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SafeTruck™ User Manual

SafeRadar, SafeMark, and SafePost Lite components

Part No. ILS_V2R1

Document version 1.4

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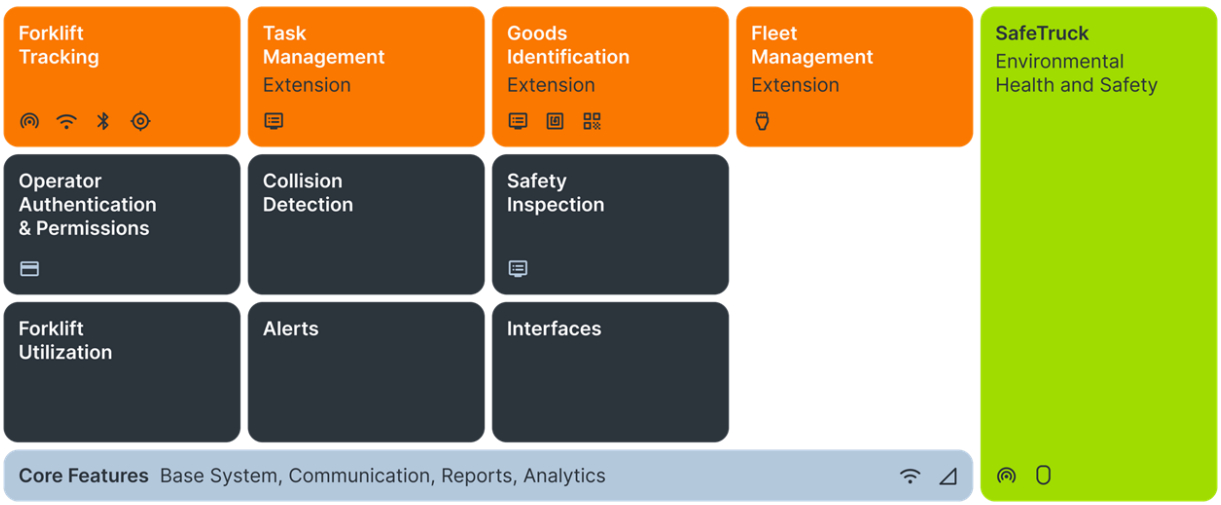
1. Introduction

The SafeTruck™ solution provides UWB-based real-time distance measurements between forklifts, vehicles, pedestrians, and fixed installed resources (e.g., gates, machines, shelves, etc.) in a peer-to-peer manner, even without any kind of positioning infrastructure.

Based on the low-latency distance measurements and warning signals enabled by the different SafeTruck components, all the related traffic participants can be extensively warned about their mutual proximity to be aware of and able to avoid potentially hazardous traffic situations. In order to ensure a further level of safety, the speed of the forklifts and other vehicles can be automatically limited with the appropriate control signals, which are only activated in the given proximity of pedestrians, fixed installed resources, and other forklifts/vehicles.

The SmarTruck™ solution is a companion system for the SafeTruck solution. It provides a complex software ecosystem for tracking, managing, and supporting logistics and storage processes carried out by using forklifts and other vehicles (MHEs). By making these processes transparent and properly documented, the SmarTruck solution can provide a solid base for analyzing the related processes and supporting optimization.



The combination of the SafeTruck and the SmarTruck systems enables an integrated and vendor-independent solution that provides utilization tracking, operator authorization, and safety control functionalities for forklifts and other vehicles involved in material-handling processes. Due to the flexible and modular design, various functional configurations can be supported.

2. Notations

The following notations are used to call attention to particular hazards or technical factors:

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTE

Indicates technical factors worth consideration (not related to personal injury).

3. SafeTruck system

The SafeTruck system is composed of the following components:

- SafeRadar (providing real-time distance information measured from SafeMark, SafePost Lite, and SafeTag components)
- SafeMark (providing reference for distance measurements on other forklifts and vehicles)
- SafePost Lite (to enable distance measurements from fixed installed resources)
- SafeTag (for pedestrian proximity detection based on distance measurements)
- ConnectBox (local intelligence, control signals, data communication, module and component integration)
- SectorMaster (providing DC power and RS-485 connectivity for the fixed installed SafePost Lite components)

Due to the two-way distance measurement procedures used for safety control purposes, distance-based proximity detection is carried out by all the related components with low latency. Therefore, at the end of a measurement procedure initiated by the SafeRadar component of a given forklift or other vehicle, all the other participating components (i.e., SafeMark, SafePost Lite, and SafeTag components) are also able to react accordingly.

Based on the distance measurement results provided by the SafeRadar/SafeMark components and the preconfigured activation zones (distance thresholds) on the ConnectBox components, there can be different (audible and visual) warning signals provided to the forklift operators. Furthermore, automatically enforced speed limitation control signals can also be activated on the forklifts or other vehicles, if necessary.

By using the fixed installed SafePost Lite components (i.e., within a building), there can be dedicated warning and slow zones (e.g., gates, cross-roads) established for the forklifts and other vehicles equipped with SafeRadar components. The fixed installed SafePost Lite components are powered and managed by the SectorMaster components, which can also provide distance-based warning and control signals for the surrounding traffic-control appliances (e.g., gates, lights, etc.).

To enable the distance-based proximity detection of pedestrians on forklifts and other vehicles, the workers are provided with handheld SafeTag components. The SafeTag components participate in the distance measurements initiated by the SafeRadar components and automatically activate the built-in audible, visual, and haptic warning signals to alarm individuals about the proximity of forklifts and other vehicles (based on the preconfigured activation zones).

DANGER

SafeTruck solution is specifically not a safety system!

Since the SafeTruck solution does not absolve the drivers and everyone else in the workplace from their responsibility and duty of care, it is essential for all individuals to pay attention to their surroundings and adhere to all safety regulations.

WARNING

Using the SafeTruck system as guidance in poor visibility is strictly prohibited!

WARNING

Risk of injury due to lack of attention!

The use of the SafeTruck solution may result in diminished awareness of the surroundings, potentially leading to severe accidents and injuries. All participants must remain aware of their surroundings when utilizing the SafeTruck solution.

Please note that SafeTruck is an auxiliary warning system limited to drivers and pedestrians within its system perimeters, so the system is not able to consider participants outside of these perimeters.

WARNING

It needs to be analyzed if there are circumstances that may harm people during the system usage. For instance, flashing LED lights might trigger epileptic seizures.

Additionally, an assessment is required to determine if every user is capable of receiving and interpreting signals properly from the devices; issues may arise from color vision deficiencies such as red-green color weakness.

WARNING

The SafeTruck system is based on UWB (Ultra-Wideband) technology; therefore, interference from other wireless technologies and physical obstacles may occur, which could negatively affect the accuracy and coverage of the system. It could result in lost radio signals or, in extreme situations, complete failure.

CAUTION

Electromagnetic radiation!

- The SafeTruck systems emit limited radio radiation. This radiation may interfere with the operation of other devices on site or may cause harm in these devices.
- Electromagnetic interference with medical devices such as pacemakers due to this radiation cannot be ruled out. Please consult the manufacturer of such devices!

4. SafeRadar, SafeMark, and SafePost Lite components

In order to introduce the SafeTruck system, it is essential to equip the forklifts and other vehicles with a SafeRadar component. The SafeRadar component initiates UWB-based real-time distance measurements from the surrounding resources equipped with SafeMarks (on the MHEs), SafePost Lites (at fixed positions within indoor environments), and SafeTags (provided to the pedestrians).

The SafeRadar, SafeMark, and SafePost Lite functionalities are provided by identical ILS_V2R1 hardware units with different firmware. The SafeMark and SafePost Lite components participate in the measurements initiated by the SafeRadar components on the appropriate MHEs and provide dedicated reference points for them.

The SafeRadar and SafeMark components are connected to the ConnectBox components by using an RS-485 bus interface to provide real-time measurement results for safety control and warning activities. The SafePost Lite components can be chained to a RS-485 bus and DC power network controlled by the SectorMaster devices.

CAUTION

The ILS_V2R1 component complies with FCC radiation exposure limits set forth for an uncontrolled environment.

The ILS_V2R1 component should be installed and operated with a minimum distance of 20 cm between the radiator and the user's body.

The ILS_V2R1 component may not be employed for the operation of toys. Operation of this device onboard an aircraft, a ship or a satellite is prohibited.

5. Installation

CAUTION

Installation of the SafeTruck systems by unauthorized service technicians is strictly prohibited!

Installation of the SafeTruck systems is always preceded by site surveys and careful preparation phases, during which the deployment plan of the components is developed together with the authorized service partners and experts.

The SafeTruck components are always installed in accordance with the deployment plan with the contribution of the authorized service technicians.

In general, the installation of the ILS_V2R1 components is accomplished with the following considerations:

- SafeRadar and SafeMark components are settled at the top of the vehicle to provide the best possible coverage (depending on the allowed dimensions).
- SafePost Lite components are mounted on the indoor components of the building structure to provide longevity with the best possible wireless coverage.
- Wherever possible, the component wiring is established in a hidden manner.

NOTE

The fixed installation and operation of the ILS_V2R1 components on building structures is only allowed indoors. The use of the ILS_V2R1 components mounted on outdoor structures, e.g., mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited.

WARNING

All components have to be installed according to the deployment plan before use.

- During installation, do not connect the devices to the power source.
- Make sure that all the seals, covers, cables, and components are properly located and fixed.
- Only connect the devices to the power supply after the installation is complete.

WARNING

A system-wide functional test must be conducted after installation.

It is recommended to test the radio spectrum in the frequency band of the SafeTruck systems for external interference periodically, particularly in the event of the activation of a new wireless system.

Interference may negatively affect the operation of the SafeTruck systems and, in extreme situations, cause complete failure.

DANGER

Touching live parts and cables may lead to fatal consequences. Using damaged, flawed components or cables is life-threatening.

- Never open or work on components without disconnecting the power supply.
- Never open or work on components without removing rings, watches, and other metal objects.
- Installation, modification, and repair of the SafeTruck components by non-authorized personnel is strictly prohibited!
- If a component or cable is damaged or malfunctioning, disconnect it from the power supply promptly and consult with an authorized service technician!
- The rules set by the local energy provider must be adhered to.

6. Operation and Maintenance

The operation of the SafeTruck system is controlled by the ConnectBox and the SectorMaster components, which automatically provide the relevant signals and interventions. Therefore, the SafeRadar, SafeMark, and SafePost Lite components do not require a user interface and do not need to be operated by users.

WARNING

All the functions of the SafeTruck system, along with the integrity and the operation of the SafeTruck components must be checked regularly (before each shift, if possible).

WARNING

Risk of injury due to signal weakening!

The human body and worn (protective) clothes could negatively affect radio signals and may even disrupt the functions of the SafeTruck system.

Please note that SafeTruck is a support warning system! All participants must remain vigilant of their surroundings, and all safety regulations must be adhered to.

The SafeRadar, SafeMark, and SafePost Lite components do not require dedicated maintenance activities for operation. During the different maintenance activities related to the co-located resources:

WARNING

- Make sure that the SafeTruck components are not exposed to direct heat, open fire, smoke, water, or dust.
- Make sure that the SafeTruck components are not cleaned by using pressure washer or corrosive chemicals.

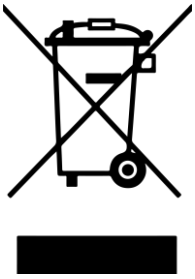
CAUTION

Risk of injury due to electronic components and heat!

- Touching live parts and cables might cause injuries.
- Malfunctions could cause components to be heated, which could result in injuries.

7. Disposal

In accordance with the WEEE Directive (Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment), the ILS_V2R1 components are provided with the following symbol:



NOTE

To minimize the negative environmental impacts of waste electrical and electronic equipment, they must be collected separately from unsorted municipal waste, in accordance with the national regulations. Moreover, electronic waste serves as valuable secondary raw materials for recycling.

NOTE

It is recommended to cooperate with a waste management company to meet the local disposal requirements.

8. Datasheet

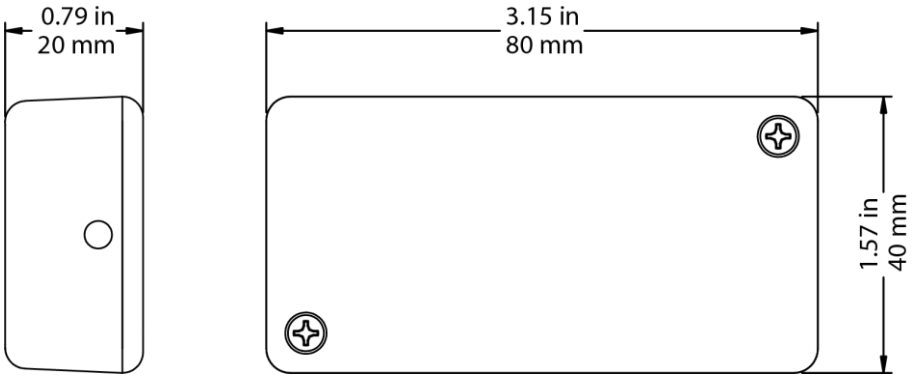
Electrical Data	
Input voltage	5 … 28 V DC (12 V typical)
Current consumption	40 mA typical, 60 mA max.
Ambient temperature	-20 … +50 °C / -4 … 122 °F
Humidity	5% … 95% r.H. (non-condensing)

RF Properties	
Technology	IEEE802.15.4-2011 UWB
Frequency bands	3.5 GHz to 6.5 GHz
Supported channels	1-5, 7 (according to IEEE802.15.4-2011 UWB)
Power spectral density	-41.3 dBm/MHz max.

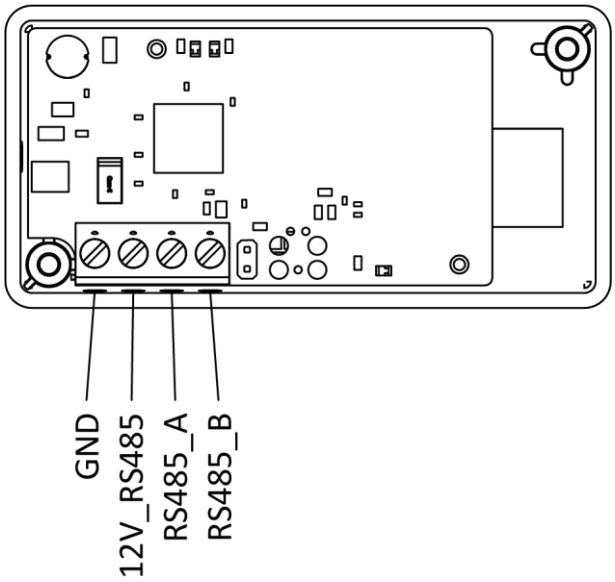
Connections	
Wire cross-section - input	0.14 mm2 … 0.5 mm2 / 26 … 20 AWG
Stripping length	5 mm / 0.2”

Mechanical Data	
IP rating	IP54
Outer dimensions	80 mm x 40 mm x 20 mm / 3.15” x 1.58” x 0.79”
Weight	40 g

Dimensions



Connection Diagram



9. FCC Compliance Statements

The ILS_V2R1 component (FCC ID: 2BFRE-ILS-V2R1) 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.

The ILS_V2R1 component has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If the ILS_V2R1 component does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The ILS_V2R1 component and its antenna(s) must not be co-located or operated in conjunction with any other antenna or transmitter.

The ILS_V2R1 component does not contain any user serviceable components and is to be used with the built-in antennas only.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the ILS_V2R1 component.