

MANUAL

EFMG

WIRELESS LARGE LED DISPLAY

Installation and user manual



Document	Version	Date	Applies to
Installation and user manual	V00x	10/2026	EFMG large LED display

This manual describes installation, connection, operation and configuration of the EFMG wireless large LED display, which shows the value of one T24 transmitter or the sum of up to eight.



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1 About this manual

This manual applies to the EFMG wireless large LED display. The display receives the values of T24 transmitters by radio; only the power supply has to be connected. It is configured with the T24 Toolkit software and a USB base station, for example octogon EFME.

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	EFMG wireless large LED display, four digits
Manufacturer type designation	T24-LD1
Hardware revisions	revision A and B with a keypad and an LED on the front panel; revision C onwards without keypad, with an indicator LED to the right of the digits
Compatible transmitters	T24 transmitters, for example octogon EFMC (in enclosure) and EFMF (OEM board)

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

- Connect an external 11 ... 30 V DC power supply capable of supplying 3.5 A. The power supply is not part of the delivery.
- The rear panel is held in place with finger screws, which only need to be gently tightened. Do not use tools to tighten or loosen the screws, as this could damage the internal threads.
- The display conforms to IP65 / NEMA 4X only when installed correctly.

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 EFMG is a large four-digit LED display for the value of one T24 transmitter or the summed value of up to eight. Only an 11 ... 30 V DC supply has to be connected; there is no signal cable. With the T24 Toolkit and a USB base station the transmitters to be displayed are selected and configured; the toolkit also offers advanced control of the radio settings and a system zero function. Two wired logic inputs allow tare and net/gross toggle to be controlled remotely.

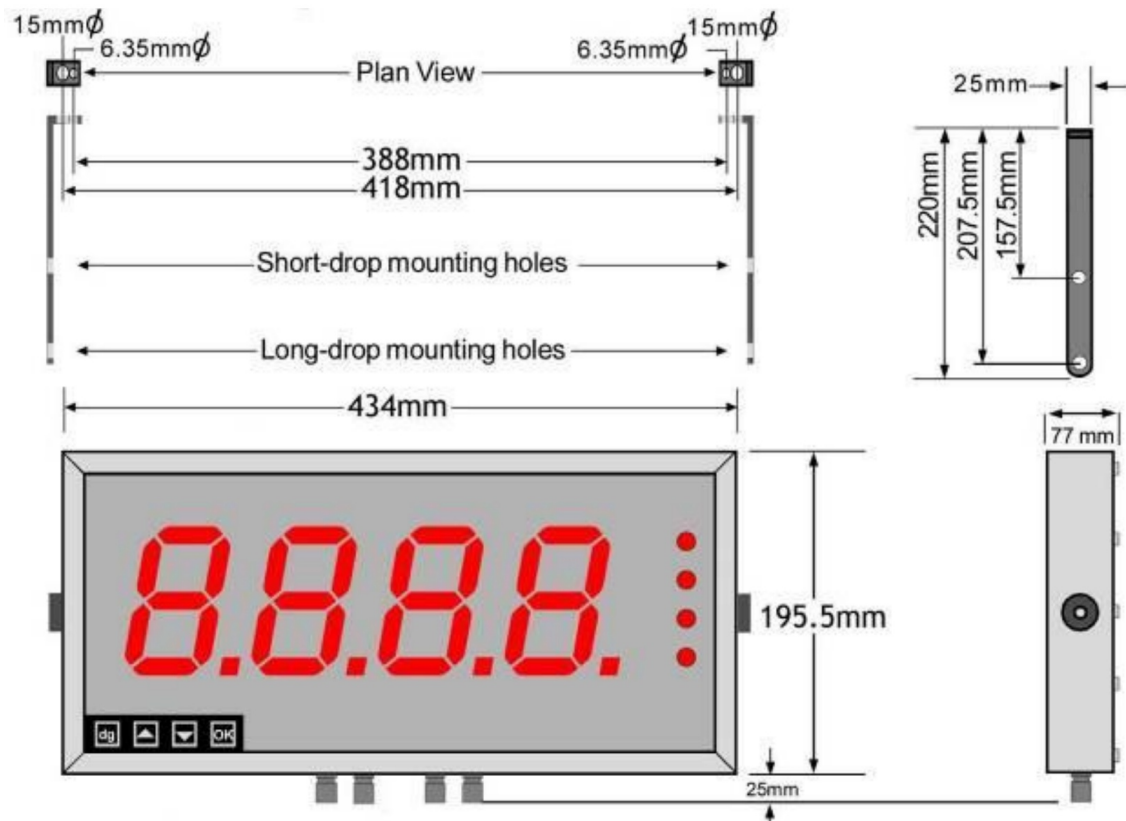
3.2 Technical data

Item	Value
Display	four LED digits, 100 mm high
Sources	one transmitter or the sum of up to eight
Display formats	0 . 0 . 0 . 0 . 00 . 0 . 000 (section 6.1)
Logic inputs	2 contact closure inputs: tare, net/gross toggle; 5 V DC, 1 mA
Radio	2.4 GHz licence-exempt transceiver, DSSS, 15 channels, 10 mW (chapter 11)
Range	up to 800 m, open field (section 11.2)
Supply voltage	11 ... 30 V DC, reverse polarity protected
Supply current	max. 3.5 A
Configuration	T24 Toolkit with a base station
Degree of protection	IP65 / NEMA 4X when installed correctly
Operating temperature	0 ... +50 °C
Storage temperature	–20 ... +70 °C
Humidity	0 ... 95 % RH, non-condensing
Dimensions (W × H × D)	434 × 195.5 × 77 mm; cable glands project 25 mm below the enclosure
Mounting	suspended from the ceiling or wall mounted

4 Mounting

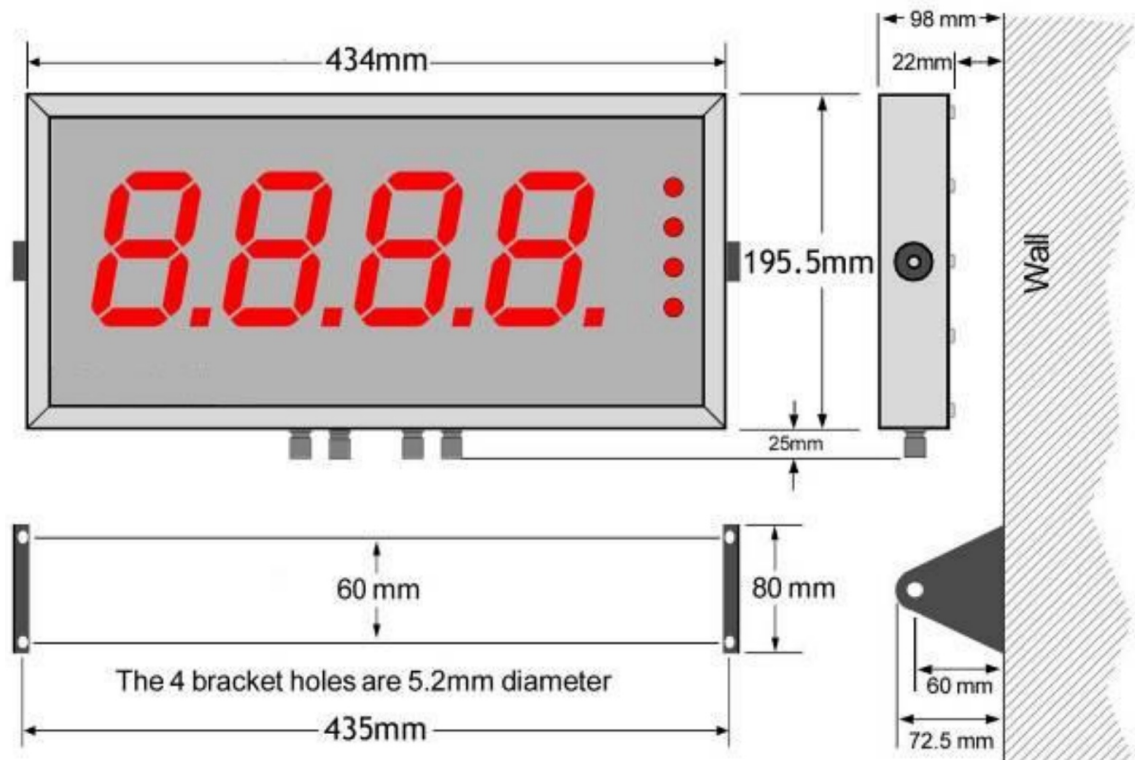
The display is designed for suspension or wall mounting. It is recommended to mount it at a higher elevation than the transmitter modules, because the antenna is located on the lower face of the display, where the cable glands are.

4.1 Suspended mounting



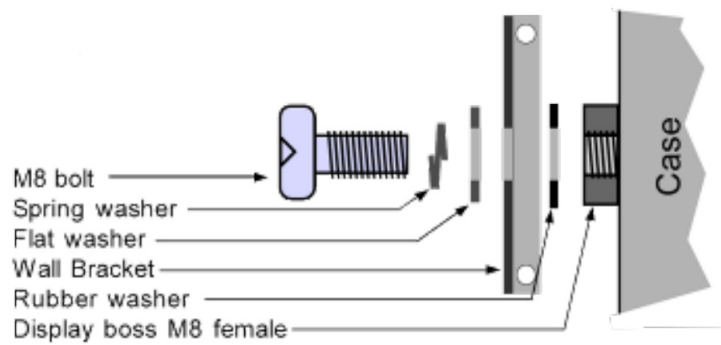
Suspended mounting, dimensions in mm: plan view of the brackets (holes 15 mm and 6.35 mm diameter), bracket with short-drop and long-drop mounting holes, front and side view. The drawing shows the keypad of revisions A and B.

4.2 Wall mounting



Wall mounting, dimensions in mm. The four bracket holes are 5.2 mm in diameter.

4.3 Fitting the brackets



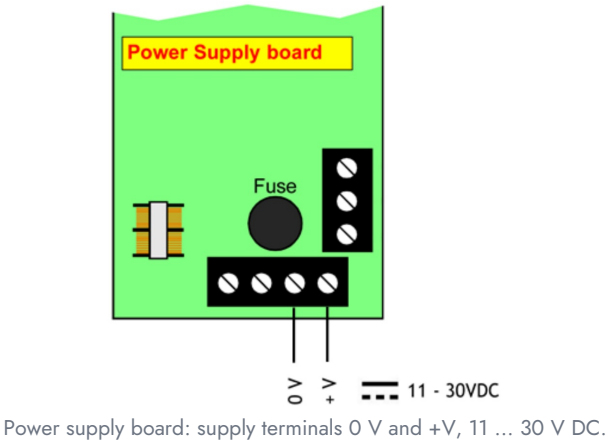
Fitting sequence of the bracket hardware, from the bolt to the display.

Order	Part
1	M8 bolt
2	spring washer
3	flat washer
4	wall bracket
5	rubber washer
6	display boss, M8 female thread

5 Electrical connections

To access the connections, remove the rear panel (finger screws, no tools – see chapter 2). The cable glands are on the lower face of the enclosure.

5.1 Power supply

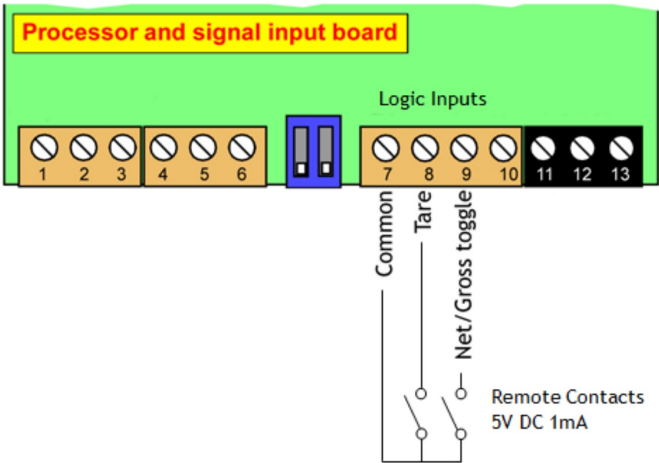


Terminal	Connection
0 V	supply 0 V
+V	supply +11 ... 30 V DC; the power supply must be capable of supplying 3.5 A

Only these two terminals of the power supply board are designated in the documentation; the other terminals and the fuse are not described. Contact octagon before using them.

5.2 Logic inputs

The logic inputs only need to be connected if their functions are required. The two contact closure inputs are pre-configured:



Processor and signal input board: logic inputs on terminals 7 to 9, remote contacts 5 V DC, 1 mA.

Terminal	Function
7	Common
8	Tare (contact closure 1)
9	Net/gross toggle (contact closure 2)

- Each input provides a 5 V DC signal; when it is connected to Common, a current of 1 mA flows.
- Because of this small signal, only switches with gold contacts or self-cleaning contacts are recommended.
- Terminals 1 to 6 and 10 to 13 and the switch block on this board are not described in the documentation; contact octagon before using them.

6 Operation

6.1 Display formats and messages

The display format, set in the toolkit (section 9.1), determines the range of values that can be displayed:

Format	Minimum displayable value	Maximum displayable value
0	-1999	9999
0.0	-199.9	999.9
0.00	-19.99	99.99
0.000	-1.999	9.999

Display	Meaning
- - - -	no new data has arrived from an input within its timeout
-Ur-	the value is below the minimum displayable value of the format
-Or-	the value is above the maximum displayable value of the format

6.2 Tare and net/gross

- When the tare contact is closed, the display shows zero and switches to net mode.
- The net/gross contact toggles between the net and the gross value.

From revision C onwards the top LED to the right of the digits shows the state when the logic inputs are used:

LED	Meaning
steady	showing the net value
flashing	showing the gross value
off	no tare value set; also when the logic inputs are not used

On revisions A and B the indicator LED sits with the keypad on the front panel.

6.3 Switching on

When the display is powered up, it tries to wake all transmitter modules on its radio channel and group key for the **waker Duration** set in the toolkit (section 9.1). Use the sleep delay of the transmitters to let them return to sleep after the display has been switched off.

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 The T24 Toolkit

The T24 modules are configured with the T24 Toolkit, a Windows application that is free of charge. A base station, for example the USB base station EFME, is required as the radio link between the PC and the modules. Install the software by running **setup.exe** and following the prompts.

- All items that can be changed or interacted with are shown in green. Click a green item to open a dialog window (slider, text box or list) and enter the new value.
- Double-clicking the icon in the top left of the window copies a screenshot of the current page to the clipboard.

Important Do not pair to multiple modules with multiple instances of the toolkit at the same time.

8.1 Connecting to the base station

On the start page select the interface type of the connected base station; for a USB base station no further settings are needed. The base station address is usually 1. Click **Home** to start communication. If no communication can be established, the toolkit stays on this page: check that the base station is powered and connected correctly.

8.2 Home page: connecting to a module

With communication to the base station established, pair to the module to be configured:

- Remove power from the module.
- Click **Pair** in the toolkit.
- Re-apply power to the module within 10 seconds.

If the connection succeeds, the toolkit changes to the Information page; if pairing fails, try again. Pairing does not change the radio settings of the module – the base station adopts those of the module. While the toolkit is connected, the module usually stops its normal transmission of messages.

- To configure the base station itself, hold the shift key and click **Pair**.
- If the power supply of the module cannot be reached, click the **Click Here** link at the bottom of the page and follow the prompts (soft pairing).

8.3 Information

Shows information about the connected module. A name can be entered to recognise the module later. The features supported by the module are shown as icons – coloured if supported, greyed out if not: protected calibration, group key support (and whether a group key is configured), listing of sleeping modules (base stations only), extended range radio (introduced 2015) and version 4.0 radio (better performance in hostile RF environments).

8.4 Battery and radio levels

Shows the radio signal levels at the base station and at the remote module, and the battery voltage of battery powered modules. The battery level at which a transmitter reports low battery can be set here (at 2.1 V the module stops working); below this level the bar turns orange. **Advanced** shows the details of the received radio packets:

Value	Meaning
LQI	Link quality indicator, 0 ... 100. Communication is achieved within this range; towards zero it may become intermittent.
RSSI	Received signal level, from about -30 (good signal) to -98 (weak signal).
CV	Correlation value, how well the signal can be decoded: 55 (poor) ... 110 (excellent).

8.5 Radio settings

Item	Function
Channel	Radio channel 1 ... 15, default 1. The spectrum analyser helps to find a clean channel.
Group Key	Only visible on modules that support group keys. Only modules with identical group keys can communicate; blank for operation together with older modules.
Reset Module Only	Enabled after a change. New radio settings only take effect after a reset or power cycle; this button makes the module adopt them while the base station stays on the existing settings, then returns to the Home page.
Reset Module and Base Station	Enabled after a change. Module and base station adopt the new settings and the connection is re-established.

When the radio settings of a base station are changed, the two reset buttons are not shown; the change takes effect immediately.

8.6 Radio settings advanced

- **Repeater Subgroup:** default 0, which lets all repeaters repeat messages from this module.
- Remote module radio settings tool: sets a batch of modules to the radio settings of the base station. Usually reached by pairing to the base station (shift + **Pair**). Remove power from the remote module, click the **Click Here** link, re-apply power. The toolkit stays paired as before; only the remote module changes its radio settings.

8.7 Save and restore

Save writes all configuration information of the connected module, including calibration data, to a file with the extension **.tcf**. **Restore** loads such a file into the connected module and overwrites all configuration information including user calibration data.

9 Display settings in the T24 Toolkit

Pair the toolkit to the display as described in section 8.2: remove the supply of the display, click **Pair**, re-apply the supply within 10 seconds. The following pages are specific to the display.

9.1 Input settings

Parameter	Function
Waker Duration	seconds during which the display tries to wake the transmitter modules when it is powered up; 0 disables the function. All transmitters on the same radio channel and group key are woken.
Display Update Data Tag	alternatively, the data tag whose arrival triggers a display update, for example the data tag of a handheld display function button – updates on demand
Data Tag (per input)	data tag (hexadecimal) of the transmitter that supplies this input; the values of all inputs are summed
P	gives 5 seconds to pair to a module (usually by power cycling it) and takes over its data tag and ID automatically
X	resets the data tag to zero
Timeout	in milliseconds; recommended 3 × the transmission interval of the transmitter. If no new message arrives within this time, - - - is displayed
Format	number of integer digits and decimal places, entered with zeros and a decimal point, e.g. 00.00 ; determines the displayable range (section 6.1)

9.2 Output scaling

Scales the displayed value, for example to show tonnes from a transmitter calibrated in kg. Enter the original and the required value at a low and a high point. Example: keep both low points at zero, enter 1000 as **At High Input Value** and 1 as **Display Should Read Value**.

9.3 Zero settings

Parameter	Function
Perform System Zero	stores the current values of all inputs and subtracts them from all subsequent outputs, so that the present input reads zero; it is retained after power-up. The data transmitted by the transmitters is not affected. Perform it with all inputs operational.
Remove System Zero	removes all system zeros and restores the outputs to normal
Advanced	system zero from an external module: data tag of the message to use for the external system zero, with P (pair, 5 s) and X (reset data tag and ID, disables the function)

Example: a four-input weighing platform with calibrated transmitters shows a gross value of 50 kg from the platform structure alone. A system zero, performed with all inputs operational, removes it; the next time the display is powered on, the same input yields zero.

10 Fault finding

Observation	What to check
The display stays dark	Supply 11 ... 30 V DC on 0 V and +V, power supply capable of 3.5 A.
- - - -	No new data within the timeout. Is the transmitter powered, awake and in range? Do data tag, radio channel and group key match? Timeout at least 3 × the transmission interval.
-Ur- or -Or-	The value is outside the range of the display format: choose a format with fewer decimal places or scale the output.
Transmitters are asleep after switching on	Waker Duration is 0 or too short.
The indicator LED is not lit	The logic inputs are not used, or no tare value is set.
Tare or net/gross does not react	Check the wiring to terminals 7 (Common), 8 and 9 and use switches with gold or self-cleaning contacts.
Poor reception	Mount the display higher than the transmitters; keep the lower face with the antenna free (chapter 4 and section 11.3).

11 Radio, antenna and range

11.1 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 antenna on the lower face of the display, where the cable glands are located

11.2 Range

Maximum range in an open field site between this device and the other module, depending on the antenna of the other module. The display 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.

11.3 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.

12 Approvals and declaration of conformity

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

12.1 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.

12.2 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.

12.3 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.