PatrolIR PTZ

Pan and Tilt

Operator's Manual

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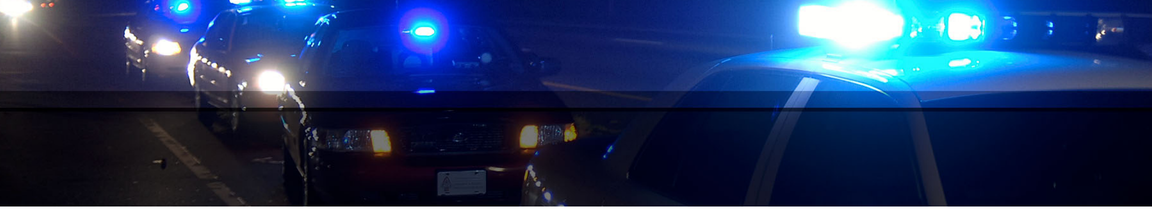
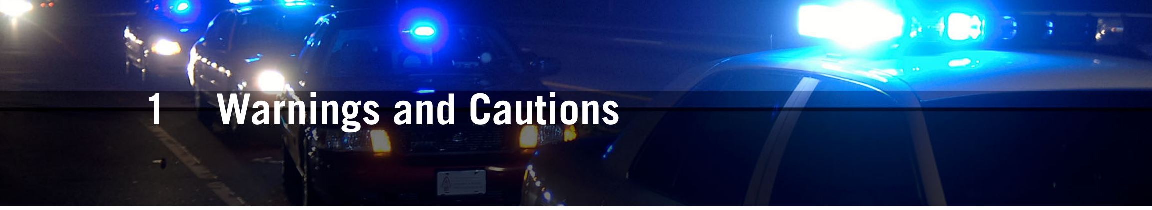




1 Warnings and Cautions

This guide uses the term Caution to indicate a potentially hazardous situation, which, if not avoided, may result in injury, damage to the vehicle or PatrolIR PTZ, or other property damage.

> **Caution!** Failure to follow the caution may result in damage to the equipment or injury.

Warnings and Cautions:

Do not operate any function that takes your attention away from safely driving your vehicle.

Any function that requires your prolonged attention should only be performed after coming to a complete stop. Always stop the vehicle in a safe location before performing these functions. Failure to do so may result in an accident.

Consult your local and state driving regulations prior to installation.

In many states using active monitors in view of the driver is prohibited. Consult your local and state driving regulations for laws and guidelines. User assumes all risks and indemnifies the manufacturer from any liability.

Minimize display viewing while driving.

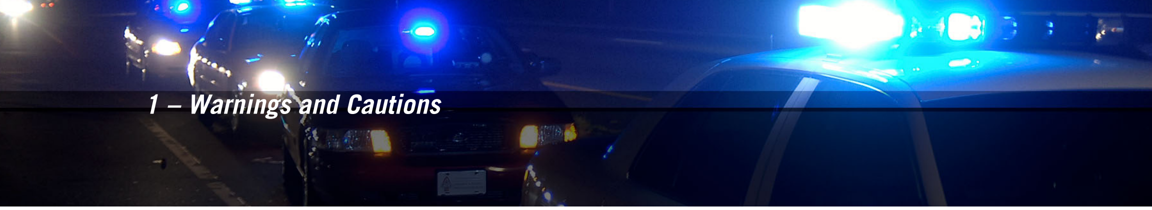
Viewing the display may distract the driver from looking ahead and may result in an accident. The PatrolIR PTZ thermal imaging system should not be used as a substitution for head lamps or head lamp assisted human vision during vehicle operation.

Use this product for mobile 12VDC applications.

Use for other applications may result in excess heat, fire, and equipment malfunction.

When installing the PatrolIR PTZ, do not block the vehicle's vents or radiator panels.

Doing so may result in heat buildup, equipment breakage, and/or fire.



Caution! The PatrolIR PTZ thermal imaging system is not intended to be used as the primary navigation system. The PatrolIR PTZ should not to be used as a substitution for head lamps or head lamp assisted human vision during vehicle operation. It should be used only as an aid to cautious night-time driving.

Note: *All thermal imaging systems are subject to export control. Please contact FLIR for export compliance information concerning your application or geographic area.*

2 Introduction

Congratulations!

The FLIR PatrolIR PTZ is a state-of-the-art thermal imaging system that will provide you with excellent night visibility and situational awareness, without any form of natural or artificial illumination.

The PatrolIR PTZ system is designed for simple, intuitive operation. The basic system includes a camera assembly and a joystick control panel.

The PatrolIR PTZ uses standard 12 VDC battery power and the images from the 320 x 240 pixel detector are compatible with virtually any existing display and recorder that accepts composite video.

The PatrolIR PTZ is available with NTSC output, the same format used on common television and VCR video input in the Americas and some Asian countries. It is also available with PAL output, the same format used on common televisions and VCR video input in Europe.

The PatrolIR PTZ features a wide field of view and is capable of providing an image even in absolute darkness.

Figure 2-1: PatrolIR PTZ Makes the Difference

The upper image represents what the human eye sees looking at a camouflaged subject in shady brush. The lower image is an infrared thermal picture taken at the same moment as the visible image above.

3 Getting Started

3.1 Parts List

The PatrolIR PTZ camera and its accessories are delivered in a box which contains the items below.

Description		FLIR PN
PatrolIR PTZ camera with attached 18’ cable and wired Joystick Control Unit with fuse holder/cigarette lighter plug and BNC video connector.	white color, NTSC	427-0019-01-00
	white color, PAL	427-0019-02-00
Two sets of mounting hardware with whelan bracket for the camera, one set of mounting hardware for the Joystick Control Unit, 5-amp fuses, 10 cable clips and a BNC to RCA adapter		
PatrolIR PTZ Pan and Tilt Operator’s Manual		427-0001-00-11

3.2 Operational Overview

The PatrolIR PTZ is easy to install and operate. The system operates on 12 volts DC and there are no camera adjustments. The thermal imaging camera inside the PatrolIR PTZ is completely sealed and extremely rugged. The camera has been qualified for operation in all types of weather conditions over the specified operating temperature range and includes an automatic window heater that will prevent icing under most conditions.

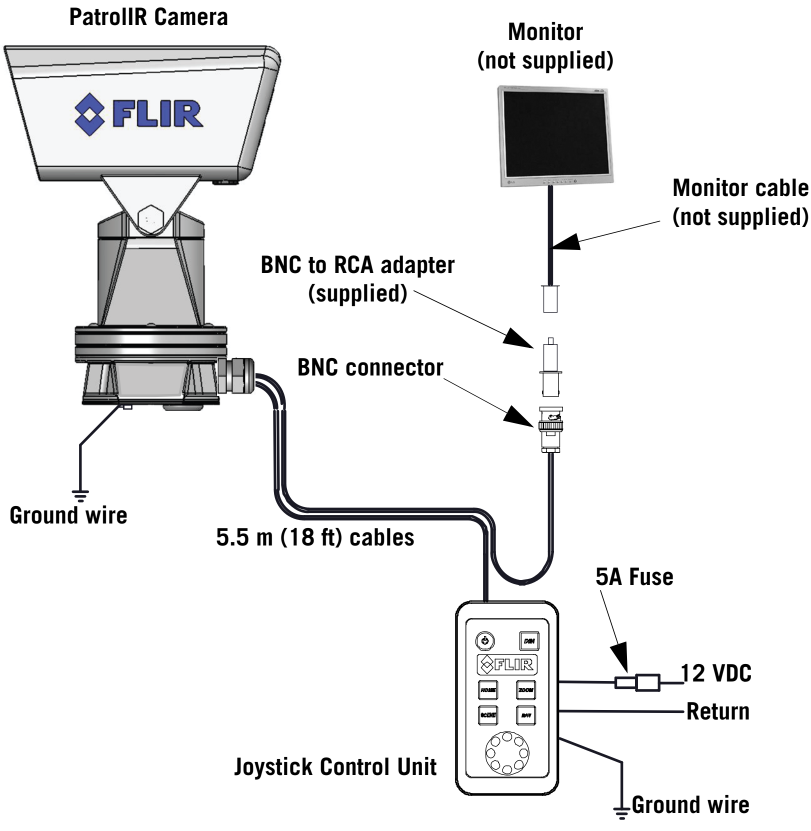


Figure 3-1: Pan and Tilt PatrolIR PTZ

3.3 Installation

Caution! The PatrolIR PTZ should be installed by a trained professional. Incorrect installation could void your warranty.

It is strongly recommended that you DO NOT separate the Camera from its base during installation.

3.3.1 Camera Mounting

Caution! The PatrolIR PTZ is intended to be mounted above the mounting plane. Any other type of installation is not appropriate.

Note: *An optional mounting bracket is available for the PatrolIR PTZ that allows the unit to be mounted behind the Whelen LFL Liberty series light bar. The front of the bracket mounts to the underside of the lightbar and the rear is supported by adjustable, padded standoffs.*

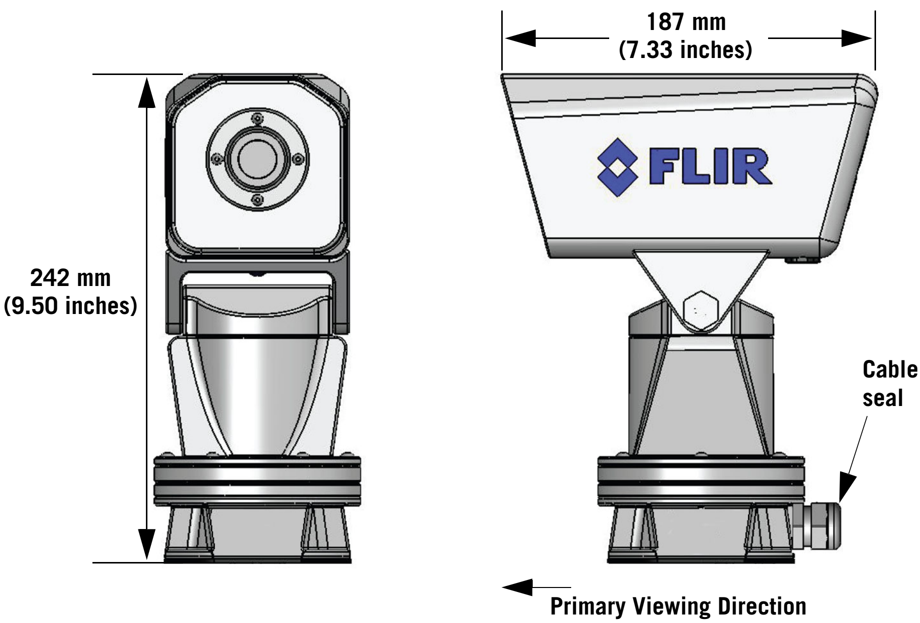


Figure 3-2: Navigator Pan and Tilt

Mount the camera with the front of the base towards the primary viewing direction. The camera will rotate (pan) approximately 180° in either direction from the primary viewing direction.

In order to secure the mounting screws, manually tilt the camera to its highest position and rotate the body until the access hole in the front of the camera body is lined up with the mounting screw. Figure 3-3 shows a screwdriver through the access hole. By rotating the camera, each of the four mounting screws can be tightened.

Figure 3-3: Accessing the mounting screws

Your PatrolIR PTZ can be installed with machine screws, washers, lock washers, and hex nuts as described below.

Step 1 Drill the screw mounting holes per the installation template provided in paragraph 7.1 “Camera Mounting Template.” on page 25. A sketch is shown below in Figure 3-4.

Step 2 Check that all the screw holes line up and the front of the camera base is towards the primary viewing direction. (The cables exit the rear of the camera base.)

Step 3 Check the gasket under the base for integrity and using a 3mm Allen wrench, securely fasten the camera in place with four M5 socket-head machine screws, flat washers, lock washers, and hex nuts provided. See Figure 3-5

Step 4 Securely attach the ground wire to the vehicle ground plane.

Step 5 Route the control/power cable to the Joystick Control Unit and the video cable to the monitor. See Figure 3-1 for a schematic representation of the cabling connections.

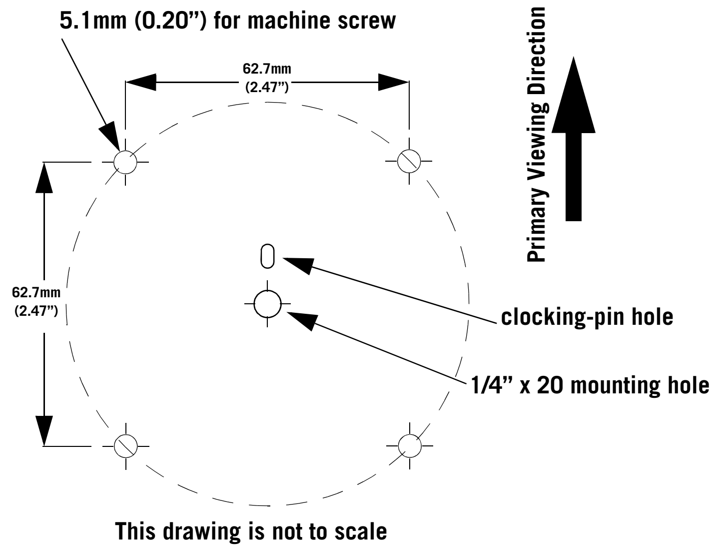


Figure 3-4: Base Mounting Template for the Camera

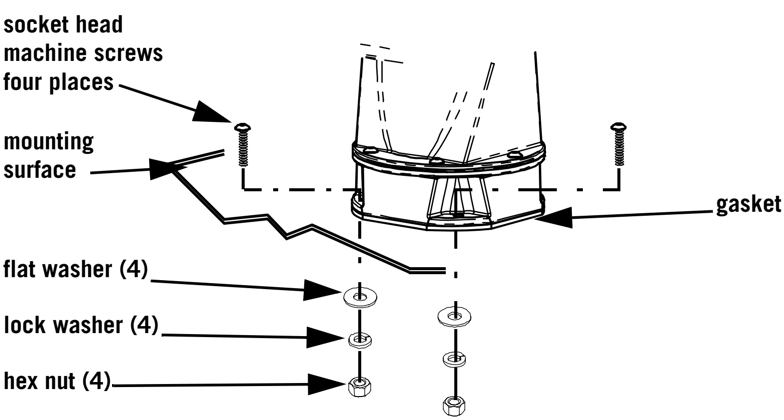


Figure 3-5: Securing the Camera

3.3.2 Fuse and Joystick Control Unit Mounting

Caution! Changing the wiring configuration of the PatrolIR PTZ or attempting to utilize controllers or wiring harnesses other than those supplied by FLIR may cause permanent damage to the unit and may void the warranty.

Caution! Do not connect the camera to anything other than 12 VDC power. Operating the camera outside of the specified input voltage range or the specified operating temperature range can cause permanent damage.

After routing the camera cables to the desired location for the display and the Joystick Control Unit, verify that the cables will reach before cutting and drilling any mounting holes.

Step 1 Drill holes for the six studs and cut an access hole for mounting the Joystick Control Unit per the installation template provided in paragraph 7.2 "Joystick Control Unit Mounting Template." on page 27. A sketch is shown below in Figure 3-6.

In order to install the camera power and communication, you must separate the keypad/joystick assembly from the back enclosure of the JCU.

Step 2 Remove the four nuts, washers, and lock washers as shown in Figure 3-7.

Step 3 Separate the keypad/joystick assembly from the back enclosure and slide the power and communication cable through the cable seal (Figure 3-7).

Step 4 Connect the camera power and communication cable leads to the Joystick Control Unit terminal block as shown in Figure 3-8, there are six color coded wires from the two cables entering the JCU. Refer to Table 3-1 for wiring terminations. The terminal numbers are silk-screened onto the printed wiring board.

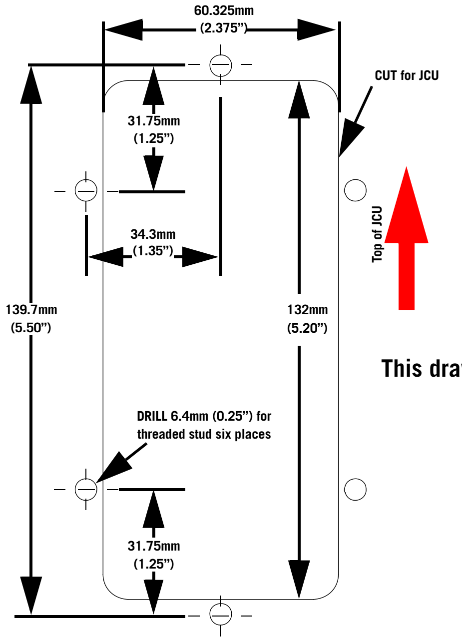


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Figure 3-6: Joystick Control Unit mounting template

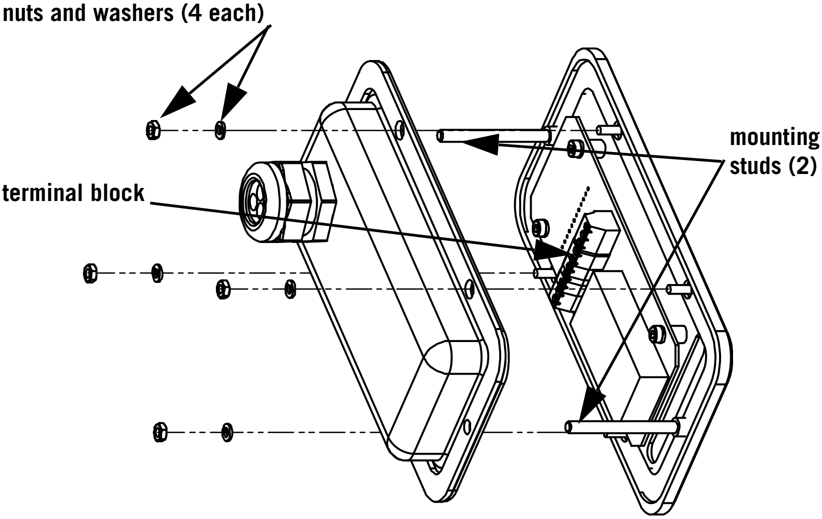


Figure 3-7: JCU Disassembly

Table 3-1: JCU Terminal block connections

Signal name and source	Wire color	Terminal block location
+12VDC IN—from main electrical power cable	Red	#1
12VDC RETURN—from main electrical power cable	Black	#2
+12VDC OUT—to camera control/power cable	Red	#3
12VDC OUT RETURN—to camera control/power cable	Black	#4
-RS422 OUT—to camera control/power cable	Green	#5
+RS422 OUT—to camera control/power cable	White	#6

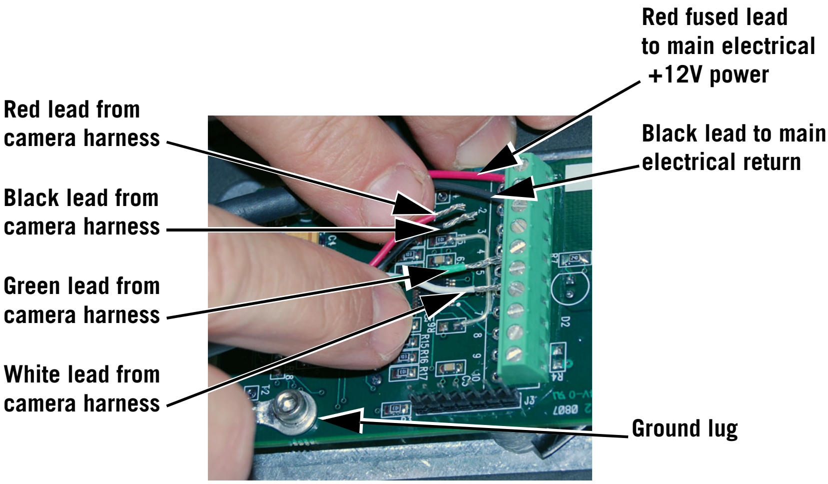
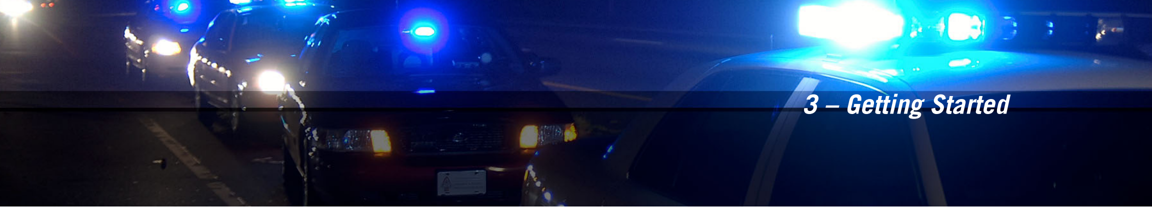


Figure 3-8: Control and power connections to JCU terminal block

Step 5 Re-attach the keypad/joystick assembly to the back enclosure. The cables will easily slide through the cable seal. Secure using the four nuts, washers, and lock washers as shown in Figure 3-7.

Step 6 Check the gasket under the Joystick Control Unit for integrity and securely fasten the switch in place with the two M4 flat washers, lock washers, and hex nuts provided.

Step 7 Securely attach the ground wire to the vehicle ground plane.



Step 8 Connect the 12 VDC power and return wires from your fuse panel to the JCU wiring harness. Wire must be 16 gage.

> **Note:** *Depending on your JCU mounting location you may want to connect the ground wire and power cables either before or after installing the JCU.*

3.4 Using your PatrolIR PTZ

Caution! The PatrolIR PTZ imaging system is not intended to be used as the primary navigation system. It should be used in conjunction with other navigation aids and a primary manual navigation system.

The PatrolIR PTZ is easy to use, but you should take a moment to carefully read this section so you fully understand how to use the controls and what you are seeing on your display. While the imagery you will see on the monitor may look like black and white daylight video, it isn't! A few tips on how to interpret some of the imagery will help you to make the most of your system.

3.4.1 Joystick Control Unit (JCU)

Your new PatrolIR PTZ camera system is controlled with the touch pad and the joystick shown at the right.

On/Off—enables the camera video and the JCU camera controls. This On/Off switch does not affect power to the camera; it only affects the video signal and pan/tilt control. The camera power must be controlled with a customer-provided switch or circuit breaker.

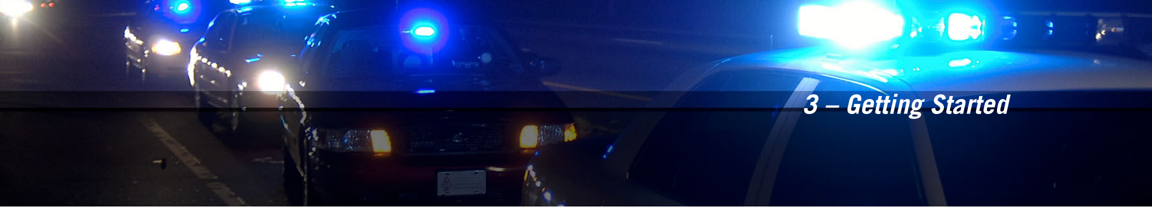
DIM—controls the brightness of the JCU panel; enabled anytime power is on.

HOME—moves the camera to the last home position setting. Or, when held down for at least four seconds, sets the current position as the home position.

ZOOM—selects either 1x or 2x as the zoom setting.

SCENE—cycles through gain settings to change the brightness and contrast of the image. Varying environmental conditions may make one setting more appropriate than another for any operation.

B/W—selects **black hot**, **white hot**, or **red hot** video image mode. Hot object appear black, white, or red respectively depending on the selected mode.



The choice of video image mode is strictly a personal preference and you should experiment to find your preferred mode.

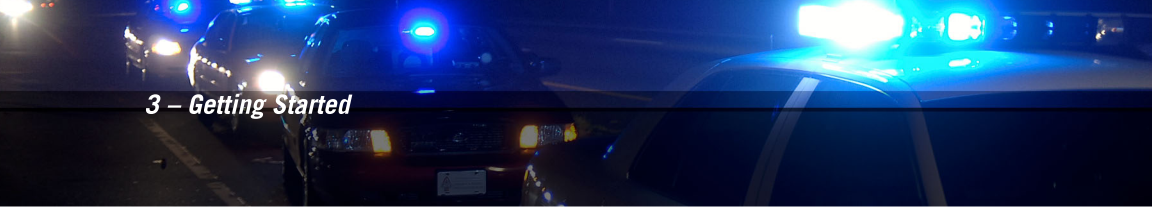
Joystick—move to the left or right to rotate the camera; forward or back to raise or lower the camera.

Make sure that the camera power is switched on at your main power panel. Ensure that your display is turned on and you have selected the PatrolIR PTZ as the source for your display.

The camera automatically adjusts to changing scene conditions. However, the camera does contain four preset conditions that might provide better imagery in certain conditions.

The thermal imager inside the camera does not sense light like conventional cameras; it senses heat or temperature differences. As you experiment with the system during daylight and nighttime operation, you will notice differences in the picture quality; this is normal. The camera senses small “differences” in apparent radiation from the objects in view, and, in **white hot** mode, displays them as either white (or lighter shades of gray) for warmer objects, and black (or darker shades of gray) for colder objects.

This is why you will see areas such as exhaust stacks or engines that appear white (or black, or red depending on the video image mode selected), while the rest of a vehicle may appear dark (or cool). Scenes with familiar objects will be easy to interpret with some experience. The camera automatically optimizes the image to provide you with the best contrast in most conditions.



Thermal (radiant) energy emitted by objects that were warmed by the sun during the day can be reflected, in much the same way sunlight can be reflected. Do not assume that the objects you are looking for will be hot and therefore show up as white. Look for variations or anomalies in scenes that you think would normally be the same temperature.

As you experiment with your PatrolIR PTZ, you will see your world in a different light. Consider every object you view in terms of how it will look "thermally" as opposed to how it looks in the visible spectrum. For example, after sunset, objects warmed by the sun will radiate for several hours and will appear warmest right after sunset. Early in the morning, many of these objects will appear cooler than their surroundings, so be sure to look for subtle differences in the scene, as opposed to just hot (white) targets.

Environmental conditions, including time of day, humidity, and precipitation, will affect the image quality. For example, the radiation of an object will be affected by even a thin layer of dew. The diurnal cycle that causes objects to heat up in the sun (this is known as solar loading) and cool off at night will also have an impact on the image. The range of temperatures of objects that appear in the image will also have an impact on the image quality, because the camera has software that automatically controls the brightness and contrast of the image based on the temperature differences of objects in the field of view.

> **Caution!** The user may experience degraded images during certain short term atmospheric conditions such as those that allow water to condense or collect on the camera window. These occurrences are temporary and will not result in permanent degradation of the imaging system. Because water droplets on the camera window temporarily reduce performance, it is recommended to mount the PatrolIR PTZ in a location with minimal exposure to water splash or spray.

If you have any questions about the operation of your PatrolIR PTZ, or you would like to provide feedback on the product, please feel free to call us at +1 888.747.FLIR in the United States.

4 Caring for your PatrolIR PTZ

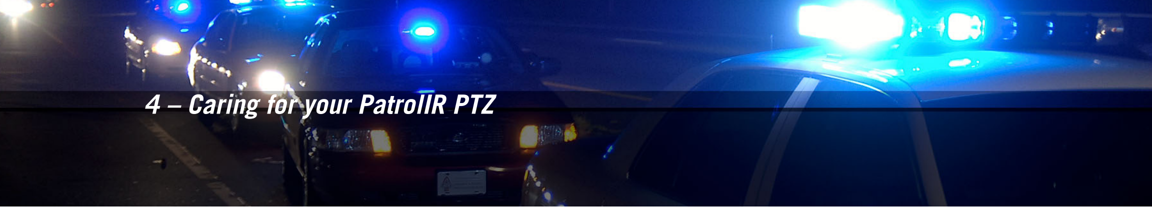
4.1 Troubleshooting

Caution! Do not open the camera body for any reason. Disassembly of the camera (including removal of the cover) can cause permanent damage and will void the warranty.

If the camera will not produce an image, check the inline fuse and the fuse panel. If a fuse has blown, determine the cause of the blown fuse, fix the problem, and replace with a 5 Ampere fuse.

Check the wiring at both the fuse panel and at the termination to the JCU. Ensure that the contacts are clean dry and free from corrosion. If maintenance on the wiring connection is required, have an authorized service representative make the appropriate repairs.

If the camera still will not produce an image, check the video connection at the camera and at your display. If the connectors appear to be properly engaged but the camera still does not produce an image, have an authorized service representative make the appropriate repairs.



4.2 Replacing the fuses

> **Caution!** Replace system fuses with the same value and type provided at the time of purchase. Using fuse values other than the ones supplied by FLIR Systems, Inc. may cause permanent damage to the unit and may void the warranty.

To replace the fuse, ensure power is off, unscrew the fuse holder, remove the fuse and replace using a 5 Ampere automotive fuse.

4.2.1 Cleaning

> **Caution!** The camera window has an anti-reflective coating and should be cleaned only with low pressure fresh water and a lens cloth.

> **Caution!** Improper care of the camera window can cause damage to the anti-reflective coating, degrade the camera's performance, and void the camera warranty.

The camera housing has a durable coating. Rinse the camera housing with very low pressure fresh water to keep it clean. If the front window of the camera gets water spots, wipe it with a clean lens cloth folded in fourths dampened with water.

Figure 4-1: PatrolIR PTZ Front Window

5 Optional Accessories

5.1 Optional Extension Cables

FLIR Systems makes available a family of extension cables and remote video/control station kits. The part numbers are as follows:

Description	**FLIR PN**
7.6 m (25') Extension Cable for Pan & Pan Tilt PatrolIR PTZ	308-0129-00
Video Extension Kit, contains: Video amplifier, 7.6 m (25') video cable, 15.24 m (50') video cable, and wiring instructions	427-0001-14-01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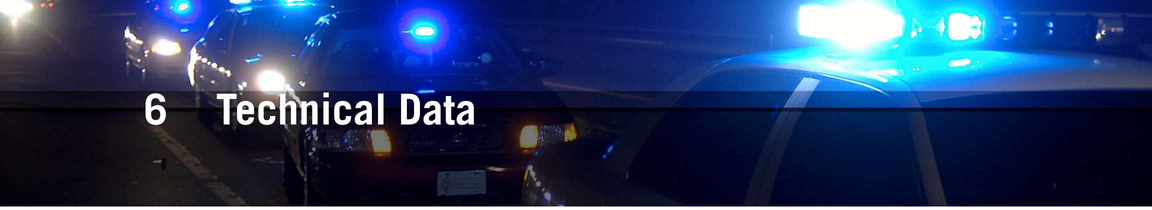

6 Technical Data

6.1 Performance Specifications

Thermal Imaging Performance	
Sensor type	320 x 240 uncooled microbolometer
Field of view	36° h x 27° v
Spectral band	8 - 14 µ
Outputs	
Video	NTSC or PAL
Connector types	BNC at primary cable end
Power	
Power requirements	12 VDC
Power consumption	5 Watts (nominal), 45 Watts (max)
Environmental	
Operating temperature	-20°C to +55°C (-4°F to +130°F)
Storage temperature	-50°C to +80°C (-58°F to +266°F)
Moisture	IPX6
Sand and dust	Mil-Std-810E
Dimensions and Weight	
Dimensions	102mm x 187mm x 242mm (4″w x 7.35″d x 9.50″h)
Weight	4.08 kg (9 lb.)

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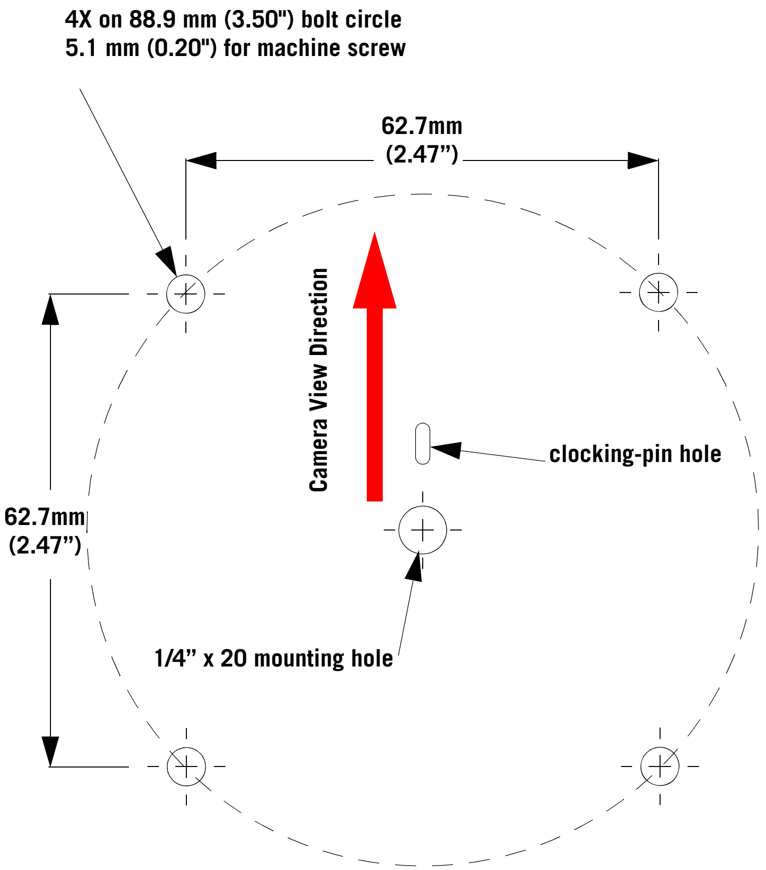
7 Mounting Templates

7.1 Camera Mounting Template.



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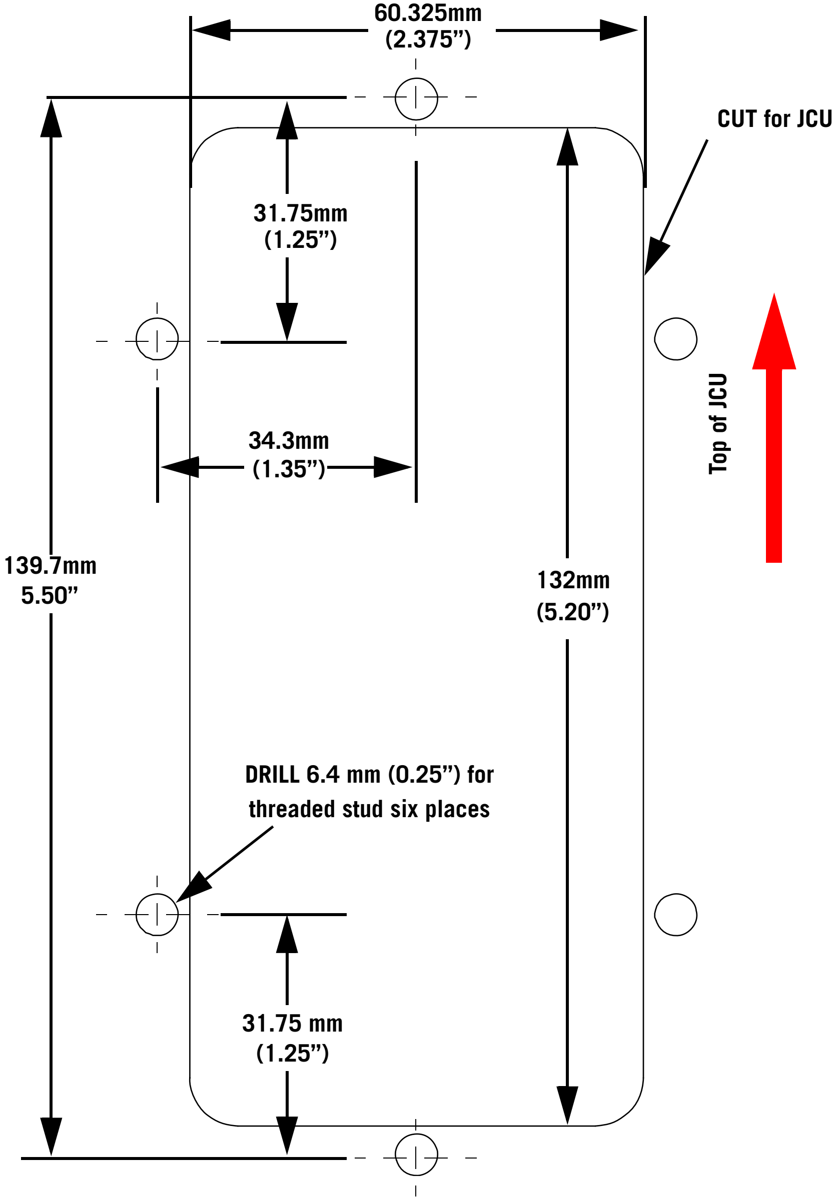
7.2 Joystick Control Unit Mounting Template.



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8 Infrared Technology

8.1 History of Infrared

Just over 200 years ago the existence of the infrared portion of the electromagnetic spectrum wasn't even suspected. The original significance of the infrared spectrum, or simply ‘the infrared’ as it is often called, as a form of heat radiation is perhaps less obvious today than it was at the time of its discovery by Herschel in 1800.

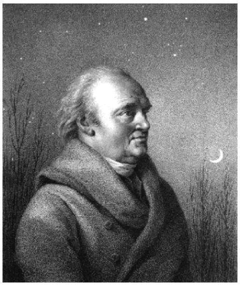


Figure 8-1: Sir William Herschel (1738–1822)

The discovery was made accidentally during the search for a new optical material. Sir William Herschel—Royal Astronomer to King George III of England, and already famous for his discovery of the planet Uranus—was searching for an optical filter material to reduce the brightness of the sun’s image in telescopes during solar observations. While testing different samples of colored glass which gave similar reductions in brightness he was intrigued to find that some of the samples passed very little of the sun’s heat, while others passed so much heat that he risked eye damage after only a few seconds’ observation.

Herschel was soon convinced of the necessity of setting up a systematic experiment, with the objective of finding a single material that would give the desired reduction in brightness as well as the maximum reduction in heat. He began the experiment by actually repeating Newton’s prism experiment, but looking for the heating effect rather than the visual distribution of intensity in the spectrum. He first blackened the bulb of a sensitive mercury-in-glass thermometer with ink, and with this as his radiation detector he proceeded to test the heating effect of the various colors of the spectrum formed on the top of a table by passing sunlight through a glass prism. Other thermometers, placed outside the sun’s rays, served as controls.

As the blackened thermometer was moved slowly along the colors of the spectrum, the temperature readings showed a steady increase from the violet end to the red end. This was not entirely unexpected, since the Italian researcher, Landriani, in a similar experiment in 1777 had observed much the same effect. It was Herschel, however, who was the first to recognize that there must be a point where the heating effect reaches a maximum, and those measurements confined to the visible portion of the spectrum failed to locate this point.

Figure 8-2: Marsilio Landriani (1746–1815)

Moving the thermometer into the dark region beyond the red end of the spectrum, Herschel confirmed that the heating continued to increase. The maximum point, when he found it, lay well beyond the red end—in what is known today as the 'infrared wavelengths'.

When Herschel revealed his discovery, he referred to this new portion of the electromagnetic spectrum as the 'thermometrical spectrum'. The radiation itself he sometimes referred to as 'dark heat', or simply 'the invisible rays'. Ironically, and contrary to popular opinion, it wasn't Herschel who originated the term 'infrared'. The word only began to appear in print around 75 years later, and it is still unclear who should receive credit as the originator.

Herschel's use of glass in the prism of his original experiment led to some early controversies with his contemporaries about the actual existence of the infrared wavelengths. Different investigators, in attempting to confirm his work, used various types of glass indiscriminately, having different transparencies in the infrared. Through his later experiments, Herschel was aware of the limited transparency of glass to the newly-discovered thermal radiation, and he was forced to conclude that optics for the infrared would probably be doomed to the use of reflective elements exclusively (i.e. plane and curved mirrors). Fortunately, this proved to be true only until 1830, when the Italian investigator, Melloni, made his great discovery that naturally occurring rock salt (NaCl)—which was available in large enough natural crystals to be made into lenses and prisms—is remarkably transparent to the infrared. The result was that rock salt became the principal infrared optical material, and remained so for the next hundred years, until the art of synthetic crystal growing was mastered in the 1930's.

Figure 8-3: Macedonio Melloni (1798–1854)

Thermometers, as radiation detectors, remained unchallenged until 1829, the year Nobili invented the thermocouple. (Herschel's own thermometer could be read to 0.2 °C (0.036 °F), and later models were able to be read to 0.05 °C (0.09 °F)). Then a breakthrough occurred; Melloni connected a number of thermocouples in series to form the first thermopile. The new device was at least 40 times as sensitive as the best thermometer of the day for detecting heat radiation—capable of detecting the heat from a person standing three meters away.

The first so-called 'heat-picture' became possible in 1840, the result of work by Sir John Herschel, son of the discoverer of the infrared and a famous astronomer in his own right. Based upon the differential evaporation of a thin film of oil when exposed to a heat pattern focused upon it, the thermal image could be seen by reflected light where the interference effects of the oil film made the image visible to the eye. Sir John also managed to obtain a primitive record of the thermal image on paper, which he called a 'thermograph'.

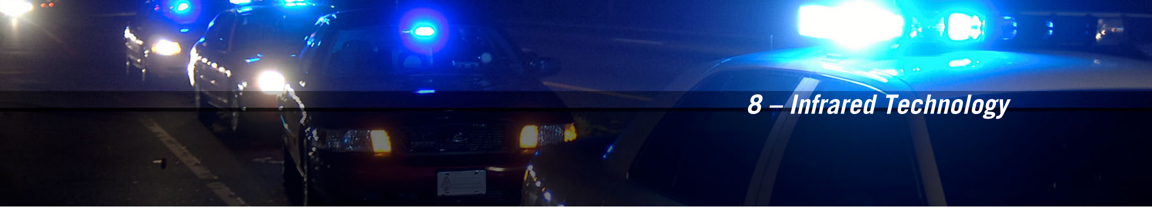
Figure 8-4: Samuel P. Langley (1834–1906)

The improvement of infrared-detector sensitivity progressed slowly. Another major breakthrough, made by Langley in 1880, was the invention of the bolometer. This consisted of a thin blackened strip of platinum connected in one arm of a Wheatstone bridge circuit upon which the infrared radiation was focused and to which a sensitive galvanometer responded. This instrument is said to have been able to detect the heat from a cow at a distance of 400 meters.

An English scientist, Sir James Dewar, first introduced the use of liquefied gases as cooling agents (such as liquid nitrogen with a temperature of -196 °C (-320.8 °F)) in low temperature research. In 1892 he invented a unique vacuum insulating container in which it is possible to store liquefied gases for entire days. The common ‘thermos bottle’, used for storing hot and cold drinks, is based upon his invention.

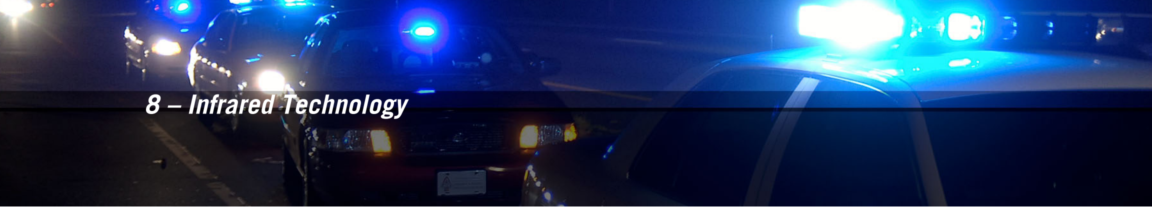
Between the years 1900 and 1920, the inventors of the world ‘discovered’ the infrared. Many patents were issued for devices to detect personnel, artillery, aircraft, ships—and even icebergs. The first operating systems, in the modern sense, began to be developed during the 1914–18 war, when both sides had research programs devoted to the military exploitation of the infrared. These programs included experimental systems for enemy intrusion/detection, remote temperature sensing, secure communications, and ‘flying torpedo’ guidance. An infrared search system tested during this period was able to detect an approaching airplane at a distance of 1.5 km (0.94 miles), or a person more than 300 meters (984 ft.) away.

The most sensitive systems up to this time were all based upon variations of the bolometer idea, but the period between the two wars saw the development of two revolutionary new infrared detectors: the image



converter and the photon detector. At first, the image converter received the greatest attention by the military, because it enabled an observer for the first time in history to literally ‘see in the dark’. However, the sensitivity of the image converter was limited to the near infrared wavelengths, and the most interesting military targets (i.e. enemy soldiers) had to be illuminated by infrared search beams. Since this involved the risk of giving away the observer’s position to a similarly-equipped enemy observer, it is understandable that military interest in the image converter eventually faded.

The tactical military disadvantages of so-called 'active’ (i.e. search beam-equipped) thermal imaging systems provided impetus following the 1939–45 war for extensive secret military infrared-research programs into the possibilities of developing ‘passive’ (no search beam) systems around the extremely sensitive photon detector. During this period, military secrecy regulations completely prevented disclosure of the status of infrared-imaging technology. This secrecy only began to be lifted in the middle of the 1950’s, and from that time adequate thermal-imaging devices finally began to be available to civilian science and industry.



8.2 How do Infrared Cameras Work?

Infrared energy is part of a complete range of radiation called the electromagnetic spectrum. The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible, infrared, microwaves (RADAR), and radio waves. The only difference between these different types of radiation is their wavelength or frequency. All of these forms of radiation travel at the speed of light (186,000 miles or 300,000,000 meters per second in a vacuum). Infrared radiation lies between the visible and RADAR portions of the electromagnetic spectrum. Thus infrared waves have wavelengths longer than visible and shorter than RADAR.

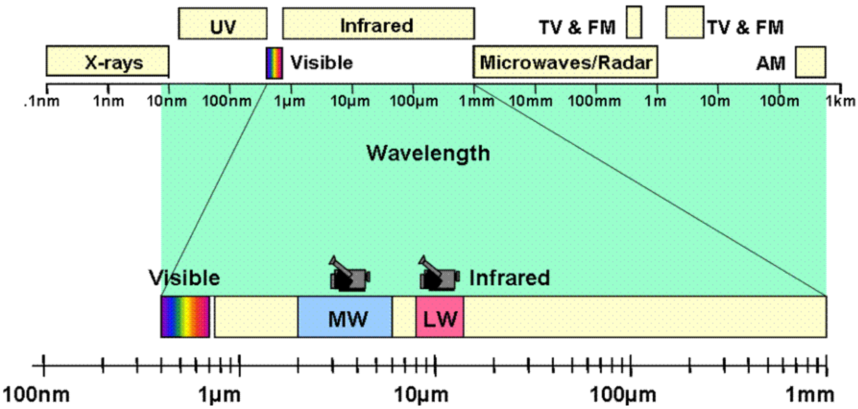
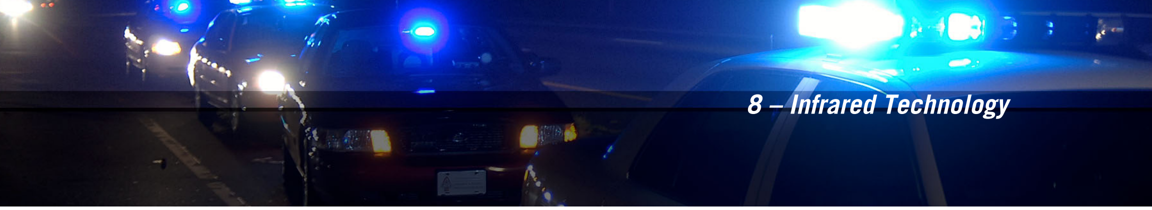


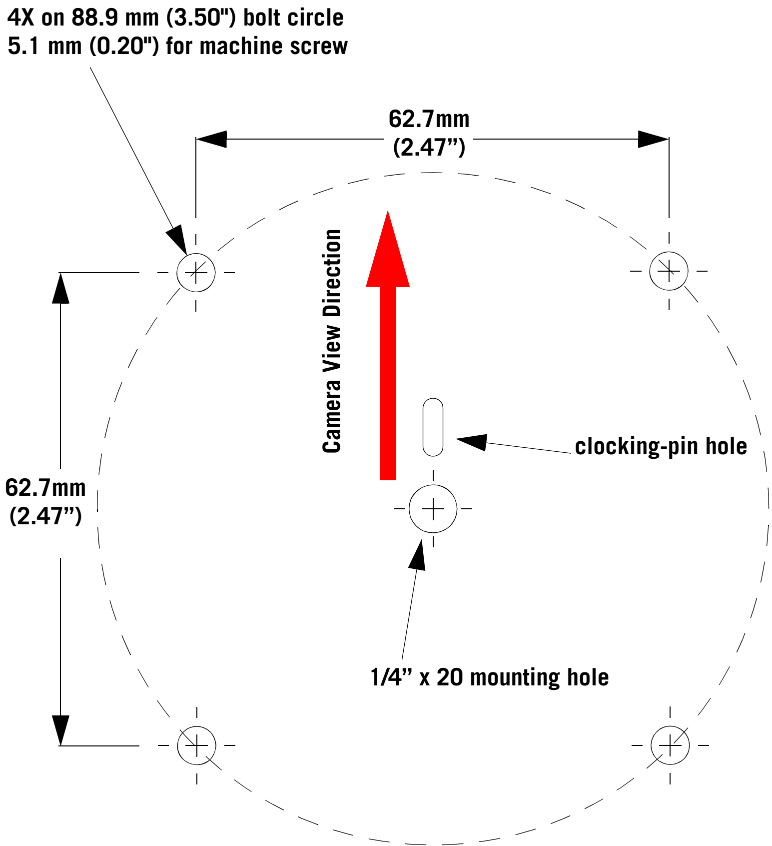
Figure 8-5: Electromagnetic Spectrum

The primary source of infrared radiation is heat or thermal radiation. Any object which has a temperature radiates in the infrared portion of the electromagnetic spectrum. Even objects that are very cold, such as an ice cube, emit infrared. When an object is not quite hot enough to radiate visible light, it will emit most of its energy in the infrared. For example, hot charcoal may not give off light, but it does emit infrared radiation which we feel as heat. The warmer the object, the more infrared radiation it emits.

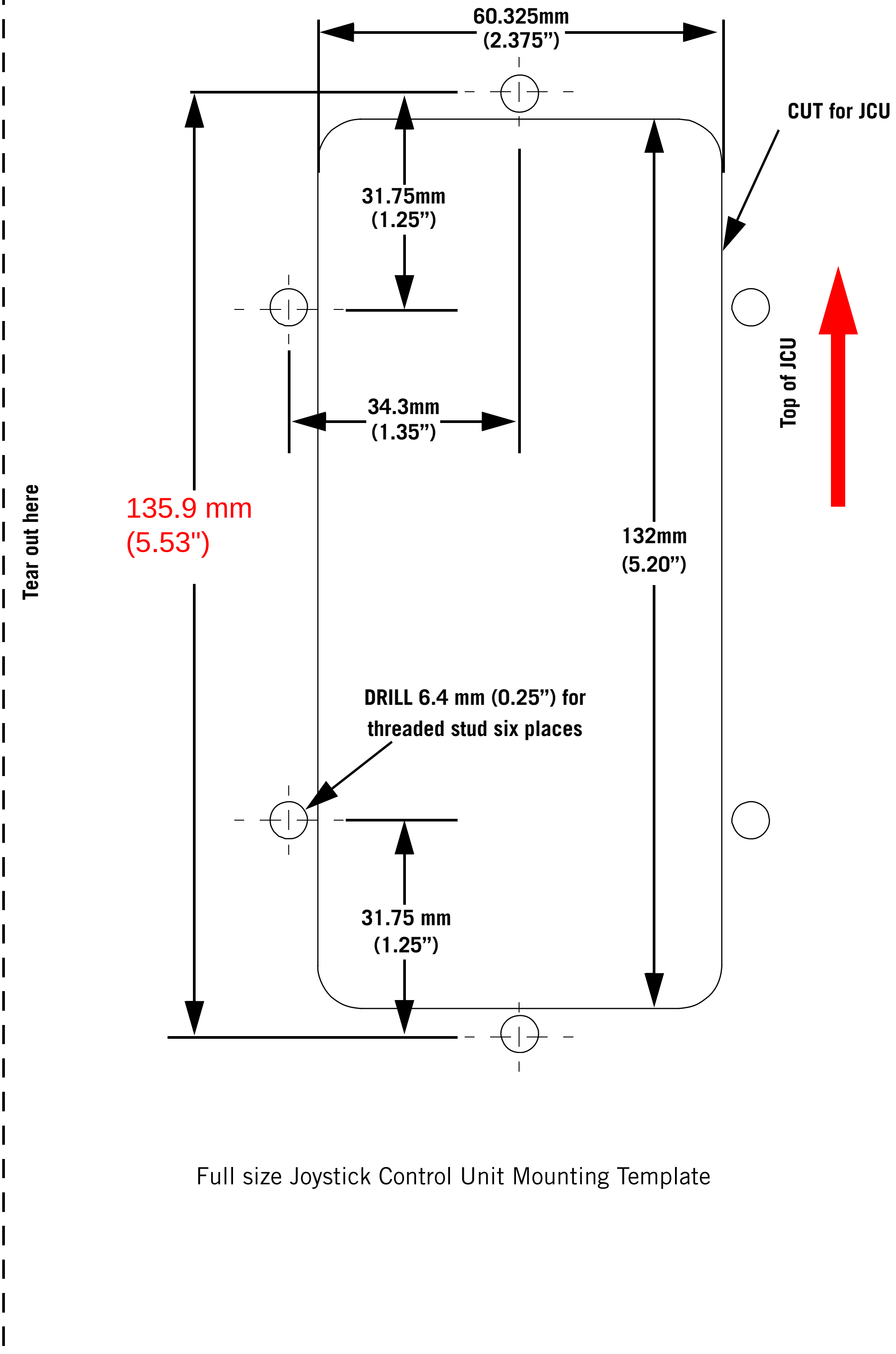
Infrared cameras produce an image of invisible infrared or "heat" radiation that is unseen by the human eye. There are no colors or "shades" of gray



in infrared, only varying intensities of radiated energy. The infrared imager converts this energy into an image that we can interpret. Several detector technologies exist; the sensor in the PatrolIR PTZ is of the latest solid state design, offering long life and fully automatic image optimization (contrast and gain). True thermal imagers should not be confused with infrared illuminator cameras that are often presented as simply “infrared cameras.” There are hundreds of low cost infrared illuminated cameras on the market at prices below $100. These cameras do not produce the same image because they do not detect heat. They operate in wavelengths near visible, and require an IR illuminator to provide an image. IR illuminators have very short range, and require a lot of power to see beyond 5 meters.



Full size PatrolIR PTZ Mounting Template



Full size Joystick Control Unit Mounting Template

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