

MANUAL

EFMD

WIRELESS HANDHELD DISPLAY

Installation and user manual



Document	Version	Date	Applies to
Installation and user manual	V00x	10/2026	EFMD, firmware v1.04 onwards

This manual describes installation, operation and configuration of the EFMD wireless handheld display: power supply, keypad and displays, the menu system on the device, the configuration software and the radio link to the transmitters.



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1 About this manual

This manual applies to the EFMD wireless handheld display with firmware v1.04 onwards. It covers installation, power supply, operation, the menu system on the device, configuration with the T24 Handheld Toolkit software and fault finding.

Display texts, key names and menu items are set in a fixed-width typeface, for example **MENU/OK**. Menu paths are written as menu > item. Software pages and buttons of the configuration software are written as they appear on the screen.

1.1 Notices

Notice	Meaning
Warning	Risk of injury or damage, or of losing the function of the system.
Important	Pay particular attention to the following instruction.
Note	Further information.

1.2 Product identification

Item	Description
Product	EFMD wireless handheld display for up to 12 T24 transmitters
Manufacturer type designation	T24-HK-S
Compatible transmitters	T24 transmitters, for example octagon EFMC (in enclosure) and EFMF (OEM board)
Firmware	v1.04 onwards; shown under Info > About

2 Safety and conditions of use

Warning T24 products are not authorised for use in safety-critical applications where a failure of the product would reasonably be expected to cause severe personal injury or death.

2.1 Rules for correct use

- The enclosure is sealed to IP67. Before refitting the battery cover, check the seals and grooves for debris and damage; keep gaskets and mating parts free from dirt.
- The battery cover should remain with the handheld case that it was shipped with.
- Apart from the battery compartment the case should not be opened.
- Use two AA alkaline batteries. Because of the higher voltage requirement of this device, NiMH and NiCd rechargeable batteries are not recommended.
- A warning, overload or underload indication on the handheld is an aid to the operator, not a safety device (see the warning above).

2.2 Radio

- The device contains a licence-exempt 2.4 GHz radio transceiver. The antenna is fitted inside the enclosure.
- Radio frequency exposure: the antenna must be installed so that a minimum separation distance of 5 cm is maintained between the antenna and all persons at all times, and the device must not be co-located or operated in conjunction with any other antenna or transmitter.
- Antennas with a gain exceeding 3 dBi are strictly prohibited for this radio.
- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3 Product description

3.1 Overview

The EFMD is an IP67-rated handheld display for viewing the data of T24 transmitters. Out of the box it works in roaming mode and displays the data of the first twelve T24 transmitters it receives. Alternatively, up to twelve inputs can be defined, each with its own settings such as overload limit and calibrated units.

- Setup on the handheld alone, including pulling transmitters onto the radio settings of the handheld; more complex setup with the T24 Handheld Toolkit software over USB.
- Out of the box some functions are hidden for simplicity; the whole menu system can be unlocked with the default password or with the toolkit.
- Displays: list, detail (with tare, maximum and minimum) and radio signal quality.
- Actions on warning, overload, underload and transmitter error: beep, vibration, flashing display, full screen warning.
- Firmware upgradeable with the toolkit.

3.2 Technical data

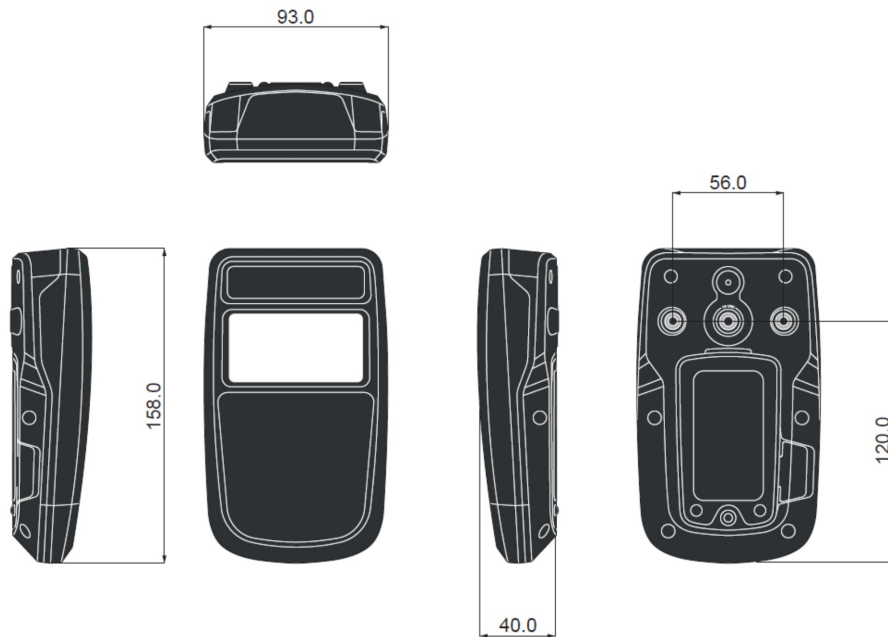
Item	Value
Inputs	up to 12 T24 transmitters; 6 shown at once in the list
Operating modes	roaming · defined inputs
Display	128 × 64 pixel monochrome dot matrix, backlit
Display update rate	200 ... 1000 ms, adjustable
Radio	2.4 GHz licence-exempt transceiver, DSSS, 15 channels, 10 mW (chapter 13); coexists with Wi-Fi, Bluetooth and Zigbee
Range	up to 800 m, open field (section 13.2)
Batteries	2 × AA 1.5 V alkaline primary cells
Supply voltage	3.0 V DC typical; internal batteries 2.5 ... 3.6 V DC
Current	active 50 mA typical, 120 mA maximum (with all actions active, e.g. vibration, buzzer and backlight) · standby 40 µA
Battery life (2 Ah cells)	standby (switched off) 1.5 years · continuous operation 35 h; the device specification states 40 h
USB	micro USB under the USB cover: connection to a PC for configuration and alternative (permanent) power supply
Clock	real-time clock, set on the device or with the toolkit
Degree of protection	IP67 · NEMA 4
Operating temperature	–10 ... +50 °C
Storage temperature	–20 ... +80 °C (device specification) · –40 ... +85 °C without batteries
Humidity	0 ... 95 % RH
Dimensions (W × H × D)	93 × 158 × 40 mm according to the enclosure drawing (section 4.1); see the note there
Mounting	1/4-inch UNC thread · two holes for no. 2 self-tapping screws

3.3 Accessories

Accessory	Description
USB cable	right angle, 1 m
Screw mounting kit	with articulating arm
Suction mounting kit	with articulating arm

4 Enclosure, dimensions and mounting

4.1 Dimensions



Enclosure drawing, dimensions in mm: top view, left side, front, right side and rear.

Note The height is not stated consistently in the documentation: the enclosure drawing shows 158 mm, the device specification 156 mm, and the dimensional drawing in the EFMD data sheet 170 mm. The difference is being clarified; allow 170 mm when planning space for the device.

4.2 Rear and mounting



Rear of the handheld.

- A 1/4-inch UNC thread on the rear takes a camera-style fixing; the mounting kits use it.
- Two further holes accept no. 2 self-tapping screws; in the enclosure drawing they are 56 mm apart.
- The battery cover is secured by a single screw at the bottom.
- The micro USB connector is under the USB cover on the rear.

4.3 Antenna position

The antenna is mounted in the top end of the enclosure, above the display. Keep this end free; the installation guidelines in section 13.3 apply to the handheld as well.

5 Power supply, switching on and off

5.1 Batteries

- Remove the single rear screw of the battery cover and take the cover off.
- Fit two AA alkaline batteries.
- Check the seals and grooves for debris and damage, refit the cover and tighten the screw.

Note If the batteries are removed for more than half an hour and the handheld is not powered by USB at the same time, the real-time clock may need resetting after the new batteries have been fitted (**System** > **Time/Date**).

5.2 Switching on and off

The top right key doubles as the power key. Hold it for approximately two seconds to switch the handheld on or off.

- **Power on Wake:** when switched on, the handheld wakes the transmitters. If only one input is defined and its ID is set, only that transmitter is woken; otherwise a broadcast wake is sent.
- **Power off sleep:** when switched off, the handheld sends all transmitters in the current list to sleep.
- **Auto-Off:** switches the handheld off after a set time without a key press (section 9.5).

5.3 USB power

The micro USB connector is used for the connection to the PC and as an alternative power supply, for example where the handheld is mounted permanently. While external USB power is applied, the USB icon is shown and the automatic switch-off of the backlight is disabled.

6 Keypad, displays and icons

6.1 Keypad



Keys and display areas.

Key	Outside the menu	In the menu
Power (top right key)	hold approx. 2 s: switch on or off	–
Soft keys (top row)	the function shown directly above the key on the display	the function shown above the key
Up / Down	scroll through the available inputs (can be disabled in the toolkit)	navigate, edit values
Left / Right	cycle through the available displays; a long press increases or decreases the number of decimal places of the selected unit (can be disabled in the toolkit)	Left = Back soft key, Right = OK
MENU/OK	open the menu (if allowed in the configuration)	select a menu item, complete an edit; a long press (approx. 1 s, then release) cancels the current edit

The handheld can be set to beep on every key press.

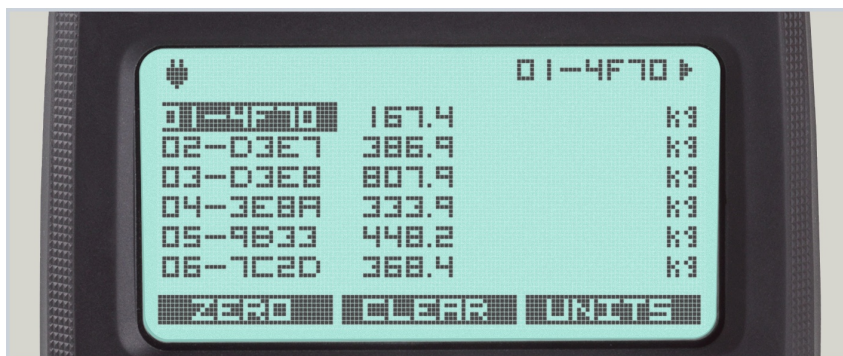
6.2 Displays

As standard there are three displays: list, detail and radio. Some of them may have been disabled in the toolkit. The left and right keys cycle through the displays, the up and down keys through the inputs. The selected input is shown in the top right corner.

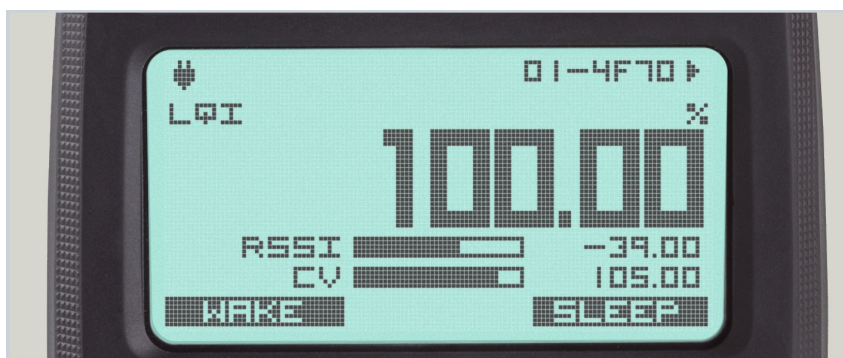
Display	Content	Soft key 1	Soft key 2	Soft key 3
List, roaming	up to 6 inputs at once (12 by scrolling): input number and data tag, value, unit	ZERO : zero the selected input or return to gross	CLEAR : clear the list and send a wake-all command (if Power on Wake is enabled)	UNITS : cycle through the available units
List, defined	as roaming, first column shows the name of the input	ZERO	no function	UNITS of the selected input

Display	Content	Soft key 1	Soft key 2	Soft key 3
Detail	one input with the maximum and minimum since the last reset	ZERO	RESET: reset maximum and minimum	UNITS
Radio	radio quality of one input: LQI, RSSI, CV	WAKE: wake the transmitter (targeted if the ID is known, otherwise broadcast)	no function	SLEEP: send the transmitter to sleep

From the list display, the right key opens the detail display and the left key the radio display; from the detail display the right key opens the radio display.



List display in roaming mode: input number and data tag, value, unit.



Radio display: link quality (LQI), radio signal strength (RSSI) and correlation value (CV) of the selected input.

6.3 Icons

Information icons appear in the top left of all displays. Events are shown here even if no action (beep, vibration and so on) has been selected for them.

Icon	Meaning
Warning	one of the input channels has triggered a warning action
Overload	one of the input channels has triggered an overload action
Underload	one of the input channels has triggered an underload action
Transmitter error	there is an error with one of the T24 transmitters (Info > Errors)
Low temperature	too cold to operate the LCD at its normal update rate; a slower rate is applied. Internal measurement (such as peak detection) is not affected
USB power	external USB power has been applied
Net	the selected display shows the net value because a tare has been executed
Keypad locked	critical processes are being performed by the toolkit or other software
Battery low	the batteries of the handheld are low

7 Basic principles of the T24 radio system

A few radio settings and concepts have to be understood to configure, deploy, optimise and troubleshoot a T24 telemetry system.

7.1 Transmitters and receivers

All T24 modules are transceivers, but they mainly work either as a transmitter or as a receiver. Transmitters are the sensor modules: they measure load, strain, voltage, temperature and so on and send messages with the measured value and status information at a user-defined rate. Receivers use these messages to display, analyse or process them – handheld displays, large displays, output modules – and can control the transmitters, for example send them to sleep or wake them. A PC and a base station are only required to configure the modules, although they can also be part of a data collection system. Once configured, the modules work autonomously.

7.2 Radio channel and group key

Two modules can only communicate if they share the same radio settings:

Setting	Meaning
Radio channel	The frequency the radio works on. The T24 band is divided into 15 channels (1 ... 15). Modules must be on the same channel to exchange messages.
Group key	Isolates groups of modules on the same channel: no module can affect another or see its messages unless both have the same group key. Defined by the user, up to 15 alphanumeric characters. Group keys were introduced with radio firmware v3.0 (March 2015); to work together with older modules that do not support them, the group key must be blank.

7.3 ID and data tag

- Every module has a unique 6-character hexadecimal ID allocated at the factory, for example **FF1234**. The ID is used to configure the module.
- A transmitter does not send its ID with its measurement messages. It identifies them with a data tag: a 4-character hexadecimal number, set at the factory to the last four characters of the ID and changeable by the user. Receivers and software select the messages they use by this data tag.
- Because of this, a transmitter can be replaced without reconfiguring the receivers: configure the replacement with the same data tag, radio channel and group key.

7.4 Operating modes of a transmitter, sleep and wake

Mode	Behaviour
Normal	Takes a reading, sends a message and enters a very low power state until the next reading.
Configuration	Pauses sending and disables the low power state so that the module can be configured; entered by pairing. Normal operation resumes afterwards.
Sleep	The module is sent to sleep by another module, or goes to sleep by itself when its messages are no longer used. It can be woken on demand by other modules or by software via a base station.

Transmitters have a sleep delay (in seconds). Most receivers and the T24 software send stay-awake messages, usually every 5 seconds, while they receive messages from a transmitter. If no stay-awake message arrives within the sleep delay, the transmitter goes to sleep. The sleep delay should therefore be at least 10 seconds; it can be set up to one hour where the receiver may be out of range for a while. Values between 30 and 300 seconds are usual. A sleep delay of zero disables the function: the transmitter then only sleeps when told to.

7.5 Pairing

Pairing finds out and matches the radio settings (channel and group key) of two modules, without any visible clue of what those settings are. It is triggered by removing and re-applying the power of the module to be paired, so no physical access to its electronics is needed.

- Pairing from the T24 Toolkit: remove power from the module, click **Pair** in the software and re-apply power. The base station adopts the radio settings of the module and puts it into configuration mode; the settings of the module are not changed.
- Pairing from a receiver: some receivers pair to a transmitter without a PC. The transmitter is set to the radio settings of the receiver, and the receiver learns its ID and data tag. The transmitter continues in normal mode with the altered radio settings.
- Soft pairing: where the power of a module cannot be reached, the T24 Toolkit can connect if the radio channel, group key and ID of the module are known. This works well with receivers; transmitters with a transmission interval of more than 5 seconds may be difficult to soft pair, and in high traffic or high noise environments it may not work reliably – then power cycle pairing is the only option.

8 First switch-on

Out of the box the handheld is in roaming mode and lists the data of the first twelve T24 transmitters it detects – no setting is needed for a first reading.

- Fit the batteries and switch the handheld on with the power key.
- Transmitters in range that are awake and have the same radio channel and group key as the handheld appear in the list.
- Select an input with the up and down keys; the right key opens its detail display, a further press its radio display, the left key goes back.
- **CLEAR** on the list display clears the list (including zeros, maximum and minimum values) so that other transmitters can be displayed.

Horizontal dashes instead of a value mean that no data has arrived from that transmitter for longer than the timeout of the input.

Note A transmitter is only displayed if its radio channel and group key match those of the handheld. Section 9.2 shows how to check and change the radio settings, and section 9.4 how to pull a transmitter onto the radio settings of the handheld (**Link Auto**).

9 Setting up on the device

Most of the setup can be done with the handheld alone. Press **MENU/OK** to open the menu; move with the up and down keys, select with **MENU/OK**. The left key acts as the **Back** soft key, the right key as **OK**. When editing values, a long press of **MENU/OK** cancels the changes. Parts of the menu system may have been hidden or locked with the toolkit.

Top-level menu	Default PIN
System	1000
Actions	2000
Inputs Setup	3000
Info	no PIN

Enter a PIN with the arrow keys and **MENU/OK**. In addition, an inputs password is set by default for the **Define Inputs** menu and below: **DEF**. PINs and password can be changed or disabled in the toolkit.

Warning Do not forget changed passwords. Unlocking without the password requires proof of right to access, may require a return to the supplier and incurs a charge.

9.1 Checking information

Menu **Info** > **Errors** · **Inputs Info** · **System Info** · **About** > **View**

9.2 Radio settings

Menu **Inputs Setup** > **Radio Channel** > **Set**

Menu **Inputs Setup** > **Group Key** > **Set**

Radio channel 1 ... 15 and group key of the handheld. To view data from a transmitter, the radio settings must match. After a change, communication with transmitters on the old settings is lost until their settings match the handheld.

Sleep/Wake

Item	Function
Power on Wake	wake when switched on: only the defined transmitter if exactly one input is defined with its ID, otherwise broadcast wake; also affects CLEAR in roaming
Keep Awake	keep all transmitters in the current list awake
Power off sleep	send all transmitters in the current list to sleep at switch-off
Wake All	send a broadcast wake command to all transmitters in the vicinity with the same radio settings
Sleep All	send a sleep command to the transmitters in the list (roaming or defined)

9.3 Roaming settings

Menu **Inputs Setup** > **Edit Inputs** > **Mode** > **Roaming**

Menu **Inputs Setup** > **Edit Inputs** > **Number of Inputs** > **1-12**

Menu **Inputs Setup** > **Edit Inputs** > **Define Inputs** > **Configure All Inputs**

In roaming mode the handheld fills the list with the first transmitters it receives, up to **Number of Inputs**. Because any transmitter may appear, the settings are global and apply to all inputs (password required):

Item	Meaning
Calibration	base measurement unit of the incoming data
Timeout	time without data after which horizontal dashes are shown instead of a value
Limits	thresholds for warning, overload and underload
Resolution	increment of the base unit in which the display changes
Zero Mask	incoming values below this are shown as zero

9.4 Defined input settings

Menu **Inputs Setup** > **Edit Inputs** > **Mode** > **Defined**

Menu **Inputs Setup** > **Edit Inputs** > **Define Inputs** > **Select Input** > **Configure Input**

In defined mode the handheld looks for specific transmitters, and each input channel can have its own configuration. A data tag must be assigned to every input that is to be used.

Group	Item	Meaning
Identity	Name	name of the input
	Data Tag	data tag of the T24 transmitter for this input
	ID	ID of the transmitter; only required for a targeted wake
	Link Auto	follow the on-screen instructions and power cycle the transmitter: data tag and ID are set, and the transmitter is pulled onto the radio settings of the handheld
Calibration	Cal Unit	base measurement unit of the incoming data
	Cal Date · Cal Period	date of calibration of the transmitter; validity in days
Timeout		time without data after which dashes are shown
Limits	Warning · Overload	values above trigger the warning or overload actions
	Underload	values below trigger the underload actions
Resolution		increment in which the display changes
Zero Mask		incoming values below this are shown as zero
Zero		currently entered tare value; can be set manually
Sleep Actions	Wake Input · Sleep Input	wake (targeted if the ID is known, otherwise broadcast) or sleep the selected input

9.5 Actions

Menu **Actions** > **Action (Warning / Overload / Underload / Errors)**

Actions Source selects whether the limits are compared with the gross or the net value. For each event type the reactions can be set separately:

Setting	Effect
Latched	the event and its actions stay active until cancelled under Info > Action Cancel
Beep	beep while the event is active
Vibrate	vibrate while the event is active
Flash Display	the display of the input that triggered the event flashes
Full Screen Warning	a full screen warning names the type of event and covers the measurement displays until the event has cleared
Allow snooze	the full screen warning can be hidden temporarily to see the displays

9.6 System settings

Item	Setting
Display > Contrast	increase or decrease, for viewing from other angles
Display > Backlight	Off · On · Auto : off after Duration seconds without a key press, on again with any key; auto is disabled on USB power
Auto-Off	Mode enabled/disabled · Timeout in minutes without a key press
Update rate	200 ... 1000 ms, regardless of how fast data arrives; slower rates increase battery life
User Interface > Key Actions	beep on key press or not
User Interface > Key Functions	hidden by default: Keys Up/Down select input or disabled · Keys Left/Right select display or disabled · Long Up/Down disabled or select input · Long Left/Right decimal places or disabled
Time/Date	Time now · Set Date · Set Time · Date Format
About	product name, serial number, firmware version

9.7 Info menu

The **Info** menu shows information without allowing anything to be changed; it has no PIN.

Item	Shows
Action Cancel	only visible while an action has been triggered and is latched
Errors	current and latched errors of each channel as a table (section 10.1)
Calibration	calibration state of the defined transmitters
Inputs Info	current input list: name, ID (if set), incoming units
System Info	battery voltage, USB link, internal temperature, system flags and startup code; filled each time the menu is opened
About	product name, serial number, firmware version

10 Menu structure

Complete menu of the handheld. Items can be hidden with the toolkit, so a particular handheld may show less.

Menu	Level 2	Level 3
System	Display	Contrast · Backlight
	Auto-Off	Mode · Timeout
	Update rate	200 ... 1000 ms
	User Interface	Key Actions · Key Functions
	Time/Date	Time now · Set Date · Set Time · Date Format
	About	–
Actions	Actions Source	Gross · Net
	Action (warning, overload, underload, error)	Latched · Beep · Vibrate · Flash Display · Full Screen Warning · Allow snooze
Inputs Setup	Radio Channel · Group Key	1 ... 15 · group key
	Sleep/Wake	Power on Wake · Keep Awake · Power off sleep · Wake All · Sleep All
	Inputs Info	–
	Edit Inputs	Mode · Number of Inputs · Define Inputs
Info	Action Cancel · Errors · Calibration · Inputs Info · System Info · About	read only

10.1 Error table

Info > Errors shows one letter per event and channel. U, W and O come from the limits set in the handheld; the others are reported by the transmitter.

Letter	Meaning
U	underload
W	warning
O	overload
I	integrity error (transmitter)
C	shunt calibration active (transmitter)
B	battery low (transmitter)
S	signal low (transmitter)
E	remote error (transmitter)

11 Configuration with the T24 Handheld Toolkit

The T24 Handheld Toolkit is the Windows software for the full configuration of the handheld. It does not configure older handheld displays or transmitters (for those, see the T24 Toolkit). Start the toolkit and connect the handheld to the PC with a USB cable. If only one handheld is connected, the toolkit connects automatically; otherwise select it on the Home page. Navigation is by the icons along the top; a sidebar on the right explains the current page (F12 hides it).

Note While the toolkit performs critical processes, the keypad of the handheld is locked and the keypad icon is shown.

11.1 Home and Information

- Home: **Serial Port** selects the connected handheld, **Connect** connects to it. Without a device, the logging page can be opened to review a previous log file.
- Information: data of the connected handheld, useful for fault finding. If pages have been locked with the configuration password, fewer icons are shown; click the padlock and enter the password to gain access to the complete toolkit.

11.2 Settings

Tab	Item	Setting
Interface	Backlight	Mode off / on / auto · Duration in seconds (auto) · Brightness ; a brighter backlight reduces battery life
	Auto-Off	Enabled · Duration in minutes without a key press until the handheld switches off
	Display Refresh	1 ... 5 updates per second; faster updates reduce battery life
Key Actions	Keypad Press Action	none or beep
	Left/Right	short press: display selection or disabled · long press: decimal places or disabled
	Up/Down	short press: input selection or disabled
Clock	Time, date	hour, minute, year, month, day · date format · Use computer time

11.3 Import and export

Depending on which sections are locked, an export may not be allowed.

- **Export** (standard export): all settings that are not locked are written to a file; on import, the sections to be overwritten (inputs, configuration, other settings) can be chosen. Keep a copy of the file in case settings need to be restored; technical support may ask for it.
- **Clone Export**: the entire device is exported, including locked sections whose passwords are entered. Passwords for the inputs and configuration sections can be encrypted into the file and are applied to the cloned device on import. Cloning duplicates all configuration, user calibration and user settings; only the original factory settings remain.
- **Import**: select a file; the toolkit shows whether it can be imported.

Warning If a clone file contains encrypted passwords, the corresponding sections are locked in the device after import, and there is no way to unlock a protected section if the password is unknown. Only import clone files from a trusted source or whose passwords you know. The toolkit warns if the firmware of the device that created the file differs from the target device; create clone files with the most recent firmware.

11.4 Configuration

Tab	Function
Menus	hide unwanted menus of the handheld
Display Modes	show or hide the list, detail and radio displays
Units	select the units available for calibration (base units) and for conversion with the UNITS soft key; set the decimal places per unit (right-click the field); filter field to find units
Custom Units	up to four own units, each with a name and a gain factor for the conversion between them (e.g. kg with gain 1, lbs with gain 2.2)
Pins	4-digit PINs for the System , Actions and Inputs menus; 0 = free access. The Info menu has no PIN
Firmware Upgrade	opens the upgrader; the upgrade file is needed. Takes approx. 60 s; do not remove power or USB during the upgrade

11.5 Management

- Configuration password: protects all configuration pages and hides the pages selected under Menu Protection. Options: allow firmware update and allow key actions change while locked.
- Inputs password: protects the Define Inputs pages and the related menus of the handheld.
- Menu Protection: show or hide the toolkit pages Actions, Inputs, Logging, Configuration, File and Settings while the configuration password is set.

Warning There is no way to unlock a protected section if the password is forgotten. Resetting a forgotten password requires proof of right to access, may require a return to the supplier and incurs additional cost.

11.6 Logging

Logs the data of the handheld to a file; a real-time chart is always shown. Log interval 10, 20, 50, 60, 100, 200, 500 or 1000 ms (100 ... 1 samples per second); log file, source values, **Start Logging**. A logged file can be loaded back into the chart (**Load Log File**). The chart can be zoomed, panned and paused, and offers measuring tools for time and value and min/max lines.

11.7 Define Inputs

Item	Function
Number of Inputs	maximum number of inputs displayed, 1 ... 12
Show Configured	only show inputs configured with a data tag
Mode	roaming (first up to 12 inputs received, global settings) or defined (up to 12 inputs with individual settings)
Radio Channel · Group Key	radio settings of the handheld; must match the transmitters (Save after changing the group key)
Clear	roaming only: clear the list and let it repopulate; wake command if Power on Wake is enabled
Wake All · Sleep All	broadcast wake · sleep all transmitters in the list
Power on Wake · Keep Awake · Power off Sleep	as in the menu (section 9.2)
Configuration	roaming only, not with active inputs password: global settings – unit type and unit, warning, underload, overload, timeout, resolution, zero mask

If the inputs password is set, only the settings along the top can be changed; click the padlock to unlock. In defined mode double-click a line of the table to configure that input on three tabs: General and Limits (data tag, ID, name, unit type and unit, warning, underload, overload), General and Display (timeout, resolution, zero mask) and General and Calibration (calibration date, validity in days).

11.8 Actions

Action source (gross or net) and, separately for warning, underload, overload and error: beep, vibrate, flash display, full screen warning, allow snooze (hide the full screen warning for 60 seconds with **MENU/OK**) and latched (the event continues until cleared in the menu).

12 Fault finding

Observation	What to check
The list stays empty	Is the transmitter powered and awake? CLEAR on the list display sends a wake command if Power on Wake is enabled; Inputs Setup > Sleep/Wake > Wake All sends a broadcast wake. Do radio channel and group key match (section 9.2)? Is the transmitter within range (chapter 13)?
Horizontal dashes instead of a value	No data within the timeout of that input. Check the transmitter and the range; wake it with WAKE on the radio display.
A defined input stays empty	The data tag of the input does not match the transmitter. Enter it again or use Link Auto .
Small values are shown as zero	Zero Mask of the input is set too high.
The value changes in coarse steps	Resolution too coarse, or too few decimal places (long press left/right).
The net value is shown	A tare is active (net icon). ZERO returns to the gross value.
A warning does not clear	The action is latched: Info > Action Cancel .
The display updates more slowly	Low temperature icon: the LCD is too cold for the normal update rate. The measurement is not affected.
Keys do not react outside the menu	Key functions disabled in the toolkit, or keypad locked (keypad icon) while the toolkit is busy.
Clock wrong after a battery change	Batteries out for more than half an hour: set Time/Date .
The handheld switches itself off	Auto-Off is enabled.
Letter B , I , C , S or E in the error table	Reported by the transmitter, not by the handheld; see the manual of the transmitter. B = its battery is low.

13 Radio, antenna and range

13.1 Radio specification

Item	Value
Licence	licence exempt
Radio type	transceiver (2-way)
Frequency	2.4000 ... 2.4835 GHz
Channels	15 (DSSS)
Modulation	MS (QPSK)
Data rate	250 kbit/s
Transmit power	10 mW
Antenna	internal 3.0 dBi inverted-F printed circuit antenna, in the top end of the enclosure above the display

13.2 Range

Maximum range in an open field site between this device and the other module, depending on the antenna of the other module. The handheld itself has the internal 3 dBi antenna.

Antenna of the other module	Range
Integrated chip antenna (1.3 dBi), e.g. EFME	600 m
Internal 3 dBi inverted-F antenna, e.g. EFMC, EFMD, EFMG	800 m
External ½-wave dipole antenna (1.1 or 2.2 dBi)	400 m
External 3 dBi surface-mount antenna (IP69K)	800 m

Tests conducted in an open field site with the transmitter at the top of a 3 m pole; the receiver was mounted 1.5 m above the ground.

13.3 Installation guidelines

Radio performance at 2.4 GHz depends strongly on the environment. Any structure within the operating region of the radios has three effects:

Effect	Consequence
Obscuration	An obstruction masks the line of sight between the radios: reduced range.
Distorted radiation pattern	Structures or objects near the antenna distort the coverage: reduced range and link quality.
Reflection	Signals arrive by an indirect path: reduced range or poor link quality.

- Maintain line of sight between the modules and keep objects or structures at least one metre away from the antennas wherever possible.
- A small increase or reduction of the antenna height often improves reception.
- Under water the range is only about 100 mm, depending on the packet rate.

14 Approvals and declaration of conformity

Region	Conformity
Europe	CE
USA	FCC, FCC ID: VHARA24
Canada	IC, IC: 7224A-RA24

14.1 Europe (CE)

The equipment complies with the EMC Directive 2014/30/EU and with the essential requirements and other relevant provisions of the Radio Equipment Directive 2014/53/EU; valid for the European Community, Switzerland, Norway, Iceland and Liechtenstein.

The EU declaration of conformity for the T24 telemetry product range (date of issue 16 October 2017) covers:

Directive	Harmonised standards
2014/35/EU Low Voltage	EN 61010-1:2010
2014/30/EU EMC	EN 61326-1:2013 · EN 61326-2-3:2013
2011/65/EU RoHS	–
2014/53/EU Radio Equipment	EN 300328 V2.1.1

The declaration of conformity is available from octogon on request.

14.2 Canada (IC)

IC: 7224A-RA24. This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To comply with Industry Canada RF radiation exposure limits for general population, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 5 cm is maintained between the radiator (antenna) and all persons at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.

14.3 USA (FCC)

FCC ID: VHARA24.

- 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 complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.