System design document

2.1.41 Mobile e-ticketing terminal (PROXmobil3)

RIPTA

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The Future of Mobility

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Copyright information

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1.0	Feb 08, 2018	Christian Anderl	Initial version

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Table of contents

1 Introduction

This chapter of the system design document contains the technical specifications of the mobile e-ticketing terminal PROXmobil3.

1.1 Symbols and conventions

In order to make the best use of this document, highlighted elements are located in several places.

The following support structures apply to this document:

Note
Indicates additional information.

Caution
Indicates warnings or other important information that have to be precisely followed.

The following conventions apply to this document:

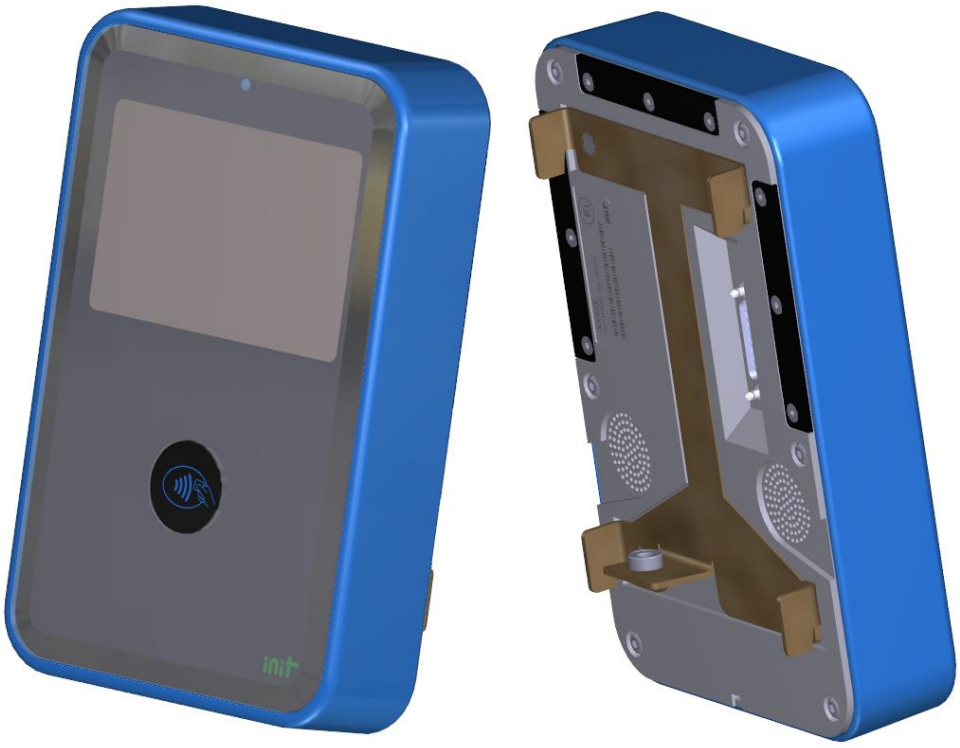
Symbol	Explanation
Interface element	Indicates elements on the user interface, e.g. buttons.
1 Introduction →5	Indicates a cross-reference and shows the page where the corresponding chapter can be found.
Introduction	Indicates a cross-reference to another document.

1.2 About PROXmobil3

The PROXmobil3 is a compact reader for contactless smartcards. It is designed for electronic ticketing on-board like in busses, trams and trains as well as to be mounted as a platform validator. The card reader supports the ISO 14443 A/B and MIFARE standards. For data transfer the PROXmobil3 features an Ethernet interface

The PROXmobil3 consists of the following main components:

- Ruggedized ABS chassis
- Mainboard (featuring all hardware functions including ARM processor module, RAM, microSD memory cards, audio functionality, system controller and power supply)
- TFT display with LED backlight
- Speaker
- Contactless smartcard reader
- 2D barcode scanner



PROXmobil3 (illustration similar, differs in color and front cover design)

2 Directives and specifications

It will be confirmed that the directives and norms described in the following section are fulfilled.

2.1 Electromagnetic compatibility

Should there be values which contradict the EMC; the stronger requirements will be met.

2.1.1 ECE Regulation No. 10 (E mark)

Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions.

The authorization according to ECE regulation No.10 will be indicated by attaching the EC approval certificate (E1) to the device.

2.1.2 EN 50121-3-2 Railway applications - Electromagnetic compatibility - Rolling stock apparatus

Immunity:

EN 61000-4-2: Electrostatic discharge immunity test

EN 61000-4-3: Radiated, radio-frequency, electromagnetic field immunity test

EN 61000-4-4: Electrical fast transient/burst immunity test

EN 61000-4-5: Surge immunity test

EN 61000-4-6: Conducted disturbances, induced by radio-frequency fields immunity test

Emitted interferences:

EN 55016-2-1: Conducted disturbance measurements

EN 55016-2-3: Radiated disturbance measurements

2.2 Shock and vibration

2.2.1 EN 61373 Railway applications - Rolling stock equipment - Shock and vibration tests

EN 60068-2-27: Environmental testing - Tests - Test Ea and guidance - Shock

EN 60068-2-64: Environmental testing - Tests - Test Fh - Vibration, broadband random and guidance

2.3 Climatic stress

2.3.1 EN 50155 Railway applications - Electronic equipment used on rolling stock

Cold in operation, heat in operation, damp heat, cyclic in operation according to EN 50155:

EN 60068-2-1: Environmental testing - Tests - Test A: Cold

EN 60068-2-2: Environmental testing - Tests - Test B: Dry heat

EN 60068-2-30: Environmental testing - Tests - Test Db: Damp heat, cyclic

2.4 Operational conditions

2.4.1 Operation voltage

Operation voltage: Permanent between 9 V and 33 V;
≤ 5 s: 9 V to 36 V.

2.4.2 Power consumption

Typical power consumption: <10 W.

2.4.3 Operating temperature

Correct operation is guaranteed for the following climatic conditions:
Without any restrictions within a range from -20 °C to +70 °C (-4 °F to 158 °F)

2.4.4 Storage temperature

The temperature range for storage ranges from -30 °C to +80 °C (-22 °F to 176 °F)

2.4.5 Humidity

Relative humidity: 10 % to 95 % (non condensing)

2.4.6 Weight

The PROXmobil3 has a weight of approx. 1.2 kg.

2.4.7 IP classification

Protection against solid foreign objects and water according to EN 60529:

IP54

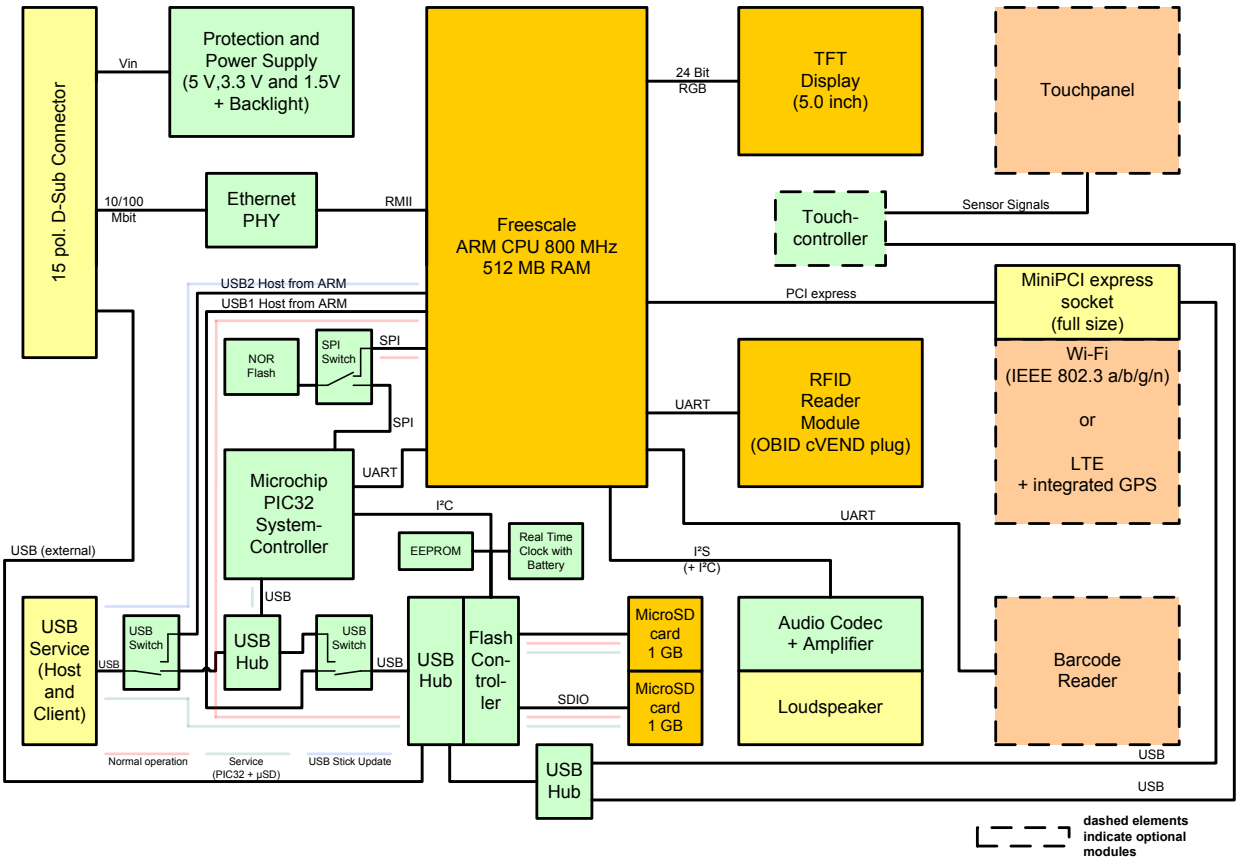
- 1st number: Degree of protection against solid foreign objects (5: Dust-protected)
- 2nd number: Degree of protection against water (4: Splashing water protected)

2.4.8 IK Code

The housing is protected according to IEC 62262 / EN 50102 against external mechanical impacts and complies with IK code rated to **IK05**.

3 Architecture of the device

3.1 Block diagram



Block diagram

3.2 Housing

The PROXmobil3 is rugged in design and the housing is made in a special die casting process named thermoplastic structure foam molding (TSG) and are made of polystyrene (PS) or acrylonitrile butadiene styrene (ABS). This casting process creates a device that has a very stiff structure compared to normal die casting processes. The housings are flame-retardant according to UL94 V-0.

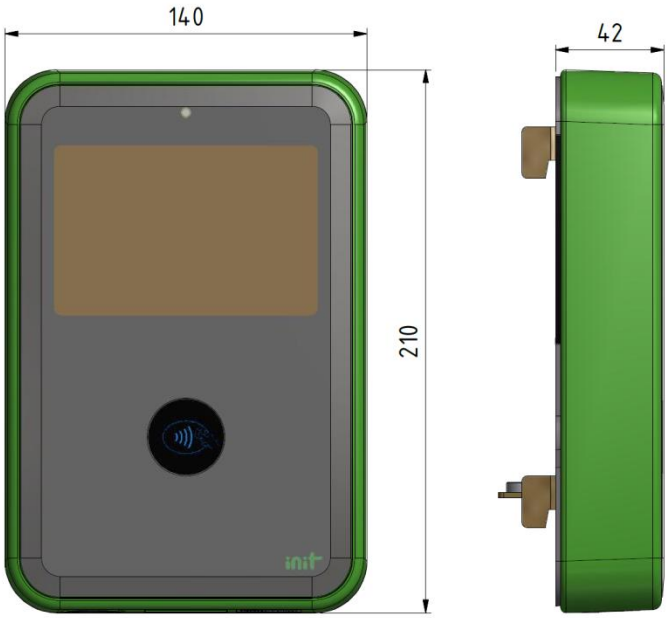
On the back there is a bent sheet metal part used for mounting on the mounting plate.

All device edges are rounded, and there are no exposed bolt heads, nuts, sharp edges, or cracks on outside surfaces. The display of the device is flush mounted in the housing. Thus the design and mounting of the housing will meet all applicable ADA requirements.

INIT uses only special paint that is made for outdoor use and it is resistant to fading, cracking and peeling. Furthermore, the surface area is non-smooth in order to minimize reflections. The color of the housing will be RAL 6018 (yellow green).

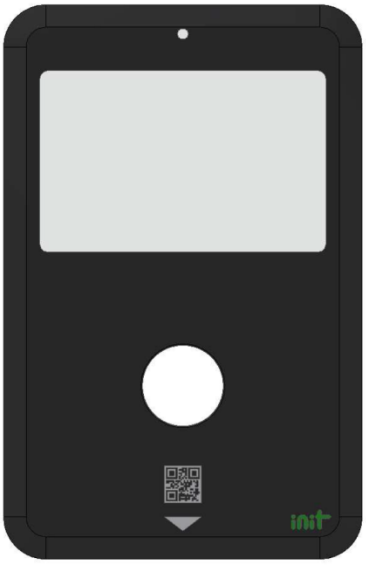
3.2.1 Dimensions

The dimensions of the PROXmobil3 are 210 mm x 140 mm x 42 mm (H x W x D, without mounting plate).



Dimensions of PROXmobil3

3.2.2 Front screen glass



Front screen glass

3.2.3 Serial number sticker

A serial number sticker including barcode and legible text is glued on the back housing of the device. Another smaller sticker is placed in the lower part of the housing to grant access to the device serial number while the device is mounted. The stickers will withstand wear and tear in a transit environment.

3.3 Mainboard

3.3.1 Printed Circuit Board

The electronics of the PROXmobil3 was developed specially for use in the automotive sector, i.e. with regard to temperature range. The PCB (printed circuit board) has a multilayered structure. Almost all components are in the SMD structural form (surface-mounted device) which allows a compact, robust and reliable design.

3.3.2 CPU module

The CPU module of the PROXmobil3 is a CPU module of the TQ-Group based on a Freescale i.MX6 processor with the following technical data:

- Solo ARM Cortex A9, 800 MHz, 512 MB DDR3L RAM
- 32 KB + 32 KB L1 Cache, 512 KB L2-Cache
- VPU (Video Processing Unit), 2D/3D GPU (Graphics Processing Unit)
- CAAM (Cryptographic Acceleration and Assurance Module)
- Automotive certification, thus long-term availability

3.3.3 Memory

The 512 MB large memory (DDR3L) is soldered directly on the CPU module in order to guarantee maximum reliability and resistance to shock and vibration.

A 16 MB SPI-flash stores the boot loader and the operating system kernel.

3.3.4 System controller

The system controller (80 Mhz PIC32 microcontroller) monitors the temperature of the device and transmits critical operating conditions to the CPU. Furthermore, it monitors and controls the inputs and outputs, i.e. for display and backlight control or the audio amplifier. It manages the start-up and shutdown sequences while the device is started and ensures that, e.g. the device functions properly after a restart.

Furthermore, the system controller manages the wake-up function (wake up, turn on) of the PROXmobil3. The wake-up times can be configured via parameters. These are stored in a parameter file which is transferred to the device via data supply channels. Further information is available in the corresponding system design documents.

3.3.5 MicroSD cards

Two industrial grade microSD cards are used to store the operating system and the application. Each microSD card has a non-volatile flash memory of 1 GB. Another card is in the mounting panel and serves as backup storage for sales data.

3.3.6 Power supply

All internal voltages are generated with switching regulators. This ensures maximum efficiency and minimizes power and heat losses.

Some power supplies which need to deliver little electricity are implemented with linear regulators.

3.3.7 Battery

The built-in lithium battery is used for buffering the real-time clock when the power is off.

Provided that PROXmobil3 is stored in a cool, dry area, the battery can provide power for the real-time clock for at least ten years. High humidity and high temperatures reduce the durability of the battery. When the PROXmobil3 is switched on, no energy from the battery is required, which increases its durability.

3.3.8 Real-time clock

The PROXmobil3 has a battery-backed real-time clock. Thus the set time is stored even when the entire system is separated from the power supply. The real-time clock is synchronized with the central system via the Ethernet network connection (LAN).

3.3.9 Ethernet

The PROXmobil3 has a 100Base-T Ethernet interface (10/100MBit) according to IEEE 802.3. In the project the interface is used for data supply and data retrieval.

3.3.10 Watchdog

A Watchdog functionality is integrated in the system controller which monitors the operating system. There is a software part monitoring the software tasks of the current system which periodically sends a trigger signal to the watchdog. When a critical system task or the entire system is blocked, no trigger signals are sent. If the watchdog is not triggered by the software within a certain time period (configurable), the hardware is reset and the system is restarted.

3.3.11 Audio

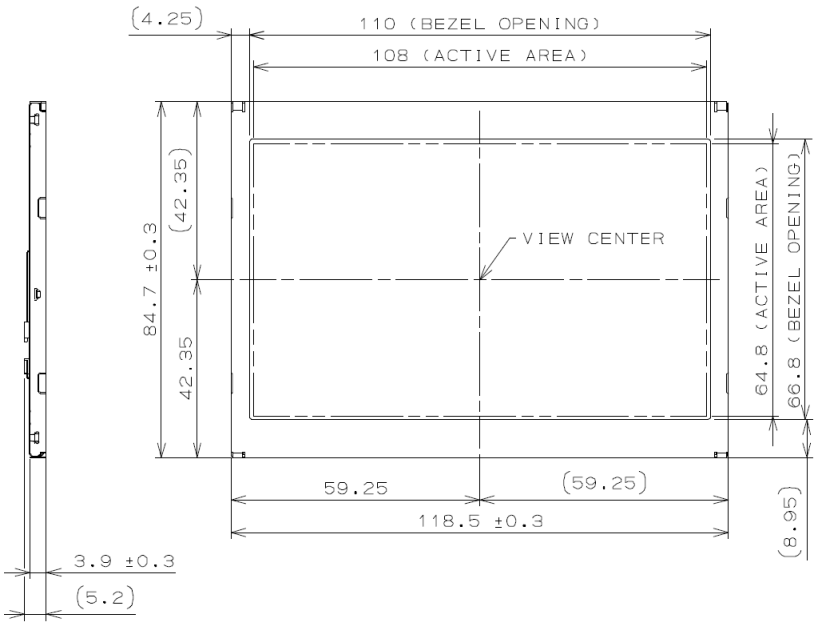
The device is equipped with two loudspeakers and can therefore produce audio sounds via the audio codec and the integrated 2-watt amplifier.

3.4 TFT display

The TFT display has a screen size of 5”, a screen size resolution of 800 x 480 pixels and 16.7 million colors. It should be noted that the visible surface area is slightly smaller than that of the display. 754 x 480 pixels are visible; this corresponds to a visible diagonal of 119 mm (4.69 inch).

The display has a viewing angle of at least 70° in all directions. It has a LED backlight with a typical luminance of 900 cd/m² and a contrast ratio of typically 1000:1.

A 3 mm thick chemically hardened safety glass protects the screen against vandalism. Thus the device is protected against external mechanical stresses.

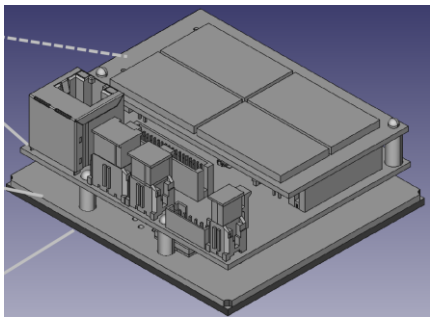


Drawing - display

3.5 Contactless card reader

Card reader module

The PROXmobil3 features a card reader module from Feig Electronic for contactless reading and writing cards. The contactless card reader is a compact module consisting of controller circuit board, antenna circuit board and optional secure access module (SAM) slots.



Card reader module - setup (optional secure access module slots included)

The card reader is equipped with a security microcontroller which immediately deletes the internal cryptographic keys in case of physical attack attempts. The controller controls the RFID sensor chip, prepares the data for the host and ensures appropriate encryption.

For more information about the contactless card reader module please refer to:

- 2.1.41-App_cVEND_plug_Reader_Datasheet_V03.pdf

The connection of the controller to the mainboard is realized through a serial port.

3.5.1 Supported standards

The RFID reader is a chip realizing the communication with the contactless card and transmitting the data to the controller. The RFID reader for customer cards supports the following standards:

- ISO/IEC 14443 A and B
- MIFARE
- ISO 15693
- NFC mobile phone support (Passive Communication Mode) according to ISO 18092
- The operating frequency is 13.56 MHz

3.5.2 PCI and EMV

The validator is PCI-DSS 3.0 compliant for the acceptance of bank-issued contactless credit and debit cards, including EMV-compliant cards.

The integrated Feig reader module "OBID cVEND plug Flex" has the following payment certifications:

- EMV Contactless V2.4, Level 1
- EMV Contactless V2.4, Level 2
- PCI 4.0, SRED incl. Open Protocol

Future formats can be realized by a firmware update but this might require a recertification process.

3.5.3 Secure Access Modules (SAMs)

The card reader offers the option on four sockets for Secure Access Modules (SAM). The SAM will facilitate the acceptance of fare media formats in place of security keys in the event of a security breach.

3.6 2D barcode scanner

Imaging engine N5680

The PROXmobil3 offers the integration of the Honeywell N5680 imaging engine in the lower part of the device to read 2D barcodes from mobile phones and paper printouts.

The module has the following features:

- CMOS sensor with global shutter and 844 x 640 pixel resolution; 60 frames per second
- Visible red LED illumination
- 2D Symbologies: Aztec Code, Data Matrix, (Micro) QR Code, among others
- Linear Symbologies: UPC/EAN/JAN, Code 128, 2D Stacked: PDF417, among others

For more information about the barcode reader module please refer to:

- 2.1.41-App_Barcode_Reader_N5600.pdf

4 Mounting accessories

4.1 General specifications

All mounting accessories required for installation of the PROXmobil3 will be provided by INIT.

4.1.1 Weight

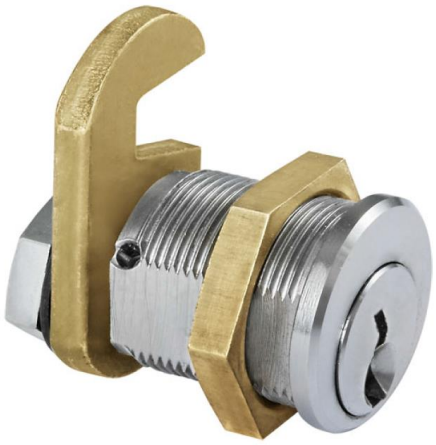
Each bracket weighs approximately 1.2 kg.

4.1.2 Color

The color of the mounting plate cover will be similar to RAL 7001 (Silver Grey).

4.2 Security lock

For rod and mast mounting the PROXmobil3 is secured to the mounting plate by a security lock using a cylinder lever lock with 1 lever and 5 pin tumblers model number MK5 2700 manufactured by ZIKON (Assa Abloy).



Security lock MK5 2700

The lock is integrated in the lower part of the mounting plate and prevents access to the fixation screw for demounting the device from the mounting accessory. The locking mechanism covers the opening of the fastening screw with the bar of the lock.

The key can be removed in locked state only.

4.3 Bracket types

Various types of mounting plates/brackets are available for PROXmobil3, e.g. for mounting on rod, mast and on the vehicle dashboard.

4.3.1 Rod holder

The rod holder is intended for mounting on a holding rod. With use of different sealing plugs various rod diameters are supported (30 mm, 32 mm, 35 mm and 40 mm).

The lock is placed in the lower part, whose bolt covers the mounting screw. The key can be removed only in locked state.

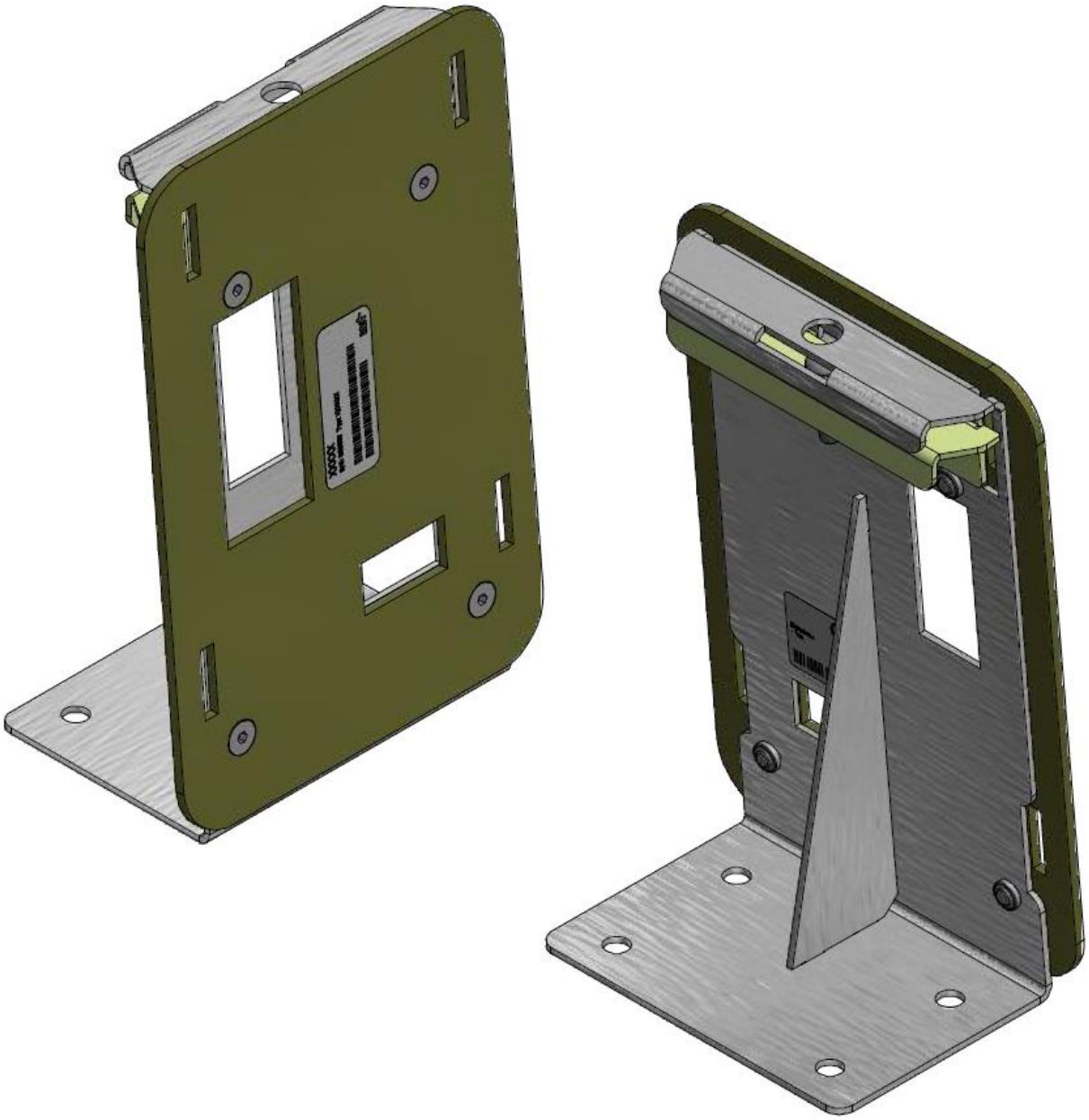
Rod holder

4.3.2 Dashboard holder

Using the dashboard holder, the PROXmobil3 can be mounted on flat surfaces.

Due to lack of space, this holder does not provide a lock, but it provides a Torx security screw.

The back of the mounting plate is powder coated, the color is similar to RAL 9005 "Jet Black". The mounting plate cover is not applicable for this bracket type.

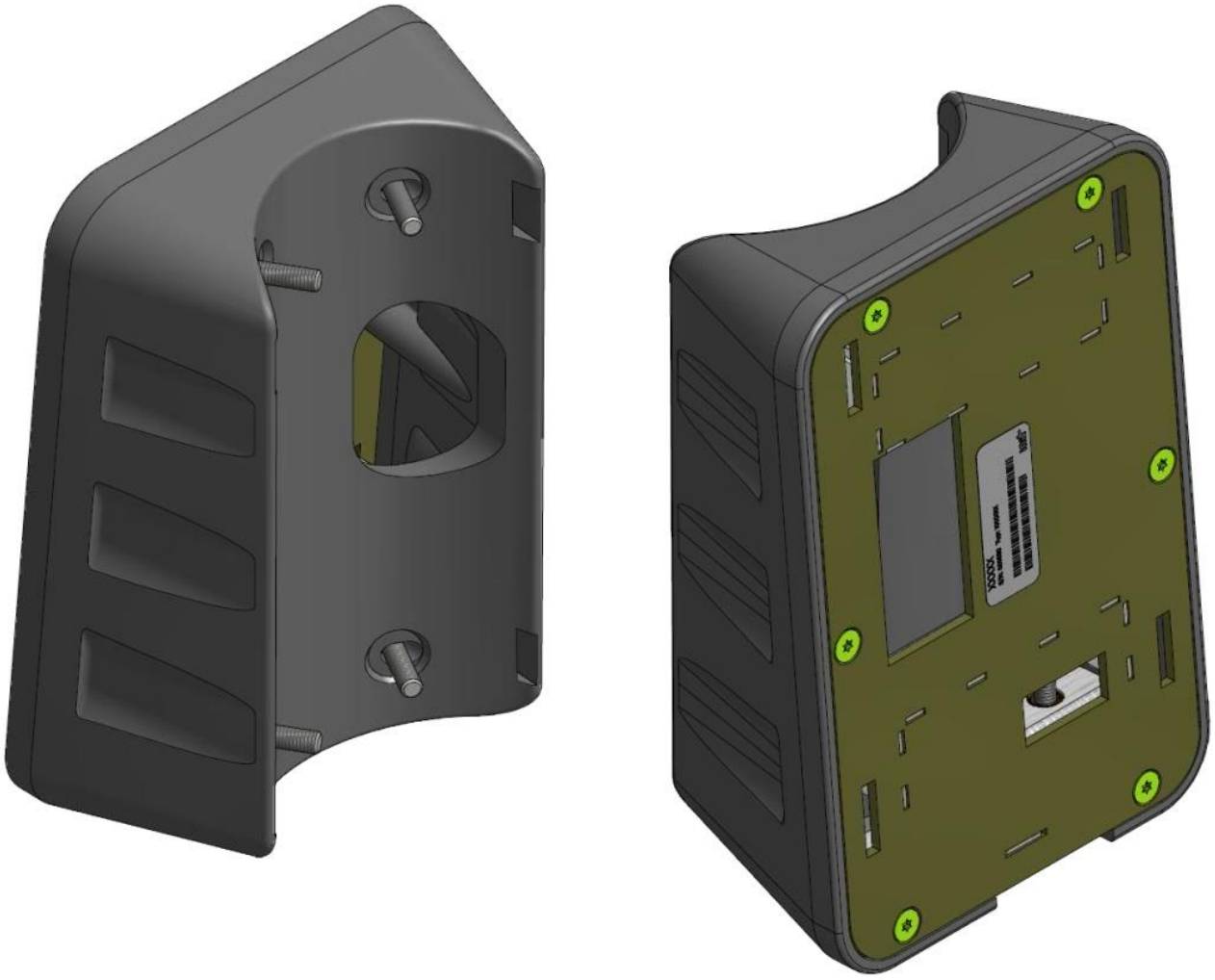


Dashboard holder

4.3.3 Mast holder

The mast holder is designed for a mast with a diameter of 101.6 mm.

The lock is placed in the lower part, whose bolt covers the mounting screw. The key can be removed only in locked state.



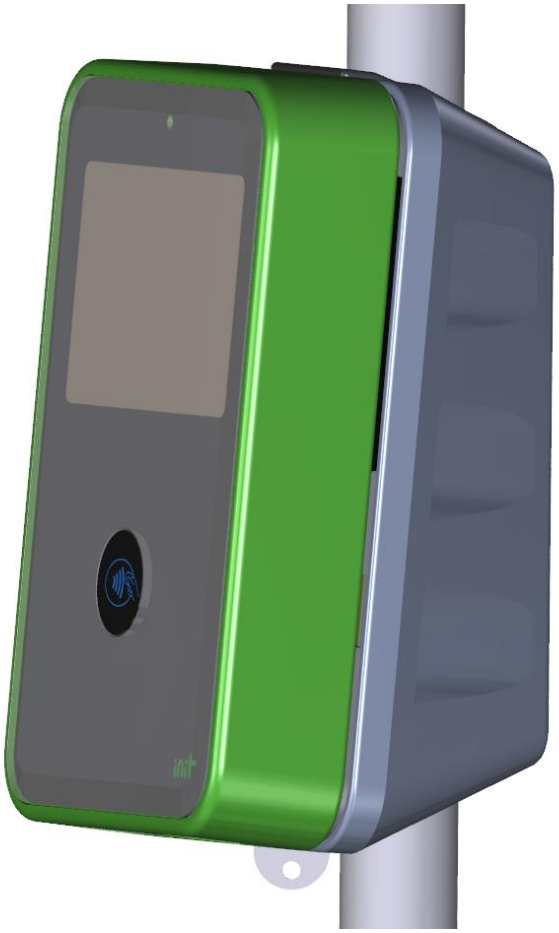
Mast holder

5 Mounting/dismounting

For all mounting solutions, the device cable is first plugged into the PROXmobil3 and subsequently inserted into the holder and screwed in place. The device is therefore guaranteed to be free from float.

For bracket types with lock afterwards the opening for the security screw is covered and the key can be removed.

5.1 Rod/pole mounting solution (on-board)



PROXmobil3 - Mounted to vehicle holding rod

5.2 Dashboard mounting solution (on-board)

PROXmobil3 – Mounted to dashboard holder

5.3 Mast mounting solution (outdoor)

PROXmobil3 - Mounted to mounting pole/ platform mast

6 Plug connector

6.1 Main plug connector

The 15 pin D-Sub main plug connector contains the following interfaces:

- Power supply (CL30/CL15/ground)
- Ethernet (2 pair; 10/100 MBit)
- I2C for address memory in the mounting plate (4 lines)
- USB for backup storage in the mounting plate (1 pair)

6.2 USB service plug connector

The device provides a USB service interface via a non-standard IP protected magnetic connector which is on the bottom side of the device. The service interface can be used in two different ways: As a client and as a host

USB service plug connector (Rosenberger MF2K201-400L)

6.2.1 USB client

If a PC or laptop is connected to the service interface, the microSD cards inside the PROXmobil3 are displayed on the configured service laptop in Windows Explorer as disk drives. Furthermore, the system controller is available for software updates, configurations and to test installations.

Note

Accessing the device is limited to trained service personnel only by the use of a non-standard service cable (Rosenberger L99-985-1500) and the requirement of installing the dedicated USB driver and INIT Service Software Tools (compatible with Microsoft Windows XP and Windows 7).

6.2.2 USB host

The PROXmobil3 supports USB host functionality to upload and download files from and to the device using a standard USB flash memory drive. For this purpose the USB port needs to be activated as host interface (e.g. by using a maintenance card). Afterwards the USB interface acts as host and is able to power external USB devices.

7 Maintenance and cleaning instructions

7.1 General

The device is designed that all the components needed for maintenance are easily accessible.

Note
Regular maintenance should be performed only by trained service staff.

7.2 Maintenance

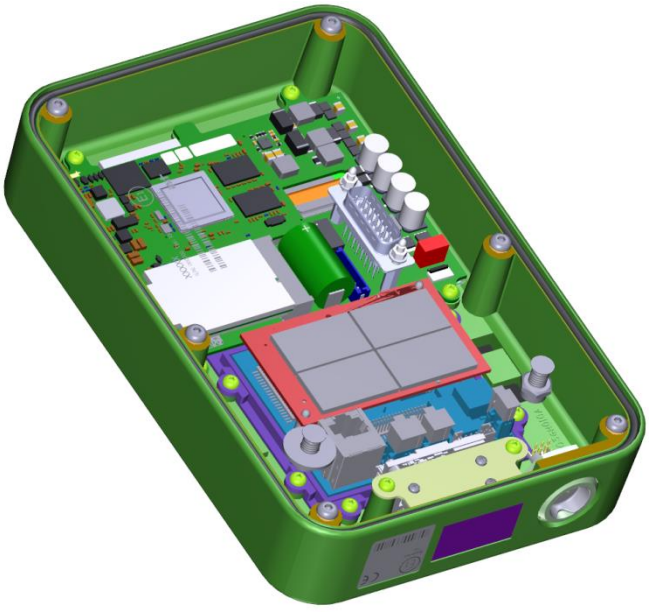
Apart from battery exchange, no regular maintenance is required.

Caution
The internal battery is soldered onto the main board and should only be replaced by the manufacturer; otherwise the guarantee will expire.

7.3 Exchange of Secure Application Modules (SAM)

To replace the SAM/retailer cards, the device must be removed from the mounting plate.

After removing the 6 housing screws, the device can be opened by removing the back panel from the housing. Afterwards the SAM sockets are directly accessible.



Location of the SAM sockets within the opened device (grey rectangles on the red board)

7.4 Cleaning

The housing and the display can be cleaned with mild soap, detergent solutions (tenside) or fabric softener with a damp (not dripping wet) cloth.

8 Abbreviations

ABS	**A**crylnitril**b**utadien**s**tyrol
ARM	**A**dvanced **R**ISC **M**achines
CPU:	**C**entral **P**rocessing **U**nit
IP	**I**ngress **P**rotection
LED	**L**ight **E**mitting **D**iode
PCAP	**P**rojected **Cap**acitive Touchscreen
PS	**P**oly**s**tyrol
RAM	**R**andom **A**ccess **M**emory
RTC	**R**eal **T**ime **C**lock
SAM	**S**ecure **A**ccess **M**odule
SMD	**S**urface **M**ounted **D**evice
TFT	**T**hin **F**ilm **T**ransistor
TSG	thermoplastic structural foam molding
USB	**U**niversal **S**erial **B**us
WWAN	**W**ireless **W**ide **A**rea **N**etwork

9 Appendix

2.1.41-App_Barcode_Reader_N5600

2.1.41-App_cVEND_plug_Reader_Datasheet_V03.pdf