

MANUAL

EFMI

ATEX WIRELESS HANDHELD DISPLAY

Installation and user manual



Document	Version	Date	Applies to
Installation and user manual	V00x	10/2026	EFMI

This manual describes the intrinsically safe EFMI handheld display: explosion protection, operation, configuration with the PC software and the technical data.



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1 About this manual

This manual is valid for the EFMI ATEX/IECEx handheld display. It is to be used together with the manual of the transmitters (for example the ATEX/IECEx transmitter EFMH). Read chapter 2 before taking the handheld into a hazardous area.

Display texts are set in a fixed-width typeface, for example **BUSY**. Buttons and pages of the PC software are written as they appear, for example Pair or Global Settings.

1.1 Notices

Notice	Meaning
Warning	Safety instruction of the explosion protection or warning of the source documentation, reproduced word for word.
Important	Pay particular attention to the following instruction.
Note	Further information.

1.2 Device identification

	EFMI
Product	ATEX/IECEX handheld display for radio transmitters, IP67, two lithium AA cells
Manufacturer type	X24-HD, covered by the certificates in section 2.2

2 Safety and explosion protection

2.1 Intended use

The EFMI receives the radio messages of transmitters and displays their values – inside the hazardous area. According to its certificates, it is battery powered, handheld equipment for radio data capture and display. It comprises an enclosure accommodating two Ex certified AA cells (Baseefa 14ATEX0107U), an antenna printed circuit board, a printed circuit board with a liquid crystal data display and radio module. The printed circuit board is connected by ribbon cable to the front panel of the enclosure, which contains six membrane switches.

Data transmission and reception is by radio. Entity parameters are not required because there are no external connections.

2.2 Marking and certificates

Marking as specified in the certificates (the ATEX marking is preceded by the specific marking of explosion protection, Ex in a hexagon):

Certificate	Marking
ATEX, group I	I M2 Ex ib I
ATEX, group II	II 2G Ex ib IIC T4 Gb Ta = -20°C to +50°C
IECEX	Ex ib I Ex ib IIC T4 Gb Ta = -20°C to +50°C

	ATEX	IECEX
Certificate	EU-type examination certificate Sira 15ATEX2345X, Issue 1	IECEX Certificate of Conformity IECEX SIR 15.0125X, Issue No. 0
Date	Issue 1: 15th October 2019 (Issue 0: 08 August 2016)	2016-08-08
Issued by	CSA Group Netherlands B.V., notified body number 2813	SIRA Certification Service, CSA Group
Type of protection	–	Intrinsically Safe
Standards	EN 60079-0:2012/A11:2013 EN 60079-11:2012	IEC 60079-0 : 2011 Edition 6.0 IEC 60079-11 : 2011 Edition 6.0

The EU declaration of conformity names the ATEX directive 2014/34/EU (EN 60079-0:2012+A11:2013, EN 60079-11:2012), the EMC directive 2014/30/EU (EN 61326-2-3:2013, EN 61326-1:2013) and the Radio Equipment Directive 2014/53/EU (EN 300328 V2.1.1). It is available from octogon on request.

2.3 Specific conditions of use

Both certificate numbers end in X: "If the sign 'X' is placed after the certificate number, it indicates that the equipment is subject to Specific Conditions of Use identified in the schedule to this certificate." The ATEX certificate (15.1, 15.2) and the IECEx certificate (conditions 1, 2) state the same two conditions:

Warning The permitted cell type is Energizer Lithium L91, size AA (Baseefa 14ATEX0107U).

Warning No precautions against electrostatic discharge are necessary for portable equipment that has an enclosure made of plastic, metal or a combination of the two, except where a significant static-generating mechanism has been identified. Activities such as placing the item in a pocket or on a belt, operating a keypad or cleaning with a damp cloth, do not present a significant electrostatic risk. However, where a static-generating mechanism is identified, such as repeated brushing against clothing, then suitable precautions shall be taken, e.g. the use of anti-static footwear.

2.4 Safety instructions

Warning Use only Energizer L91 cells. Do not change cells in an explosive atmosphere!

Warning The battery compartment cannot be opened in the hazardous area!

Warning Remove a handheld battery (Not in hazardous area!), click Pair in the Toolkit and replace battery to perform a full pairing.

Warning T24 modules cannot be used in hazardous areas!

Configuration uses a T24 base station (chapter 7).

3 Product description

The EFMI is a highly configurable handheld display that works with ATEX/IECEx transmitters and with the transmitters of the non-certified radio range. It allows wireless remote viewing of remote inputs such as strain gauge or voltage, using 2.4 GHz radio: the transmitter measures its input value and periodically transmits it, the handheld captures and displays it.

The handheld can display data from any transmitter detected, or up to 24 specific transmitters can be defined for the operator to cycle through. Grouping functions allow up to 8 group totals to be viewed. Each group or individual transmitter has a user-defined name, scaling, display format, zero functions and overload settings.

3.1 Display and keys

- Liquid crystal display with 7 digits (7-segment); indicators **G**, **NET**, **SIG LOW**, **BATT LOW** and, for the transmitter, **REMOTE ERROR** and **REMOTE BATT LOW** (section 6.2).
- Three keys: Power (power symbol), Next (triangular arrow) and Tare (T symbol) (section 6.1).
- Backlight and buzzer, both configurable.

3.2 Transmitters

Where	Transmitter
Hazardous area	EFMH ATEX/IECEx transmitter for strain gauge sensors
Safe area only	transmitters of the non-certified radio range, for example EFMC

4 Radio system basics

A few basic radio settings and concepts must be understood to configure, deploy, optimise and troubleshoot the radio system.

4.1 Transmitters and receivers

All modules of the radio system are transceivers, but each mainly works either as a transmitter or as a receiver. Transmitters measure an input, such as strain, and send messages containing the value and status information at a user-defined interval. Receivers use these messages to analyse, display or perform other actions – for example handheld displays, large displays, analogue outputs and relay modules. Receivers can also control 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 may be part of a data collection system. Once configured, the modules operate autonomously.

The ATEX/IECEx approved modules – the transmitter EFMH and the handheld display EFMI – belong to the X24 range, the approved members of the larger T24 telemetry range. Systems can be put together using X24 modules in the hazardous area and T24 modules in the safe area. The X24 transmitters can be used with any of the T24 receivers.

Warning T24 modules cannot be used in hazardous areas!

4.2 Radio channel and group key

To communicate, two radio modules must share the radio channel and the group key. Pairing (section 4.5) learns these settings and recovers unknown settings.

Setting	Description
Radio channel	The frequency the radio operates on. The radio band is divided into 15 channels (1 ... 15). Modules must be on the same channel to transfer messages. The default is channel 1.
Group key	Isolates groups of modules even if they operate on the same radio channel. This improves efficiency and offers security: no module can affect another or see its messages unless both share the same group key. The group key is defined by the user, up to 15 alphanumeric characters. Group keys were introduced with radio firmware v3.0 in March 2015; newer modules work with older ones, but then group keys cannot be used (the group key field must be blank).

When you pair to a remote module, the base station adopts the radio channel and group key of the remote module. To set the same group key on several remote modules, either pair to each one in turn and set its radio channel and group key, or configure the base station first (hold the shift key and click Pair on the Home page) and then use the tool on the radio settings advanced page to give each module the radio settings of the base station (chapter PC software and base station).

4.3 ID and data tag

To configure a module, its ID is used in communications: a unique 6-character hexadecimal identifier (numbers 0 ... 9 and letters A ... F, for example FF1234), allocated at the factory.

A transmitter sends its messages without broadcasting its ID; the messages are identified by a data tag – a 4-character hexadecimal number that can be configured by the user. When a module leaves the factory, the data tag is set to the last 4 characters of its ID. Receivers and software identify the messages they want by this data tag.

This allows a transmitter to be replaced without reconfiguring the receivers that use its messages: configure the replacement transmitter with the same data tag, radio channel and group key, and the rest of the system will not notice the difference.

4.4 Transmitter modes of operation

Mode	Description
Operational (low power mode)	Normal mode: take a reading, send a message, then enter a very low power state until the next reading, to maximise battery life. During the low power state the transmitter cannot be communicated with – hence the configuration mode.
Operational (non low power mode)	If battery life is not an issue, the module is externally powered or transmission rates are so high that low power mode is not available, the module does not enter a low power state between transmissions.
Configuration	The module pauses sending its messages and disables its low power state so that it can be configured. This is achieved by pairing with the PC software. When configuration is complete, the module resumes normal operation.

Mode	Description
Sleep	Modules can be sent to sleep by other modules, or go to sleep themselves when their messages are no longer used (sleep delay). Sleeping modules can be woken on demand by other modules or by software via the base station.

Sleep delay

Transmitters have a sleep delay setting (in seconds) that lets them go into sleep mode when their data messages are no longer required, for much longer battery life. A sleep delay of zero disables this function; the module then only sleeps when told to do so.

Most receivers and the software send stay awake messages when they see messages arrive from transmitters. If the sleep delay time has elapsed without a stay awake message, the transmitter enters sleep mode. Stay awake messages are usually sent every 5 seconds, so the sleep delay should be at least 10 seconds; it can be set up to an hour where the receiver is likely to be out of range for a time but the transmitter must stay awake. Usually the sleep delay is set between 30 and 300 seconds.

4.5 Pairing and soft pairing

The radio settings of a module cannot be seen from outside. Pairing determines the radio settings (radio channel and group key) and matches them between two modules, and optionally puts a transmitter into configuration mode. Because modules may be installed where they cannot be reached, pairing is activated by removing and re-applying the module's power.

With the PC software and a base station, pairing connects to a module without knowing anything about it beforehand: remove power from the module, click a Pair button in the software and re-apply power. The base station is automatically configured to match the radio settings of the module and places the module into configuration mode. When configuration is complete, the module returns to normal operation.

Soft pairing: pairing by power cycling is absolute and works under all circumstances. Where the power supply cannot be reached, the software offers soft pairing: configure the base station to the radio channel and group key of the remote module and enter the unique ID of the module. This works well with receivers, as they do not operate in low power modes; with transmitters the software must change them from normal operation into configuration mode, which may not work reliably in high traffic or high noise environments. If no connection can be made, power cycle pairing may be the only option.

4.6 Asynchronous operation, bandwidth and repeaters

Transmitters send their messages at a fixed user-defined interval, timed from when they were woken or powered on, so the measurements of different transmitters are not synchronised. Logging software records the last value received from each transmitter. If recorded sets of readings must be within a certain time of each other, that time is the maximum message interval to set for the transmitters, regardless of the log interval (which should always be greater than the transmitter message interval). Example: with 10 transmitters at 333 ms message interval, the logged values are only known to be within 333 ms of each other.

Each radio channel (1 ... 15) has a finite capacity. Modules on the same channel – even with different group keys – all share it. Each message takes around 3 ms, so at most 300 messages per second could be transmitted on one channel; in practice the limit is around 200 messages per second per channel. With more transmitters, message collisions and lost messages increase. Example: 2 modules may transmit 100 times per second, or 100 modules once per second. Modules that do not need to communicate with each other can be put on separate channels.

Repeaters retransmit messages to increase the range or to bypass obstacles. A repeater must use the same radio channel and group keys as the modules it repeats. Every module has a repeater subgroup setting (default 0): a repeater repeats messages from all modules whose subgroup is 0 or matches its own; a repeater with subgroup 0 repeats all modules. Changing the subgroup is normally only necessary when the bandwidth is very full.

5 Quick start

Getting the handheld and a transmitter working out of the box. Two Energizer L91 AA lithium batteries are required for the handheld; the transmitter needs its own power supply (EFMH: two Energizer L91 cells, see its manual).

5.1 Inserting the batteries

Warning Use only Energizer L91 cells. Do not change cells in an explosive atmosphere!

- Remove the two screws on the rear battery compartment.
- Insert two AA batteries (Energizer L91).
- Refit the battery compartment cover.

The handheld is now switched on and displays **BUSY** until it detects a transmitter.

5.2 Viewing transmitter data

By factory default no specific transmitters are configured, so the handheld displays data from any transmitter on the same radio channel and using the same group key. If handheld and transmitter are purchased at the same time, both default to radio channel 1 and a blank group key.

Once power has been applied to the transmitter, the handheld briefly displays its data tag and then shows its value. With more than one transmitter, the Next key (triangular arrow) moves to the next available transmitter.

Note When no transmitters are specified as inputs, the handheld wakes sleeping transmitters as it detects them, but does not send them to sleep. After the handheld is turned off, the transmitters remain awake. Use the sleep delay setting of the transmitters to make sure they turn off again when the handheld is turned off or moves out of range.

6 Operation

6.1 Keys

Each key has two functions. A short press is a press and release; a long press is press and hold for around 2 seconds.

Key	Short press	Long press
Power	Toggle the backlight on and off (manual backlight mode).	Power the handheld on and off: hold the key until the display shows BUSY , then release.
Next (triangular arrow)	Step to the next transmitter or group. A brief prompt – the data tag or a user-defined name – is displayed before the value.	Display the data tag or name of the currently viewed transmitter or group without moving to the next. With drill down allowed: view the inputs of a group (section 8.5).
Tare (T)	Toggle between gross and zeroed net mode: in gross mode the key zeroes the display, in net mode it returns to gross. Gross and net states are retained through power off.	In net mode: briefly display the gross value, remaining in net mode.

6.2 Indicators

Indicator	Meaning
G	The display is showing gross weight.
NET	The display is showing net weight.
SIG LOW	The radio signal from the transmitter is low. The transmitter is still functioning, but the limit of the range may be near and communication may start to deteriorate. Until - - - - - is displayed, the communication is still OK and the display can be relied on for accuracy.
BATT LOW	The batteries in the handheld are low and need to be replaced (outside the hazardous area, section 2.4).
REMOTE ERROR	The transmitter has an error that the handheld does not recognise.
REMOTE BATT LOW	The battery or supply of the transmitter is low.

Note Even with a degraded signal the display value will always be correct.

6.3 Errors

Display	Meaning
Error 1	The transmitter has a strain gauge input and is in shunt calibration mode: an external module has placed it in shunt calibration mode, so this error is displayed instead of a misleading reading.
Error 2	Input integrity error: the transmitter has found a problem with its input, for example open or short circuits. This error is displayed instead of a misleading reading. Only certain transmitters support it, such as the EFMH.
Overload	The overload limit set by the user has been exceeded.

7 PC software and base station

The modules are configured with the T24 Toolkit PC software, which is suitable for all versions of Windows. Run the installer and follow the prompts to install the software.

A base station is also required to configure the modules. A USB base station is simply plugged into a USB socket of the PC. For other base stations please contact octogon.

Warning T24 modules cannot be used in hazardous areas!

In the software, all items that can be changed or interacted with are coloured green. Click a green item to change it; a dialog window with a slider, text box or list opens for the new value.

7.1 Base station communications

Select the interface type of the connected base station. For a base station on a serial port, the COM port and the baud rate must be known. The base station address is usually 1; it is only different if it has been changed for multi base station configurations. Click Home to start communication with the base station. If no communication can be established, the software stays on this page: check that the base station is powered and correctly connected to any converters.

7.2 Connecting to the device (pairing)

On the Home page you can now pair with the remote module. Pairing removes the need to know the radio settings of the module and ensures that it is in a suitable state for configuration.

- Remove one battery of the handheld – not in the hazardous area (section 2.4).
- Click Pair in the software.
- Replace the battery within 10 seconds. This full pairing works regardless of the radio settings in the base station or the handheld.

Warning Remove a handheld battery (Not in hazardous area!), click Pair in the Toolkit and replace battery to perform a full pairing.

If the connection is successful, the software changes to the Information page. If pairing fails, try again.

Note Pairing does not change the radio settings of the connected module – the radio settings of the base station are changed to match those of the remote module. While the software is connected to a module for configuration, the normal transmission of messages is usually inhibited.

- To connect to and configure the attached base station itself, hold the shift key and click Pair.
- Manual connection: if the power supply of the remote module cannot be reached, click the 'Click Here' link at the bottom of the Home page and follow the prompts (soft pairing).

7.3 Pages for every module

Page	Content
Information	Shown after successful pairing. Name: a short description to recognise the module. Features: supported features are coloured, unsupported ones greyed out – for example calibration protected, group key supported / group key configured, extended range radio fitted.

Page	Content
Radio settings	Channel: 1 ... 15, default 1 – the analyser shows a clean channel. Group key: only visible on modules that support group keys; only modules with identical group keys can communicate. To use them with older modules without group keys, the field must be blank. New radio settings take effect only after a reset or power cycle: Reset Module Only (the module adopts the new settings, the base station keeps the old ones, the Home page is shown) or Reset Module and Base Station (both adopt the new settings and the connection is re-established). For the base station itself, changes are immediate.
Radio settings – Advanced	Repeater Subgroup (default 0 – all repeaters repeat this module). Remote Module Radio Settings Tool: gives a batch of remote modules the radio settings of the base station – remove power from the remote module, click the Click Here link, apply power to the remote module. The software stays paired to the module or base station it was paired to.
Save and restore	Save: writes all configuration information including calibration data to a file (extension .tcf). Restore: loads a saved file into the same or a different module; all configuration information including user calibration data is overwritten.

7.4 Channel monitor and analyser

The channel monitor shows a summary of the data sent by transmitters: data tag, total number of messages received, transmission rate, link quality, data value and any error messages. Some base stations also list sleeping modules; they show an ID instead of a data tag.

Important To see any data, the base station must be on the same radio channel as the transmitters and must have a matching group key.

Item	Function
Radio channel tabs	Change the radio channel the base station operates on.
Clear List	Clear all detected messages from the list.
Wake All	Wake all modules on the current radio channel.
Start Logging	Asks for a file name, then logs the received data to a CSV file in the format: Data Tag, Elapsed ms, Value.
View Last Log	Opens the last logged file in the application associated with CSV files.
Move Group Channel	Visible if the base station has a group key set, enabled once at least one module is listed. Asks for a new radio channel; all detected transmitters and all other modules on the same channel and group key, such as handhelds, are moved to it, then the base station itself moves. Only transmitters are listed, so make sure the other receivers of the group are available to be woken – all modules on the same channel and group key are woken before they are moved.

The analyser is a tool for choosing the best channel or diagnosing poor communication. It shows the radio signal levels detected across all channels, which helps to detect noisy areas, for example a Wi-Fi network. Although 16 channels are shown, the modules operate on radio channels 1 ... 15.

8 Handheld configuration

The PC software provides simple configuration of the handheld. Pair to the handheld (section 7.2). If the radio channel and group key of base station and handheld are known to be the same, you can also soft pair: perform a manual pair and enter the ID of the handheld.

Important Changes are not saved to the handheld until you click on a new input tab or select another page to view.

8.1 Modes of operation

The handheld can display data from several transmitters and the sum of several transmitters. How it operates depends on its list of transmitters (inputs) and the optional summing groups. When turned on, the handheld wakes all transmitters using the same radio channel and group key, if this feature is selected (Do Sleep Wake).

Mode	Description
No list entered (default, roaming)	The handheld displays data from any transmitter using the same radio channel and group key. With Set Size, the Next key cycles around the n transmitters with the highest signal; with a set size of 1 you can walk up to a transmitter, press Next and effectively select it. The data tags are displayed briefly before the values. The transmitters should have their sleep delay enabled, as the handheld wakes all transmitters but does not send them back to sleep.
List entered	Up to 24 known transmitters are entered in the list. Each can be named – the name is shown instead of the data tag – and configured separately for overload, format, scaling etc. If sleep and wake is enabled, the transmitters are sent to sleep when the handheld is turned off.
List entered plus summing groups	With at least one input in the list, up to eight summing groups can be defined, and any input can belong to any group. The Next key then cycles around the groups instead of the inputs; each group displays the summed total of its inputs. Groups have names, overload levels, scaling and formats. Unless disabled, you can drill down to the inputs of a group.

8.2 Global settings

Item	Description
Global Timeout (s)	How long the handheld waits without data from the viewed transmitter before indicating that the signal has been lost. Set it to at least twice the slowest transmitter interval.
Do Sleep Wake	Enables the handheld to wake and sleep transmitters. With no transmitters defined, all sleeping transmitters (same radio channel and group key) are woken as they come into range, but never sent to sleep. With transmitters defined, all transmitters are woken during the first 12 seconds after turning the handheld on (not only those defined), and the transmitters in the list are sent to sleep when the handheld is turned off.
Backlight Control	Disable or enable the backlight. Enabled: either on as soon as the handheld turns on and controlled by a short press of the power key, or automatic – on when a key is pressed, off after 30 seconds.
Auto Power Off	Time in minutes after which the handheld turns off if no key has been pressed; zero disables it. A change requires a power cycle.
Buzzer Control	Whether the buzzer sounds when certain states are active.
Leading Zero Suppression	Removes leading zeros from displayed values in all modes.
Activate Viewed Input LED	With no transmitters defined, the viewed transmitter always activates its LED. With transmitters defined, their LEDs only activate when viewed if this setting is activated. Disable it with transmitters of the non-certified range with firmware below 04.00 – their LEDs may remain on when the handheld is turned off.

8.3 Inputs without a transmitter list

Item	Description
Set Size	How many transmitters with the highest signal levels make up the set through which the Next key cycles (see the examples in chapter 9).
Format & Resolution	7 digits are available. Enter numerals, a zero for each digit position, and the decimal point where it shall be shown. The display always shows the correct number of integer digits and may override decimal places: format 000.0000 and value 1000.1234 display 1000.123. The last digit sets the resolution (block size of changes): with 000.0005 the display changes only in steps of 0.0005, which masks noisy digits.

Item	Description
Zero Indication Band	Band within which the display always reads zero, to mask tiny changes after pressing Tare; zero disables it. Example: with 0.2 kg the display shows a stable zero while the actual weight fluctuates less than ± 0.2 kg.
Overload	Limit above which Over Load is shown instead of the value; applies to the gross input value including any custom scaling. Zero disables it.
Define Transmitters	Click Define to open the pages for defined transmitters.

8.4 Defined transmitters

Select the input by clicking the numbered tabs along the top of the page. Clear All (switch back to roaming mode) removes all transmitters and group settings.

Tab / item	Description
General: Data Tag	Entering a data tag enables this input; zero disables it. Data tags can be entered in any of the 24 slots; Next cycles between those entered.
General: Name	Shown briefly instead of the data tag when cycling with Next. The letters M, W and K cannot be displayed on a 7-segment digit, and some letters look alike (Z and 2); the LCD preview shows how the name will look.
General: Format, Overload Limit	As in section 8.3.
Zero: Power On Zero	Automatic zero at power-on: if the value read from the transmitter is within $\pm$ this value when the handheld is turned on, the display is zeroed. Zero disables it. Example: platform calibrated in kg, minimum box weight 5 kg, power on zero 2 kg – debris between -2 and $+2$ kg is tared off at power-on.
Zero: Zero Indication Band	As in section 8.3; also applies close to zero in gross mode.
Scaling: Gain, Offset	Displayed value = transmitted value $\times$ Gain – Offset (defaults 1.0 and 0.0; the offset is applied after the gain). Uses: remove a value (offset 10 removes 10), convert units (kg to lb: gain 2.20462), change polarity (gain -1.0).
Group Membership	For each of the 8 summing groups select Yes or No: does this input contribute to the group total? Configure Groups opens the summing group pages.

8.5 Summing groups

A summing group is enabled by giving it a name. As soon as one group has been named, the handheld cycles only through the group totals instead of the individual inputs. Select the group with the numbered tabs; Back returns to the transmitter input pages.

Tab / item	Description
General: Name	Enables the group; leave blank to disable it. Shown briefly before the total. Same letter restrictions as for inputs.
General: Format & Resolution, Overload	As in section 8.3.
Allow Drilldown	On General, Zero, Scaling and Members tab: a long press of Next starts to display the individual inputs of the group; each press of Next shows the next input; after the last input the display returns to the groups.
Zero: Zero Indication Band	As in section 8.3.
Scaling: Gain, Offset	Displayed value = sum of transmitted values $\times$ Gain – Offset (defaults 1.0 and 0.0).
Members	List of the inputs (name or data tag) whose values are summed in this group.

9 Application examples

9.1 Without a transmitter list (roaming mode)

Where there are more than 24 transmitters, or the available transmitters change, the handheld is used without defined inputs. The sleep delay of the transmitters is set to 30 seconds, as in this mode the handheld wakes the transmitters but does not send them to sleep.

- Long bridge: transmitters every 10 m along a 1000 m bridge. With a set size of 10 the operator cycles around the ten nearest transmitters, then walks on. Transmitters coming into range are woken automatically and return to sleep by their sleep delay when out of range.
- Storage room: barrels on weigh scales with transmitters whose LEDs are visible. With a set size of 1, each press of Next selects the transmitter with the highest signal – the nearest barrel, whose LED lights up.

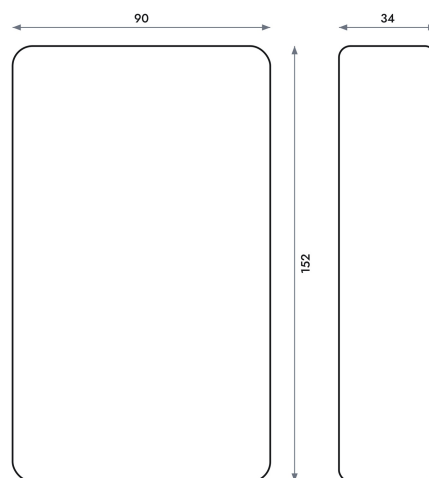
9.2 With a transmitter list

- Single transmitter: the transmitter on a guy line is the only input. Turning on the handheld wakes it; turning off sends it to sleep to conserve its battery.
- Multiple transmitters: three cranes, inputs named Crane 1, Crane 2 and Crane 3; a long press of Next verifies the name without moving on.

9.3 With summing groups

- Alternative units: a vessel on two load cells calibrated in lb. Both transmitters are inputs; group lbs and group tonnes both contain both inputs; the scaling of the tonnes group converts lb to tonnes with gain 0.000453592. Next switches between the totals, a long press shows the group name and hence the unit.
- Grouping sums: a suspended truss gantry with a load cell and transmitter at each corner, inputs named Rear L, Rear R, Front L, Front R. Groups Total (all four), Rear, Front, Left and Right: Rear L belongs to Total, Rear and Left, Rear R to Total, Rear and Right, Front L to Total, Front and Left, Front R to Total, Front and Right. The handheld shows Total, and Next steps through Rear, Front, Left and Right.

10 Enclosure and batteries



All dimensions in mm

Handheld dimensions in mm

The ABS handheld case is 90 mm × 152 mm and 34 mm deep at its highest section. There are no mounting options on the handheld enclosure. The antenna is mounted in the top end of the enclosure. The enclosure is sealed to IP67.

10.1 Opening the case

Warning The battery compartment cannot be opened in the hazardous area!

The battery compartment is secured with two Philips head screws. Once it has been removed, two further screws become accessible; these, together with the two at the top end, allow the entire case to come apart. This gives access to the legend channels, where cardboard legends can be slipped in behind the transparent label windows where supported.

- The top two screws have rubber O-rings. These rings are an integral part of the sealing mechanism.
- When the case comes apart, be careful of any wires running between the two case halves.
- Make sure gaskets and mating parts are free from dirt and debris when re-assembling.

11 Antenna and radio range

The EFMI has its antenna already fitted inside the enclosure, so there are no specific mounting requirements. The antenna is a printed circuit antenna (inverted F type, gain 3.0 dBi).

Radio performance at these wavelengths depends very much on the operating environment. Any structure within the operating region of the radios gives rise to three effects:

- Obscuration: an obstruction masks the line of sight between the radios and reduces the range.
- Aberrations to the horizontal and vertical space patterns: structures or objects in the near or intermediate field of the antenna distort the coverage patterns and adversely affect range and link quality.
- Reflection: objects in the line of sight of the transmit antenna make signals arrive by an indirect path (multipath effects), seen as reduced range or poor link quality.

Each of these reduces the RSSI figures, increases the packet loss rate and, in extreme cases, leads to complete loss of signal. If they are considered at the installation stage, a good quality link will be obtained.

11.1 Guidelines for installation

- Maintain line of sight between the modules, and keep objects and structures at least one metre away from the antennas wherever possible.
- Products with this antenna type should be oriented so that the long axis of the antenna is vertical during normal operation, if possible.
- Range under water is only 100 mm or so, depending on the packet rate.

11.2 Radio range

Maximum range in an open field site between two modules, depending on the antenna types of both modules. EFMH and EFMI both have the internal printed circuit antenna.

Antenna of the other module	Range to EFMH / EFMI
Internal printed circuit antenna (as in EFMH and EFMI)	800 m
Integrated chip antenna	600 m

Between two modules with integrated chip antennas the range is 500 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 off the ground.

12 Technical data

Parameter	Value
Display and functions	
Display	LCD, 7 digits (7-segment), indicators G, NET, SIG LOW, BATT LOW, REMOTE ERROR, REMOTE BATT LOW
Keys	Power, Next, Tare
Transmitters	any detected (roaming), or up to 24 defined
Summing groups	up to 8
Per input / group	name, scaling (gain, offset), display format, zero functions, overload
Power supply	
Cells	2 × Energizer L91 lithium AA (only these cells, section 2.3)
Power supply voltage	2.3 ... 3.0 ... 3.6 V DC (min ... typical ... max)
Current, active	typical 40 mA, max. 55 mA
Current, low power mode	typical 5 µA, max. 20 µA
Battery life (Energizer L91)	standby (powered off): more than 5 years · continuous operation: 54 hours
Radio	
Licence	licence exempt
Radio type	transceiver (2 way)
Modulation method	MS (QPSK)
Data rate	250 kbit/s
Radio frequency	2.4000 ... 2.4835 GHz
Power	10 mW
Channels (DSSS)	15
Range	up to 800 m, see section on radio range
Environment and mechanics	
Operating temperature range	−10 ... +50 °C
Storage temperature	−40 ... +85 °C
Humidity	0 ... 95 % RH
Protection	IP67
Dimensions	90 × 152 × 34 mm (34 mm at the highest section)
Enclosure	ABS, no mounting options
Antenna	internal printed circuit antenna
Explosion protection	see chapter 2

13 Radio approvals

Region	Product conforms to
Europe	CE
USA	FCC
Canada	IC

These approvals do not cover the entire set of standards that must be met in each country. Users assume full responsibility for learning and meeting the requirements of each country in their distribution market.

13.1 CE

Complies with EMC directive 2014/30/EU and the Radio Equipment Directive 2014/53/EU (European Community, Switzerland, Norway, Iceland and Liechtenstein).

This equipment is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

The EU declaration of conformity (ATEX directive 2014/34/EU, EMC directive 2014/30/EU, Radio Equipment Directive 2014/53/EU) is available from octagon on request; see also section 2.2.

13.2 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.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter RA24 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Antenna	Gain (dBi)	Antenna type
Ant A	3	Inverted F
Ant C	2.2	half wave dipole
Integrated	1.3	Chip antenna

Important 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.

13.3 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.