

argus[®]

thermal imaging from e2v

e2v

User Manual

TT-Type



P-Type



T  **USA**
Equipment
.NET
An Interworld Highway, LLC Company

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CONTENTS

1	Safety and Regulatory Information	3
1.1	FCC Compliance Information (US)	3
1.2	Canada Compliance Information	3
1.3	TUV Label	3
1.4	Camera Warnings/Cautions	3
2	Introduction	4
3	Operation and Use	5
3.1	System Configuration (TT-Type)	5
3.2	System Configuration (P-Type)	6
3.3	Display	7
3.4	Getting Started	8
3.5	Operating Notes	10
3.6	Button Summary	11
3.7	Menus	12
3.8	Zoom.....	14
3.9	Colour Cycle.....	14
3.10	Image Capture (Option).....	16
3.11	Video Capture (Option)	17
3.12	Memory Card	18
3.13	Temperature Indication	21
4	Batteries and Charging.....	22
4.1	Battery Removal and Replacement	22
4.2	Charging the Battery Inside the Camera.....	23
4.3	Charging the Battery Outside the Camera	23
4.4	Battery Life Indicator	23
4.5	Using Lithium AA Cells (Non-Rechargeable)	24
5	Changing the Lens (P-Type).....	25
5.1	Fitting the Lens.....	25
5.2	Removing the Lens	25
5.3	Set Lens Type	25
5.4	Camera Care.....	25
6	Maintenance.....	26
6.1	Cleaning.....	26
6.2	Maintenance.....	26
6.3	Replacement Parts.....	26
7	Fault Finding	28
7.1	Display Warnings	28
7.2	Batteries and Power	28
7.3	Image Problems	28
7.4	Memory Card Problems.....	28
8	Warranty Terms.....	29
8.1	Express Warranty.....	29
8.2	Exclusive Remedy.....	29
8.3	Exclusion of Consequential Damages	29
9	Appendices	30
9.1	Using Image .jpeg to View .raw Files.....	30

1 Safety and Regulatory Information

Before using this product, the customer shall read and understand all the instructions and warnings. e2v technologies does not accept responsibility for damage or injury resulting from failure to follow the instructions provided

Refer to the Product Safety Sheet PSD776213A for safety and warning notes for the P Type.

Refer to the Product Safety Sheet PSD774946A for safety and warning notes for the TT Type.

1.1 FCC Compliance Information (US)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

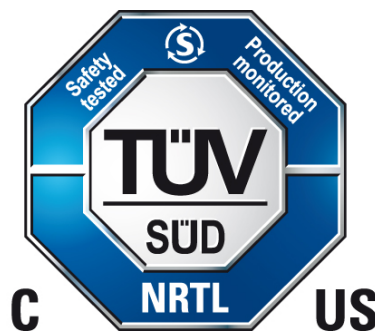
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Any modification not approved by e2v could void the user's authority to operate this equipment.

1.2 Canada Compliance Information

This Class B digital apparatus complies with Canadian ICES-003

1.3 TUV Label



See the product label for EU and other regulatory information

1.4 Camera Warnings/Cautions

- All users should familiarise themselves with the correct operation, functionality and features of the camera before use.
- The camera can only be serviced by authorised personnel. There are no end-user serviceable parts except those described in the maintenance section of this manual.
- Use only the mains power supply or vehicle power leads supplied by e2v.
- e2v technologies recommends that the camera is stored in the supplied package or an alternative case supplied by e2v technologies.
- The lens on P-Type cameras should only be changed in dry conditions to prevent water penetration into the camera.

2 Introduction

The Argus[®] TT-Type and P-Type are the latest generation of the Argus[®] Security Thermal Imaging Cameras (TIC) from e2v technologies. With over 30 years experience in thermal imaging, e2v technologies continues to produce high quality, affordable systems designed for person, vehicle and object detection in civilian and industrial security applications.

The Argus[®] TT-Type and P-Type cameras have been designed with digital imaging technology for a sharper picture and superior performance and use proven uncooled Amorphous Silicon (ASi) Microbolometer Detector technology.

The Argus[®] TT-Type and P-Type cameras are simple to operate, robust and self-contained with fully automatic operation. No control or adjustment is required in use. They are small, lightweight, ergonomic cameras which can be used for:

- Search and rescue operations involving casualties and fugitives.
- Seeing in zero visibility conditions.
- Detecting border incursions even under the cover of darkness, smoke and various weather conditions.
- Collecting evidence, occupancy evaluation and collision investigation.
- Detecting and displaying the relative temperatures of objects within the scene.

The Argus[®] TT-Type and P-Type are designed to withstand harsh environments, but contain many high-technology components and should be treated carefully. The cameras have many special features and can be set by the user. These features include:

- X2 Zoom (X4 Zoom on 320 sensor models)
- Adjustable brightness display
- Shuttered viewfinder with adjustable diopetre (P-Type).
- Direct Temperature Measurement.
- White Hot/Black Hot selection
- Time and Date.
- Customisable Start-up Screen.
- On screen set-up menu.
- Optional: Image and video capture/playback on removable memory card
- Optional: Additional range of specialised colour palettes.

This manual contains information covering operation of the system, user maintenance, care of the product and a full technical specification.

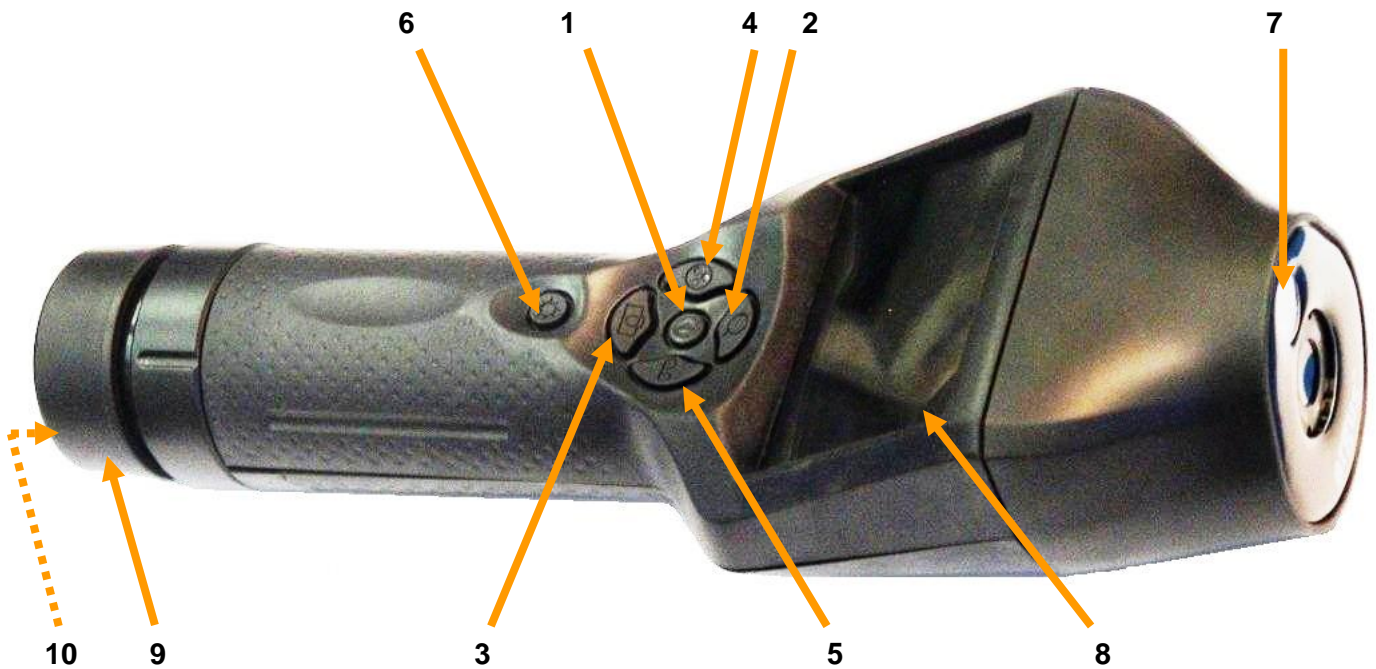
**The following versions are subject to export controls.
An export licence will be required if exported outside the EU.
Txnn0x, PBnn0, PGnn0, PYnn0**

**The following versions are exempt from export controls.
Txnn9x, PBnn9, PGnn9, PYnn9**

nn = 16 (160 Sensor) or 32 (320 sensor); x = A, B or C (lens type)

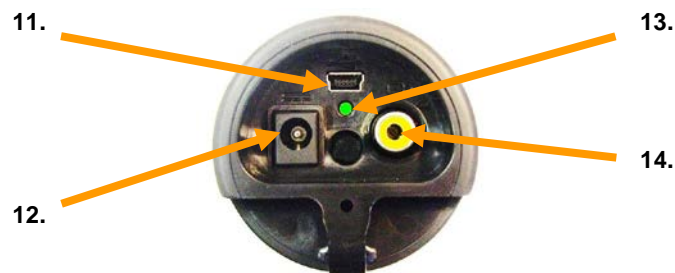
3 Operation and Use

3.1 System Configuration (TT-Type)



- | | | | | |
|----|-----------------------|---------------|-----|---------------------|
| 1. | Power Button | (Menu On/Off) | 6. | Torch On/Off Button |
| 2. | Zoom Button | (Menu Up) | 7. | Torch Light |
| 3. | Image Capture* Button | (Menu Down) | 8. | LCD Display |
| 4. | Colour Mode Button | (Menu Left) | 9. | Battery Holder |
| 5. | Video Capture* Button | (Menu Right) | 10. | Connector Cover |

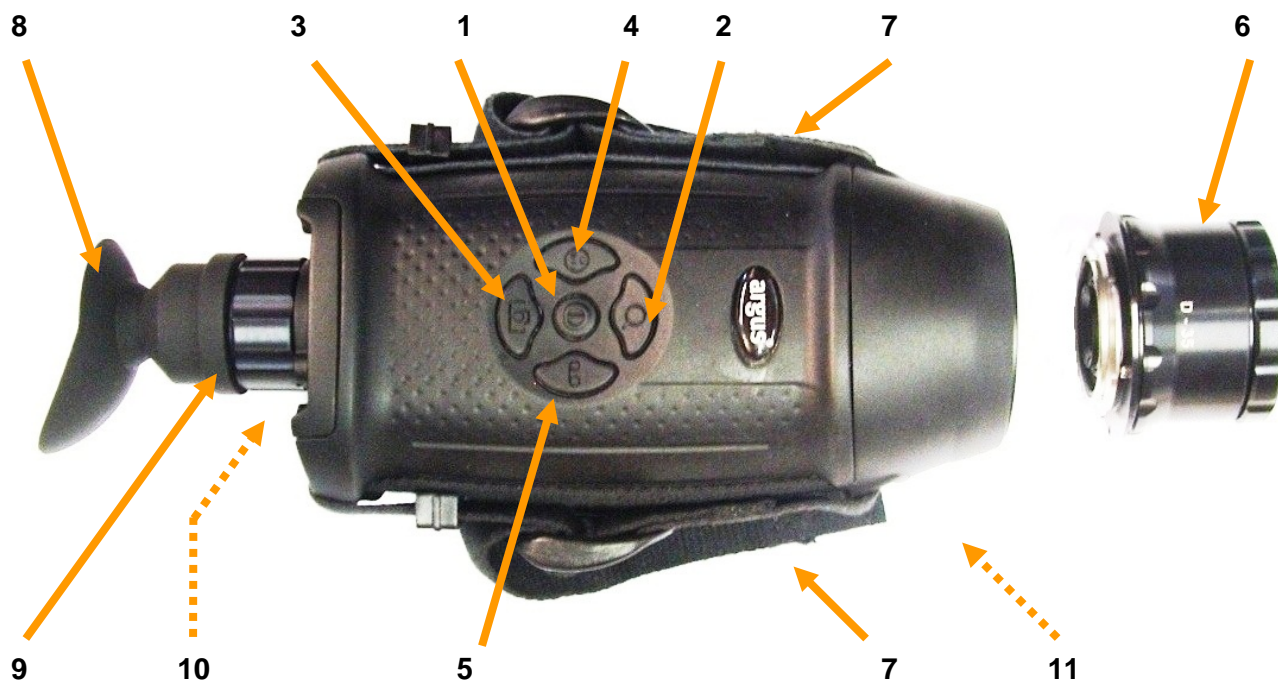
* *Optional feature*



- | | |
|-----|--------------------------------|
| 11. | USB Connector |
| 12. | Power Input Connector (12V DC) |
| 13. | Charging Indicator |
| 14. | Video Output Connector |

See section 4 for location of battery.
See section 3.12 for location of memory card.

3.2 System Configuration (P-Type)



- | | | | | |
|----|-----------------------|---------------|-----|----------------------------|
| 1. | Power Button | (Menu On/Off) | 6. | Lens (supplied separately) |
| 2. | Zoom Button | (Menu Up) | 7. | Straps |
| 3. | Image Capture* Button | (Menu Down) | 8. | Eye Piece |
| 4. | Colour Mode Button | (Menu Left) | 9. | Dioptre Adjust |
| 5. | Video Capture* Button | (Menu Right) | 10. | Connector Cover (side) |
| | | | 11. | Battery Cover (under) |

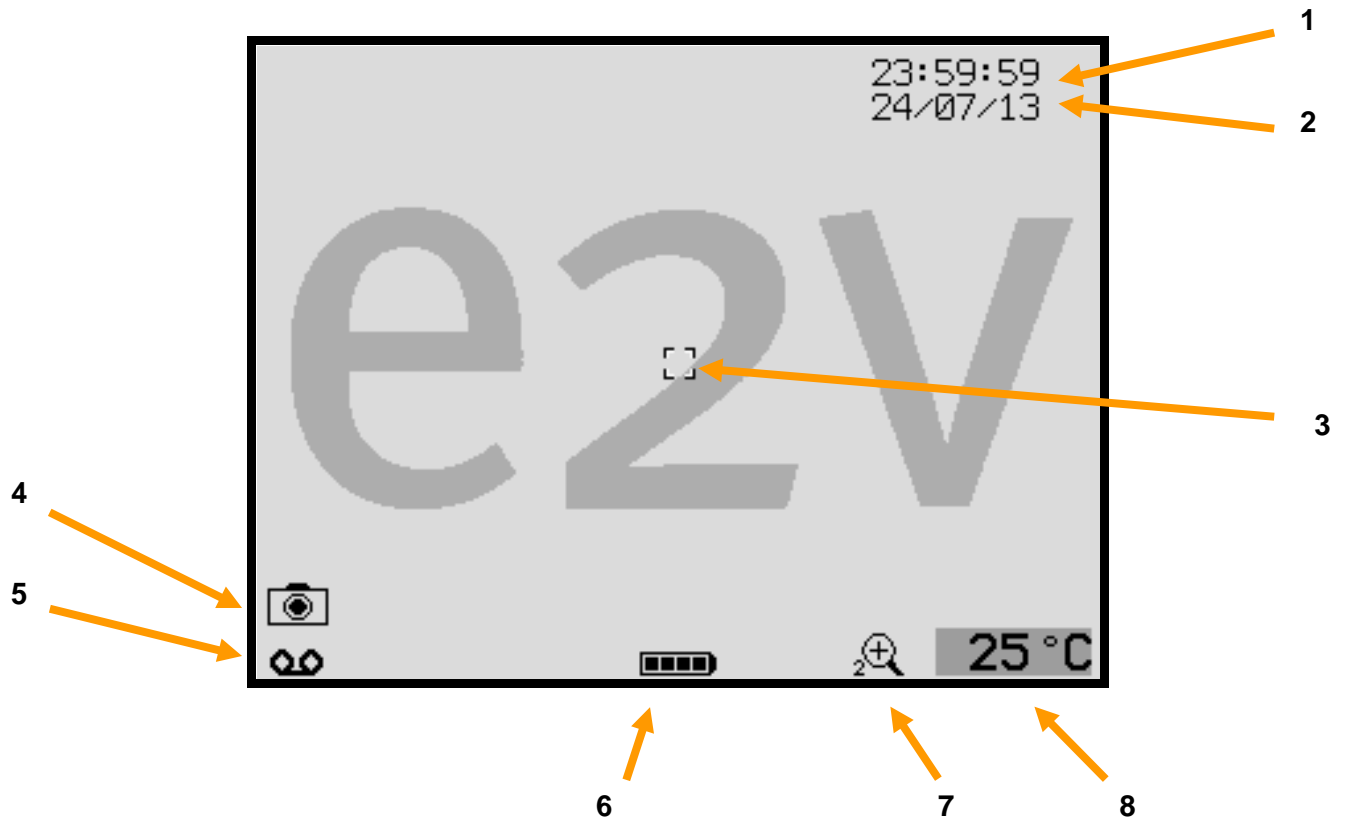
* *Optional feature*



- | | |
|-----|--------------------------------|
| 12. | Video Output Connector |
| 13. | USB Connector |
| 14. | Power Input Connector (12V DC) |

See section 4 for location of battery.
 See section 3.12 for location of memory card.

3.3 Display



- | | | | |
|----|--|----|-------------------------------|
| 1. | Time | 6. | Battery Capacity |
| 2. | Date | 7. | Zoom Symbol |
| 3. | Direct Temperature
Measurement Target | 8. | Direct Temperature
Reading |
| 4. | Image Capture Symbol* | | |
| 5. | Video Capture Symbol* | | |

* *Optional feature*

3.4 Getting Started

The packing case contains the following items (see Quick Start Guide):

- Camera (TT-Type or P-Type)
- User Manual CD
- Quick Start Guide
- Rechargeable Li-Ion Battery
- USB Lead
- Video Lead
- Neck Strap (P-Type)
- Wrist Strap (TT-Type)
- Lens Cleaning Cloth
- Power Supply Kit:
 - Mains Power Supply
 - Set of Interchangeable Plugs
 - Battery Charger Adapter
 - Vehicle Power Lead (12 V)
- A memory card is already fitted inside the camera

Lens

TT-Type cameras have an integrated lens which requires no focusing.

For P-Type cameras the lens is ordered separately and should be inserted into the front of the camera. Rotate the lens clockwise until it clicks into position and remove the supplied lens cap. Refer to section 5 for more information about changing the lens.

Battery

Insert the rechargeable Li-Ion battery into the camera as described in section 4. The rechargeable battery should be fully charged in the camera or external charger before turning on. This may take up to 4 hours using the mains power supply. The charging indicator will turn green when the battery is charged.

Three full charge/discharge cycles may be required for the battery to achieve full capacity. Please read the battery manufacturer's charging instructions provided with the battery.

Basic Operation

- Turn the camera on with a short press on the middle button.
- After about one second a start-up image will appear on the screen. (This image may be changed – see section 3.12). After a few more seconds the display will show the thermal image.
- While the camera is in operation, it will recalibrate to maintain its performance and image quality. During recalibration an internal shutter closes and the image will briefly freeze while the internal electronics optimises the performance of the sensor. This occurs more frequently when first turned on, then the calibration interval increases as the internal temperature of the camera stabilises.
- When the camera is turned on:
 - A long press on the power button will turn the camera off
 - A short press on the power button will enter the menu

Focus (P-Type Camera Only)

- **Viewfinder**

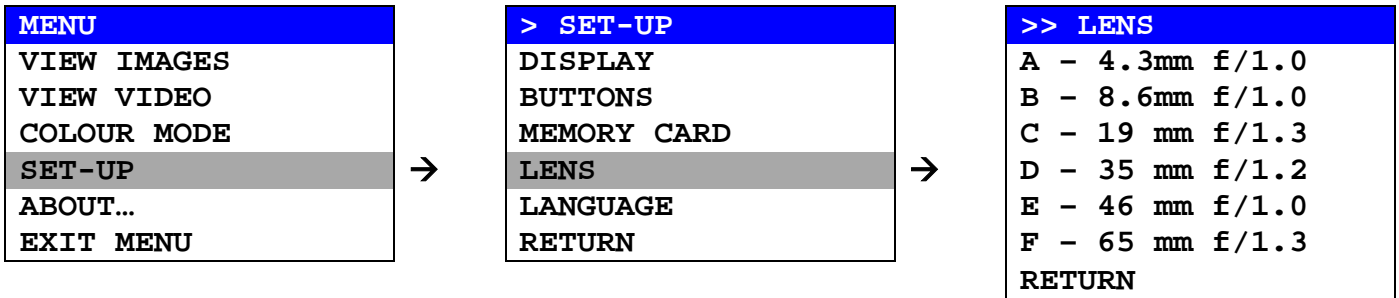
On P-Type cameras, first adjust the viewfinder (dioptre adjust) to give a sharp picture when looking at the icons such as the battery indicator. Operators who wear glasses may find it easier to remove the rubber eye-cup first. Alternatively they can remove their glasses and adjust the viewfinder. This can be adjusted for dioptres from approximately +2 to -4.

- **Front lens**

Next the front lens should be adjusted to give the sharpest picture. The lens may need to be adjusted again when looking at objects at different distances.

- **Set Lens Type**

Several lenses are available for the P-Type camera. Whenever the camera is used for the first time, or when the lens is changed to a different type, it is necessary to set the lens type on the camera menu. If this is not done it will affect the image quality and the Direct Temperature Measurement may be incorrect. Press the middle button briefly to enter the menu.



LENS	A	B	C	D	E	F
→ Identification approx.	12 m	24 m	50 m	90 m	115 m	165 m
→ Recognition approx.	45 m	90 m	190 m	350 m	460 m	650 m
→ Detection approx.	115 m	230 m	500 m	950 m	1250 m	1750 m
Field of View (Horizontal) With 160 x 120 Sensor	50°	26°	12°	6.5°	5.°	3.5°
Field of View (Horizontal) With 320 x 240 Sensor	-	50°	24°	13°	10°	7°

*Note: Identification as friend or foe at 6.25 cm/pixel;
Recognition as person/object at 25 cm/pixel;
Detection of person at 66.7 cm/pixel;*

3.5 Operating Notes

Interpreting the Image

The display shows the relative temperature differences between all the objects and backgrounds in the scene. When the colour mode is set to 'White Hot' hotter objects appear whiter and cooler objects appear blacker. When the colour mode is set to 'Black Hot' hotter objects appear blacker and cooler objects appear whiter. Changing between 'White Hot' and 'Black Hot' can be useful to make some details of the scene more obvious.

The sharpness and clarity of the image provided is related to the temperature of the scene and objects in view. A cold room provides little infrared energy and less detail is detected than in a warm environment where objects give off significant energy. In general, the warmer the scene, the more thermal contrast is available which will give greater detail in the picture.

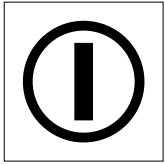
Glass and plastic are not transparent to long wavelength infrared energy so it is not possible to see through a closed window with the Thermal Imaging Camera. Just as a mirror will reflect visible light, polished surfaces (e.g. glass, polished wood and shiny materials) will reflect infrared radiation. Care must be taken to ensure that the image seen is not simply a reflection. Experience will give the operator added confidence.

Potential Applications

- **Building and Border Patrol:** *Quickly search both confined spaces and open areas.*
- **Collision Investigation:** *See tyre skid patterns at night; detect warmth from recently occupied seats; locate missing passengers or vehicle parts.*
- **Detecting Evidence:** *Locate items recently hidden or thrown away, in daylight or darkness. Detect voids and hidden compartments.*
- **Fugitive/Suspect Search:** *People hiding in dark corners or in bushes are visible by their heat signature.*
- **Occupancy Evaluation:** *Determine how many passengers were in a recently abandoned vehicle when the suspects have run away.*
- **Officer Safety:** *See in low light conditions to help identify threats to personnel, from suspects, animals or dangerous objects.*
- **Routine Patrols:** *General guarding and patrol of property. Detects hidden intruders, overheating equipment and leaking water.*
- **Routine Raids:** *Locate people hiding during a raid from their heat signature. Determine if rooms are empty in dark conditions.*
- **Search and Rescue:** *Large areas of land or water can be quickly searched on foot, from a vehicle or from a boat.*
- **Training and Assessing:** *Instructors can assess trainees in realistic night-time training exercises. The video recording option gives useful feedback when reviewing performance.*

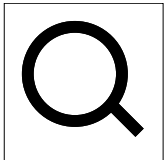
3.6 Button Summary

Power (and Menu)



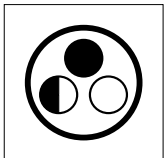
- A short press will turn the camera on. The start-up screen will appear after about one second.
- When the camera is on, hold this button down to turn the camera off. This will take several seconds.
- When the camera is on, a short press will display the menu.

Zoom



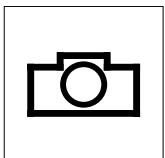
- On cameras with a '160' sensor, this will cycle between 'normal' and '2X Zoom'
- On cameras with a '320' sensor, this will cycle between 'normal', '2X Zoom' and '4X Zoom'
- Range Lock (Long press to lock/unlock)

Colour Cycle



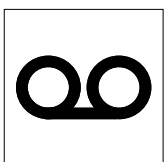
- This will cycle through the available colour modes
- All cameras have 'White Hot' and 'Black Hot' mode
- Further colour modes can be purchased from your e2v representative
- The Set-Up menu can be used to add or remove each of the available colour modes to the colour cycle button

Image Capture (option)



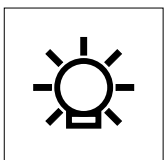
- Press this button to capture an image.
- If zoom is turned on, the image will be the full image, not the zoomed image.
- Images are normally stored on the memory card in compressed **.jpg** format. This can be changed in the set-up menu to **.raw** format which has higher depth of greyscale for more detailed analysis.

Video Capture (option)



- Press this button to start or stop video recording. Videos are stored on the Memory Card.
- If zoom is turned on, the video will be the full image, not the zoomed image.
- Videos are stored in Motion JPEG format in a **.avi** file.

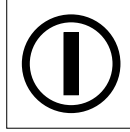
Torch On/Off (TT-Type only)



- Press this button to turn the torch light on or off.
- The torch will operate even when the camera is turned off.
- Using the torch for a long time will reduce the battery life.
- Warning: Do not look at the torch light from short range.

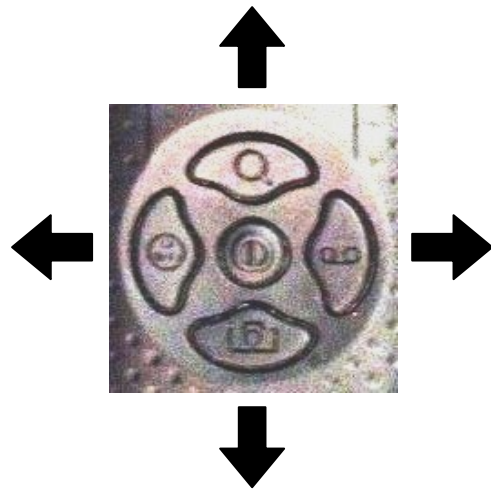
3.7 Menu

To enter the menu, press the 'Power' button briefly.

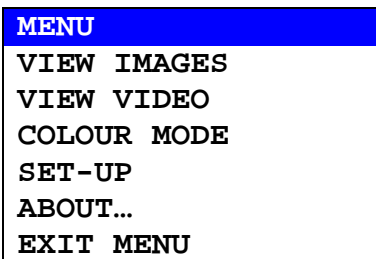


Press the 'Power' button again to select items in the menu.

Press the left button at any time to exit a menu and return to the previous menu without saving a change.



Main Menu



- **VIEW IMAGES (Option)**
View images stored on the Memory Card.
- **VIEW VIDEO (Option)**
View videos stored on the Memory Card.
- **COLOUR MODE**
Select which colour mode to use.
All cameras have 'White Hot' and 'Black Hot' mode.
A set of other colour modes is available as an option.
It is possible to select any available colour mode here, even if it has been removed from the colour cycle button.
- **SET-UP**
Enter the **Set-up Menu** which allows many of the camera features to be customised. See next page for more information.
- **ABOUT...**
Displays basic camera system information.
- **EXIT MENU**
Close the menu and return to normal camera operation.

Set-Up Menu

> SET-UP
DISPLAY
BUTTONS
MEMORY CARD
LENS
LANGUAGE
RETURN

- **DISPLAY**

The display brightness can be changed.
The date and time can be set.
Many of the display icons can be turned on or off.

>> DISPLAY
BRIGHTNESS
DATE
TIME
TEMPERATURE
TRAINING BAR
BATTERY
RETURN

- **BUTTONS**

The operation of the 4 buttons can be adjusted or turned off if required.

>> BUTTONS
ZOOM
COLOURS
IMAGE CAPTURE
VIDEO CAPTURE
RETURN

- **MEMORY CARD**

The image storage format can be set to **.jpg** or **.raw**. The memory card contents can be deleted or reformatted.

>> MEMORY CARD
FILE FORMAT
DELETE ALL
FORMAT MEMORY CARD
RETURN

- **LENS (P-Type Only)**

When the lens is changed it is important to set the lens type on this menu for correct operation.

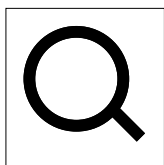
>> LENS
B - 8.6mm f/1.0
C - 19 mm f/1.3
D - 35 mm f/1.2
E - 46 mm f/1.0
F - 65 mm f/1.3
RETURN

- **LANGUAGE**

Change the menu language.
There are 3 pages and the screen will automatically scroll when moving onto the arrows.

>> LANGUAGE
↑ ↑ ↑ ↑ ↑ ↑
ENGLISH
FRANÇAIS
DEUTSCH
...
...
NEDERLANDS
↓ ↓ ↓ ↓ ↓ ↓
SAVE AND RETURN

3.8 Zoom

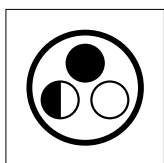


A short press on the zoom button will make the image bigger. On cameras with a '160' sensor, this will cycle between 'normal' and '2X Zoom'. On cameras with a '320' sensor, this will cycle between 'normal', '2X Zoom' and '4X Zoom'.

When the camera is in zoom mode, a magnifying glass icon appears at the bottom of the display. If not required, the zoom function can be disabled using the camera menu:

MENU > SET-UP > BUTTONS > ZOOM

3.9 Colour Cycle



A short press on the colour cycle button will change the colour mode of the camera. Changing between different colour modes can help the operator to interpret different types of scene. All cameras have 'White Hot' and 'Black Hot' mode.

A package of additional colour modes is available as an option. These include:

Sport Application Colour Modes

- Spotter Mode Red
- High Contrast A
- High Contrast B
- Night Vision Red WH (White Hot)
- Night Vision Red BH (Black Hot)
- Night Vision Green WH (White Hot)
- Night Vision Green BH (Black Hot)

Marine Application Colour Modes

- Marine Search
- Man-Overboard
- High Contrast
- Night Vision Red WH (White Hot)
- Night Vision Red BH (Black Hot)
- Night Vision Green WH (White Hot)
- Night Vision BH (Black Hot)

Security Application Colour Modes

- Search
- High Contrast A
- High Contrast B
- Night Vision Red WH (White Hot)
- Night Vision Red BH (Black Hot)
- Night Vision Green WH (White Hot)
- Night Vision Green BH (Black Hot)

-

Specialist Application Colour Modes *

- Defensive Search WH (White Hot)
- Body Search BH (Black Hot)
- Range Lock WH White Hot)
- Range Lock BH Black Hot)
- Search Mode
- High Contrast A
- High Contrast B
- Night Vision Red WH (White Hot)
- Night Vision Red BH (Black Hot)
- Night Vision Green WH (White Hot)
- Night Vision Green BH (Black Hot)

****To access all the listed colour modes both the Security and Specialist colour modes will be enabled on the menu.***

To enable or disable individual colour modes from being selected on the colour cycle button use the camera menu:

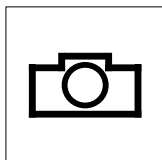
MENU > SET-UP > BUTTONS > COLOURS

The colour cycle function is turned off when only one colour mode selected (ticked). In this situation it is still possible to change the current colour mode using the camera menu:

MENU > COLOUR MODE

However, the next time the colour cycle button is pressed, the colour mode will change back to those selected on the colour cycle.

3.10 Image Capture (Option)



Press the Image Capture button to take a picture. The storage capacity on the memory card has been limited to about 1000 images to simplify replaying of images on the camera display. The remainder of the memory card is available for video storage.

If desired, the image capture button can be disabled using the camera menu:

MENU > SET-UP > BUTTONS > IMAGE CAPTURE

Images are normally stored on the memory card in compressed **.jpg** format. The format can be changed to **.raw** format to give uncompressed monochrome images with higher depth of greyscale for more detailed analysis. The **.raw** format is not supported by all computer image viewing programs. e2v suggests using 'ImageJ' available at <http://rsbweb.nih.gov/ij/> . See section 10.1 for more information about 'ImageJ'. To change the format, use the camera menu:

MENU > SET-UP > MEMORY CARD > FILE FORMAT

Images stored on the memory card can be viewed on the display using the camera menu:

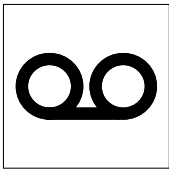
MENU > VIEW IMAGES

Images can be deleted individually while viewing them – a short press on the middle menu button will bring up the 'Delete' menu. Images can also be deleted using the computer connection.

The full contents of the memory card (all images and videos) can be deleted using the camera menu:

MENU > SET-UP > MEMORY CARD > DELETE ALL

3.11 Video Capture (Option)



Press the video capture button to start recording video.
Press the video capture button again to stop recording.

If desired, the video capture button can be disabled using the camera menu:

MENU > SET-UP > BUTTONS > VIDEO CAPTURE

Videos are stored on the memory card in Motion JPEG format in a **.avi** file . The files have a maximum length of 10 minutes to simplify transfer to a computer. The camera will automatically start a new file every 10 minutes.

Images stored on the memory card can be viewed on the display using the camera menu:

MENU > VIEW IMAGES

Videos can be deleted individually while viewing them – a short press on the middle menu button will bring up the ‘Delete’ menu. Images can also be deleted using the computer connection.

The full contents of the memory card (all images and videos) can be deleted using the camera menu:

MENU > SET-UP > MEMORY CARD > DELETE ALL

Note that video files can be very large. 10 minutes of video typically generates a 100 MB file. This can be copied to the computer using the USB lead, but it will be quicker to remove the memory card and use a memory card reader attached to the computer.

3.12 Memory Card

The camera is supplied with a memory card already fitted. This is used for:

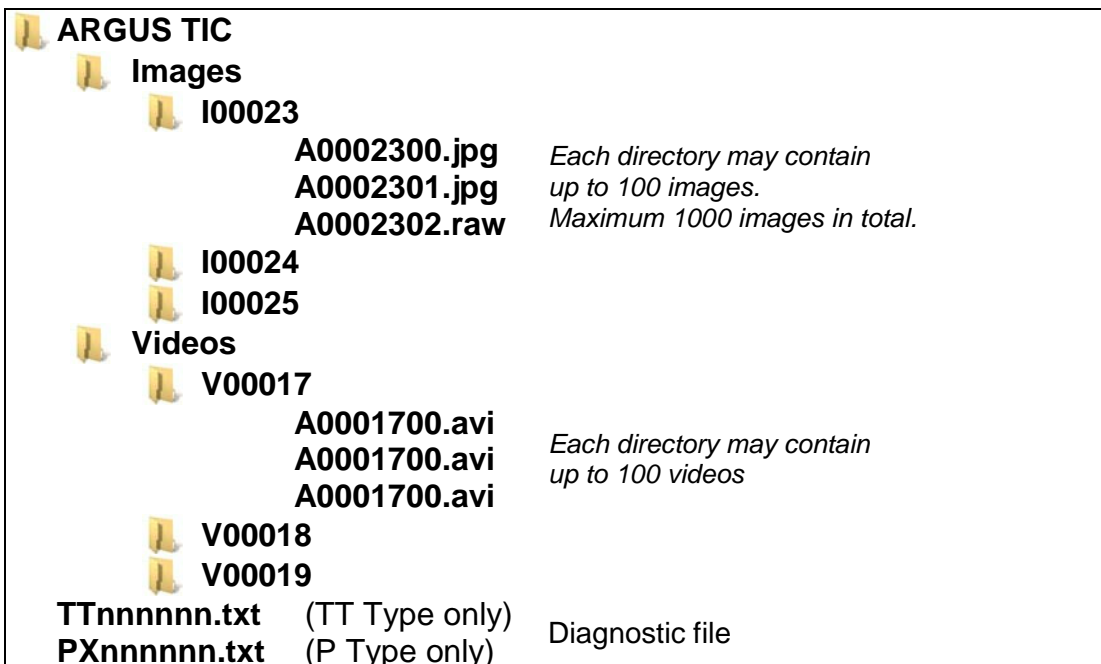
- Storing images (option)
- Storing videos (option)
- Storing camera diagnostic information
- Changing the start-up image
- Updating the camera software

How to Copy the Memory Card Contents to a Computer

There is no need to remove the memory card to transfer the contents to a computer. Follow the following instructions:

1. Turn the camera on.
2. Connect the camera to the computer using the USB lead.
3. The computer should recognise the memory card as a 'Mass Storage Device'. If an explorer window does not open automatically, select 'My Computer' to locate the memory card.
4. Files can be copied from this window to directories on the computer.
5. Close the window.
6. Remove the USB lead from the computer and camera.

The structure of the directories on the memory card is follows:



When large video files have to be copied, it will be quicker to remove the memory card and connect to the computer using a memory card reader.

How to Change the Camera Start-Up Image

A custom start-up image can be loaded into the camera as follows.

1. Generate an image file on the computer in the following format:

Name:	Splash.bmp
Size:	320x240 pixels
Format:	24 Bit Bitmap

2. Turn the camera on.
3. Connect the camera to the computer using the USB lead.
4. The computer should recognise the memory card as a 'Mass Storage Device' and open an explorer window.
5. Copy the image file from the computer to the top level 'ARGUS TIC' directory.
6. Close the window.
7. On Windows computers it is recommended to select 'Safely Remove Hardware' before disconnecting the camera.
8. Remove the USB lead from the computer and camera.
9. Turn the camera off and back on. The camera will read the new image file when it turns on.
10. Turn the camera off and back on again. This time the new image will appear at start-up.

Keep a copy of the image file on your computer. The camera will rename the image file on the memory card after it has been successfully loaded into the camera.

Diagnostic File

The diagnostic file can be found in the top level 'ARGUS TIC' directory on the memory card. The name of the file is:

TTnnnnnn.txt (TT Type) or **PXnnnnnn.txt** (P Type)

(nnnnnn is the camera serial number)

The diagnostic file contains information about the camera which may be useful to e2v in diagnosing any camera faults. e2v may ask you to copy this file from the memory card to a computer and send it by email to e2v for fault finding.

How to Replace a Memory Card

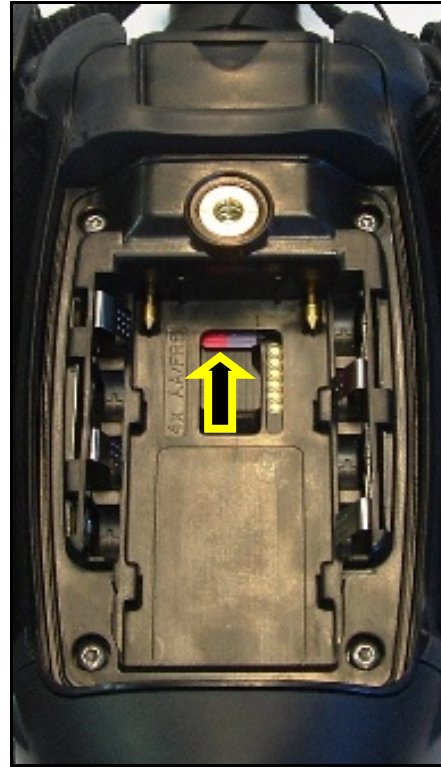
TT-Type

Remove the battery holder. The memory card can be found inside the camera, between the plastic case and the connector.



P-Type

Remove the battery cover and battery. The memory card can be found in a slot under the battery.



To replace a memory card it is necessary to push the card into the socket. It will then spring out.

The memory card can be replaced with a card compatible with MicroSD™ and MicroSDHC™ memory cards. See section 6.3 for information.

Whenever a memory card is inserted into the camera for the first time, or if you experience problems with a memory card, the card should be reformatted in the camera as follows:

Copy any data you want to keep from the memory card to a PC. Use a memory card reader, or use the camera USB link (see above).

Make sure the memory card is inserted correctly into the camera and the USB lead removed. Select 'Format Memory Card' on the camera menu:

MENU > SET-UP > MEMORY CARD > FORMAT MEMORY CARD

The camera will automatically generate the directory structure after reformatting.

MicroSD™ and MicroSDHC™ are trademarks of the SD Card Association.

3.13 Temperature Indication

The camera allows the operator to view the average temperature of the centre spot of the scene (defined by the target markings). The temperature reading is displayed in the bottom right-hand corner of the display. This system is intended to give the operator the ability to detect possible hazards, heat signatures of people or objects, and to compare temperatures.

The temperature measurement feature can be changed between Celsius (°C) and Fahrenheit (°F) or made invisible using the camera menu:

MENU > SET-UP > DISPLAY > TEMPERATURE

Notes:

- The camera can measure scene temperature between approximately 0 °C and +150 °C (32 °F and +300 °F)
- The object being measured must fully fill the target marks to get a good reading
- If the temperature is higher than the maximum, the display will show '+++'.
If the temperature is lower than the minimum, the display will show '---'.

Caution: Different types of materials have different infrared emission characteristics. This will affect the accuracy of the temperature reading.

A perfect 'black body' has an emissivity of 1.0 and will give the most accurate reading. Most materials have an emissivity less than 1.0. Very reflective materials have very low emissivities and the temperature reading is strongly affected by the temperature of the object in the reflection. Very cold objects have very little infrared emission and it is difficult to determine their exact temperature with any degree of accuracy. Therefore the temperature reading should be used as an indication only and not relied upon for personal safety.

Typical Emissivities of Some Materials

Matt black surface	1.00	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 10px;">Most accurate</div> <div style="margin-bottom: 10px;">↑</div> <div style="margin-bottom: 10px;">↓</div> <div style="margin-bottom: 10px;">Least accurate</div> </div>
Snow	0.96 – 1.00	
Skin	0.98	
Water	0.95 – 0.98	
Concrete	0.85 - 0.97	
Rubber	0.95 – 0.97	
Asphalt	0.90 – 0.96	
Glass	0.80 – 0.95	
Plastic	0.84 – 0.94	
Brick (red, rough)	0.93	
Paper	0.93	
Sand	0.90	
Cotton Cloth	0.77	
Aluminium foil	0.04 – 0.06	
Polished silver	0.02	

4 Batteries and Charging

The camera is supplied with a rechargeable lithium-ion battery. This must be fitted inside the camera and fully charged before first use.

A new and fully charged Li-ion battery will give about 5 hours of use. This time will be reduced when operating in very cold temperatures, continually using the torch-light (TT-Type only) or if continually recording video to the memory card (optional feature).

The capacity of rechargeable batteries declines with age. When this occurs it will be necessary to replace the rechargeable battery to achieve the normal operating time. Replacement batteries can be purchased from many electrical or photographic shops and websites. In case of difficulty, contact your e2v representative.

The camera has been tested and certified for use with the following rechargeable lithium-ion batteries:

- Duracell DR5
- ENIX FML9051

4.1 Battery Removal and Replacement

TT-Type

Hold the camera with the display facing down and rotate the battery locking ring one quarter turn anti-clockwise. Carefully pull the battery holder out from the camera. Press down on the battery clip to slide out the old battery.

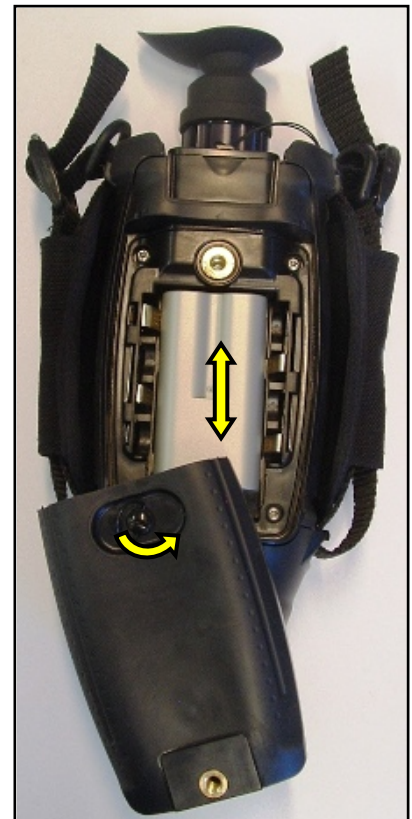
Slide in a new battery then carefully slide the battery holder back into the camera. Rotate the battery locking ring clockwise to the locked position.



P-Type

Turn the battery locking screw anti-clockwise by one quarter turn and pull to remove the battery compartment cover. Slide the battery away from the eye-piece to remove it.

Slide in a new battery and replace the battery cover. Turn the battery locking screw clockwise to lock the battery compartment



4.2 Charging the Battery Inside the Camera

Remove the connector cover. Plug in the mains power supply or vehicle adapter to the 12 V DC input. On the TT-Type there is a light next to the connector which will indicate the status of charging. On the P-Type there is a small light inside the viewfinder (above the image).

Off:	No power applied or no battery fitted
Yellow:	Charging
Green:	Battery fully charged
Red:	Battery too warm/cold for charging

A fully discharged battery will take about 4 hours to fully charge inside the camera. The camera can be operated normally while the battery is charging, but this will result in longer charging times.

4.3 Charging the Battery Outside the Camera

The battery can be removed from the camera to be charged. This allows the camera to be used with a spare battery while the first one is charging.

Remove the battery as described above.
Slide the battery onto the External Battery Charger and connect this to the mains power supply or vehicle adapter.

The 'STATUS' light is red when power is connected.
The 'CHARGING' light will indicate the status of charging:

Red:	Charging
Green:	Finished Charging

A fully discharged battery will take about 4 hours to fully charge using the External Battery Changer



4.4 Battery Life Indicator

The battery symbol gives an indication of the remaining battery capacity.

When the battery symbol turns red and shows one bar, there is less than one hour of capacity.

When there are no bars and the battery symbol is flashing the camera will soon automatically turn off.

If the camera is turned on and the external power supply is connected, the battery indicator will show a red flash symbol.



4.5 Using Lithium AA Cells (Non-Rechargeable)

TT-Type

An alternative battery holder is available which allows the camera to be powered using four non-rechargeable Lithium AA cells.

The Lithium AA battery holder is intended to be used as a spare battery pack and does not allow external power/charging, video output or USB connectivity.



P-Type

Four non-rechargeable Lithium AA cells can be fitted inside the battery compartment instead of the Li-ion rechargeable battery. Be careful to insert the AA cells in the correct direction as shown inside the battery compartment.

Do not connect the mains power adapter to the 12 V DC input when AA batteries are fitted. The camera will always take its energy from the lithium AA cells if they are fitted and internally disconnect the 12 V DC input. The charging light will not come on.



Lithium AA cells will give about 5 hours of normal use. The camera has been tested and certified for use with the following types of Lithium AA cells:

- Energizer Lithium AA/L91
- Duracell Lithium AA LF1500

The camera will not operate correctly with other types of AA cells such as alkaline, Ni-MH, zinc carbon or zinc chloride.

WARNING: Do not attempt to recharge Lithium AA cells. Do not fit Lithium AA cells incorrectly.

5 Changing the Lens (P-Type)

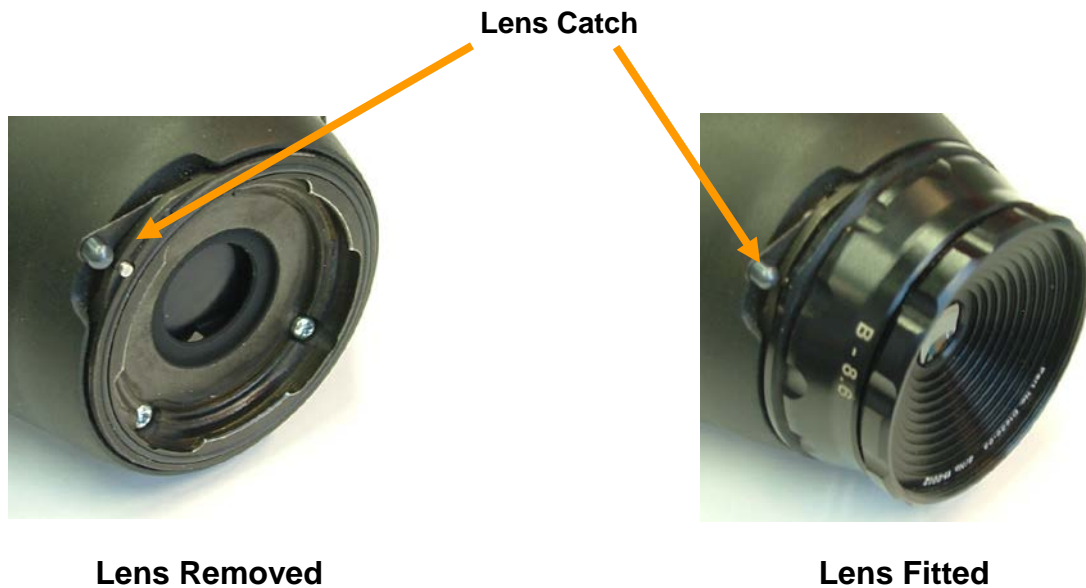
5.1 Fitting the Lens

For P-Type cameras the lens is ordered separately

- Remove the protective cover from the front of the camera
- Insert the lens into the front of the camera and rotate the lens clockwise until it clicks into position
- Set the lens type on the camera menu

5.2 Removing the Lens

Press and hold the lens catch shown below. At the same time, rotate the lens anti-clockwise.



5.3 Set Lens Type

Whenever the camera is used for the first time, or when the lens is changed to a different type, it is necessary to set the lens type on the camera menu. If this is not done, it will affect the image quality and the Direct Temperature Measurement may be incorrect.

MENU > SET-UP > LENS

5.4 Camera Care

- The camera is not IP65 rated (waterproof) when the lens is removed. Do not change the lens in wet, damp or marine environments, to prevent water getting inside the camera.
- When the lens is removed the camera sensor and calibration shutter are exposed. Do not touch these to prevent damaging them.
- The lens should only be cleaned with a soft cloth or warm water. Do not use tools, hard brushes or solvents.

6 Maintenance

6.1 Cleaning

The camera may be cleaned with a cloth soaked with warm, clean, soapy water. **Do not use solvents or abrasive cleaners.** When cleaning the camera, prevent ingress of water by ensuring that the following parts are fitted: battery compartment, connector cover, front lens (P-Type). In marine environments, do not allow build-up of salt on the camera.

6.2 Maintenance

No routine maintenance is required for the camera other than to ensure the battery cover on the P-Type is regularly lubricated with the silicone grease as supplied. If it is not in regular use, it should be switched on for a period of ten minutes every month to check correct operation.

6.3 Replacement Parts

The following items may be replaced by the user:

Item	Description
Batteries	Use only the following batteries:
	Duracell DR5 (Rechargeable)
	ENIX FML9051 (Rechargeable)
	Energizer Lithium AA/L91 (Primary)
	Duracell Lithium AA LF1500 (Primary)
USB Lead	USB cable with mini-USB connector (2 metres)
Video Lead	Video cable with phono connector (2 metres)
SDCard	4G MicroSD or MicroSDHC Memory Card (tested with Verbatim, Samsung and Transcend). Maximum supported size 32GB
Vehicle Charger Lead Fuse	250 V 1 A Fast Acting Fuse, UL Certified. 1.25 x 0.25 inch (32 x 6 mm). Do not use any other fuse type or rating.

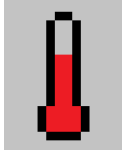
The following items are available as spares and accessories from e2v:

Part No.	TT	P	Description
ARG_TTP_BP	✓	✓	Lithium Ion Rechargeable Battery
ARG_TTAA	✓	X	AA Battery Holder for TT-Type Cameras
ARG_TT_BHC	✓	X	Black, hard carry case for TT-Type Cameras
ARG_P_BHC	X	✓	Black, hard carry case for P-Type Cameras
ARG_TTP_SC	✓	✓	Black, soft carry case
ARG_TTP_PSU	✓	✓	Power Pack containing mains power supply and worldwide adapters, battery charger with adapter plate, vehicle power cable
ARG_TTRC	✓	X	Rechargeable Battery Carrier for TT-Type Cameras
ARG_TTH	✓	X	Holster for TT-Type Cameras
ARG_TTP_IV	✓	✓	Image and Video Capture (Software token upgrade)
ARG_TTP_AM_F	✓	✓	Force Application Colour Modes
ARG_TTP_AM_M	✓	✓	Marine Application Colour Modes
ARG_TTP_AM_S	✓	✓	Sport Application Colour Modes
ARG_TTP_AM_SS	✓	✓	Specialist Application Colour Modes
ARG_PLENSB	X	✓	Lens B (8.6mmFL, 160:26 deg FOV, 320:50 deg FOV, D=230m)
ARG_PLENSC	X	✓	Lens C (18.6mmFL, 160:12 deg FOV, 320:24 deg FOV, D=500m)
ARG_PLENSD	X	✓	Lens D (35mmFL, 160:6.5 deg FOV, 320:13 deg FOV, D=1000m)
ARG_PLENSE	X	✓	Lens E (46mmFL, 160:5 deg FOV, 320:10 deg FOV, D=1250m)
ARG_PLENSF	X	✓	Lens F (65mmFL, 160:3.5 deg FOV, 320:7 deg FOV, D=1750m)

THERE ARE NO OTHER USER SERVICEABLE PARTS. If any damage beyond these parts occurs, return the camera to e2v technologies or an authorised repair centre. Any attempt at repair by unauthorised personnel may cause serious damage and will invalidate the warranty.

7 Fault Finding

7.1 Display Warnings



Over Temperature:

The internal temperature of the camera is above the correct operating range. The camera must be turned off to cool down and prevent permanent damage.



General Warning:

The control system has detected an internal camera fault. Turn the camera off for five minutes and turn back on again. If the warning symbol is still present, or the symptoms return, contact your e2v representative.

Failure to act upon these warnings may result in damage to the system and may invalidate the warranty.

7.2 Batteries and Power

Battery charging LED is RED on camera

Battery is too hot or cold to be charged safely. Allow battery to cool or warm to ambient temperature and try again.

Battery capacity is lower than when new

All rechargeable batteries lose capacity over time. When capacity becomes lower than required for the application, obtain a new battery.

Camera does not turn on

Battery may be discharged. Power the camera with an external supply (mains or vehicle) and charge the battery.

7.3 Image Problems

Image will not focus (P type)

Adjust both the eyepiece and the front lens to obtain focus

Image quality poor (P type)

Check lens type on menu is the same as the lens type fitted

7.4 Memory Card Problems

If problems are experienced in writing to or reading from the memory card:

- Reformat the memory card in the camera (not on a computer).
- Try removing the memory card (with the camera turned off), then replace the memory card in the socket.
- Try replacing the memory card with another good quality memory card.

8 Warranty Terms

8.1 Express Warranty

e2v technologies ("e2v") warrants that this product is free from mechanical defects or faulty workmanship for two (2) years from the date of shipment, with the exception that the warranty period for the rechargeable battery pack is one (1) year from that date, provided it is maintained and used in accordance with e2v's instructions and/or recommendations.

This warranty does not apply to expendable or consumable parts whose normal life expectancy is less than one (1) year. Replacement parts and repairs are warranted for ninety (90) days from the date of shipment.

e2v shall be released from all obligations under this warranty in the event that persons other than its own or authorised service personnel make repairs or modifications, or if the warranty claim results from misuse of the product. No agent, employee or representative of e2v may bind e2v to any affirmation, representation or modification of this warranty concerning the goods sold under this contract.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. e2v SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

8.2 Exclusive Remedy

It is expressly agreed that the Purchaser's sole and exclusive remedy for breach of the above warranty, for any tortious conduct of e2v, or for any other cause of action, shall be the repair and/or replacement, at e2v's option, of any equipment or parts thereof, that after examination by e2v are proven to be defective. Replacement equipment and/or parts will be provided at no cost to the purchaser, F.O.B. e2v's plant. Failure of e2v to successfully repair any non-conforming product shall not cause the remedy established hereby to fail of its essential purpose.

8.3 Exclusion of Consequential Damages

PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT UNDER NO CIRCUMSTANCES WILL e2v BE LIABLE TO PURCHASER FOR ECONOMIC, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES OF ANY KIND WHATSOEVER INCLUDING, BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS AND ANY OTHER LOSS CAUSED BY REASON OF THE NON-OPERATION OF THE GOODS. THIS EXCLUSION IS APPLICABLE TO CLAIMS FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST e2v.



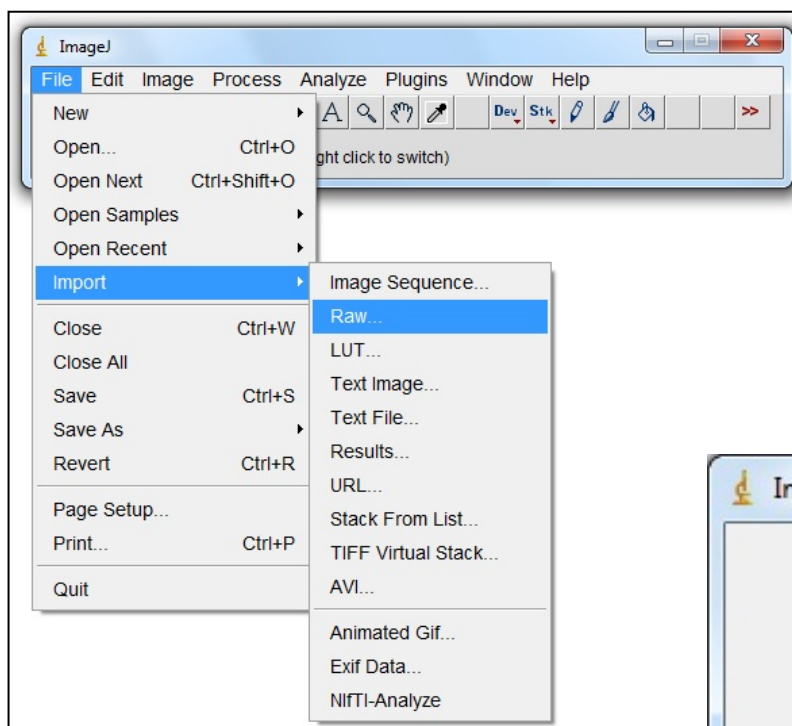
9 Appendices

9.1 Using Image .jpeg to View .raw Files

Images are normally stored on the memory card in compressed **.jpg** format. The format can be changed to **.raw** format to give uncompressed monochrome images with higher depth of greyscale for more detailed analysis. The **.raw** format is not supported by all computer image viewing programs. E2v suggests using 'ImageJ' available at <http://rsbweb.nih.gov/ij/> . To change the format, use the camera menu:

MENU > SET-UP > BUTTONS > IMAGE CAPTURE

.raw images can be imported into 'ImageJ' as follows:



1. Click on the menu:
File > Import > Raw

2. Select the .raw file from the correct directory.

3. Change the Import Settings as shown (right).

4. Click 'OK'

