

BENNING

Operating manual

Translation of the German original version



BENNING TC 20

5333 / 09/2024 en

Legal notice

Notes concerning the documentation

Ensure that the applicable documentation is used for this product. For safe handling, knowledge that is provided in these instructions is required.

The product may only be handled while following this documentation, particularly the safety instructions and warnings it contains. The personnel must be qualified for the respective task and have the capability to recognise risks and prevent possible dangers.

Manufacturer and holder of rights

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Disclaimer

The contents of the documentation has been checked to ensure that it corresponds to the hardware and software described. Nevertheless, deviations cannot be ruled out, so Benning cannot guarantee complete correspondence. The contents of this documentation are checked at regular intervals, and any corrections that are needed are contained in the versions that follow.

General non-discrimination

Benning is aware of the importance of language with regard to the gender equality and endeavors to take this into account at all times. To improve readability, we have refrained from consistently using differentiating formulations.

Table of contents

1	Introduction	7
1.1	General notes.....	7
1.2	History.....	8
1.3	Service & support.....	9
2	Safety	10
2.1	Warning system.....	10
2.2	Symbols used.....	11
2.3	Intended use.....	11
2.4	Special types of risks.....	12
2.5	Standards applied.....	13
3	Scope of delivery	14
4	Device structure	15
5	Functions	16
6	Getting started	17
6.1	Charging the battery.....	17
6.2	Switching the device ON/OFF.....	17
6.3	Setting the language.....	17
6.4	Auto power-off (APO).....	17
7	Settings	18
7.1	Albums.....	18
7.2	Emissivity.....	18
7.3	Distance.....	19
7.4	Display settings.....	19
7.5	Image settings.....	20
7.6	Enhanced IR.....	21
7.7	Palettes.....	21
7.8	Level & Span.....	22
7.9	Temperature alarm.....	22
7.10	Temperature range.....	22
7.11	Capture mode.....	23
7.12	More settings.....	23
8	Operation	24

8.1	Requirements for measuring.....	24
8.2	Temperature measurement.....	24
8.3	Transferring data to the PC.....	25
8.4	Casting the device screen to the PC.....	25
9	Maintenance.....	26
9.1	Maintenance schedule.....	26
9.2	Cleaning the device.....	26
9.3	Calibrating the device.....	26
9.4	Updating the firmware.....	27
10	Technical data.....	28
11	Disposal and environmental protection.....	30
	Index.....	31

Table of figures

Figure 1 BENNING TC 20 device structure	15
---	----

List of tables

Table 1	History.....	8
Table 2	Symbols on the device.....	11
Table 3	Symbols used in the operating manual.....	11
Table 4	Albums.....	18
Table 5	Material-specific emissivity	18
Table 6	Distance.....	19
Table 7	Display settings.....	19
Table 8	Image mode.....	20
Table 9	Parallax correction	20
Table 10	Colour distribution.....	20
Table 11	Enhanced IR.....	21
Table 12	Palettes.....	21
Table 13	Level and span	22
Table 14	More settings	23
Table 15	Maintenance schedule.....	26
Table 16	Technical data	28

1 Introduction

The BENNING TC 20 thermal imaging camera described here (in the following only referred to as “device”) is intended for making thermal images and optical images. The device determines the surface temperature of an object by measuring the IR radiation (infrared radiation) emitted by the object. The integrated infrared detector of the device determines the intensity of the IR radiation and makes it visible to the human eye as a thermal image.

The temperature measuring range of the device is between -20 °C and +550 °C (-4° F to 1022° F) with an accuracy of ± 2 % of the measured value or 2 °C at an ambient temperature of +25 °C and an object temperature above 0 °C.

Further information



<https://tms.benning.de/tc20>

On the Internet, you will find the following additional information directly at the specified link or at www.benning.de (product search):

- Operating manual of the device in several languages
- Further information depending on the device (e. g. brochures, technical reports, FAQs)

1.1 General notes

Target group

This operating manual is intended for the following groups of people:

- Professional users, craftspeople and do-it-yourselfers

Required basic knowledge

To understand these operating manual, you will need general knowledge of testing and measuring equipment. Moreover, you will need basic knowledge of the following issues:

- Thermography

Purpose of the operating manual

This operating manual describes the device and provides you information about how to handle it.

Keep this operating manual in a safe place for later use. Read this operating manual before handling the device and follow the instructions.

NOTE

Disclaimer of liability

Please make sure that any person using the device has read and understood the instructions of this operating manual before handling the device and that the instructions are adhered to in all points. Non-observance of this operating manual might result in product damage, property damage and/or personal injury.

Benning assumes no liability for damage and malfunctions resulting from the failure to observe the instructions in this operating manual.

The devices are subject to continuous further development. Benning reserves the right to make changes to the device's design, configuration and technology. The information in this operating manual corresponds to the state of technical knowledge at the time of printing. For this reason, no claims for certain device characteristics can be derived from the contents of this operating manual.

Information in this operating manual can be changed at any time without prior notice. Benning is not obligated to make amendments to this operating manual or to keep it up to date.

Direct any technical questions to Technical Support [▶ page 9].

Trademarks

All trademarks used are the property of their respective owners, even if they are not separately marked as such.

1.2 History

Release number	Amendments
09/2024	• Initial release

Table 1: History

1.3 Service & support

Please contact your specialty retailer or the BENNING Service Center for any repair or service work that might be required.

Technical Support

Please contact our Technical support for technical questions on handling the device.

Phone:	+49 2871 93-555
Fax:	+49 2871 93-6555
E-Mail:	helpdesk@benning.de
Internet:	www.benning.de

Returns management

Easily and conveniently use the BENNING returns portal for a quick and smooth returns processing:

<https://www.benning.de/service-de/retourenabwicklung.html>

Phone:	+49 2871 93-554
E-Mail:	returns@benning.de

Return address

BENNING Elektrotechnik und Elektronik GmbH & Co. KG
Retourenmanagement
Robert-Bosch-Str. 20
D - 46397 Bocholt

2 Safety

2.1 Warning system

This operating manual contains notes that must be taken into consideration for your personal safety and in order to avoid injuries and damage to property. Warnings about your personal safety and to prevent personal injuries are marked with a warning triangle. Warnings on sole prevention of material damage are shown without a warning triangle. The warnings are shown in descending order depending on the hazard level as follows.



DANGER

Extremely dangerous situation for humans

If you do not pay attention to this warning, irreversible or deadly injuries will occur.



WARNING

Hazard to humans

If you do not pay attention to this warning, irreversible or deadly injuries could occur.



CAUTION

Minor hazard to humans

If you do not pay attention to this warning, minor or moderate injuries could occur.



NOTICE

Danger to property, not to persons

If you do not pay attention to this warning, material damage could occur.

If multiple hazard levels occur, the warning for the highest respective hazard level will be used. In addition, a warning about personal injuries can also include a warning about material damage.

2.2 Symbols used

Symbols on the device






Symbol	Meaning
	Warning! Laser beam! Please observe the information provided in this operating manual in order to avoid dangers.
	The device complies with EU directives.
	The device complies with directives applicable in Great Britain.
	At the end of product life, dispose of the unserviceable device via appropriate collecting facilities provided in your community.
	Please observe the operating manual.

Table 2: Symbols on the device

Symbols used in the operating manual



Symbol	Meaning
	General warning
	Warning of laser beam!

Table 3: Symbols used in the operating manual

2.3 Intended use

Only use the device within the framework of the corresponding technical data. Any operating conditions that deviate from this shall be considered as improper use. Solely the user of the device shall be liable for any resulting damage.

Please note the following:

- In case of improper use, the liability and warranty claims become void. Solely the user of the device shall be liable for any damage resulting from improper use. Uses not complying with the intended use include e. g.:
 - Use of components, accessories, spare or replacement parts that have not been released and approved for the respective application by Benning
 - Non-observance, manipulation, changes or misuse of the operating manual or the instructions and notes contained therein
 - Any form of misuse of the device
 - Any use other than or beyond that described in this operating manual
- Warranty and liability claims are generally excluded if the damage is the result of force majeure.
- If any prescribed services are not performed regularly or not on time, according to the manufacturer's specifications during the warranty period, a decision about a warranty claim can only be made once the findings are available.

Direct any questions to Technical Support [[▶ page 9](#)].

Using the device

Please observe the following basic obligations when using the device:

- The device may only be used in a technically perfect and safe condition. Always check the device for damages before using it.
- The personnel must be qualified for the respective task.
- Observe relevant regulations on occupational safety and health as well as those on environmental protection.
- The device may only be used in dry environments.
- Do not use the device in potentially explosive environments.
- Do not use the device in extremely hot, cold, dusty, corrosive, salty, alkaline or humid environments.
- Do not use the device in the vicinity of high levels of electromagnetic radiation.
- Avoid violent impacts or dropping the device.

Securing the device

If the device is not in a technically perfect and operationally safe condition, safe operation is no longer guaranteed. Make sure that the following measures are taken:

- Switch off the device.

The following characteristics indicate that safe operation is no longer guaranteed:

- The device shows visible damage.
- The device does not work properly in compliance with regulations (e. g. errors during measurements).
- The device shows recognisable consequences of prolonged storage under inadmissible conditions.
- The device shows recognisable consequences of extraordinary stress due to transport.

2.4 Special types of risks



WARNING

Laser beam

Eye damage or risk of accident due to glare are possible in case of eye contact with the laser beam.

- Never look directly into a laser beam or its reflections!
- If the laser beam hits your eye, close your eyes and immediately turn your face away from the laser beam. Normally, eyes close automatically due to the blink reflex and aversion responses take place.
- Do not point the laser beam at persons or animals.
- Do not leave the unit switched on unnecessarily.

2.5 Standards applied

The device has been built and tested in compliance with the following standards and has left the factory in perfectly safe condition.

- IEC / DIN EN 55032 (VDE 0878-32)
- IEC / DIN EN 60825-1
- IEC / DIN EN 61010-1 (VDE 0411-1)
- IEC / DIN EN 61010-3-2 (VDE 0838-2)
- IEC / DIN EN 61010-3-3 (VDE 0838-3)

3 Scope of delivery

The scope of delivery of the device includes the following components:

- 1 x BENNING TC 20 thermal imaging camera (item no.: 050520)
- 1 x USB-C connecting cable
- 1 x quick reference guide

Optional accessories

- Stand-by case, size S, 220 x 110 x 50 mm, with belt loop (item no.: 010912)
- Stand-by case, size M, 240 x 180 x 70 mm (item no.: 010913)
- Power supply unit incl. USB-C connecting cable (item: 10237620)

4 Device structure



Figure 1: BENNING TC 20 device structure

1	USB-C port	Interface for charging the storage battery [▶ page 17] and for transmitting data [▶ page 25] and firmware [▶ page 26].
2	State of charge of the rechargeable battery [▶ page 17] and time	
3	Colour scale [▶ page 22] from min. to max. measured temperature value	
4	Emissivity [▶ page 18] and distance of the object [▶ page 19]	
5	“Back” navigation key	Press the key to exit a menu item or setting.
6	Lenses	Laser beam outlet Optical lens Thermal lens
7	Shutter button	
8	Tripod thread and attachment point for the wrist strap	
9	“Up” and “Down” navigation keys	In the menu: Press the key to navigate the menu or the setting values. In the live view: Press a navigation key to select a different palette [▶ page 21].
10	“On/Off & Menu” key	Press the key for approx. 3 seconds to switch the device ON or OFF. In the live view: Press the key to open the menu. In the menu: Press the key to select or enable a setting. In an album / image: Press the key to delete an image.
11	Enhanced IR [▶ page 21]	
12	Temperature measuring points and temperature unit [▶ page 19]	

5 Functions

Album file management

The device has an integrated flash memory with 4 GB storage capacity for storing thermal images and videos. Depending on the camera settings, the storage capacity is sufficient for a maximum of 30,000 images.

The captured images are saved in “Albums” [▶ page 18] and stored in chronological order. Depending on the set device time/date, the most recent file in each album is displayed first.

You can delete files by opening the image file, pressing the “On/Off & Menu” key again and confirming the delete process.

Self-calibration

The device carries out a self-calibration at regular intervals to optimise image quality and measuring accuracy. Self-calibration occurs more frequently during the start-up process or in very cold or hot environments and is indicated by the prompt “Image calibrating ...” on the screen.

For further functions and how to use them, refer to “Settings” [▶ page 18].

6 Getting started

6.1 Charging the battery

Charge the integrated lithium-ion battery completely before using the device for the first time. Use the USB-C cable included in the scope of delivery for charging.

Make sure that there is no flammable material within 2 metres of the charger during the charging process.

The state of charge of the rechargeable battery is shown on the display via a battery symbol with segments. Charge the device at the latest when all segments of the battery symbol have disappeared and the battery symbol lights up red.

The charging time is about 3 hours.

6.2 Switching the device ON/OFF

To switch the device on or off, press the “ON/OFF & Menu” key for approx. 3 seconds.

6.3 Setting the language

You can set the language [▶ page 23]. To do this, open the menu under “Settings” > “More Settings” > “Language”.

6.4 Auto power-off (APO)

In the factory settings, the automatic power-off is disabled (“OFF”).

You can set a time-dependent, automatic power-off for the device [▶ page 23]. If you do not use the device during the set switch-off time (10 to 60 minutes), the device switches off automatically.

7 Settings

7.1 Albums

Menu

“Settings” > “Albums”

Settings	Meaning and operation
Albums	Albums are added automatically each month.

Table 4: Albums

7.2 Emissivity

Make the following measurement settings to achieve the best possible measuring result.

Menu

“Settings” > “Emissivity”

The emissivity describes the ability of a body to emit electromagnetic radiation (heat radiation) compared to an ideal thermal radiator – a so-called black body. Thus, the value is always between 0 and 1.

The emissivity depends on the material (material-specific) and must be adjusted for correct measuring results.

Non-metals generally have a high emissivity (> 0.9) and provide good temperature measuring results.

The suitability of shiny surfaces, bare metals and metal oxides for infrared measurement is only limited, as they have a low emissivity and thus emit only a low level of heat radiation. Even if the emissivity is set correctly for these materials, a lower measuring accuracy must be assumed.

The device provides the following material-specific emissivities:

Material	Emissivity
PCB (printed circuit board)	0.91
Cement concrete	0.95
Ceramics	0.92
Rubber	0.95
Paint	0.93
Wood	0.85
Asphalt	0.96
Brick	0.95
Sand	0.90
Soil	0.92
Cotton	0.98
Cardboard	0.90

Table 5: Material-specific emissivity

7.3 Distance

Make the following measurement settings to achieve the best possible measuring result.

Menu

“Settings” > “Distance”

Settings	Meaning and operation
Distance	Distance to the measuring object

Table 6: Distance

7.4 Display settings

Menu

“Settings” > “Display Settings”

You can make the following settings and you can show and hide parameters in the live view:

Settings	Meaning and operation
Hot (Max. / red)	Show and hide temperature measuring points.
Cold (Min. / blue)	
Center (Cen. / white)	
Parameters	Show and hide the emissivity and distance.
Brand logo	Show and hide the logo.
Unit	Select a unit [°C, °F, K].
Time and Date	<ul style="list-style-type: none"> • Enable “12-hour”. • Set the time. • Date

Table 7: Display settings

7.5 Image settings

Image mode

Menu

“Settings” > “Image Settings” > “Image Mode”

Setting	Meaning and operation
Thermal	Only the thermal image is displayed in the live view.
Fusion	A combination of the thermal and visual images is displayed in the live view. If you have selected the "Fusion" image mode, enter the distance from the object under “Settings” > “Image Settings” > “Parallax Correction”.
Visual	Only the visual image is displayed in the live view.

Table 8: Image mode

Parallax correction

Menu

“Settings” > “Image Settings” > “Parallax Correction”

Setting	Meaning and operation
Parallax correction	If you have selected the “Fusion” image mode, select the distance from the object as well. It is necessary to specify the distance [m] to the target object in order to obtain a better overlap of the thermal and visual images and to minimise parallax errors.

Table 9: Parallax correction

Colour distribution

Menu

“Settings” > “Image Settings” > “Image mode” > “Color Distribution”

Settings	Meaning and operation
Histogram	You can use this setting if you have image files with a large temperature range.
Linear	You can use this setting if you have image files with a small temperature range.

Table 10: Colour distribution

7.6 Enhanced IR

Menu

“Settings” > “Enhanced IR”

Settings	Meaning and operation
Enhanced IR	Enhanced thermal resolution The high frame rate of 25 Hz enables the thermal resolution (infrared resolution) to be scaled up by a factor of six. This increases the image quality and contour sharpness.

Table 11: Enhanced IR

7.7 Palettes

Menu

“Settings” > “Palettes”

Setting	Meaning
White Hot	The hot area is displayed bright.
Black Hot	The hot area is displayed dark.
Rainbow	The hot area is displayed in several colours. This view is suitable for objects without significant temperature differences.
Ironbow	The hot area is displayed like red-hot iron.
Red Hot	The hot area is displayed in red.
Fusion	The hot area is displayed in yellow.
Above Alarm	The range above the adjustable temperature value is displayed in red.
Temperature	Temperature value for the excess temperature alarm (“Above Alarm”).

Table 12: Palettes

7.8 Level & Span

Menu

“Settings” > “Level & Span”

You can specify the temperature range. The level defines the temperature level and the span defines the temperatures within the displayed temperature range. These are applied to the selected colour palette in the view.

Setting	Meaning and operation
Auto	The device sets the displayed temperature range automatically.
Manual	You can set the displayed temperature range manually via “Parameters”. Procedure: You can select the upper and lower threshold value using the “On/Off & Menu” key. If the lock symbol is open and the value is highlighted in blue, you can set this value using the arrow button. Press the “On/Off & Menu” key to save the threshold value. The lock symbol is now closed.

Table 13: Level and span

7.9 Temperature alarm

Menu

“Settings” > “Temperature Alarm”

The device provides a “Temperature Alarm” function. You can specify a temperature threshold. If the threshold value is exceeded or not reached, the measured value “Max” will be displayed in red or the measured value “Min” in blue.

7.10 Temperature range

Menu

“Settings” > “Temperature Range”

To improve measurement quality, the device offers two temperature measuring ranges:

- -20 ... 150 °C
- 100 ... 550 °C

You can select one of the two measuring ranges or the “Auto Switch” mode. In the “Auto Switch” mode, the device automatically recognises the appropriate temperature range.

7.11 Capture mode

Menu

“Settings” > “Capture Mode”

The device provides two different capture modes:

- Capture One Image
When the shutter button is pressed, the device captures a single image.
- Scheduled Capture
When the shutter button is pressed, the device continuously captures images depending on a time interval. The time interval and the number of images can be set. You can also select whether the visual image shall also be saved. During capturing, a counter shows the number of images captured. The time interval is also displayed and counts down until the shutter is released.

7.12 More settings

Menu

“Settings” > “More Settings”

Setting	Meaning and operation
Laser	Enable/disable the laser for targeting the object.
Auto Power-off	Enable/disable the automatic switch-off and select the time (10/20/30/40/50/60 minutes) for it.
Auto Sleep	Enable/disable the sleep mode and select the time (10/20/30/40/50/60 minutes) for it. Wake up by pressing any key.
Device Information	Device data <ul style="list-style-type: none"> • Model • Firmware • Serial number • Memory
Save Logs	Enable/disable the storage of error logs in the internal memory.
Format Storage	You can format the memory. The device formats the internal memory and deletes all existing data.
Restore Device	Reset to factory settings.
Language	Select the language.

Table 14: More settings

8 Operation

8.1 Requirements for measuring

- Please consider the brightness of the surrounding light conditions:
 - The ambient light must not be too bright.
 - Avoid measuring in direct sunlight.
- The device battery is fully charged.
- Please consider sources of interference that might be present. Strong sources of interference in the vicinity of the device might involve unstable readings and measuring errors.

8.2 Temperature measurement

Requirements

- Please observe the requirements for measuring.
- You have configured the camera live view.
- You have made the required device settings.
- The device is not connected to the PC.

Procedure – Capturing a thermal image

In the camera live view, focus on the object to be checked and press the shutter button. Depending on the selected capture mode [▶ page 23], one or more thermal images are captured.

If you have selected the scheduled capture mode, press the shutter button again to stop capturing.

The images created will be saved to the current album [▶ page 18].

8.3 Transferring data to the PC

The image files stored on the device can be transferred to a PC.

Requirements

- PC with USB-A port and sufficient storage space
- USB-A to USB-C connecting cable

Procedure

1. Switch on the device.
2. Connect the device to your PC using the USB-A to USB-C connecting cable.
3. On the display, you are prompted to select the respective USB mode. Select the “USB Drive” mode.

When connecting for the first time, a driver is installed automatically.

The device can be recognised as a USB drive e. g. via Windows® Explorer.

4. Copy the files to your PC.
5. Disconnect the device from your PC.

8.4 Casting the device screen to the PC

You can use an external software application based on the UVC protocol to cast the device screen live to your PC screen.

Requirements

- PC with USB-A port and sufficient storage space
- USB-A to USB-C connecting cable

Procedure

1. Switch on the device.
2. Connect the device to your PC using the USB-A to USB-C connecting cable.
3. On the display, you are prompted to select the respective USB mode. Select the “USB Cast Screen” mode.

4. Open the external software application and make the required settings.

The device screen is now displayed on the PC.

9 Maintenance

There are no components in the device that you can replace.

9.1 Maintenance schedule

The following table provides an overview of all maintenance and servicing work that you must carry out permanently or at regular intervals.

Interval	Measures
Regularly, as needed	<ul style="list-style-type: none"> • Cleaning the device
As needed / every 6 months	<ul style="list-style-type: none"> • Charging the battery
Every 12 months	<ul style="list-style-type: none"> • Calibrating the device [▶ page 26]

Table 15: Maintenance schedule

9.2 Cleaning the device

Clean the device regularly and as the need arises.

Requirements

- A clean and dry cloth or special cleaning cloth



NOTICE

Wrong cleaning agents

Using the wrong cleaning agents can damage the device.

- Do not use any solvents, abrasives or polishing agents.

Procedure

Clean the exterior of the device with a clean and dry cloth or a special cleaning cloth.

9.3 Calibrating the device

Benning guarantees compliance with this technical and accuracy specifications stated in this operating manual for the first 12 months after the delivery date.

To maintain accuracy of the measuring results, make sure that the device is recalibrated in annual intervals by the BENNING Service [▶ page 9].

As part of a calibration, the device is provided with the latest firmware update and thus always remains up to date.

<http://calibration.benning.de>



9.4 Updating the firmware

Requirements

- PC with USB-A port and sufficient storage space
- USB-A to USB-C connecting cable

Procedure

1. Download the device firmware from the product page of the device at <http://tms.benning.de/tc20>.
2. Switch off the device.
3. Connect the device to your PC using the USB-A to USB-C connecting cable.
The device can be recognised as a USB drive e. g. via Windows® Explorer.
4. Copy the device firmware as an unzipped file from your PC to the top level of the recognised USB drive.
5. Disconnect the device from your PC.
6. Switch on the device.
The message "Firmware updating ... %" is displayed. The device software is updated. Once the update is complete, the device restarts. The current version of the device firmware can be found under "Device Information".

10 Technical data

Contamination level	2
Protection category (DIN VDE 0470-1, IEC / EN 60529)	IP 54 1st digit: 5 = complete protection against accidental contact and protection against dust in harmful quantity 2nd digit: 4 = protection against splashing water from any direction
Housing dimensions (length x width x height)	196 mm x 117 mm x 59 mm
Drop test height	2 m
Weight	290 g
Electromagnetic compatibility (EMC)	EN 55032, EN 55035
Laser type	Laser class 2, EN 60825-1
Temperature measurement	
Measuring range	-20 °C ... 550 °C (-4 °F ... 1022 °F)
Measuring accuracy	Max. ± 2 °C (3.6 °F) or ± 2 % of the measured value at an ambient temperature of 25 °C (77 °F) and an object temperature above 0 °C (32 °F). *valid after a switch-on time of >30 minutes, infrared calibration with measuring spot size of 65 mm, measuring distance of 0.6 m.
AUTO measurement	<ul style="list-style-type: none"> • Maximum temperature (hot spot) • Minimum temperature (cold spot) • Medium temperature (center spot)
Thermal image	
Infrared resolution	96 x 96 (9,216 pixels)
NETD value (sensor sensitivity)	<50 mK (at 25 °C, F#=1.0)
Enhanced IR	240 x 240 (57,600 pixels)
Frame rate	25 Hz
Spectral range	7.5 ... 14 μ m
Focal length	1.35 mm
Field of view (FOV)	50° x 50°
IFOV value	8.89 mrad
Focusing system / focusing distance	Fixed focus / min. 0.1 m
Visual image	
Image resolution	0.3 MP (640 x 480 pixels)
Distance to Spot ratio (D:S)	112:1
Display	2.4" (6.0 cm) colour LC display (240 x 320 pixels)
Image mode	Thermal, Fusion, Visual
Colour palettes	Black Hot, White Hot, Ironbow, Rainbow, Fusion, Red Hot, Above Alarm
Data storage and interface	
Storage type	Integrated flash memory 4 GB
Capacity	approx. 30.000 images
File format	Radiometric JPEG (images)

Interface	USB-C
Power supply	
Battery type	Rechargeable lithium-ion battery 3.64 V, 3.36 Ah
Operating duration	Max. 8 h (typical)
Charging time	3 h
Energy saving function / Auto Sleep mode	Automatic power-off after 10, 20, 30, 40 minutes or never
Operating conditions	
Operating temperature	-10 ... 50 °C (do not permanently expose the device to sunlight)
Max. relative air humidity	95 % (non-condensing)
Operating conditions	To be used inside or outside buildings, both in dry environments
Storage	
Ambient temperature	-40 ... 70 °C (do not permanently expose the device to sunlight)
Max. relative air humidity	95 % (non-condensing)
Tripod thread	1/4 inch

Table 16: Technical data

11 Disposal and environmental protection



At the end of product life, dispose of the unserviceable device via appropriate collecting facilities provided in your community.

Index

A

Album file management	16
File management	16
Automatic power-off	
ATO time	17

B

Basic knowledge	7
-----------------	---

C

Calibrating	26
Capture modes	23
Capture One Image	23
Capturing a thermal image	24
Cleaning	26
Copyright	2

D

delete	16
Device	
Calibrating	26
Cleaning	26
Securing	12
Disclaimer	2, 11
Disposal	30
Documentation	2

E

Emissivity	18
Environmental protection	30

F

Further information	7
---------------------	---

H

History	8
Holder of rights	2

I

Intended use	11
--------------	----

M

Maintenance	26
Maintenance schedule	26
Manufacturer	2
Measurement	

Requirements	24
--------------	----

N

Navigate the menu	15
Non-discrimination	2

O

ON or OFF	15
Open the menu	15

P

Purpose of the operating manual	7
---------------------------------	---

R

Return address	9
Returns management	9

S

Scheduled Capture	23
Scope of delivery	14
Securing	12
Self-calibration	16
Service & Support	
Technical Support	9
Standards applied	13
Switch off	17
Switch on	17
Symbols	
Device	11
Operating manual	11

T

Target group	7
Technical data	28
Technical Support	9
Temperature range	
Auto switch	22
Temperature Alarm	22
Trademarks	8

W

Warning system	10
Warranty	11

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