

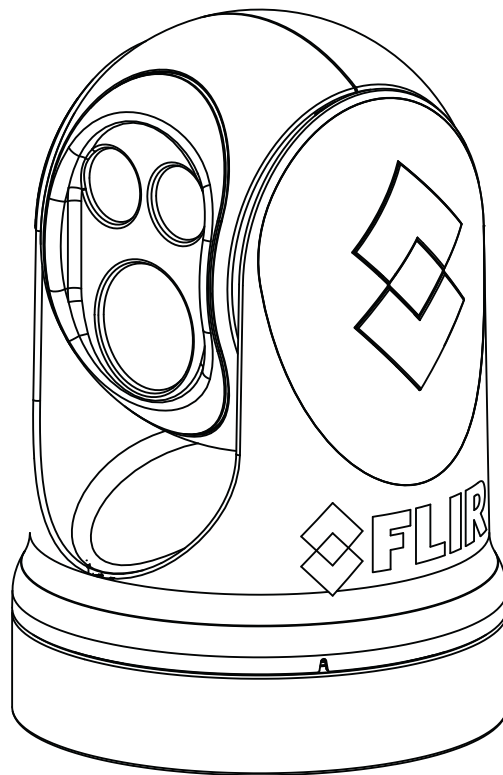


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# Operator's Manual

## M400

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### Document History

Version	Date	Comment
100	December 2015	
110	June 2016	Added Video Tracking and Firefighter modes.

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# Contents

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M400 Overview	
General Information.....	7
Additional References .....	7
Documentation Conventions .....	8
Warnings and Cautions .....	8
System Description .....	9
Standard Features .....	9
M400 Components: .....	10
Multiple Cameras, Joysticks, and Other Devices: .....	10
Thermal Video Display .....	11
Video Screen Icons .....	11
Position indicator icons .....	12
Scene type icons .....	12
Active Camera Icons .....	12
On-Screen-Display (OSD) Menu .....	12
M400 System Startup	
System Startup and Shutdown .....	13
Park Mode .....	13
The Bootup Process .....	13
Powering the Camera .....	13
Powering the JCU II.....	14
JCU II Power Menu .....	14
Standby States.....	14
M400 Joystick Control Unit	
Introduction.....	16
JCU II Joystick.....	16
Tilting the Camera .....	16
Rotating the Camera .....	16
Zooming the Camera.....	16
JCU II Buttons .....	17
Power Button .....	17
Menu Button .....	17

Home Button .....	17
Scene Button—IR imaging only .....	18
Color Button—IR Imaging only .....	18
Focus Buttons .....	18
Camera Button .....	18
User Buttons .....	18
Display Camera and JCU II IP Address .....	19
Button Summary .....	19

## M400 System Configuration

Overview .....	20
Main Menu.....	20
Park camera: .....	21
Firefighter/Exit Firefighter mode (M400XR only): .....	21
InstAlert/Exit InstAlert mode: .....	21
IceAlert/Exit IceAlert mode: .....	21
Surveillance: .....	23
Surveillance settings... .....	23
Scan Width: .....	23
Scan Speed: .....	23
NMEA: .....	23
Spotlight: .....	24
Image settings... .....	24
Set-up... .....	24
Help... .....	24
About... .....	24
Image Settings Menu .....	24
Polarity—IR camera only: .....	25
Stabilization: .....	25
Mirrored view: .....	25
Autofocus .....	25
Display icons: .....	25
Help text: .....	25
Color: .....	25
Icon & text color: .....	26
VIS low light mode: .....	26
Set-up Menu.....	26
Save current settings as start-up defaults: .....	26
Restore settings from defaults: .....	26
User interface preferences... .....	26
NMEA settings... .....	26
InstAlert highlight: .....	26
IceAlert highlight: .....	26
Visible Camera Low Light mode: .....	26
Calibration & diagnostics... .....	27
Manual FFC .....	27
IR Test Pattern: .....	27

Activate Spotlight Demo: .....	27
Activate Pan and Tilt Pattern: .....	27
Reset IR Lens: .....	27
Set Az & El zero reference: .....	27
User Interface Preferences Menu.....	28
Joystick mode: .....	28
User button 1:	
User button 2:	
User button 3: .....	28
IR/Daylight zoom lock: .....	28
IR digital zoom: .....	28
VIS digital zoom: .....	28
NMEA Data.....	28
NMEA Settings .....	30
Radar cursor (RSD): .....	30
Next Waypoint (BWC): .....	30
Radar target (TTM): .....	30
Firefighter Mode—M400XR only	
Overview .....	31
Firefighter Settings Menu .....	32
Exit Firefighter .....	32
Select Temperature Units (°F/°C) .....	32
Isotherm Thresholds .....	32
Video Tracking Mode—M400XR only	
Overview .....	33
Joystick Operation .....	35
Video Tracker Errors .....	35
M400 Reference Information	
Introduction.....	36
Acronyms .....	36
List of Icons .....	37
System Specifications .....	40
Troubleshooting Tips .....	40
Video not displayed on monitor .....	40
Cleaning .....	41
Video not switching between thermal and visible .....	41
Noisy image .....	41

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Image too dark or too light .....	42
Performance varies with time of day .....	42
Eastern or Western exposure .....	42
Multiple Cameras and/or JCU IIs on a single network .....	42

# M400 Overview

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## General Information

This manual describes the operation of the M400 cameras.



This manual includes information about the following topics:

- System description
- Using the Joystick Control Unit
- System startup and shutdown
- Using Firefighter mode—M400XR only
- Using Video Tracking mode—M400XR only
- Using the on-screen-display (OSD) menus for controlling the M400
- Helpful reference information such as acronyms, parts lists, a table of icons, and a comparison of model features

### Additional References

The M400 system comes with a complete documentation set, available on the FLIR website, that includes this manual as well as other information. All documents are in PDF format and can be viewed with Adobe Acrobat Reader:

- *M400 Installation Guide* (FLIR Doc. # 432-0012-00-12) contains information about how to install the camera.
- *M400 Quick Start Guide* (FLIR Doc. # 432-0012-00-11) is a double-sided card that shows the functions executed by the Joystick Control Unit.

**Documentation Conventions**

For safety, and to achieve the highest levels of performance from the M400 system, always follow the warnings and cautions in this manual when handling and operating the M400 system.

**Warning:** Warning notices are used to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury or death exist with this equipment, or may be associated with its use.

**Caution:** Caution notices are used where equipment might be damaged if care is not taken or an operation might have an unexpected outcome.

**Note:** Notes call attention to information that is especially significant to understanding and operating the equipment.

**Warnings and Cautions**

**Warning:** Do not use the M400 system as the primary navigation system. Use it in conjunction with other navigation aids and a primary manual navigation system.

**Warning:** Ensure power is removed before accessing power wires during installation or removal of system components. Damage to equipment or injury to personnel may result.

**Warning:** Use of insufficient wire gauge can result in fire.

**Warning:** The M400 system is not designed to operate in an enclosed environment in the presence of flammable gases. Failure to follow this warning may result in explosion or fire.

**Warning:** The M400 camera body is a remotely and automatically controlled device. Ensure camera motion has been disabled before cleaning surfaces that can cause pinch hazards.

**Caution:** Do not open the M400 unit for any reason. Disassembly of the M400 (including removal of the cover) can cause permanent damage and will void the warranty.

**Caution:** Be careful not to leave fingerprints on the M400 optics.

**Caution:** The M400 requires a power supply of 12 Vdc to 24 Vdc nominal, 5.5 A maximum @ 24 Vdc, 11 A maximum @ 12 Vdc. Absolute voltage range: 12 Vdc to 32 Vdc. Operating the system outside of the specified input voltage range or the specified operating temperature range can cause permanent damage.

Operating temperature range	-20 °C to +55 °C (-4 °F to +131 °F) per IEC 60945
Storage temperature range	-50 °C to +80 °C (-58 °F to +176 °F)



## System Description

The multi-sensor M400 is a stabilized maritime thermal and high definition (HD) visible-light camera system for use on most types of vessels. The long wave infrared (LWIR) thermal camera provides excellent nighttime visibility and situational awareness, without any form of natural or artificial illumination. The HD visible-light camera with 30X optical zoom provides daytime viewing.

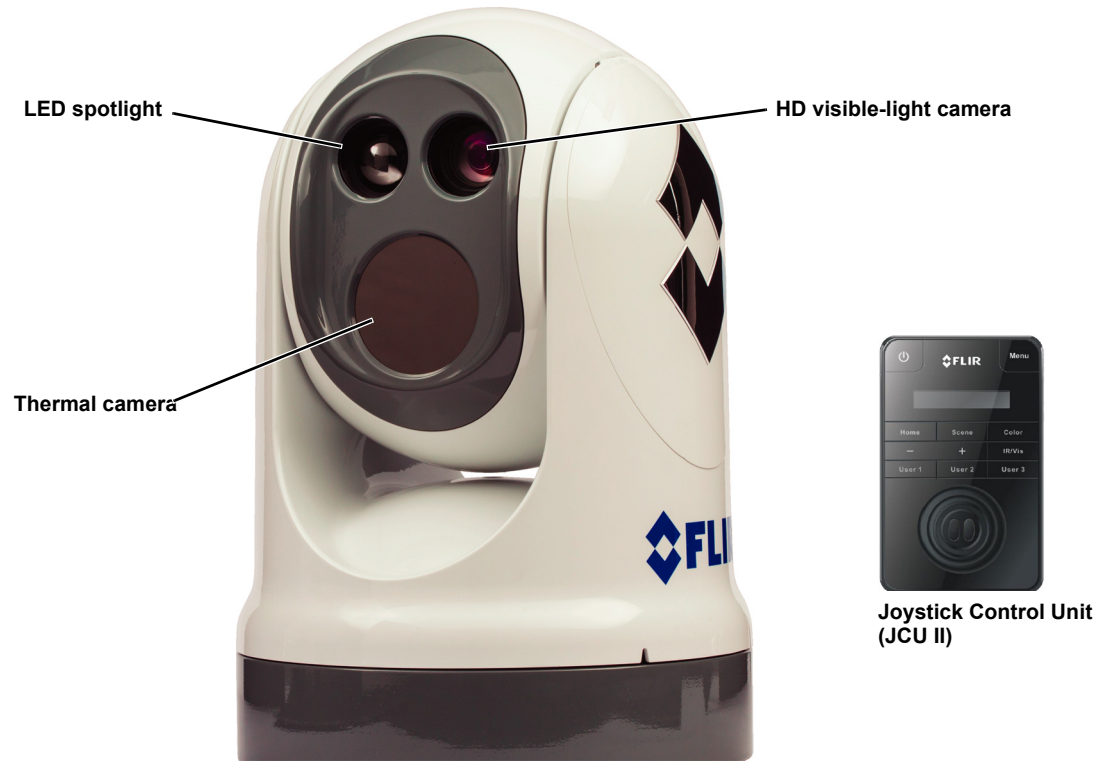


Figure 1-1: M400 Pan/Tilt Camera System

### Standard Features

- Thermal camera, 4x continuous optical zoom
- HD visible-light camera, 30x continuous optical zoom
- High intensity LED spotlight
- Active gyro-stabilization
- Radar integration to follow specific radar targets (NMEA 0183 serial communications)
- Dual, independent H.264 network video streams
- HD-SDI (Serial data interface)
- Analog video

The thermal camera, HD visible-light camera, and spotlight are aligned to view or illuminate a target for quick identification providing enhanced navigational abilities in a variety of conditions.

**M400 Components:**

- Main camera body, also known as the pan/tilt camera unit
- Joystick Control Unit (JCU II), compatible with the MU, MV, and M400 camera systems
- Ethernet switch with power over Ethernet (PoE) to power the JCU II and network to the camera
- Analog and/or digital video monitors (customer supplied)
- Personal computer (PC) to control and configure the system (customer supplied)

The M400 camera body and JCU II are network devices. In some installations, additional M400 cameras and/or additional JCU II may also be used.

The camera body's pan/tilt mechanism allows the operator to rotate 360° in azimuth, tilt +/- 90° in elevation. The camera body houses the two cameras and the LED spotlight.

The JCU II is the primary control for the camera. The JCU II is used to wake the system or put it in standby, select the active camera, operate the pan and tilt movement of the camera, zoom the active camera, control the M400 modes and features, and configure the system settings by means of OSD menus.

The JCU II has various buttons, an LCD display, and the joystick. The joystick can be moved left and right or forward and back, and rotated in either direction. "M400 Joystick Control Unit" on page 16 describes the functions of the JCU II in detail.

The M400 uses on-screen icons to indicate the camera position (azimuth and elevation) and various system settings that have been enabled. These symbols are introduced in "Thermal Video Display" on page 11 and are further explained throughout this manual in the discussion of related functions.

**Multiple Cameras, Joysticks, and Other Devices:**

More than one JCU II can be used to control the camera, and more than one display can be used to view the video. A personal computer (PC) on the same network as the camera, can use a web browser to view video, control, and configure the system. The camera's web server uses password protected accounts to control access to camera functions. Using a PC is described in the *M400 Installation Guide*.

Also, a single JCU II can be used to select and control more than one camera. In this case, a menu on the JCU II lists available cameras. In the LCD display of the JCU II, the name of the currently selected camera is displayed. When more than one JCU II is installed in the network, a camera will respond to commands from any JCU II that has the camera selected.

Typically, a JCU II and a video monitor are mounted in close physical proximity, as a pair, so you can immediately see the changes on the video screen when you use the JCU II to change the camera position (pan or tilt).

## Thermal Video Display

The infrared (IR) imaging thermal camera relies on the fact that all objects, even very cold objects like ice, emit thermal energy in the portion of the infrared spectrum that the camera can see. Therefore, unlike an illuminated infrared camera, the thermal imaging camera does not need an additional active illumination source and images are based on directly radiated energy rather than reflected energy.

When the thermal camera is in white-hot mode, the warm objects in the scene are shown as white, or lighter shades of gray, and cold objects are shown as black or darker shades of gray. When the video polarity is switched, this is reversed.

This is why hot objects such as parts on a running outboard motor appear white (or black or red depending on the video image mode selected), while the water or other cold objects appear dark (or cool). Scenes with familiar objects will be easy to interpret with some experience. The camera automatically optimizes the image to provide the best contrast in most conditions.

### Video Screen Icons

Depending on the system settings, various symbols are shown on the screen. Some of these icons are always shown on the screen, and some appear momentarily or only when certain functions are enabled or executed. The icons can be shown as white or red. See “Display icons:” on page 25 for a description of menu options and the displayed icons.

The following figures illustrate some of the icons displayed by the system, as well as an example of the OSD menu that is shown when the Menu button is pressed. Using the menus is described in “M400 System Configuration” on page 20.

A complete list of all of the icons used in the system and a brief description of how they are used can be found in “List of Icons” on page 37.

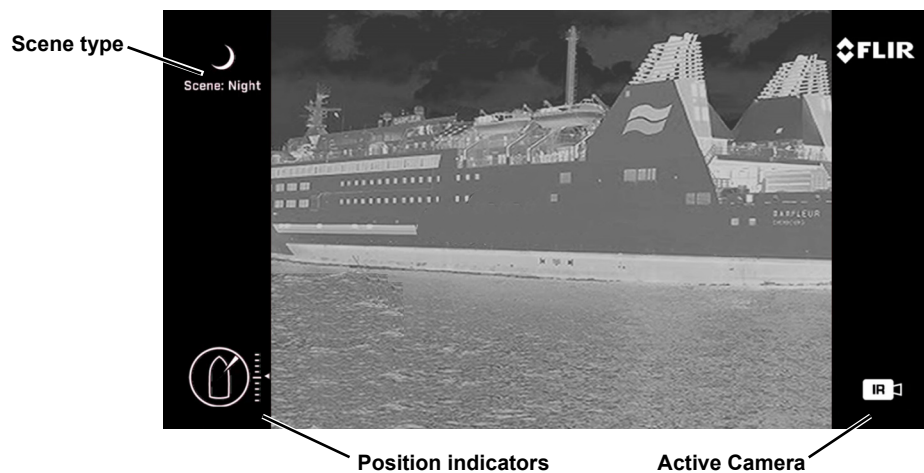


Figure 1-2: On-screen Icons

**Position indicator icons**

The azimuth position indicator shows the direction the camera is pointing relative to the vessel. The shaded triangle shows the approximate camera field of view (FOV).



Azimuth



Elevation

The elevation position indicator shows the vertical tilt of the camera above or below the horizontal plane of the vessel.

**Scene type icons**

The Scene button on the JCU II cycles through four preset automatic gain control (AGC) settings, which change the image brightness and contrast settings. Regardless of the scene setting, the thermal camera automatically adjusts to the scene to provide a balanced, high-quality image. However, you may prefer an image that has more or less contrast than the default one provided, and the Scene button provides that type of fine adjustment.



Night



Harbor



Day



Contrast

**Active Camera Icons**

At any given time, either the thermal camera (IR) or the HD visible-light camera is designated as the Active camera. The Active camera responds to commands such as zoom or focus that could apply to either camera. Pressing the CAMERA button on the JCU II toggles the active camera between the thermal camera and the HD visible-light camera.



Thermal



Visible

**On-Screen-Display (OSD) Menu**

The OSD menu appears when the Menu button on the JCU II is pressed. Menu entries are selected using the joystick and the joystick buttons. Pressing the Menu button again removes the menu from the screen.

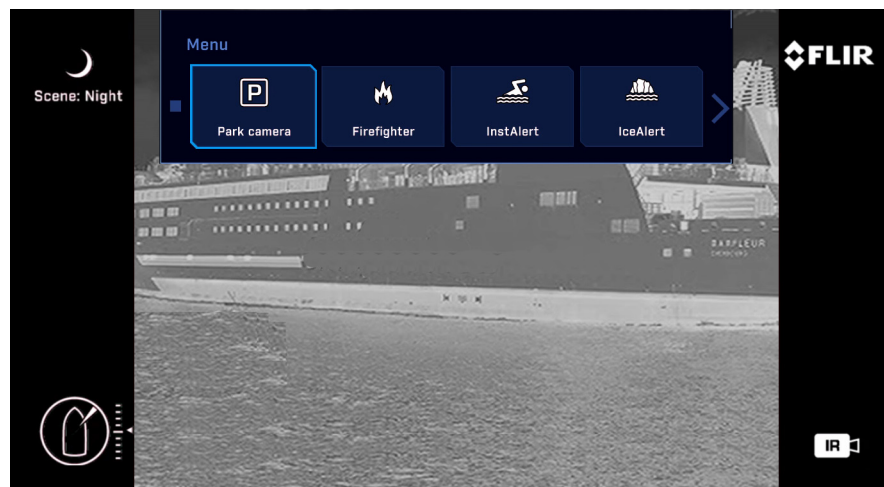


Figure 1-3: OSD Menu

# M400 System Startup

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## System Startup and Shutdown

The M400 camera does not have an on/off switch. Instead, its power state is controlled by the JCU II. Generally, the camera is never completely off but in a Park mode or standby state waiting for a “wake” command from the JCU II.

Typically, the M400 system is connected to power through a circuit breaker, which functions as the primary on/off switch for the system. Should it be necessary for some reason to completely shut down the system, the circuit breaker is used. In normal operation, however, the camera will have power and will be in one of four states or modes:

- Bootup, or powering on
- Powered on and fully functional
- Park mode, powered on with video turned off
- Standby, a low-power state waiting for a wake command

## Park Mode

When the system is in Park mode, the camera does not generate a live video signal. After the bootup is complete or when done using the system, Park the camera from the OSD menu to keep the system ready to use at a moments notice.

## The Bootup Process

The bootup process is slightly different depending on whether the system had been completely turned off or is being wakened from a standby state. Most of what happens, however, is the same.

### Powering the Camera

During bootup, a series of screens are shown as various components are activated. How the screen looks will vary depending on the particular configuration settings of your installation. In general, the following sequence occurs:

1. If starting from a full shutdown, make sure the monitor is turned on, then power on the system.
2. The FLIR splash screen is shown, then live video with a counter showing boot progress.
3. When the bootup is complete (about 4 minutes), the monitor shows the welcome screen with icons, live video, and the OSD menus are enabled.



**Important:** Do not power on the JCU II until the message “Welcome System is ready for use” is shown. Fully establishing a connection may take up to four minutes. Please be patient while the system verifies each component.

### Powering the JCU II

When the JCU II is receiving power, the Power button will be lit amber. When the button is pressed for approximately three seconds, the JCU II will turn on and search for cameras on the network.

On the LCD screen, *Starting*, then *Searching...* is shown. When a camera is found, the message changes to *Connecting...*, which continues to flash until the connection process completes and is replaced by the camera ID, such as *M400*. When more than one camera is found on the network, the JCU II attempts to reconnect to the last camera it was connected to, or if it has not connected to a camera, it will prompt the user to select a camera.



### JCU II Power Menu

The JCU II LCD screen generally shows the ID of the camera that is connected to the JCU II. The various functions are accessed from a set of menus, with each menu entry selectable in the JCU II display. When powered on and connected to a camera, pressing and holding the Power button causes the JCU II to enter the Power Menu.

Use the JCU II joystick to scroll up and down (push fore and aft), and select an entry by clicking the left joystick button. When the JCU II is in the Power Menu mode, the other JCU II buttons are disabled.

In the JCU II display, a down arrow (v) indicates you can access additional menu choices by moving the joystick down. An up arrow (^) indicates the last menu entry is displayed, and the other choices must be accessed by moving the joystick up. A double arrow indicates you can move up or down in the menu.

The Power Menu shows the following menu options:

```
Assign JCU?  
JCU Stndby?  
Camera Stndby?  
System Stndby?  
Global Stndby?  
Calibrate JCU?  
Cancel
```



### Standby States

When finished with the camera, Park the camera from the OSD menu to keep the system ready to use at a moments notice on a command from the JCU II. When in Park mode, the system does not generate a live video signal.

To initiate other standby modes, press and hold the Power button. After a brief countdown, the Power Menu is shown. Scroll down with the joystick, press the left joystick button to select an option from the menu. The menu options available will reflect the available hardware on the camera network.

- JCU Stndby?—select to power down the JCU II.
- Camera Stndby?—select to power down the camera, leaving the JCU II powered to connect to a different camera.
- System Stndby?—select to power down the camera and the JCU II.
- Global Stndby?—select to power down all the cameras and all the JCU IIs present on the network.

**Troubleshooting Tip:** If the JCU II does not have power, it may be connected to a Power over Ethernet (PoE) switch that has not been powered on, or it may be connected to a network switch that does not provide PoE power.

**Troubleshooting Tip:** If this is the first time the JCU II has been used to connect to the camera, or if the camera was not powered before the JCU II, `v Select Camera` is shown on the LCD screen. Scroll down with the joystick to select a camera to control. When the ID of the camera appears, press the left joystick button to select it. The camera ID will blink momentarily to indicate it has been selected.

# M400 Joystick Control Unit

## Introduction

The Joystick Control Unit (JCU II) is the primary method of controlling the M400 camera. Use it to move the camera, zoom the camera, switch between infrared and visible-light cameras, adjust image settings, and access the on-screen menus.

This chapter describes how to use the JCU II buttons to operate the camera features. Some of these features vary depending on the specific way the system has been configured. Table 3.1 on page 19 summarizes the actions of each button.

Refer to the various configuration settings and how they affect operation in Chapter 4, "M400 System Configuration," on page 20.

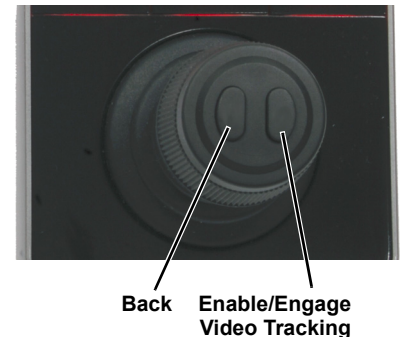


## JCU II Joystick

The JCU II joystick can be moved left or right, forward and back, and twisted in either direction. The joystick movement is translated to control the pan/tilt position of the camera and the zoom setting of the camera.

The right and left joystick buttons on the top of the joystick are used to select and navigate when in the on-screen-display menus and the JCU Power Menu.

Video Tracking—M400XR only—Use the right joystick button to enable and engage video tracking with the M400XR system. Use the left joystick button to stop tracking.



## Tilting the Camera

The camera has two tilt modes: Gaming and Pilot. When in Gaming mode (the default), moving the joystick forward tilts the camera up; moving the joystick back tilts the camera down.

When in Pilot mode, moving the joystick forward causes the camera to tilt down; moving the joystick back causes the camera to tilt up.

See "User Interface Preferences Menu" on page 28 for details about this settings.

## Rotating the Camera

Use the joystick to rotate the camera to the left and right. Push the joystick to the right and the camera will pivot to the right. Push the joystick to the left and the camera will pivot left.

## Zooming the Camera

Twisting the joystick causes the camera to zoom in (clockwise) or zoom out (counterclockwise).



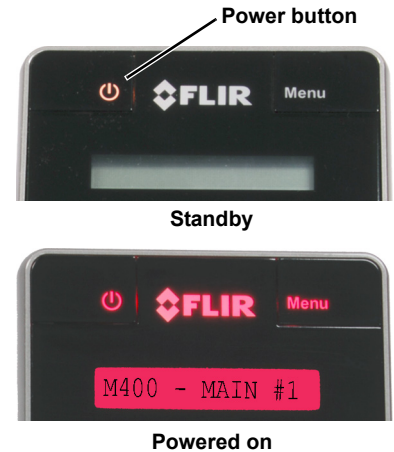
## JCU II Buttons

All of the buttons on the JCU II perform multiple functions. In most cases, each performs one function when it is pressed briefly (short press) and a different function when it is pressed and held (long press). The descriptions of the buttons in this section assume that the JCU II is powered on (not in standby) and connected to an M400 camera system.

### Power Button

**Short Press**—When the JCU II is powered on, a short press of the Power button cycles through the four levels of brightness (including off) for the JCU II display. The JCU II controls are back lit to make them easier to see at night. Use this button to adjust the brightness of the back lighting.

**Long Press**—When the JCU II is in standby, pressing and holding the Power button is used to “wake up” the camera. When the JCU II is powered on, it is used to access the JCU II Power Menu to perform functions such as selecting another camera or placing the system in standby. Refer to “JCU II Power Menu” on page 14.

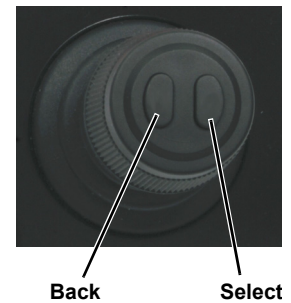


### Menu Button

Press the Menu button to access the system on-screen-display (OSD) menus. In most cases, there is no need to modify the factory default configuration settings of the system. Refer to “M400 System Configuration” on page 20.

When the OSD menu is shown, use the joystick up, down, left, and right to navigate through the menu entries. The buttons on top of the joystick are used as select and back buttons.

- Joystick Up – move up in a vertical menu
- Joystick Down – move down in a vertical menu
- Joystick Right/Left – move to the next menu or menu choice
- Menu – Exit Menu
- Right joystick button – select a menu or menu choice
- Left joystick button – back to the last menu or exit OSD menu



### Home Button

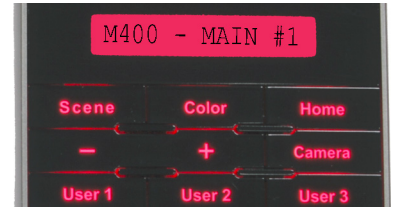
**Short Press**—A short press of the Home button moves the camera to its home position. The home position is a programmable preset position that operators can use as a reference. When the Home button is pressed, the home icon appears briefly on the video monitor display.



**Long Press**—Pressing and holding the Home button sets the home position. First use the joystick to point the camera’s line of sight to the a new home position. Press and hold the Home button until the home symbol flashes on the video monitor display; the new home position is set.

**Scene Button—IR imaging only**

The M400 thermal sensor automatically adjusts to changing conditions providing optimized high-contrast images. The preset automatic gain control (AGC) settings offer the most balance and image quality for specific conditions. Experiment with the different settings to find out which settings work best in different conditions. The Scene button only effects the IR camera.



**Short Press**—A short press of the Scene button cycles through the four preset AGC settings, which change the image gain and level settings. The icon for each scene preset is shown on the video monitor display.



**Color Button—IR Imaging only**

**Short Press**—Pressing the Color button cycles through the preset color palettes of the active IR camera. See “Color:” on page 25 for these additional options.

**Long Press**—Press and hold the Color button to invert the thermal camera video polarity (for example, changing from black-hot to white-hot).

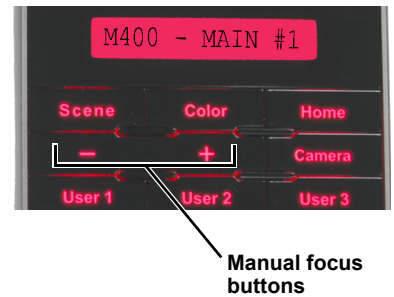
**Focus Buttons**

The M400 thermal camera can be focused either manually or automatically. The visible-light camera is always focused automatically.

The manual focus buttons are effective only when the IR camera is the Active Camera.

the - button will move the focus nearer  
the + button will move the focus farther away

During the manual focus operation, the OSD focus bar will change accordingly.



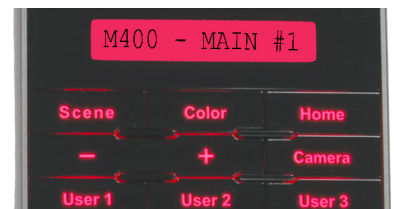
**Camera Button**

Switch the Active Camera shown on the main video output. The buttons on the JCU II are effective only on the Active Camera, except as noted.

**User Buttons**

The User buttons are programmable one-touch buttons to access the most often used functions. Configure the short-press action of this button from the User Programmable Button menu entry (see page 28).

- Short Press**—
- User 1** – Auto Focus
  - User 2** – Stabilization on/off
  - User 3** – Spotlight



**Long Press**—Press and hold a user button to open the OSD menu to reprogram a function.

**Display Camera and JCU II IP Address**

Press the Color button while pushing the joystick forward; the IP address of the JCU II and then the camera will display on the JCU II screen.

**Button Summary**

Table 3.1 summarizes the action of each button on the JCU II.

**TABLE 3.1 Summary of Button Actions**

<b>Button</b>	<b>Action</b>
Color Short	Cycle through the thermal palette options of the IR thermal imaging sensor.
Power Short	Change JCU II back light illumination level
Power Long	Display JCU II Power Menu
Home Short	Return to home position
Home Long	Set home to current position
Menu Short	Display or exit menus
Scene Short	Cycle through four preset scene settings
User 1	Auto Focus (can be reprogrammed)
User 2	Horizontal and Vertical Stabilization on/off (can be reprogrammed)
User 3	Spotlight on/off (can be reprogrammed)
Color + Joystick Forward	Display JCU II and camera system IP address
Right Joystick Button	Select a menu or menu choice in OSD. For M400XR only, enable video tracking, then again to select a target
Left Joystick Button	Back to the last menu in OSD or exit OSD menu For M400XR only, stop tracking a target or disable video tracking

# M400 System Configuration

## Overview

This chapter describes how to configure the system options using on-screen-display (OSD) menus. Operating the M400 camera does not require modifying any of the factory configuration settings. However, the OSD menus allow setting the following:

- Choose configuration options that match personal preferences such as Joystick Mode or the default color scheme.
- Enable or disable specialized modes such as InstAlert, IceAlert, NMEA messaging, or operating the camera in Surveillance mode.

After making updates, most of the changes persist. However, a few settings revert to the factory default when the system is rebooted.

Not all options can be used at the same time. The way the various options interact is also described in the following sections.

Some configuration settings are changed directly by pressing a button on the JCU II. These are described in “JCU II Buttons” on page 17. The way some of the buttons work can be modified using OSD menus, described in this chapter.

## Main Menu

Use the Menu button to turn the OSD menu on or off. When the OSD menu is shown, the joystick is used to navigate through the menus and select various menu entries.

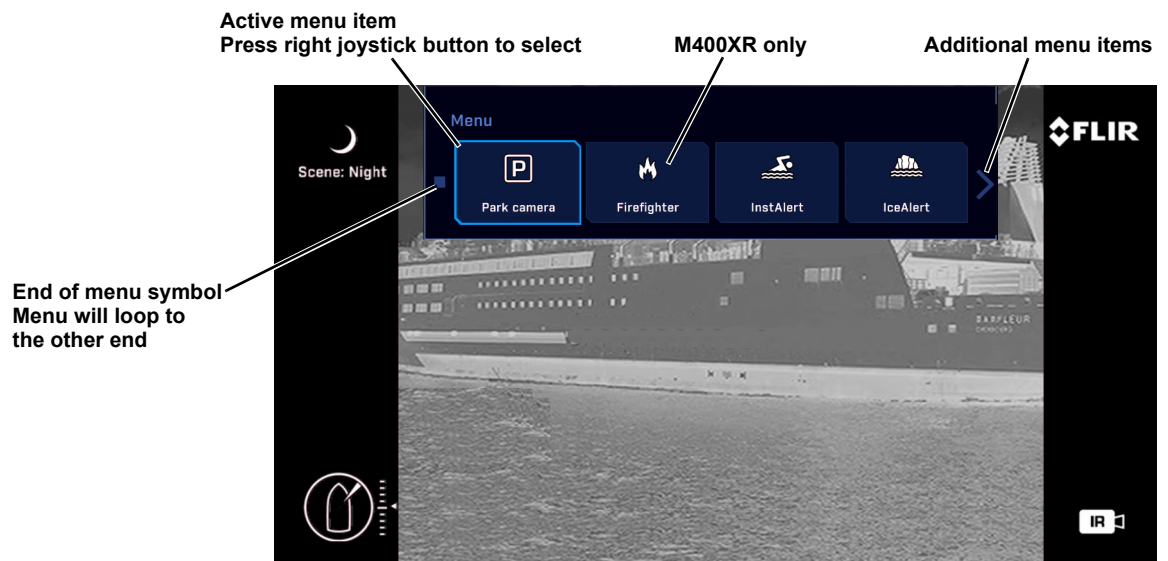


Figure 4-1: OSD Main Menu

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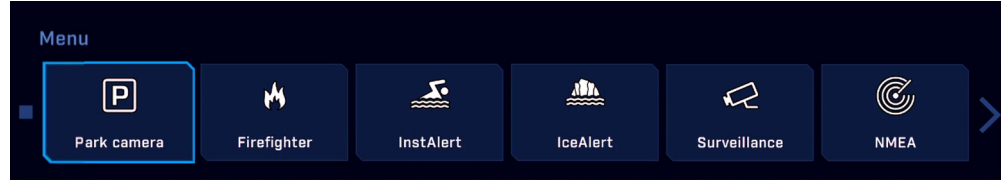
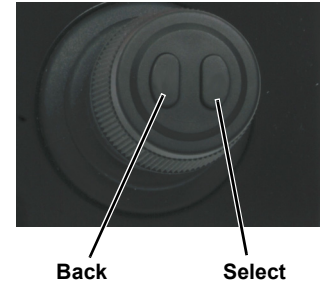
## Main Menu

Use the joystick to navigate through the menus and select options.

Press the Menu button to exit the menus.

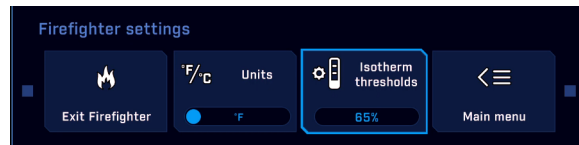
**Note:** During navigation in the OSD menu, camera zoom is disabled, but manual focus/Auto focus is still enabled.

Some features are directly accessible from the main menu. Selecting a menu button below invokes the action immediately and closes the OSD menu.

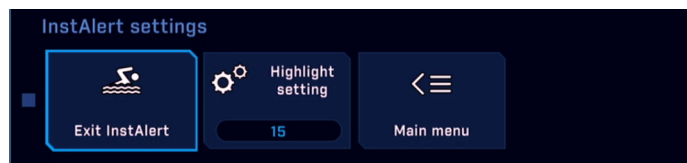


**Park camera:** the camera drives to its predefined Park position and remains fully active (no Stand-by) except that the video is turned off. To exit Park position and return to normal operation, press the Home button. The camera will then return to Home position. The Park position can be reconfigured by an admin user through the web browser interface. See the *M400 Installation Guide*.

**Firefighter/Exit Firefighter mode (M400XR only):** When the camera is placed in Firefighter mode, a special isotherm palette is invoked so that a set percentage of the hottest temperatures in the image are highlighted in red to orange temperature bands, while temperatures below the Isotherm threshold percentage are all in shades of gray. After invoking the mode, pressing the Menu button will show the InstAlert settings menu. The Highlight setting controls the percentage of the hottest temperatures to display in Red-Orange



**InstAlert/Exit InstAlert mode:** When the camera is placed in InstAlert mode, a special search palette is invoked so that a set percentage of the hottest temperatures in the image are highlighted in Red-Orange shades, while colder temperatures are all in shades of gray. Especially useful for locating people or running boats in the dark. After invoking the mode, pressing the Menu button will show the InstAlert settings menu. The Highlight setting controls the percentage of the hottest temperatures to display in Red-Orange.

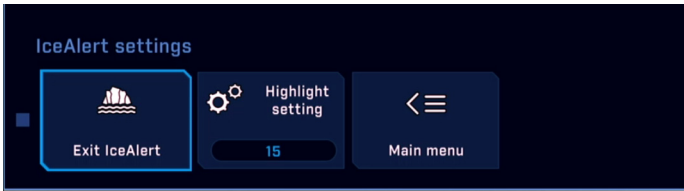


**IceAlert/Exit IceAlert mode:** Conversely to InstAlert mode, when the camera is placed in IceAlert mode, a special search palette is invoked so that a set percentage of the coldest temperatures in the image are highlighted in Blue-Green shades, while warmer temperatures are all in shades of gray. Especially useful for locating ice in the dark. After invoking the mode,

---

## Main Menu

pressing the Menu button will show the IceAlert settings menu. The Highlight setting controls the percentage of the coldest temperatures to display in Blue-Green.



**Surveillance:** When the camera is in surveillance mode, it pans continuously left and right, until it is taken out of surveillance mode or until the JCU II is used to move the camera. The camera does not automatically resume panning; enable surveillance again by pressing a User button (if it is programmed to enable this mode) or selecting it in the main menu.

**Surveillance settings...** When Surveillance settings is selected from the Setup menu or the Menu button on the JCU II is pressed when in Surveillance mode, the following OSD menu is shown.



**Scan Width:** In surveillance mode, the Scan Width determines the range of horizontal azimuth (pan) covered by each scan. The choices are:

**Custom:** The camera scans from approximately 20° left and right of center (40° total).

**Small:** The camera scans from approximately 20° left and right of center (40° total).

**Medium:** The camera scans from approximately 40° left and right of center (80° total).

**Large:** The camera scan covers 80° to the left and right of center (160° total). The default scan width is wide.

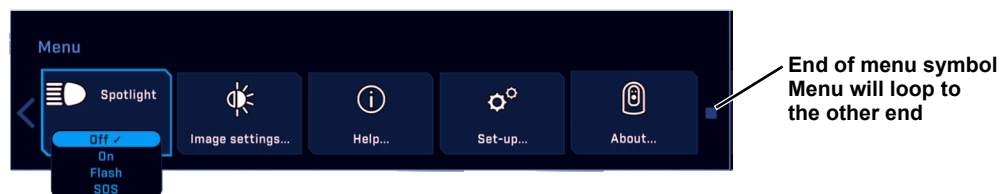
**Note:** The center of the scan pattern is determined by the direction the camera is pointing when surveillance is enabled. The scan pattern is not centered about the home position, unless the camera is in the home position when surveillance is enabled.

**Scan Speed:** In surveillance mode, the scan speed determines how quickly the camera scans back and forth. The choices are fast, medium, and slow.

The scan speed is affected by the zoom state (if the camera is zoomed in, it scans at a slower rate). The default scan speed is slow; try all three settings to determine which is best for any situation.

**NMEA:** Select this option to enable or disable the processing of messages using the NMEA interface. The factory default setting is disabled. All messages are ignored when NMEA Mode is disabled even if the specific message types are enabled. See “NMEA Settings” on page 30.

The following main menu buttons provide additional choices for system settings and information.



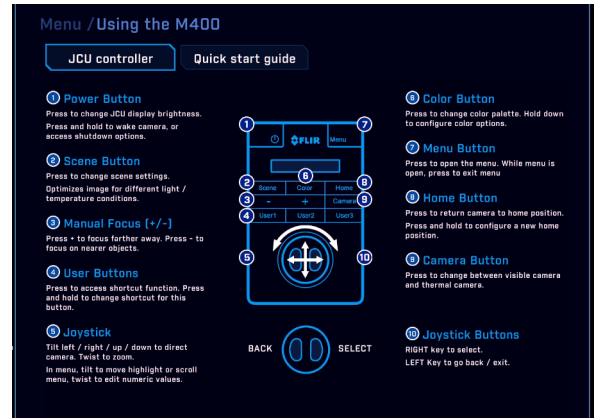
## Image Settings Menu

**Spotlight:** Select this option and then select one of the active spotlight modes (On, Flash, SOS). The Spotlight turns on in the selected mode. A user programmable button (UPB) can be programmed as Spotlight on/off or as Signal Light to control the light. When set to Signal Light, the UPB will turn on the Spotlight when pressed and turn off the Spotlight when released.

**Image settings...** See “Image Settings Menu” on page 24.

**Set-up...** See “Set-up Menu” on page 26.

**Help...** Refer to the help menus for camera operation information.

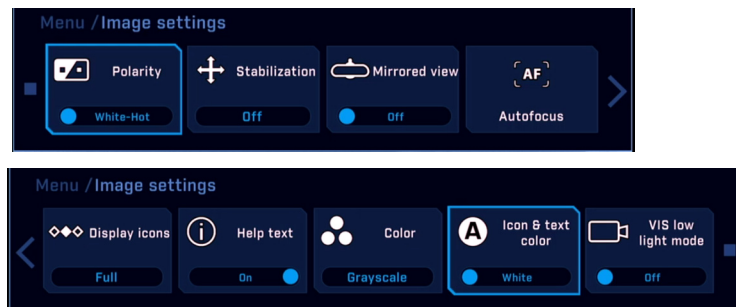


**About...**



## Image Settings Menu

When Image settings is selected from the main menu, the following OSD menu items are shown.





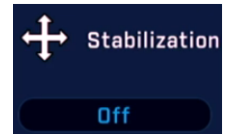
**Polarity—IR camera only:** Inverts the colors representing hot and cold in the infrared imagery. When using the IR camera the color palettes described below are available. Inverting the polarity reverses the color map of the thermal image.

Color Palette	Polarity	Inverted
Grayscale	White-Hot	Black-Hot
Redscale	Red-Hot	Red-Cold
Fusion	Fusion	Fusion-Invert



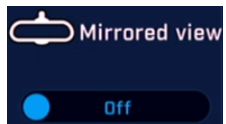
**Stabilization:** Off, Vertical, Horiz & vertical

Select this option to enable or disable the two-axis mechanical gyro stabilization. Gyro Stabilization is automatically turned off when the camera in Park mode or in standby, but the system restores the setting when the camera is returned to service.

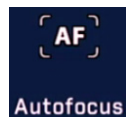


**Mirrored view:** On/Off

Select this option to revert the video image make the scene appear as if viewed in a mirror.

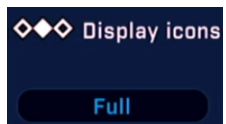


**Autofocus**



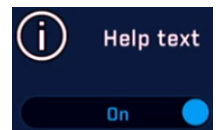
**Display icons:** Minimal, Custom, Full

Selecting **Minimal** turns off most of the on-screen icons except when their corresponding controls are actively in use. The pan position (azimuth) icon, tilt (elevation) position icon, and the FLIR logo are always displayed. Other icons such as home and scene display on the screen only momentarily when they are changed. Selecting **Full** maximizes the display of the on-screen icons. Some icons such as home are only displayed momentarily. Refer to *M400 Installation Guide* for configuring which icons are selected in each setting.



**Help text:** On/Off

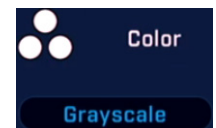
Help text can be displayed to provide contextual information to the user. Unlike feedback or notification text which is always shown, the help text is controlled by this setting.



**Color:** Grayscale, Redscale, Fusion

Cycle through the available color palettes. Inverting the polarity reverses the color map of the thermal image.

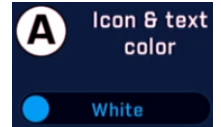
Color Palette	Polarity	Inverted
Grayscale	White-Hot	Black-Hot
Redscale	Red-Hot	Red-Cold
Fusion	Fusion	Fusion-Invert



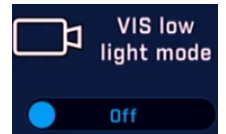
---

## Set-up Menu

**Icon & text color:** Red/White



**VIS low light mode:** On/Off



## Set-up Menu

When Setup is selected from the main menu, the following OSD menu is shown.



**Save current settings as start-up defaults:** Select this option to store the current camera settings described below for start-up or anytime **Restore settings from defaults** is selected.

**Restore settings from defaults:** Select this option to revert to the stored values of the following settings.

Active Camera	Scene	Color
Home position	Polarity	Stabilization
Icon display	Help text	Mirrored View
Joystick mode	UPB assignments	NMEA auto movement settings
InstAlert settings	IceAlert settings	

**User interface preferences...** See “User Interface Preferences Menu” on page 28.

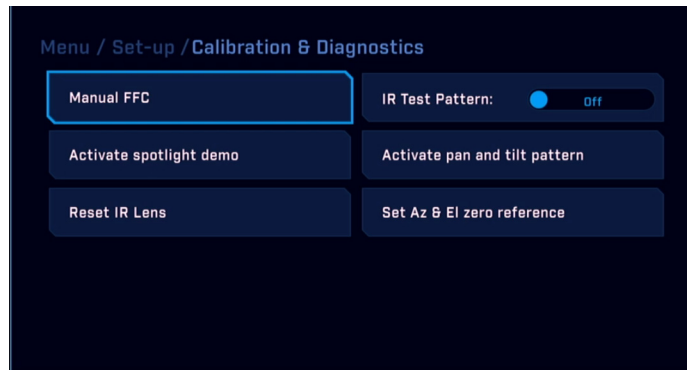
**NMEA settings...** See “NMEA Settings” on page 30.

**InstAlert highlight:** Set the percentage of the highest temperatures in a scene to be displayed in Red/Orange. All other temperatures are shown in grayscale.

**IceAlert highlight:** Set the percentage of the lowest temperatures in a scene to be displayed in Blue/Green. All other temperatures are shown in grayscale.

**Visible Camera Low Light mode:** Select between Auto and Manual operation.

**Calibration & diagnostics...**



**Manual FFC** This function applies to the IR camera only. When selected, the camera drives the camera to a preset position and performs the FFC calibration (< 5 s). The camera then returns to its Home position.

**IR Test Pattern:** On/Off)

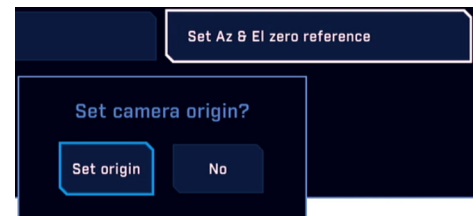
**Activate Spotlight Demo:**

**Activate Pan and Tilt Pattern:**

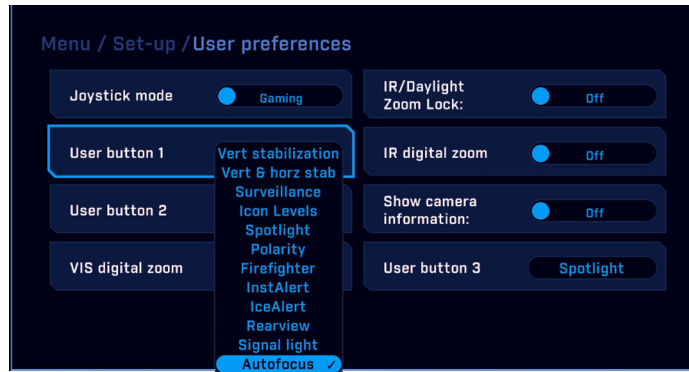
**Reset IR Lens:**

**Set Az & El zero reference:** Icons on the video show the direction the camera is facing in relation to an outline of a ship. The M400 camera has a “forward” direction adjustment which has been set at the factory. After the camera is installed, both the azimuth and elevation should be set to account for variations required during installation so that the icons on the video show the expected angular position of the camera. The azimuth direction should be directly toward the front of the vessel; the elevation may be set to the horizon or another user preferred reference.

1. Using the JCU II, point the camera directly ahead and choose an elevation reference point. For example, place the horizon in the center of the video.
2. Press the Menu button to turn the OSD menu on.
3. Navigate to **Set-up Menu, Calibration & diagnostics...**, then select **Set Az & El zero reference**.
4. Select **Set origin** to set the azimuth and elevation offsets.
5. Verify that the icons on the video correspond to the direction the camera is pointing.



## User Interface Preferences Menu



**Joystick mode:** Gaming/Pilot) In managing the elevation (tilt) of the camera, the joystick can be used in one of two modes.

**Gaming Mode:** Moving the joystick forward causes the camera to tilt up. Moving the joystick back causes the camera to tilt down. This is the factory default mode.

**Pilot Mode:** Moving the joystick forward causes the camera to tilt down. Moving the joystick back causes the camera to tilt up.

**User button 1:**

**User button 2:**

**User button 3:** The User buttons are programmable one-touch buttons on the JCU II that quickly access common settings or useful functions. Use this menu to select a function to associate with each User button from the following choices: Stabilization, Surveillance, Icon Levels, Spotlight on/off, Invert polarity, InstAlert on/off, IceAlert on/off, Rearview on/off, Signal Light, Autofocus

**IR/Daylight zoom lock:** On/Off)

**IR digital zoom:** On/Off)

**VIS digital zoom:** On/Off)

## NMEA Data

This section describes how to configure and use the set of NMEA interface functions supported by the M400. The NMEA interface allows the M400 to communicate with radar, GPS, or other devices using the National Marine Electronics Association (NMEA) 0183 protocol. NMEA 0183 (or NMEA for short) is a combined electrical and data specification for communication between marine electronic devices.

When NMEA is being used, the M400 acts as a listener and receives messages from the main control unit that is monitoring various sending devices in the system, such as radar, GPS, or independent input ports. The M400 connects to the other equipment through the M400 Connection box.

The NMEA protocol allows the camera to automatically point toward vessels and other objects that show up on the display and to track their movement. The M400 can receive three types of NMEA messages.

- Radar Cursor Tracking, which is implemented using the NMEA Radar System Data (RSD) sentence format
- Slew to Waypoint, which uses the NMEA Bearing and Distance to Waypoint, Great Circle (BWC) sentence format
- Radar Tracking, which uses the NMEA Tracked Target Message (TTM) sentence format

Even though you can only choose three types of messages to enable through the NMEA interface, the M400 uses additional messages to perform the calculations needed to respond to these three. If your system is not responding as expected, verify that the NMEA device sending messages is sending the following additional message types:

- HDT Heading, True
- GGA Global Positioning System Fix Data
- VHW Water Speed and Heading
- OSD Own Ship Data
- TLL Target Latitude and Longitude

Any combination or all three messages can be enabled; when more than one type is enabled, the system processes RSD first, then BWC, and finally TTM. For example, if the unit is listening to BWC or TTM messages and looking at a particular target and it receives an RSD message, it waits until the end of the dwell time and then move on to the RSD message, ignoring all other input.

**Note:** Using the joystick to pan or tilt the camera always takes priority over processing of an NMEA message.

Each message type has a unique icon associated with it. Depending on the Icon Display Mode, these icons either always display or display momentarily when a message is received. In both cases, they flash on and off when the message is received.

Additional settings such as target dwell time affect how the messages are processed. Dwell time determines how long the camera remains on a particular target. The ability of the M400 to accurately track a target depends on the quality of the data sent from the radar unit.

The ability of the radar to effectively track a target is influenced by several factors, such as the make and model of the radar unit, the radar update rate, the relative angular rate of the target, the angular rate of the boat heading and the velocity of the target being tracked.

**Note:** It is important to enter the accurate offset location of the camera above the water line to ensure the unit's pointing accuracy for close-in targets. Refer to the *M400 Installation Guide*.

While you can choose to track a large number of targets, in practical terms the number of targets is linked to the dwell time. Since the camera looks at each target for a minimum of 10 seconds before moving on to the next target, when the number of targets become too large, the system will take too long to cycle through them all for the information to be of any real use.

## NMEA Settings

Configure how the NMEA interface works with settings on the NMEA Menu. Select NMEA Data from the Main Menu or when in NMEA mode, select Menu to see the following OSD menu.



**Radar cursor (RSD):** When this option is enabled, you can control the camera by using the cursor on the radar display screen to highlight a target. The camera will track (point toward) whatever target is selected by the cursor. Moving the cursor to a different target will move the camera to the new target (see note below). The camera will continue to follow the cursor until this option is disabled from the main menu. This function is implemented with NMEA RSD messages.



When the camera is in this mode, an icon is either briefly or continuously displayed, depending on the setting of Icon Display Mode.

**Note:** The camera points toward the cursor position for the dwell time period (a minimum of 10 seconds). If the cursor is moved during that time, the camera will not move immediately to the new position. It will ignore all other RSD messages (produced when the cursor is moved to another position) until the dwell time expires. Then it will respond to the next RSD message received.

**Next Waypoint (BWC):** When this option is enabled, the camera will move to a preselected waypoint when that waypoint gets to within approximately 3 mile (5 km), based on waypoint location information from the NMEA BWC messages. When the camera is in this mode, an icon is either briefly or continuously displayed, depending on the setting of Icon Display Mode.



For example, while en route the operator could designate a buoy, an island or any other landmark as a navigation waypoint and the camera will point toward it automatically when in range. The camera will remain on the target for the specified dwell time. If an additional BWC message is received, the camera will point to the newer BWC heading for an additional dwell time period.

**Radar target (TTM):** When this option is enabled, the camera tracks selected radar targets using data from NMEA Target Tracking Messages (TTM) provided by the radar unit. When the camera is in this mode, an icon is either briefly or continuously displayed, depending on the settings of Icon Display Mode.



While it is possible to select up to 100 targets to be tracked by M400 (refer to the radar or GPS documentation on how to designate a target), typically the operator selects five or less. Once targets are selected, the camera will point toward each sequentially, and track it using position data sent from the radar unit.

The camera points at each target for a preset amount of dwell time (10 seconds by default) before moving on to the next target. The dwell time is determined by the setting of Radar Target Dwell.

Due to the way radar operates, it is possible to lose a target momentarily. To ensure that the tracking process continues after the momentary loss of a target, the TTM function maintains the last known position of the target in its queue for 60 seconds after receiving the last valid message. After the 60 seconds has lapsed, that target is removed from the queue.

# Firefighter Mode—M400XR only

## Overview

When the system is in firefighter mode, the estimated temperature of a spot meter target area is monitored and displayed on the screen. In Firefighter mode the color palette is changed to use colored gradients that represent temperatures. When in Firefighter mode, select the MENU key on the JCU II to open the Firefighter menu to set the temperature units or Isotherm thresholds.

**Caution:** A number of factors can affect the accuracy of the M400XR temperature reading such as the distance to the target, humidity, and other atmospheric conditions. While the Firefighter Mode features of your M400XR system provide an important reference point in understanding temperatures in a target environment, you should never rely on camera data as your primary source of information. The M400XR system should always be used in conjunction with other appropriate tools.

Firefighter mode can be activated when either camera is active. If the daylight camera is active, the spot meter, temperature scale, and firefighter scene icon will be shown.

Enable firefighter mode by pressing the MENU button and selecting Firefighter.

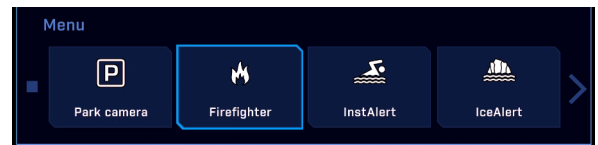


Figure 5-1: Firefighter mode

The temperature/color scale shown along the edge of the video adjusts dynamically between high gain (0 °F to 300 °F; 0 °C to 150 °C) and low gain (0 °F to 1000 °F; 0 °C to 600 °C) based on the temperature in the scene.

Using the system in firefighter mode temporarily disables some other system features:

- If NMEA mode has been enabled, it is disabled until firefighter mode is disabled.
- The Video Setup Menu cannot be accessed from the main menu while using this mode.
- The color palette or the video polarity cannot be changed.

## Firefighter Settings Menu

Use the options on this menu to define the color ranges for temperature tracking. When you select Menu when in Firefighter mode, the following on-screen menu is shown.



### Exit Firefighter

Select this option to exit firefighter mode. If you have enabled firefighter mode, the setting reverts to disabled when the system is rebooted.

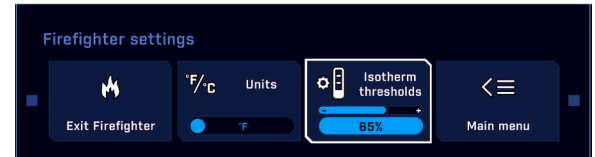
### Select Temperature Units (°F/°C)

Set the temperature units used for the temperature/color scale.

### Isotherm Thresholds

The Isotherm thresholds OSD menu allows adjusting a single value (%) to set the thresholds at which temperatures in a scene are filled with yellows and reds that represent defined temperature bands. The video stream changes dynamically to show the effect of adjustments. Selecting the Firefighter thresholds OSD menu item again saves the value and exits the edit mode.

- Set the percentage to control the colored portion of the scene temperature range. Temperatures below this range will be shown in shades of gray.
- Move the joystick to the right to increase the percentage; to the left to decrease it.



The scales have the following minima, maxima and indices:

	High Gain °C	Low Gain °C	High Gain °F	Low Gain °F
Actual max	160	620	320	1148
Scale max	150	600	300	1000
Labels	0,50,100,150	0,150,300,450,600	0,100,200,300	0,250,500,750,1000
Scale min	0	0	0	0
Actual min	- TBC	- TBC	- TBC	- TBC



# Video Tracking Mode—M400XR only

## Overview

To enable Video Tracking mode press the right joystick button and manually center the target in the acquisition gate by pointing the camera using the joystick. Press the right joystick button again to engage the target and begin tracking. When a target is selected, the acquisition gate is no longer shown and the Tracking icon is shown on the display.

Acquisition is easiest when the target has clear contrasts, rigid edges, and a predictable rate of motion. For example, it is easier for the system to track a boat in the open ocean than when the shoreline is in the background because the boat has a clearer contrast.

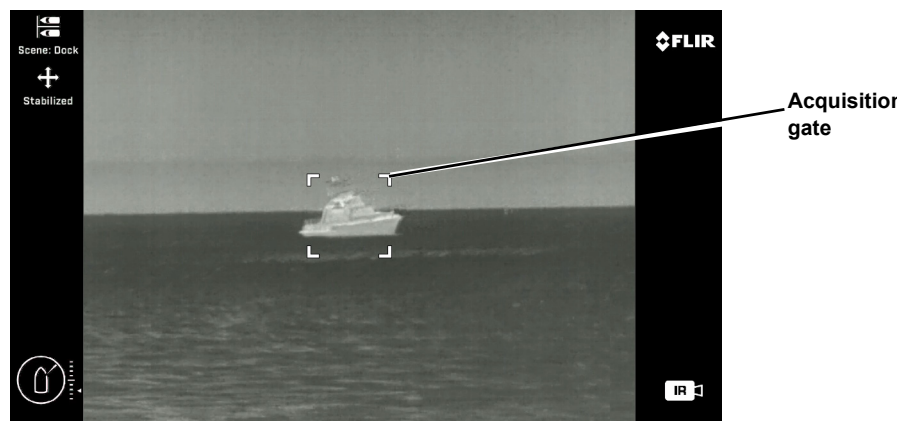
The tracker uses a gray scale frame from either the IR or the visible camera. The visible camera color frame is converted to a gray scale frame for the tracker. Because of this conversion, what is seen on the visible camera as very distinct, may sometimes appear less so to the tracker.

Once a target is being tracked by one of the cameras, that camera will continue to provide video to the tracker even if the active camera is changed. In other words, a target can be tracked using the IR camera while the visible camera video is being shown. If the target is lost (acquisition gate reappears), manually reacquiring the target will begin tracking using the current active camera.

Consider the following in order to maintain an active tracking session:

- Very fast turns by the target that change the aspect ratio of the target may cause confusion
- Very fast turns by the tracking vessel or heavy swells may challenge the ability of the camera to keep the target in view. Stabilization modes are recommended.

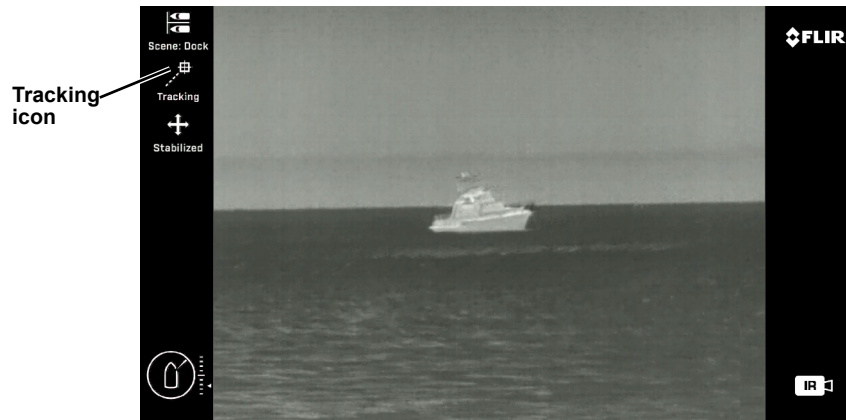
**Acquisition state**—Use the joystick to move the camera. Zoom in to more clearly focus on the target and initiate tracking by pressing the right joystick button.



Joystick Buttons: Left - Exit Video Tracking mode  
Right - Acquire target, engage tracking

Figure 6-1: Video Tracking Mode—Acquisition state

**Tracking state**—When the target is acquired, the acquisition gate disappears and the tracking icon is shown.



Joystick Buttons: Left - Cancel tracking

Figure 6-2: Video Tracking Mode—Tracking state

**Seeking state**—In the seeking state, orange cross-hairs will be shown within the acquisition gate and flash at 2 Hz, while trying to acquire the target. After the seek period times out, the system will return to the acquisition state and you will need to reacquire the target manually.



Joystick Buttons: Left - Cancel tracking to reacquire target  
Right - Reacquire target

Figure 6-3: Video Tracking Mode—Seeking state

While a target is being tracked the system may lose and reacquire the target automatically. For example, if the target you are tracking is a small boat that is temporarily obscured by a large wave, the tracker will seek to predict where the target will be next based on its previous rate of change, and attempt to reacquire it.

## Joystick Operation

When the Video Tracking mode is enabled by pressing the right joystick button, the behavior of the joystick changes so that tracker-specific features can be controlled.

When acquiring a target, use the JCU II to:

- Point the camera at the area containing a possible target (normal pan and tilt joystick operation).
- Begin tracking a target (press right joystick button).

Once you engage tracking, use the JCU II to:

- Disengage Video Tracking (press left joystick button).
- Re-acquire a target or acquire a new target (press right joystick button).

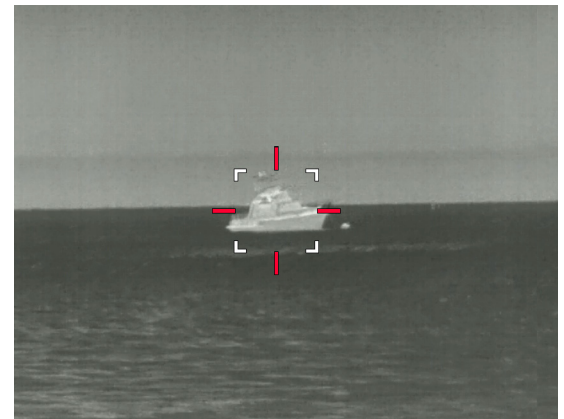


## Video Tracker Errors

If the red cross hairs are seen it means one of two things:

### Communications error with the imx6

- In the case of a Comms error, Nexus will reset the imx6 which may take 1-2 minutes, it will do this 5 times before giving up
- If the Tracker reconnects in any of the 5 times all operations will return to normal
- During the error period attempting to enter Track mode will show the box with red cross hairs



### Tracker reports a problem capturing frames from one of the cameras

- Tracking on the other camera should behave as normal
- Attempting to Track on the camera that has an error will give the red box

# M400 Reference Information

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## Introduction

This chapter includes a glossary of acronyms, a list of symbols used in on-screen-display (OSD), and a number of lists and tables that summarize system information and show how features vary by camera model.

It also includes a set of tips for troubleshooting issues.

## Acronyms

Table 7.1 lists each acronym that is used in this manual and its meaning.

**TABLE 7.1 Acronyms**

Acronym/Term	Definition
AGC	Automatic Gain Control
ANSI	American National Standards Institute
API	Application Programming Interface
B/W	Black and White
DLTV	Daylight TV, used to reference visible-band cameras
EAR	Export Administration Regulations
EMI	Electromagnetic Interference
FFC	Flat Field Correction
FLIR	Forward Looking Infrared
FoV	Field of View
FPS	Frames per Second (refresh rate)
HFoV	Horizontal Field of View
ICD	Interface Control Document
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IR	Infrared or thermal
JCU	Joystick Control Unit
LCD	Liquid Crystal Display
LSZH	Low Smoke Zero Halogen
LWIR	Long-wave infrared
MFD	Multifunction display
NMEA	National Marine Electronics Association

## List of Icons

TABLE 7.1 Acronyms

Acronym/Term	Definition
NTSC	National Television System Committee
OSD	on-screen-display
P/T	Pan/Tilt
PAL	Phase Alternating Line
PoE	Power over Ethernet
SCTE	Society of Cable Telecommunications Engineers
SDK	Software Developer's Kit
UPnP	Universal Plug and Play
Vdc	Volts, Direct Current
VIS	Visible (visible-band camera reference)

## List of Icons

Table 7.2 lists the icons that may be shown on the screen during various operations, with a brief description of their meaning. Some icons display permanently and some only display briefly. The display of some icons is affected by settings on the Display Icons menu (see page 25).



TABLE 7.2 Video Display Icons




Icon	Name	Description
	Thermal camera	
	Daylight camera	
	Azimuth (Position)	Shows the azimuth (or direction) of the camera relative to the vessel. The shaded triangle shows the approximate camera field of view (FOV).

TABLE 7.2 Video Display Icons (Continued)





















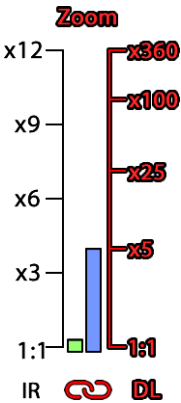
Icon	Name	Description
	Elevation (Tilt)	Shows the vertical tilt of the camera. The shaded triangle shows the approximate camera position.
	Focus Scale	Shown when autofocus is invoked to indicate the progress of the operation.
	Home	Indicates the camera is in the home position; the icon flashes when a new home position is set.
	Lock zoom	Lock the zoom of cameras to the active payload, whenever possible.
	Mirrored View	
	Polarity	
	Color Palette	
	Spotlight (continuous)	
	Spotlight (SOS)	
	Spotlight (Flash)	
	NMEA BWS Message	Receiving NMEA messages using Bearing and Distance to Waypoint, Great Circle (BWC) sentence format has been enabled; this is also known as slew to waypoint.
	NMEA RSD Message	Receiving NMEA messages using the Radar System Data (RSD) sentence format has been enabled; this is also known as radar cursor tracking.

TABLE 7.2 Video Display Icons (Continued)

Icon	Name	Description
	NMEA TTM Message	Receiving NMEA messages using the NMEA Tracked Target Message (TTM) sentence format has been enabled; this is also known as radar tracking
	Power down	The camera is shutting down.
	Scene: Night	One of four scene presets (automatic gain control settings) optimized for use on the open water at night.
	Scene: Docking	One of four scene presets (automatic gain control settings) optimized for use when the boat is docking at night.
	Scene: Day	One of four scene presets (automatic gain control settings) optimized for use on the open water during the day.
	Scene: Contrast	One of four scene presets (automatic gain control settings) optimized for providing visibility to small moving objects.
	Vertical Stabilization	Indicates the gyro stabilization setting is vertical only (point mode), which improves camera image stability while keeping the camera pointing in the same position relative to the vessel as it turns.
	Vertical and Horizontal Stabilization	Indicates the gyro stabilization setting, which improves camera image stability, while keeping the camera pointing in the same direction even as the vessel turns.
	Zoom scale	Shown to indicate the progress of the zoom position of the active camera.

## System Specifications

Table 7.3 lists details about physical characteristics, power usage, and environmental features of the M400 camera.

**TABLE 7.3 Specifications**

<b>Physical Characteristics</b>	
Camera Size	32.4 cm (12.75 in) diameter by 46 cm (18.1 in) tall
Camera Weight	12.22 kg (27 lb), depending on the camera model
Joystick Size	9.1 X 14.2 X 8.13 cm (3.6 X 5.6 X 3.2 in) 7.4 cm (3 in) above platform including joystick
Joystick Weight	0.45 kg (1 lb)
<b>Power</b>	
Camera Input Power	24 Vdc, 2.5 A typical, 5.5 A max 12 Vdc, 5 A typical, 11 A max Absolute range 12 Vdc to 32 Vdc
JCU II Input Power	Power over Ethernet (PoE) per IEEE 802.3af
Consumption	50 W nominal, 132 W maximum
<b>Environmental</b>	
Operating temperature range	-20 °C to +55 °C (-4 °F to +131 °F) per IEC 60945
Storage temperature range	-50 °C to +80 °C (-58 °F to +176 °F)
Automatic Window defrost	Standard
Sand/dust	IEC 60945
Water Ingress	IP X6
Shock	15 g vertical, 9 g horizontal
Vibration	IEC 60945
Lightening Protection	IEC 60945
Salt Mist	IEC 60945
Wind	100 knot (115 mph)
EMI	IEC 60945

## Troubleshooting Tips

This section includes information that may help with common issues that may arise during operation of the M400 system.

### Video not displayed on monitor

The camera will not display video if it is in standby mode. Power cycle the camera and allow the system to complete the bootup cycle prior to JCU II connection. Ensure the JCU II is assigned to



the camera, the camera ID appears in the JCU II display, and the camera responds to JCU II input (for example, pan/tilt movements).

If the camera will not produce an image, check the video connection at the camera and at the display. If the connectors appear to be properly connected but the camera still does not produce an image, ensure that power has been properly applied to the camera and circuit breaker is set properly. If a fuse was used, be sure the fuse is not blown.

Check the wiring at both the electrical panel and at the termination to the JCU II. 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.

### **Cleaning**

**Warning:** The M400 camera body is a remotely and automatically controlled device. Ensure camera motion has been disabled before cleaning surfaces that can cause pinch hazards.

If the camera lens has become smudged or dirty, clean it with low-pressure fresh water and a soft cloth. Improper care of the camera window can cause damage to its anti-reflective coating, degrade the camera's performance, and void the camera warranty.

The camera housing has a durable marine 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 and dampened with fresh water.

### **Video not switching between thermal and visible**

On dual payload models, the display can be switched between the thermal camera and the visible camera either by pressing and holding the Scene button, or, if the User Programmable Button is set to Switch IR/VIS Video, pressing the User button. If neither of these operations causes the display to switch from the thermal camera to the visible-light camera, be sure the proper input channel is selected on the display, and be sure the cable labeled VIS/IR is connected to the display.

### **Noisy image**

A noisy image is usually attributed to a cable problem—too long or inferior quality—or the cable is picking up electromagnetic interference (EMI) from another device. Although coax cable has built-in losses, the longer the cable is or the smaller the wire gauge/thickness, the more severe the losses become; and the higher the signal frequency, the more pronounced the losses. Unfortunately this is one of the most common and unnecessary problems that plagues video systems in general.

Cable characteristics are determined by a number of factors such as core material, dielectric material and shield construction, among others and must be carefully matched to the specific application. Moreover, the transmission characteristics of the cable will be influenced by the physical environment through which the cable is run and the method of installation. Use only high quality cable and ensure the cable is suitable to the marine environment.

Check cable connector terminations. Inferior quality connections may use multiple adapters that can cause unacceptable noise.

**Image too dark or too light**

By default, the M400 thermal camera uses an automatic gain control (AGC) setting that has proven to be superior for most applications. However, a specific environment may benefit from a different AGC setting. For example, a very cold background (such as the sky) could cause the camera to use a wider temperature range than appropriate. Try to keep the ocean, and not the sky or the boat, as the predominant object in the image. Refer to “Home Button” on page 17 for information about how to make adjustments to the image.

**Performance varies with time of day**

You may observe differences in the way the camera performs at different times of the day, due to the diurnal cycle of the sun. Recall that the camera produces an image based on temperature differences.

At certain times of the day, such as just before dawn, the objects in the image scene may all be roughly the same temperature, compared to other times of the day. Compare this to imagery right after sunset, when objects in the image may be radiating heat energy that has been absorbed during the day due to solar loading. Greater temperature differences in the scene generally will allow the camera to produce high-contrast imagery.

Performance may also be affected when objects in the scene are wet rather than dry, such as on a foggy day or in the early morning when everything may be coated with dew. Under these conditions, it may be difficult for the camera to show the temperature the object itself, rather than of the water coating.

**Eastern or Western exposure**

While a boat is under way, the camera may inevitably end up pointing directly east or west, and this may cause the sun to be in the field of view during certain portions of the day. We do not recommend intentionally viewing the sun, but looking at the sun will not permanently damage the sensor. In fact the thermal imaging camera often provides a considerable advantage over a conventional camera in this type of back-lit situation.

However, the sun may introduce image artifacts that will eventually correct out and it may take some time for the camera to recover. The amount of time needed for recovery will depend on how long the camera was exposed to the sun. The longer the exposure, the longer the recovery time needed.

**Multiple Cameras and/or JCU IIs on a single network**

You can configure your system with multiple cameras and multiple JCU IIs on the same network. More than one JCU II can be used to control a given camera. The camera will respond to commands from both JCU II's in the order the commands are received across the network. Unpredictable behavior may result from users sending conflicting commands from separate JCU II's (for example, one user pans left and the other user pans right). In general, the camera will respond to the last command received and there is no way to set priority, given that IP networks use a “best effort” delivery protocol.