TELEDYNE PRINCETON INSTRUMENTS
Everywhere**you**look™

Part of the Teledyne Imaging Group

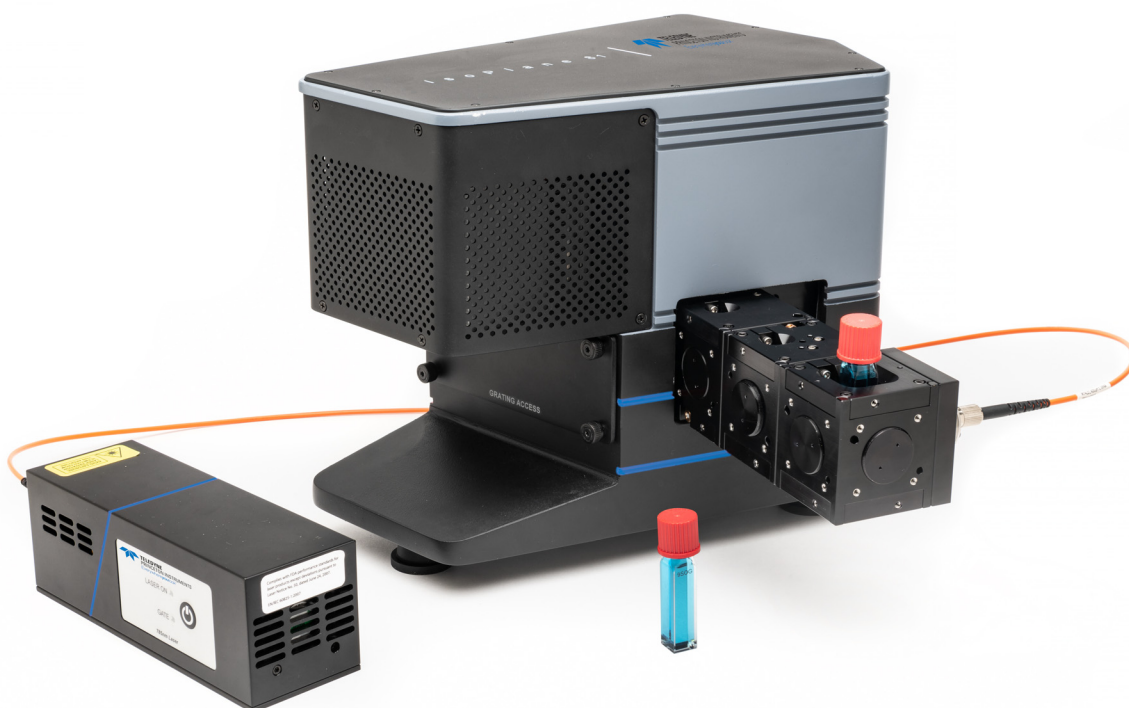# IsoPlane® 81 Imaging Spectrometer System Manual

4411-0167
Issue 1
December 21, 2020

Revision History

Issue	Date	List of Changes
Issue 1	December 21, 2020	This is the initial release of this document.

Table of Contents

Chapter 1: About this Manual

Thank you for purchasing an IsoPlane® 81 Imaging Spectrometer System from Teledyne Princeton Instruments (TPI). Since 1981, Teledyne Princeton Instruments has been the legendary name behind the most revolutionary spectroscopy and imaging products for cutting-edge research.

Please read the manual carefully before operating the system. This will help you optimize the many features of this system to suit your research needs.

If you have any questions about the information contained in this manual, contact the Teledyne Princeton Instruments customer service department. Refer to Contact Information (in the Warranty and Service section at the end of this manual).

1.1 Intended Audience

This user manual is intended to be used by scientists and other personnel responsible for the installation, setup, configuration, and acquisition of imaging data collected using an IsoPlane 81 system.

This document provides all information necessary to safely install, configure, and operate the IsoPlane 81, beginning with the system's initial installation.

1.2 Related Documentation

Table 1-1 provides a list of related documentation and user manuals that may be useful when working with the IsoPlane 81 system. To guarantee up-to-date information, always refer to the current release of each document listed.

Table 1-1:   Related Documentation

Document Number	Document Title
4411-0157	IsoPlane 81 785 nm Multimode Diode Laser Source User Manual
–	IsoPlane 81 Imaging Spectrometer System Data Sheet

Teledyne Princeton Instruments maintains updated documentation and user manuals on their FTP site. Visit the Teledyne Princeton Instruments FTP Site to verify that the most recent user manual is available and being referenced:

ftp://ftp.princetoninstruments.com/Public/Manuals/Princeton Instruments

1.3   Document Organization

This manual includes the following chapters and appendices:

- **Chapter 1, About this Manual**

    This chapter provides information about the organization of this document, as well as related documents, safety information, and conventions used throughout the manual.

- **Chapter 2, IsoPlane 81 System**

    This chapter provides information about the components included with a standard IsoPlane 81 Imaging Spectrometer System, as well as options that are available for purchase from Teledyne Princeton Instruments.

- **Chapter 3, Installation of LightField for the IsoPlane 81**

    This chapter provides information about the installation of Teledyne Princeton Instruments LightField® data acquisition software.

- **Chapter 4, Getting Started**

    This chapter provides information about the installation, configuration, and calibration of the IsoPlane 81 Imaging Spectrometer System, as well as using LightField to acquire spectrographic data.

- **Appendix A, Technical Specifications**

    This appendix provides technical specifications and data for the IsoPlane 81 Imaging Spectrometer System.

- **Appendix B, Outline Drawings**

    This appendix provides outline drawings of the IsoPlane 81 Imaging Spectrometer System.

- **Appendix C, Changing Gratings**

    This appendix provides the procedures necessary to remove and install a grating on the IsoPlane 81 Imaging Spectrometer System.

- **Appendix D, Internal Shutter**

    This appendix provides the procedures necessary to remove and install the internal shutter on the IsoPlane 81 Imaging Spectrometer System.

- **Appendix E, Timing Generator**

    This appendix provides information about the IsoPlane 81 Imaging Spectrometer internal timing generator.

- **Warranty and Service**

    Provides warranty information for the IsoPlane 81 Imaging Spectrometer System. Contact information is also provided.

1.4   Safety Information

This section provides information about all Laser Warning symbols, as well as other safety-related symbols used within this manual.

⚠️ **CAUTION!** ────────────────────

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

1.4.1   Safety-Related Symbols Used in this Manual

⚠️ **CAUTION!** ────────────────────

A Caution provides detailed information about actions and/or hazards that may result in damage to the equipment being used, including but not limited to the possible loss of data.

⚠️ **WARNING!** ────────────────────

A Warning provides detailed information about actions and/or hazards that may result in personal injury or death to individuals operating the equipment.

⚠️ **WARNING! RISK OF ELECTRIC SHOCK!** ────────

The use of this symbol on equipment indicates that one or more nearby items pose an electric shock hazard and should be regarded as potentially dangerous. This same symbol appears in the manual adjacent to the text that discusses the hardware item(s) in question.

1.4.2　Laser Warning Symbols

This section illustrates typical Laser Warning Labels related to the operation of the IsoPlane 81 Imaging Spectrometer System and the IsoPlane 81 Diode Laser Source.

Figure 1-1:　Typical Laser Aperture Label

AVOID EXPOSURE
LASER RADIATION
IS EMITTED FROM
THIS APERTURE

Figure 1-2:　Typical Laser Warning Label

DANGER
INVISIBLE LASER RADIATION
AVOID DIRECT EXPOSURE
TO BEAM
785 nm LASER PRODUCT
MAXIMUM POWER 500 mW
CLASS IIIb LASER PRODUCT

1.5   IsoPlane 81 Safety Information

Before turning on the power supply, the ground prong of the power cord plug must be properly connected to the ground connector of the wall outlet. The wall outlet must have a third prong, or must be properly connected to an adapter that complies with these safety requirements.

⚠ **WARNINGS!** ────────────────

1. If the IsoPlane 81 system is used in a manner not specified by Teledyne Princeton Instruments, the protection provided by the equipment may be impaired.
2. If the equipment or the wall outlet is damaged, the protective grounding could be disconnected. Do not use damaged equipment until its safety has been verified by authorized personnel. Disconnecting the protective earth terminal, inside or outside the apparatus, or any tampering with its operation is also prohibited.

Inspect the supplied power cord. If it is not compatible with the power socket, replace the cord with one that has suitable connectors on both ends.

⚠ **WARNING!** ────────────────

Replacement power cords or power plugs must have the same polarity and power rating as that of the original ones to avoid hazard due to electrical shock.

This page is intentionally blank.

Chapter 2: IsoPlane 81 System

This chapter provides an introduction to, and overview information about, Teledyne Princeton Instruments' IsoPlane 81 Imaging Spectrometer System.

The IsoPlane 81 is an integrated 80.8 mm focal length imaging spectrometer with a built-in 256 x 1024 (row x column) TEC-cooled back-illuminated CCD detector and a motorized single-turret grating drive. Its proprietary optical design produces diffraction-limited imaging with zero coma or astigmatism at any wavelength across the entire focal plane of the sensor.

Figure 2-1 shows the items typically included as part of a standard IsoPlane 81 Imaging Spectrometer System.

Figure 2-1: Typical IsoPlane 81 System Components

Imaging Spectrometer

CUBE

CUBE Stack, Laser, and Fiber

The following items are included as standard equipment with every IsoPlane 81 system:

- IsoPlane 81 Software: Powered by LightField;
  Each IsoPlane 81 ships with fully featured software powered by Teledyne Princeton Instruments' 64-bit LightField software. For users requiring a full license to run other TPI hardware, please contact your local sales associate.
- Laser-Cut Entrance Slit;
  A precision laser-cut slit is shipped with each unit. Each slit is laser engraved with its width on the handled end of the slit carrier.

> **NOTE:**
> Additional slits are sold separately.

- Diffraction Grating;
  Each IsoPlane 81 is shipped with a user-replaceable diffraction grating already installed in the instrument. Additional gratings may be purchased separately.
- Focusing CUBE;
  A Focusing CUBE is shipped with each IsoPlane 81. This CUBE houses an f/4 double achromatic lens with a clear aperture diameter of 7.5 mm.
- USB 3.0 data interface cable;
- External power supply.

2.1   Experiment Interface Panel

Figure 2-2 illustrates the IsoPlane 81's Experiment Interface Panel.

Figure 2-2:   IsoPlane 81 Experiment Interface Panel
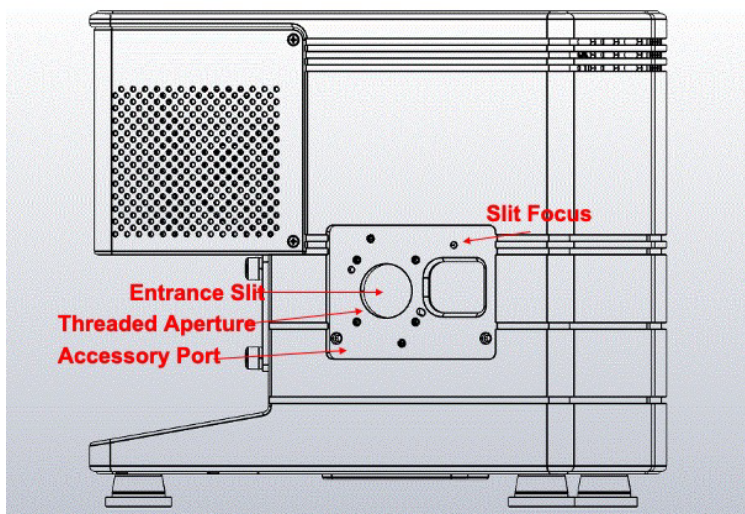
Table 2-1 provides information about experiment interface ports and equipment.

Table 2-1:   Experiment Interface Ports and Equipment

Item	Description
Accessory Port	Compatible with IsoPlane 81 CUBES. Extensible to Thorlabs® 30 mm Cage System.
Entrance Slit	User-changeable entrance slit.
Entrance Slit Carrier	User-changeable entrance slit carrier (not shown in picture).
Slit Focus	Requires a 5/64" Allen wrench. Used to focus the system.
Threaded Aperture	SM-1, 1-inch diameter.

2.2   Power and Data Interface Panel

Figure 2-3 illustrates the IsoPlane 81 Power and Data Interface Panel where all data input/output ports, as well as the input power connector, are located.

Figure 2-3:   IsoPlane 81 Power and Data Interface Panel
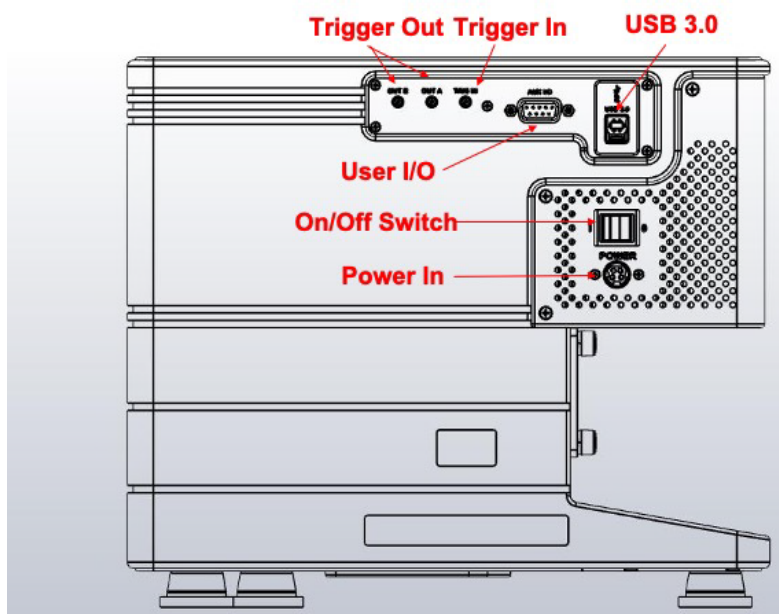
Table 2-2 provides information about the power and data interface ports.

Table 2-2:   Power and Data Interface Panel

Port	Description
User Input/Output	General purpose input/output port.
Output Trigger A, B	Fully programmable output triggers using the integrated Timing Generator.
Power In	Power input from external power supply provided with the IsoPlane 81 system.
Trigger In	Allows data acquisition and readout to be synchronized with external events. Positive or negative edge triggering is programmable.
USB 3.0	Control signals and data are transmitted between IsoPlane 81 and host computer via this port.

2.3   IsoPlane 81 System Maintenance

⚠️ **WARNING!** ─────────────────────

Turn off all power to the equipment and secure all covers before cleaning the unit. Otherwise, damage to the equipment or injury to you could occur.

─────────────────────────────────

2.3.1   Cleaning

Although there is no periodic maintenance that needs to be performed on an IsoPlane 81 spectrometer, users are advised to wipe it down with a clean damp cloth from time to time. This operation should only be done on the external surfaces and with all covers secured. In dampening the cloth, use clean water only, and wring out all excess water. The cloth should only be slightly damp, not wet (i.e., no water should drip off the cloth).

No soap, solvents, or abrasives should be used. Not only are they not required, but they could damage the finish of the surfaces on which they are used.

2.3.2 Repairs

Because the IsoPlane 81 system contains no user-serviceable parts, repairs must be performed by Teledyne Princeton Instruments. Should the system need repair, contact Teledyne Princeton Instruments customer support for instructions. Refer to Contact Information on page 60 for complete information.

Save the original packing materials and use them whenever shipping the system or system components.

2.4 Available Accessories

Refer to Table 2-3 for information about accessories that are available for use with the IsoPlane 81.

Table 2-3: Available IsoPlane 81 System Accessories (Sheet 1 of 5)

Accessory	Description	Part Number
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 10 µm width, 3.3 mm tall.	ISO81-SLIT-10
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 25 µm width, 3.3 mm tall.	ISO81-SLIT-25
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 50 µm width, 3.3 mm tall.	ISO81-SLIT-50
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 100 µm width, 3.3 mm tall.	ISO81-SLIT-100
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 150 µm width, 3.3 mm tall.	ISO81-SLIT-150
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 200 µm width, 3.3 mm tall.	ISO81-SLIT-200
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 300 µm width, 3.3 mm tall.	ISO81-SLIT-300
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 500 µm width, 3.3 mm tall.	ISO81-SLIT-500
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 25 µm pinhole.	ISO81-SLIT-H

Table 2-3:   Available IsoPlane 81 System Accessories (Sheet 2 of 5)

Accessory	Description	Part Number
IsoPlane 81 Slit	Interchangeable input slit; Precision laser-cut slit, 25 μm pinhole for kinetic mode.	ISO81-SLIT-HK
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 3600 g/mm, 240 nm blaze.	ISO81-GRT-3600-240
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 2400 g/mm, 500 nm blaze.	ISO81-GRT-2400-500
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1800 g/mm, 250 nm blaze.	ISO81-GRT-1800-250
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1800 g/mm, 550 nm blaze.	ISO81-GRT-1800-550
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1200 g/mm, 850 nm blaze.	ISO81-GRT-1200-850
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1200 g/mm, 550 nm blaze.	ISO81-GRT-1200-550
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1200 g/mm, 450 nm blaze.	ISO81-GRT-1200-450
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1200 g/mm, 300 nm blaze.	ISO81-GRT-1200-300
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 1180 g/mm, 750 nm blaze.	ISO81-GRT-1180-750
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 600 g/mm, 750 nm blaze.	ISO81-GRT-600-750
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 600 g/mm, 900 nm blaze.	ISO81-GRT-600-900
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 600 g/mm, 500 nm blaze.	ISO81-GRT-600-500
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 600 g/mm, 275 nm blaze.	ISO81-GRT-600-275
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 300 g/mm, 320 nm blaze.	ISO81-GRT-300-320

Table 2-3:   Available IsoPlane 81 System Accessories (Sheet 3 of 5)

Accessory	Description	Part Number
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 295 g/mm, 575 nm blaze.	ISO81-GRT-295-575
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 295 g/mm, 270 nm blaze.	ISO81-GRT-295-270
IsoPlane 81 Aluminum-Coated Ruled Grating	Interchangeable by user; 150 g/mm, 300 nm blaze.	ISO81-GRT-150-300
IsoPlane 81 Wavelength-Stabilized Multimode 785nm Laser	Fiber coupled; 475 mW power, adjustable, narrow laser line; Ideal for Raman spectroscopy.	ISO81-LAS-785
IsoPlane 81 Wavelength-Stabilized Single-Mode 532nm Laser	Fiber coupled; 100 mW power, adjustable, narrow laser line; Ideal for Raman spectroscopy.	ISO81-LAS-532
IsoPlane 81 Wavelength Calibration Reference Lamp	Atomic emission lamp; Switchable mercury (Hg) and neon-argon (Ne-Ar); Allows automated spectral wavelength calibration; USB interface.	ISO81-CAL-WL
IsoPlane 81 QTH Calibration Lamp	Allows automated relative intensity calibration; Stabilized optical output; NIST traceable; USB interface.	ISO81-CAL-QTH
IsoPlane 81 Basic CUBE	Allows easy mating to IsoPlane 81 entrance or other IsoPlane 81 accessories; Compatible with Thorlabs Cage System.	ISO81-CUBE0
IsoPlane 81 Focusing CUBE	Optimized for UV, VIS, or NIR; Contains achromatic doublet for focusing incoming light onto the IsoPlane 81 slit; Precision X-Y stage for fine focus and slit alignment.	ISO81-CUBE1
IsoPlane 81 Raman Filter CUBE	Contains mounted narrowband laser line filter, TPI long-pass dichroic filter, and matching edge filter (OD 6) with precision built-in angle tuning adjustment; Optimized for 532 nm or 785 nm Raman spectroscopy (check with our sales team for other wavelengths).	ISO81-CUBE2

Table 2-3:   Available IsoPlane 81 System Accessories (Sheet 4 of 5)

Accessory	Description	Part Number
IsoPlane 81 Sample Chamber CUBE	Contains two (2) lenses and four (4) optical ports; Contains sample chamber for 12.5 mm cuvette (not included) and light cover.	ISO81-CUBE3
IsoPlane 81 Beam Splitter CUBE	With different T:R ratio; Allows splitting of beam paths in transmission and reflection optical ratio without beam walk off; Contains precisely aligned and mounted non-polarizing cubic beam splitter.	ISO81-CUBE4
IsoPlane 81 Filter CUBE	Five (5) positions for 0.5 inch diameter filters; Filters not included.	ISO81-CUBE5
IsoPlane 81 785 nm Raman Probe	105 µm FC/PC excitation fiber and 400 µm FC/PC collection fiber; Ideally suited for use with ISO81-LIN-ARY linear fiber array for maximum efficiency.	ISO81-PROBE-785 RAM
IsoPlane 81 532 nm Raman Probe	105 µm FC/PC excitation fiber and 400 µm FC/PC collection fiber; Ideally suited for use with ISO81-LIN-ARY linear fiber array for maximum efficiency.	ISO81-PROBE-532 RAM
Standalone 785 nm Raman Microscopy Accessory	Most cost-effective way of enabling 785 nm Raman microscopy measurement with IsoPlane 81 spectrometer; Connect directly to IsoPlane 81; Plug-and-play with pre-aligned optics; Built-in witness camera and LED illumination for brightfield image; Fiber coupling for laser input.	785RAMAN-MICRO-ISO81-MI-OEM
Standalone 532 nm Raman Microscopy Accessory	Most cost-effective way of enabling 532 nm Raman microscopy measurement with IsoPlane 81 spectrometer; Connect directly to IsoPlane 81; Plug-and-play with pre-aligned optics; Built-in witness camera and LED illumination for brightfield image; Fiber coupling for laser input.	532RAMAN-MICRO-ISO81-MI-OEM
IsoPlane 81 Fiber Port, VIS (400 nm - 700 nm)	Allows easy attachment of fibers via FC/PC terminal and aspheric collimation lens to IsoPlane 81; Optimized for visible applications.	ISO81-FP-VIS
IsoPlane 81 Fiber Port, NIR (650 nm - 1050 nm)	Allows easy attachment of fibers via FC/PC terminal and aspheric collimation lens to IsoPlane 81; Optimized for NIR applications.	ISO81-FP-NIR

Table 2-3:   Available IsoPlane 81 System Accessories (Sheet 5 of 5)

Accessory	Description	Part Number
IsoPlane 81 Linear Fiber Array, 1 Meter Length	Array of fifty 50 μm fibers circularly packed at the collection end terminated with an FC/PC connector delivering light to a 3.0 mm tall linear array; Maximizes light gathering power without loss in spectral resolution; Includes self-aligning IsoPlane 81 fiber adapter.	ISO81-FIBER-LIN-1M
IsoPlane 81 Linear Fiber Array, 3 Meter Length	Array of fifty 50 μm fibers circularly packed at the collection end terminated with an FC/PC connector delivering light to a 3.0 mm tall linear array; Maximizes light gathering power without loss in spectral resolution; Includes self-aligning IsoPlane 81 fiber adapter.	ISO81-FIBER-LIN-3M
IsoPlane 81 Bifurcated Linear Fiber Array	Two collection ends each equipped with twenty-five 50 μm fibers circularly packed with FC/PC connectors leading into a split linear array 2 x 1.5 mm tall; Ideal for absorption spectroscopy where a live reference channel is required; Maximizes light-gathering power without loss in spectral resolution; Includes self-aligning IsoPlane 81 fiber adapter.	ISO81-FIBER-BI-LIN
IsoPlane 81 Laser Excitation Fiber	105 μm multimode fiber for coupling laser excitation light from IsoPlane 81 laser.	ISO81-FIBER-LAS
IsoPlane 81 Fiber Patch Cable	400 μm multimode fiber for coupling light from QTH lamp for absorption/transmission spectroscopy.	ISO81-FIBER-PTH

Chapter 3: Installation of LightField for the IsoPlane 81

This chapter provides the installation procedure for LightField® application software for the IsoPlane 81.

3.1   Prerequisites

Before beginning to install LightField for the IsoPlane 81, verify that:

- The operating system on the desired host computer is either Microsoft® Windows® 8 (64-bit) or Microsoft Windows 10 (64-bit);
- You have a LightField license USB dongle;
- The host computer supports USB 3;
  If it does not support USB 3, refer to the host computer manufacturer's instructions for installing a USB 3 interface card;
- The host computer is connected to the Internet. An Internet connection is required for product activation.

3.2   Installation Procedure

Perform the following procedure to install LightField for the IsoPlane 81 on the host computer:

1. Use the LightField Installation CD or download the latest LightField software from TPI's public FTP site:
   ftp://ftp.princetoninstruments.com/Public/Software/Official/LightField.
2. Double-click on *LightField Install.exe* to start the software installation. Follow the on-screen prompts to finish
3. After the installation has been completed, reboot the host computer. A shortcut to LightField can be found on the desktop.
4. Connect the IsoPlane 81 system to the host computer with the USB 3 cable. Apply power and turn on the IsoPlane 81 spectrometer.
5. Before starting the software, make sure the license dongle is inserted into a USB port on the host computer.
6. Launch LightField and begin experiment configuration. If installation is successful and the IsoPlane 81 system is correctly connected, then an instrument icon will be displayed under Device panel.

This page is intentionally blank.

Chapter 4:   Getting Started

This chapter provides information about the configuration of an IsoPlane 81 system as well as using LightField to acquire spectrographic data.

4.1   Initial Setup

Perform the following procedure to set up an IsoPlane 81 system:

1. If necessary, install LightField for the IsoPlane 81. Refer to Chapter 3 for complete information.
2. Position the IsoPlane 81 where it will be used.
3. Insert the slit into the slit carrier.
   - To remove the entrance slit, pull rightward on the stainless steel pin until the entrance aperture is fully exposed, and then pull outward.
   - To install the entrance slit, align the slit carrier with the entrance aperture and slide the slit leftward until it comes to a stop.

   NOTE:
   The slit is installed properly if, when sliding it rightward just enough to expose the entrance aperture and then pushing back leftward, the slit is magnetically pulled against its internal reference.

4. Connect the host end of the supplied USB 3.0 cable to the host computer and the peripheral end to the IsoPlane 81.
5. Connect the power supply shipped with the IsoPlane 81 to the POWER connector located on the side of the IsoPlane 81.
6. Verify that the IsoPlane 81 is connected to the host computer's USB 3.0 port.

   NOTE:
   USB 3.0 ports are typically indicated by SS next to the standard USB logo.

7. Turn the POWER switch on the IsoPlane 81 to the ON position.
8. Launch LightField.

4.2   Initialization

When the IsoPlane 81 is plugged in, it initializes to zero order, or 0 nm. If the power is switched off and then on again, the IsoPlane 81 will reinitialize. Initialization provides the system with a reference, or starting position, to keep track of wavelength position, grating location, and other parameters.

4.3   Focus the Slit

This section provides information about focusing the slit on the IsoPlane 81. Typically the focus is factory set. This task may or may not be needed for system maintenance.

4.3.1 Required Tools

The following tools are required to focus a slit:

- 5/64 Allen wrench
- #1 Phillips head screwdriver

4.3.2 Focus Procedure

Perform the following procedure to focus the slit:

1. Illuminate the slit with light from the IsoPlane 81 atomic emission wavelength calibration lamp.

   NOTE:

   If you do not have an IsoPlane 81 atomic emission wavelength calibration lamp, use a suitable atomic emission lamp.
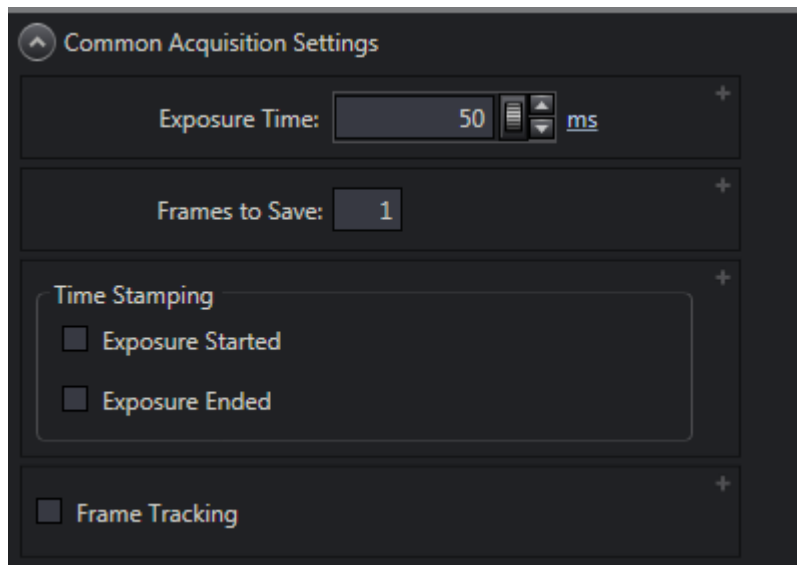
2. If necessary, within LightField, on the Experiment Setting tab, open the Regions of Interest expander and select Bin Center 10 rows. See Figure 4-1.
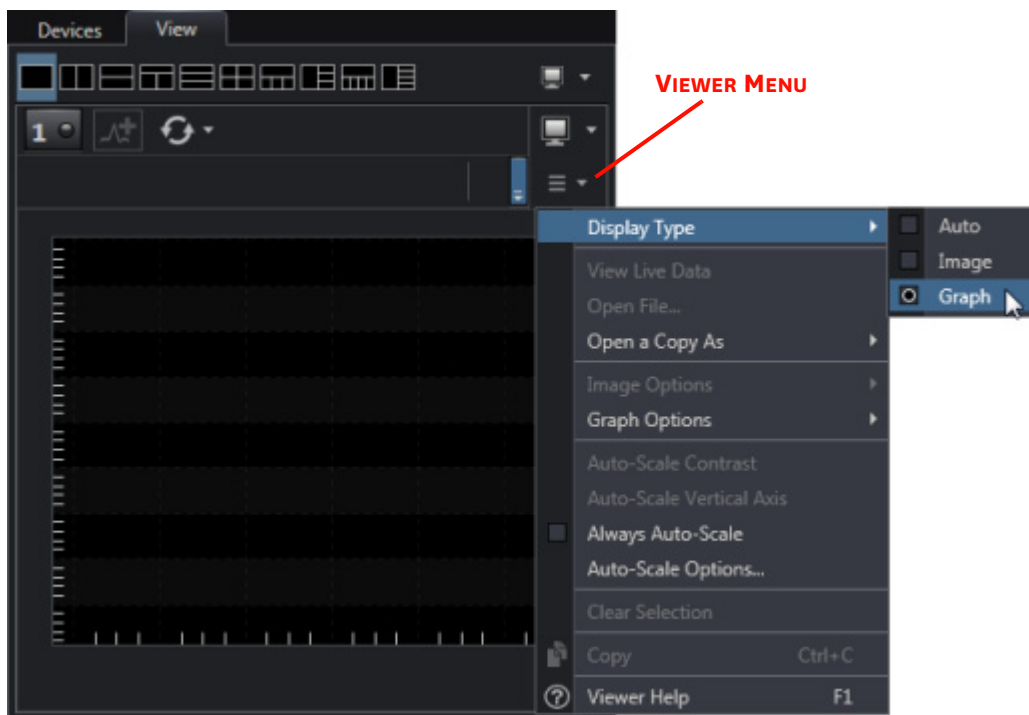
Figure 4-1: Configure Regions of Interest
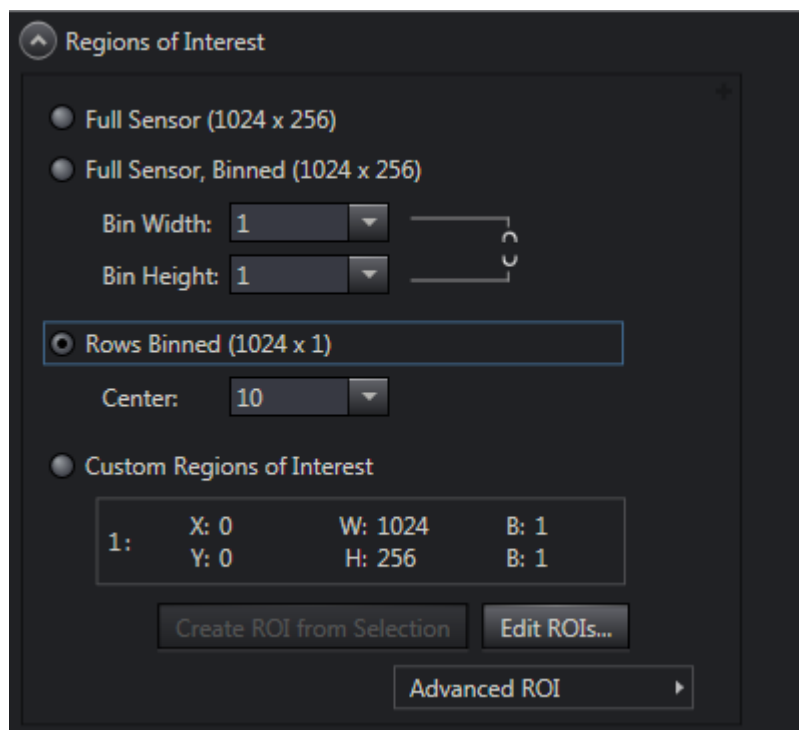
3. On the Common Acquisition Settings expander, configure an Exposure Time of 50 ms. See Figure 4-2.

Figure 4-2: Configure Exposure Time

4. Click on the View tab, and from within the Viewer Menu, select Display Type ►
    Graph. See Figure 4-3.

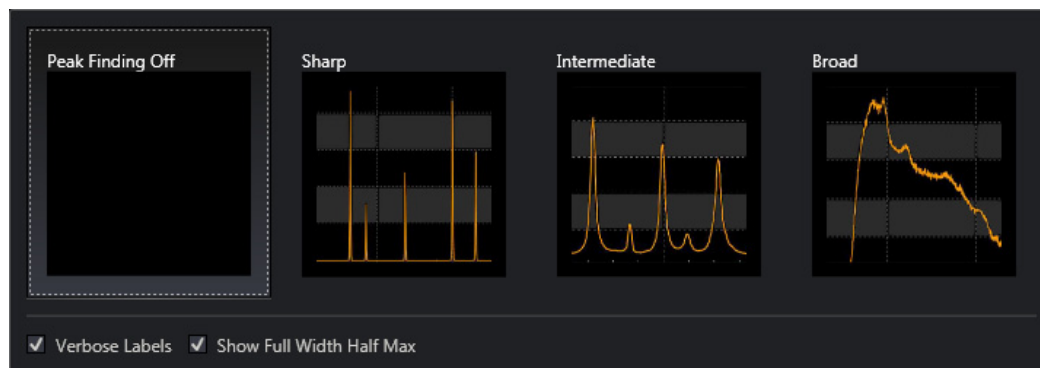**Figure 4-3: Configure Display Type**

5. Click [Run] at the top of the workspace to begin data acquisition.
6. Verify that there is sufficient ambient room light illuminating the slit.

7. Click the Peak Finding button [ ] and select Sharp. See Figure 4-4.

Figure 4-4:   Peak Finding Options

8. Using the 5/64" Allen wrench, turn the focus screw, located on the side of the IsoPlane 81, clockwise until the peak width has noticeably increased. Then turn the screw counter-clockwise until peak width has reached a minimum value. At this point, the slit is focused. See Figure 4-5.

Figure 4-5:   Focus Adjustment Screw
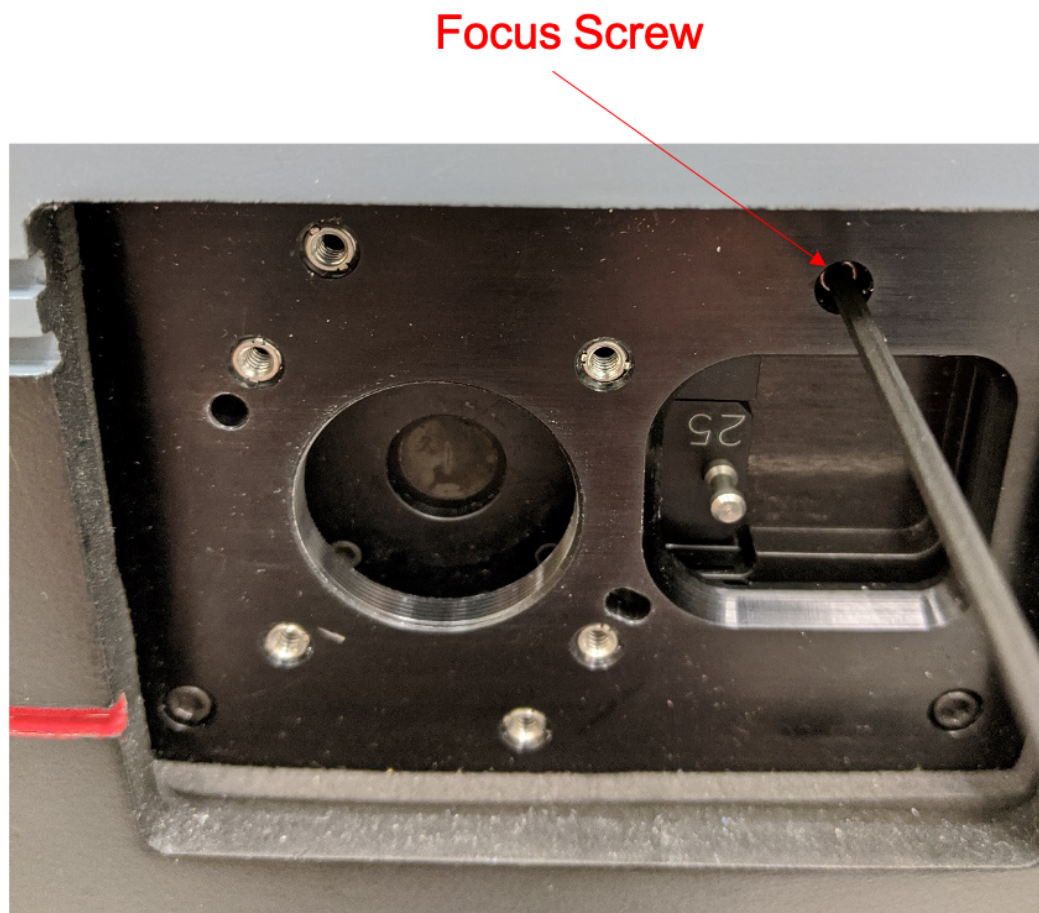
9. Within LightField, click [Stop] to halt data acquisition.

4.4 Attach Focusing CUBE

Once the slit has been focused, perform the following procedure to install the Focusing CUBE:

1. Install the Focusing CUBE by aligning the stainless steel pins and carefully pressing the CUBE onto the instrument. See Figure 4-6.
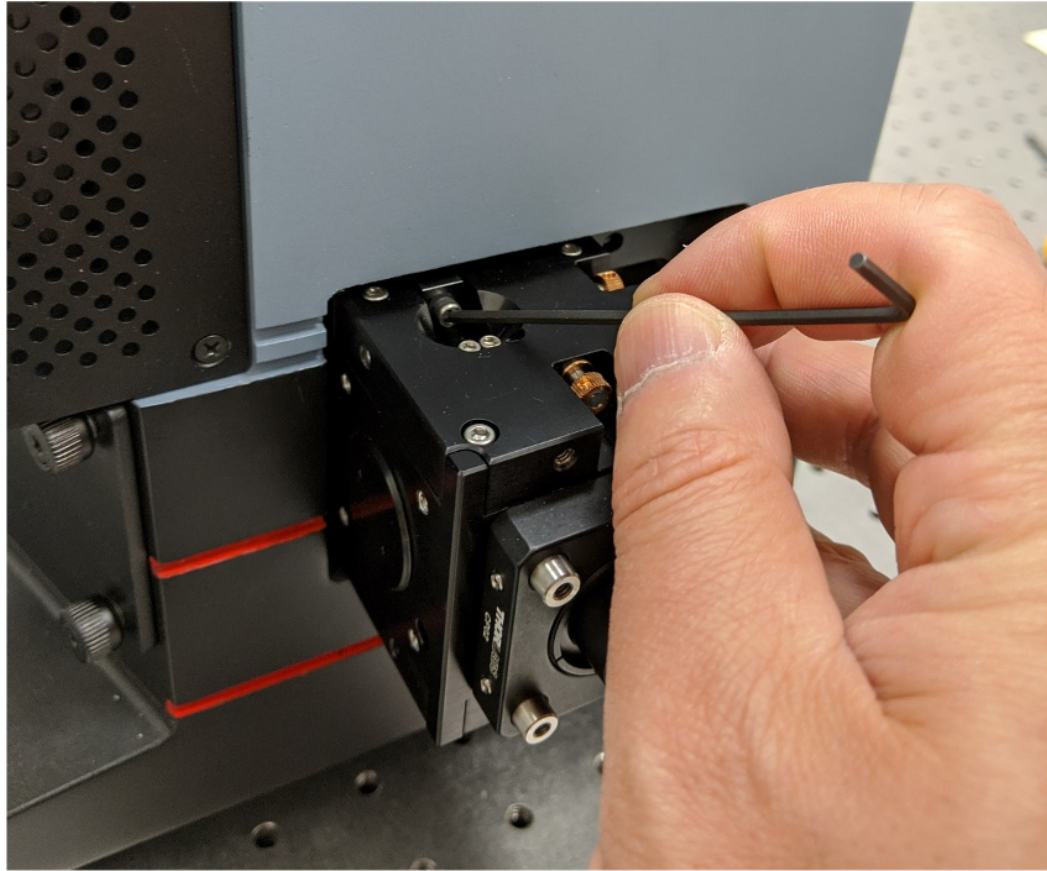
Figure 4-6: Installing the Focusing CUBE


2. Using the #1 Phillips head screwdriver, turn the coupling screw clockwise until finger tight. See Figure 4-7.

> **NOTE:**
>
> Tightening the bottom screw is necessary only if installing additional CUBES to the Focusing CUBE.

Figure 4-7:   Securing the Focusing CUBE

3. Push the slit rightward to expose the full entrance aperture.
4. Within LightField, from the Readout expander, select Full Frame from the Mode pull-down list. See Figure 4-8.

Figure 4-8:   Configure Readout Mode
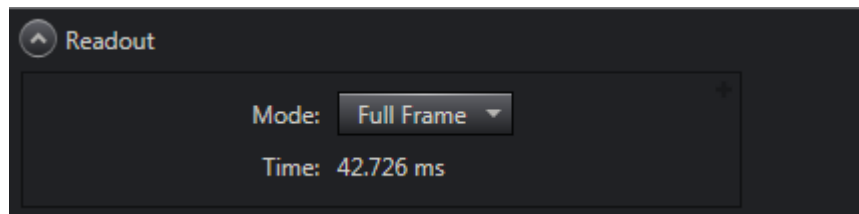
5. From the Region of Interest expander, set ROI to Full Sensor.
6. Point the IsoPlane 81 at an object that is more than 3 m (9.8 feet) away.

7. On the Spectrometer expander, set the grating to 0 nm, click [Run] and adjust the focusing screw until the image comes into best focus.

> 🔍 **NOTE:** _____
>
>   The horizontal lens alignment screw may require adjustment as well. However, this adjustment should only be performed following the installation of all remaining CUBES and/or fore optics.

📇 **NOTE:** ────────────────────────────

The installed lens is not intended for wide-field imaging. A diffraction-limited image will not be acquired. A camera lens is necessary when performing wide-field imaging.

4.4.1   Install Additional CUBES

If desired, additional CUBES may be stacked onto the Focusing CUBE. Figure 4-9 illustrates a typical configuration with three CUBES installed. Refer to Chapter 2 for a list of compatible CUBES.

Figure 4-9:   Typical IsoPlane 81 System with Three (3) CUBES Installed
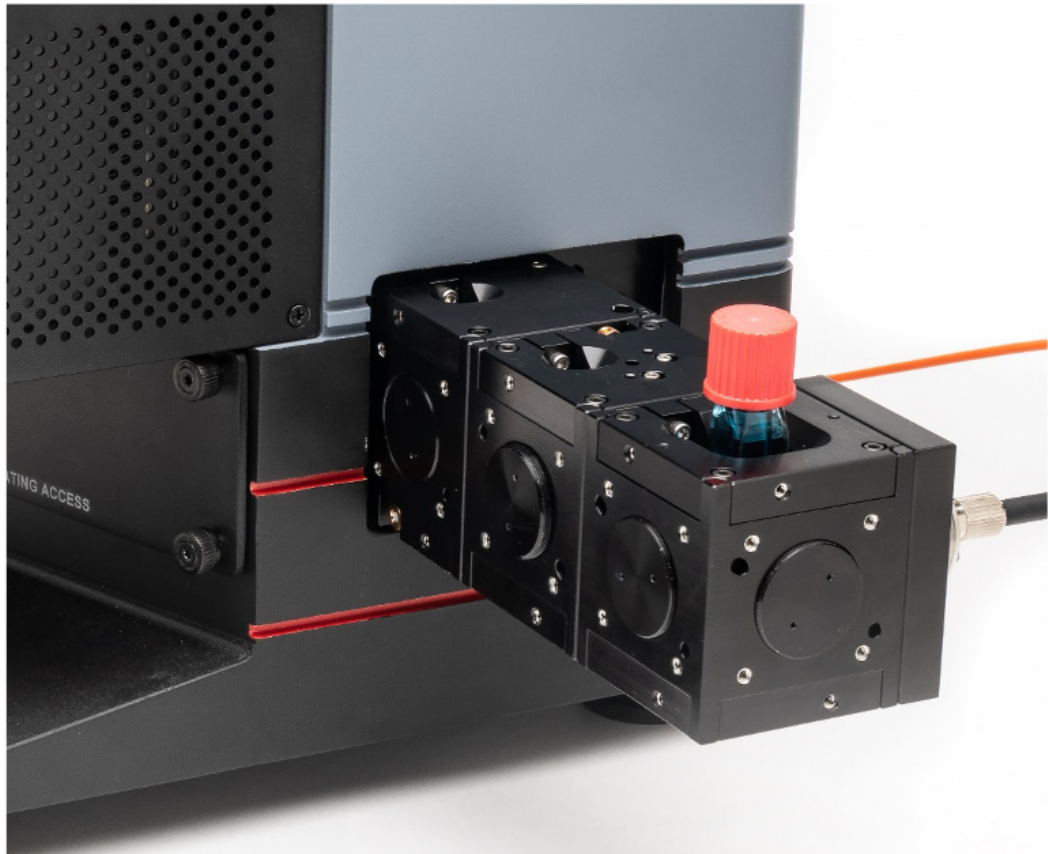
Perform the following procedure to install additional CUBES onto the input to the IsoPlane 81:

1. Use the #1 Phillips head screwdriver to tighten the bottom screw on the previously installed CUBE.
2. Install the second CUBE by aligning the stainless steel pins and carefully pressing the CUBE onto the existing CUBE.
3. Using the #1 Phillips head screwdriver, turn the coupling screw clockwise until finger tight.
4. Repeat step 1 through step 3 for each additional CUBE that is to be installed on the IsoPlane 81.
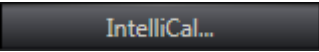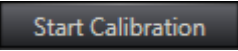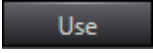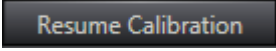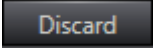
4.5   Calibration

Each IsoPlane 81 spectrometer is factory calibrated prior to shipment. However, it is strongly recommended that once the instrument arrives, a new IntelliCal® calibration be performed.

> **NOTE:**
>
> Installing and replacing the entrance slit may cause a slight offset to the calibration that must be corrected by performing a new system calibration.

Perform the following procedure to perform an IntelliCal calibration on the IsoPlane 81 Imaging Spectrometer System:

1. Install an IntelliCal Light Source on the input to the IsoPlane 81 system.
2. Configure the IntelliCal Light Source for the desired calibration wavelength.
3. Within LightField, open the Calibration expander.
4. Click **IntelliCal...** to initiate the calibration process.
5. Select the desired Calibration Type. When performing a Broad Calibration, select the desired Center Wavelength(s).
6. Click **Start Calibration** to start the calibration.
7. When the calibration has been satisfactorily completed, click **Use** .
   - To continue the calibration process, click **Resume Calibration** .
   - To discard the calibration results, click **Discard** .

4.6   Experiment Design

Once the system has been focused and calibrated, experiments can be designed and built by:
   - Adding additional CUBES to the IsoPlane 81 system input;
   - Interfacing with IsoPlane 81 via Thorlabs® 30 mm Cage System components;
   - Using free space optics mounted on an optical bread board.

4.7   Configure LightField for Operation with IsoPlane 81

Launch LightField after verifying the IsoPlane 81 is connected to the host computer and is powered on. When LightField launches, it looks for available devices and will load corresponding icons into the Available Devices panel. Before designing a new experiment or running an existing one, the appropriate device icons must be dragged into the Experiment Devices panel. Once there is at least one device, the Experiment Settings panel will be populated with expanders for groups of experiment settings.

Perform the following procedure to add the IsoPlane 81 to an experiment:

1. After LightField opens, an icon representing the IsoPlane 81 should be visible within the Available Devices area. See Figure 4-10. LightField might automatically add the IsoPlane 81 if it is the only device connected.

Figure 4-10: Typical LightField Available Devices Panel
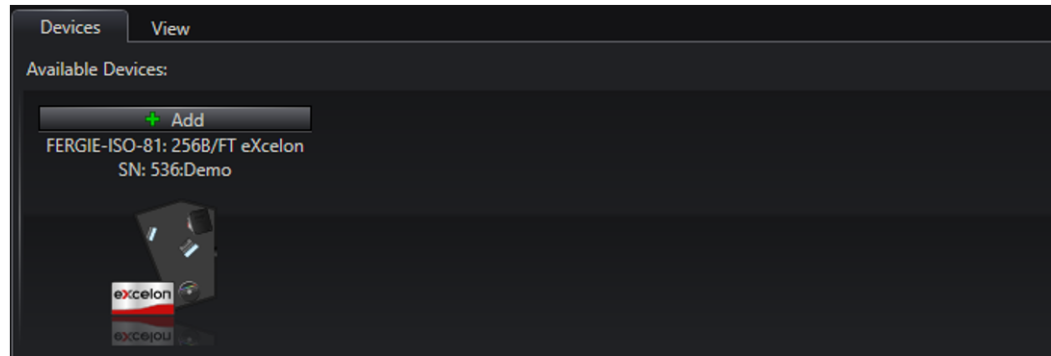
🔍 **NOTE:**

> Please contact customer support or a local sales engineer
> for information about how to obtain a full LightField license.
> Refer to Contact Information (in the Warranty and Service
> section at the end of this manual) for complete information.

2. Within the Available Devices area, left-click on (and hold) the IsoPlane 81 icon and
    then drag it into the Experiment Devices area. See Figure 4-11.

Figure 4-11: Typical Devices Workspace
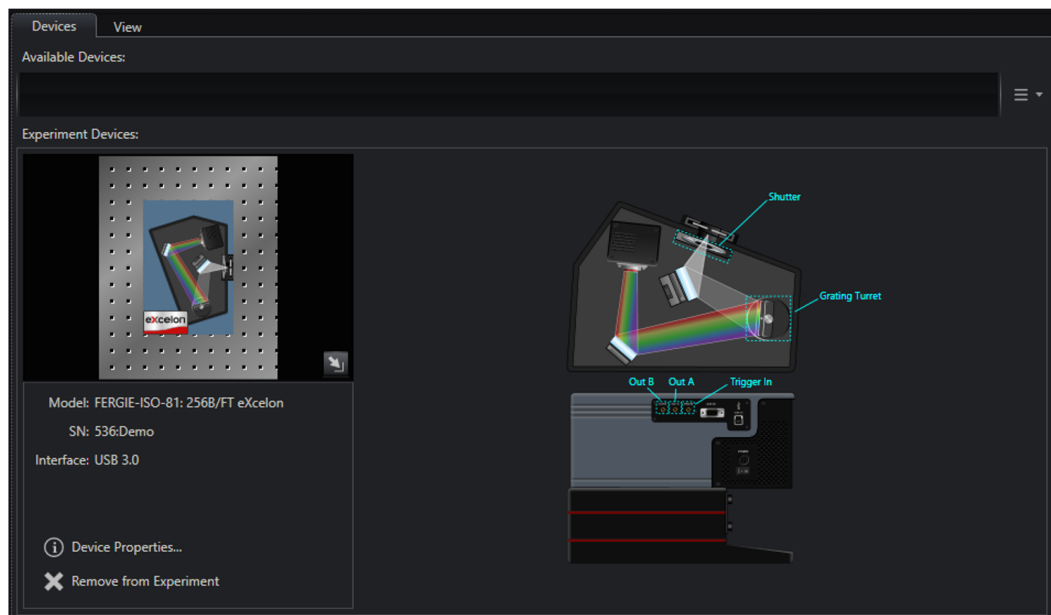
3. The Experiment Settings stack is automatically populated with the appropriate set
    of expanders with default parameter values used. Figure 4-12 illustrates a typical
    Experiment Settings stack.

Figure 4-12: Typical Experiment Settings Stack
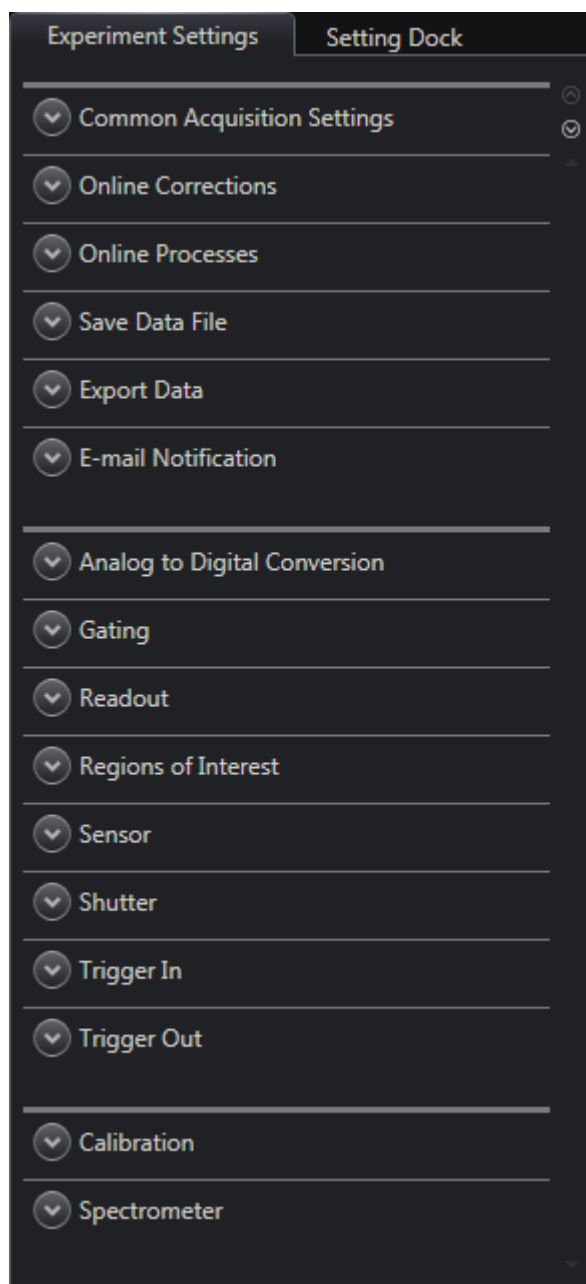
4. The Status bar across the bottom of the LightField workspace includes a status icon for Temperature Status that reports the current system temperature and indicates whether the programmed target temperature has been reached. See Figure 4-13.

Figure 4-13: Typical Status Bar
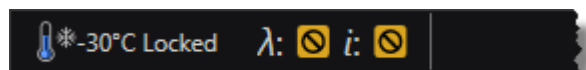
5. Wait until the detector reaches operating temperature; LightField will display "Locked" once the temperature setpoint is reached. See Figure 4-14.

Figure 4-14: Typical Sensor Expander
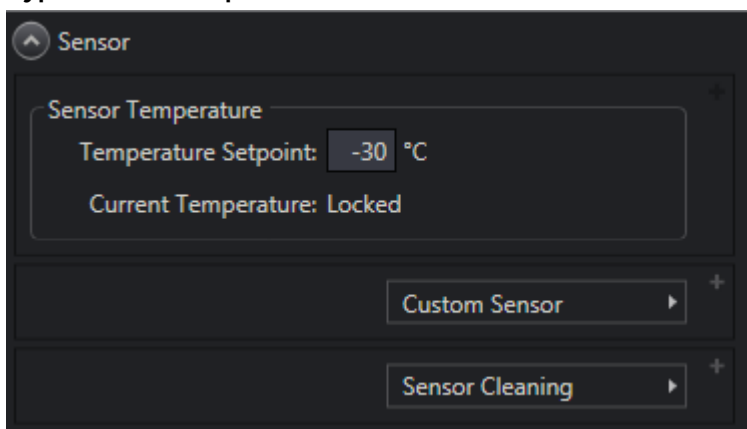
Alternatively, click on ![-30°C Locked] to open the Sensor Temperature dialog, shown in Figure 4-15.

Figure 4-15: Typical Sensor Temperature Dialog
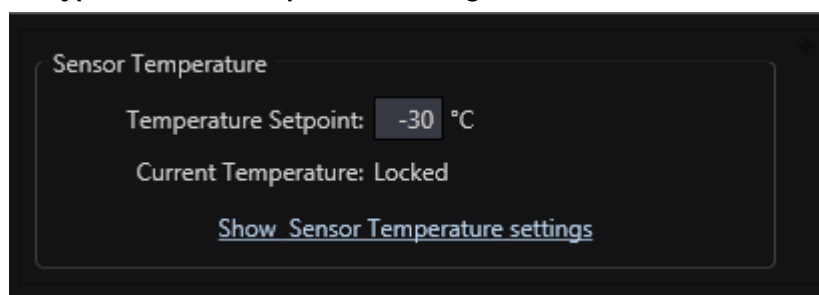
6. Open the Spectrometer expander and program the desired Center Wavelength.

    For example, in Figure 4-16, the 1200 g/mm, Blaze: 550 nm Grating has been factory installed, and the Center Wavelength is programmed to 546 nm for a mercury (Hg) lamp.

Figure 4-16: Typical Spectrometer Expander
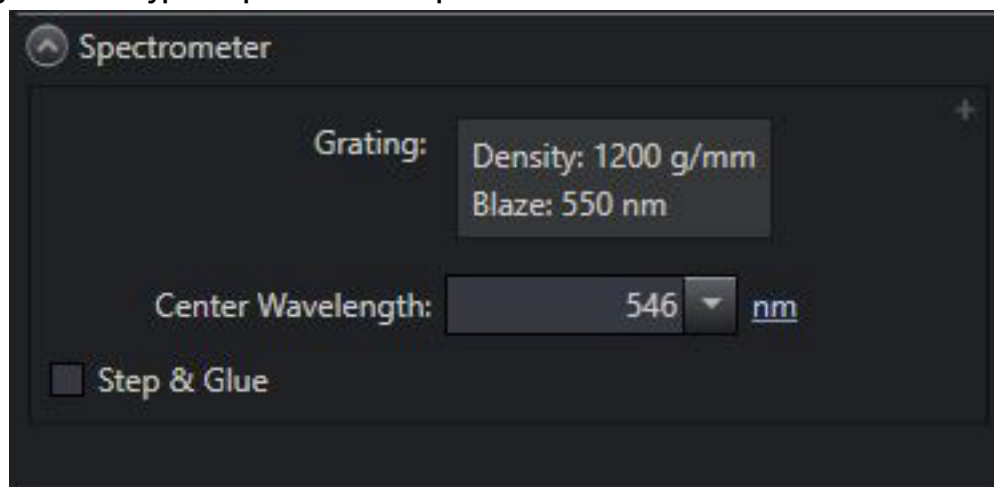
7. Verify that an appropriate incoming light source is installed and turned on.

8. Click ![Acquire] to begin data acquisition.

This page is intentionally blank.

Appendix A: Technical Specifications

NOTE: ———————————————————————————
> All specifications are subject to change.

This appendix provides technical information and specifications for the IsoPlane 81 system. Additional information may be found on data sheets available on the Teledyne Princeton Instruments website (www.princetoninstruments.com).

A.1   General System Specifications

Refer to Table A-1 for general system specifications.

Table A-1:   General System Specifications

Parameter	Specification		
	Minimum	Nominal	Maximum
Read Noise	–	4 e⁻ rms @ 200 kHz 7 e⁻ rms @ 1 MHz 20 e⁻ rms @ 4.55 MHz	–
Vertical Shift Rate[a]	5.6 µsec/row (BRX) 15.2 µsec/row (BX)	–	35 µsec/row (BRX) 95 µsec/row (BX)
Nonlinearity	–	–	<1% @ all ADC rates
Dimensions			
Length	–	11 in (26.8 cm)	–
Width	–	7 in (18.0 cm)	–
Height	–	8 in (21.0 cm)	–
Weight	–	19.5 lbs (8.84 kg)	–

a. Software programmable

A.2   Power Specifications

All voltages required by the IsoPlane 81 system are generated and delivered by an external power supply included with each IsoPlane 81 system.

> ⚠️ **CAUTION!** ———————————————
>
> Use of a power supply other than that provided with the IsoPlane 81 system will void the system warranty. For specific power supply requirements, contact Teledyne Princeton Instruments. Refer to Contact Information (in the Warranty and Service section at the end of this manual) for complete information.

Refer to Table A-2 for power specifications for the external IsoPlane 81 power supply.

Table A-2:   Power Specifications

Parameter	Specification			Units
	Minimum	Nominal	Maximum	
Input				
Voltage	90	–	246	V_{AC}
Frequency	47	–	63	Hz
Output				
Voltage	–	18	–	V_{DC}
Current	–	–	4.45	A
Power	–	–	80	W

A.3   Environmental Specifications

Refer to Table A-3 for environmental specifications.

Table A-3:   IsoPlane 81 Environmental Specifications

Parameter	Specification		
	Minimum	Nominal	Maximum
Storage Temperature	-20°C		+55°C
Operating Temperature	+5°C		+30°C
Operating Ambient Relative Humidity	<80% (non-condensing)		

> 🔍 **NOTE:** ———————————————
>
> The cooling performance may degrade if the room temperature is above +23°C.

A.3.1   Ventilation

A minimum of 1 inch (2.54 cm) clearance is required around all vents on the IsoPlane 81 system.

When the IsoPlane 81 is operated within an enclosure, >30 cfm air circulation and heat dissipation of 200 W is required.

A.4   Cooling Specifications

Refer to Table A-4 for cooling specifications for the IsoPlane 81 system.

Table A-4:   Temperature Specifications

Specification	Cooling Temperature			Units
	Minimum	Default	Maximum	
Cooling Temperature	–	-55[a]	-60	°C
Temperature Stability	±1			°C

a. Guaranteed at ambient temperature of +20°C

A.5   CCD Specifications

Refer to Table A-5 for CCD specifications for the IsoPlane 81 system.

Table A-5:   CCD Specifications[a]

Parameter	Specification
CCD	Proprietary
Image Type	Monochrome
Resolution	1024 x 256
Pixel Size	13 μm x 13 μm
Active Area	13.3 mm x 3.3 mm
Frame Rate	34 fps (full frame)

a. Specifications are valid as of the publication date of this manual. For up-to-date specifications, refer to the IsoPlane 81 data sheets available for download from www.princetoninstruments.com.

A.6 Optical Specifications

Refer to Table A-6 for optical specifications.

Table A-6:   Optical Specifications

Parameter	Specification			Units
	Minimum	Nominal	Maximum	
Focal Length	–	80.8	–	mm
Aperture Ratio	–	f/4.0	–	–
Wavelength Range	200	–	1100	nm

A.7 Spectral Specifications

Refer to Table A-7 for spectral specifications.

Table A-7:   Spectral Specifications

Parameter	Specification			Units
	Minimum	Nominal	Maximum	
Spectral Resolution (FWHM)	–	0.13	–	nm
Astigmatism	0[a]			–
Wavelength Accuracy[a]	–	0.13	–	nm
Wavelength Repeatability[a]	–	0.015	–	nm
Drive Step Size	–	0.035[a]	–	nm

a. With 1200 g/mm grating @ 435 nm

A.8 Grating Specifications

Refer to Table A-8 for information about IsoPlane 81-compatible gratings.

Table A-8: IsoPlane 81-Compatible Grating Information

Part Number	Grooves/mm	Blaze Wavelength (nm)
ISO81-GRT-3600-240	3600	240
ISO81-GRT-2400-500	2400	500
ISO81-GRT-1800-250	1800	250
ISO81-GRT-1800-550	1800	550
ISO81-GRT-1200-850	1200	850
ISO81-GRT-1200-550	1200	550
ISO81-GRT-1200-450	1200	450
ISO81-GRT-1200-300	1200	300
ISO81-GRT-1180-750	1180	750
ISO81-GRT-600-750	600	750
ISO81-GRT-600-900	600	900
ISO81-GRT-600-500	600	500
ISO81-GRT-600-275	600	275
ISO81-GRT-300-320	300	320
ISO81-GRT-295-575	295	575
ISO81-GRT-295-270	295	270
ISO81-GRT-150-300	150	300

NOTE:

Contact Teledyne Princeton Instruments for additional grating options. Refer to Contact Information (in the Warranty and Service section at the end of this manual) for complete information.

A.9   Quantum Efficiency

Figure A-1 illustrates the quantum efficiency of the IsoPlane 81 system.

Figure A-1:   Relative QE vs. Wavelength
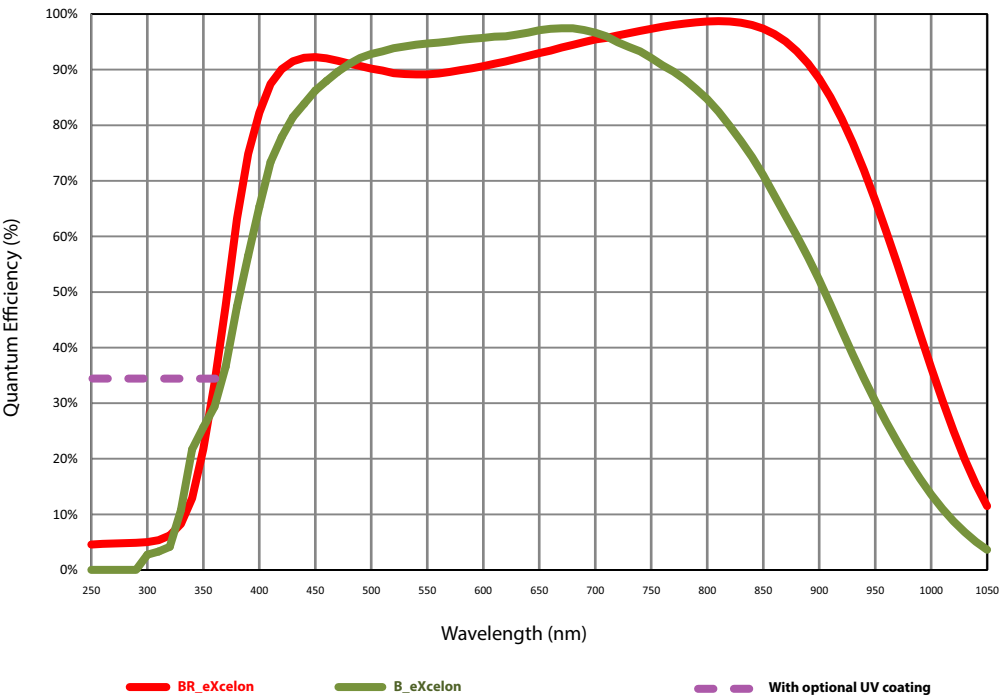
Appendix B: Outline Drawings

Figure B-1:   IsoPlane 81 Outline Drawings
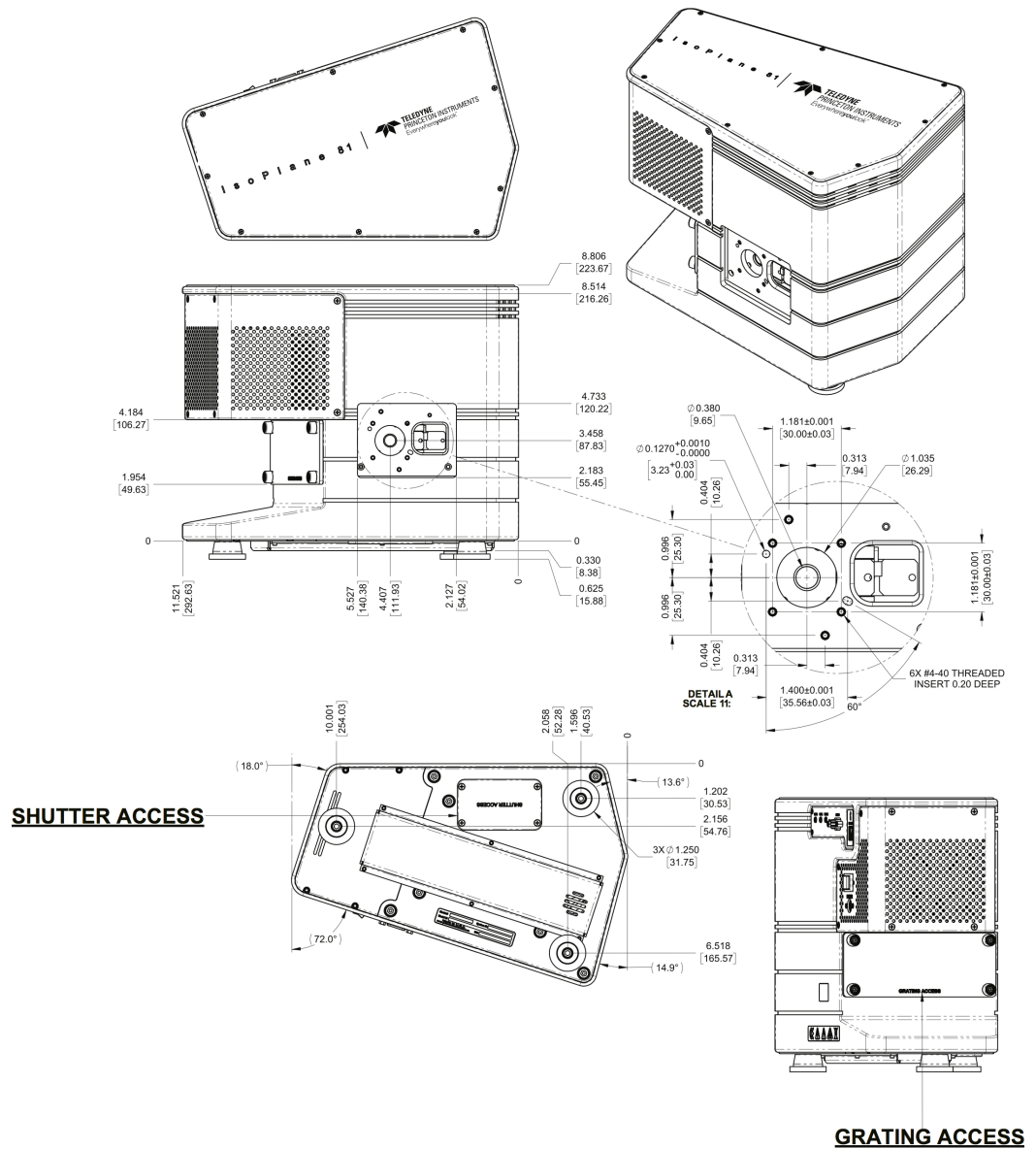
This page is intentionally blank.

Appendix C: Changing Gratings

This appendix provides information about removing and installing an IsoPlane 81 grating.

C.1   Grating Carrier Replacement Procedure

Perform the following procedure to replace an IsoPlane 81 Grating Carrier:

1.   Loosen the four hand-tight screws securing the Grating Housing Cover to the IsoPlane 81 chassis. See Figure C-1.

Figure C-1:   Removing the IsoPlane 81 Grating Housing Cover
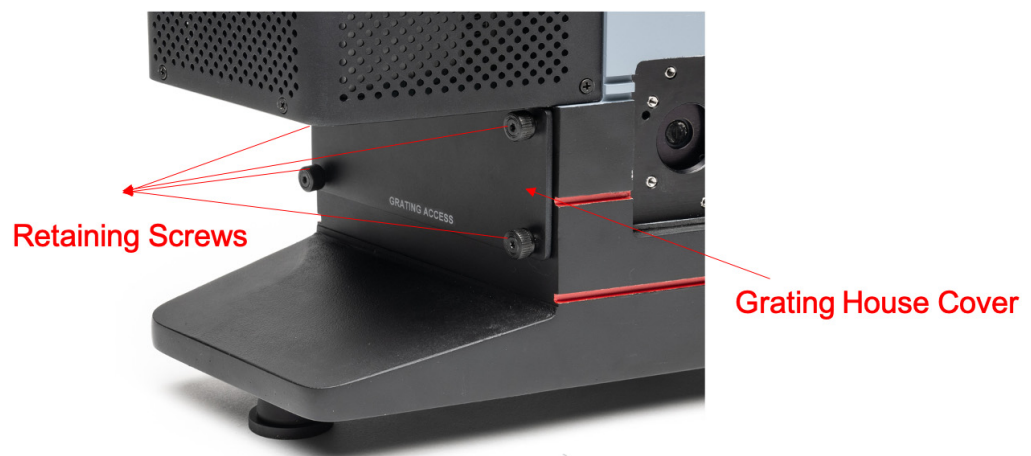
2.   Remove the Grating Housing to expose the rear of the grating drive. See Figure C-2.

Figure C-2:   IsoPlane 81 Grating Drive (Rear View)

3. If not already running, launch LightField.
4. Open the LightField Spectrometer Grating and Offset add-in.
5. When prompted, select Change a grating. See Figure C-3.

Figure C-3:   LightField Spectrometer Grating and Offset Option Dialog
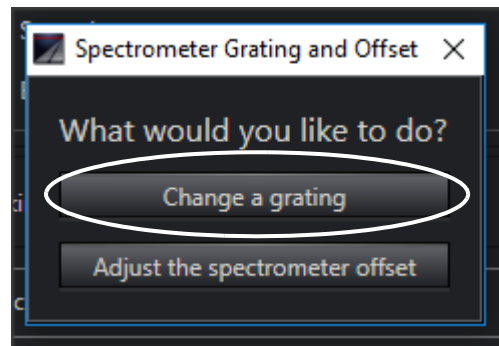
6. Locate the securing knob indicated in Figure C-4.

Figure C-4:   Grating Housing: Securing Knob
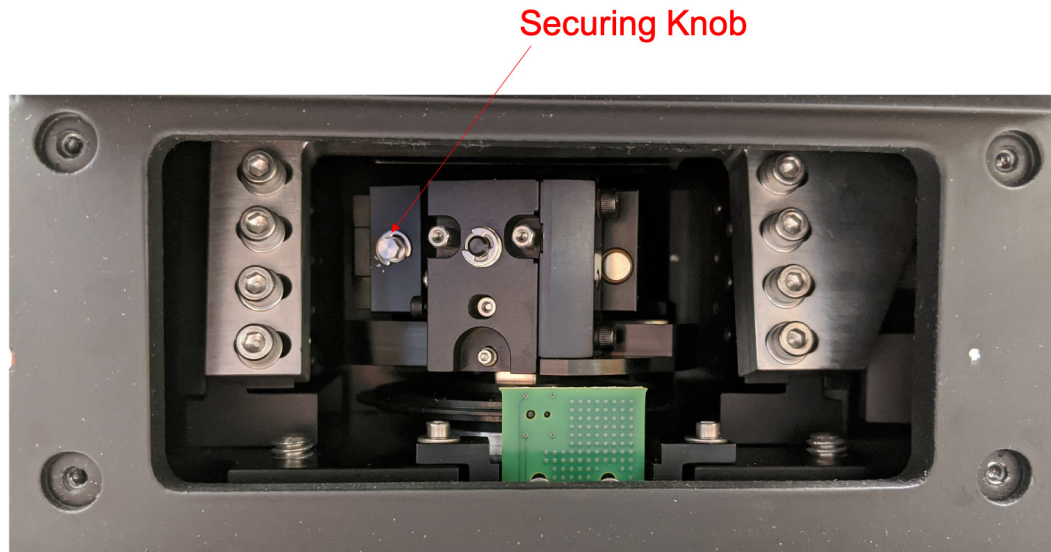
7.   Carefully rotate the securing knob clockwise to loosen it. See Figure C-5.

Figure C-5:   Loosening Securing Knob

NOTE:
Securing screw is left-hand threaded. Turn the knob **CLOCKWISE** to **LOOSEN** it.
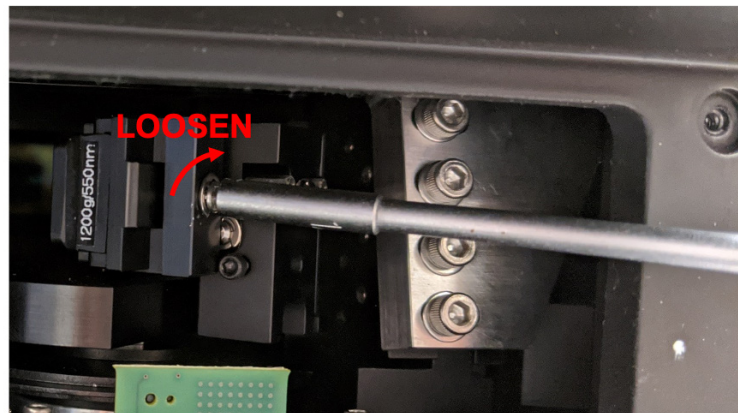
8.   Once the securing knob is loosened, carefully grasp the Grating Carrier and slide it out of the unit. See Figure C-6.

NOTE:

The Grating Carrier is magnetically retained in place, so some minor resistance may be observed when sliding it out of the unit.

Figure C-6:   Remove Grating Carrier
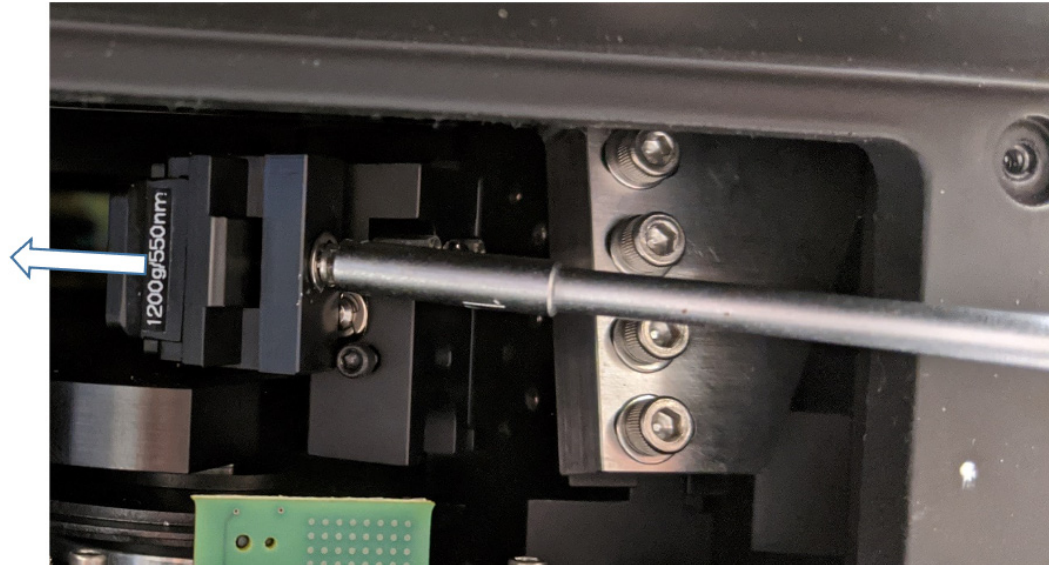
9.   Place the removed Grating Carrier, shown in Figure C-7, in the provided protective case for safe storage.

Figure C-7:   Typical IsoPlane 81 Grating/Grating Carrier Assembly

10. Select the new Grating/Grating Carrier, remove it from its storage case, and carefully slide it into place within the IsoPlane 81. See Figure C-8.

> **NOTE:**
>
> In addition to the securing knob, the Grating Carrier is magnetically retained in place. It will snap into position as it approaches its proper location.

Figure C-8:   Insert Grating Carrier
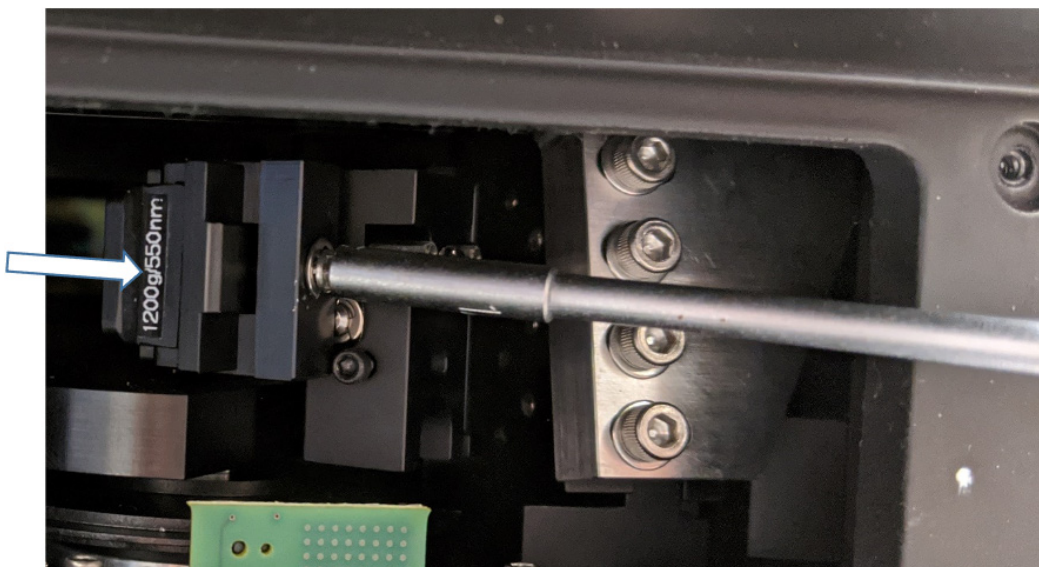
11. Once in place, carefully rotate the securing knob counterclockwise to tighten it. See Figure C-9.

Figure C-9:   Tightening Securing Knob

NOTE:
Securing screw is
left-hand threaded.
Turn the knob
**COUNTERCLOCK
WISE** to **TIGHTEN** it.
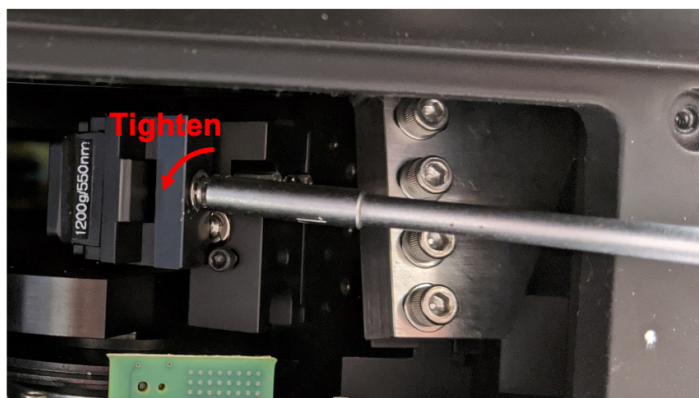
12. Within LightField, select the grating that has been installed, and click Set Grating.

13. When the Grating Change is complete dialog is displayed, similar to that shown in Figure C-10, dismiss it by clicking on the X in the upper right-hand corner.

Figure C-10: Spectrometer Grating and Offset Dialog: Grating Change Complete
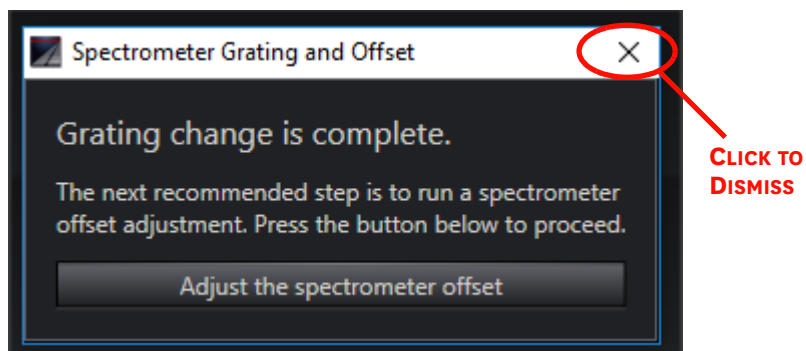
14. Now that a new Grating Carrier has been installed, it must be aligned. Proceed to Section C.2.

C.2 Grating Carrier Alignment

This section provides information necessary to align an IsoPlane 81 Grating Carrier.

The following tools are required to align an IsoPlane 81 Grating Carrier:

- 0.05" Allen wrench
- 5/64" Allen wrench
- 3/32" Allen wrench
- 1/8" nut driver

C.2.1 Grating Carrier Adjustment Screws

Figure C-11 shows the locations of all adjustment screws required to align an IsoPlane 81 Grating Carrier.

Figure C-11: Grating Carrier Adjustment Screws
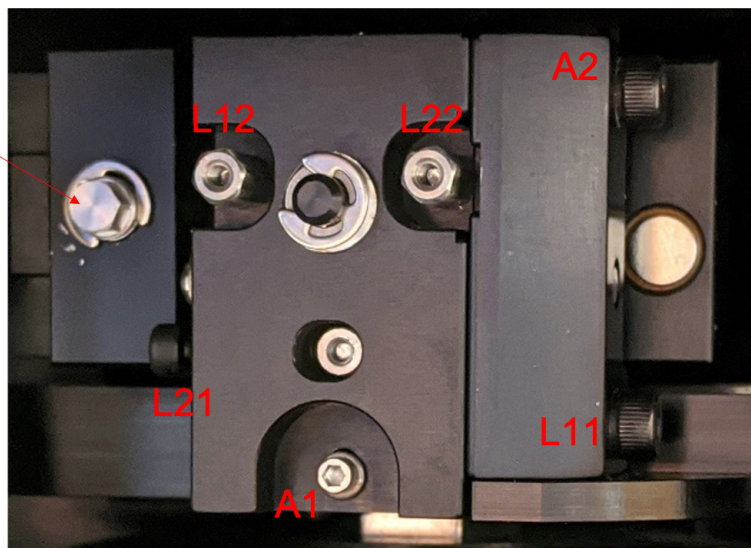
Refer to Table C-1 for information about each adjustment screw, listed alphabetically by label/identifier.

Table C-1: Grating Adjustment Screws

Label/Identifier	Adjustment/Purpose	Adjustment Tool
A1	Tilt adjustment.	0.05" Allen wrench
A2	Tangent adjustment.	5/64" Allen wrench
L11	Tilt adjustment, initial lock.	3/32" Allen wrench
L12	Tangent adjustment, initial lock.	1/8" nut driver
L21	Tilt adjustment, final lock.	3/32" Allen wrench
L22	Tangent adjustment, final lock.	1/8" nut driver

C.2.2   Grating Carrier Alignment Procedure

Perform the following procedure to align a grating carrier in the IsoPlane 81:

1. Using the tool specified in Table C-1, loosen the following adjustment screws:
    - L11;
    - L12;
    - L21;
    - L22.

2. Illuminate the entrance slit using a mercury (Hg) atomic emission lamp.

    NOTE:

    If a mercury (Hg) atomic emission lamp is not available, fluorescent room lights or any other atomic emission source that emits in the target wavelength range may be used.

3. Position the grating at 0 nm. Verify the entrance slit is installed and properly focused.

4. Figure C-12 illustrates, in flowchart format, the procedure required to align a grating. Perform this iterative procedure until the grating is properly aligned.

    NOTE:

    When using fluorescent room lights or other atomic emission source to align the grating, in addition to the 0 nm line, a second visible line as far from 0 nm as possible, while still being convenient, must be used when making adjustments indicated in Figure C-12.

Figure C-12: Grating Alignment Procedure Flowchart

NOTE:

WAVELENGTHS USED IN THIS PROCEDURE ARE BASED ON USING A MERCURY ATOMIC EMISSION LAMP. WHEN USING FLUORESCENT ROOM LIGHTS OR OTHER ATOMIC EMISSION SOURCE TO ALIGN THE GRATING, IN ADDITION TO THE 0 NM LINE, A SECOND VISIBLE LINE AS FAR FROM 0 NM AS POSSIBLE, WHILE STILL BEING CONVENIENT, MUST BE USED WHEN MAKING ADJUSTMENTS INDICATED

Start

1. Move grating to 0 nm

2. Adjust A1 until the slit image is centered top/bottom

3. Move grating to 546 nm

4. Adjust A2 until the slit image is centered top/bottom

5. Is slit image centered at 0 nm and 546 nm? — No / Yes

6. Move grating to 871 nm

7. Is slit image centered top/bottom? — No / Yes

8. Lightly tighten L11 and L12

9. Is slit image centered at 0 nm and 546 nm? — No / Yes

10. Tighten L21, L22, L11, and L12

11. Is slit image centered at 0 nm and 546 nm? — No / Yes

12. Loosen L21, L22, L11, and L12

Complete

Refer to Step-Specific Notes on the next page.

Step-Specific Notes

See Figure C-11 as required.

- Step 8

  If adjustment screws L11 and L12 are too tight, adjustments to A1 and A2 may not be possible. If this happens, loosen L11 and L12 and proceed to step 9.

- Step 9

  If it is observed that the slit image is centered at 546 nm, but is not centered at 0 nm, return to step 1.

  If it is observed that the slit image is centered at 0 nm, but is not centered at 546 nm, return to step 3.

- Step 11

  If it is observed that the slit image is centered at 546 nm, but is not centered at 0 nm, proceed to step 12, and then return to step 1.

  If it is observed that the slit image is centered at 0 nm, but is not centered at 546 nm, proceed as directed to step 12, and then return to step 3.

5. Click Next.
6. Proceed to Section C.3.

C.3   Replace Grating Housing Cover

Perform the following procedure to replace the Grating Housing Cover:

1. Position the Grating Housing Cover over the Grating Drive chamber.
2. Carefully tighten each of the four (4) hand-tight screws to secure the Grating Housing Cover to the IsoPlane 81 chassis. See Figure C-13.

Figure C-13: Replacing the IsoPlane 81 Grating Housing Cover

Retaining Screws

Grating House Cover

C.4   Final Alignment

Once the Grating has been aligned and the Grating Housing Cover has been reinstalled, the final step is to return to LightField and adjust the spectrometer offset.

Perform the following procedure:

1. Within LightField, open the LightField Spectrometer Grating and Offset add-in.
2. When prompted, select *Adjust the spectrometer offset*. See Figure C-14.

Figure C-14: LightField Spectrometer Grating and Offset Option Dialog
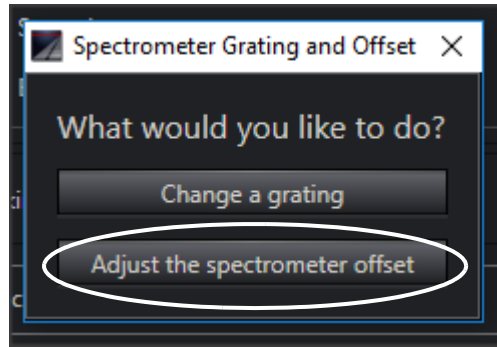
3. Click to preview the light source

   Verify there is a strong, focused peak at 0 nm. If the peak is missing, weak, or out of focus, verify the light source is turned on as well as the system is configured properly. Acquire another image.

4. Click the button associated with the grating for which the offset is being calculated. LightField calculates and displays the new offset value, in steps, in the Calculated column with the corresponding wavelength error, in nm, next to it.

5. Click to clear the set of offset values that have just been calculated.

   If desired, the offset may be manually fine-tuned using the four Manual Adjustments arrows (« < > ») provided.

6. Click to accept the calculated offset value, apply it to the system, and store the new value in the spectrometer's EEPROM.

Appendix D: Internal Shutter

Each IsoPlane 81 is shipped with an internal mechanical shutter that can be replaced in the field. This appendix provides information about the removal and installation of this internal shutter.

D.1   Required Tools

The following tools are required to remove and install an internal shutter on the IsoPlane 81:

- #1 Phillips head screwdriver;
- 3/8" Allen wrench.

D.2   Internal Shutter Removal Procedure

Perform the following procedure to remove the internal shutter from the IsoPlane 81:

1. Disconnect all cables and other equipment/accessories from the IsoPlane 81.
2. Carefully turn the IsoPlane 81 over onto a clean, flat, dry, sturdy surface so that the underside of the chassis is accessible.
3. Use a #1 Phillips head screwdriver to loosen/remove each of the four (4) Phillips head screws securing the shutter access panel to the underside of the IsoPlane 81 chassis. See Figure D-1.

Figure D-1:   Remove Shutter Access Panel: Underside of IsoPlane 81
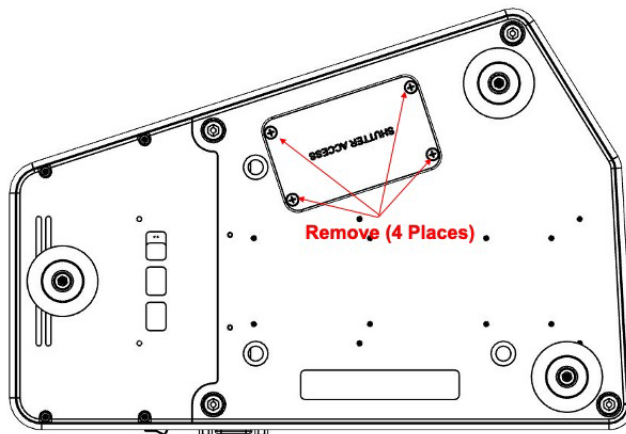
4. Once the access panel has been removed, use the 3/8" Allen wrench to loosen the two Allen screws that are visible.
5. Carefully disconnect the two-conductor electrical shutter cable.
6. Carefully slide the shutter down to remove it.

D.3   Internal Shutter Installation Procedure

Perform the following procedure to install an internal shutter into the IsoPlane 81:

1. Carefully slide the shutter into the bottom of the IsoPlane 81 chassis.
2. Carefully reconnect the two-conductor electrical shutter cable.
3. Use the 3/8" Allen wrench to secure/tighten the two Allen screws.
4. Replace the shutter access panel.
5. Replace the four (4) Phillips head screws to secure the shutter access panel to the underside of the IsoPlane 81 chassis and use the #1 Phillips head screwdriver to tighten each screw. See Figure D-2.

Figure D-2:   Install Shutter Access Panel: Underside of IsoPlane 81
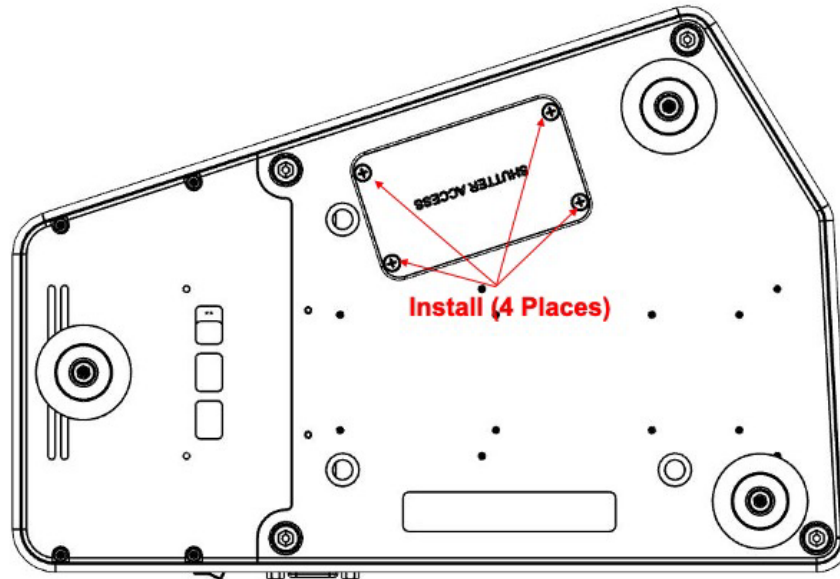
Appendix E: Timing Generator

The IsoPlane 81 includes a built-in general purpose Timing Generator (TG) with 10 ns resolution. The TG is often used in conjunction with the IsoPlane 81 laser accessory, but is not limited to the laser. It can control the timing of any two devices that support TTL-level timing inputs. The timing generator provides two output pulses. In a pump-probe experiment, for example, the first pulse could time the pump flash and the second could time the probe laser pulse.

The user can easily set the width and delay of each pulse from the starting point, T_0. LightField provides a virtual oscilloscope display so the user can view the timing graphically. The timing generator has access to internal signals of the IsoPlane 81, so that the pulses can easily be coordinated with the exposure and readout of the IsoPlane 81 CCD. It also has flexible trigger modes, so the user can easily synchronize it to an experiment. Furthermore, the user can set the TG to provide multiple (or single) sets of pulses in response to a trigger.

E.1 T_0

T_0 is the time from which the TG times its pulses. T_0 only exists inside the TG and is not directly accessible to the user. When using external trigger, T_0 is a few nanoseconds after the trigger pulse (the interval from trigger to T_0 is the sum of a few propagation delays in electronic components and the time for the trigger to travel from the connector to the TG). When the TG is being timed from the camera operation, T_0 is the time when the TG receives the "go ahead" signal from the camera. In many cases, the delay from trigger to T_0 is small enough to ignore.

E.2 Configuring the Timing Generator in LightField

Open the Camera Timing Dashboard and select either Repetitive or Sequential mode. Repetitive mode is discussed first; sequential mode is a little more complex.

E.2.1 Repetitive Timing Mode

LightField labels the two pulses Gate and AUX Output. These outputs and the Trigger input are available on the Auxiliary Cable (TPI part 6050-0752).

> ⚠ **CAUTION!**
> Exercise caution when plugging the AUX Cable into the rectangular connector adjacent to the USB connector. The connector is delicate. Be sure to squeeze the two finger grips on the sides of the connector when plugging it in. This releases the locking barbs. When plugged in, the connector will be locked in.

The AUX cable has three coaxial cables that terminate in three color-coded BNC connectors:

- Black
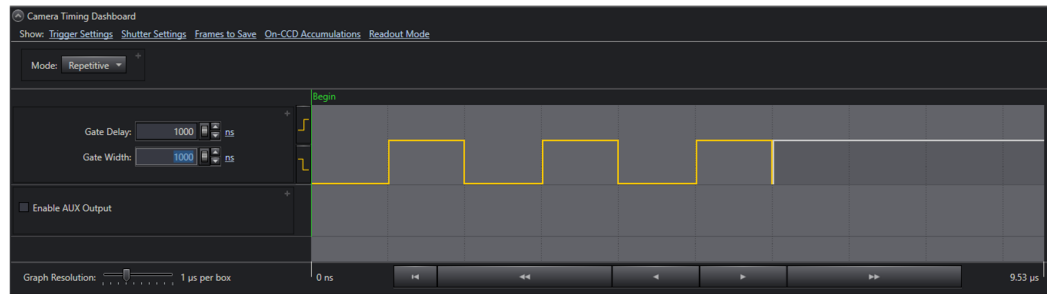 This is the external trigger input.
- Red

This is the Gate output.
- Green
  This is the AUX output.

In LightField, the number of on-CCD accumulations was set to 3. The Camera Timing Dashboard will now look like that illustrated in Figure E-1.

Figure E-1:   On-CCD Accumulations

In order to use the AUX pulse also, enable it in the Trigger Out expander or in the Camera Timing Dashboard. The Camera Timing Dashboard will now look like that illustrated in Figure E-2.

Figure E-2:   AUX Pulse
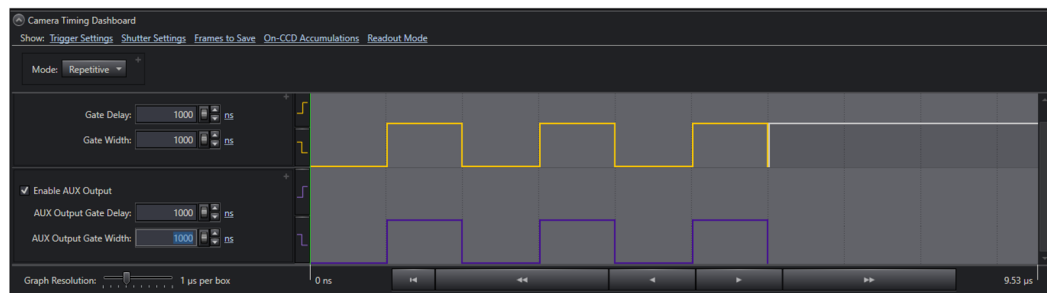
Adjust widths and delays by entering values in the appropriate windows, or using the spinners. The above screens show the internal trigger, readout per trigger mode. Internal trigger selects the trigger from the camera and a complete pulse set is generated, then the control is returned to the camera for readout.

E.2.2   Sequential Timing Mode

Sequential Mode is used to create a sequence of pulse sets that change linearly from frame to frame. Figure E-3 is an example of sequential operation with 3 frames in the sequence and 3 pulses in each frame. LightField displays the first and last sequence. The trigger can be either internal or external. If you select external trigger, you can have each external trigger start one pulse (Gate per Trigger) or each trigger start the set of pulses per frame (in this example 3 gates/frame) or have a single external trigger start the whole sequence of gates and readouts (Start on Single Trigger). If you select internal trigger, the selections are limited to Readout per Trigger and Gate per Trigger. Gate per Trigger provides only one gate, even when more have been selected.

Figure E-3:   Sequential Operation
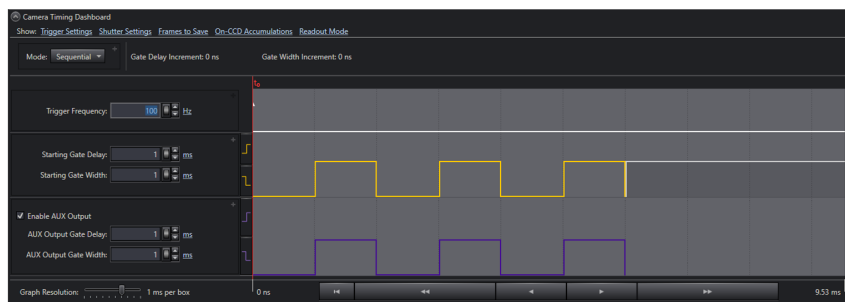
E.3   Clarification of Gate Terminology

LightField uses the term "gate" for historical reasons related to PI-MAX cameras, which truly have a gate capability. IsoPlane 81 cameras are not gateable, so the "gate" signal is merely a timing signal available for the convenience of the user. In experiments with no background signal, if the "gate signal" triggers a laser probe, for example, then results similar to a gated experiment can be achieved. If, however, there is a background signal, the IsoPlane 81 camera will integrate it over the whole exposure time.

This page is intentionally blank.

Warranty and Service

Limited Warranty

Teledyne Princeton Instruments, a business unit of Teledyne Digital Imaging US, Inc. ("Teledyne Princeton Instruments", "us", "we", "our") makes the following limited warranties. These limited warranties extend to the original purchaser ("You", "you") only and no other purchaser or transferee. We have complete control over all warranties and may alter or terminate any or all warranties at any time we deem necessary.

Basic Limited One (1) Year Warranty

Teledyne Princeton Instruments warrants this product against defects in materials and/or workmanship for a period of up to one (1) year after shipment. During this period, Teledyne Princeton Instruments will repair the product or, at its sole option, repair or replace any defective part without charge to you, or issue a credit for the original price of the defective product. You must deliver the entire product to the Teledyne Princeton Instruments factory or, at our option, to a factory-authorized service center. You are responsible for the shipping costs to return the product. International customers should contact their local Teledyne Princeton Instruments authorized representative/distributor for repair information and assistance, or visit our technical support page at www.princetoninstruments.com.

Limited One (1) Year Warranty on Refurbished or Discontinued Products

Teledyne Princeton Instruments warrants, with the exception of the CCD imaging device (which carries NO WARRANTIES EXPRESS OR IMPLIED), this product against defects in materials or workmanship for a period of up to one (1) year after shipment. During this period, Teledyne Princeton Instruments will repair or replace, at its sole option, any defective parts, without charge to you, or issue a credit for the original price of the defective product. You must deliver the entire product to the Teledyne Princeton Instruments factory or, at our option, a factory-authorized service center. You are responsible for the shipping costs to return the product to Teledyne Princeton Instruments. International customers should contact their local Teledyne Princeton Instruments representative/distributor for repair information and assistance or visit our technical support page at www.princetoninstruments.com.

XP Vacuum Chamber Limited Lifetime Warranty

Teledyne Princeton Instruments warrants that the cooling performance of the system will meet our specifications over the lifetime of an XP style detector (has all metal seals) or Teledyne Princeton Instruments will, at its sole option, repair or replace any vacuum chamber components necessary to restore the cooling performance back to the original specifications at no cost to the original purchaser. Any failure to "cool to spec" beyond our Basic (1) year limited warranty from date of shipment, due to a non-vacuum-related component failure (e.g., any components that are electrical/electronic) is NOT covered and carries NO WARRANTIES EXPRESSED OR IMPLIED. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Sealed Chamber Integrity Limited 12 Month Warranty

Teledyne Princeton Instruments warrants the sealed chamber integrity of all our products for a period of twelve (12) months after shipment. If, at anytime within twelve (12) months from the date of delivery, the detector should experience a sealed chamber failure, all parts and labor needed to restore the chamber seal will be covered by us. Open chamber products carry NO WARRANTY TO THE CCD IMAGING DEVICE, EXPRESSED OR IMPLIED. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Vacuum Integrity Limited 12 Month Warranty

Teledyne Princeton Instruments warrants the vacuum integrity of "Non-XP" style detectors (do not have all metal seals) for a period of up to twelve (12) months from the date of shipment. We warrant that the detector head will maintain the factory-set operating temperature without the requirement for customer pumping. Should the detector experience a Vacuum Integrity failure at anytime within twelve (12) months from the date of delivery all parts and labor needed to restore the vacuum integrity will be covered by us. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Image Intensifier Detector Limited One Year Warranty

All image intensifier products are inherently susceptible to Phosphor and/or Photocathode burn (physical damage) when exposed to high intensity light. Teledyne Princeton Instruments warrants, with the exception of image intensifier products that are found to have Phosphor and/or Photocathode burn damage (which carry NO WARRANTIES EXPRESSED OR IMPLIED), all image intensifier products for a period of one (1) year after shipment. See additional Limited One (1) year Warranty terms and conditions above, which apply to this warranty. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

X-Ray Detector Limited One Year Warranty

Teledyne Princeton Instruments warrants, with the exception of CCD imaging device and fiber optic assembly damage due to X-rays (which carry NO WARRANTIES EXPRESSED OR IMPLIED), all X-ray products for one (1) year after shipment. See additional Basic Limited One (1) year Warranty terms and conditions above, which apply to this warranty. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

Software Limited Warranty

Teledyne Princeton Instruments warrants all of our manufactured software discs to be free from substantial defects in materials and/or workmanship under normal use for a period of one (1) year from shipment. Teledyne Princeton Instruments does not warrant that the function of the software will meet your requirements or that operation will be uninterrupted or error free. You assume responsibility for selecting the software to achieve your intended results and for the use and results obtained from the software. In addition, during the one (1) year limited warranty. The original purchaser is entitled to receive free version upgrades. Version upgrades supplied free of charge will be in the form of a download from the Internet. Those customers who do not have access to the Internet may obtain the version upgrades on a CD-ROM from our factory for an incidental shipping and handling charge. See Item 13 in the following section of this warranty ("Your Responsibility") for more information.

Owner's Manual and Troubleshooting

You should read the owner's manual thoroughly before operating this product. In the unlikely event that you should encounter difficulty operating this product, the owner's manual should be consulted before contacting the Teledyne Princeton Instruments technical support staff or authorized service representative for assistance. If you have consulted the owner's manual and the problem still persists, please contact the Teledyne Princeton Instruments technical support staff or our authorized service representative. See Item 13 in the following section of this warranty ("Your Responsibility") for more information.

Your Responsibility

The above Limited Warranties are subject to the following terms and conditions:

1. You must retain your bill of sale (invoice) and present it upon request for service and repairs or provide other proof of purchase satisfactory to Teledyne Princeton Instruments.

2. You must notify the Teledyne Princeton Instruments factory service center within thirty (30) days after you have taken delivery of a product or part that you believe to be defective. With the exception of customers who claim a "technical issue" with the operation of the product or part, all invoices must be paid in full in accordance with the terms of sale. Failure to pay invoices when due may result in the interruption and/or cancellation of your one (1) year limited warranty and/or any other warranty, expressed or implied.

3. All warranty service must be made by the Teledyne Princeton Instruments factory or, at our option, an authorized service center.

4. Before products or parts can be returned for service you must contact the Teledyne Princeton Instruments factory and receive a return authorization number (RMA). Products or parts returned for service without a return authorization evidenced by an RMA will be sent back freight collect.

5. These warranties are effective only if purchased from the Teledyne Princeton Instruments factory or one of our authorized manufacturer's representatives or distributors.

6. Unless specified in the original purchase agreement, Teledyne Princeton Instruments is not responsible for installation, setup, or disassembly at the customer's location.

7. Warranties extend only to defects in materials or workmanship as limited above and do not extend to any product or part which:

   • has been lost or discarded by you;
   • has been mishandled, misused, abused, damaged, improperly installed, altered from their original state;
   • has had serial numbers removed, altered, defaced, or rendered illegible;
   • has been subjected to improper or unauthorized repair, inadequate maintenance, or improper storage;
   • has been installed, operated, or maintained in a manner inconsistent with instructions furnished by us;
   • has been damaged due to fire, flood, radiation, or other "acts of God" or other contingencies beyond the control of Teledyne Princeton Instruments; or
   • is a shutter which is a normal wear item and as such carries a onetime only replacement due to a failure within the original 1 year Manufacturer warranty.

8. The warranty period for repaired or replaced products shall be the greater of (i) ninety (90) days, or (ii) the unexpired portion of the original warranty period.

9. Teledyne Princeton Instruments is not liable for recall, retrieval, removal, dismantling, re-installation, redeployment, or re-commissioning of any defective products or any costs associated therewith, including, but not limited to, any subsea work performed

below the waterline, heavy lift operations, or the transportation to or from offshore locations.

10. After the warranty period has expired, you may contact the Teledyne Princeton Instruments factory or a Teledyne Princeton Instruments authorized representative for repair information and/or extended warranty plans.

11. Physically damaged units or units that have been modified are not acceptable for repair in or out of warranty and will be returned as received.

12. THESE EXPRESS WARRANTIES, INCLUDING THE REMEDIES SET FORTH HEREIN, ARE EXCLUSIVE AND ARE IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS INTENDED OR GIVEN. IN THE CASE OF GOODS OTHER THAN THOSE OF SELLER'S OWN MANUFACTURE, SELLER MAKES NO WARRANTIES, EXPRESS, STATUTORY, OR IMPLIED.

13. When contacting us for technical support or service assistance, please refer to the Teledyne Princeton Instruments factory of purchase, contact your authorized Teledyne Princeton Instruments representative or reseller, or visit our technical support page at www.princetoninstruments.com.

Contact Information

Teledyne Princeton Instruments' manufacturing facility for this product is located at the following address:

Teledyne Princeton Instruments
3660 Quakerbridge Road
Trenton, NJ 08619 (USA)

Tel: 1-800-874-9789 / 1-609-587-9797
Fax: 1-609-587-1970

Customer Support E-mail: techsupport@princetoninstruments.com

Refer to http://www.princetoninstruments.com/support for complete support and contact information, including:

• Up-to-date addresses and telephone numbers;
• Software downloads;
• Product manuals;
• Support topics for Teledyne Princeton Instruments' product lines.

This page is intentionally blank.

www.princetoninstruments.com

TELEDYNE PRINCETON INSTRUMENTS
Everywhere**you**look™

Part of the Teledyne Imaging Group

info@princetoninstruments.com
USA +1 877-474-2286 | **France** +33 (1) 60 86 03 65 | **Germany** +49 (0) 89 660 7793 | **UK & Ireland** +44 (0) 1628 472 346
Singapore +65 6408 6240 | **China** +86 10 659 16460 | **Japan** +81 (3) 5639 2741