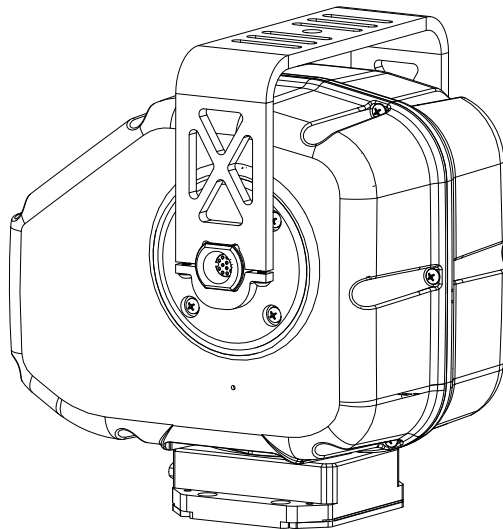![FLIR logo]

High-Performance
Pan-Tilt Unit

MODEL: PTU-5

VERSION: 3.01
REVISION DATE: February 23, 2018

User Manual

DOCUMENT CONTROL

Date	Author	Rev. #	Changes
03/2017	A. Hernandez	1.00	Initial production release
08/2017	A. Hernandez	2.00	Update wiring, add vent hole warnings
11/2017	A. Hernandez	3.00	Update wiring and miscellaneous updates
02/2018	A. Hernandez	3.01	Correct 26-pin numbering

COPYRIGHT NOTICE

1 - Introduction

The PTU-5 provides the fastest, most accurate pan-tilt unit in its size class that allows you to mount and aim cameras, antennas, lasers, and other payloads. This *User Manual* contains setup, general configuration, wiring, and mechanical interface information that is intended for use by design engineers and integrators who are configuring, installing, and programming the PTU. Please see for a list of other documents related to FLIR PTUs.

1.1 - General PTU Features

The PTU-5 offers the following general features:

- Extra small, rugged, portable MIL-spec design with low weight and high performance

- Turn on and begin slewing to track moving targets in seconds (<5 seconds startup time)

- Reduced calibration movement (PTU-5 does not need to home to 0,0).

- Programmable ranges of motion

- Output shaft encoders ensure reliability and accuracy

- High holding torque with no "droop" on power off

- MIL-STD shock and vibration tested

- Flexible design supports a wide range of applications and sensors

- Shared common firmware and command set with other FLIR PTUs

- 26-pin base connector for simplified wiring with direct connections to power and the host PC

- Slip ring for continuous 360° pan operation with no external payload cables.

- Serial communication capability via terminal or computer

- Simple ASCII command mode

- High-speed binary command interface

- Constant-current motor drives for increased performance and control

- Flexible connectivity options

- Unregulated 12-30 VDC power input

1.2 - PTU-5 Features

In addition to the general features listed above, the PTU-5 offers the following features:

- **Payload (top mount):** 5lbs

- **Payload (side mount):** 6lbs (two 3lb loads)

- **Dimensions:** 6.2" x 4.9" x 6" (approximately 158mm x 125mm x 153mm)

- **Swept volume:** 0.17 cubic feet, with no external motor cable

- **Weight:** 4lbs (approximately 1.81kg)

- **Pan and Tilt Resolution:** 0.005° in eighth-step mode

- **Accuracy/Repeatability:** 0.1°

- **Range of Motion:** 360° continuous pan, +/-180° tilt (side mount only)

- **Axis Speeds:** 120°/second pan; 50°/second tilt

- **Slip Ring Channels:** 11 (including power, video, serial, and Ethernet)

- **Connectors:** HD26 (base), M12 (payload; Phoenix Contact #1411979, mates to #1411987)

- **Voltage:** 12-30VDC input, 24VDC internal, with built-in reverse polarity protection

Please refer to the *PTU-5 Product Datasheet* for complete specifications.

1.3 - Applications

The PTU-5 is well suited for the following applications:

- Mid- and short-range surveillance systems

- Automated detection and tracking

- Visible and thermal cameras

- Industrial automation

- Harbor and port security

- Border security & law enforcement

- Highway & transportation monitoring

- Military special operations

- Robotics & computer vision.

1.4 - What's Different About the PTU-5

Users who are familiar with other FLIR pan tilts will notice the following differences in the PTU-5:

- The PTU-5 uses different connectors than those used on other PTUs; however, these connectors also conform to established industry standards.

- The PTU-5 uses a hybrid drive with both belts and gears.

- Encoders included on the output axes allow the PTU-5 to reset to locations other than home.

- The encoders correct for backlash and other nonlinearities for a more accurate output angle measurement.

- The Web interface shows motion in both degrees and steps.

1.5 - About This Manual

This section describes the formatting conventions and information contained in this manual.

1.5.1 - Formatting Conventions

This manual uses several formatting conventions to present information of special importance.

Lists of items, points to consider, or procedures that do not need to be performed in a specific order appear in bullet format:

- Item 1

- Item 2

Procedures that must be followed in a specific order appear in numbered steps:

1. Perform this step first.

2. Perform this step second.

Specific keyboard keys are depicted in square brackets and are capitalized, for example: [ESC]. If more than one key should be pressed simultaneously, the notation will appear as [KEY1]+[KEY 2], for example [ALT]+[F4].

Interface elements such as document titles, fields, windows, tabs, buttons, commands, options, and icons appear in **bold** text.

Menus and submenus have the notation **Menu>Submenu**. For example, "Select **File>Save**" means that you should first open the **File** menu, and then select the **Save** option.

Specific commands appear in standard `Courier` font. Sequences of commands appear in the order in which you should execute them and include horizontal or vertical spaces between commands.

This manual also contains important safety information and instructions in specially formatted callouts with accompanying graphic symbols:

⚠️	**WARNING: WARNINGS ALERT YOU TO THE POSSIBILITY OF PERSONAL INJURY IF THESE INSTRUCTIONS ARE NOT FOLLOWED.**

⚠️	**CAUTION: CAUTIONS ALERT YOU TO THE POSSIBILITY OF EQUIPMENT OR PROPERTY DAMAGE IF THESE INSTRUCTIONS ARE NOT FOLLOWED.**

📋	*Note: Notes provide helpful information.*

1.6 - Model Number

Each PTU unit includes a model number that is located on the base of the unit. This number lists the options present on that particular unit. The PTU-5 model number is 445-0005-01-00.

1.7 - PTU Package Contents

Your PTU package includes the following items:

- PTU-5 unit

- AC/DC power supply with cord (PT-PS-30V-NA) - optional

- Payload mounting brackets (top standard; side optional)

- Mating connector for payload (Molex #1200655109) - optional

- Breakout cable (308-0278-XX-00, where XX is the cable length in feet); available in various lengths - optional

- USB to RS-485 adapter cable - optional

- *PTU-5 Series Quick Start Guide*

1.8 - Related Documentation

The following additional documentation is available for your PTU:

*   *PTU Product Datasheet:* product specifications for your specific PTU model

*   *Pan-Tilt E Series Command Reference Manual:* command instructions

1.9 - Additional Resources

FLIR Systems, Inc. also maintains a technical support Web site with additional resources for customers in the **Support** section at *www.FLIR.com/MCS*. Resources include electronic copies of user manuals, firmware downloads, 3D CAD models, technical notes, and other information.

1.10 - Technical Support

FLIR Systems, Inc. provides a range of technical support options:

*   **Email:** *MCS-Support@flir.com*

*   **Web:** *www.FLIR.com/MCS*

*   **Phone:** (888)747-3547

The preferred method of contacting Technical Support is via email, which helps ensure proper dispatching and tracking to address your questions promptly.

When contacting Technical Support, please provide the following information:

*   PTU model and configuration

*   Payload (Please include photos, if possible.)

*   Parameter settings

*   Description of issue/symptoms

This page intentionally left blank.

2 - Safety

2.1 - Overview

This chapter contains important safety instructions. You must read, understand, and comply with all of these safety instructions in order to protect both persons and property. The benefits of a safe installation include increased usability, reliability, and reduced damage to the PTU, payload, and/or other property.

2.2 - Safety Warnings and Cautions

- PTU installation and setup should be only be performed by qualified personnel.

- The installation must comply with all applicable codes (such as building codes, marine safety codes, etc.).

- The installation must be free of obstructions throughout the entire potential range of pan-tilt motion, which may extend beyond user-specified limits when the PRU is resetting. When planning the installation, make sure to take the payload into account to ensure that the PTU and payload remain unobstructed at all times.

- All mounting methods and materials must be capable of supporting at least four times the combined weight of the PTU, mounted payloads, and cabling.

- Corrosion-resistant hardware (such as stainless steel screws) must be used for all outdoor installations.

- Do not install the PTU in any location that exceeds the PTU's environmental specifications.

- Always incorporate a readily accessible power disconnect into the installation wiring. (See *"Basic Setup" on page 10* and *"Wiring and Connectors" on page 16*.)

- Removing power by disconnecting the power cable or cable harness is not recommended and can result in damage to the system.

- All service procedures must be performed by qualified service personnel in accordance with all applicable instructions.

- If the PTU is damaged, immediately remove power and contact FLIR Systems, Inc.

- Only use replacement parts recommended by FLIR Systems, Inc.

- Use caution when lifting the PTU and/or payload.

- Keep all persons and objects well away from the PTU panning and tilting radius with payload installed.

- Do not touch or otherwise handle the PTU while in motion or if there is a possibility of motion. Always remove power before servicing the PTU and/or payload.

Copyright 2018, FLIR Commercial Systems, Inc.

3 - Quick Start

The PTU provides direct Ethernet and serial control for all motions. You may also use a joystick or proprietary controller.

This chapter helps you power up your PTU and test direct communications from a host computer.

3.1 - System Overview

The PTU includes an integrated controller that can be accessed using a Web/Ethernet interface. The controller will also accept control commands from any host computer over a serial (RS-485) connection. The basic connections are:

• DC power

• Pan-tilt control via either Ethernet or RS485 serial connection

The PTU also allows payload pass-through wiring that internally routes payload signals (payload power, video, etc.) from a single stationary connector in the PTU base to a single payload connector that moves with your payload.
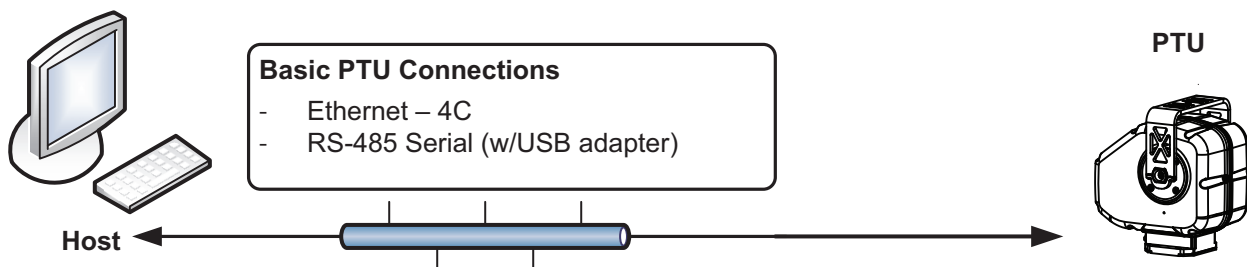
Figure 3-1: Pan-Tilt System Overview

You may control the PTU from any host computer using either the built-in Web interface or the ASCII protocol described in the included *Pan-Tilt E Series Command Reference Manual*. The PTU also supports a binary protocol via a C Software Development Kit (PTU-SDK) for high speed, hard real-time controls such as tracking. Drivers are also available using third-party software packages such as LabVIEW and digital video control systems.

3.2 - Installation Components

A complete PTU-5 system configuration requires the following components:

- PTU-5 (not shown)

- AC/DC power supply (PT-PS-INT-30V) – Optional – (1)

- Breakout cable (308-0278-XX-00) – Optional – (2)

- USB to RS-485 converter (PTU-CONV-USB-RS485) – Optional – (3)

- Side payload mounting brackets (261-2664-00)– Optional – (4)

- *PTU-5 User's Manual* (this document; available for download)

- *Pan-Tilt E Series Command Reference Manual* (available for download)
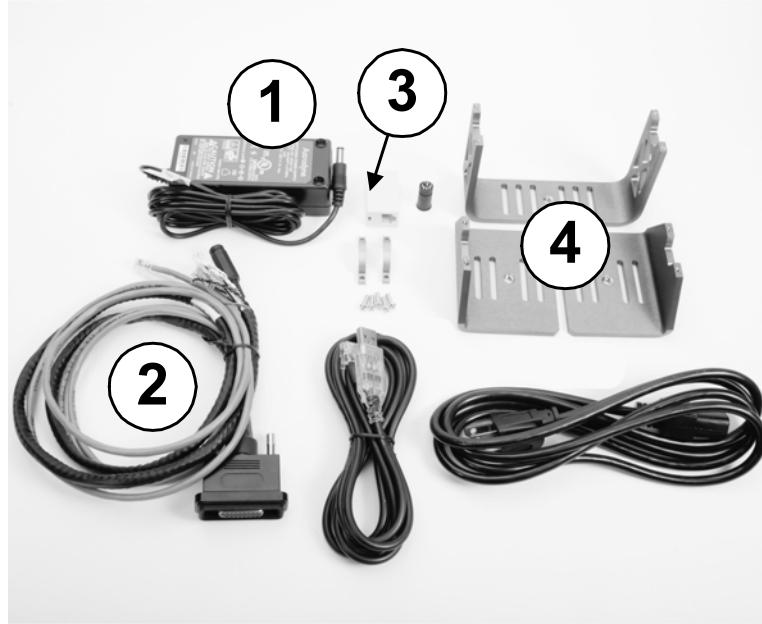
3.3 - Basic Setup

To perform a basic PTU setup and installation:

1. Mount the PTU securely to a lab bench, tripod, or other stable platform. Verify that there is enough clearance around the unit. See *"Mounting the Unit" on page 15* for detailed mounting instructions.

2. Attach either the optional breakout cable or customer-supplied cable to the 26-pin connector at the base of the PTU by inserting the cable into the connector and then tightening the mounting screws (one each on the left and right sides of the connector).
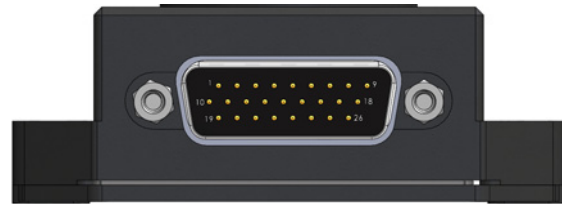
⚠️ *CAUTION: DISCONNECTING THE CABLE WHILE THE PTU IS POWERED ON CAN DAMAGE THE UNIT. ALWAYS POWER DOWN THE PTU BEFORE DISCONNECTING THE CABLE.*

⚠️ *CAUTION: THE HOLE ON THE SIDE OF THE PTU COVER IS NOT A RESET BUTTON. DO NOT INSERT ANY OBJECT INTO THIS HOLE AS IT MAY PIERCE THE WATERTIGHT MEMBRANE AND EXPOSE THE PTU TO MOISTURE DAMAGE.*

3. Connect the AC plug on the power supply into a power strip with a switch, and then connect the DC connector to either the breakout cable or customer-supplied cable.

4. Establish Ethernet or serial wiring to the PTU as appropriate for your needs.

   - Please see *"Ethernet Connection" on page 11* for Ethernet/Web instructions.

   - Please see *"Serial Connection" on page 13* for serial/ASCII instructions.

5. Power on and test the PTU.

6. Attach a payload to the top or side brackets.

> ⚠️ ***CAUTION: THE PTU-5 DOES NOT SUPPORT SIMULTANEOUS MOUNTING OF PAYLOADS ON BOTH THE TOP AND SIDE BRACKETS.***

3.4 - Ethernet Connection

The PTU contains a Web-based interface that allows you to test and program various functions. This interface is accessible via the Ethernet connection on the breakout cable.

> 📋 *Note: You may use simultaneous Ethernet and serial connections.*

To connect, power on, and test the PTU using the Ethernet connection and Web interface:

1. Connect one end of an RJ-45 Ethernet cable to the PTU, and then connect the other end of the cable to the host computer, either directly or through a router/hub.

2. Connect a power source to the PTU, making sure to incorporate a readily accessible power disconnect (such as a power strip) to allow safe power removal from the system.

> ⚠️ ***CAUTION: REMOVING POWER BY PULLING THE PLUG CAN DAMAGE THE PTU.***

3. Ensure that the PTU is clear to move in both axes (pan and tilt) without hitting any obstructions before applying power.

> ⚠️ ***WARNING: HITTING AN OBSTACLE WHILE THE PTU IS IN MOTION COULD CAUSE A MOUNTING OR OTHER STRUCTURAL FAILURE THAT COULD RESULT IN INJURY OR DEATH.***

4. Power on the PTU. When the PTU-5 is powered up, it goes through a short reset in both axes. The amount of motion on reset will vary at different areas of the axis, but generally it will move no more than 12 degrees in either direction.

5. Launch a Web browser. The PTU supports modern versions of the Microsoft Internet Explorer®, Mozilla® Firefox®, and Google® Chrome® browsers with JavaScript enabled.

6. Download the **PTU Finder** utility from FLIR. A list of the individual PTUs currently connected to the network and their corresponding IP addresses will appear in the application window.

> *Note: If you have simultaneous Ethernet and serial connections to a PTU, you may enter* `NI` *in the terminal to retrieve the IP address of the PTU.*

7. In your browser, navigate to the appropriate IP address (such as `http://192.168.1.101`). A web page appears when you are connected to the selected PTU. The PTU Web interface allows you to configure the network interface, configure various parameters, and control the PTU.

8. Navigate to the **PTU Control** page.

9. Click the arrows to pan and tilt the PTU and verify that it is working properly. You can use the Units radio buttons to specify the units to use (either **Degrees** or **Steps**).

Please refer to the *Pan-Tilt E Series Command Reference Manual* for instructions on using the Web interface.

Copyright 2018, FLIR Commercial Systems, Inc.

◆◆FLIR®
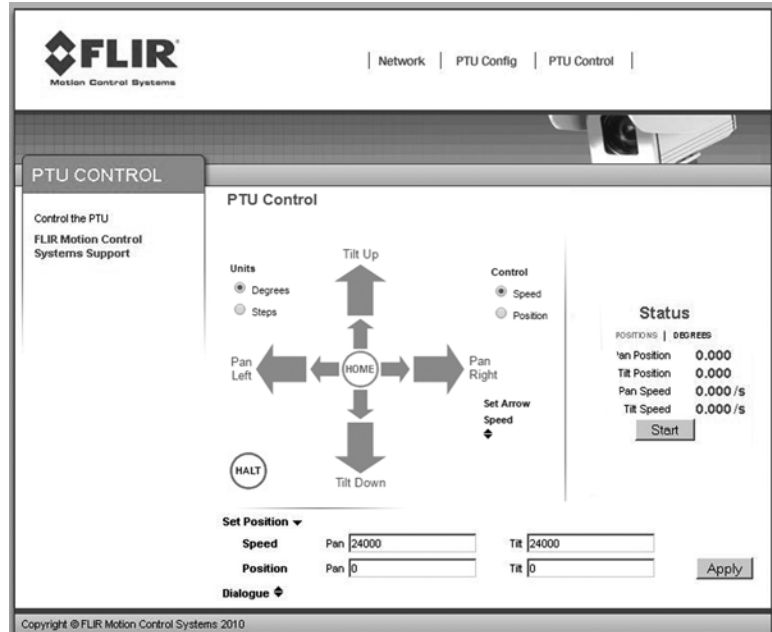
3.5 - Serial Connection

Note: You may use simultaneous Ethernet and serial connections.

To connect, power on, and test the PTU using the serial interface:

1. Connect the PTU as follows:

   - Attach the DB25 to DB9 converter on one side of the RS-232 to RS-485 converter.

   - Attach one end of the four-pin RJ-11 phone cable to the other side of the RS-232 to RS-485 adapter.

   - Set the switches on the RS-232 to RS-485 converter to **T RxON** and **DCE**.

   - Attach the four-pin RJ-11 female-to-female adapter to the other end of the phone cable. This is important because the adapter rearranges the pins; the PTU will not function if the adapter is not attached correctly.

   - Connect the RS485 connector from the breakout cable into the adapter.

   - Provide power to the converter through the included power supply.

   - Alternatively, you can connect the USB to RS-485 cable (PTU-CONV-USB-RS485) to a USB port on the host PC and the RJ-11 connector on the breakout cable.

   RS-232

   RS-232 to RS-485 adapter

   DB9 to DB25 adapter

   F-F adapter

   Phone cord
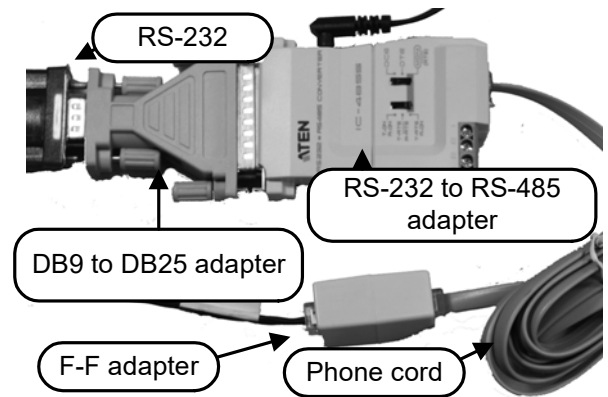
2. Open a terminal program such as HyperTerminal® or TeraTerm®.\

3. Create a new connection with the following communications parameters:

   - 9600 baud

   - 8 data bits

   - 1 stop bit

   - no parity

   - no handshaking

   Note: HyperTerminal is available with Microsoft® Windows XP® and previous versions. You may download TeraTerm from http://ttssh2.sourceforge.jp/.
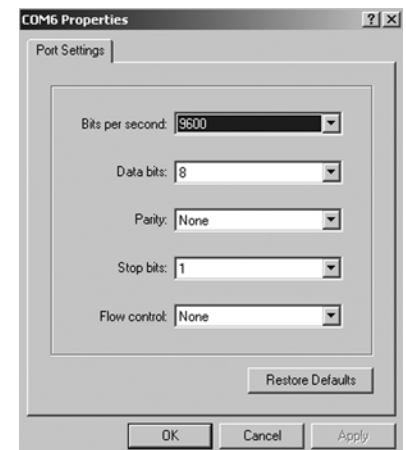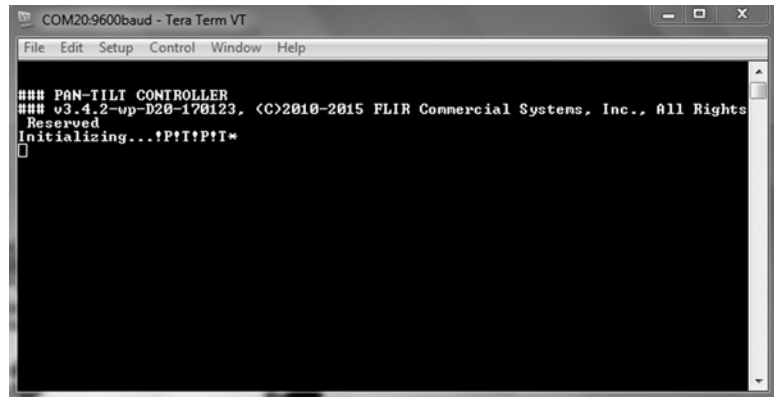
4. Provide DC power to the PTU. The factory cable (part number 308-0278-XX-00) allows easy plug-in power from the factory AC/DC power supply model PT-PS-INT-30V. Alternatively, you may provide your own DC power source if appropriate.

⚠️ ***CAUTION: USE AN APPROPRIATELY RATED POWER STRIP WITH SURGE PROTECTION TO ALLOW SAFE POWER REMOVAL WHEN YOU ARE READY TO POWER DOWN.***

5. Power on the PTU by turning on the switch on the power strip. If power is working, the unit will begin a self-calibration and text will appear on your terminal identifying the unit's configuration.

6. Test pan-tilt operation by typing commands into your terminal program. The following command sequence will familiarize you with basic PTU-D48E operation:

```
pp2500 tp-900 PS1900 pp0
```

This sequence:

- sets the pan axis to position 2500

- sets the tilt axis to position -900

- sets the pan speed to 1900 positions per second, and

- sets the pan position back home.

7. Power down the PTU by turning off the switch on the power strip.

8. Mount and wire your payload (e.g. camera) on the PTU, as described in *"Installation & Setup" on page 15*.

Please see *"ASCII Command Syntax" on page C-3* for an overview of the ASCII command syntax and a list of commonly used commands. The *Pan-Tilt E Series Command Reference Manual* contains complete command interface instructions.

4 - Installation & Setup

This section describes proper mechanical and electrical PTU-5 installation.

4.1 - Mounting the Unit

The basic mounting pattern uses four #1/4-20 screws in a 1.18" (30mm) by 2.28" (58mm) rectangular pattern. All four mounting screws must be used, and mount must be strong enough to support the combined load of the PTU, payload, and additional forces exerted on the system (such as wind, G forces, etc.). A good rule of thumb is that the mount must be capable of supporting at least four times the combined weight of the PTU and payload. For example, a mount for a PTU-5 must be able to support at least 48lbs.
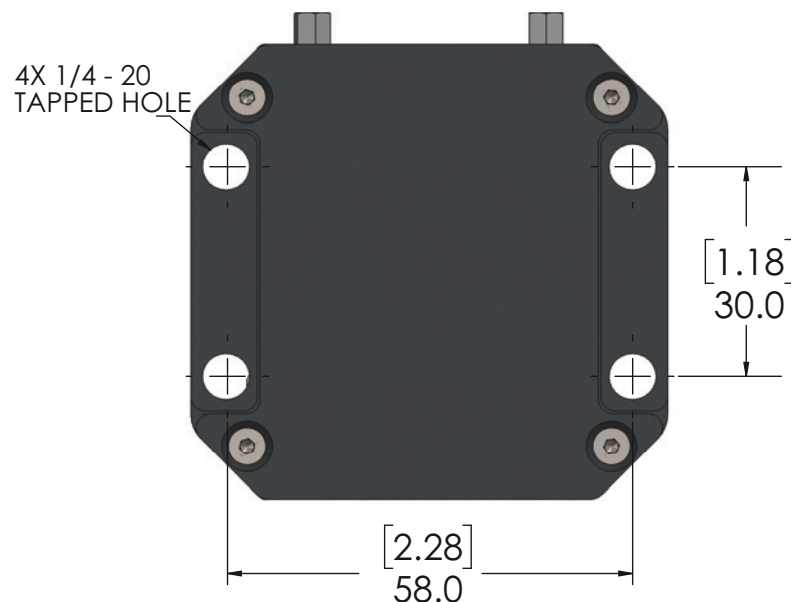
Figure 4-1: Hole Mounting Patterns

⚠ **WARNING: FAILURE TO USE ALL FOUR MOUNTING SCREWS AND/OR TO SECURE THE PTU AND ITS PAYLOAD TO A SUFFICIENTLY STRONG MOUNTING CAN CAUSE THE INSTALLATION TO FAIL. THIS CAN RESULT IN PERSONAL INJURY OR DEATH, AND/OR DAMAGE TO THE PTU AND/OR PAYLOAD.**

4.2 - Wiring and Connectors

The PTU-5 has both a base connector and a payload connector for customer attachment. Please refer to *"Electrical Specifications" on page A-1* for detailed pin-out and connector requirements.

4.2.1 - Mechanical Overview

The PTU-5 contains two receptacles.

- **Base Receptacle:** The base of the PTU-5 houses the 26-pin base connector.

- **Payload Receptacle:** The payload connector is a 12-pin circular M12 receptacle.

Note: The PTU-5 is IP67 rated with no payload cable attached. If you need a payload cable, then that cable should be designed so as to maintain the IP67 rating. FLIR recommends using the Molex #1200655109 cable.

Basic control requires connecting a DC power source and a host PC to the PTU. The supplied breakout cable and power supply allow you to have your PTU plugged in and running within minutes. *"Electrical Specifications" on page A-1* contains specific pin outs and wiring diagrams for the available PTU wiring configurations; if needed, you may use this information to make custom cables to suit your specific installation requirements. Please refer to *"Quick Start" on page 9* for basic connection and power-on instructions.

The PTU-5 also provides payload pass-through signals that connect between pins in the base receptacle to corresponding pins in the payload receptacle. Additional pins in the base receptacle provide other controls to the PTU controller board, including both RS485 and Ethernet controls.

CAUTION: ALWAYS FOLLOW ALL APPLICABLE SPECIFICATIONS (INCLUDING BUT NOT LIMITED TO MAXIMUM VOLTAGE AND CURRENT) WHEN ATTACHING PAYLOAD SIGNALS TO THE SYSTEM.

4.2.2 - Wiring

The PTU is offered with one wiring configuration that includes the following connections:

- 1 power circuit (4C)

- Chassis ground (2C)

- 1 Ethernet connection (4C; to PTU internal electronics only)

- 1 RS485 connection (4C)

- 11 general I/O lines (11C)

The PTU-5 requires a minimum of ten connections at the base for power, RS-485 communications, and shielding.

4.3 - Power Sources

The PTU requires an unregulated 12-30VDC power source capable of 17 continuous peak watts. Since the PTU has a DC to DC converter, you may not see reduced performance if you use a lower-voltage power supply.

> ⚠️ **CAUTION: THE PTU CONTAINS REVERSE POLARITY, OVER-VOLTAGE AND OVERCURRENT PROTECTION; HOWEVER, SUSTAINED OVERLOAD CAN DAMAGE THE UNIT.**

4.4 - Shielding

Shielding protects the PTU from external Electromagnetic Interference (EMI) and prevents radiation emission from internal and external cabling. Proper shielding must be used to meet the regulatory requirements described in *"Regulatory & Warranty Information" on page E-1*. All PTU wiring configurations provide a shield pin at both the base and the payload, as described in *"Electrical Specifications" on page A-1*. This shield is also attached to the PTU housing. The shield pin is not connected to ground internally. The shield potential will vary from ground and must not be confused with a ground pin.

Ideally, either the PTU chassis or the shield pin at the base connector should be routed to a long grounding rod that is embedded in the ground. If needed, it is also acceptable to route the shield pin to the power ground through a surge protection device.

> ⚠️ **CAUTION: THE PTU WILL NOT BE PROPERLY SHIELDED UNTIL THE SHIELD PIN IS PROPERLY CONNECTED.**

4.5 - Interface and Host Settings

The PTU-5 includes both an Ethernet connection and RS-485 communications. You may connect to your PTU using either or both of these methods; the Web interface is only available when using an Ethernet connection, and the terminal interface is only available when using a serial connection.

4.5.1 - Ethernet Connection

The PTU Ethernet connection uses a standard Cat-5 (RJ-45) network cable.

* You may connect the PTU directly to a host computer or indirectly through a router, hub, etc.

* The PTU will either accept IP addresses from a DHCP server or select its own IP address if connected directly to the host computer.

* If needed, you may use a coupling to extend the Ethernet connection on the breakout cable.

> *Note: The Ethernet and serial interfaces may be connected simultaneously; however, you should only use one interface at a time for command and control of the PTU.*

Connect, power on, and test the PTU using the Ethernet connection and Web interface as described in *"Ethernet Connection" on page 11*.

4.5.2 - RS-485 Electrical Connection

The PTU RS-485 communications use the following connections:

* **Duplex:** full

* **Connections:** Tx+, Tx-, Rx+, and Rx-

* **Voltage:** RS-422 or RS-485 levels

Serial communication between the PTU and your host computer should be set as follows:

* **Baud rate:** 9600. You may adjust the baud rate using software commands. Please refer to the *Pan-Tilt E Series Command Reference Manual* for instructions.

* **Start bit:** 1

* **Data bits**: 8

* **Stop bit:** 1

* **Handshaking:** off

* **XON/XOFF:** not used

4.6 - Initial Power-Up and Test

This section describes how to power up and test your PTU using either the Web or serial interface. Test and verify all cable connections and connector wiring before power-up.

> *Note: Complete the initial installation and testing, then exercise the PTU and familiarize yourself with its operations and commands before mounting your payload (such as a camera).*

4.6.1 - Web Interface

To test the PTU using the Web interface, follow the procedure in *"Ethernet Connection" on page 11* to connect the PTU, power on the unit, and access the Web interface.

The Web interface has a number of pages, including:

- **PTU Config:** Allows you to configure speed, acceleration, and power options.
- **Network:** Allows you to configure the PTU's IP and MAC addresses.
- **PTU Control:** Allows you to control the PTU. Use this page to test PTU motion and exercise the unit.

Please see the *Pan-Tilt E Series Command Reference Manual* for more information about the Web interface.

4.6.2 - Terminal Interface

To test the PTU using the serial interface:

1. Configure the RS-485 port on the host computer as described in *"Serial Connection" on page 13*.

2. Power up the PTU. A boot message will appear on your terminal screen and the unit will begin a reset cycle. An asterisk (*) appears on your screen when the reset cycle is finished. If the PTU did not reset properly, please refer to the troubleshooting instructions below.

3. Please see *"Serial Command List" on page C-4* for a list of basic commands, and the *Pan-Tilt E Series Command Reference Manual* for a complete list of commands and associated parameters and other usage instructions.

4.7 - Payload Mounting

The PTU payload bracket system can be configured in a number of ways to support a variety of payloads including cameras, lasers, antennas, and other equipment. Figure 3 shows all bracket configurations available for the PTU-5.

> ⚠️ **_WARNING: FAILURE TO FOLLOW ALL PAYLOAD MOUNTING INSTRUCTIONS COULD RESULT IN A STRUCTURAL FAILURE THAT MAY RESULT IN DEATH, PERSONAL INJURY, AND/OR DAMAGE TO THE UNIT._**

The following guidelines apply to all payload mounts:

- The maximum payload mounting screw diameter is 1/4" when using the center hole on each bracket (slots accommodate smaller screws). Also, payload mounting screws must not extend more than 1/8" below the top mounting bracket, to avoid gouging the PTU housing.

- Always use washers, lock washers, etc. as appropriate.

- If the PTU is being mounted in an outdoor location, use corrosion-resistant hardware (such as stainless steel).

- Apply thread locking compound to all screws, such as Loctite® 242, which is suitable for applications that are field serviceable since it is easily removable with common hand tools and works with both stainless and plated metals. Consider other compounds for high-shock/vibration applications where field service is not a concern.

The PTU-5 allows the following bracket mounting options:

Figure 4-2: Bracketing Options

4.7.1 - Side Bracket Attachment

To attach side mounting brackets:

1. Verify that the PTU has been powered on and allowed to reset, which places the mounting hub in its "home" position.

2. Power off the PTU.

3. Remove the top mounting bracket by removing the two screws and one clamp at either side of the bracket.

4. Orient the side bracket so the horizontal mounting arm is on the bottom.

5. Attach the bracket using one clamp secured with two screws torqued to 32 inch-pounds. The thread holes in the hub come with thread locking compound applied to them. Reapply thread lock to the hub whenever you remove the bracket using a compound such as Loctite® 242.

6. Reset the PTU and ensure that the bracket moves properly throughout the entire range of motion.

Note: If you ordered your PTU with a top bracket, the unit will arrive with the bracket already attached.

Note: Default tilt axis limits are set to +30°/-90°. If you will be using the PTU with side brackets only, then you may specify tilt axis limits up to +/- 90° using the TNU and TXU ASCII commands, as described in the Pan-Tilt E Series Command Reference Manual.

CAUTION: THE HOLE ON THE SIDE OF THE PTU COVER IS NOT A RESET BUTTON. DO NOT INSERT ANY OBJECT INTO THIS HOLE AS IT MAY PIERCE THE WATERTIGHT MEMBRANE AND EXPOSE THE PTU TO MOISTURE DAMAGE.

4.7.2 - Payload Attachment

The following guidelines apply to all payload attachments:

- Mount all payloads as close to the PTU as possible. This minimizes the distance between the payload Center of Gravity (CG) and the center of rotation of the axes, which reduces stress on the PTU and mounting. It also improves performance by reducing the amount of torque required to move the payload.

- Verify that the payload will clear the PTU housing and all surrounding objects throughout the entire range of motion.

- Your PTU is rated for the loads specified in *"PTU-5 Features" on page 2*; however, load distribution affects the actual weight that the PTU can safely move. The amount of torque needed to move a payload depends on a number of factors such as (but not limited to) payload weight, distance from the payload CG to the center of rotation, acceleration and speed settings, power levels, and environmental factors.

Top-mounted payload CG is above the tilt axis center of rotation and requires more torque.

Side-mounted payload CG is closer to the tilt axis center of rotation and requires less torque.
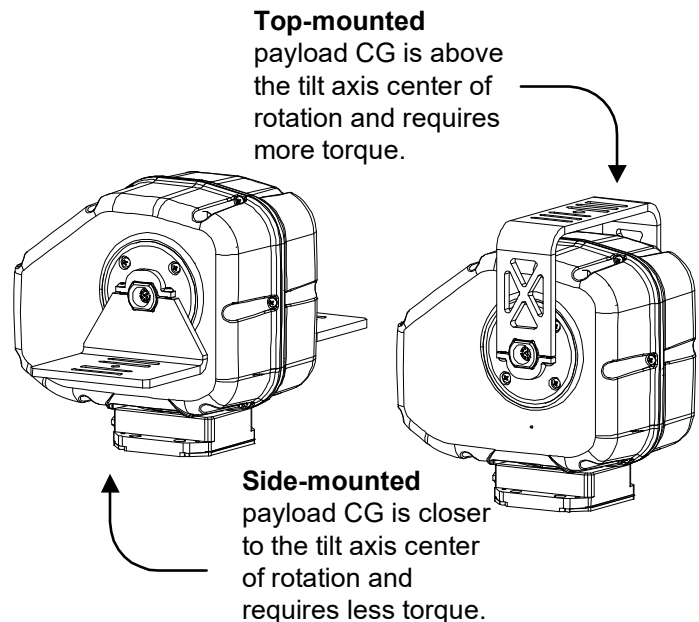
- The PTU allows full control over acceleration, speed, and power levels. Mount your payload and configure these parameters appropriately to ensure reliable operation.

- If your installation is not usable across the full range of motion, use the `TXU`, `TNU`, `PXU`, and/or `PNU` commands to set software motion limits. When resetting a PTU-5 that is positioned near those limits, the PTU may briefly move outside those limits.

To attach and test your payload:

1. Mount your payload. Side mounting is preferable for heavy loads because this keeps the payload CG closer to the tilt axis, thereby minimizing torque requirements.

2. Verify that the payload is securely attached to the payload bracket.

3. Move the PTU tilt axis through its entire range to test its ability to carry the load.

> ⚠ **CAUTION: THE CG OF TOP-MOUNTED PAYLOADS IS FURTHER FROM THE TILT AXIS AND MAY REQUIRE MORE TORQUE THAN A SIMILAR SIDE-MOUNTED PAYLOAD.**

- If you are using the Web interface, open the **PTU Control** page and click the arrows to move the PTU through its full range of tilt motion, as described in the *Pan-Tilt E Series Command Reference Manual*. If needed, click **Halt** to stop the PTU immediately.

- If you are using the terminal interface, enter `TN TX` to query the tilt minimum and maximum limits, then enter `TP<min> A TP<max>` to cycle the PTU through its entire tilt range (where `<min>` is the number returned by the `TN` query and `<max>` is the number returned by the `TX` query). If needed, enter `H` to stop the PTU immediately.

> ⚠ **WARNING: STOP THE PTU IMMEDIATELY BY EITHER CLICKING HALT (WEB INTERFACE) OR ISSUING AN H COMMAND (SERIAL INTERFACE) IF THE PAYLOAD IS ABOUT TO COLLIDE WITH THE PTU-5 AND/OR ANOTHER OBSTACLE. A COLLISION COULD CAUSE A STRUCTURAL FAILURE THAT MAY RESULT IN INJURY OR DEATH.**

If the load is too heavy or moving too quickly, the PTU will lose synchronization, which will be audible as a grinding sound from the PTU motors. Stop the test immediately if this occurs, and refer to *"Heavy-Payload Operation" on page 28* and *"Battery Powered Operation" on page 29*. This does not damage the PTU but does indicate that the payload is not mounted and/or the PTU is not configured correctly to move the payload.

> Note: Please refer to *"Heavy-Payload Operation" on page 28* for more information on configuring the PTU for heavier payloads.

> ⚠ **CAUTION: DO NOT PROCEED BEYOND THIS STEP UNLESS AND UNTIL THE PTU PASSES THE TILT AXIS MOTION TEST.**

4. Move the PTU pan axis through its entire range to test its ability to carry the load.

    - If you are using the Web interface, open the **PTU Control** page and click the arrows to move the PTU through its full range of pan motion, as described in the *Pan-Tilt E Series Command Reference Manual*. If needed, click **Halt** to stop the PTU immediately.

    - If you are using the terminal interface, enter `PN PP` to query the pan minimum and maximum limits, then enter `PN<min> A PP<max>` to cycle the PTU through its entire tilt range (where `<min>` is the number returned by the `PN` query and `<max>` is the number returned by the `PX` query). If needed, enter `H` to stop the PTU immediately.

⚠️ **WARNING: STOP THE PTU IMMEDIATELY BY EITHER CLICKING HALT (WEB INTERFACE) OR ISSUING AN H COMMAND (SERIAL INTERFACE) IF THE PAYLOAD IS ABOUT TO COLLIDE WITH THE PTU AND/OR ANOTHER OBSTACLE. A COLLISION COULD CAUSE A STRUCTURAL FAILURE THAT MAY RESULT IN INJURY OR DEATH.**

If the load is too heavy or moving too quickly, the PTU will lose synchronization, which will be audible as a grinding sound from the PTU motors. Stop the test immediately if this occurs, and refer to *"Heavy-Payload Operation" on page 28* and *"Battery Powered Operation" on page 29*..

5. If the PTU passes the above pan and tilt axis load handling tests, you are ready to begin controlling your payload using the commands described in the *Pan-Tilt E Series Command Reference Manual*.

This page intentionally left blank.

5 - Configuring & Programming

This chapter describes how to configure and program your PTU.

Note: You may also have a simultaneous Ethernet connection to the Web interface, as described in "Ethernet Connection" on page 11.

Follow the appropriate instructions to connect the PTU-5 to the host computer, power it on, and access it via:

- **Web:** *"Ethernet Connection" on page 11*.
- **Serial:** *"Serial Connection" on page 13*.

5.1 - Range of Motion

The PTU-5 range of motion can be limited in the following ways:

- **Factory:** Factory limits are smaller than hard limits to prevent physical damage to the PTU and/or payload.
- **User:** User limits are programmable limits that are smaller than hard limits and can be as large as factory limits.

The PTU-5 uses high-precision mechanical stops on the tilt axis. Resetting the PTU-5 may temporarily move the PTU beyond its software-configured range of motion in the tilt and/or pan axis.

5.1.1 - Default Limits

In Figure 5-1:

• The positive pan axis direction is clockwise when looking down at the top of the PTU.

• The positive tilt axis direction is clockwise when looking sideways at the PTU with the motors and connectors facing to the right.
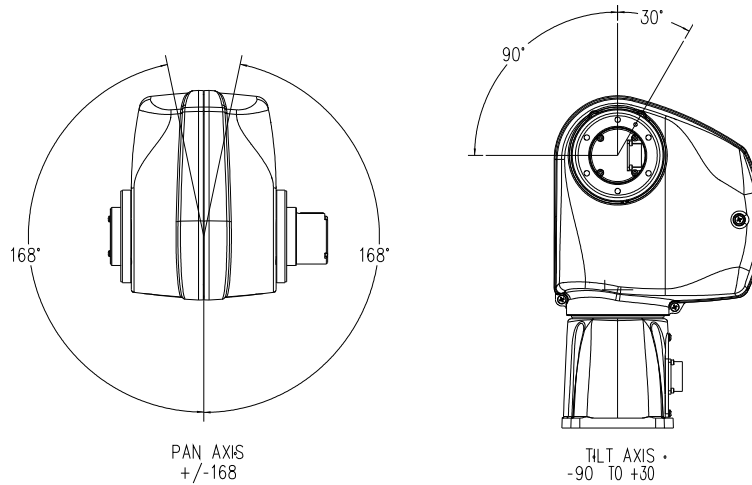
Figure 5-1: Pan-Tilt Default Factory Limits (PTU-D100 shown with identical limits to the PTU-5)

Note: The default pan axis user limits are +/- 168°. The default tilt axis limits are +30° and -90°. You can only use the full +/-90° tilt axis with side brackets because the top bracket will impinge on the PTU body.

5.2 - Resolution and Step Modes

The PTU uses stepper motors that drive the unit through a gear reduction system. The internal controller allows stepper motor control in manual (½, ¼, and 1/8) or automatic step modes. The following table lists the pan and tilt axis resolution in degrees.

Note: Larger step modes increase torque and maximum speed vs. smaller step modes. The PTU includes an automatic stepping mode (auto-step) that optimizes this trade-off for many applications. You may command the PTU in 1/8 steps when in automatic stepping mode.

5.2.1 - Resolution

This table displays the PTU-5 pan and tilt resolutions.

	½ STEP	¼ STEP	1/8 STEP
PAN AXIS	0.02°	0.01°	0.005°
TILT AXIS	0.02°	0.01°	0.005°

5.3 - User-Programmable Settings

The PTU has a number of user-programmable parameters that can significantly affect performance for a given payload and application. These parameters should be set to values that are appropriate for your payload and application needs. This section provides an overview of how to optimize your PTU for high-power and/or high-speed operation. Please refer to the *Pan-Tilt E Series Command Reference Manual* for complete instructions.

> ⚠ *CAUTION: USE HIGH-SPEED AND/OR HIGH-POWER SETTINGS WITH CARE, PARTICULARLY WHEN MOUNTING A HEAVY AND/OR BULKY PAYLOAD.*

> ⚠ *WARNING: FAILURE TO ADEQUATELY SECURE THE PTU TO A MOUNTING THAT CAN WITHSTAND THE FORCES APPLIED BY BOTH HIGH-SPEED, HIGH-POWER MOVEMENT AND ENVIRONMENTAL FASCTORS SUCH AS VEHICLE MOVEMENT OR WIND CAN CAUSE A STRUCTURAL FAILURE RESULTING IN INJURY OR DEATH.*

5.3.1 - High-Speed Operation

The following factors should be considered when planning high speed operation:

- Load weight, weight distribution, and dynamics.

  - Move the payload as close to the axis centers of rotation as possible. Doing this will reduce the torque required to move the payload and allow a higher top speed.

  - Balancing the load, such as by using a counterweight or splitting the payload into two pieces can also help significantly.

- Desired upper speed limit.

- Rate of acceleration.

- The base (start-up) speed.

- Power supply voltage. Higher voltages within the permissible range significantly improve axis speed and acceleration performance.

- In-motion power modes. If the duty cycle is less than 20%, you may use high move power to increase the top speed.

- Multi-axis dynamics. Simultaneously moving the tilt and pan axes affects the forces exerted on the PTU.

- Always begin high-speed tests on each axis in isolation. Only perform simultaneous pan-tilt movements once each individual axis is optimized.

- The base speed is the PTU minimum speed. In practice, the unit will instantly accelerate to this speed. Setting a base speed can help speed up movement by eliminating a segment of acceleration time.

- Aggressive acceleration settings with heavy payloads can cause increased wear on the PTU.

An example configuration string for high speed operations is:

```
PA9000    PU6000    TA9000    TU6000    DS
```

5.3.2 - Heavy-Payload Operation

If the PTU fails the initial load handling tests, you may be able to program it for higher-power operations. The speed and acceleration of a mechanical system depend on the inertial properties of the payload. The ability of the PTU to successfully move the payload without losing synchronization depends upon the inertial payload factors and their relationship to power supply voltage, unit speed, acceleration, position, motor torque, etc.

To increase payload capacity:

Configure the PTU for increased motor current and torque. If your move duty cycle is less than 20%, you can set the **Move Power** to High (**Web**) or use the following serial commands: `PMH TMH PHR THR`.

You may also:

- Move the payload CG closer to the PTU tilt axis. See *"Payload Attachment" on page 21*.

- Determine if the payload can be modified to lighten it.

- Set the base speed to 0.

- If the PTU is having trouble resetting the tilt axis, try using user limits to reduce the tilt-axis range of motion.

- Reduce speed and/or acceleration.

Please refer to the *Pan-Tilt E Series Command Reference Manual* for more information.

5.3.3 - Battery Powered Operation

The PTU can be battery powered. Battery-powered applications must conserve as much power as possible. The PTU includes commands that control pan-tilt motor power consumption both while moving and when stopped. For example, you can use the `PHO` and `THO` commands to set holding power to off. Please refer to the *Pan-Tilt E Series Command Reference Manual* for more information.

> ⚠ ***CAUTION: ALWAYS USE A FUSE WHEN CONNECTING THE PTU TO A BATTERY.***

This page intentionally left blank.

A - Electrical Specifications

This Appendix describes the PTU-5 wiring. Please refer to *"Mechanical Overview" on page 16* for a mechanical overview.

⚠️	***CAUTION: DO NOT EXCEED MAXIMUM RATED PASS-THROUGH AMPERAGES. FUSE PAYLOADS AT RATED TRIP VALUES. THE PTU-D300E WARRANTY DOES NOT COVER DAMAGE CAUSED BY OVERCURRENT SITUATIONS.***
⚠️	***CAUTION: ALWAYS TERMINATE THE SHIELD LINE TO AN APPROPRIATE SYSTEM SHIELD OR GROUND CONNECTION.***

In general:

- TX lines carry data from the PTU-5.
- RX lines carry data to the PTU-5.

A.1 - 26-Pin Base Connector

This table displays the PTU-5 D-Sub HD26-pin connector pin assignments.

PIN	ASSIGNMENT
1	PTU POWER SUPPLY
2	PTU POWER SUPPLY RETURN
3	PTU_PHY_RXP
4	PTU_RS485_TX-
5	PTU_RS485_GROUND
6	PAYLOAD SIGNAL 6
7	PAYLOAD SIGNAL 9
8	PAYLOAD SIGNAL 2
9	CHASSIS GROUND
10	PTU POWER SUPPLY
11	PTU_PHY_TXP
12	PTU_PHY_RXN
13	PTU_RS485_RX+
14	PAYLOAD SIGNAL 7
15	PAYLOAD SIGNAL 10
16	PAYLOAD SIGNAL 3
17	PAYLOAD SIGNAL 4
18	CHASSIS GROUND
19	PTU POWER SUPPLY RETURN
20	PTU_PHY_TXN
21	PTU_RS485_TX+
22	PTU_RS485_RX-
23	PAYLOAD SIGNAL 11
24	PAYLOAD SIGNAL 5
25	PAYLOAD SIGNAL 8
26	PAYLOAD SIGNAL 1
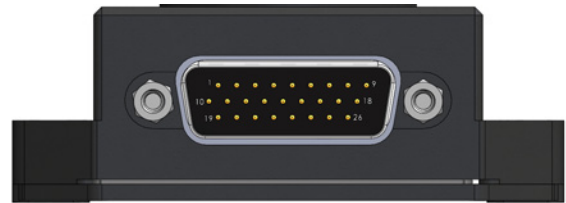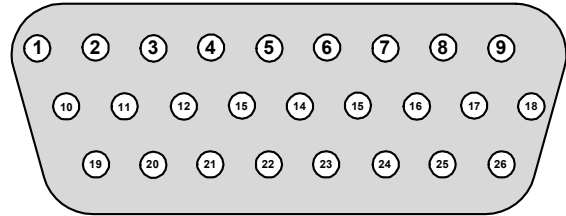
A.2 - 12-Pin Payload Connector

This table displays the PTU-5 M12 12-pin payload connector pin assignments.

PIN	ASSIGNMENT
1	PAYLOAD SIGNAL 3
2	PAYLOAD SIGNAL 6
3	PAYLOAD SIGNAL 7
4	PAYLOAD SIGNAL 11
5	PAYLOAD SIGNAL 10
6	PAYLOAD SIGNAL 9
7	PAYLOAD SIGNAL 4
8	PAYLOAD SIGNAL 1
9	PAYLOAD SIGNAL 2
10	PAYLOAD SIGNAL 5
11	NOT USED
12	PAYLOAD SIGNAL 8
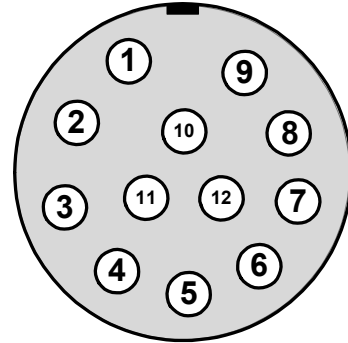
A.3 - 26-Pin Breakout Cable

This diagram displays the optional 26-pin breakout cable (308-0278-XX-00) wiring and connectors.

Note: Some of the signals shown here may not be used in your configuration.

PTU-5 Breakout Cable

Power connector (center hot)

Ethernet connector

RJ11 6P4C, tab up

PTU SUPPLY RETURN (PIN_19 = KHAKI; PIN_2 = PURPLE)
PTU SUPPLY (PIN_1 = WHITE/RED; PIN_10 = DARK BLUE)

PTU_PHY_TXP (WHITE/ORANGE)
PTU_PHY_TXN (ORANGE)
PTU_PHY_RXP (WHITE/GREEN)
PTU_PHY_RXN (GREEN)
PAYLOAD SIGNAL 7 (WHITE/BLACK)
PAYLOAD SIGNAL 11 (WHITE/BLUE)
PAYLOAD SIGNAL 6 (WHITE/PURPLE)
PAYLOAD SIGNAL 10 (WHITE/BROWN)
PAYLOAD SIGNAL 5 (LIGHT BLUE)
PAYLOAD SIGNAL 9 (GRAY)
PAYLOAD SIGNAL 2 (BLACK/RED)
PAYLOAD SIGNAL 4 (BLACK/BLUE)

CHASSIS GROUND (NONE)
PAYLOAD SIGNAL 1 (YELLOW/GREEN)
PAYLOAD SIGNAL 8 (WHITE/GRAY)
PAYLOAD SIGNAL 3 (WHITE/YELLOW)
PTU_RS485_GND (BLACK)
PTU_RS485_TX+ (BROWN)
PTU_RS485_TX- (RED)
PTU_RS485_RX+ (WHITE)
PTU_RS485_RX- (YELLOW)

A.4 - PTU-5 Internal Wiring

This diagram displays the internal PTU-5 wiring.

This page intentionally left blank.

Copyright 2018, FLIR Commercial Systems, Inc.

B - Mechanical Drawings

The drawings in this Appendix describes the payload mounting patterns for the different brackets and displays the PTU dimensions.

TOP MOUNT BRACKET CONFIGURATION

1/4-20 UNC THRU

[.39]
TYP 10.0

[.94]
24.0

[.73]
18.5

[.08]
R2.0

[2.44]
62.0

[3.42]
86.9

[.26]
6.5

[2.94]
74.8

[6.82]
173.3

Copyright 2018, FLIR Commercial Systems, Inc.

SIDE MOUNT BRACKET CONFIGURATION

1/4-20 UNC THRU

[.08]
R2.0

[1.18]
30.0

[1.57]
40.0

[.39]
10.0 TYP

[1.44]
36.5

[2.28]
58.0

[1.45]
36.9

[.26]
6.5

[2.43]
61.6
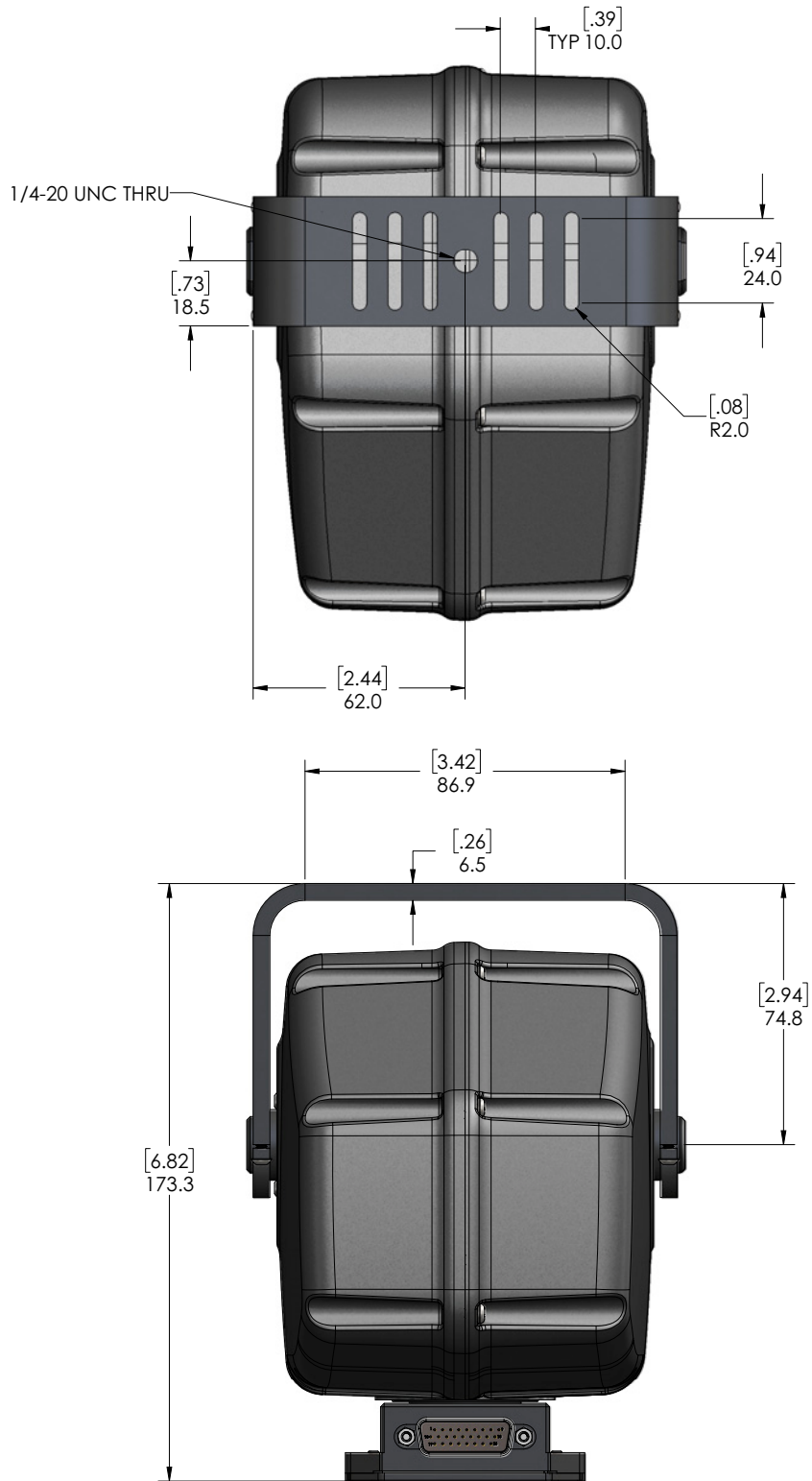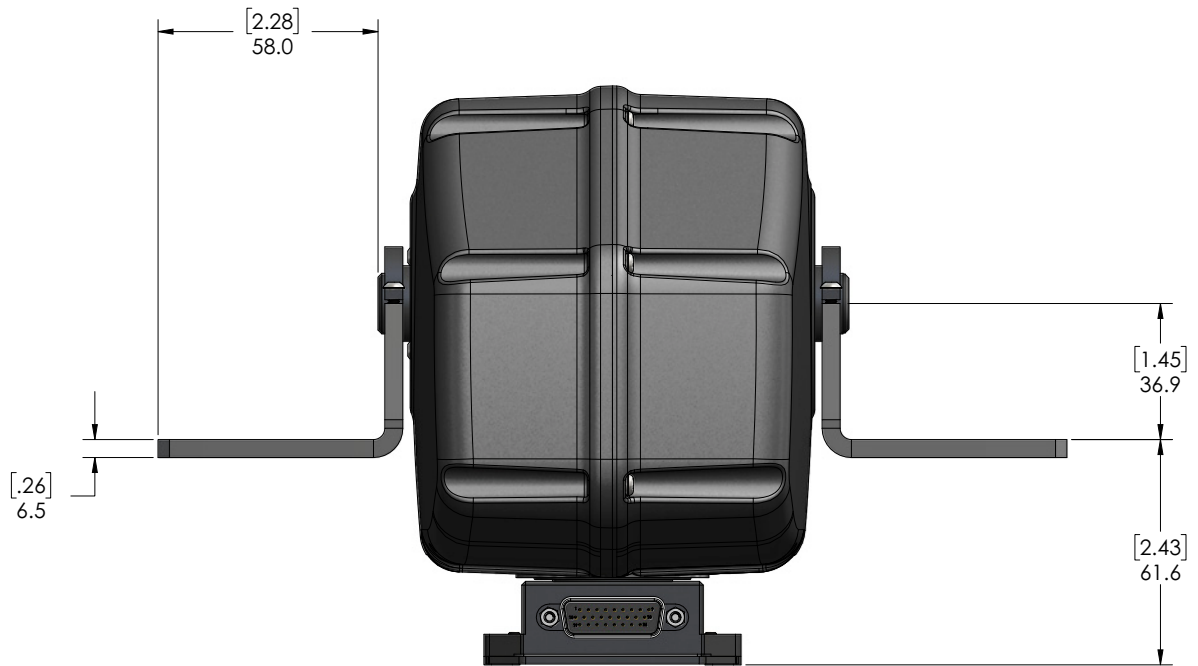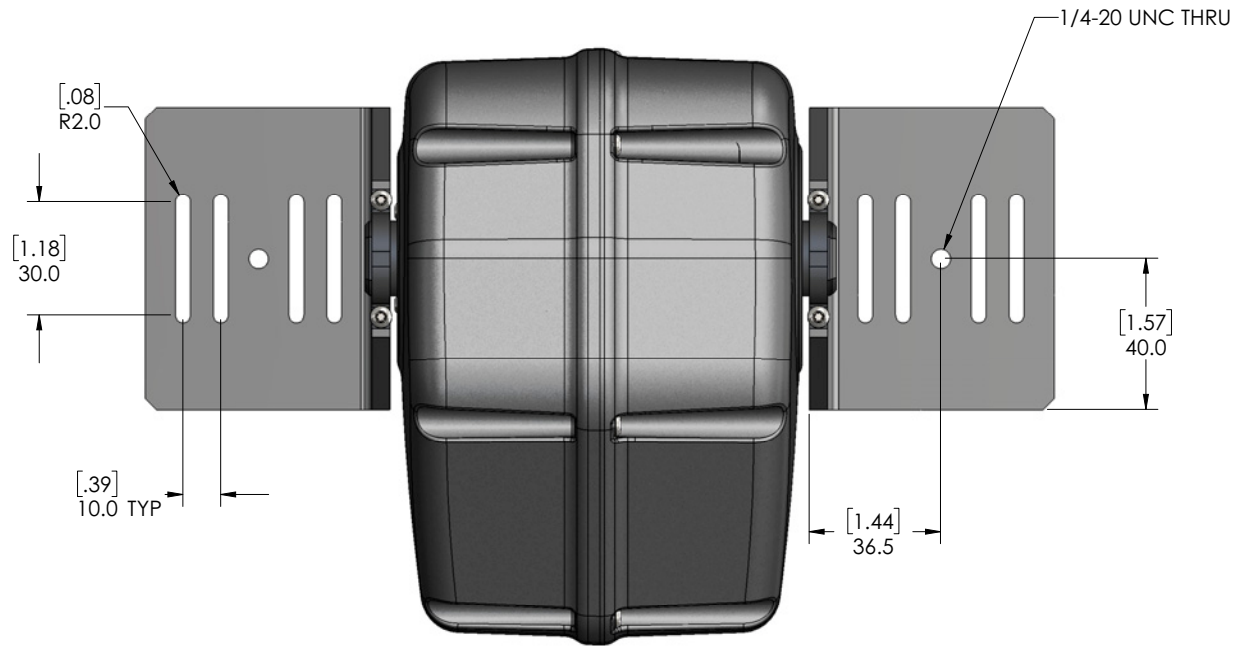
This page intentionally left blank.

C - Networking

This section describes the basic installation and setup steps required to network your pan-tilt units.

C.1 - Ethernet

To connect multiple PTU units to a single host computer via Ethernet:

1. Plan the physical placement of each PTU and the host computer.

2. Connect each PTU to your network using the Ethernet connection on each unit.

3. On the host computer, run the **PTU Finder** utility to locate the PTU IP addresses.

4. Launch a Web browser and point it to the IP address of the unit you want to connect to. You may open multiple browser windows/tabs to connect to multiple units at once.

Please see *"Ethernet Connection" on page 11* for more information about connecting to a PTU using the Web interface.

C.2 - Serial

You may connect up to 127 PTUs to a single host computer port. The host computer can then address each connected PTU as if it were the only unit on the network. This makes it easy to migrate code developed for a single PTU to a network of PTUs controlled by one host computer.

To connect multiple PTU units to a single host computer via serial:

1. Assign a unique network ID number to each PTU.

2. Connect the PTU units and host computer to the serial network.

3. Test the configuration by addressing each PTU by its unit ID and issuing commands and queries, such as:

    -   `PS` - pan speed setting

    -   `TS` - tilt speed setting

    -   `PD` - current pan speed

    -   `TD` - current tilt speed

C.2.1 - Serial Networking Connections

Multiple PTUs can be networked and connected to the host computer's RS-232 port. All network communications use RS-485, meaning that you must have an RS-232 to RS-485 adapter if the host computer does not directly support full-duplex RS-485 I/O. The host computer functions as the network host, meaning that its TX and RX lines define the directions of data traffic flow. Each PTU on the network is a client that communicates with the host using a full-duplex connection.
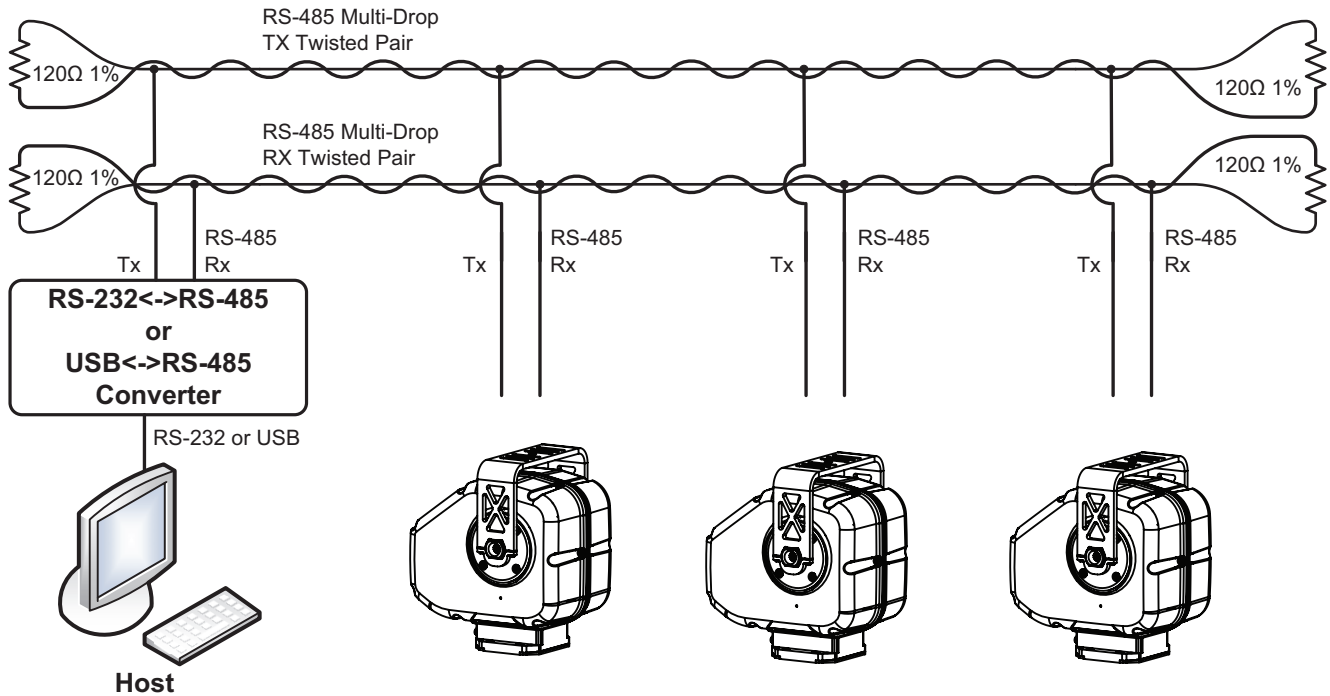
Figure C-1: PTU Network Configuration

When making your own data cables, FLIR Systems, Inc. recommends using a good quality twisted pair cable with about 100Ω impedance, which provides good noise immunity for RS-485 connections.

The following RS-232 to RS-485 converters are recommended:

• ATEN IC-485S

• Moxa A50

Both adapters require a flipped RJ-12 connector (such as a standard phone cord).

Terminate the serial network by placing 120 Ω 1% resistors between the RS-485 Transmit+/Transmit- (Tx+/Tx-) and Receive+/Receive- (Rx+/Rx-) wires at each end of the network, as shown in Figure C-1.

C.2.2 - ASCII Command Syntax

This section provides a brief overview of the ASCII command syntax. Please refer to the *Pan-Tilt E Series Command Reference Manual* for complete information and instructions.

The PTU uses both commands and queries. A command tells the PTU to do something (such as pan to a specific angle). A query asks the PTU to return the requested value (such as reporting the current pan angle).

The basic ASCII command syntax is `<command><parameter><delimiter>`, where:

- `<command>` is the actual command (such as `PP` for pan position),

- `<parameter>` is a numerical value (such as the desired pan position), and

- `<delimiter>` is a character used to denote the end of a command. Valid delimiter characters can be either [SPACE] or [ENTER].

The basic ASCII query syntax is `<command><delimiter>`, where:

- `<command>` is the actual command (such as PP for pan position),

- `<delimiter>` is a character used to denote the end of a query. Valid delimiter characters can be either [SPACE] or [ENTER].

For example:

- **Command:** `PP<position><delim>` sets the desired absolute pan position.

- **Query:** `PP<delim>` returns the current absolute pan position.

Commands and queries return results that display on the terminal screen, as follows:

- A successfully executed command displays `*` on the terminal screen.

- A successfully executed query displays `<QueryResult>` (where `<QueryResult>` is the result of the query you just executed).

- A failed command displays `! <ErrorMessage>` (where `<ErrorMessage>` describes the error encountered).

- A pan axis limit hit asynchronously displays `!P`.

- A tilt axis limit hit asynchronously displays `!T`.

This sample command sequence pans the PTU-E46 to the left, waits, and then pans it back to the right:

```
S
PP-2500 *
A *
PP * Current Pan position is -2500
PP2500 *
A *
PP * Current Pan position is 2500
```

C.2.3 - Serial Command List

These tables list the most commonly used serial commands. Please refer to the *Pan-Tilt E Series Command Reference Manual* for complete information about the available commands and their usage.

LIMITS

CMD	DESCRIPTION	CMD	DESCRIPTION
PN	Minimum pan position	L	Query limit status
PX	Maximum pan position	LE	Enable limits
TN	Minimum tilt position	LD	Disable limits
TX	Maximum tilt position	LU	User limits

POSITION

CMD	DESCRIPTION	CMD	DESCRIPTION
PP	Pan position	PR	Pan resolution
TP	Tilt position	TR	Tilt resolution
PO	Pan offset		
TO	Tilt offset		

SPEED

CMD	DESCRIPTION	CMD	DESCRIPTION	CMD	DESCRIPTION
PS	Pan speed	PA	Pan acceleration	PU	Pan upper speed
TS	Tilt speed	TA	Tilt acceleration	PL	Pan lower speed
PD	Pan speed offset	PB	Pan base speed	TU	Tilt upper speed
TD	Tilt speed offset	TB	Tilt base speed	TL	Tilt lower speed

MISCELLANEOUS

CMD	DESCRIPTION
A	Await
R	Reset
DF	Restore factory defaults
DS	Default save
DR	Restore saved settings
H	Halt
O	Returns the PTU temperature.
MC	Monitor Cycles Since Boot

D - Troubleshooting

This appendix presents common mechanical, power, and networking challenges and resolutions, and also provides information about contacting FLIR Technical Support.

D.1 - Mechanical

After powering on, the PTU stops moving with a grinding noise.

- If you have a payload attached:
    - The payload may be too heavy. Try moving the payload closer to the center of rotation of the affected axis and/or reducing the payload weight.
    - The movement settings may be too aggressive. Reduce the upper speed limit and/or acceleration.

- If you do not have a payload attached, contact FLIR Technical Support.

D.2 - Power

The PTU-5 reset movements are different than other PTU models.

This is normal behavior; the PTO does not return to 0,0.

D.3 - Networking

Unable to determine the PTU IP address to access the onboard Web page.

- If you are running Windows, use the **PTU Finder** tool included on the CD that shipped with your PTU.

- If you are not running Windows, attach a serial device to the PTU host port and then issue the `NI` command to query the IP address of the PTU.

PTU-E46 Web page controls are sluggish.

- Adjust the speeds and/or step size by clicking the **Set Arrow Step Size** or **Set Arrow Speed** headers in the **PTU Control** Web page, as described in the *Pan-Tilt E Series Command Reference Manual*.

- Try closing other programs on your computer to free up resources.

Unable to establish serial communications with the PTU.

- If you are using RS-485:
  - Try using a null-modem adapter.
  - If you are using a laptop, make sure that it is plugged in. RS-485 will not work if the PTU and host computer grounds are too far apart.

- If you are using the USB to RS-485 adapter provided by FLIR Systems, Inc:
  - Make sure the adapter is powered.
  - Try using a null-modem adapter.
  - If you are using a laptop, make sure that it is plugged in. RS-485 will not work if the PTU and host computer grounds are too far apart.

D.4 - Technical Support

FLIR Systems, Inc. provides a range of technical support options:

- **Email:** *MCS-Support@flir.com*
- **Web:** *www.FLIR.com/MCS*
- **Phone:** (888)747-3547

The preferred method of contacting Technical Support is via email, which helps ensure proper dispatching and tracking to address your questions promptly.

When contacting Technical Support, please provide the following information:

- PTU model and configuration
- Payload (Please include photos, if possible.)
- Parameter settings
- Description of issue/symptoms

E - Regulatory & Warranty Information

E.1 - Regulatory Information

Electromagnetic Interference (EMI) is any signal or emission, either radiated in free space or conducted along power or signal leads, that endangers the function of a radio navigation or other safety service or that seriously degrades, obstructs, or repeatedly interrupts a licensed radio communications service.

Class A

Class A equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

FLIR PTUs using a cable length of 7' or less, and using the PT-PS-INT30V power supply have been tested to comply with FCC Class A requirements. Full compliance in systems using a 3' motor cable requires an external direct connection from either the controller or the PTU head to earth ground.

Caution: Changes or modifications of this equipment not expressly approved by manufacturer could result in violation of Part 15 of the Federal Communication Commission's rules. The FCC has prepared the following booklet: "How to Identify and Resolve Radio-TV Interference Problems." It is available from the US Government Printing Office, Washington DC, 20402. Stock Number 004-00-00345-4.

FCC Notice

According to 47CFR, Parts 2 and 15, Subpart B Class A:

This device complies with FCC Part 15, Subpart B Class A of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, (2) This device must accept any interference received including interference that may cause undesired operations.

CE Notice

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

E.2 - About FLIR Systems, Inc.

FLIR Systems, Inc. is the world's largest commercial infrared company with the more high quality thermal night vision systems in the field than all other manufacturers combined. Our rugged, stabilized imagers are on thousands of civil and military surface and airborne platforms in the USA and around the world.

With thousands of our thermal cameras on the job in military, scientific, law enforcement, and security applications, FLIR brings an unmatched level of experience and dedication to the creation of cutting edge thermal night vision systems.

We design and manufacture all of the critical technologies inside our products, including detectors, electronics, special lenses, and pan/tilt motion control systems. All of our products are proudly assembled right here in the USA.

For additional technical information, or to see a demonstration of these revolutionary thermal night vision systems, contact a FLIR representative today. You can also visit www.FLIR.com to watch product videos and see how thermal imaging can help you see night and day.

In 1992, FLIR MCS (formerly Directed Perception) created one of the first miniature computer-controlled pan/tilt tracking mounts and continues to lead the field in innovation, applied design, and service. Our patented pant/tilt units are in use in a wide range of industries including security and surveillance, industrial automation, robotics, communications, military/aerospace, law enforcement, education, R&D, webcams, and teleconferencing/distance learning applications. Some of the payloads that can be precisely controlled include sensors like video cameras, thermal imagers, laser rangefinders, microwave antennas, and many more. FLIR MCS maintains engineering capabilities in mechanical design, electronics, and embedded and network software development. Find out more at *www.FLIR.com/mcs*.

E.3 - Limited Warranty

FLIR warrants that the Goods, at Delivery and for 365 days (Warranty Period), will conform to published specifications and be free from defects in materials, unless another Warranty Period is stated on the Front of the Acknowledgment. Buyer shall report any claimed defect in writing to FLIR promptly upon discovery and within

the Warranty Period. FLIR shall elect either to repair or replace nonconforming Goods at the appropriate FLIR service center nearest to Buyer (Remedy).

This warranty does not extend to: (a) Goods repaired or modified in any manner by persons other than FLIR or FLIR's authorized designee; and (b) Goods that are defective due either to normal wear and tear, or Buyer's failure to properly store, install, operate or maintain the Goods. The Remedy is FLIR's sole obligation, and Buyer's exclusive recourse, for all claims of defects with respect to the Goods.

If the Remedy is adjudicated insufficient, however, FLIR shall refund the Price paid without further liability to Buyer relating to the subject Goods. Buyer shall pay costs of returning Goods under a warranty claim, and FLIR shall pay the costs of sending Goods to Buyer after the Remedy is performed. SELLER MAKES NO OTHER WARRANTY OF ANY KIND WITH RESPECT TO THE GOODS OR SERVICES.

ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, and NONINFRINGEMENT ARE HEREBY DISCLAIMED.

PTU-5 User Manual v. 3.01 (02/23/2017)

6769 Hollister Avenue
Goleta, CA 93117
p: (805) 964-9797
f: (805) 690-5933
www.FLIR.com/MCS