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Eltav Valve Device (VD)

Operation Manual

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Approvals Signatures (on P4)

Document Version	Date	Name	Signature (Print your name)

FCC ID: X2VVDA1114
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.

IC: Industry Canada 8876A-VDA0001X
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.

C ETL US LISTED
Intertek
XXXXXXX
Conforms to ANSI/UL std XXX
Certified to CAN/CSA std CXX No.XX

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Safety Precautions

IMPORTANT:

The equipment contains communication devices. Any changes or modifications made to the equipment without the written consent of ELTAV, and its resellers or distributors, can nullify the user's authority to operate this equipment.

The user assumes all risks associated with the use and handling of the equipment, and specifically acknowledges that ELTAV, and its resellers or distributors, will not be liable for any damages of any kind, including personal injury or property damages resulting from use of the equipment.

IMPORTANT:

Carefully read the safety information contained in this section, and throughout this user guide, before installing, operating, or performing any maintenance task on the equipment.

IMPORTANT:

Operations not performed as per the instructions in this user guide are done at the user's own risk and liability.

IMPORTANT:

Only trained, authorized personnel should install, maintain and repair the equipment.

IMPORTANT:

For preventing electrostatic charge on plastic surface of the VD always wipe the surface with a wet cloth.

Once you have thoroughly reviewed this user guide, if you have any questions, please contact ELTAV at +972-9-7440012 or your reseller.

General

- Follow all warnings and cautions provided in this User's Guide.
- Comply with all approved and established precautions for operating the equipment.
- Never install equipment that is damaged.

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1. Introduction

Eltav Wireless Monitoring Ltd. (www.eltav.com) is a private Israeli company established on July 2006.

The company mission is to develop, manufacture and sell real time and low cost wireless monitoring systems for valves (mainly quarter turn) widely used in the PROCESS INDUSTRY**.**

The process industry is the largest industry in the world (pharmaceutical, oil, food, semiconductors, water treatment, etc.). Close to 200 millions valves are sold per year. The estimated number of installed worldwide industrial valves is 2-3 billion. 80% of the sold or installed valves are manual. The balance is actuated (pneumatic or electric) and approximately 60% of the actuated valves are not monitored. Almost all manual valves sold or installed are not monitored.

One of the solutions to monitor valves is a switch box which is mounted on top of the valve or actuator. However, since the cost of wiring including the wired infrastructure is extremely high ($5000 per a monitored valve in an explosive environment), the wired solution is not affordable for most of the valves. A monitoring solution of 5,000 valves site (considered a small pharmaceutical process line) can cost a prohibitive $25 million dollar.

Therefore, there is a growing interest in the market for Eltav's unique wireless monitoring solution which will allow wirelessly monitoring of valves at a fraction of the cost (5-10%) of the current solution. By deeper valve monitoring the process line will increase yield, provide better safety, meet regulation, reduce pollution and a better control of process line operation will be achieved.

This unique add-on wireless solution is being offered to end users at 5% -10% of the cost of a wired solution.

The ELTAV system should be regarded as an add-on layer on top of the traditional Process Management Systems (PMS) and designed to enhance the monitoring capacity and capability of the traditional wireless networks. For that purpose, the ELTAV system is a low cost and versatile solution that was carefully designed for very easy installation, implementation, operation and maintenance on existing and new process manufacturing lines. The ELTAV system is committed to provide the necessary means and tools to integrate the ELTAV system with the most commonly used systems, formats and standards in the process industry.

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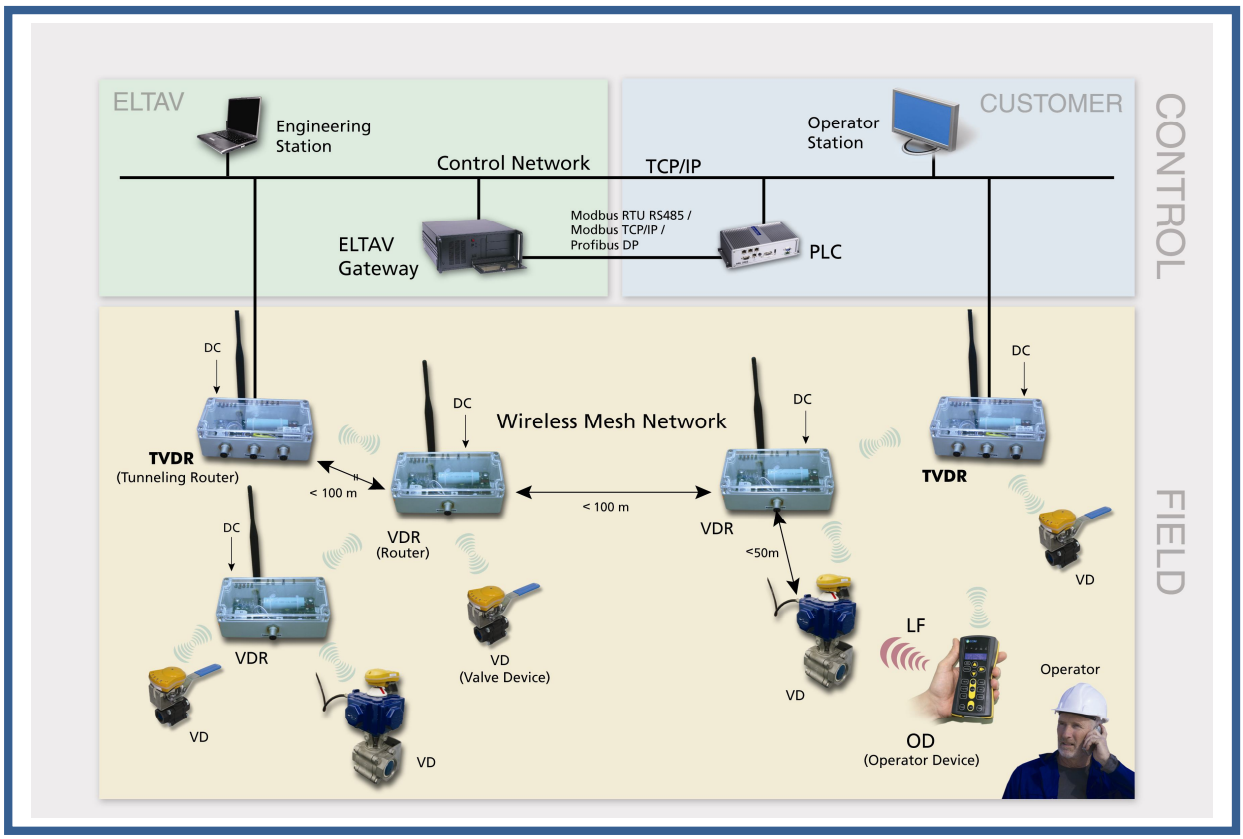
2. Definitions & Block Diagram

2.1 Eltav System Components



The Eltav System consists of the following components:

(1) VD (Valve Device) – The end user device installed on the valve (or actuator) and reporting on valve status (by measuring stem angle) every predetermined period (default set to 15 minutes) or whenever a deviation in stem angle is detected

(2) VDR (Valve Device Router) – Collects reported data from all associated VDs and transfers wirelessly to next VDR

(3) TVDR (Tunneling VDR) – Last-hop VDR that transfers collected data from VDRs to Eltav Gateway. Several TVDRs can be connected via TCP/IP to Eltav Gateway (for redundancy).

(4) Eltav Gateway – An industrial Computer running:
   a) EMS – for managing the Eltav Network, and
   b) OPC server – for creating interfaces to OPC data clients and/or PLCs

(5) OD (Operator Device) – Enables to add the operator to the network for receiving messages, report performance and assist in installation and maintenance tasks. Practically the OD acts as the mobile field worker's operator panel of the Eltav System.

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3. VD - Principles of Operation

(1) A small *Valve Device* (VD) is externally affixed to a quarter turn valve (and when possible, by a standard ISO 5211 mating flange) using a simple attachment mount. The VD is battery powered and uses the standard wireless 802.15.4/ZigBee, 2.4 GHz protocol to wirelessly transmit and receive messages for monitoring the status of the valve. The system will utilize ISA100 standard compliance solution as soon as the standard will be released.

(2) The VD incorporates a shaft that is fastened to valve stem through a special cylinder which transfers the turn of the stem to the VD. An internal VD sensor measures the circular position of the VD shaft thus measuring the angular position of the stem in degrees relative to valve.

(3) The VD reports the valve position (angle) every 15 minutes (configurable) or immediately when it is sensing motion of the valve lever. The VD temperature, VD battery status, and other VD housekeeping information are broadcasted with every VD message. Each VD message is transmitted with a real time stamp. In between transmissions the VD is in its dormant status for saving battery power.

(4) At normal operation profile the battery should suffice for about 5 years. Battery pack is replaceable in the field.

(5) The sensed VD information is broadcasted to a network of VDRs (Valve Device Router) that are installed along the process line.

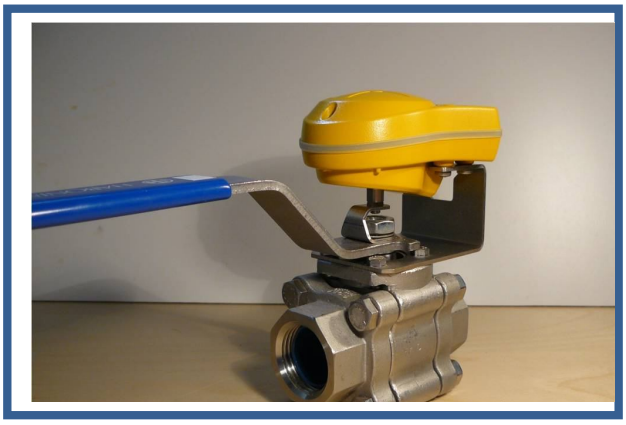
(6) One or more VDR(s) (Called Tunneling Router or TVDR) are connected directly to the site network using TCP/IP communication on Ethernet. The TVDRs are responsible for the bi-directional communication between all VDRs and the Eltav Gateway.

(7) Remote VDRs transmit their messages wirelessly to nearby VDRs that are closer to the TVDR. The VDRs network acts as a relay that retransmits the messages received from remote VDRs through the ZigBee wireless network until they get to a TVDR. ZigBee mesh technology is implemented in the application.

(8) The VD also consists of a Low Frequency (LF) receiver for receiving setting commands from the Operator Device (OD).

(9) The operator uses the *Operator Device (OD)* which allows inserting operator ID into the VD when a manual valve operation is executed. Additionally the OD is used to set up and configure the VD and prepare it to join (or leave) the network. The OD uses short range Low Frequency (LF) to communicate with the VD and the ZigBee network for getting responses.

(10) The VD can be installed on an actuator for monitoring its position or on manually operated valves.



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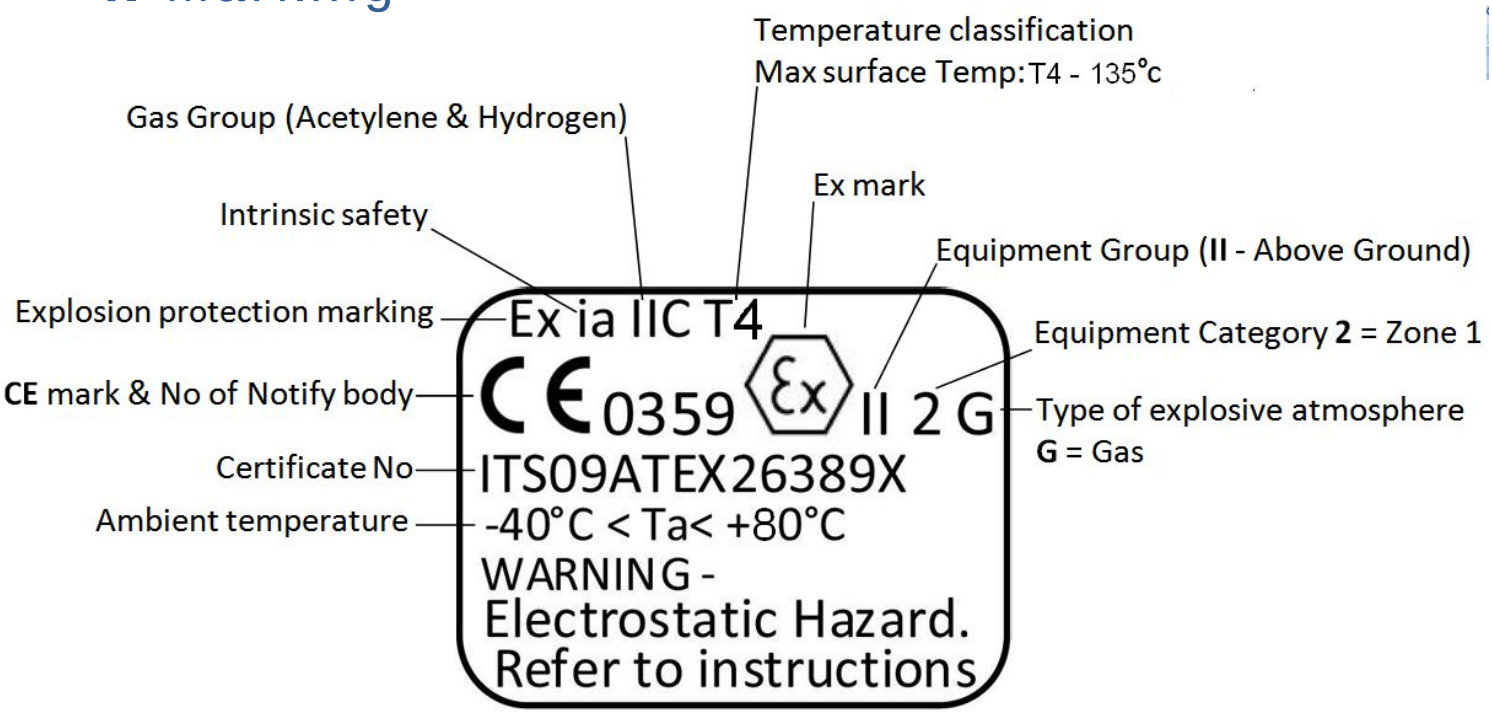
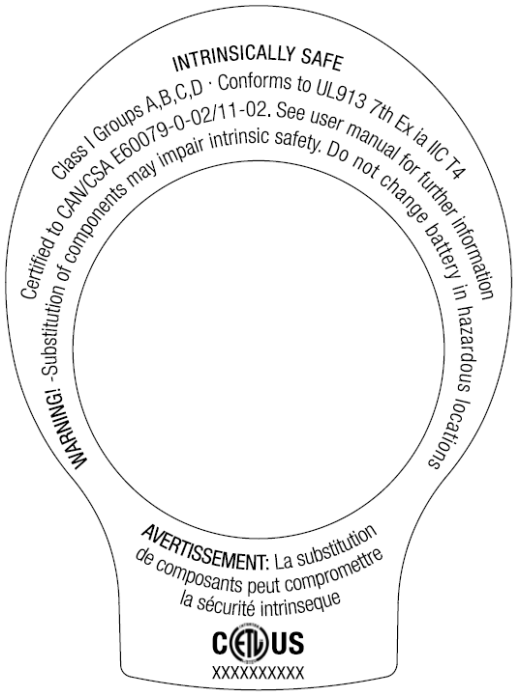
4. Marking





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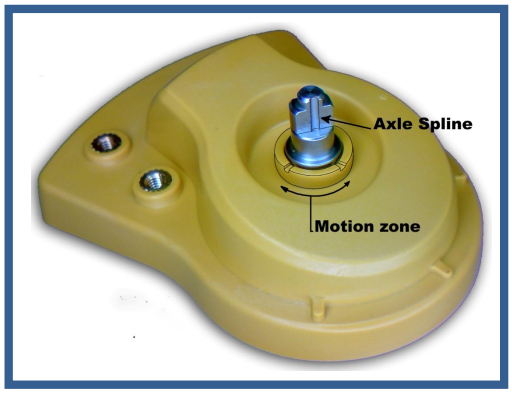
5. VD – Installation and Operation Instructions

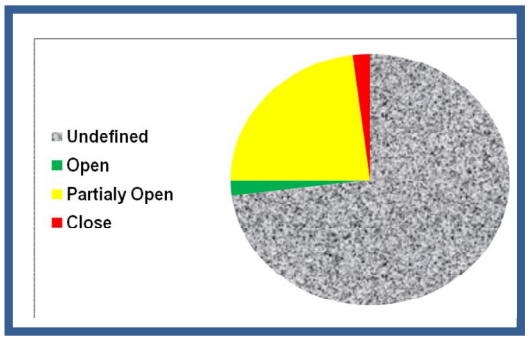
A series of mechanical flanges are used for installing the VD on specific types of valves/actuators. Most of the time such flanges consists of two part: (1) connects the fixed part of the VD to the fixed part of the valve, and (2) connects the rotating part of the VD to the rotating part of the valve.

The VD has an effective valve position (angle) measurement range of about 110º. On VD's stem there is an Axle Spline indicating the position of the stem (valve). On the bottom of each VD there are two engraved lines marking a range of 90º. This is the effective motion zone of the VD's stem for measuring position of quarter turn valves. At manufacturing all VDs are calibrated for centering the Motion Zone in the position measurement range.



When installing the VD on a quarter turn Valve or Actuator the installer has to make sure that the ***Axle Spline*** is always in the range between the two engraved signs of the ***Motion zone***. During installation the installer has to calibrate the relative positions of the VD and the Valve to guarantee effective and accurate position measurements.

The complete motion span of the VD is described in the figure herein showing that it is divided into two areas by two specific angles, valve OPEN and valve CLOSED. The two specific angles are actually sectors due to the tolerance set for the two valve positions. This divides the motion span of the VD into four sectors:

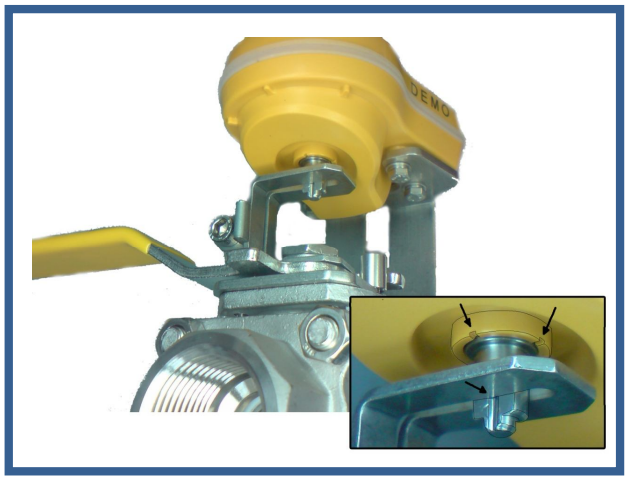


(1) Valve OPEN (green sector) – when valve's position is within this sector the VD reports that valve is OPEN – zero degrees (the angle and tolerance are set in calibration process).

(2) Valve CLOSE (red sector) – when valve's position is within this sector the VD reports valve CLOSED (the angle and tolerance are set in calibration process).

(3) The yellow sector is the quarter turn motion span of the valve and the VD will report as PARTIALLY OPEN and the measured angle.

(4) The gray sector represents the UNDEFINED positions angle first because it is out of range for the valve's span and second because it is out of range for the position sensing of the VD.



During installation a calibration process has to be performed for teaching the VD the angles for both OPEN and CLOSE positions. Calibration is performed by the OD communicating with the VD.

Next step is to make the newly installed VD to join the network. This is also done by the OD communicating with the VD to provide all passwords and information required to join the Zigbee network.

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The OD is used for turning the VD ON and OFF and also for all VD settings as presented in OD's Operation Manual

The drawing on the right presents the colors and function of the 4 LEDs on the VD top panel. All LED indications are by blinking:

a. Every 30 seconds
b. At every change in valve's position (angle)
c. At every transmission of the VD

(1) The OPEN/CLOSE LEDs have a special combination indication:

a. For a "partially open" valve both OPEN and CLOSE LED's will blink
b. For an "undefined position" of the valve neither the OPEN nor CLOSE LED's will blink

(2) At special operations like: ON, OFF, Calibrate and OD LF commands a sequence of the LED's is activated.

(3) Online indicates the VD is registered on the network

(4) Tx indicates transmission

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6. VD – Troubleshooting

6.1 VD fails to join network

When VD fails to join the network follow these steps:

(1) Check in EMS if the network operates and make sure that all VDRs and TVDRs are ON and operational. If "yes" move to step (2). If "no" move to step (3). If necessary use the EMS user manual.

(2) Use OD to leave and rejoin the network (follow instructions in OD user manual). This step will refresh in OD the network information. After OD rejoins the network, use the OD to command the VD to rejoin the network. This step guarantees that VD gets updated network information.

(3) Use EMS to "kill the network" and wait for the network to reestablish. When network is reestablished repeat step (2) above.

6.2 OD fails to establish a LF session with VD

When OD fails to establish a LF session with VD it is usually a LF signal propagation issue meaning the OD is either to close or too far from VD. Consult the OD user manual for trying to adjust the distance/orientation of OD relative to the VD.

6.3 Valve reports on "Undefined State"

Usually this indicates on wrong mounting of the VD on valve and motion sector of the valve is not within the motion sector of the VD. Check and reinstall.

6.4 VD is not reporting correctly on OPEN and CLOSE positions of Valve

This indicates on wrong calibration setting of the VD. Follow OD user manual to reset present calibration and repeat calibration setting procedure.

7. Specifications

General	
Purpose	**Wirelessly monitoring the position of manual and actuated valves in the process industry**
Installation	**VD can be mounted on operating installed valves using ISO/DIS 5211.2 F03 to F12 Flanges and on actuators using the NAMUR interface, or on new manual valves and actuators.**
Wireless Communication	**Two way Radio – IEEE 802.15.4 – 2006 at 2.4 GHz.**
Communication Protocol	**Zigbee Pro version Will be modified in future to ISA-100 when released.**
Message Hopes till Reached TVDR	**Up to 10 hopes from VD to VDR to VDR till it reaches a TVDR**
Approach	**Angle measurement of valve stem position.**
Update Rate	**VD at sleep all time. VD transmits its status every 15 minutes or immediately when valve moved more than 1^0.**
Latency	**Less than 0.1 sec in average (assuming one hop)**
Interface to Existing Process Control Systems	**The Eltav Gateway is designed to deliver data collected from the process line to any typical client or format commonly used in the traditional process control lines. This starts with OPC for the Delta V or similar systems and down to the valve status report fed directly to the LPC in the line.**

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Valve Device (VD)	
Sense Movement Duration	Between 30 msec to 4 minutes
Sector	Quarter turn: - 10^0 to +100^0
Resolution	0.1^0
Accuracy	$\pm 1^0$
Calibration and setup on valve	Using Operator Device (OD) with short range Low Frequency wireless communication between OD and VD.
Battery	2 X Lithium Tadiran ½ AA TL4902. Field replaceable.
Battery Life	5 years assuming one valve position change per hour and nominal configuration.
Message timing	Each message is sent by VD with real time stamp
VD max Transmitted Power	+3dBm.
VD Antenna	Internal +2 dBi peak. Optional external antenna F-SMA connector (VD mounted or remote).
Communication range VD - VDR	Open space – about 70m. In doors at non obstructed environment – about 25 m.
Additional VD Measurements	VD internal temperature, battery voltage and unit's house-keeping parameters.
Valve Transition Measurement (optional)	After 1^0 move of valve, VD collects up to 64 readings of valve position every 5 ms up to 9.6 sec (user selectable in discrete steps) and transmits them as a packet.

Valve Device (VD)	Cont.
VD software upgrade	Both the Zigbee stack and the MCU application can be upgraded through the Zigbee link (DOR – Download Over Radio).
Case Material	Nylon 12 with 50% glass beads, UV stable

Environmental	
Operating Temperature (VD/VDR/TVDR)	-40^0C to 85^0C
VD/VDR/TVDR sealing	IP66 grade
VD ATEX	Category 2 / Division 1 - II 2 GD EEx ia IIC T6 (intrinsic safety Zone 1/21)

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