result of sampling noise inherent in Flyer 3D Head's DSP-based servo loop.

Symptom:

- Power (+48 VDC) has just been applied to the head, the Power 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 3D Head's OS or flash memory is corrupted.

Maintenance/ Troubleshooting

Troubleshooting

A fault exists that prevents Flyer 3D Head's Operating System (OS) from booting. This fault condition may be field repairable. Contact SYNRAD Technical Support for instructions on how to proceed.

Symptom:

- Power (+48 VDC) has just been applied to the head, the Power LED is green, but the Status indicator is blinking red at a slow (2 Hz) rate.

Possible Causes:

- Flyer 3D Head 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 Power 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 3D Head's OS has completed an alternate boot sequence.

A fault exists that prevents Flyer 3D Head'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 3D Head boots up normally (Power LED is solid green), but after the servos are initialized, the Status LED begins flashing green at a fast (10 Hz) rate. The Laser Control LED may be off or may flash periodically.

Possible Causes:

- A flashing green Status LED indicates a mark session is in progress because the Mark On Startup property is enabled. The Laser Control LED will flash green whenever PWM Command signals are sent to the laser to initiate lasing as allowed by mark file automation.

Allow the mark session to continue or halt the mark session as required. To force the mark session to end, access the Flyer web page and click the MarkOnStartup link. When the property value changes from 'Yes' to 'No', close the web page and reboot the Flyer 3D marking head.

Maintenance/ Troubleshooting

Troubleshooting

Symptom:

- The Status indicator begins flashing red at a fast (10 Hz) rate and the laser does not fire when a mark is commanded.

Possible Causes:

- The Fast Acting Safety Interlock (FASI) feature is enabled; however, a high level (5 V–24 VDC) signal was not detected on input IN3.

Connect a 5–24 VDC signal to input IN3 as described in the Input/Output circuitry section in the Technical Reference chapter.

Symptom:

- Flyer 3D Head booted up normally (Power 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 3D Head 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.

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:

- The Status indicator turns red when a mark is commanded.
- If the Status LED turns solid red when a mark is attempted, a servo (optical scanner) fault may have occurred.

Remove power, wait 30 seconds, and reapply power. If the fault re-occurs, contact SYNRAD Technical Support.

Symptom:

- Flyer 3D Head boots up normally (Power 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 3D Head's control circuitry detected a fault in the optical scanner system.

Maintenance/ Troubleshooting

Troubleshooting

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 and there is no Ethernet communication with the head (the Mark button is grayed out).

Possible Causes:

- If the Status LED is solid red, not blinking, 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 # 5 on switch bank S1 was not switched back to the OFF position.

Refer back to Service Bulletin #08, Reprogramming FH Flyer Marking Heads and Fenix Flyer Laser Markers, and complete or restart the reprogramming procedure. If the fault re-occurs, contact SYNRAD Technical Support.

Symptom:

- No marks or very light marks appear on the part or the mark is not to scale.

Possible Causes:

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

Locate the Final Test Report shipped with your Flyer 3D head to determine the actual working distance. Refer back to Figure 1-16, Working distance measurement, in the Introduction chapter and then measure working distance from the bottom panel of the Flyer 3D Head 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 correct working distance.

Symptom:

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

Possible Causes:

- The protective output window has become coated with marking debris or vapor.

Carefully inspect and clean the output window as described in Cleaning optics section earlier

Maintenance/ Troubleshooting

Troubleshooting

in this chapter. Replace the output window if necessary.

Symptom:

- Power and Status indicators on the marking head are illuminated green and the Laser Control LED flashes; however, no mark is made when marking is commanded through WinMark Pro.

Possible Causes:

- The laser is not enabled.

Check that the laser's Ready light is illuminated. On Series 48 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 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 Flyer 3D Head marking head.

Refer to the connection section in the quick start guide for information on connecting the Laser Control cable between Flyer 3D Head's and your particular laser.

Symptom:

- Flyer 3D Head is not marking properly or there are indications of operational faults within the head.

Possible Causes:

- Flyer 3D Head has, or is experiencing, one or more fault or error conditions.

Before contacting SYNRAD Technical Support, download and review Flyer 3D Head's Error Logs. To do this, go to the Tools menu in WinMark Pro, highlight Get Flyer 3D 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 3D Head's operation.

Symptom:

- Power was applied to the head, the Power 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.

Communications

Maintenance/ Troubleshooting

Troubleshooting

Symptom:

- ☐ WinMark Pro opens in “Device Simulation” mode.

Possible Causes:

- ☐ Flyer 3D Head’s Ethernet port is disconnected.

Verify the correct type of Ethernet cable (crossover or straight-through) is connected, depending on your application. See the technical reference chapter and the Quick Start Guide located on our website.

- ☐ Flyer 3D Head’s IP address was changed.

In the Device Simulation dialog, click ‘Enter IP Address for Flyer Head’ and enter a valid IP address in the text box (the last connected IP address appears in the drop-down list). If the IP address is unknown, see Ethernet configuration in the technical reference chapter for information on resetting Flyer 3D Head’s IP address.

- ☐ The Flyer 3D Head is unavailable (already connected to another instance of WinMark Pro).

The Flyer 3D Head will not respond if it is already connected to another WinMark application like WinMark Launcher or Digital Scope, a .NET form control, or an ActiveX control.

Symptom:

- ☐ The Flyer 3D Head name is grayed-out on the Mark button.

Possible Causes:

- ☐ Flyer 3D Head’s Ethernet port is disconnected or the head is unavailable (already connected to another instance of WinMark Pro).

Create an Ethernet connection between Flyer 3D Head and your computer or close any other open WinMark applications.

Stand-alone mode

Symptom:

- ☐ Flyer 3D Head is waiting for an input during a Stand-alone mark session. Power and Status indicators are illuminated green, but the head will not connect and communicate to WinMark Pro through the Ethernet connection.

Possible Causes:

- ☐ Flyer 3D Head will not connect to the Ethernet port while waiting for an input during a Stand-alone mark session.

Maintenance/ Troubleshooting

Troubleshooting

Disconnect power from the head and then create an Ethernet connection between Flyer 3D Head 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.

Symptom:

- ☐ An error occurs when WinMark Pro, a .NET or ActiveX application, or a Flyer 3D Head (in Stand-alone mode) tries to open an .MKH or .TXT file.

Possible Causes:

- ☐ When mark (.MKH) or text (.TXT) files are stored in the Flyer Filestore, on a Windows® marking computer, or on a network share, the format of the path to this file differs depending on whether the file will be accessed by a Windows operating system or by the Flyer 3D Head (using a Linux OS).

To access files using WinMark Pro or a custom .NET or ActiveX application running on a Windows computer, pathnames must be written using a backslash (\) character. For example, \MarkFile1.mkh or C:\MarkFileFolder\TextFile.txt.

To access files within the Flyer Filestore or on a network share using a Flyer 3D Head in Stand-alone mode, pathnames must be written using a forward slash (/) character. For example, /MarkFile1.mkh or /network/MarkFileFolder/TextFile.txt.

Tracking mode

Symptom:

- ☐ Flyer 3D Head does not track moving parts.

Possible Causes:

- ☐ Tracking is not enabled.

In WinMark Pro v7, check that Track Marking Object (on the Drawing object's Marking tab) is Yes.

- ☐ Encoder pulses are not being read by the Flyer head.

Close WinMark Pro and open Digital Scope (DigScope.exe). Rotate the 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 Flyer head.

Close WinMark Pro and open Digital Scope (DigScope.exe). Trigger the part sensor and verify

Maintenance/ Troubleshooting

Troubleshooting

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 Flyer 3D tab under Tools / General Settings....

- ☐ A physical part sensor is not installed.

Enable the Internal Part Trigger property (on the Flyer 3D tab under Tools / General Settings...) and then enter a Part Pitch value.

- ☐ A position encoder is not installed.

Enable Encoderless Tracking (on the Flyer 3D 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.

- ☐ 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.

Maintenance/ Troubleshooting

Troubleshooting

- The Product Line Speed value is set improperly.

If Encoderless Tracking is specified, check that Product Line Speed (on the Flyer 3D 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 Flyer 3D tab under Tools / General Settings...). WinMark Pro v7 and Flyer support Motion Vector values in 0.01° increments.

Indicator LEDs

Flyer 3D 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 head.

Power LED

The Power LED illuminates green when +48 VDC is applied to the Power connector.

Status LED

The Status LED can indicate several different operational states as described in the following table.

Automation I/O

Symptom:

- Flyer 3D Head is not responding to automation inputs or the automation controller is not "seeing" Flyer 3D Head outputs.

Possible Causes:

- I/O voltage levels are incorrect.

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.

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

Maintenance/ Troubleshooting

Troubleshooting

Double-check field wiring to ensure that I/O 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.

Use Digital Scope (DigScope.exe), shown in the figure below, to verify proper I/O functionality between 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.

Maintenance/ Troubleshooting

Troubleshooting

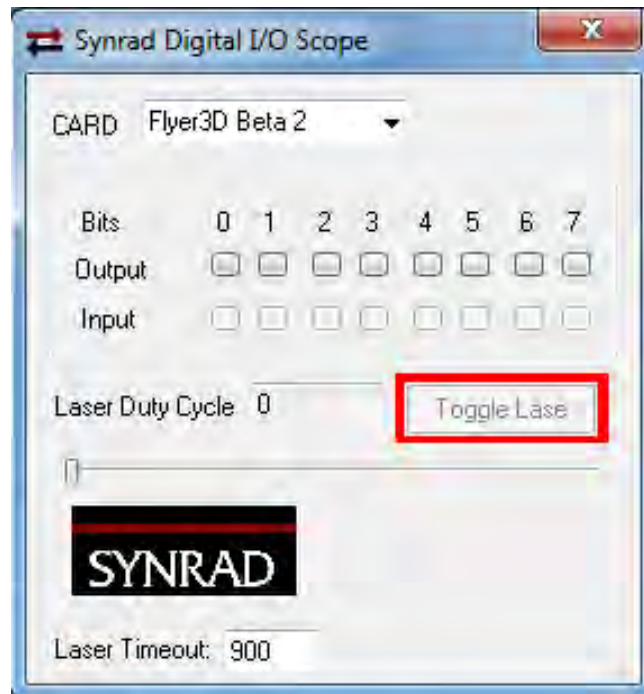


Figure 7-2 Digital Scope window

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.

Appendix A



This appendix contains the following information:

- Power measurements – describes how to measure laser output power through a Flyer 3D head.

Appendix A

Power measurements

The Power measurements section includes subsections:

- Setup
- Input measurements
- Output measurements

This Appendix describes how to measure laser power through the Flyer 3D head using a SYNRAD Power Wizard® power meter. Use this procedure to verify Flyer 3D head is properly aligned to the laser 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 **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 Flyer 3D head for power measurements, perform the following steps to ensure the optical scanners are centered in the mark field. Be sure power is first removed from both laser and Flyer 3D head.

- 1 Place a beam block on the marking surface in the center of the mark field. This prevents the beam from traveling beyond the work area during power measurements.
- 2 Remove any Beam Enclosure Tube or shielding from between Flyer 3D Head and the laser.
- 3 Power up the laser and Flyer 3D head. On power-up, before marking begins, the optical scanner mirrors are centered in the mark field.
- 4 Open the Digital Scope executable (DigScope.exe) and verify you are connected to Flyer 3D Head.

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 all components are properly aligned to the beam path.

Appendix A

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.

Note: A precision aperture ring inside Flyer 3D Head's input aperture housing is designed to clip all energy outside of the expanded beam's $1/e^2$ point (to eliminate excessive laser energy (heat) that adds no value—processing speed or quality—to the laser manufacturing process. Because of the aperture, you will see a power loss of approximately 10 – 20% through the Flyer 3D head.

Warning Serious personal injury



This product emits invisible infrared laser radiation from a Class 4 laser in the 10.6 μm CO₂ wavelength band and emits visible laser radiation from a Class 3R laser in the 630–680 nm 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. CO₂ lasers emit an invisible beam that is capable of seriously burning human tissue.

Power measurements

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 in the Laser Duty Cycle box to set the desired power percentage.
- 3 Ensure that all personnel are clear of the beam path and then press the Toggle Lase button.

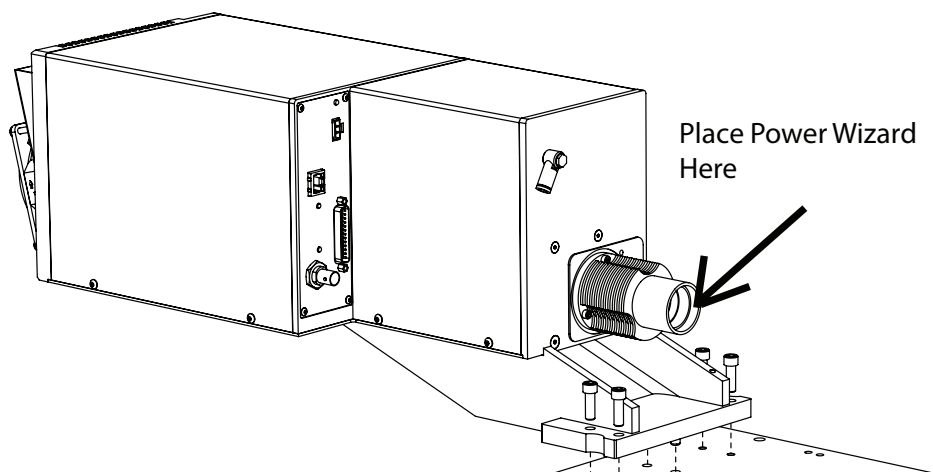


Figure A-1 Input aperture location.

Appendix A

- 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 3D Head's input aperture. See the figure above.
- 7 Keep the 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.
- 10 Release the Reset button and quickly verify that the display reads 0.0 W (± 0.3 W).
- 11 Immediately place the Power Wizard's target area in the center of the output aperture's beam path.

Hold the Power Wizard approximately one-half the distance between the bottom of the output aperture and the mark surface to ensure that the Power Wizard is in the path of a unfocused beam.
- 12 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.
- 13 Press Toggle Lase to turn off the laser.
- 14 Repeat Steps 3 through 8 two or three times to get a good average output power reading.

If power loss through the Flyer 3D Head exceeds 10 – 20%, remove the protective output window and take another set of output power measurements. Excessive power loss through the output window may indicate that the window is dirty. Inspect it for contaminants and, if required, carefully clean the window as described in Cleaning optics section in the Maintenance/Troubleshooting chapter.

If the Flyer 3D marking head is mounted in a non-standard configuration (without using a SYNRAD designed Mounting Rail), verify that alignment to the laser is correct.

Appendix B

B

The Flyer 3D Head properties section includes subsections:

- Flyer 3D Head properties- Lists Flyer 3D Head property categories and describes each specific Flyer 3D Head property in detail.

Appendix B

Flyer 3D Head Properties

The Flyer 3D Head properties section includes subsections:

- Interface properties
- Set-up properties
- Tracking properties
- Maintenance properties
- Stand-alone properties
- I/O measurements

The properties listed in this Appendix are specific to each individual Flyer 3D Head and control how it connects to your factory network, how it is set-up for Tracking or Stand-alone marking, even how it is maintained. To access these properties, open WinMark Pro Laser Marking Software, v7.0 or higher and click Tools/General Setting. In the General Settings dialog, click the Flyer 3D (Flyer) tab and review or modify properties as required for the application.

Interface properties

Interface properties on the Flyer tab (Figure B-1) include head-specific version information as well as Ethernet communication parameters.

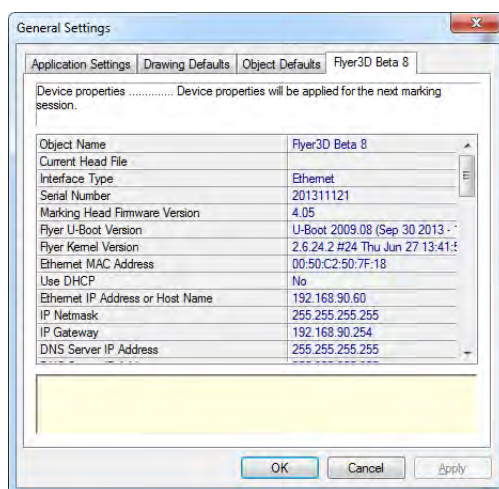


Figure B-1 Flyer tab – Interface properties.

Object Name

Enter a reference name for the device. This name is primarily used when referring to the head in a .NET or ActiveX application. The factory default name is "Flyer3Dxxxxx"; where xxxxx are the last five digits of the head's unique serial number. The Object Name will always appear as the title of the Flyer tab.

Appendix B

Flyer 3D Head Properties

Current Head File

This property displays the path and filename of the file currently loaded into Flyer 3D Head's RAM.

Interface Type

This read-only property indicates the interface method used to communicate with the currently active marking head. In "demo" mode, the Interface Type is None.

Serial Number

This read-only property provides the nine-digit serial number of the currently active Flyer 3D Head.

Marking Head Firmware Version

This read-only property displays the current firmware version detected in the Flyer 3D Head.

Flyer 3D Head U-Boot Version

This read-only property displays the current version of Flyer 3D Head U-Boot code.

Flyer 3D Head Kernel Version

This read-only property displays the current version of the Flyer 3D Head kernel.

Ethernet MAC Address

This read-only property displays Flyer 3D Head's factory-set Ethernet MAC (Media Access Control) address.

Use DHCP

When set to Yes, Flyer 3D Head will contact the network's DHCP (Dynamic Host Configuration Protocol) Server for IP Address, IP Netmask, IP Gateway, and DNS Server IP addresses. By default, Use DHCP is set to 'No'.

Note: We do not recommend using DHCP. Under the DHCP scheme, Flyer 3D Head's IP address and DNS name will change each time the head is turned off for a time period that exceeds the DHCP lease.

Ethernet IP Address or Host Name

Enter an IP Address for the Flyer 3D Head in the form "xxx.xxx.xxx.xxx". Click the ellipsis to open the pre-formatted Select Ethernet IP Address dialog and enter an Ethernet IP address.

IP Netmask

Enter an IP Netmask address for the associated Ethernet IP Address or Host Name property when Use DHCP is set to 'No'. Click the ellipsis to open the pre-formatted Select Ethernet IP Address dialog and enter an IP netmask address.

Appendix B

Flyer 3D Head Properties

IP Gateway

Enter a IP Gateway address for the gateway used when the Ethernet IP Address or Host Name address resides outside your internal native Ethernet network. Click the ellipsis to open the pre-formatted Select Ethernet IP Address dialog and enter an IP gateway address.

DNS Server IP Address

A DNS Server resolves domain names or hostnames into IP addresses. If required in your application, enter a DNS Server IP Address. There are two property slots allowed for DNS server addresses. Click the ellipsis to open the pre-formatted Select Ethernet IP Address dialog and enter a DNS Server address.

Share Name

When using a network for mark file or font storage, enter the name of the share folder located on the specified server. For example, if the path to the folder is "H:\Mark Files\Flyer Share", enter "Flyer Share" (without the quotes) as the Share Name.

Share Server

Enter the IP address of the desired network server or computer where the share folder is located.

Share Domain

Enter a name for the domain to use to connect to a given server or share.

Share Username

Enter a legitimate user name from the list of users with access to the network share folder.

Share Password

Enter the user's password to gain access to the desired network share.

Share ReadOnly

Set the Share ReadOnly property to 'No' to prevent Flyer 3D Head from writing data to the network share. When set to Yes, Flyer 3D Head is allowed to write to the share.

Network Share Available

This read-only property indicates that Flyer has successfully mounted the network share using the specified share properties.

Appendix B

Flyer 3D Head Properties

Set-up properties

Flyer 3D Head's set-up properties (Figure below) include working distance properties and miscellaneous configuration functions.

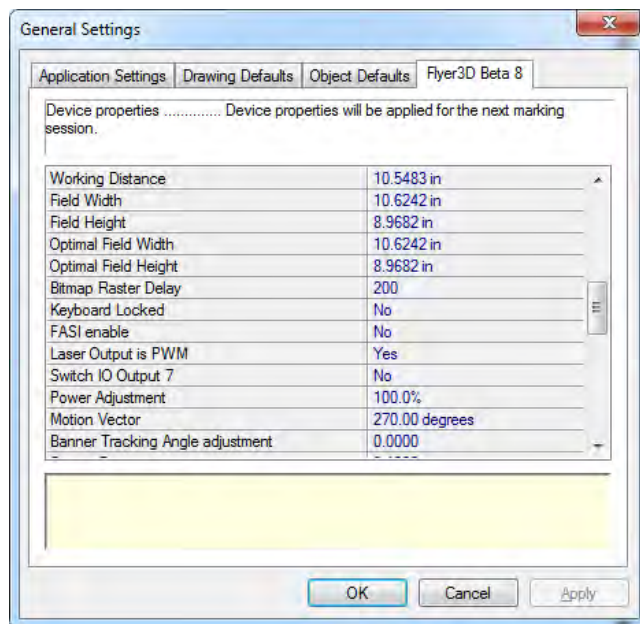


Figure B-2 Flyer tab – Set-up properties.

Working Distance

The Working Distance is the precise distance from the bottom surface of the Flyer 3D Head to the mark surface. At this distance, the exact point of focus is maintained across the corresponding mark field. For optimal marking results, fixture your part precisely at this distance.

The Working Distance property is preset at the factory to match the field size specified when the system is ordered. This property value corresponds to the extents of the allowable mark field as shown by the read-only Field Width/Field Height and Optimal Field Width/Optimal Field Height values.

If the Working Distance property has been changed, consult the Final Test Report shipped with your Flyer 3D Head (or see the working distance figure in the introduction chapter) for the correct Working Distance value.

Field Width

A read-only property showing the maximum field width of the current mark field.

Field Height

A read-only property showing the maximum field height of the current mark field.

Appendix B

Flyer 3D Head Properties

Bitmap Raster Delay

This head-specific delay is used when marking grayscale images or when Bitmap Scan Type is set to Continuous. This delay compensates for the time required for the galvanometer mirrors to reach the commanded coordinates for each raster line. Adjust this value as required to eliminate any minute offset of the image from its intended mark coordinates.

FASI Enable

This read-only property displays the status of Flyer 3D Head's Fast Acting Safety Interlock (FASI) setting, which is controlled by an internal DIP switch in the head. When FASI is enabled, the laser will not fire unless an active high signal (5 V–24 VDC) is present on input IN3.

Laser Output is PWM

This read-only property displays the status of Flyer 3D Head's PWM/Gate setting, which is controlled by an internal DIP switch in the head. For proper marking operation, "PWM" is the correct setting. In "Gate" mode, laser output is simply switched on or off at 100% duty cycle (100% power output); there is no output power control.

Switch IO Output 7

On Flyer 3D Head's, you can configure output OUT7 in one of two ways—as a normal output controlled by WinMark Pro or as an over-temperature warning. When Switch IO Output 7 is No, output OUT7 functions as a normal output and is Set or Cleared by WinMark Pro's SetDigital commands.

When Switch IO Output 7 is Yes, output OUT7 cannot be activated by SetDigital commands; instead, it serves as an over-temperature warning output and activates when the air temperature near Flyer 3D Head's power amplifiers or CPU rises to indicate that additional cooling is required.

Power Adjustment

This global head property increases or decreases the mark file's Power setting by a fixed percentage to compensate for minor output power variations from one laser to another. This property allows the use of a single set of mark files by a number of individual Flyer 3D Heads without having to create and maintain multiple mark files for each laser marker. The default value is 100%.

Tracking properties

Twelve tracking properties (following figure) are available for use when a Flyer 3D Head is setup for a tracking or banner tracking application. In WinMark Pro v7, these tracking properties are stored in the Flyer 3D Head because tracking properties are likely to vary for each individual installation due to small variances in line speeds and encoder setup. See Appendix D, Tracking, for complete information on configuring a successful tracking application.

Appendix B

Flyer 3D Head Properties

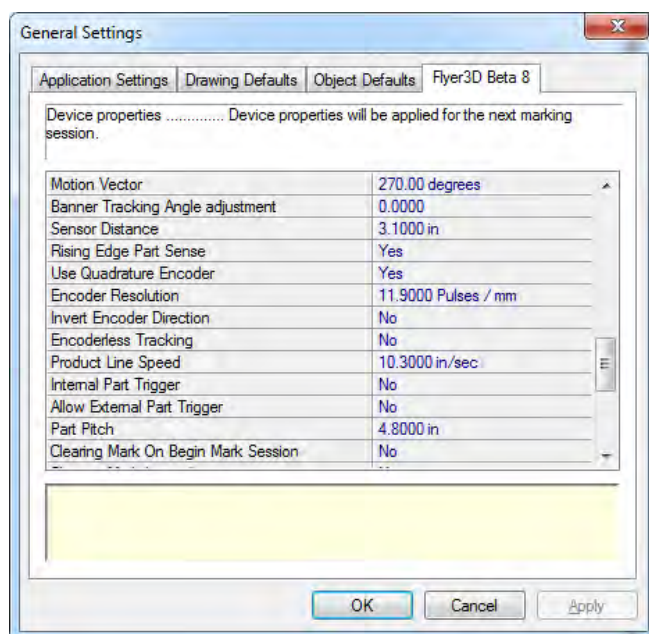


Figure B-3 Flyer tab – Tracking properties.

Motion Vector

Set the direction of part movement through the marking field. When looking at WinMark's Drawing Canvas, 0° is part movement towards the right, 90° is movement towards the bottom, 180° is towards the left, and 270° is part movement towards the top of the Drawing Canvas.

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

Banner Tracking Angle Adjustment

Fine-tune any angular misalignment of the Flyer 3D Head to part movement. The angle adjustment is accurate to 0.0001 degrees, but can only provide $\pm 0.15^\circ$ of adjustment. Any further adjustment must be made by physically moving the marking head or parts handling equipment. See Appendix E, Banner Tracking, or WinMark Pro Application Note #8, WinMark Pro's Banner Tracking Functionality (on the WinMark web site at <https://www.synrad.com/resources/libraries/articles>) for details on banner tracking setup and optimization.

Appendix B

Flyer 3D Head Properties

Sensor Distance

Use Sensor Distance (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) to change the location of the mark on the part in the axis of part motion. In WinMark Pro v7, Sensor Distance units correspond to the selected Show Units Type—Inches, Millimeters or Centimeters.

Tip: Position the physical location of the part sensor so that the sensor does not trigger while the Flyer 3D Head is marking a part. “Line speed too fast - missed start” errors may occur if the ‘start mark’ input is triggered while Flyer 3D Head is marking in tracking mode.

Rising Edge Part Sense

Set to ‘Yes’ to trigger marking on the rising edge of the part sensor’s output signal. Select ‘No’ to trigger marking on the sensor signal’s falling edge.

Use Quadrature Encoder

Choose ‘Yes’ to specify a quadrature encoder input where ‘A’ and ‘B’ phases generate direction and part movement information. If No, the expected input is a part movement signal from a unidirectional encoder. A unidirectional encoder is appropriate in applications where the product transport does not reverse direction during marking.

Encoder Resolution

Set the number of encoder pulses counted per millimeter of distance traveled by the product conveyor. Measurement units are fixed as pulses/mm even when WinMark is configured to display measurement units in Inches or Centimeters.

Invert Encoder Direction

Toggle Yes/No to invert phasing of a quadrature encoder’s bi-directional output signal so that the actual direction of part movement through the mark field is correctly sensed as “forward”. This property allows you to invert phasing of the encoder’s ‘A’ and ‘B’ outputs without physically changing field wiring.

Encoderless Tracking

When set to No, XY position data is generated based on input signals from an external position encoder. This provides the most accurate mark results because Flyer 3D Head compensates for any slight deviation in line speed.

If products travel through the marking area at a constant velocity and no encoder is installed, select Yes. This causes Flyer 3D Head to generate XY data at a fixed rate determined by the Product Line Speed property.

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

Appendix B

Flyer 3D Head Properties

Product Line Speed

When the Encoderless Tracking property is 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 motion.

Internal Part Trigger

Set to 'No' if an external part sensor is connected to your system. If sensor installation is not feasible (for example, in a continuous web process), choose 'Yes'. This causes Flyer 3D Head to generate internal triggers at the distance interval specified by the Part Pitch property.

Note: When Internal Part Trigger is set to 'Yes', Flyer 3D Head still accepts external triggers. This feature allows you to send an initial external trigger to synchronize mark placement to a specific area on the web. After the first externally triggered mark, subsequent marks are lased as the Internal Part Trigger property initiates marking at the Part Pitch interval or when the external trigger (IN0) goes active.

Allow External Part Trigger

When Internal Part Trigger is Yes, choose 'Yes' to allow Flyer 3D Head to accept external part trigger signals on input IN0. (for example, an initial external trigger can synchronize marking to a specific location on a continuous web with subsequent marks determined by the Part Pitch value). Choose 'No' to ignore any signals on input IN0.

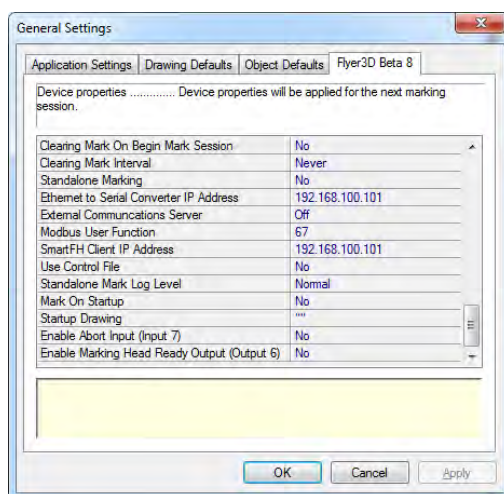


Figure B-4 Flyer tab – Maintenance, stand-alone, and I/O properties.

Part Pitch

When Internal Part Trigger is Yes, enter a Part Pitch in the selected units of measure. Part Pitch (or Mark Pitch) determines where the mark is placed on the part and is 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.

Maintenance properties

Flyer 3D Head maintenance properties (figure above) allow you to enable and configure the clearing mark function.

Appendix B

Flyer 3D Head Properties

The clearing mark was developed to help a small segment of customers whose mark consists of long durations of high frequency, small angle movements. This non-lasing clearing move is designed to redistribute lubricant along the galvanometer's bearing raceway and to reposition ball bearings around the race to promote a continuous and evenly worn bearing race. For more information about the how the clearing mark feature can increase the service lifetime of Flyer 3D Head marking heads, refer to SYNRAD Technical Bulletin # 07 or see the Flyer 3D Head 3D Operator's Manual for details.

Clearing Mark On Begin Mark Session

When set to Yes, the Clearing Mark On Begin Mark Session initiates a clearing mark at the start of each mark session. The default setting is No.

Clearing Mark Interval

If Clearing Mark On Begin Mark Session is set to No, then select a Clearing Mark Interval. This enables a clearing mark after the specified number of marks has occurred, even across multiple mark sessions. For those customers who require a clearing mark, SYNRAD recommends an interval of once every 10,000 marks. The default is Never.

Stand-alone properties

Stand-alone properties (shown back in the prior figure) configure the Flyer 3D Head head to function independently of a Windows computer. In Stand-alone mode, Flyer 3D Head operates autonomously—communicating to automation equipment using discrete I/O signals—with no connection to the WinMark Pro computer. Refer to the Flyer 3D Head 3D Operator's Manual for complete information on Stand-alone setup and operation.

Standalone Marking

Set to No (the default setting) when you wish to control Flyer 3D Head from the WinMark Pro computer—during mark file development, for example. When set to Yes, Flyer 3D Head operates autonomously using mark files stored in its Filestore or on a network share.

Ethernet to Serial Converter IP Address

When using an Ethernet-to-serial converter to send serial port data to a Flyer 3D Head head operating in Stand-alone mode, enter the IP address of your converter. When configuring your converter, the converter's port address must be set to 7963.

External Communications Server

The SYNRAD external Ethernet communications server (SynComm), built into Flyer 3D Head 3D heads allows users to access various marking head functions over a network using the Modbus® protocol via Flyer 3D Head's Ethernet port using one of two different protocols: (1) Modbus TCP/IP protocol for interaction with PLCs or other MODBUS network devices or (2) Modbus-Asynchronous protocol, a SYNRAD-modified Modbus protocol for peer-to-peer communications.

Note: To enable the Flyer 3D Head web page's Mark, Abort, and Status button functionality, set the External Communications Server property to Modbus or Modbus-Async and then set Standalone Marking to Yes.

Appendix B

Flyer 3D Head Properties

For complete details about using the Modbus protocol through the external Ethernet communications server, see WinMark Application Note # 05, as well as sample Visual Basic and Visual C++ code installed with WinMark: C:\Program Files\WinMark\Samples.

Modbus User Function

Specify a user function code when operating on a Modbus network. Valid codes are within the range of 65–72 and 100–110 decimal; the WinMark default value is 67. A Modbus user-defined function code allows you to perform many of the operations necessary for marking head control over a Modbus network.

Use Control File

When set to Yes, Flyer 3D Head operates in a subset of Stand-alone mode based on configuration data from a predefined Master Control File. See Appendix C, Master Control File, for details on configuring and operating with a Master Control File in Stand-alone mode.

Standalone Mark Log Level

When operating in Stand-alone mode, choose a mark log level. Based on the Standalone Mark Log Level chosen, Flyer 3D Head sends one of five types of information back to WinMark Pro (when connected to the Flyer 3D Head head). From the least amount of logging to the most, the options are: Errors Only, Light, Normal (default), Verbose, and Everything.

Mark On Startup

When operating in Stand-alone mode and Mark On Startup is set to Yes, Flyer 3D Head automatically loads the specified Startup Drawing on boot-up and begins the mark session immediately.

Startup Drawing

Flyer 3D Head loads the specified drawing when operating in Stand-alone mode and Mark On Startup is set to Yes. The Startup Drawing may reside in Flyer 3D Head's Filestore or on a network share.

I/O properties

I/O properties (shown back in the prior figure) allow you to configure the Flyer 3D Head head to interface in specific ways with factory automation equipment.

Enable Abort Input (Input 7)

Configure the Flyer 3D Head head to use input IN7 in one of two ways—as a normal input to Flyer 3D Head (or WinMark Pro) or as an 'abort marking' input. When Enable Abort (Input 7) is Yes, a voltage signal on input IN7 will halt the current mark session and cause the mark file to execute any defined On Abort Session events. If set to No, input IN7 functions as a normal automation input.

Appendix B

Flyer 3D Head Properties

Enable Marking Head Ready Output (Output 6)

When set to Yes, Flyer 3D Head output OUT6 is activated when the head is fully booted up. This action signals automation equipment that the head is operational and ready to accept commands.

Appendix C



This appendix contains the following information:

- Master Control File – describes how to create and configure a Master Control File to perform automated marking operations in Stand-alone mode.

Appendix C

Master Control File

The Master Control File section includes subsections:

- Overview
- Hardware/software setup
- Starting/ending a MCF session
- Master Control File specifications
- Master Control File syntax
- Master Control File examples

Master Control File (MCF) operation is a specialized subset of Stand-alone operation where the Flyer 3D Head loads a master file on boot-up. This feature allows a single file, the Master Control File, to configure Flyer 3D Head to load and mark .mkh files (previously stored in the Filestore or on a network share) in a user-controlled sequence based on the status of the head's 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.

Overview

The Master Control File (MCF), a simple text file named `master.ctf`, resides in the Filestore's root directory. The MCF is read once by Flyer 3D Head during boot-up, analyzed, and its instructions are written into Flyer 3D Head RAM as the mark session begins. Based on the instructions in the MCF, Flyer 3D Head performs a continuous sequence of actions based on MCF keyword values and digital inputs applied to the User Interface connector.

MCF 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 Flyer 3D Head's digital I/O circuits.
- Manage multiple mark files using a single text file (named "master.ctf") resident in the root directory of the Flyer 3D Head Filestore.
- Store mark files internally in Flyer 3D Head's 32-MB flash memory or store files on a network share.
- Operate in either continuous mode, where Flyer 3D Head reads input status and loads the appropriate file before every mark, or strobed mode, where Flyer 3D Head marks the same file each time until a strobe input dictates that another file be loaded and marked.

Appendix C

Master Control File

- 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 3D Head 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.

Important Note: Flyer 3D Head 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 3D Head is rebooted.

Tip: By storing files on a network share, files become accessible over Flyer 3D Head's Ethernet port. This makes it possible to modify one mark file using WinMark Pro, while another file is loaded and marked as directed by the Master Control File.

Starting/ending a MCF session

Start a MCF mark session

- 1 Place the material or part to be marked in position on the marking surface at the proper working distance.
- 2 Check that all safety precautions (safety glasses and shielding) are in place around the beam area.
- 3 Power down Flyer 3D Head and then remove the Ethernet connection if desired.

Note: The Ethernet connection must be active if mark files reside on a network server instead of in the Flyer 3D Head Filestore.

- 4 Restart the Flyer 3D Head and enable your automation control system.
- 5 Flyer 3D Head 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 Ethernet during the time that Flyer 3D Head 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 3D Head Logs and then choose Mark Log. The Mark Log text file is uploaded to the computer location you specify.

Appendix C

Master Control File

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 Flyer 3D 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 3D Head Files window.

End a MCF mark session

- 1 To end a stand-alone Master Control File mark session, first connect Flyer 3D Head to the WinMark Pro computer via the Ethernet port.
- 2 Click the Mark button to open the Launcher window.

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



Flyer 3D Head's operating system requires approximately 25–30 seconds to boot up. Repeatedly cycling power during the boot up sequence may cause corruption of Flyer 3D's flash memory and operating system.

Note: If the Filestore does not appear when you switch operating modes, right-click in the Flyer 3D Head Files window and choose Refresh from the contextual menu.

Note: In certain situations when Mark On Startup is enabled, Flyer 3D Head may not exit stand-alone marking, depending on the configuration of mark file automation. If this occurs, set-up an Ethernet connection and access the Mark On Startup property through the Flyer 3D Head web page. See Flyer 3D Head web interface in the Technical Reference chapter for details.

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

Note: In an automated system, you can configure input IN7, using WinMark Pro's Enable Abort Input (Input 7) property, to halt a mark session when activated by a PLC or automation controller.

To start another automated mark session, press the F1 key on the WinMark computer's keyboard, click Start-F1 in the Launcher window, or restart (reboot) the Flyer 3D Head.

To exit Flyer 3D Head's automated stand-alone marking mode, go to the Flyer 3D tab and set the Mark On Startup property to 'No'. Click the Apply button to accept the change, and then click 'OK'.

Master Control File specifications

This section describes the requirements and structure of a Master Control File for a stand-alone Flyer 3D Head application.

Appendix C

Master Control File

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 3D Head 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 Flyer 3D Head Filestore, then that file is opened, analyzed, and written to RAM at the beginning of a mark session.
- 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 Flyer 3D Head 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.
- If master.ctl does not exist or if Flyer 3D Head finds an error in the file, then the head operates as if Use Control File is set to No.
- 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 Flyer 3D Head 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 3D Head to function in one of two ways—in a continuous mode or in a strobed mode.

Continuous 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 3D Head 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 3D Head loops without marking until a valid mark file match occurs.

Strobed mode

In strobed mode, each mark file loaded into memory begins a new mark session, which could

Appendix C

Master Control File

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 3D Head 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 3D Head performs another input read and loads the corresponding mark file into memory. If a valid strobe input does not occur, Flyer 3D Head continues to mark the previous file loaded into memory.

- The Master Control File can direct Flyer 3D Head to read the state of all eight digital inputs or it can configure Flyer 3D Head to read up to 16 bit states using a multiplexed scheme. Flyer 3D Head 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

the input value corresponds to decimal 15 ($8 + 4 + 2 + 1 = 15$) or hexadecimal 0x0F.

- The Master Control File can direct Flyer 3D Head to set the state of all eight digital outputs. Flyer 3D Head 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
--------	------	------	------	------	------	------	------	------

Appendix C

Master Control File

Output state 1 0 0 0 0 0 0

Bit masks

Several of Flyer 3D Head'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 3D Head 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 Flyer 3D Head 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 3D Head 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	1
Strobe mask value (0x03) 0	0	0	0	0	0	0	1	1
Desired input state (0x01) 0	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 3D Head 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	0	1	1
Desired input state (0x01) 0	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

Appendix C

Master Control File

Strobe function is valid, which instructs Flyer 3D Head 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.

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 3D Head 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 3D Head 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	

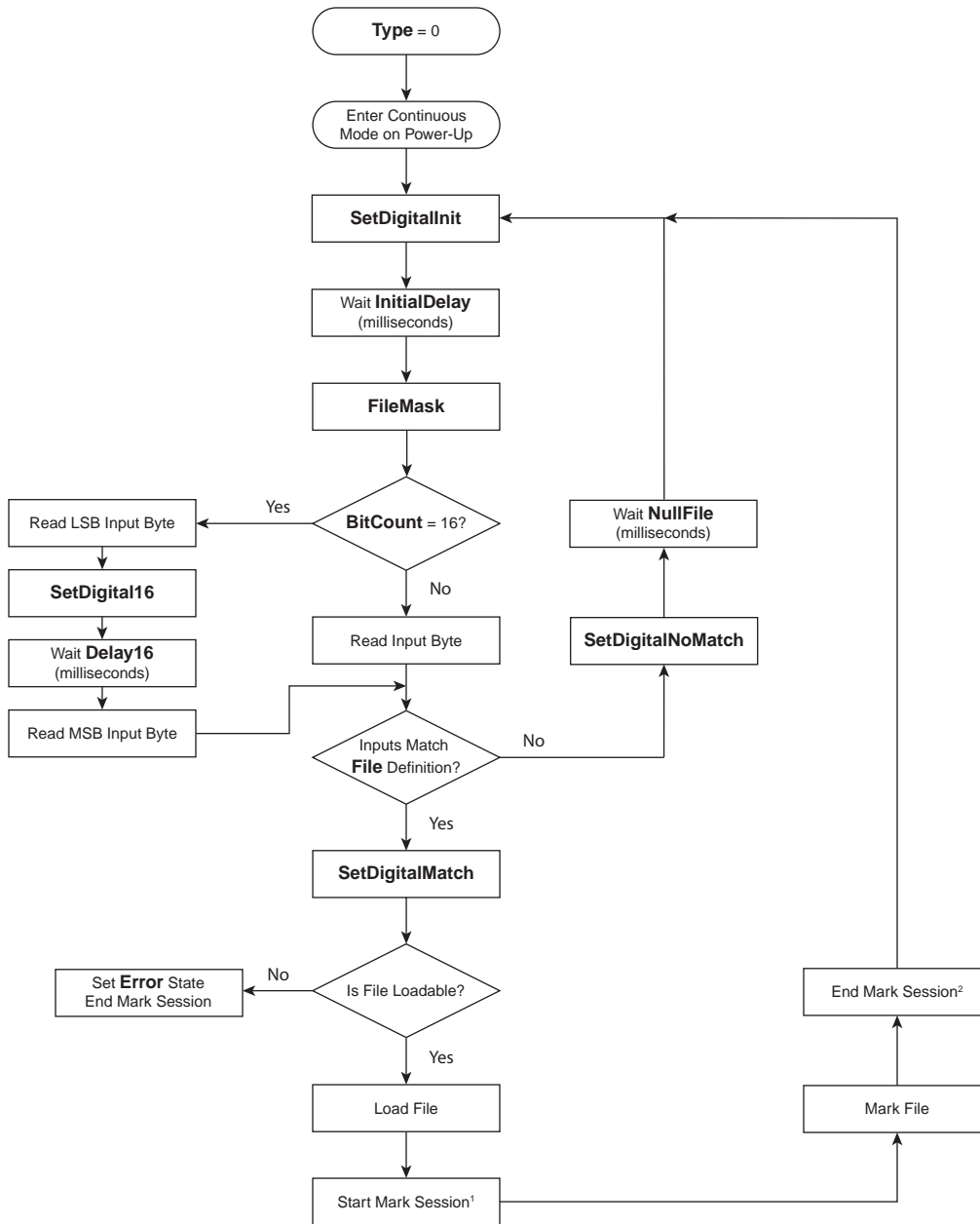
The mask value (0x60) means that only OUT5 and OUT6 will be changed, if necessary, to the desired output state. In this example, the result of the mask (the new output state) tells Flyer 3D Head to Set OUT5 and Clear OUT6 to indicate that a file match was successful. Note that outputs OUT7, OUT4, and OUT3–OUT0 are unchanged because of the mask operation.

Appendix C

Master Control File

Master Control File flowcharts

Figure below 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.

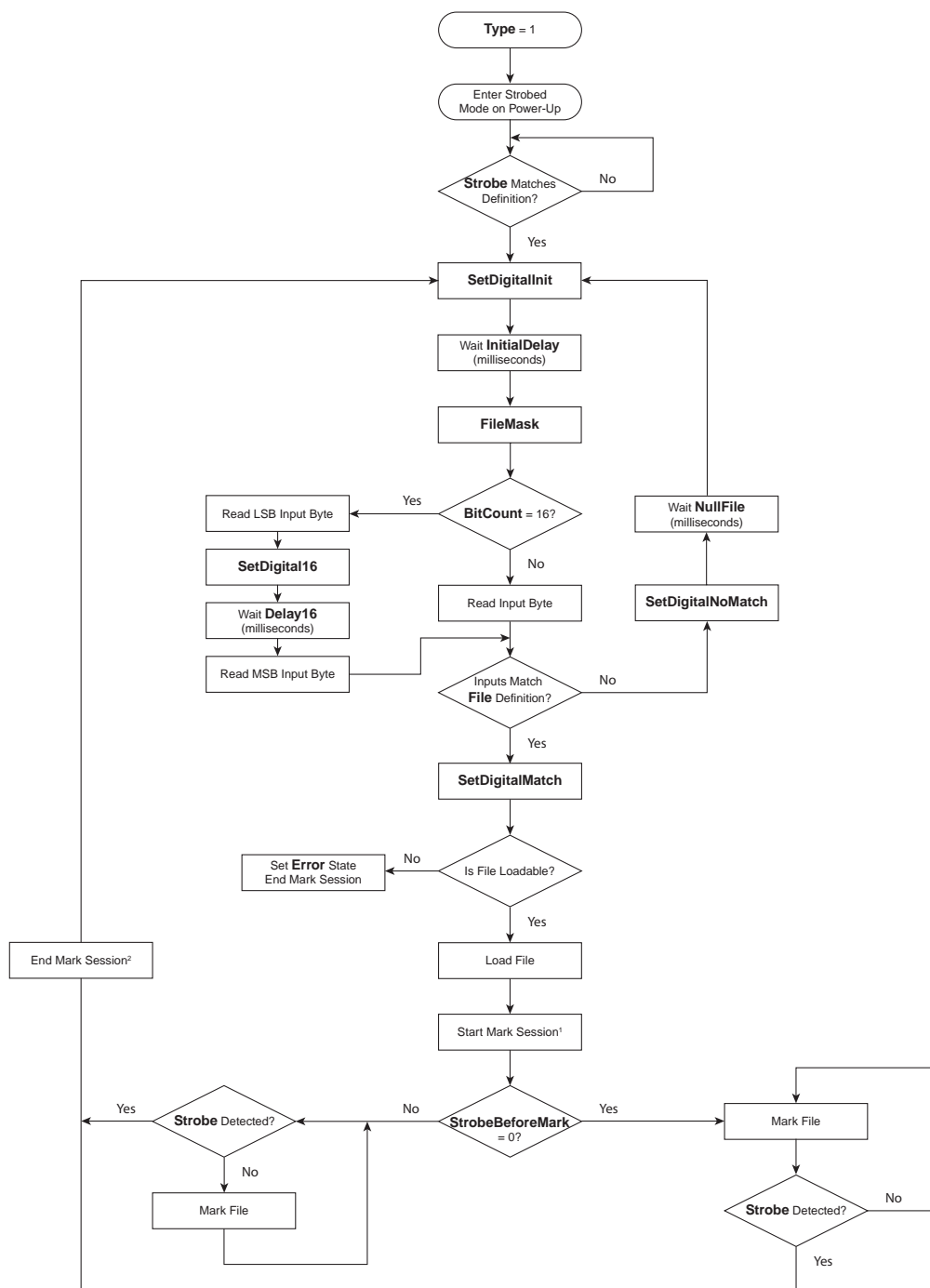
2 Run On After Mark Session automation (if any) in the mark file and end mark session.

Figure C-1 Master Control File flowchart keywords and arguments-continuous mode.

Appendix C

Master Control File

Figure below 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 C-2 Master Control File flowchart-strobed mode.

Appendix C

Master Control File

Master Control File Flowcharts (Continued.)

- 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 3D 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 a space character is a delimiter.

Appendix C

Master Control File

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.

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 3D Head to read file input bits and load another mark file.

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 3D Head 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, Flyer 3D Head 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.

The Strobe input must be applied before the current mark is complete, if not, Flyer 3D Head continues marking the file currently loaded into memory. Flyer does not constantly monitor the Strobe input, but 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.

Appendix C

Master Control File

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.

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 InitialDelay 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.

Appendix C

Master Control File

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.

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.

Appendix C

Master Control File

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

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.

Notes: If an InitialDelay is not specified, set File select inputs for the next match during the current mark so a valid input state is ready when the current mark is complete.

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

Appendix C

Master Control File

```
# mark file 5 and mark file 6.mkh reside on a network share connected via
# 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.

Required: No

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

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.

Appendix C

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.

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.

Master Control File examples

Continuous MCF example

Continuous Master Control File example where a new file (or the same file) is
loaded into Flyer RAM for each mark. Each mark begins and ends a distinct mark
session. OnBeforeMarkSession and OnAfterMarkSession events occur before/after
each mark. File selection inputs are checked before every mark.
Type=0

Output mapping (OUT7 – OUT0):
OUT4 Ready/markings ----| (OUT4 state defined in MKH files)

Appendix C

Master Control File

```
# Control -----| |
#           ||
#           / \
# (Outputs) 7654 3210
# Controls mask = 1110 0000 (0xE0 hex)
# SetDigitalInit = 100- ---- (0x80) Flyer ready for file select inputs
# SetDigitalMatch = 010- ---- (0x40) valid MKH file was loaded
# SetDigitalNoMatch = 001- ---- (0x20) no MKH files match input state
# Error = ---- 1111 (0x0F) exit loop, can't read file
# Ready to mark = ---1 ---- (OUT4 state defined in MKH files)
# Busy marking = ---0 ---- (OUT4 state defined in MKH files)

# Specify control loop output states:
SetDigitalInit=0xE0 0x80
SetDigitalMatch=0xE0 0x40
SetDigitalNoMatch=0xE0 0x20
Error=0x0F 0x0F

# Delays - allow control loop delays between various loop conditions.
# Add a 100 ms delay for file input states to settle.
InitialDelay=100

# Wait 100 ms if input states do not match valid file selection and check again.
NullFile=100

# Input mapping (IN7 – IN0):
# Start mark input-----|
# File select inputs-| |
#           / \
#           / \
#           / \
# (Inputs) 7654 3210
# Start Mark = ---- ---1 (IN0 state defined in MKH files)
# File mask = 1111 1110 (0xFE)

# Specify inputs used for file selection. In this case, read inputs IN7 – IN1. FileMask=0xFE

# With inputs (IN7 – IN1) we will not use the zero state where IN7 – IN1
# are all “0” because this could indicate inputs are disconnected or
# unavailable. We must ensure only active input states begin lasing.
# File=0 /0.mkh Use File=0 state to test SetDigitalNoMatch output and
# NullFile delay.

# LSB input values are always defined as: IN0 = 1 (0x01); IN1 = 2 (0x02);
# IN2 = 4 (0x04); IN3 = 8 (0x08); IN4 = 16 (0x10); IN5 = 32 (0x20);
# IN6 = 64 (0x40); and IN7 = 128 (0x80) regardless of FileMask value.
#
# If BitCount=16, MSB input values are always defined as: IN0 = 256
# (0x0100), IN1 = 512 (0x0200), ... IN7 = 32768 (0x8000) regardless
# of FileMask value.

# Now for the mark file equates
# !!!!! PATH AND FILENAMES ARE CASE SENSITIVE !!!!!
#
# Even though IN0 is masked out by FileMask, it is still used in the file
# equates. The input value is ANDed with the FileMask value to determine
# the file selection value. Example:
# |-INPUT BITS -|
# 7 6 5 4 3 2 1 0
# 0 0 0 0 0 1 1 1 -- input value = 7 (0x07)
# & & & & & & & -- AND
# 1 1 1 1 1 1 1 0 -- FileMask = 254 (0xFE)
```

Appendix C

Master Control File

```
# ===== equals
# 0 0 0 0 1 1 0 - file select value = 6 (0x06)
#
# Even though the first two file mask inputs are active, the file
# select value is 6 (0x06), not 3 (0x03).

#Flyer's Linux OS requires a pathname format with forward
# slash (/) characters, not backslash (\) characters.

File=2 /Markfile1.mkh
# "/" symbol indicates file resides in Filestore's root directory
# Match if only IN1 is active (IN1 bit value = 2)

File=4 /Folder1/Markfile2.mkh
# Markfile2.mkh resides in Folder1 in the Filestore
# Match if only IN2 is active (IN2 bit value = 4)

File=6 /network/Markfile3.mkh
# Markfile3.mkh and Markfile4.mkh reside in a network share folder.
# Match if only IN1 and IN2 are active (2 + 4 = 6)

File=8 /network/Markfile4.mkh
# Match if only IN3 is active (IN3 bit value = 8)

# End of File.
```

Strobed MCF example

```
# Strobed Master Control File example where a new file is loaded into Flyer RAM
# for each mark or the existing file is marked multiple times. A Strobe input
# ends the current mark session and begins a new session and OnBeforeMarkSession
# and OnAfterMarkSession events occur before/after each session. If a Strobe
# input is not detected, the currently loaded file continues to mark and in this
# case, OnBeforeMarkSession and OnAfterMarkSession events do not occur. File
# selection inputs are checked only after the Strobe input goes active.
Type=1
```

```
# Output mapping (OUT7 - OUT0):
# OUT4 Ready/markings ----| (OUT4 state defined in MKH files)
# Control -----|
#      ||
#      /\|
# (Outputs)      7654 3210
# Controls mask = 1110 0000 (0xE0 hex)
# SetDigitalInit = 100- ---- (0x80) Flyer ready for file select inputs
# SetDigitalMatch = 010- ---- (0x40) valid MKH file was loaded
# SetDigitalNoMatch= 001- ---- (0x20) no MKH files match input state
# Error = ---- 1111 (0x0F) exit loop, can't read file
# Ready to mark = ---1 ---- (OUT4 state defined in MKH files)
# Busy marking = ---0 ---- (OUT4 state defined in MKH files)
```

```
# Specify control loop output states:
SetDigitalInit=0xE0 0x80
SetDigitalMatch=0xE0 0x40
SetDigitalNoMatch=0xE0 0x20
Error=0x0F 0x0F
```

```
# Delays - allow control loop delays between various loop conditions.
# Add a 100 ms delay for file input states to settle.
InitialDelay=100
```

```
# Wait 100 ms if input states do not match valid file selection and check again.NullFile=100
```

```
# Input mapping (IN7 - IN0):
# Strobe input-----|
```

Appendix C

Master Control File

```
# Start mark input----||
# File select inputs-||
#
#
#
#
# (Inputs) 7654 3210

# Strobe = ----1 (0x01) Load another file into RAM for marking
# Strobe mask = 0000 0001 (0x01) Strobe only valid if IN0=1 and IN7 - IN1=0
# Start Mark = ----1- (IN1 state defined in MKH files)
# File mask = 1111 1100 (0xFC)

# Specify input mask/input state for Strobe.
# !!!! IMPORTANT NOTE !!!
# The Strobe input must be active BEFORE Flyer reaches the Wait Digital Before
# Piece automation stage or the Strobe input will NOT be recognized.
Strobe=0x01 0x01

# Specify inputs used for file selection. In this case, read inputs IN7 - IN2.FileMask=0xFC

# With inputs (IN7 - IN2) we will not use the zero state where IN7 - IN2
# are all "0" because this could indicate inputs are disconnected or
# unavailable. We must ensure only active input states begin lasing.
# File=0 /0.mkh Use File=0 state to test SetDigitalNoMatch output and
# NullFile delay.
#

# LSB input values are always defined as: IN0 = 1 (0x01); IN1 = 2 (0x02);
# IN2 = 4 (0x04); IN3 = 8 (0x08); IN4 = 16 (0x10); IN5 = 32 (0x20);
# IN6 = 64 (0x40); and IN7 = 128 (0x80) regardless of FileMask value.
#
# If BitCount=16, MSB input values are always defined as: IN0 = 256
# (0x0100), IN1 = 512 (0x0200), ... IN7 = 32768 (0x8000) regardless
# of FileMask value.

# Now for the mark file equates
# !!!!! PATH AND FILENAMES ARE CASE SENSITIVE !!!!!
#
# Even though IN0 and IN1 are masked out by FileMask, it is still used in the
# file equates. The input value is ANDed with the FileMask value to determine
# the file selection value. Example:
# |-INPUT BITS -|
# 7 6 5 4 3 2 1 0
# 0 0 0 0 1 1 1 -- input value = 7 (0x07)
# & & & & & & -- AND
# 1 1 1 1 1 0 0 -- FileMask = 252 (0xFC)
# = = = = = -- equals
# 0 0 0 0 1 0 0 -- file select value = 4 (0x04)
#
# Even though only the first file mask input is active, the file
# select value is 4 (0x04), not 1 (0x01).
# Flyer's Linux OS requires a pathname format with forward slash (/)
# characters, not backslash (\) characters.

File=4 /Markfile1.mkh
# "/" symbol indicates file resides in Filestore's root directory
# Match if only IN2 is active (IN2 bit value = 4)

File=8 /Folder1/Markfile2.mkh
# Markfile2.mkh resides in Folder1 in the Filestore
# Match if only IN3 is active (IN3 bit value = 8)

File=12 /network/Markfile3.mkh
# Markfile3.mkh and Markfile4.mkh reside in a network share folder
# Match if only IN2 and IN3 are active (4 + 8 = 12 (0x0C hex))

File=16 /network/Markfile4.mkh
```

Appendix C

Master Control File

Match if only IN4 is active (IN4 bit value = 16 (0x10 hex))

End of File

Note: When using a Strobed Master Control File scheme in an automated system, the PLC or automation controller should begin evaluating the next mark during the Set Digital Before Mark stage in the automation loop. When the specified output transitions to indicate the head is “busy” (marking), determine the need to mark the same file or a new file and then assert Strobe (IN0) and file select inputs (IN7–IN2) before clearing the ‘start mark’ input (IN1). The Strobe input must be active before Flyer 3D Head reaches the Wait Digital Before Piece automation stage or the Strobe input will not be recognized.

Appendix D

D

This appendix contains the following information:

- Tracking – describes the Flyer 3D Head’s tracking function and terminology and explains how to connect user-supplied position encoder, part sensor, and DC power supply components to create a successful tracking application.

Important Note: Please review all sections in this appendix thoroughly before designing your Flyer 3D Head tracking system.

Note: If you are installing a Flyer 3D Head to operate in Tracking mode, please perform the tasks described in the Getting Started and Operation chapters before proceeding with this section.

Appendix D

Tracking

The Tracking section includes subsections:

- Introduction
- Tracking definitions
- Tracking mark criteria
- Tracking hardware
- WinMark Pro tracking properties
- Determining line speed
- Tracking optimization

Introduction

Unlike static laser marking systems that require parts to be stationary during marking, Flyer 3D Head's tracking mode is capable of marking parts "on-the-fly" as they move through the marking field. Initial material samples should be tested by SYNRAD Applications Lab to determine the optimum power, speed, and field 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.

In addition to tracking, Flyer 3D Heads also 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 current mark field. See Appendix E, Banner Tracking, or WinMark Pro Application Note #08, WinMark Pro's Banner Tracking Functionality (on the web site at <https://www.synrad.com/resources/libraries/articles>), for details on banner tracking setup and optimization.

Appendix D

Tracking

Tracking setup

A typical Flyer 3D Head tracking setup is shown in the figure below. In addition to the items listed under Basic system 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
- Part movement or conveyor system

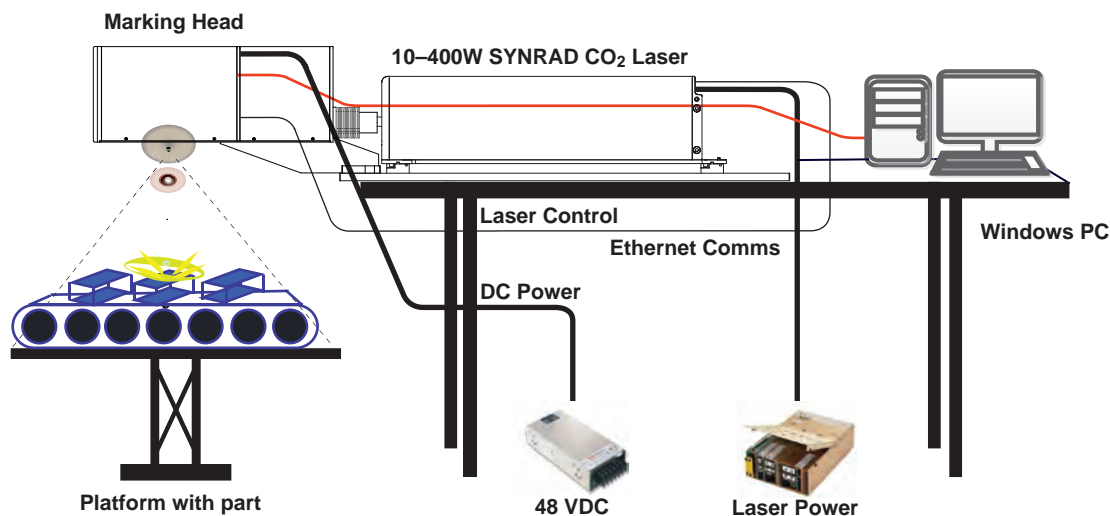


Figure D-1 Flyer 3D Head tracking setup.

Tracking definitions

Before calculating the approximate tracking line speed for Flyer 3D 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 Flyer 3D Head tracking application.

Important Note: The Flyer 3D Marking Window (Drawing Canvas) is a “landscape” orientation where the X-axis is the long axis. Depending on the size of the Tracking Window, maximum tracking speed may occur when the Motion Vector property is set to 0° or 180°.

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 at the correct working distance for the selected mark field. The Drawing Canvas would exactly cover the maximum Marking Window. For example, a Flyer 3D Head setup with

Appendix D

Tracking

a 300 mm × 300 mm nominal mark field would encompass a maximum Marking Window (and Drawing Canvas size) of 347 mm × 304 mm.

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 below illustrates Usable Field Size.

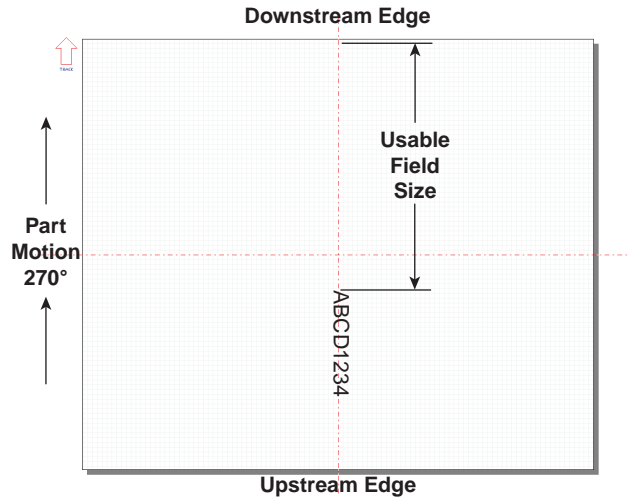


Figure D-2 Usable Field Size.

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 the figure below.

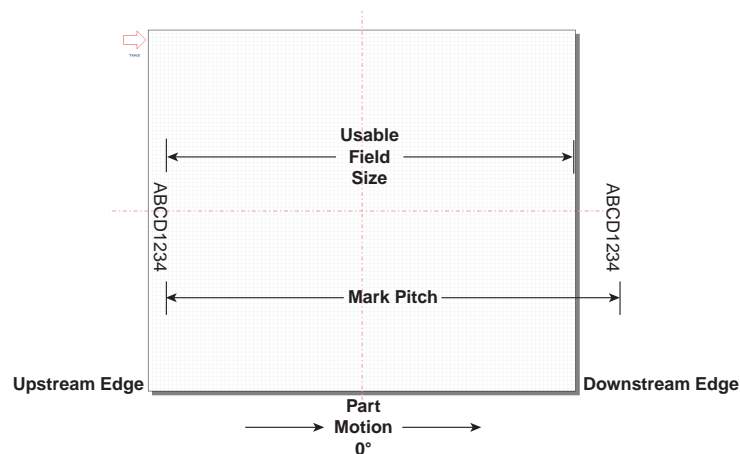


Figure D-3 Mark Pitch greater than Usable Field Size.

Appendix D

Tracking

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 3D Head where marking is completed without error. The Tracking Window is defined as the smaller of either Usable Field Size or Mark Pitch. Because the Tracking Window is located within the Marking Window, it can never exceed the extents of the Marking Window.

For example, Figure below shows an application using a 200 mm × 200 mm nominal mark field (269 mm × 227 mm actual field size) with a 0° Motion Vector. The Marking Window dimension, in the direction of part motion, is 269 mm. Mark placement creates a Usable Field Size measuring 262 mm and part spacing creates a Mark Pitch measuring 134 mm. By definition, the Tracking Window is the smaller of Usable Field Size, which is 262 mm, or Mark Pitch, which measures 134 mm. In this case, the actual Tracking Window is limited to 134 mm.

Note: The fastest Cycle Time for a given Mark is achieved in the longest Tracking Window.

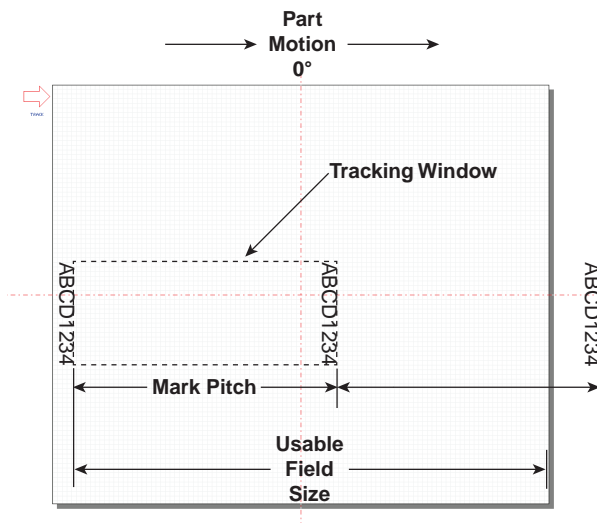


Figure D-4 Tracking Window.

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 Flyer 3D Head. See the figure on the following page.

Appendix D

Tracking

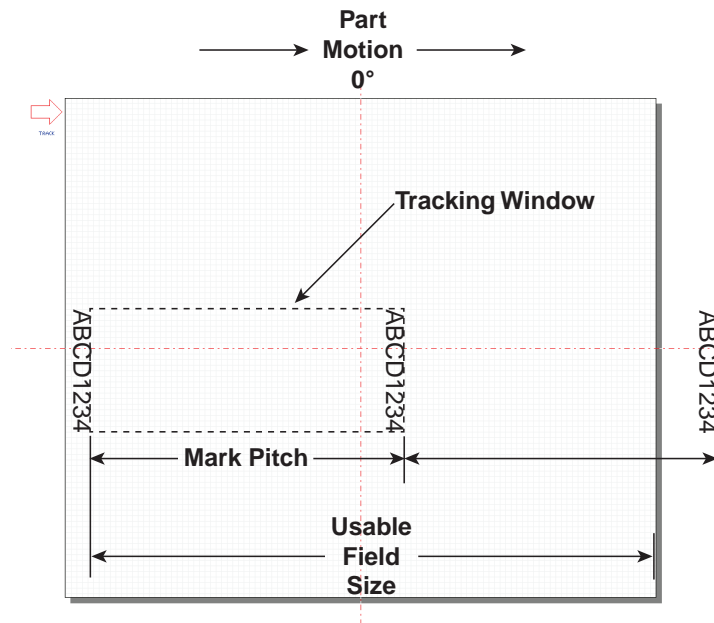


Figure D-5 Target Area.

Object Reference Point

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

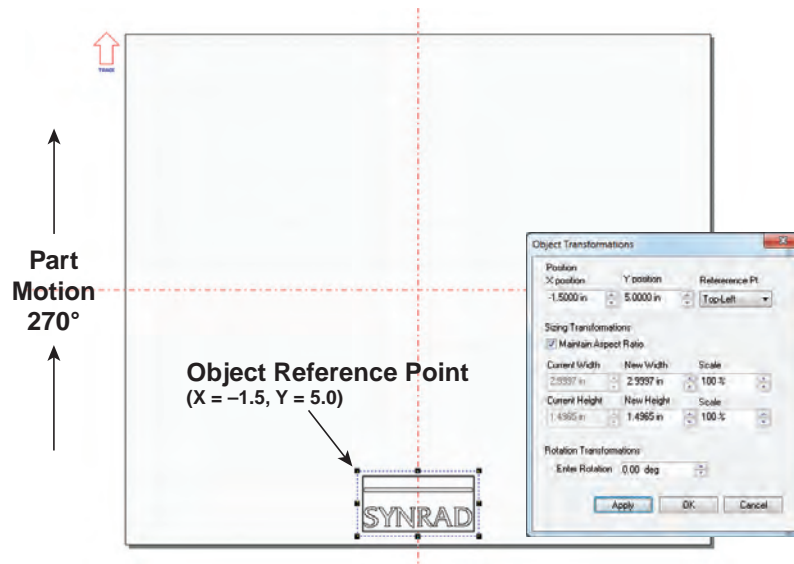


Figure D-6 Object Reference Point.

Appendix D

Tracking

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 3D 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 the Tracking hardware section later in this appendix for details on calculating Encoder Resolution. After determining the correct value, open and run a Linestackxxx.mkh mark file 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 the following figure.

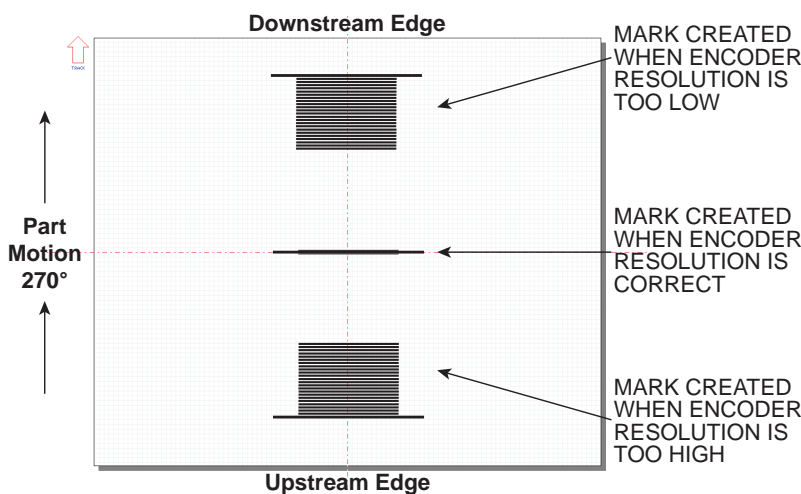


Figure D-7 Checking Encoder Resolution.

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.

Appendix D

Tracking

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.

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 below shows how the same text positioned differently can give two very different values for Usable Field Size.

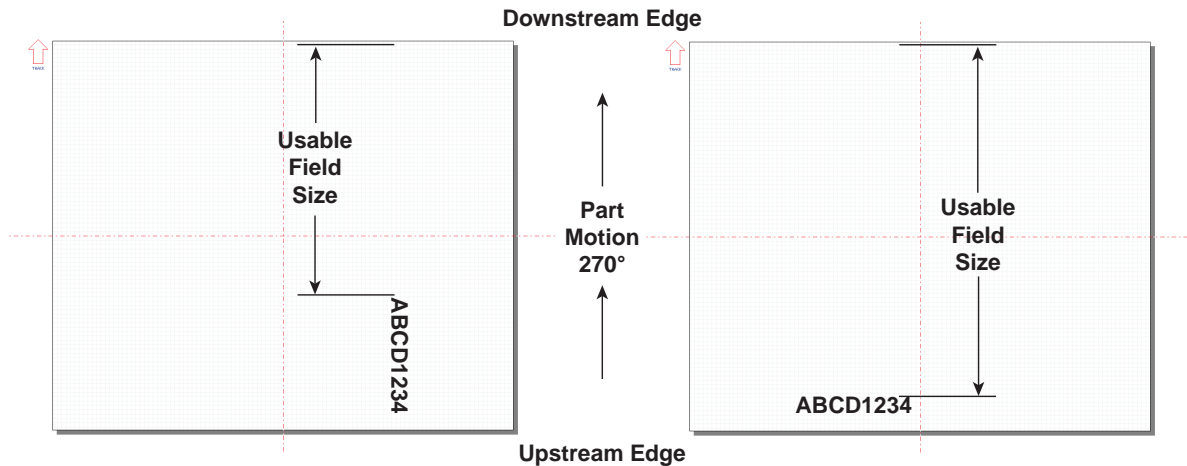


Figure D-8 Usable Field Size comparisons.

- 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 the figure below, "Line 2" will mark unless unmarked areas move outside the Marking Window.

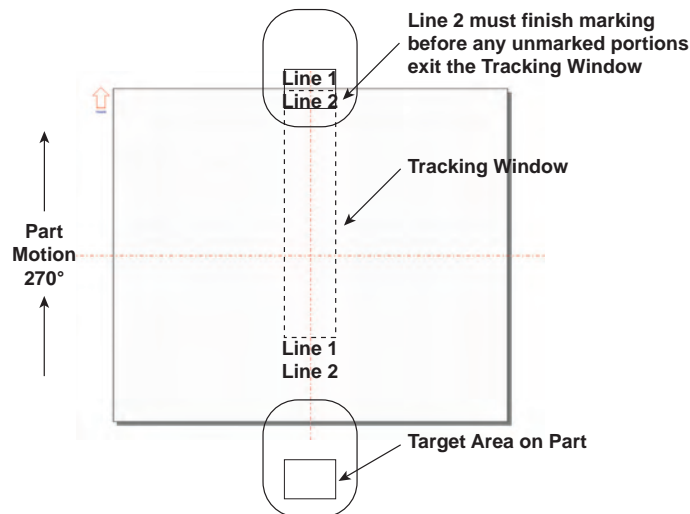


Figure D-9 Maximum marking position in Tracking Window.

Appendix D

Tracking

Tracking hardware

Tracking with a Flyer 3D Head requires 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 Flyer 3D 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, Flyer 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. See 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 3D 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 D-1 lists electrical specifications for choosing a position encoder when connecting to Flyer 3D Head's high-speed inputs IN1 and IN2.

Table D-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 3D Head's internal 15 V supply)
Output Signal	Open collector (PNP or NPN) or open drain (P-channel or N-channel) Low level output voltage: -0.6 V to +1.7 VDC (0 V typ.) High level output voltage: +5.0 V to 24.0 VDC On-state current: 6 mA typical; 9 mA maximum at 5 VDC 22 mA typical; 32 mA maximum at 12 VDC 32 mA typical; 47 mA maximum at 15 VDC 62 mA typical; 90 mA maximum at 24 VDC Quadrature or bidirectional output recommended (Flyer 3D Heads will accept a unidirectional encoder input)

Encoder connection

Encoder outputs are connected directly to Flyer 3D Head'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 D-10 shows a customer-supplied power supply driving a current-sinking NPN open collector en-

Appendix D

Tracking

coder. Figure below shows how to power the same type encoder from Flyer 3D Head 's built-in +15 VDC power supply. See figures on the following page when wiring current-sourcing PNP encoders.

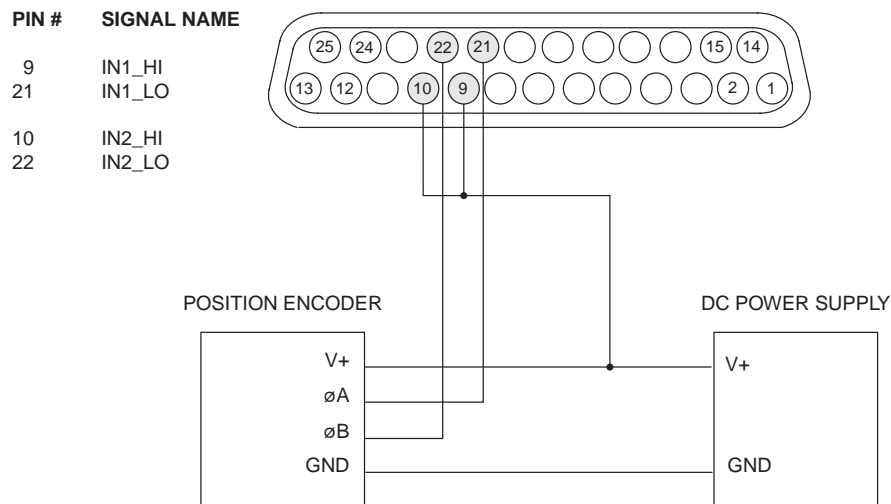


Figure D-10 Wiring diagram for current-sinking (NPN open collector) encoders.

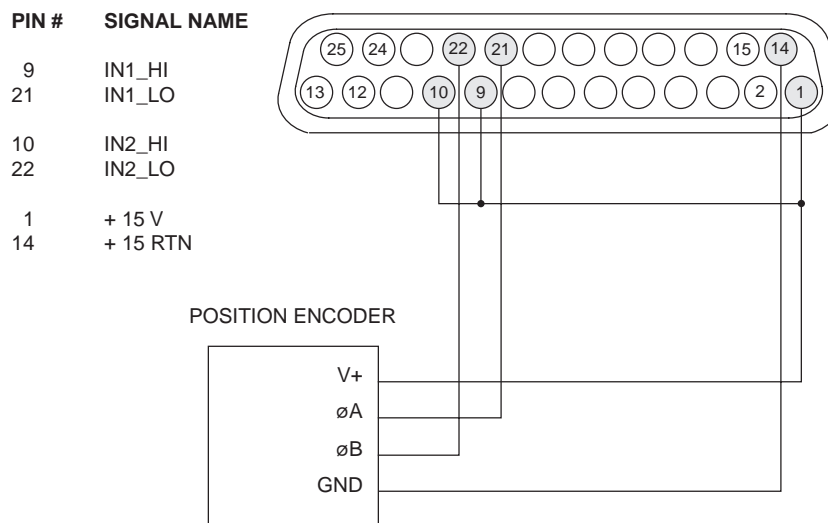


Figure D-11 Wiring diagram for current-sinking (NPN open collector) encoders using Flyer's built- in power supply.

Appendix D

Tracking

Figure below shows a customer-supplied power supply driving a current-sourcing PNP open collector encoder. Figure D-13 shows how to power the same type of encoder from Flyer 3D Head's built-in +15 VDC power supply.

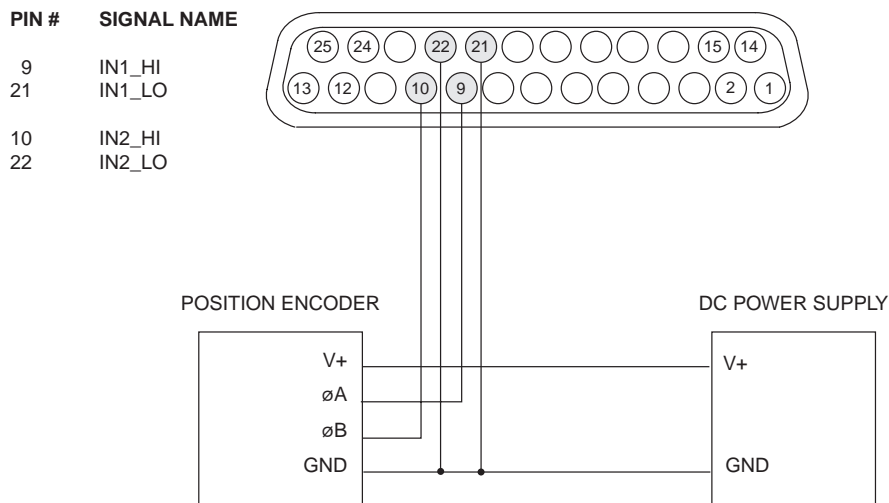


Figure D-12 Wiring diagram for current-sourcing (PNP open collector) encoders.

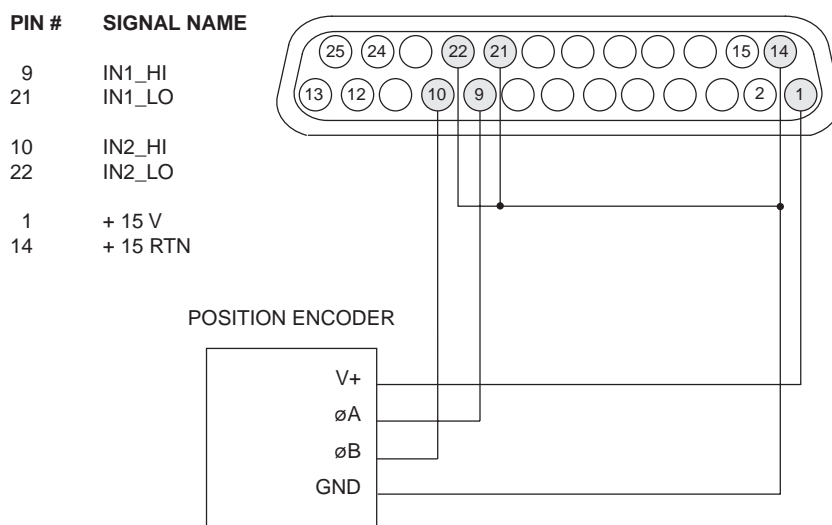


Figure D-13 Wiring diagram for current-sourcing (PNP open collector) encoders using Flyer's built-in power supply.

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.

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 Flyer 3D tab under Tools / General Settings).

Appendix D

Tracking

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) x 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:

$$\begin{aligned}\text{Encoder Resolution} &= X \times Y \times 1 \text{ m}/1000 \text{ mm} \\ &= 800 \text{ pulses/rev} \times 14.32 \text{ rev/m} \times 1 \text{ m}/1000 \text{ mm} \\ &= 11456.0 \text{ pulses/m} \times 1 \text{ m}/1000 \text{ mm} \\ \text{Encoder Resolution} &= 11.456 \text{ pulses per millimeter of conveyor motion}\end{aligned}$$

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.

Flyer 3D Head'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 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... / Flyer 3D tab / Encoder Resolution).

If necessary, fine-tune encoder resolution using the `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.

Appendix D

Tracking

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

- 1 Go to the WinMark folder on your computer and open a linestackxxx.mkh file.

Note: If you are tracking with a Motion Vector other than 270° , you must rotate the appropriate liestackxxx.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 positioned at the same height (working distance) as the part to be marked otherwise the difference in height will affect marking performance as the mark may be out of focus (too faint). Changes in working distance, especially when tracking, 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 the figure below.

Part sensor

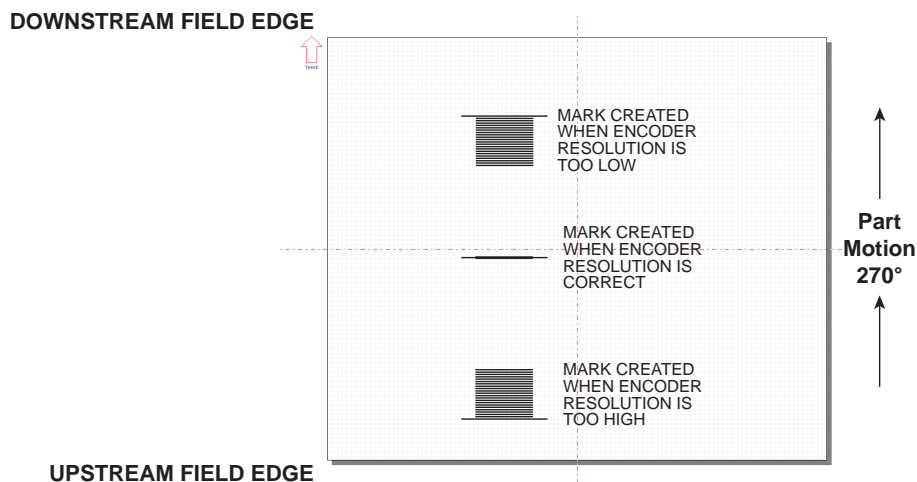


Figure D-14 Linestack mark.

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

Appendix D

Tracking

When tracking, a part sensor is required to send 'start mark' signals to the Flyer 3D 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 D-2 lists electrical specifications for choosing a part sensor.

Table D-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) or debounced mechanical limit switch Low level output voltage: -1.0 V to +1.0 VDC (0 V typ.) High level output voltage: +3.0 V to 24.0 VDC On-state current: 6 mA typical; 9 mA maximum at 5 VDC 16 mA typical; 23 mA maximum at 12 VDC 20 mA typical; 29 mA maximum at 15 VDC 32 mA typical; 47 mA maximum at 24 VDC

Part sensor connection

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

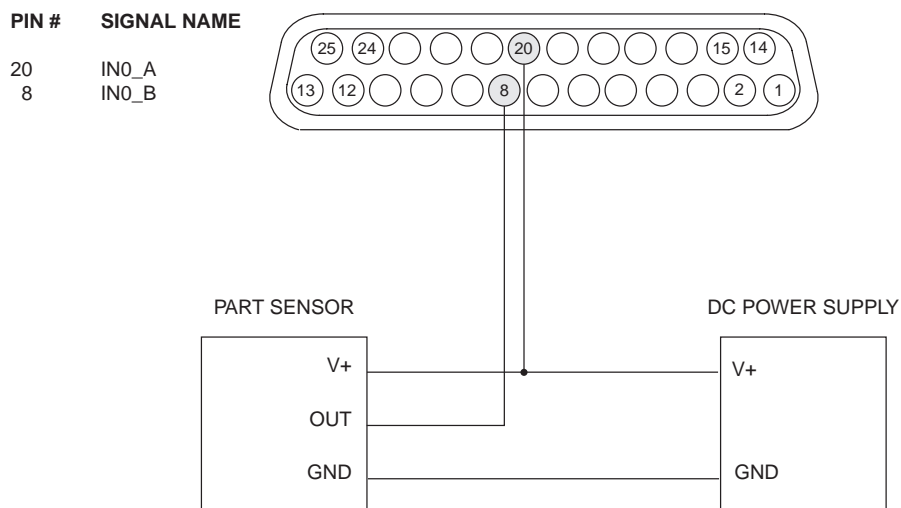


Figure D-15 Wiring diagram for current-sinking (NPN open collector) part sensors.

Appendix D

Tracking

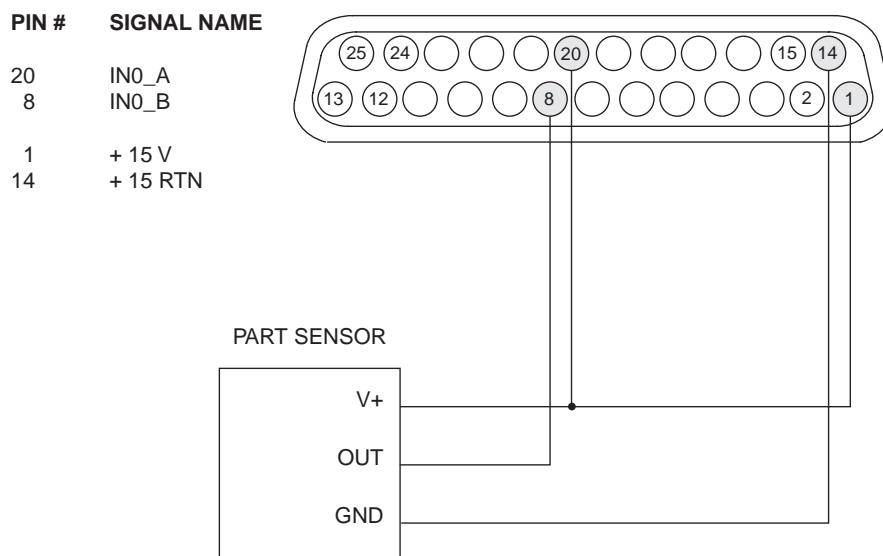


Figure D-16 Wiring diagram for current-sinking (NPN open collector) part sensors using Flyer's built-in power supply.

Figure below shows a customer-supplied power supply driving a current-sourcing PNP open collector part sensor. Figure D-18 shows how to power the same type part sensor from Flyer 3D Head's +15 VDC power supply.

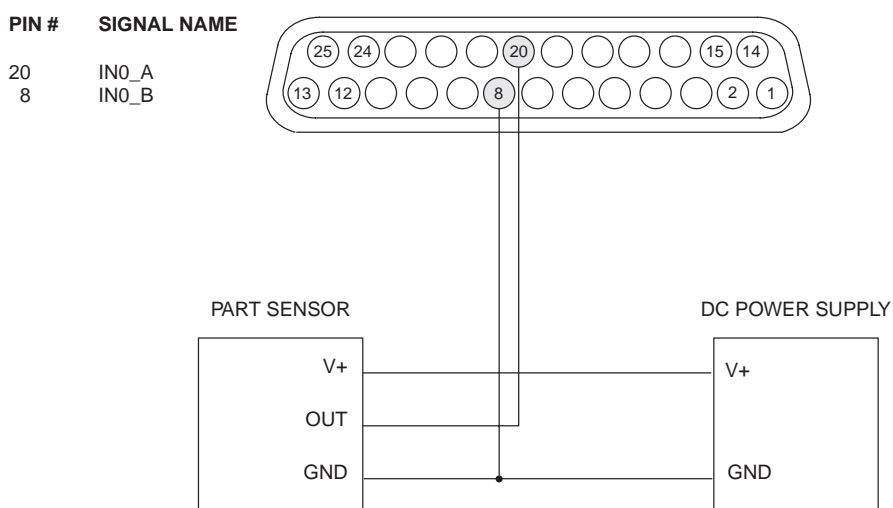


Figure D-17 Wiring diagram for current-sourcing (PNP open collector) part sensors.

Appendix D

Tracking

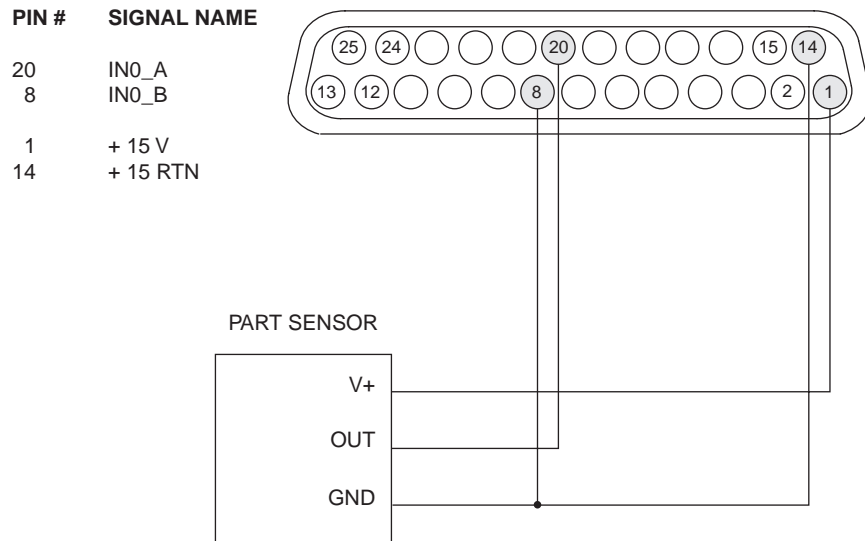


Figure D-18 Wiring diagram for current-sourcing (PNP Open Collector) sensors using Flyer's built-in power supply.

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 the figure below and following the steps below:

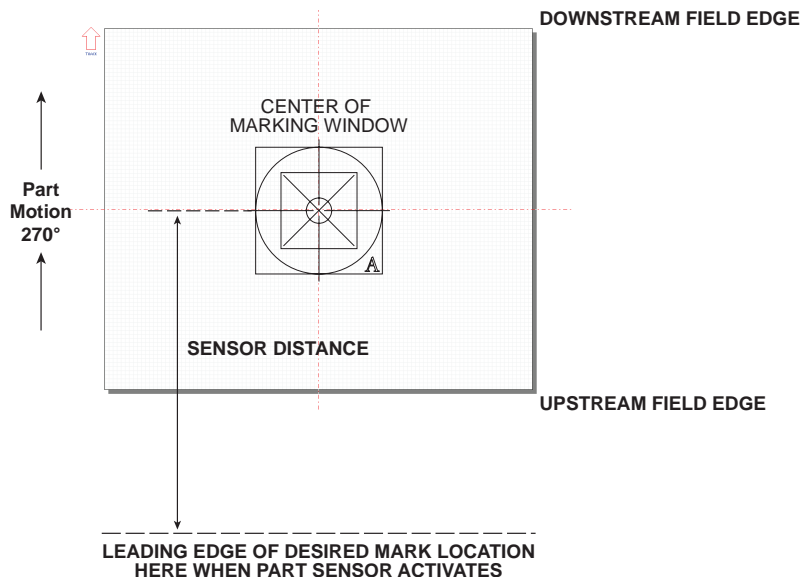


Figure D-19 Part sensor setup.

- 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 Flyer 3D Head to generate "Missed Start" errors. Mechanical or

Appendix D

Tracking

relay contact outputs may also provide part sense inputs, however the user must properly debounce the contacts to prevent multiple part sense inputs to Flyer.

- 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 Locate and load FactoryTestMark1.mkh from the C:\Program Files\WinMark folder.
- 4 Center a sheet of anodized aluminum or a scrap production part on the conveyor at the point of focus and mark the test mark file. This step locates the center of the Marking Window.
- 5 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.
- 6 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.
- 7 Enter this number (in the selected units of measure) for the Sensor Distance value in WinMark Pro.

DC power supply

The Flyer 3D 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 below lists electrical specifications when choosing an external DC power supply to power your input/output circuits.

Table D-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 properties

WinMark Pro v7 contains a Flyer 3D tab (labeled Flyer 3D Beta 2 in Figure below). 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). Tracking parameters

Appendix D

Tracking

are located on the Flyer 3D 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 Flyer 3D tab corresponds to the “name” given to your Flyer 3D head. Every Flyer head leaves the factory with a unique name based on the head’s serial number—“Flyerxxxxxx”; where xxxxxx are the last

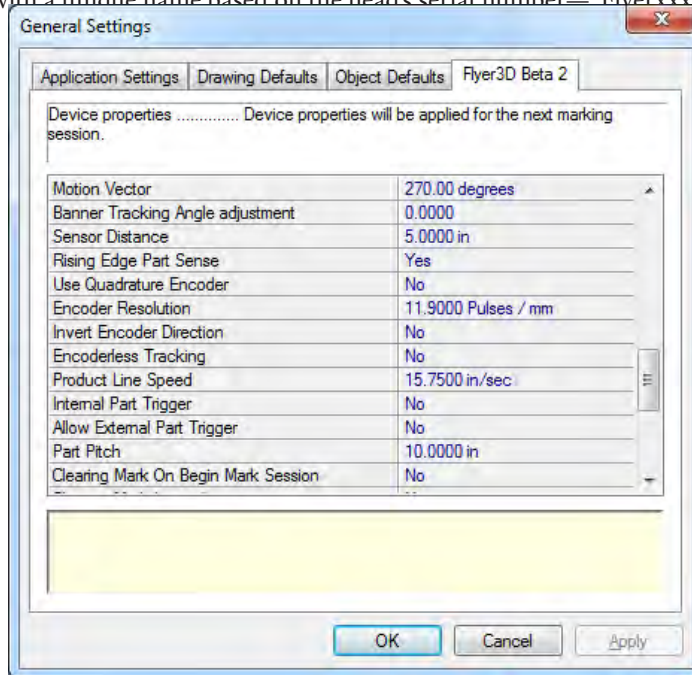


Figure D-20 Tracking properties on the Flyer 3D tab.

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 like its Ethernet IP address or a reference to its physical location such as “AssemblyLine3”.

To setup your Flyer 3D Head for tracking, make sure the head is communicating with WinMark Pro v7 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 D-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 0° or 180° provide the fastest line speeds because part movement is along the long axis of the marking field; 90° or 270° part movement is slightly slower due to the shorter mark area. WinMark Pro v7 and Flyer support Motion Vector values in 0.01° increments.

Appendix D

Tracking

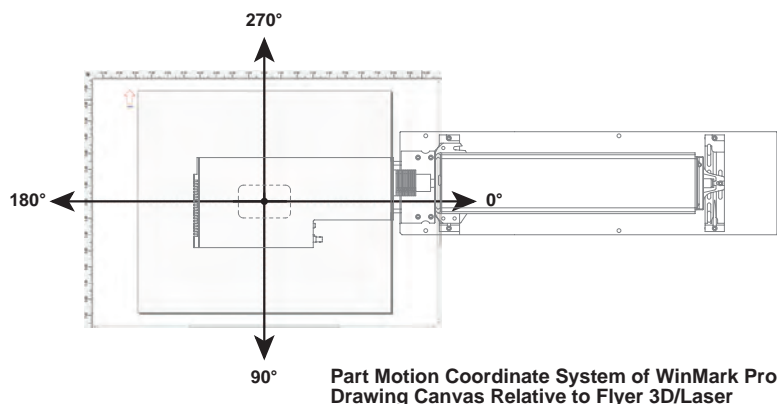


Figure D-21 Drawing Canvas coordinates relative to Flyer 3D.

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, 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), the Flyer 3D head 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 Flyer 3D Head 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 below 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.

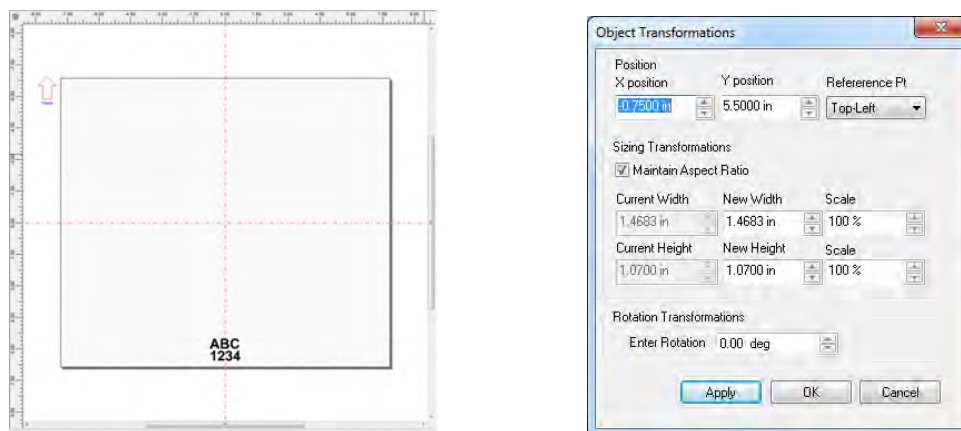


Figure D-22 X-Y position Object Reference Point coordinates.

Appendix D

Tracking

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 below illustrates typical part sensor waveforms.

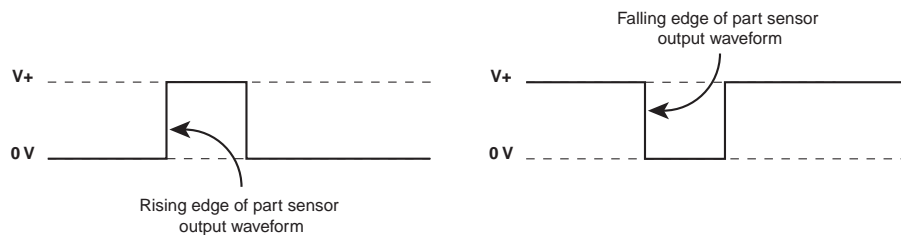


Figure D-23 Part sensor output waveforms.

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. Refer back to the Tracking 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.

Appendix D

Tracking

Encoderless Tracking

In constant velocity (line speed) applications, Encoderless Tracking allows tracking without using an external encoder. When Yes is selected, the Flyer3D head 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.

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 Flyer 3D Head 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), the Flyer head 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 Flyer 3D Head 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'.

Appendix D

Tracking

Determining line speed

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 Flyer 3D Head in tracking mode.

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

Sample calculations

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

Sample calculation #1

Refer to the figure below and read through the following sample line speed calculation.

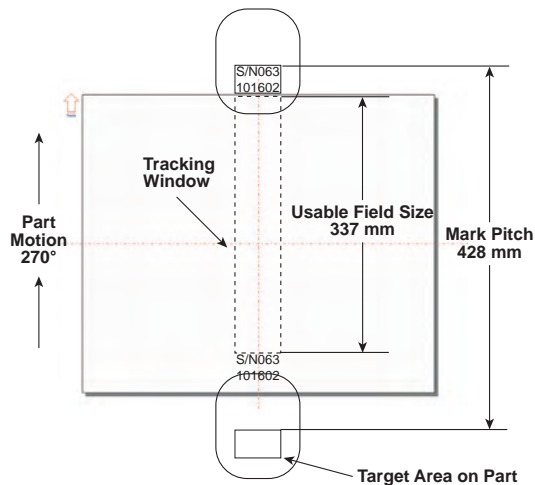


Figure D-24 Flyer tracking line speed calculation #1.

The mark is being made by a Flyer 3D Head in tracking mode with mark field dimensions of 400 mm × 350 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 337 mm.

The Tracking Window is defined as the smaller of either Usable Field Size or Mark Pitch. Usable Field Size is 337 mm and Mark Pitch is 428 mm, so the Tracking Window is 337 mm.

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

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

Appendix D

Tracking

$$= 337 \text{ mm} / 0.32 \text{ sec}$$

$$\text{Line Speed} = 1053 \text{ mm/sec} = 63.1 \text{ m/min} = 207.0 \text{ ft/min}$$

Sample calculation #2

Refer to figure below and the following sample line speed calculation.

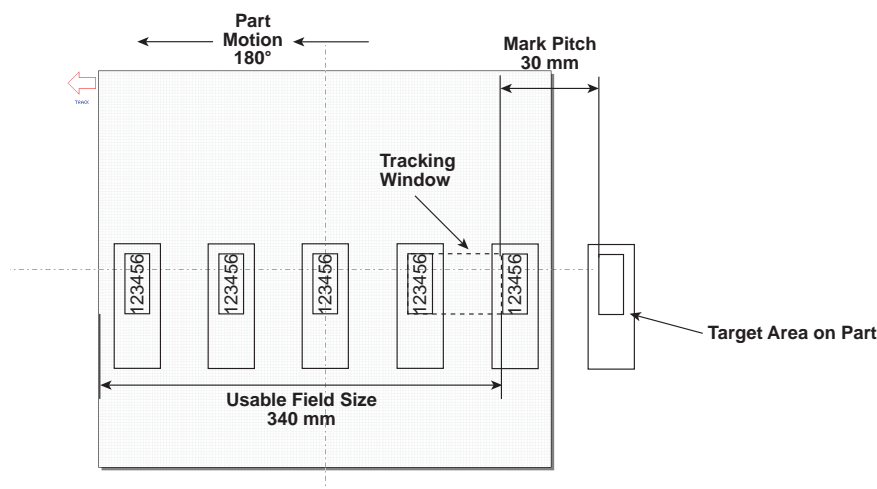


Figure D-25 Flyer 3D tracking line speed calculation #2.

The mark is being made by a Flyer 3D Head in tracking mode with mark field dimensions of 400 mm × 350 mm. A Motion Vector of 180° is set due to the application's part motion requirements. Usable Field Size is 340 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.

$$\begin{aligned} \text{Line Speed} &= \text{Tracking Window} / \text{Cycle Time} \\ &= 30 \text{ mm} / 0.20 \text{ sec} \end{aligned}$$

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

Tracking optimization

Text

The best, and fastest, files to mark in a Flyer 3DHead 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 D-28), Flyer 3D Head 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 D-28 illustrates placement of the text to be marked on the Drawing Canvas.

Appendix D

Tracking

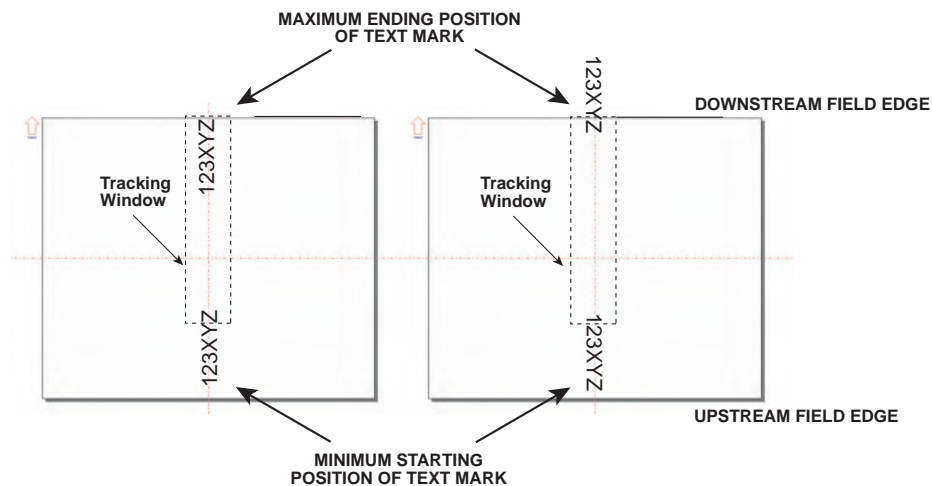


Figure D-26 Sample text mark.

Flyer 3D Head 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 D-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.

Because Flyer 3D Head 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 the following figure so that the laser mark is made moving against, or counter to, the direction of part motion.

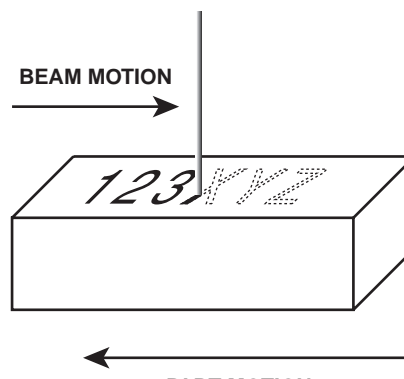


Figure D-27 Beam/mark motion.

- 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 to the figure on the prior page).

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.

Appendix D

Tracking

- 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®, or CorelDRAW®.

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 in the following figure, arrange drawing objects as required.

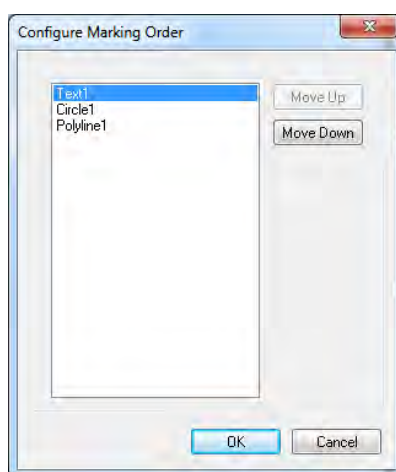


Figure D-28 Configure Marking Order dialog box.

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.

Appendix D

Tracking

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 the prior figures).
- If the Tracking Window is smaller than Usable Field Size, increase the Mark Pitch so it is equal to, or greater than, the Usable Field Size. If this is not possible, then consider adding a second Flyer 3D Head so 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 to mark vector circles instead of raster-filled cells.
- Simplify line art.

Summary

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

Appendix E

E

This appendix contains the following information:

- Banner tracking – describes the Flyer 3D Head banner tracking function and explains how to configure the system to create a successful banner tracking application.

Important Note: Please review all sections in this appendix and Appendix D (Tracking) before designing your Flyer 3D Head banner tracking system.

Note: If you are installing a Flyer 3D Head to perform banner tracking, please perform the tasks described in the Technical Reference and Operation chapters before proceeding with this section.

Appendix E

Banner Tracking

The Banner tracking section includes subsections:

- Introduction
- Banner tracking definitions
- Banner tracking mark criteria
- Banner tracking hardware
- WinMark Pro banner tracking properties
- Mark file banner tracking setup
- Determining line speed
- Banner tracking optimization

Introduction

Flyer 3D Head's support a feature called banner tracking. The banner tracking function allows the Flyer 3D Head to create marks on moving objects (tracking) where the mark extends beyond the extents of WinMark Pro's Drawing Canvas. This function is useful for marking long text strings, logos, or other objects, on lengths of cable, piping, tubing, etc. as the material moves through the mark field. Banner tracking text strings can be serialized as required by the application.

This Appendix does not cover standard tracking functionality in its entirety, but provides only new information related to banner tracking or existing tracking properties that behave differently in banner tracking mode. For complete tracking details, see Appendix D or the WinMark Pro Laser Marking Software User Guide.

Banner tracking definitions

The definition of the terminology used in banner tracking is identical to standard tracking with the addition of one new term, the Banner Window. See Appendix D or the WinMark Pro Laser Marking Software User Guide to review standard tracking definitions.

Banner Window

The Banner Window is the area within the Marking Window (the area contained within the Drawing Canvas) where each segment of the banner mark is marked. Ideally, the Banner Window size, defined by the Banner Window Interval property, should cover no more than 50% to 75% of the length of the maximum mark field. WinMark Pro then breaks up the entire banner mark into multiple Banner Windows and marks each segment as it tracks through the Tracking Window (the area where marking is completed without error).

Banner tracking mark criteria

- In WinMark control mode (where WinMark sends microvector data to the head through an Ethernet connection), the banner mark can consist of any vector objects, WinMark stroke text, TrueType®/ OpenType® style text, and bitmaps including 1D or 2D barcodes and black & white or grayscale bitmap graphics.

Appendix E

Banner Tracking

- In Stand-alone control mode (where the .mkh mark file resides in the head's Filestore or on a network share), the mark can consist of any vector objects, WinMark stroke text, TrueType-style text, and bitmaps including 1D or 2D barcodes and black & white or grayscale bitmap graphics.
- In Stand-alone control mode, the mark cannot contain OpenType-style text objects.
- Although WinMark Pro automatically adjusts marking to begin on the downstream edge of raster objects such as bitmap graphics, filled text, or barcodes in order to optimize banner tracking speed, the Raster Scan Direction property must be set so the scan direction is at right angles to the banner tracking direction.
- When marking raster-style objects, such as barcodes, try to position these objects so they do not cross a Banner Window boundary. This will eliminate any gaps, overlaps, or "stair steps" in situations where banner tracking parameters are not precisely adjusted.
- The Drawing's field transformation properties (Field Offset X, Field Offset Y, Field Rotation, Field Transform Org X, and Field Transform Org Y) must be set to zero (0), their default values.
- When banner tracking, set the Encoderless Tracking property to No in order to prevent stitching mismatches at Banner Window boundaries. We highly recommend the use of a position encoder to account for the very slight variations seen in all part motion systems. Encoderless banner tracking will not provide acceptable results when subtle changes in part velocity occur.

Banner tracking hardware

The hardware required for banner tracking is identical to standard tracking hardware. See Appendix D for detailed information.

WinMark Pro banner tracking properties

In WinMark Pro v7, the Flyer 3D tab (labeled Flyer3D Beta 2 in the figure below) contains head specific tracking setup parameters. These tracking properties are located on the Flyer 3D tab

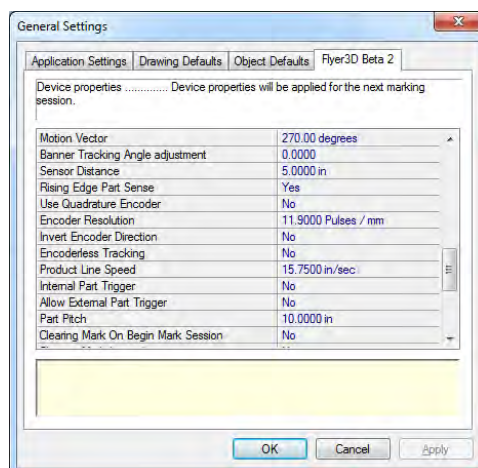


Figure E-1 Tracking properties on Flyer 3D tab.

Appendix E

Banner Tracking

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.

To setup your Flyer 3D Head for banner tracking, connect with WinMark Pro v7 through an Ethernet connection and then edit the parameters described below. The properties described below are only those that affect banner tracking differently than standard tracking. For complete descriptions of all tracking properties, see Appendix D or the WinMark Pro Laser Marking Software User Guide.

Motion Vector

Set the direction of part movement through the mark field. When looking at WinMark Pro's Drawing Canvas (shown in the figure below), 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 0° or 180° provide the fastest line speeds because part movement is along the long axis of the marking field; 90° or 270° part movement is slightly slower due to the shorter mark area. WinMark Pro v7 and Flyer 3D Head's support Motion Vector values in 0.01° increments.

Note: The Drawing's Field Rotation property must be set to zero (0).

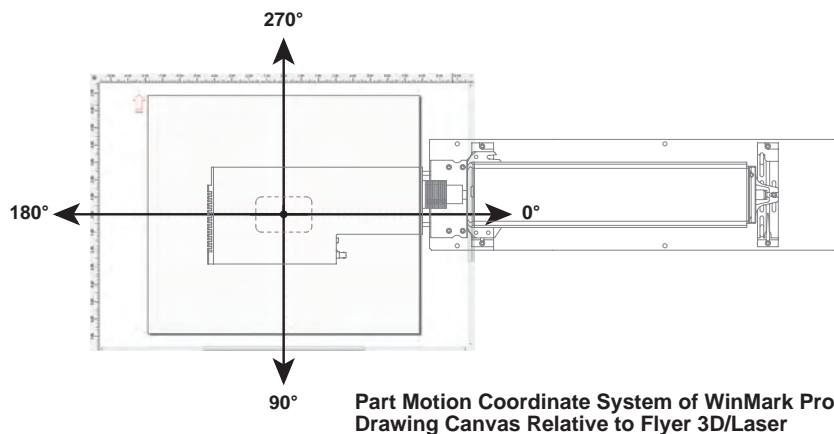


Figure E-2 Drawing Canvas coordinates relative to the Flyer 3D Head.

Banner Tracking Angle Adjustment

Use the Banner Tracking Angle Adjustment property to fine-tune any angular misalignment of the marking head to part movement. This property can only provide $\pm 0.15^\circ$ of adjustment; any further adjustment must be made by physically moving the marking head.

To fine-tune the banner tracking angle once the initial tracking setup is complete, create a mark file containing three parallel lines in the direction of travel as shown in the following figure. Center one line on the Drawing Canvas and place the other two lines on each edge of the canvas.

Appendix E

Banner Tracking

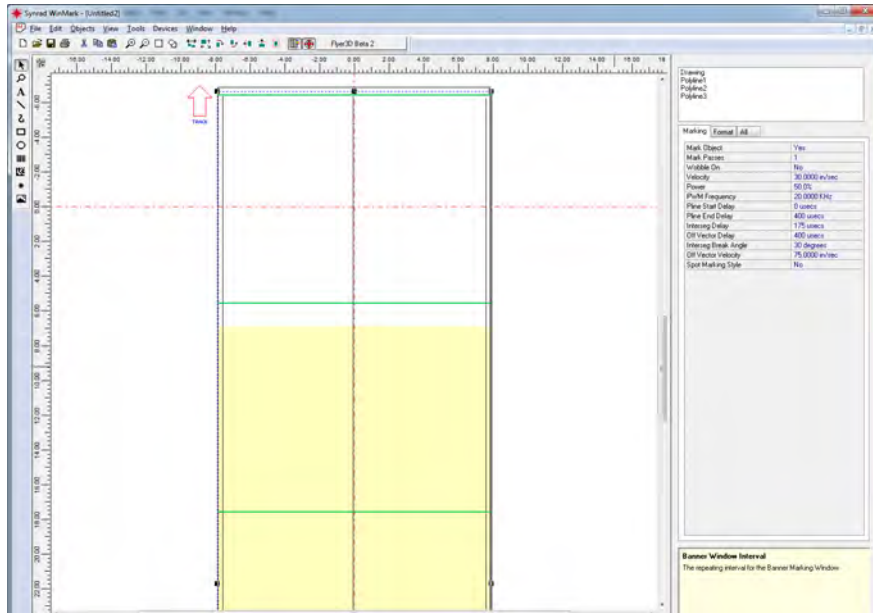


Figure E-3 Mark file for fine-tuning Banner Tracking Angle Adjustment.

While marking these lines, verify that each line is stitched together lengthwise without any offset. If one or more lines exhibit an offset or “stair step”, change the Banner Tracking Angle Adjustment property value until all three lines are straight, without any offsets or steps.

Note: Gaps, overlaps, or steps in any of the three lines indicate that either Encoder Resolution and/or Banner Tracking Angle Adjustment values must be adjusted as described in the Banner tracking optimization section.

Sensor Distance

The Sensor Distance value is not related to the physical part sensor location, but 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.

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’s Drawing Canvas (in the axis of part motion) has no affect on part mark location although, when banner tracking, the leading edge of the mark should be positioned halfway between the top of the Drawing Canvas and the center (0,0 coordinates) as shown in the following figure to establish the top edge of the first Banner Window.

Appendix E

Banner Tracking

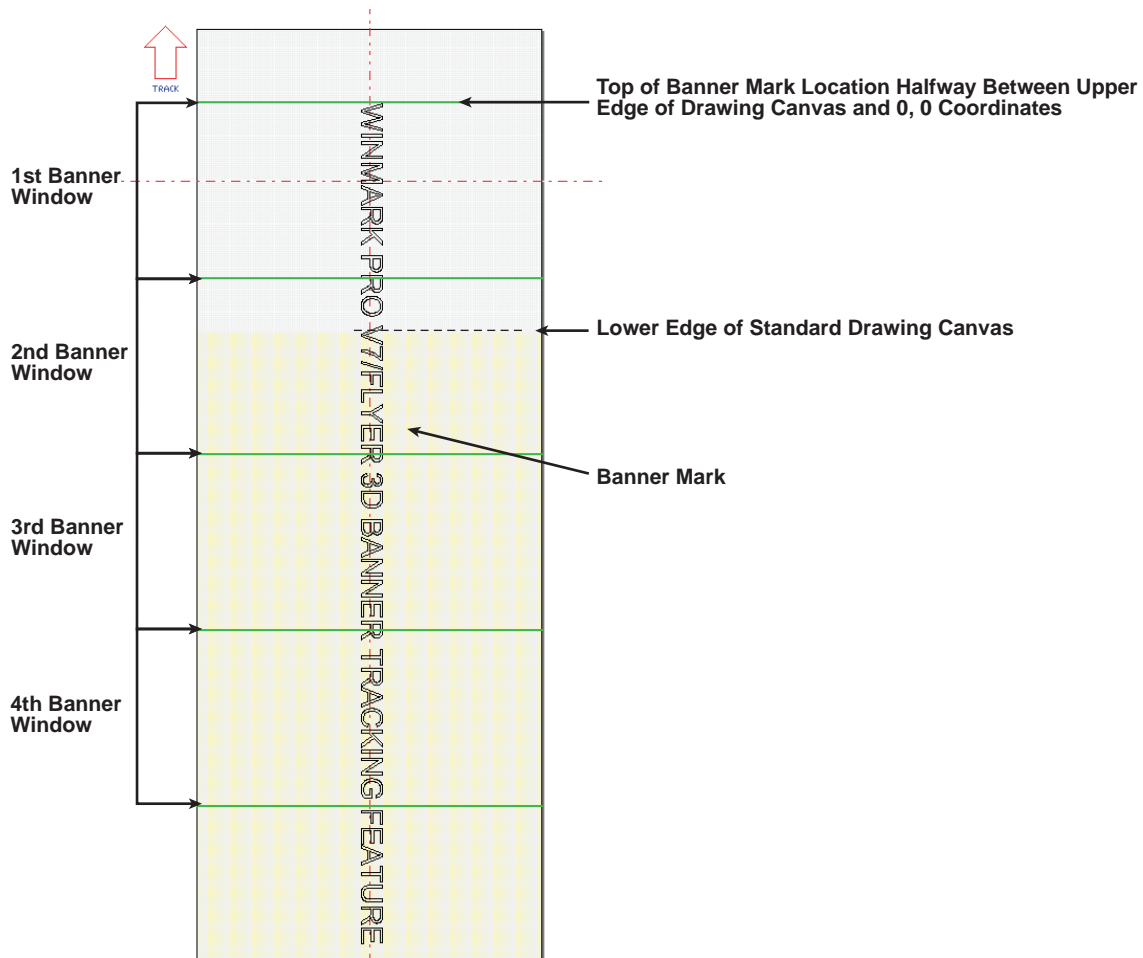


Figure E-4 Banner mark location on Drawing Canvas.

Encoder Resolution

Encoder Resolution is the number of encoder pulses received per millimeter of distance traveled by the part conveyor. This property value is accurate to four decimal places (0.0001 pulses per millimeter). To obtain accurate banner tracking, it may be necessary to fine-tune this property to the third or fourth decimal point.

Before fine-tuning the Banner Tracking Angle Adjustment property, first adjust Encoder Resolution to eliminate any gaps or overlaps in the lines in the setup file (the three parallel lines shown in Figure E-3) as described in the Banner tracking optimization section.

Encoderless Tracking

We highly recommend that you set Encoderless Tracking to No and install a position encoder. A position encoder connected directly to the motion system provides the best accuracy when mark objects extend across Banner Window boundaries. Encoderless banner tracking will not provide acceptable results when subtle changes in part velocity occur.

Appendix E

Banner Tracking

Part Pitch

When using internal triggering (Internal Part Trigger property is Yes), an error will occur if the Part Pitch property is set to a value smaller than the total length of all combined banner intervals required to mark the entire object. In applications where parts are spaced very close together, you must carefully select a Banner Window Interval value that is close to a multiple of the mark's total length. For example, a part is banner marked with a 400 mm length of text. If you enter a Banner Window Interval value of 300 mm, the mark would be made in two banner window intervals for a total length of 600 mm.

Therefore, the closest spacing for the next part would be 200 mm due to the extra space left over in the second banner interval (two banner windows with a total length of 600 mm minus the 400 mm text mark). In this case, the minimum Part Pitch is 600 mm. If you picked a Banner Window Interval of 200 mm, the total length of the two combined banner intervals would be 400 mm, matching the length of the actual mark, and you would have the closest spacing possible; where the parts can be positioned end-to-end (using a Part Pitch property value of 400 mm).

Mark file banner tracking setup

Set the following properties to configure Flyer 3D Head for banner tracking. When the Drawing object is selected, these three banner tracking properties appear on the Marking tab:

Track Marking Object

As with a standard tracking mark, set Track Marking Object to Yes.

Banner Marking

When Track Marking Object is Yes, the Banner Marking property appears. To perform a banner mark, set this property to Yes.

Banner Window Interval

When Banner Marking is Yes, the Banner Window Interval property appears. The Banner Window Interval determines the size of the banner marking area, the Banner Window. The numeric value entered should be no more than 50% to 75% of the length of the maximum mark field (the Marking Window).

If the Banner Window Interval is too large (greater than 75% of the length of the Marking Window), "line speed too fast to finish" errors may occur. If the Banner Window Interval is too small, the computer (in WinMark control mode) or the Flyer 3D Head (in Stand-alone mode) must perform more mathematical calculations, resulting in sub-optimal line speeds.

Refer back to the Part Pitch description for information on how the Banner Window Interval affects Part Pitch and minimum part spacing. Also note that the ideal position for the leading edge of the banner mark location is halfway between the downstream edge of the Drawing Canvas and the center (0, 0 coordinates).

Note: Banner Window Intervals are displayed as solid green lines spaced perpendicular to part motion across the Drawing Canvas.

Appendix E

Banner Tracking

Determining line speed

Because banner tracking marks typically extend beyond the Marking Window, it is not possible to calculate line speed as done in standard tracking. Banner tracking line speeds must be determined experimentally.

Banner tracking optimization

Optimize the banner tracking setup

- 1 First, run the appropriate `linestackxxx.mkh` file and adjust Encoder Resolution (see Appendix D) until all long and short lines in the `linestack` file appear as a single long line.
- 2 Create a banner tracking setup file as shown in the figure below.
- 3 Run the banner tracking setup file and fine-tune the Encoder Resolution value as required to eliminate line gaps or line overlaps as shown by lines "A" through "D" in the figure below. When gaps or overlaps are eliminated, proceed to Step 4.

Note: Although your mark may exhibit "stair steps" because of angular misalignment, there should be no gaps or overlaps between the steps.

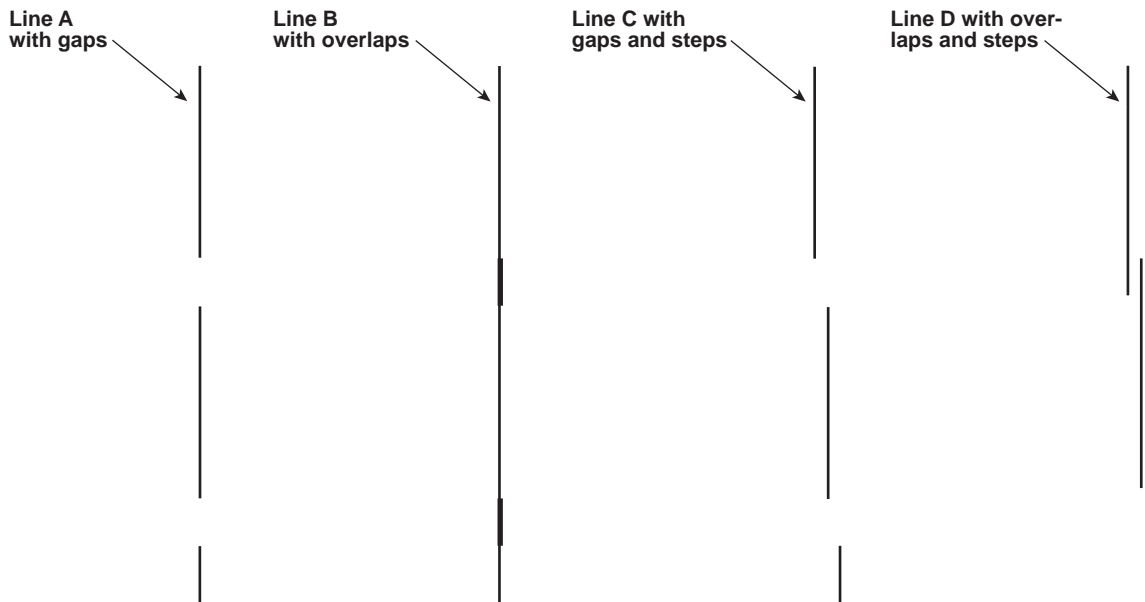


Figure E-5 Illustration of lines showing gaps and overlaps between Banner Windows.

- 4 If the mark produced by the banner tracking setup file has "stair steps" as shown by line "E" in Figure E-6, fine-tune the Banner Tracking Angle Adjustment value, increasing or decreasing the angle in the range of -0.15° to $+0.15^\circ$. If you cannot eliminate the steps within the allowable range of $\pm 0.15^\circ$, you will need to carefully change the physical angle of the marking head/laser assembly in relation to part movement. Continue fine-tuning the Banner Tracking Angle Adjustment until all three lines in the setup file are solid, straight lines as demonstrated by line "F" in the following figure.

Appendix E

Banner Tracking

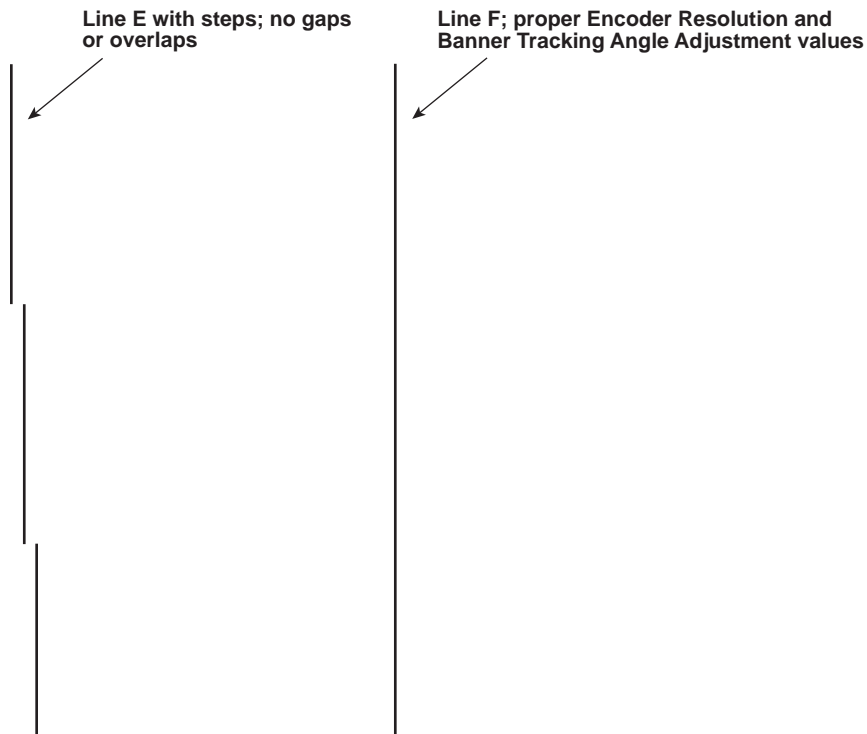


Figure E-6 Illustration of line showing “stair steps” between Banner Windows.

Optimize the marking method

The speed of banner tracking will vary depending on the type of objects in the mark file and the mark mode selected—WinMark control mode or Stand-alone control mode. In Stand-alone control mode (where the .mkh mark file resides in the head’s Filestore or on a network share), marks are generally quicker, especially when stroke fonts are used. If the banner tracking file contains TrueType-style fonts, WinMark control mode is generally faster.

Line speed can also be affected by the Banner Window Interval property. Best results are obtained experimentally by increasing or decreasing Banner Window Interval values until fastest line speeds are consistently achieved.

Appendix F

F

This appendix contains the following information:

- Radial marking – describes the Flyer 3D Head radial marking function and terminology and explains how to connect user-supplied motion control components to mark bitmaps around the circumference of a cylindrical object or to step and raster across a flat surface.

Important Note: Please review this appendix thoroughly before designing your Flyer 3D Head radial marking system.

Appendix F

Radial Marking

The Radial marking section includes subsections:

- Introduction
- Radial marking methodology
- Equipment setup
- WinMark Pro/Flyer 3D Head setup

Introduction

Most 2D and 3D scan heads are designed to mark flat surfaces that are within the focal plane of the head's focusing lens (2D heads) or a combination of flat and stepped surfaces that are within the Z-axis range of the dynamic focusing lens (3D heads). For 2D heads, variations in surface flatness or surfaces that are not parallel to the lens compromise the accuracy of beam placement on the part surface. For example, as surface curvature increases steeply away from the focal plane, focused spot size begins to increase and the beam's incident angle increases to a point where mark segments become elongated along the beam path.

Traditionally, marking an image on a curved surface or cylinder requires the user to break an image into individual sections, or tiles, to minimize the distortion of each tile. The curved surface or cylinder is then marked section by section, while carefully positioning the cylindrical surface between marks to 'stitch' the image together. Even a three-axis scan head that compensates for surface curvature, can, at best, only mark approximately 120° around a cylinder. For marks designed to wrap completely around an object, you still need to tile the image and then carefully reposition the cylinder to stitch the image together.

The WinMark Pro/Flyer 3D Head implementation works with a user-supplied motion control system, like a stepper system, and input/output (I/O) signals to mark raster images around cylindrical objects. This is accomplished by marking a single raster line at a time while using I/O signals between the Flyer 3D Head and parts handling equipment to coordinate marking and part rotation. Because each raster line is positioned in the same area of the mark field, there is no distortion throughout the image, even if it wraps completely around the object.

Radial marking methodology

Once a mark file containing a bitmap image is created and the Radial Marking property is enabled, marking begins one raster line at a time. After each line is marked, a Flyer 3D Head output signals parts handling equipment that a raster line is complete. The parts handler then rotates the object by one step and signals a Flyer 3D Head input to begin another scan line. This handshaking sequence continues until the bitmap is completely marked. While this seems to be a time-consuming process, I/O and part movement occurs quickly, so there is very little difference in actual process time compared to standard marking.

To view a video showing an example of radial marking, check the SYNRAD web site at: https://www.synrad.com/applications/markings_coding#keyapplications and look for the video titled "Marking PVC Around a Circumference" on the playlist.

Equipment setup

The user must install a rotary mechanism under the marking head with the long axis of rotation centered under the output aperture, at the point of focus as shown in the following figure.

Appendix F

Radial Marking

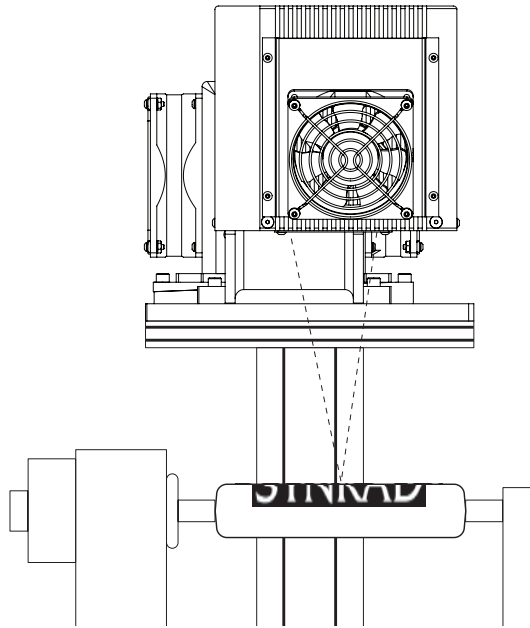


Figure F-1 Rotary stepper mechanism positioned under Flyer 3D Head.

The drive mechanism must be able to rotate incrementally in discrete steps that relate to the focused spot size. For example, on a Flyer 3D Head with a 347 mm × 304 mm field, each rotational step must be 0.010" (0.245 mm).

To interface with the Flyer 3D Head, the control system for the drive mechanism must have at least two dedicated inputs and two dedicated outputs that operate in the range of 5.0 V–24.0 VDC.

The parts handling controller must provide a 'start mark' output to Flyer 3D Head input IN0 and a 'part moving' output to Flyer input IN4. The Flyer 3D Head will provide a 'move part' output on OUT4 and a 'step command' output on OUT5 to your parts handling inputs.

WinMark Pro/Flyer 3D setup

Mark file setup

After the rotary control system is complete, perform the following steps to configure WinMark Pro and the Flyer 3D head for radial marking:

- 1 Open (or create) a mark file containing an imported bitmap object.
- 2 With the Drawing object selected, click the Automation tab and setup the normal WinMark automation loop using IN0 and OUT4 on the Flyer 3D head as described in the WinMark Pro User's Guide.
- 3 Select the bitmap object, click the Format tab and set the Radial Marking property to Yes.
- 4 Click the Part Moving Input property and click the arrow button. In the drop-down list, click IN4 and choose Set (see the following figure). One raster line in the bitmap is marked each time this Flyer input transitions from an active (Set) to inactive (Clear) state.

Appendix F

Radial Marking

The screenshot shows the 'Marking' tab of a configuration window. The 'Part Moving Input' property is set to 'IN1'. The 'Step Command Output' property is set to 'OUT5' with the 'Set' button highlighted. The 'Timeout (msec)' property is set to 'Ignore'.

Property	Value
Object Left Pos	-1.0000 in
Object Top Pos	-0.4667 in
Object Right Pos	1.0000 in
Object Bottom Pos	0.4667 in
Raster Scan Dir	Vertical
Array Columns	1
Array Rows	1
Bitmap Inverted	No
Bitmap Scan Type	Normal
Radial Marking	Yes
Part Moving Input	IN1
Step Command Output	OUT5
Timeout (msec)	Ignore

Figure F-2 Configure the Part Moving Input property.

- Click the Step Command Output property and click the arrow button. In the drop-down list, click OUT5 and choose Set (see the following figure). When Set (active), this Flyer 3D Head output signals parts handling equipment to rotate the part one step.

The screenshot shows the 'Marking' tab of a configuration window. The 'Step Command Output' property is set to 'OUT5' with the 'Set' button highlighted. The 'Timeout (msec)' property is set to 'Ignore'.

Property	Value
Object Left Pos	-1.0000 in
Object Top Pos	-0.4667 in
Object Right Pos	1.0000 in
Object Bottom Pos	0.4667 in
Raster Scan Dir	Vertical
Array Columns	1
Array Rows	1
Bitmap Inverted	No
Bitmap Scan Type	Normal
Radial Marking	Yes
Part Moving Input	IN1
Step Command Output	OUT5
Timeout (msec)	Ignore

Figure F-3 Configure the Step Command Output property.

- Click the Timeout (msec) property and enter a value for WinMark to wait until the next input (IN4) state change (enter -1 to wait indefinitely). When a Step Command Output transition occurs, the Part Moving Input must also transition within the specified timeout period or the mark session will abort.

Appendix F

Radial Marking

Standard automation flowchart

The following figure illustrates the standard WinMark Pro Automation Flowchart. Radial marking and its corresponding automation occur within the Mark stage.

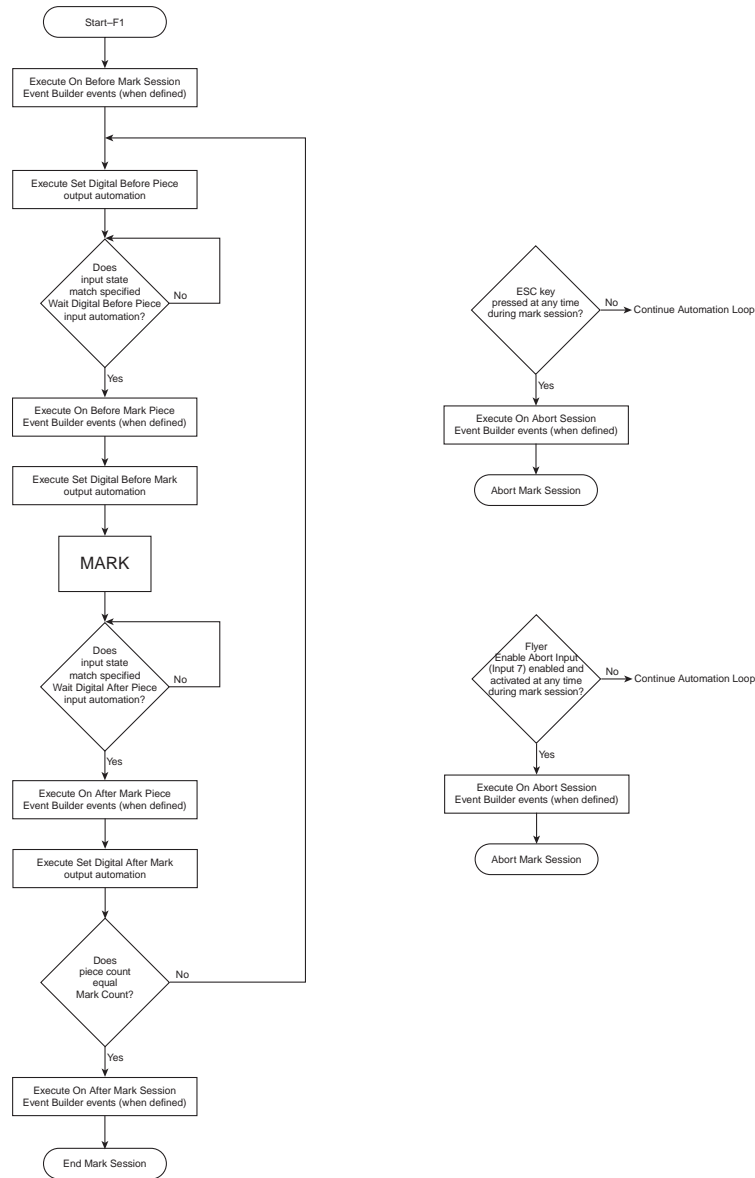


Figure F-4 WinMark Pro Automation Flowchart.

When a mark session begins, WinMark begins the standard automation loop by executing On Before Mark Session Event Builder events and continues through Set Digital After Mark outputs before checking if the current piece count equals the Mark Count property value. If not, WinMark begins executing at the Set Digital Before Piece stage again. When piece count equals Mark Count, WinMark executes On After Mark Session events and ends the mark session. Each pass through the automation loop results in a single part (or array of parts) being marked.

Appendix F

Radial Marking

Radial marking flowchart

The difference between radial marking and standard parts marking is that radial marking automation runs completely within the Mark stage of automation and does not exit until the bitmap image is completely marked or the session is aborted (see the following figure). Each pass through this loop results in a single raster line being marked. After the last raster line is marked, WinMark exits the Mark stage and continues with the next automation stage—Wait Digital After Piece.

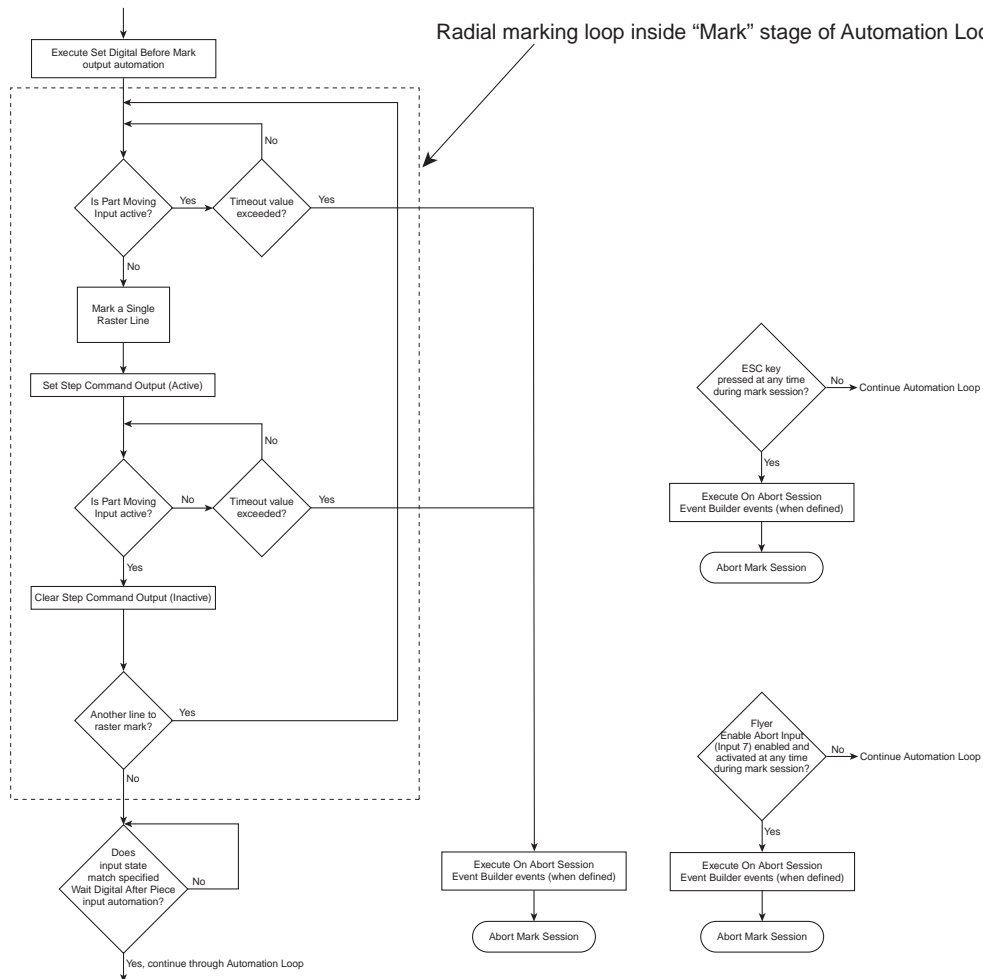


Figure F-5 Radial marking state diagram.

- 1 When a radial marking mark session starts (by pressing F1 or clicking the Start-F1 button), WinMark Pro begins the standard automation loop by executing On Before Mark Session Event Builder events, when defined.

Appendix F

Radial Marking

- 2 At the next stage, Set Digital Before Piece, output OUT4 is Set (active) to signal parts handling equipment to move a part into position for marking.
- 3 WinMark then pauses at the Wait Digital Before Piece step until the parts handler Sets (activates) Flyer 3D Head input IN0, which signals the part is positioned and lasing can begin.
- 4 Next, any defined On Before Mark Piece Event Builder events are executed.
- 5 In this next stage, Set Digital Before Mark, WinMark Clears Flyer 3D Head output OUT4 to signal the parts handler that lasing will begin.
- 6 Immediately on entry to the Mark stage, WinMark checks Flyer 3D Head's designated Part Moving Input (input IN4 in this example). If the input is Set (active), WinMark verifies the Timeout (msec) value has not been exceeded; if the Part Moving Input is Clear (inactive; meaning that part rotation has halted), then the first raster line in the bitmap image is marked.
- 7 After completion of the raster line, Flyer 3D Head's designated Set Command Output (output OUT5 in this example) is Set active to indicate part rotation can begin.
- 8 WinMark checks Flyer 3D Head's Part Moving Input (IN4). If Set (active), then part movement is occurring and WinMark Clears Flyer 3D Head's Set Command Output to reset the 'rotate part' signal. If input IN4 is Clear (inactive), WinMark verifies the Timeout (msec) value has not been exceeded.
- 9 If the bitmap image contains another unmarked raster line, WinMark loops back to wait for the Part Moving Input IN4 to toggle from a Set (active) to Clear (inactive) state and then marks another raster line. These steps within the Mark stage of WinMark's automation loop continue until the last raster line is lased.
- 10 When the last raster line in the image is marked, WinMark (at the Wait Digital After Piece step) verifies that input IN0 was cleared during the mark. Parts handling equipment can Clear IN0 anytime after it "sees" output OUT4 go Clear (inactive) on entry into the Mark stage.
- 11 WinMark proceeds to execute any On After Mark Piece Event Builder events and then, in the Set Digital After Mark step, WinMark Sets Flyer 3D Head output OUT4 to signal parts handling to remove the previous piece and position the next piece for lasing. If the piece count does not equal the Mark Count property, WinMark loops back to the Set Digital Before Piece stage and prepares to mark another part. If the piece count equals Mark Count, WinMark executes any defined On After Mark Session events and then ends the mark session.

In a radial marking automation loop, as well as in the standard automation loop, WinMark Pro will immediately execute any defined On Abort Session Event Builder events and then abort the mark session if the ESC key is pressed or if Flyer 3D Head's Enable Abort Input (Input 7) property was previously enabled and is now active.

Index

A

Allow External Part Trigger property
description, 147
Automation
troubleshooting, 132–133

B

Banner Tracking Angle Adjustment property
description, 145
Beam Enclosure Tube 136

C

Caution
condensation, 36, 40, 51, 136, 154
CDRH requirements 27
CE mark 29
Cleaning materials 120
Cleaning optics 120–122
cleaning solvents, 122
Cleaning solvents 122
Clearing mark 148
Clearing Mark Interval property
description, 148
Clearing Mark On Begin Mark Session property 148
description, 148
Compliance
EU, 28–29
Connection
part sensor, 185–187
rotary position encoder, 180–182
Contact information
European headquarters, 21
Customer Service 21
Cycle Time
definition, 176

D

Daily inspections 118
DC Power cable 124
DC power supply 188
built-in, 181, 182, 185, 188
external, 188
specifications, 188
DHCP 141
note, 141
Disposal 25
DNS server 142
DNS Server IP Address property
description, 142
Drawing Canvas 145

E

Encoder connection 180–182
Encoderless 131, 179, 180
definition, 192
Encoderless Tracking property 147
description, 146
Encoder Resolution 178
calculating, 183
checking, 178, 184
definition, 191
fine-tuning, 183–184
Encoder Resolution property
description, 146
Encoder setup 183–184
calculating resolution, 183
Ethernet IP Address or Host Name property
description, 141
Ethernet MAC Address property
description, 141
EU 27
EU requirements 28
External Communications Server property
description, 148

F

FASI Enable property
description, 144
Fast Acting Safety Interlock (FASI) 144
FCC 27
FCC requirements
caution to the user, 28
FDA 27
Field Height property
description, 143
Filestore 149
Flyer Device tab 140
Interface properties, 140
Flyer Kernel Versio property
description, 141
Flyer U-Boot Version property
description, 141

G

Gas purge specifications 34, 40
Graphics
tracker marking, 196–197

H

Hazard information
additional laser safety information, 25
disposal, 25
general hazards, 24
terminology, 23

I

Input IN0 147
 Input IN3 144
 Interface Type property
 description, 141
 Internal Part Trigger property 147
 description, 147, 162
 Internal Trigger 131
 definition, 192
 Introduction
 Tracking setup, , 173, 199
 Invalid Sensor Distance error 195
 Invert Direction
 definition, 191
 Invert Encoder Direction property
 description, 146
 IP Netmask property
 description, 141

L

Laser Control cable 128
 Laser Institute of America (LIA) 25
 Laser Marking FAQ 132
 Laser Output is PWM property
 description, 144
 L-bracket 138
 Line Speed 179, 180
 calculations, 193–194
 definition, 192
 Line speed formula 193

M

Maintenance
 Daily inspections, 118
 Mark 176, 179, 192, 193, 197
 definition, 174
 Marking Head Firmware Version property
 description, 141
 Marking Window 146, 179, 193, 195, 196
 definition, 174
 Mark On Startup property
 description, 149
 Mark Pitch 147, 178, 192, 193, 197
 definition, 175
 Mark placement 196
 Master Control File (MCF) 149
 Missed Start error 187
 MODBUS 148
 Modbus I/P 148
 Modbus I/P protocol 148
 Modbus User Function property
 description, 149
 Motion Vector 193, 194

 definition, 189
 Motion Vector property
 description, 145
 Mounting Rail 138

N

Network Share Available property
 description, 142

O

Object Name property
 description, 140
 Occupational Safety and Health Administration (OSHA) 25
 Optics
 cleaning, 120–122
 Optimization 197
 Output OUT7 144, 149
 over-temperature warning output 144

P

Part Edge Sense 188
 definition, 191–192
 Part Pitch property 147
 description, 147
 Part sensor 184–187
 connection, 185–187
 setup, 187
 specifications, 185
 Pitch
 definition, 192
 Power Adjustment property
 description, 144
 Power measurement 136–138
 input measurements, 136–137
 setup, 136
 Power property 144
 Power Wizard 137, 138
 Product Line Speed property 146

Q

Quadrature Encoder
 definition, 191

R

Rising Edge Part Sense property
 description, 146
 Rotary position encoder
 connection, 180–182
 setup, 183–184

S

- Safety precautions
 - laser, 24
- Sales and Applications 21
- Sample line speed calculations 193–194
- Select Ethernet IP Address dialog box 141
- Sensor Distance 178, 188, 191, 195, 196
 - definition, 190
- Sensor Distance property 146
- Serial Number property
 - description, 141
- SetDigital commands 144
- Set Marking Order 196
- Share Domain property
 - description, 142
- Share Name property
 - description, 142
- Share Password property
 - description, 142
- Share ReadOnly property
 - description, 142
- Share Server property
 - description, 142
- Share Username property
 - description, 142
- Show Units Type property 146
- Standalone Marking property
 - description, 148
- Startup Drawing property
 - description, 149
- Status indicator 128, 129
- Switch IO Output 7 property
 - description, 144

T

- Target Area 178, 190, 196
 - definition, 176
- Technical Support 21
- Text
 - tracker marking, 194–195
- Too Fast To Finish error 196
- Tracker marking
 - graphics, 196–197
 - mark placement, 196
 - optimization, 197
 - summary, 197
 - text, 194–195
- Tracking hardware 180–189
 - part sensor, 184–187
- Tracking mark criteria 180–181
- Tracking setup
 - Encoderless, 192
 - Encoder Resolution, 191
 - Internal Trigger, 192

- Invert Direction, 191
- Line Speed, 192
- Motion Vector, 189
- Part Edge Sense, 191–192
- Pitch, 192
- Quadrature Encoder, 191
- Sensor Distance, 190
- Tracking system 174
- Tracking Window 178, 190, 193, 194, 196, 197
 - definition, 176–177
- Track Marking Object 130
- Track Marking Object property 145
- Troubleshooting 124–131, 132–134
 - automation I/O, 132–133

U

- Usable Field Size 175, 179, 193, 197
 - comparisons, 179
 - definition, 175
- Use Control File property
 - description, 149
- Use DHCP property 141
 - description, 141
- Use Quadrature Encoder property
 - description, 146

W

- Working Distance property
 - description, 143

Z

- Z-axis adjustment 127