((SENSONEO))

WatchDog

Datasheet 2021

WatchDog is the ultimate service monitoring device for waste collection vehicles.

Content

Quick overview of device features

Automate service verification

WatchDog is a **powerful ultra-high frequency (UHF) radio-frequency identification** (RFID) reader with up to 4 antennas. Short-distance (low-power) antennas **recognize bags, bins or containers and record the pickup**. Reading range is adjustable (via antenna power adjustment). All data flows to Sensoneo platforms including **satellite location and time&date.**

For reliable service verification, **each asset needs unique identification**. We recommend RFID. Sensoneo offers tags, stickers and special trash bags with built-in **ultra-high frequency (UHF) radio-frequency identification (RFID) chips.**

Stop collecting unpaid trash

Collect only trash you get paid for. Long-range (high-power) RFID antennas recognize bins or bags near the truck. **WatchDog warns Dustmen about unpaid trash.** Curbside readings are possible **only for UHF RFID chips**. Reading range is up to 4 meters. For lower frequencies (LF or HF) RFID chips reading range is 1 meter or less.

Prevent fraud

Collect only trash from authorized bags, bins and containers. **Pickup details contain Asset ID, date&time and satellite (vehicle) location**. The Operator easily spots pickup without an Asset ID (RFID chip) and can investigate. Also, comparing satellite (vehicle) location with an existing database highlights stolen bins.

Track satellite (vehicle) location

WatchDog offers **industrial-grade location accuracy using Global Navigation Satellite System (GNSS)**. We have access WatchDog supports **GPS, GLONASS, Galileo, Beidou and QZSS** satellite systems. More satellites improve location accuracy and ensure signal availability. WatchDog accuracy is 2.5m (CEP).

We are proud of our enterprise-grade hardware design

Reliable data supply

WatchDog collects all the data to the Main unit. The communication module sends data via **GPRS, NB-IoT or CAT-M1** to Sensoneo cloud-based platform every in real-time. In case of power supply fail, data is safe with the Main unit`s backup power source.

Resilient hardware design

Sensoneo Engineers are proud to **design truly resistant hardware perfect for harsh conditions.** WatchDog is a result of **Sensoneo in-house R&D.** It is made in the EU using superior components. **Operating temperature is -30 °C to 70 °C.** Humidity & temperature sensor allows for a built-in self-diagnostic. For extreme weather conditions, a self-heating system is available.

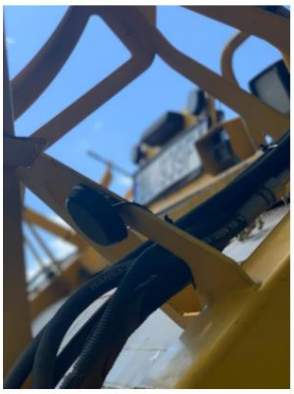
Built for integration

Easily integrate any existing and future devices on the truck with WatchDog. The Main unit can accommodate **data collection and transfer for several connected devices.** Its robust computing capability supports multitasking. Available interfaces are **CAN bus, RS485/RS422, STROBE Pulse, FLASH Beacon and BEEPER indicator.**

RFID Watchdog is robust and multifunction equipment for professionals in the waste-collecting segment. RFID UHF scanner (reader) is reading simultaneously more tags.

List of product features

- Satellite location, dat&time
- Monitoring waste collection
- State-of-the-art connectivity
- 12V/24V automotive powering with interruption backup – plug & play
- Remote battery operated buttons to report waste bin status
- Passive RFID tags mounted on the emptying mechanism to detect tilt
- The system operated when the engine is running only – auto power on/off
- Curbside bin recognition providing an early warning for unpaid bins




WatchDog design - 5 components

Main Unit

Main Unit is the “brain” of the device. It collects & transfers data, ensures backup /power & data/ in case of power failure, tracks vehicle location. This is the Master device in the system.

RFID Antennas

There are several RFID antennas placed on the vehicle – long-range (high-power) and short-range (low-power). Antennas read RFID tags on the bins and send the info to the Main Unit. RFID reading provides service verification, inventory updates and fraud prevention.

Smart Bin Tags (or Stickers)

All trash bag, bin or container is equipped with tag or sticker with a UHF RFID chip. Each chip has a unique identification number. Watchdog recognizes the identification number when the bin is close proximity.

Built-in Smart Tags

RFID Tags are placed on the vehicle arms to recognize the emptying movement. It is a tool for fraud prevention. Every time the arms are in the emptying position, the built-in RFID tag (passive) placed on the vehicle arms swipes the RFID antenna and emptying is recorded. If the bag, bin or container is not recognized at the same time, you are collecting waste for free.

Smart Buttons

One or more Smart Buttons can be installed on the vehicle and connected to the Main Unit. Smart buttons serve as manual feedback from Dustmen. The staff shall push the button to provide the feedback (agreed and configured in the Dashboard). Feedback is recorded in the Sensoneo Platform (Dashboard). Example: record the bin fill level - 3 buttons - each representing a fill level (empty, half-empty, full).

Technical specification

Mechanical and environmental

Main unit

Table 1. Mechanical and environmental

Parameter	Value	Note
Operating temperature range	-30 °C to 70 °C	
Storage temperature range	-40 °C to 80 °C	
Recommended/Optimal storage conditions	<30°C, <75 %RH	
Operating humidity	0 to 100 %RH	
Operating pressure	700 mbar to 1100 mbar	
Ingress protection	IP67, IP68, IP69K	IEC 60529/A1 IP68: 1.2m / 2hours
Protection against impacts (hammer test)	IK08	EN 60068-2-75 (1.7kg / 29.5cm / 5 Joule)
Dimensions	259 x 128 x 92 (box) 296 x 129 x 99 (box with bracket) 296 x 167 x 99 (box with antennas and connectors / without cables)	Length x Width x Height
Housing material	ALU (housing) / PC (antennas) / copper alloy (connectors)	
Surface finishing	Al Mg Si powder-coated + Natural anodized	
Weight	TBD g	
Mounting	Bracket	

Smart buttons

Table 2. Mechanical and environmental

Parameter	Value	Note
Operating temperature range	-30 °C to 70 °C	
Storage temperature range	-40 °C to 80 °C	
Recommended/Optimal storage conditions	<30°C, <75 %RH	
Operating humidity	0 to 100 %RH	
Operating pressure	700 mbar to 1100 mbar	
Ingress protection	IP67, IP68, IP69K	IEC 60529/A1 IP68: 1.2m / 2hours
Protection against impacts (hammer test)	IK10	EN 60068-2-75 (5kg / 40cm / 20 Joule)
Dimensions	TBD mm x TBD mm x TBD mm	Length x Width x Height
Housing material	TBD	
Weight	TBD g	
Mounting	Mounted with two ring brackets	

Bluetooth data connectivity

Table 3. Bluetooth general specification

Parameter	Value
Supported standard version	V5.1 BLE
Bluetooth Low Energy	Yes
Advertising mode	Yes (1 sec interval)
Maximum Bluetooth peer connections in configuration mode	1
Maximum Bluetooth peer connections in Master mode	TBD
Bluetooth connection to CAN bus adapter	Yes
Antenna type	Integrated (dome type)
Maximal radiated RF power (EIRP)	+10 dBm

LTE NB-IoT connectivity

Table 4. NB-IoT specification

Parameter	Value
Supported standard	LTE Cat NB1 Release 13 (NB-IoT)
Uplink data rate	70 kbps
Downlink data rate	32 kbps (multi-tone)
SMS	No
Frequency bands	B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/ B20/B25/B26/B28
Conducted RF output power	23 dBm ±2 dBm
TRP	TBD dBm
TIS	TBD dBm
Protocol stacks	TCP/IP, UDP/IP, FTP
DFOTA	Yes
SIM card	3FF (Micro SIM) MFF2 (chip SIM)(Optional)
eSIM	TBD
Antenna type	Integrated (dome type)
Regulatory	• CE RED • FCC • PTCRB
Carrier approvals	• Vodafone • Telefonica • T-Mobile • Telstra • Verizon • AT&T
PSM	Yes
eDRX	Yes (Optional)
Mobility	Yes, nomadic, without full hand-over

NB-IoT frequency bands

BAND	Uplink frequency (MHz)	Downlink frequency (MHz)
B1	1920 – 1980	2110 – 2170
B2	1850 – 1910	1930 – 1990
B3	1710 – 1785	1805 – 1880
B4	1710 – 1755	2110 – 2155
B5	824 – 849	869 – 894
B8	880 – 915	925 – 960
B12	699 – 716	729 – 746
B13	777 – 787	746 – 756
B17	704 – 716	734 – 746
B18	815 – 830	860 – 875
B19	830 – 845	875 – 890
B20	832 – 862	791 – 821
B25	1850 – 1915	1930 – 1995
B26	814 – 849	859 – 894
B28	703 – 748	758 – 803

LTE CAT-M1 connectivity

Table 5. Cat-M1 specification

Parameter	Value
Supported standard	LTE Cat M1 Release 13
Uplink data rate	375 kbps
Downlink data rate	375 kbps
Frequency bands	B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/ B20/B25/B26/B28
Conducted RF output power	23 dBm ±2 dBm
TRP	TBD dBm
TIS	TBD dBm
Protocol stacks	TCP/IP, UDP/IP, FTP
DFOTA	Yes
SIM card	3FF (Micro SIM) MFF2 (chip SIM) (Optional)
eSIM	TBD
Antenna type	Integrated (dome type)
Regulatory	• CE RED • FCC • PTCRB
Carrier approvals	Vodafone, Deutsche Telekom, Telefonica, T-Mobile, Telstra, Verizon, AT&T
PSM	Yes
eDRX	Yes (Optional)
Mobility	Yes, full hand-over

Table 6. Cat-M1 frequency bands

Band	Uplink frequency (MHz)	Downlink frequency (MHz)
B1	1920 – 1980	2110 – 2170
B2	1850 – 1910	1930 – 1990
B3	1710 – 1785	1805 – 1880
B4	1710 – 1755	2110 – 2155
B5	824 – 849	869 – 894
B8	880 – 915	925 – 960
B12	699 – 716	729 – 746
B13	777 – 787	746 – 756
B17	704 – 716	734 – 746
B18	815 – 830	860 – 875
B19	830 – 845	875 – 890
B20	832 – 862	791 – 821
B25	1850 – 1915	1930 – 1995
B26	814 – 849	859 – 894
B28	703 – 748	758 – 803

GPRS connectivity

Table 7. GPRS specification

Parameter	Value
Supported standard	
Uplink data rate	85.6 kbps
Downlink data rate	107 kbps
SMS	No
Frequency bands	850/900/1800/1900 MHz
Conducted RF output power	23 dBm ±2 dBm
TRP	TBD dBm
TIS	TBD dBm
Protocol stacks	TCP/IP, UDP/IP, FTP
DFOTA	Yes
SIM card	3FF (Micro SIM) MFF2 (chip SIM) (Optional)
Antenna type	Integrated (dome type)
Regulatory	• CE RED • FCC • PTCRB
Carrier approvals	• Vodafone • Telefonica • T-Mobile • Telstra • Verizon • AT&T
Mobility	Yes, full hand-over

EDGE connectivity

Table 8. EDGE specification

Parameter	Value
Supported standard	
Uplink data rate	236.8 kbps
Downlink data rate	296 kbps
SMS	No
Frequency bands	850/900/1800/1900 MHz
Conducted RF output power	23 dBm ±2 dBm
TRP	TBD dBm
TIS	TBD dBm
Protocol stacks	TCP/IP, UDP/IP, FTP
DFOTA	Yes
SIM card	3FF (Micro SIM) MFF2 (chip SIM) (Optional)
Antenna type	Integrated (dome type)
Regulatory	• CE RED • FCC • PTCRB
Carrier approvals	• Vodafone • Telefonica • T-Mobile • Telstra • Verizon • AT&T
Mobility	Yes, full hand-over

LTE Cat 1 connectivity (4G)(optional)

Table 9. LTE Cat-1 specification

Parameter	Value
Supported standard	LTE Cat 1 Release 11
Uplink data rate	5 Mbps
Downlink data rate	10 Mbps
UMTS/HSPA+/GSM/GPRS/EDGE	Yes (850/90/1900/21000)
LTE Frequency bands	B1/B2/B3/B4/B5/B7/B8/B12/B13/ B20/B28
Conducted RF output power	23 dBm ±2 dBm
TRP	TBD dBm
TIS	TBD dBm
Protocol stacks	TCP/IP, UDP/IP, FTP
DFOTA	Yes
Antenna type	Integrated (dome type)
SIM card	3FF (Micro SIM) MFF2 (chip SIM) (Optional)
eSIm	TBD
Regulatory	• CE RED • FCC • PTCRB
Carrier approvals	• Deutsche Telekom • T-Mobile • Verizon • AT&T
Mobility	Yes, full hand-over

Table 10. Cat-M1 frequency bands

Band	Uplink frequency (MHz)	Downlink frequency (MHz)
B1	1920 – 1980	2110 – 2170
B2	1850 – 1910	1930 – 1990
B3	1710 – 1785	1805 – 1880
B4	1710 – 1755	2110 – 2155
B5	824 – 849	869 – 894
B7	2500 - 2570	2620-2690
B8	880 – 915	925 – 960
B12	699 – 716	729 – 746
B13	777 – 787	746 – 756
B20	832 – 862	791 – 821
B28	703 – 748	758 – 803

Satellite (vehicle) location

GNSS

Table 11. GNSS specification

Parameter	Value	Note
High precision positioning	No	
Industrial/Professional precision positioning	Yes	
Dead reckoning	Yes	• With Embedded IMU (3D Accelerometer, 3D gyroscope) • Not required information about vehicle speed from speed meter and vehicle movement direction
Additional vehicle information for Dead reckoning	Not required information from the vehicle	
System	• GPS (Global) • QZSS (Japan) • GLONASS (Russian Federation) • Galileo (EU) • BeiDou (China)	
Data rate	<30Hz	
SBAS accuracy	2.5m CEP	
RTK	No	
Channels	72 channels	
Simultaneous concurrent bands	3	

Bands	• GPS:
	  ○ L1C/A (1575.420 MHz),
	• GLONASS:
	  ○ L1OF (1602 MHz),
	• GALILEO:
	  ○ E1B/C (1575.420 MHz),
	• BEIDOU:
	  ○ B1I (1561.098 MHz),
	• QZSS:
	  ○ L1C/A (1575.420 MHz),	

TTFF	Cold start: 26s Aided (hot) start: 3s	
Assistance	Yes	
Antenna type	Integrated (dome type)	Internal: connected via SMA connector
Sensitivity	-160dBm (tracking & nav.) -148dBm (cold start) -157dBm (hot start)	
Protocol	NMEA	
Storage on module	No	

RFID scanner

Table 12. RFID scanner specification

Parameter	Value	Note
Frequency range	860 MHz to 960 MHz	
EU band channels	• 4 (865.70 MHz) • 7 (866.30 MHz) • 10 (866.90 MHz) • 13 (867.50 MHz)	Compliant to ETSI EN 302 208
US band channels	• 1 (917.10 MHz) • 2 (917.30MHz) • ... • 49 (926.70 MHz) • 50 (926.90 MHz)	Compliant to FCC part 15.247
Custom bands	Yes	Custom table configuration possible only in production
Antenna gain	> -1dB	
Compliance	ETSI EN 302 208 ISO18000-6C/EPC	
Maximal RF TX conducted power	+27dBm	
TX Power level configurable	Yes, 1dB step	Configurable via Configuration App
Maximal RF TX radiated power	+30dBm	
RFID tag reading distance	<4.0m	
RFID detection distance configuration	No	Distance detection configuration is possible only empirically via TX output power setting.
Multiple antenna configuration	Yes	Configurable via Configuration App
Multiple antenna configurations	• 1 antenna • 1+1 antenna • 2+2 antennas	Configurable via Configuration App
Antenna type	External	
Separate power setting for dedicated antennas	Yes	
Multiple tag scanning	Yes	
Tag read time	400ms (typ)	
Tag idle time	100ms	
Antenna connector	TNC	

Built-in Sensors

Temperature sensor

Table 13. Temperature sensor

Parameter	Value
Measurement range	-40 °C to 80 °C
Measurement resolution	0.1 °C
Measurement accuracy	± 0.5 °C
Sensing point	Internal
Calibrated in production	No

Humidity sensor

Table 14. Humidity sensor

Parameter	Value
Measurement range	0 °RH to 100 °RH
Measurement resolution	0.1 °RH
Measurement accuracy	± 3 °RH
Sensing point	Internal
Calibrated in production	No

Heating system

Main unit is equipped by heating system which ensures tempered temperature inside the device in deep frost conditions. Purpose of heating system is ensure suitable inside temperature conditions based on body temperature and inside humidity. Side effect of the heating system will be de-icing of the housing to ensure better RF performance of the antennas.

Table 15. Heating system

Parameter	Value
Heating temperature	Configurable
Heating temperature range	5 °C to 20 °C (default 10 °C)
Control method	Adaptive PID regulator
Measured variables	• Internal temperature • Internal humidity • near heating-element temperature
Heating element	Built in non-linear
Fault condition protection	Yes (safety thermostat)
Fault condition temperature threshold	50 °C
Fault condition temperature hysteresis	10 °C
Heating power	50 W max. (@24V) 25 W max. (@12V)

Power management

Main Unit

Table 16. Main unit power management

Item	Parameter	Note
Power source	Vehicle power network	
Supported supply voltage systems	12V DC / 24V DC	
Nominal supply voltage 12V system	13.5V DC	
Nominal supply voltage 24V system	27.0V DC	
Operating supply voltage range (12V)	6V to 16V	Code A, ISO 16750-2
Operating supply voltage range (24V)	10V to 32V	Code E, ISO 16750-2
System power backup	Yes	
Supported automotive standard	• ISO 16750-2 • ISO 7637-2	
ISO 16750-1 Operating mode	3.2	Engine operative
ISO 7637-2 Severity level	IV	
Power modes	Off mode (optional)	
	Idle mode	
	Run mode	

System power backup

Purpose of this power backup is supplying system in case engine is turn off to prevent functionality and data loss.

Table 17. System power backup

Item	Parameter
Power backup cover time	>10min
Power backup recovery time	<120sec
Energy storage medium	Super Capacitors

Remote buttons

Table 18. Remote buttons power management

Item	Parameter	Note
Power source	Battery pack with primary battery cells	User (service-man) replaceable
Battery pack capacity (nom.)	TBD	
Battery pack voltage (nom.)	3.67V	
Number of battery cells in battery pack	TBD	
Battery lifetime (storage)	>5 years	In Power off mode
Battery capacity annual wearing	<1%	
Battery operation time (Idle/ Run mode)	>8 years	
	Idle mode	Device is powered but all functions are in idle state to reduce power consumption. Bluetooth advertising mode (beacon mode) is active.
	Run mode	Device is powered and processing dedicated functions (e.g. measuring sensors, transmitting data, communicating with ConfigApp, etc.).

Interfaces

Power supply interface without remote control

Purpose of this interface is to provide plug-and-play power from vehicle power network to the main unit.

Table 19. Power interface specification

Item	Parameter	Note
Connector type (external)	M12 A-coding, 4-pins, Male	
Connector type (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)
Accessibility	External	User accessible
Poles	4	
Polarity	Male	
Current rating	4A+4A	
Remote Power on signal	No	Nominal level 12V DC / 24V DC. If not use required, tie to plus power pole.
Mating connector type	M12 A-coding, 4-pins, Female	

Power supply interface with remote control (optional)

Purpose of this interface is to provide plug-and-play power from vehicle power network to the main unit.

Table 20. Power interface specification

Item	Parameter	Note
Connector type (external)	M12 A-coding, 4-pins, Male	
Connector type (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)
Accessibility	External	User accessible
Poles	4	
Polarity	Male	
Current rating	4A+4A	
Remote Power on signal	Yes (optional)	Nominal level 12V DC / 24V DC. If not use required, tie to plus power pole.
Mating connector type	M12 A-coding, 4-pins, Female	

Power supply interface remote control configuration

Remote control configuration is set by solder jumper J4 (PWR-ON-BYPASS).

Table 21. Remote control jumper configuration

Jumper J4	Configuration	Note
Assembled	Power bypass	Without external power control. Device is running immediately power is present.
Removed	External power control	With external power control. Device is running when power and control signal is present.

CAN bus interface output

Purpose of this interface is connection to external peripherals. In this case WatchDog unit acts as Master.

Table 22. CAN bus interface specification

Item	Parameter	Note
Standard	ISO 11898-2	
Data rate	<12 Mbps	
Termination	Yes (120R)	Software controlled
Galvanically isolated	Yes	max. 50V_{RMS}
Connector type (external)	M12 A-coding, 5-pins, Female	
Connector type (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)

CAN bus interface input (optional)

Purpose of this interface is connection to external peripherals. In this case WatchDog acts as the TAP.

Table 23. CAN bus interface specification

Item	Parameter	Note
Standard	ISO 11898-2	
Data rate	<12 Mbps	
Termination	Yes (120R)	Software controlled
Galvanically isolated	Yes	max. $50V_{RMS}$
Connector type (external)	M12 A-coding, 5-pins, Male	
Connector type (internal)	not used	

Isolated power supply interface

Purpose of this isolated power supply is supplying of external peripherals connected either via CAN bus or via RS485 bus or via RS232 bus.

Table 24. Isolated power supply interface specification

Item	Parameter	Note
Nominal output voltage	24V DC	
Accuracy+Regulation	±2% max.	
Max. output current	85mA	
Short circuit protection	Yes	Automatic recovery
Overload protection	Yes	Limited in range 162mA to 287mA
Fusing	Yes	Input fuse (resetable) 0.5A
Galvanically isolated	Yes	Max. $50V_{RMS}$
Connector type (external)	not used	
Connector type (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 ($0.2mm^2$ – $1.5mm^2$)

RS232 interface (optional)

Purpose of this optional interface is future development.

Table 25. RS232 interface specification

Item	Parameter	Note
Standard	RS232 (EIA/TIA-232-F)	
Handshaking	Partial handshaking	RXD, TXD, RTS, CTS
Data rate	<460800 bps	
Galvanically isolated	Yes	Max. $50V_{RMS}$
Connector type (external)	M12 A-coding, 8-pins, Female	
Connector (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 ($0.2mm^2$ – $1.5mm^2$)

RS485 / RS422(optional) / Profibus (Optional) interface

Purpose of this interface is future development and interface is internal until purpose is found. Either RS485 or RS422 or Profibus interface can be configured.

Table 26. RS485/RS422/Profibus interface specification

Item	Parameter	Note
Standard	• RS485 (EIA/TIA-485-A) • RS422 (EIA/TIA-422) (optional) • Profibus (IEC 61158) (optional)	• RS485 is default • RS422 is configurable by solder jumpers • Profibus is configurable by solder jumpers
Duplex	• Full duplex (4-wire configuration) • Half duplex (2-wire configuration)	Configurable by cable wiring or solder jumper on the board
Data rate	<25 Mbps	
Galvanically isolated	Yes	Max. $50V_{RMS}$
Termination	Yes (120R)	Software controlled (only RS485/RS422), External termination for Profibus
Connector type (external)	• RS485: M12 A-coding, 5-pins, Female • RS422: M12 A-coding, 8-pins, Female • Profibus OUT: M12 **B-coding**, 5-pins, Female • Profibus IN: M12 **B-coding**, 5-pins, Male	• RS485 is default, • RS422 is optional (upon request) • Profibus is optional (upon request)
Connector (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24

Strobe pulse and Trigger Pulse Interface (optional)

Strobe signal provides event indication to outer system. Trigger signal provides indication from outer system to WatchDog. This interface is optional upon request.

Table 27. Strobe interface specification

Item	Parameter	Note
Output type	MOSFET Relay	
Galvanically isolated	Yes	
Galvanically Isolated power	Not required	Not required outside power source
Maximal open circuit voltage	50V	
Protection circuit	PTC resettable fuse	200mA hold current at 25°C
Maximal cable length	20m	
Maximal output current	100mA	
Trigger functionality	Configurable	by Configuration Application
Bidirectional	Yes	
Common pole	No	
Indication	No	
Connector type (external)	M12 A-coding, 4-pins, Female	
Connector (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 ($0.2mm^2$ – $1.5mm^2$)

Table 28. Trigger interface specification

Item	Parameter	Note
Compliance	According IEC 61131-2	
Input levels according IEC 61131-2	Type 1	
Rated input voltage	24V DC	
Minimal voltage level V_{IH}	4.0V	
Maximal voltage level V_{IL}	2.0V	
Minimal input voltage	-24V	
Driving current	<5mA	
Common pole	No	
Indication	No	
Galvanically isolated	Yes (optical)	
Connector type (external)	M12 A-coding, 4-pins, Female	
Connector (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)

Flash beacon and Beeper Interface

Purpose of this interface is provide driving of external flash beacon and Beeper (loud buzzer).

Table 29. Flash beacon interface specification

Item	Parameter	Note
Switch type	Open collector, Smart MOSFET	Switched negative pole
Voltage	VMAINOUT	Tied internally from system power bus
Maximal current	500mA	
Galvanically isolated	No	
Over-current protection	PTC resettable fuse	1500mA hold current at 25°C
Connector type (external)	M12 A-coding, 3-pins, Female	
Connector (internal)	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)

Table 30. Beeper interface specification

Item	Parameter	Note
Switch type	Open collector, Smart MOSFET	Switched negative pole
Voltage	VMAINOUT	Tied internally from system power bus
Maximal current	500mA	
Galvanically isolated	No	
Over-current protection	PTC resettable fuse	1500mA hold current at 25°C
Connector type (external)	M12 A-coding, 3-pins, Female	
Connector (internal	Terminal block	Spring cage, Push-button (Screwless), AWG16 – AWG24 (0.2mm^2 – 1.5mm^2)

Extension board interface

Extension interface is dedicated for future use (additional CAN bus instance, etc.) based on SPI bus interface.

Table 31. Extension board Interface Pinout

Pin	Signal	Note
1	+3.3V	Power supply line +3.3V
2	RAD-ENA	Enable signal (output)
3	RAD-CLK	SPI Clock signal (output)
4	RAD-CTL1	Control signal 1 (input or output)
5	RAD-MISO	SPI MISO signal (input)
6	RAD-SS	SPI SS signal (output)
7	GND	GND common pole
8	RAD-MOSI	SPI MOSI signal (output)
9	RAD-INT	Interrupt signal (input)
10	+5.0V	Power supply line +5.0V

User interfaces

Main unit

Table 32. Main unit user interface

Parameter	Value
Use/Service button	Yes, 1x
Service indication LEDs	Yes (1x Yellow, 1x RGB)
Service Buzzer	Yes
Flash beacon	Yes (external)
Flash beacon colour	Red
Flash beacon pattern	STOP
Flash beacon pattern size	approx. 34cm at 2.5m distance
Beeper	Yes (external)
Beeper sound level	>90 dB @1m
Magnet user interaction	Yes, by holding magnet at specified area
Operator interaction	via Remote buttons
Configuration	• via Configuration App • remote configuration

Real time clock

Table 33. Real time clock

Parameter	Value	Note
Real time clock	Yes	
Initial accuracy	<10ppm, not calibrated	
Aging	<3ppm	First year
NTP time server synchronisation	Yes (optional)	Only UTC time
BLE time synchronisation	No	
Downlink message time synchronisation	No	
GSM network time synchronisation	No	
GNSS time synchronisation	Yes (primary)	Only UTC time
Time zone setting	No	Only UTC time
Daylight saving time setting	No	
Resolution	1 s	
Time base oscillator frequency	32768 Hz	Based on crystal oscillator
Time format	Hours/Minutes/Seconds	
Date format	Day/Month/Year/Weekday	
Backup battery	Yes (super capacitor)	
Backup duration	approx. 1 week	
Hour format	24 hr	

Storage

Configuration storage

Purpose of this memory is storing of system/device configuration.

Table 34. Configuration storage

Parameter	Value	Note
Configuration/Settings storage	Yes	
Storage medium	EEPROM with UID	
Storage capacity	32KB	
Storage file system	No	
Unique ID	Yes	

Large amount data storage

Purpose of this memory is to store large amount data like:

- firmware backup memory
- log storage
- assistance data for GPS
- storing of measured data in case of power failure
- bad payers database file

Table 35. Raw data storage

Parameter	Value
Large amount storage	Yes
Storage medium	Flash
Storage capacity	8MB
Storage file system	TBD

Security

Device level security

Table 36. Device level security

Parameter	Value	Note
Genuine hardware protection	Yes	
Cryptographic Co-processor	Yes	Optional
ECDSA	FIPS186-3 Elliptic Curve Digital Signature Algorithm	Optional
ECDH	FIPS SP800-56A Elliptic Curve Diffie-Hellman Algorithm	Optional
NIST Standard P256 Elliptic Curve Support	Yes	Optional
Hash algorithm	SHA-256	Optional
Key length	256-bit	Optional
Key storage	Up to 16 keys	Optional
Monotonic counters	2x	Optional
Random Number Generator	Yes (FIPS)	Optional
Unique Serial Number	Yes (72-bit)	Optional

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