



DENSIT-RT6

Hand-probe Densitometer

battery powered

User Manual

ENGLISH



METRITEC GmbH | Keeleng 13 | D-24975 Husby | GERMANY
Telefon +49 (0)4634-931570 | Fax +49 (0)4634-931571
service@metritec.de | www.metritec.de

Content

1. Measurement of the optical density.....	3
2. General description.....	4
3. Starting up: Inserting the batteries	6
4. Measuring mode.....	7
4.1. Switching ON.....	7
4.2. ZERO adjustment	8
4.3. Measuring procedure.....	9
4.4. HOLD function.....	10
4.5. Switch OFF.....	10
4.6. Setting the backlight	11
5. Calibration	12
5.1. One-factor calibration procedure.....	15
5.2. Two-factor calibration procedure.....	18
6. Battery indicator.....	21
7. Technical data	22

1. Measurement of the optical density

With radiographic testing, defects in technical equipment or components can be detected on the basis of differences in density of the developed X-ray films. For quality assurance of the film evaluation, the degree of blackening is determined as optical density. Optical density is measured using the transmitted light method according to ISO 5-2 and ISO 5-3.

Optical density is defined by the decimal logarithm of the ratio of the luminance in front of the film to the transmitted luminance behind the film:

$$D = \lg \frac{L_0}{L_F}$$

D = diffuse optical density

L_0 = luminance in cd/m^2 "in front" of the film (without X-ray film)

L_F = luminance in cd/m^2 "behind" the film (with X-ray film)

In practice, this formula means that at a measured density value of $D = 1$, one tenth (10%) of the occurring light intensity is transmitted through the film, and a density value of $D = 2$ means that one hundredth (1%) is let passed. An optical density value of $D = 3$ means that the film density lets through one thousandth (0.1%) of the light intensity.

2. General description

The DENSIT-RT6 handheld probe densitometer is a precise and reliable instrument for measuring the density of technical X-ray films. It is used for the standard-compliant evaluation of radiographic images. The portable densitometer is to be used together with a film viewer. The measured value for the film density is the diffuse optical density D in the measuring range 0 to 5.

The DENSIT-RT6 consists of a handy measuring instrument and a hand-held probe connected by a 1 m flexible cable.

Further features:

- sensor aperture 3 mm in diameter
- user-friendly keypad with 5 keys for on/off, measuring and calibrating function
- clear LCD digital display with 3-level backlighting
- powered by standard batteries (type AA)
- robust IP65-housing of plastic provided with a removable shock protection
- CE conformity marking

Handling: Avoid extreme cable buckling to prevent wire breakages. The probe cable is a high-quality, flexible data cable. Its design and properties are used as supply and data line. Its design and properties are primarily intended to ensure functionality and comfort in using.

Keypad:

LIGHT

switching cyclically
between 3 levels
of backlighting

(p. 11)

HOLD

Measuring mode:
the last measured
value D is displayed
and frozen

(p. 10)

Calibrating mode:
confirm / save input /
quit

(p. 17, 19f)



UP

function key for
calibrating

(p. 15ff)

DOWN

function key for
calibrating

(p. 15ff)

ZERO

ON-/OFF switch

(p. 7 / 10)

ZERO setting button

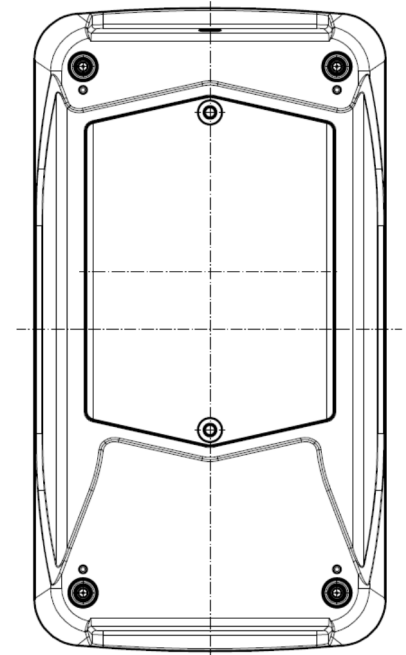
(p. 8)

3. Starting up: Inserting the batteries

The DENSIT-RT6 is powered by 4 standard batteries 1.5 Volt type AA. The required batteries are included in the delivery. For reasons of transport safety, they are delivered in a separate box.

The battery compartment is located on the bottom of the device. To insert the battery, **first remove the blue shock protection** from the housing. Then loosen the 2 screws of the battery cover.


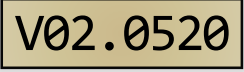

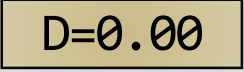
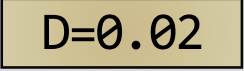
Insert the four batteries, making sure the polarity is correct. Close the cover again and put on the shock protection. The densitometer is now ready for operation.



When removing and reattaching the blue shock protection, make sure that the probe and the probe cable are not damaged.



4. Measuring mode

4.1. Switching ON

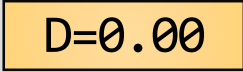

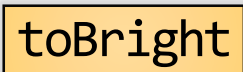
Button	Operation	Display	Commentary
	press "ZERO" button ↓		program starts: software version appears
	wait for short ↓		"METRITEC" appears briefly
	↓		automatic zero setting (after power-on)
			the present <i>D</i> value is displayed

4.2. ZERO adjustment

The diffuse optical density measurement is a relative measurement of the luminance with and without film density. The **reference value** for the optical density of the radiographic image is the luminous surface luminance **without X-ray film**. This reference value is to be set to zero before each measurement.


	press "ZERO" button ↓		zero setting: "ZERO" appears briefly
---	--------------------------	--	---

Possible displays:

display okay		zero value has been set: ready for measurement, see 3.4
automatic error display		luminance too low for measurement
automatic error display		luminance too bright for measurement

4.3. Measuring procedure

- (a) Start with the zero adjustment. Hold the probe exactly vertical to the film viewer's internally illuminated **diffusion plate**, as exactly as possible at the point where the X-ray film is to be evaluated.

 ZERO	press "ZERO" button ↓	ZERO	zero setting: "ZERO" appears briefly
		D=0.00	zero value has been set


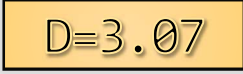

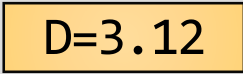
- (b) Place the **X-ray film** on the diffusion plate and hold the probe vertically on the spot where you want to measure the film density.

read off value	D=4.38	the actual <i>D</i> value
----------------	---------------	---------------------------



- (c) The displayed measured value corresponds to the film density.

4.4. HOLD function

This function can be used to hold a current measured value. The density value is held flashing in the display.

	press "HOLD" button		the last measured D value is maintained; flashing display
	press again		return to measuring

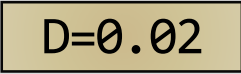

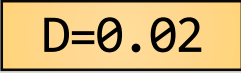


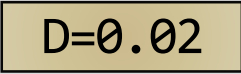
4.5. Switch OFF

	keep "ZERO" pressed for 3 seconds		device switches off
---	-----------------------------------	--	---------------------

There should be a pause of about 5 seconds between switching the device off and on again.

4.6. Setting the backlight

The digital display of DENSIT-RT6 has an orange backlight, which makes the operator's work more comfortable. Three levels are available. By pressing the "LIGHT" key, the desired brightness level can be set.

basic setting	after switch-on		backlight level 1: minimum brightness
 LIGHT	press "LIGHT" button		backlight level 2: medium brightness
 LIGHT	press once again		backlight level 3: maximum brightness
automatic downshift	after 10 min.		return to basic setting

Note: The illumination level affects the power consumption of the device. For this reason, an automatic switch-off function has been set up. If no key is pressed for 10 minutes, the lighting switches off to save power.

5. Calibration

The calibration of DENSIT-RT6 is done conscientiously by us as the manufacturer on a registered BAM-tested reference density strip and should only be carried out by authorised specialists on an annual basis. To avoid measurement errors, the quality of the film viewer and the reference density strip should be ensured.

The DENSIT-RT6 is adjusted using two calibration factors A and B. This ensures a particularly high accuracy over the entire measuring range..

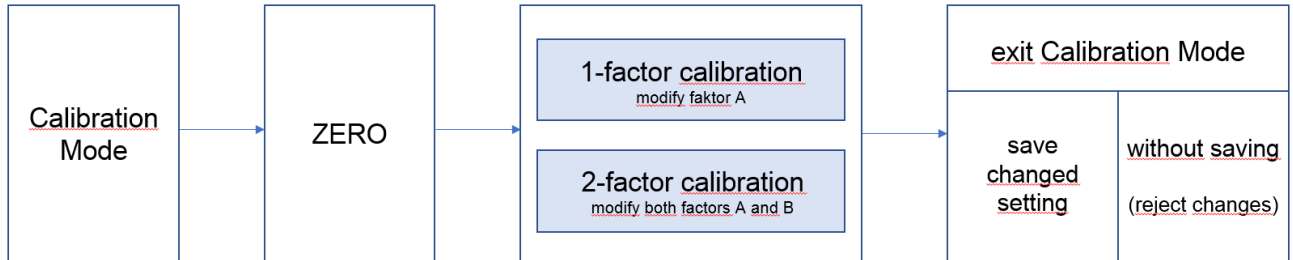
Density: $D = f(D, \Delta D)$

Calibrating equation: $\Delta D = A \cdot f(D) + B$

If unwanted deviations ΔD from the reference values are found due to the existing measurement conditions, a re-calibration must be carried out. Check carefully whether this is necessary.

In many cases, setting factor A is sufficient for precise calibration. In other cases it might be necessary to calibrate with factor B additionally.

Calibration procedure overview:






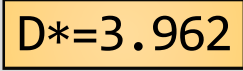
Specials in Calibration Mode:

- The asterisk "D*" indicates the Calibration Mode.
- 3 decimal places are available for the calibration function.
- The measuring procedure is unchanged and is started with the zero adjustment.
- If calibration factor **A** is being changed, the display is indicating e.g. **DA=3.982**.
- If calibration factor **B** is being changed, the display is indicating e.g. **DB=0.883**.



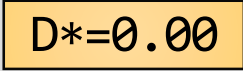
5.1. One-factor calibration procedure

For an overview of the digital calibration procedure, see above pages 13 and 14.
The following is a step-by-step guide to one-factor calibration.



1) Enter Calibration Mode

 UP	+	 DOWN	keep both arrow keys pressed for 3 seconds		starting Calibration Mode
wait for short					the present <i>D</i> value

2) Zero adjustment

 ZERO	press "ZERO" button ↓		zero setting in CaliMode: *ZERO* appears briefly
			zero value has been set






- 3) Set calibration factor A: Place the reference density strip (BAM) and measure a **darker reference value**; for example $D = 4.07$

	<p>read of actual value</p> <p>$D^*=4.014$ present deviation ΔD from setpoint</p>
<p> or </p> <p>press or tap <i>one of the arrow keys</i></p> <p>release</p>	<p>$DA=4.071$ set factor A</p> <p>$D^*=4.073$ adjusted actual value</p>








- 4) To check the setting, measure the remaining reference values.
(if necessary continue on page 18)
- 5) There are two ways to end the calibration:
- with Save = adopt new settings
 - without saving = reject the changes and cancel calibration

After exiting, the densitometer returns to normal measuring mode.

a) Quit CaliMode with saving

 HOLD	press "HOLD" button		"CaliSave" appears briefly
	automatic query		Save Yes / No? Cursor flashes "Y"
 HOLD	press "HOLD" to confirm		new setting for factor A has been saved, quit CaliMode




b) Exit CaliMode without saving

 HOLD	press "HOLD" button		"CaliSave" appears briefly
	automatic query		Save Yes / No? Cursor flashes "Y"
 UP	move cursor with "UP" key		Save Yes / No? Cursor flashes "N"
 HOLD	press "HOLD" to confirm		cancel, new setting for A <u>not</u> accepted, exit CaliMode

5.2. Two-factor calibration procedure

For two-factor calibration, also start by adjusting calibration factor A. Start by following the step-by-step guide from page 15 to point 4).

- 5) To then set calibration factor B, select **a brighter reference value** on the reference density strip; for example $D = 0.88$.






	read of actual value	$D^* = 0.923$	present deviation ΔD from setpoint
 LIGHT +  UP or  DOWN	hold down "LIGHT" while press or tap <i>one of the arrow keys</i>	$DB = 0.880$	set factor B
	release	$D^* = 0.881$	adjusted actual value

Note: Keep to the sequence described above, first correct factor A before changing factor B!









6) Now factor A must be recalibrated in any case (!). Repeat the steps from point 3 until the nominal/actual value tolerance is maintained over the entire measuring range (see figure "2-factor calibration", p.14 below).

7) End the two-factor calibration with or without saving:

a) quit CaliMode with saving

 HOLD	press "HOLD" button		"CaliSave" appears briefly
	automatic query		Save Yes / No? Cursor flashes "Y"
 HOLD	press "HOLD" to confirm		new settings for A and B have been saved, quit CaliMode

b) exit CaliMode without saving



	<p>press "HOLD" button</p> <p>automatic query</p>		<p>"CaliSave" appears briefly</p>
	<p>move cursor with "UP" key</p>		<p>Save Yes / No? Cursor flashes "Y"</p>
	<p>press "HOLD" to confirm</p>		<p>Save Yes / No? Cursor flashes "N"</p>
	<p>press "HOLD" to confirm</p>		<p>cancel, new settings for A and B <u>not</u> accepted, exit CaliMode</p>

When the process is finished, the instrument returns to normal measuring mode.

6. Battery indicator

When the DENSIT-RT6 is switched on, the battery status is continuously monitored. A battery warning is only given if the supply voltage is outside the operating limits.

Possible displays:

automatic display		"LOW BATT" = batteries too low
automatic display		"HI. BATT" = wrong batteries

The battery warning is displayed for 5 seconds, then the device switches off automatically.

- Replace the batteries.
- Follow the instructions "Inserting the batteries" on page 6.

7. Technical data

Measuring range "diffuse optical density D ":	0 - 5.0
Measuring accuracy:	$\Delta D = \pm 0.01$ for $D \leq 4.8$ $\Delta D = \pm 0.03$ for $D > 4.8$
Repeat accuracy:	± 0.01
Range of application:	550 - 320.000 cd/m ²
Sensor aperture diameter:	Ø3 mm
Powered by standard batteries:	4x 1.5V Alkaline type AA (LR6)
Battery life (at min. backlight):	approx. 1.500 operating hours
Probe cable length:	115 cm
Dimension of housing:	170 x 95 x 40 mm
Weight incl. batteries:	430 g