



# Product user manual & operation description

EMV3000

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## Document version

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## FCC and IC compliance statement EMV3000

This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s).

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.

Changes or modifications made to this equipment not expressly approved by Emsyscon Solutions may void the FCC authorisation to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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## Purpose

This manual provides guidelines on how to install, wire and connect an EMV3000. Based on our experience, a number of recommendations are illustrated.

Note that only the products that follow are within Emsyscon's scope of delivery:

- EMV3000
- EMV3000 mounting material (on demand)
- ...

All other devices and items necessary for installation are excluded from Emsyscon's scope of delivery. Although this manual refers to third party items, such as but not limited to cables, connectors, ... these items are only mentioned for a better understanding of the installation guidelines.

This document is primary addressed to installers and field technicians in order to determine the best applicable workflow.

## Contact

Use the contacts below for assistance and/or information:

[www.emsyscon.com](http://www.emsyscon.com) | E: [info@emsyscon.com](mailto:info@emsyscon.com)

## Terminology

The table below contains a list in alphabetical order of the most important acronyms and/or terms used in this document:

Term	Definition
AFC	Automatic Fare Collection
EMV	Europay Mastercard and Visa
EPO	Emergency Power Off
ESD	Electrostatic Discharge
FCC	Federal Communications Commission
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
NFC	Near Field Communication
PCA	Printed Circuit Assembly
PCI	Payment Card Industry
POI	Point of Interaction
PTS	PIN Transaction Security
PWM	Pulse Width Modulation

Term	Definition
SAM	Secure Access Module/Secure Application Module
TFT	Thin-Film Transistor
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver-Transmitter
UOM	Unit of Measure
UPS	Uninterruptable Power Supply
USB	Universal Serial Bus

Table 1: Terminology

# 1 INTRODUCTION

## 1.1 EMV3000

The EMV3000 is a compact NFC contactless smart card reader. It is designed specifically for public transport Automatic Fare Collection (AFC) systems, but can also be used in unattended devices like vending machines, parking meters, toll gates and more.

The EMV3000 supports all major smart cards compliant to ISO 14443 Type A and B.

## 1.2 EMV3000 Key features

- Contactless smart card reader 13.56 MHz NFC.
- 1 SAM card slot.
- EMV Level 1, Visa and MasterCard Level 2, PCI PTS POI v5.x compliant.
- Interface via USB or TTL UART.
- Integrated 4 LEDs and 1 beeper.
- Possibility to drive external LEDs and beeper.
- Tamper-proof hardware design.
- Compact dimensions.

## 1.3 EMV3000 Mechanical

Dimensions	Millimetres	Inches
Enclosure:	77.10 W x 12.40 D x 75.44 H	3.05 W x 0.49 D x 2.97 H
Weight	Grams	Lbs
Weight:	90 Grams	0.198Lbs

Table 2: Mechanical specifications

## 1.4 EMV3000 Environmental

	Celsius	Fahrenheit
Operating temperature	-20°C +70 °C	-4 °F to +140 °F
Storage temperature	-30 °C +80 °C	22 °F to +176°F
Operating humidity	< 75% RH	< 75% RH
Storage humidity	<93% RH	<93% RH

Table 3: Environmental specifications

## 1.5 EMV3000 Electronic and operation

Subject	Description
Antenna gain	< 2
Audio	Internal PWM beeper with the ability to drive external beeper
Bandwidth	14 kHz
Card reader	Full NFC forum-compliant for contactless communication at 13.56 MHz
Channel spacing	Not applicable
Data rates	Conform ISO14443
Indicators	4 Green LEDs with the ability to drive 4 external LEDs
Intelligence (processor)	Microcontroller with dedicated hardware security mechanisms
Intended area of use	Living area Automobile Industrial range Mechanical range
Intended use	Validate ISO14443 cards
Interface types	USB/TTL UART
ITU Emission designator	14K0A1D
Minimum distance of the antenna to the human body	4 mm
Number of channels	1
Number/Type of antenna(s)	1 Integrated PCB Antenna
Operating frequency range	13.56 Mhz, with a bandwidth of 300Khz
Output power	Maximum 1.25 W
Power supply	5V or USB powered
RF type	Transceiver
Security	1 SAM card slot
Type(s) of modulation (e.g. BPSK, FSK, ASK, ...)	ASK and FSK
Type of radio transmission Use of frequency spectrum e.g. DSSS, OFDM, ...)	ITU ISM Band 13.560MHz

Table 4: Electronic and operation



## 1.6 EMV3000 Identification label

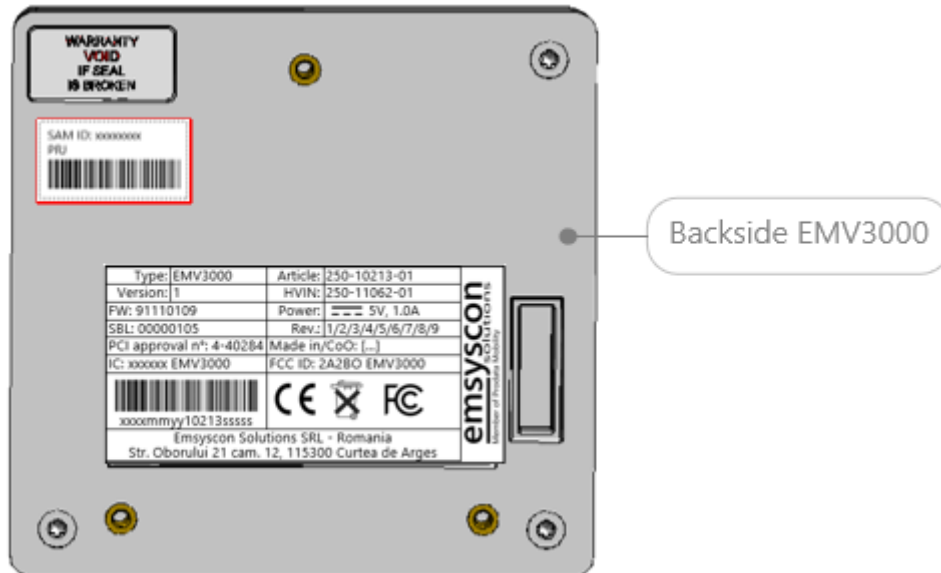


Figure 1: Identification label EMV3000



## 1.8 Used symbols

A number of symbols are repeatedly used in this manual. Their meaning is indicated below.








Symbol	Description	Meaning
	Attention!	Pay particular attention to the work to be done.
	Read carefully	Read this advice.
	Time	Realistic time indication taken up by these activities.
	Special tooling	Use the specified tooling.
	Danger: electricity	The components may contain electrically charged or live elements.
	Static electricity	Watch out for static discharge. Obey the proper handling procedures!
	Glue	Respect the instructions and the recommended adhesive to obtain perfect bonding of the parts. Consult the manufacturer's datasheet of the particular adhesive for detailed handling instructions.

Table 5: Used symbols

## 1.9 General guidelines

- Emsyscon recommends to perform an incoming inspection of all parts that will be used during the firmware update of this product. Also sub-assemblies, made by subcontractors, should be checked carefully.
- Incoming inspection of the parts will be performed based on the documents and product data below (contact Emsyscon for further instructions if not available):
  - ▶ Supplier part numbers and technical specifications/datasheets
  - ▶ Mechanical drawings
  - ▶ Cable drawings
- Read all sections carefully before starting the installation. The sections are not necessarily organised in a logical workflow.
- All UOM (unit of measurement) are according to the metric system (metres, kilogram...) unless specified otherwise in this document.

## 2 SAFETY INFORMATION

### 2.1 General safety

Observe the rules that follow to ensure general safety.

**Remark:** The information that follows is based on a wide range of hardware products. Part of this information is product specific and might not be applicable to the product(s) outlined in this manual.

- Observe good housekeeping in the area of the equipment during and after installation.
- When lifting a heavy object:
  - ▶ Ensure that you can stand safely without slipping.
  - ▶ Distribute the weight of the object to lift equally between your feet.
  - ▶ Use a slow lifting force, never move suddenly or twist when you attempt to lift.
  - ▶ Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. Do not attempt to lift any object that weights more than 16 kg or that you think is too heavy for you.
- Do not perform any action that can cause hazards to others or that can make the installation unsafe.
- Before you start the installation, ensure that other service technicians and/or customer's personnel are not in a hazardous position.
- Place removed equipment and other parts in a safe place, away from all personnel, while you are installing the product(s).
- Keep your tool case away from walk areas so that other people will not trip over it.
- Do not wear loose clothing that can be trapped in any moving parts of the equipment or work tools. Ensure that your sleeves are fastened or rolled up above your elbows. Fasten long hair.
- Insert the end of your necktie or scarf inside clothing or fasten it with a nonconductive clip, about 8 cm from the end.
- Do not wear jewellery, chains, metal-frame eyeglasses, or metal fasteners for your clothing, because metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- Reinstall all safety shields, guards, labels and ground wires after installation of the product(s).
- Fan louvers on the equipment help to prevent overheating of internal components. Do not obstruct fan louvers or do not cover them with labels or stickers (if applicable).

## 2.2 Electrical safety

Observe the rules that follow when working on electrical equipment.

- Use only approved tools and test equipment (GS-, IEC 60900-, VDE standards). Some hand tools have handles covered with a soft material that does not insulate you when working with live electrical currents.
  - Many customers have, near their equipment, rubber floor mats that contain small conductive fibres to decrease electrostatic discharges. Do not use this type of mat to protect yourself from electrical shock.
  - Locate the (room/place) emergency power-off (EPO) switch, disconnecting switch, or electrical outlet. If an electrical accident occurs, you can then operate the switch or unplug the power cord quickly.
  - Do not work alone under hazardous conditions or near equipment that has hazardous voltages.
  
  - Disconnect all power before:
    - ▶ Performing a mechanical inspection.
    - ▶ Working near power supplies.
    - ▶ Removing or installing main units.
  
  - Before you start to work on the equipment, unplug the power cord. If you cannot unplug it, ask the customer to power off the wall box that supplies power to the machine, and to lock the wall box in the off position.
  
  - Observe the precautions that follow if you need to work on equipment that has exposed electrical circuits:
    - ▶ Ensure that another person, familiar with the power-off controls, is near you. That person must be present to switch off the power, if necessary.
    - ▶ Use only one hand when working with powered-on electrical equipment; keep the other hand in your pocket or behind your back.
- CAUTION:**
- An electrical shock can only occur when there is a complete circuit. By observing the above rule, you may prevent a current from passing through your body.**
- ▶ When using testers, set the controls correctly and use the approved probe leads and accessories for that tester.
  - ▶ Stand on suitable rubber mats (obtained locally, if necessary) to insulate you from grounds such as metal floor strips and machine frames.
- 
- Regularly inspect and maintain your electrical hand tools for safe operational condition.
  - Do not use worn or broken tools and testers.
  - Never assume that power has been disconnected from a circuit. Always check that it has been powered off.

- Always look carefully for possible hazards in your work area. Examples of these hazards are moist floors, not grounded power extension cables, power surges, and missing safety grounds.
- Do not touch live electrical circuits with the reflective surface of a plastic dental mirror. The surface is conductive; touching can cause personal injury and equipment damage.
  
- Do not install the parts that follow with the power on (if applicable):
  - ▶ Power supply units.
  - ▶ Pumps.
  - ▶ Blowers and fans.
  - ▶ Motor generators.
  - ▶ Units similar to those listed above.This practice ensures correct grounding of the units.
  
- If an electrical accident occurs:
  - ▶ Use caution; do not become a victim yourself.
  - ▶ Switch off power.
  - ▶ Send another person to get medical aid.

## 2.3 Safety inspection checklist

The purpose of this inspection checklist is to assist in identifying potentially unsafe conditions. This checklist addresses only those items.

Use good judgement to identify potential safety hazards when fitting non-Emsyscon hardware features or options that are not covered by this inspection checklist.

If any unsafe conditions are present, you must determine how serious the detected hazard could be and whether you can continue without first correcting the problem.

Consider the conditions that follow and the safety hazards they present:

- Electrical hazards, especially primary power (primary voltage on the frame can cause serious or fatal electrical shock).
- Explosive hazards, such as a bulging capacitor.
- Mechanical hazards, such as loose or missing hardware.

To determine whether there are any potentially unsafe conditions, use the following checklist at the beginning of every service task.

Begin the checks with the power off, and the power cord disconnected.

Checklist:

No	Description	OK	NOK
1	Check exterior covers for damage (loose, broken, or sharp edges)	<input type="checkbox"/>	<input type="checkbox"/>
2	Power off the equipment, disconnect the power	<input type="checkbox"/>	<input type="checkbox"/>
3	Check the power cord for (if applicable):		
a	A third-wire ground connector in good condition, use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and the frame ground	<input type="checkbox"/>	<input type="checkbox"/>
b	Power cord/cable should be an authorized type, specified for the equipment	<input type="checkbox"/>	<input type="checkbox"/>
c	Insulation must not be worn	<input type="checkbox"/>	<input type="checkbox"/>
4	Check for cracked or bulging batteries (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>
5	Check for any obvious non-Emsyscon alterations, use good judgment as to the safety of any non-Emsyscon alterations	<input type="checkbox"/>	<input type="checkbox"/>
6	Check inside and/or outside the equipment for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage	<input type="checkbox"/>	<input type="checkbox"/>
7	Check for worn, frayed, or pinched cables	<input type="checkbox"/>	<input type="checkbox"/>
8	Check that the equipment fasteners (screws or rivets) have not been removed or tampered with	<input type="checkbox"/>	<input type="checkbox"/>

Table 6: Safety inspection checklist

## 2.4 Handling devices that are sensitive to electrostatic discharge

Any equipment part containing transistors or integrated circuits (ICs) should be considered sensitive to electrostatic discharge (ESD). ESD damage can occur when there is a difference in charge between objects.

Protect against ESD damage by equalizing the charge so that the equipment, the part, the work mat, and the person handling the part are all at the same charge.

### Notes:

1. Use product-specific ESD procedures when they exceed the requirements noted here.
2. Ensure that the ESD protective equipment you use have been certified (ISO 9000) as fully effective.

When handling ESD-sensitive equipment:

- Keep the parts in protective packages until they are inserted into the product.
- Avoid physical contact with other people.
- Wear a grounded wrist strap against your skin to eliminate static on your body.
- Prevent the part from touching your clothing. Most clothing is insulative and retains a charge even when you are wearing a wrist strap.
- Use a grounded work mat to provide a static-free work surface. The mat is especially useful when handling ESD-sensitive devices.

- Select a grounding system, such as those listed below, to provide protection that meets the specific service requirement.

Note: The use of a grounding system to guard against ESD damage is desirable but not necessary.

- ▶ Attach the ESD ground clip to any frame ground, ground braid, or green-wire ground.
- ▶ When working on a double-insulated or battery-operated system, use an ESD common ground or reference point. You can use coax or connector-outside shells on these systems.
- ▶ Use the round ground prong of the AC plug on AC-operated equipment.

## 2.5 Safety notices



DANGER

Before powering on the equipment after installation, make sure that all screws, springs and other small parts are in place and are not loose inside the equipment. Verify this by shaking the equipment and listening for rattling sounds (if possible). Metallic parts or metal flakes can cause electrical short circuits.



DANGER

Do not disassemble a standby battery, do not throw it into water, or do not short-circuit it. Dispose of the battery as required by local ordinances or regulations. Use only the battery as specified in the installation list or approved equivalent. Use of an incorrect battery can result in ignition or explosion of the battery.



DANGER

The lithium battery can cause a fire, an explosion, or a severe burn. Do not recharge it, do not remove its polarised connector, do not disassemble it, do not heat it above 100°C, do not incinerate it, or do not expose its cell contents to water. Dispose of the battery as required by local ordinances or regulations. Use only the battery as specified in the installation list or approved equivalent. Use of an incorrect battery can result in ignition or explosion of the battery.



DANGER

If an LCD/TFT display breaks and the fluid inside the display gets into your eyes or on your hands, immediately wash the affected areas with water for at least 15 minutes. Seek medical care if symptoms from the fluid are present after washing.



## 3 GENERAL INSTALLATION GUIDELINES



- Before starting the installation works, make sure to disconnect the vehicle battery in order to avoid short circuits. Some vehicles may have a secondary battery or even UPS/no break power supplies for some functions. Obey at all times the instructions of the vehicle manufacturer and vehicle owner.
- Respect at all times the safety guidelines and use the right tooling.
- Emsyscon does not accept any responsibility for damage or injury that occurs during installation.
- Electrical installation must be carried out by authorised staff. The placing, installation and specifications of all cables must comply with the instructions and must meet all statutory regulations concerning the use of cables.
- Emsyscon is not responsible for any injury or damage incurred when deviating from the instructions in this installation guide.

## 4 INSTALLATION TOOLING LIST

This section is a summary of the most-used tools necessary to install the EMV3000. These tools should be at the technician’s disposal to carry out normal installation work.

Equivalents of this tooling can also be used by the installer/technician, this depending on availability and corresponding with the tooling technical specifications.

Supplier references in this tooling list are subject to change and must be verified by the installer before purchase and/or use during installation.

The list provided is for references purposes only and may be extended depending on the nature of the job to be done.

Note: The correct use of the proper tooling contributes to the quality of the work executed.



The tooling mentioned in this section is not part of Emsyscon’s scope of delivery.



N°	Description	Image	Reference
1	Drilling machine		T01
1	Torx screwdrivers or bit set (range size T10 – T30)		T02

Table 7: Tooling list

## 5 INSTALLATION MATERIAL

### 5.1 Standard installation material

This section contains the standard installation material that is delivered with the EMV3000. Optional, any specific and/or additional installation material can be delivered by Emsyscon upon request (see section 5.2).

Article n°	Qty	UOM	Description	Image	Reference
N/A					

Table 8: Standard installation material

### 5.2 On demand installation material



The material mentioned in this section is not part of the standard installation material, but can be ordered at Emsyscon.




Article n°	Qty	UOM	Description	Image	Reference
N/A	1	pcs	CAB Micro USB		D01
N/A	3	pcs	SCW M2.5x06 DIN7985 steel zinc plated Torx		D02
N/A	3	pcs	WAS spring lock DIN127 M2.5 steel zinc plated		D03

Table 9: On demand installation material

## 6 INSTALLATION INSTRUCTIONS

### 6.1 EMV3000 mechanical integration

1. The EMV3000 back shell contains 3 mounting holes (3 inserts M2.5) (Figure 4). These mounting holes can be used to fix the EMV3000 to a mounting frame. Mounting frames are project specific but can be ordered at Emsyscon.



The maximum screw length mounted into the EMV3000 is 6mm. This based on a mounting frame with 2mm thickness. Depending on the mounting frame thickness, the screw length must be adapted by the installer.

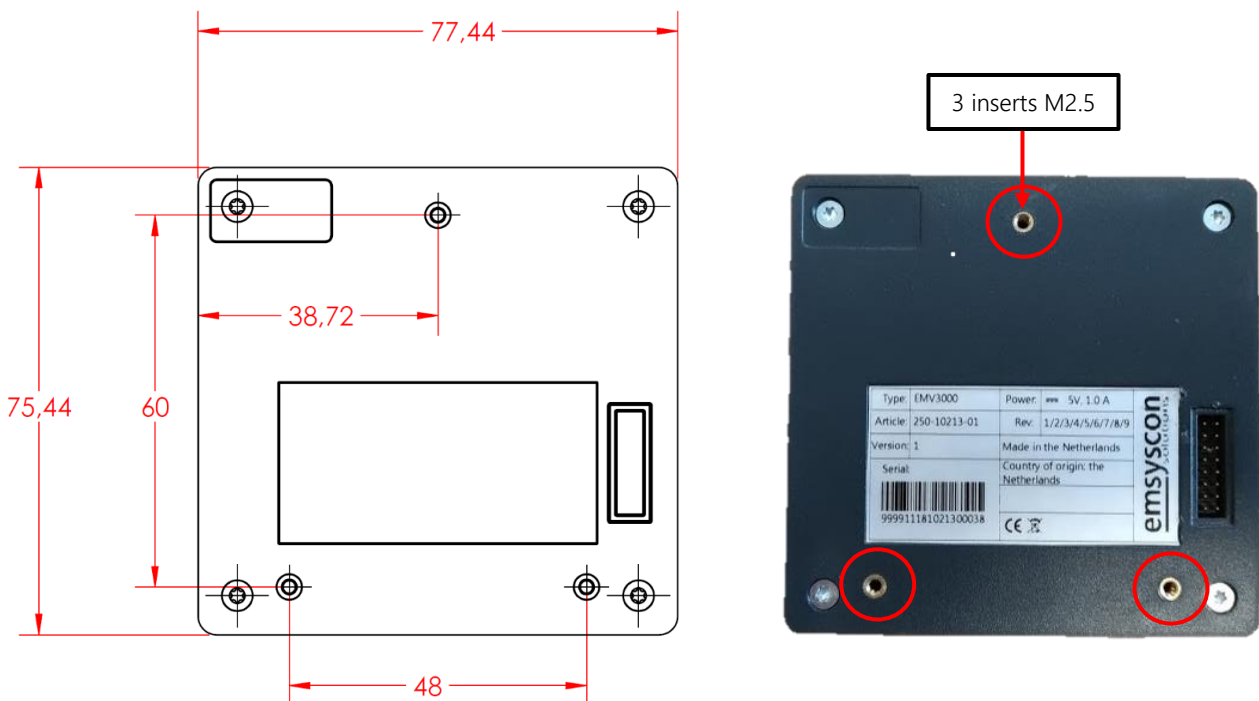


Figure 3: Mounting holes

- The EMV3000 is mounted with 3 screws (reference D02) and 3 spring lock washers (reference D03) on the mounting frame (Figure 5).


 Torque setting screwdriver: 40 N.cm



Figure 4: Mount EMV3000

## 6.2 EMV3000 Cable connection(s)

**Read This** Always integrate a cable strain relief when connecting the EMV3000. This to avoid bad connections and loss of data and power connection over a period of time.

### 6.2.1 Connection via micro-USB cable

The EMV3000 is connected via a micro-USB cable (Figure 6).

**Read This** Emsyscon advises to use a cable length of maximum 2 meters.



Figure 5: Connection via micro-USB cable

## 6.2.2 Connection via 16-way connector

This type of connection is only used in case of a printed circuit assembly (PCA) integration (Figure 7).

Example of an EMV3000 integrated via a PCA (Figure 7).

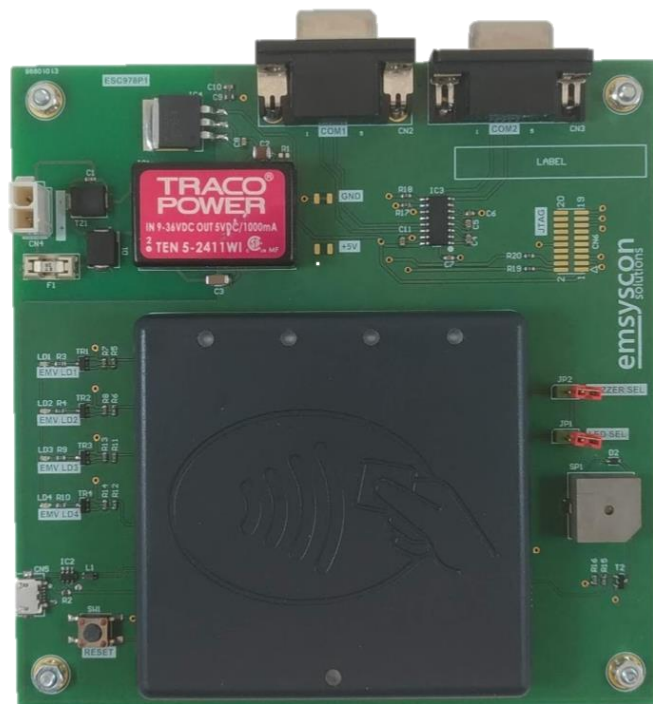
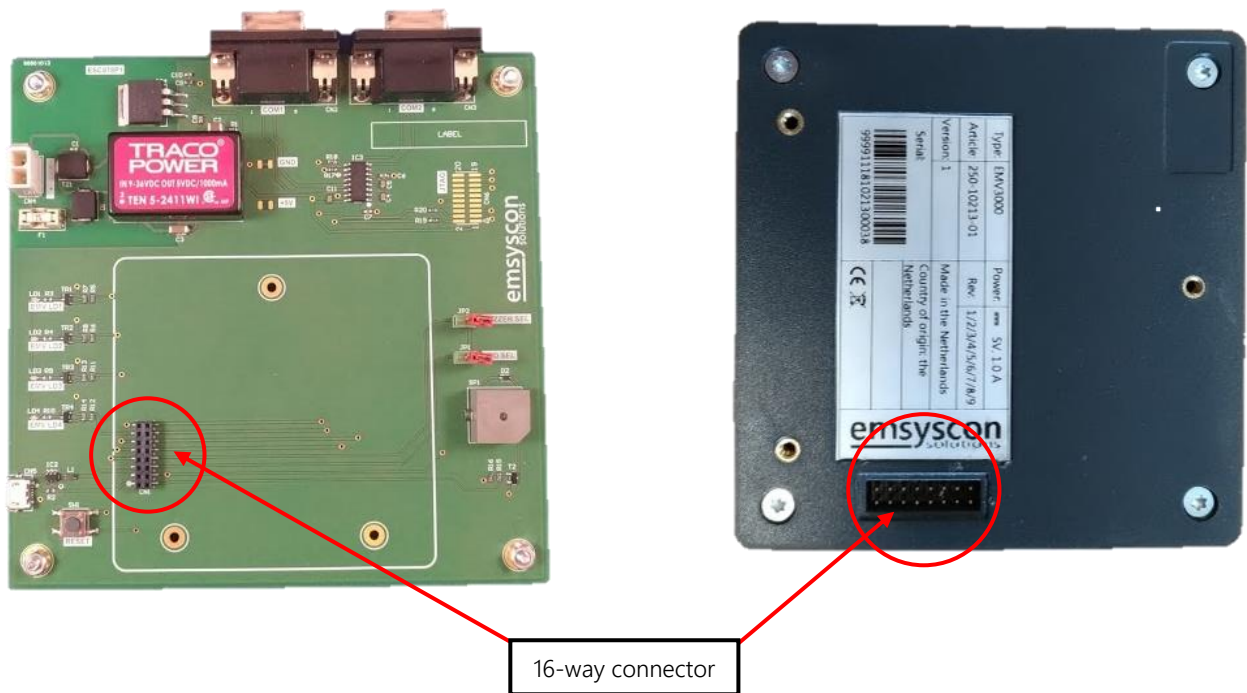


Figure 6: Connection via 16-way connector

## 6.3 EMV3000 Cable connection diagram(s)

### 6.3.1 Micro-USB connection diagram

Micro USB connection PIN	Connection
1	+5V
2	USB0B_N
3	USB0B_P
4	Not connected
5	GND (SHLD)

Table 10: Pin layout micro-USB connection

### 6.3.2 16-way Connector diagram

16-way connection PIN	Connection
1	+5V
2	BUZZER E
3	USB0B_N
4	nRESET
5	USB0B_P
6	LED SELECT
7	EXT EMV LED1
8	BUZZER SELECT
9	EXT EMV LED2
10	DBG TXD
11	EXT EMV LED3
12	DBG RXD
13	EXT EMV LED4
14	UART TXD
15	GND
16	UART RXD

Table 11: Pin layout 16-way connector

## 7 EMV3000 IN OPERATION

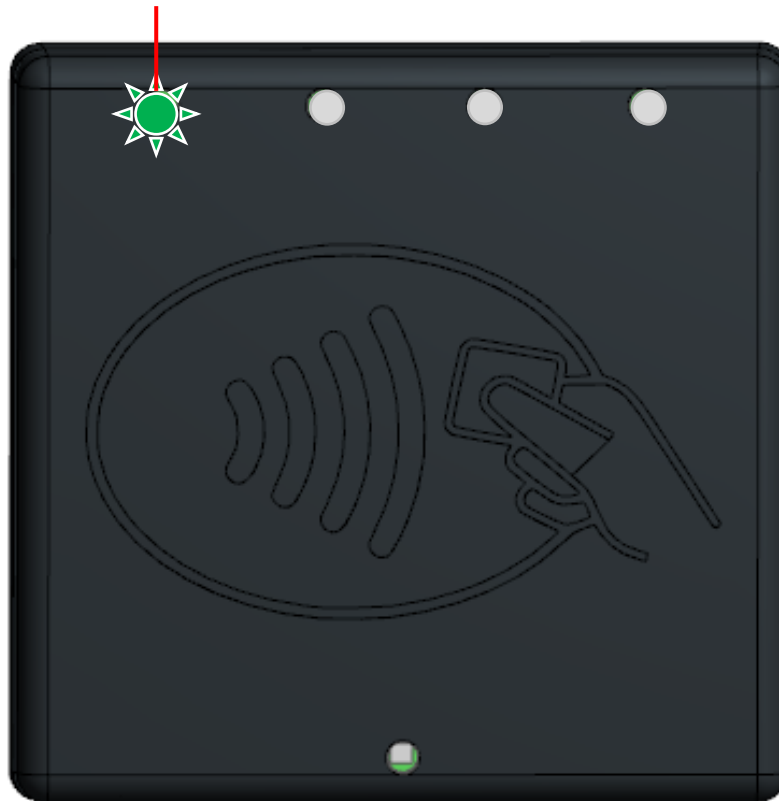
### 7.1 Standard operation modus

When powering on the EMV3000, the device will boot and start up. After maximum 10 seconds the device is ready for use.

Once the start-up process is finished, the EMV3000 LED 1 will blink once every 5 seconds.

The EMV3000 is now in normal operation and the contactless card reader is ready to use.

LED 1 blinks once every 5 seconds



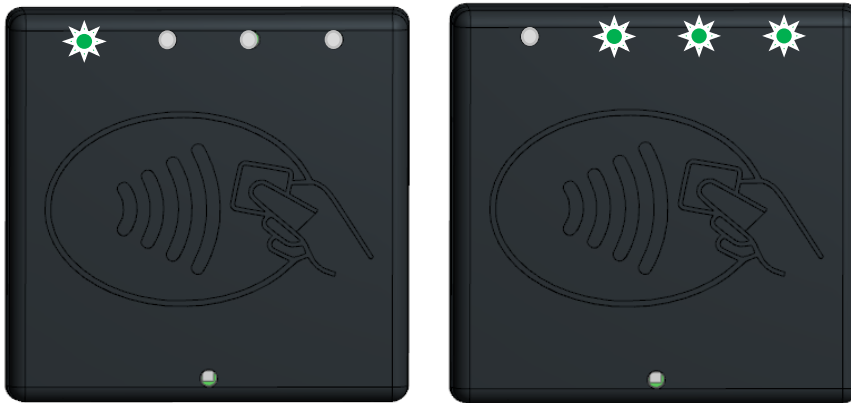
Period	Time(s)	LED 1	LED2	LED3	LED4
1	1	ON	OFF	OFF	OFF
2	5	OFF	OFF	OFF	OFF
Period 1 and 2 repeats					

Figure 7: EMV3000 standard operation modus



## 8 EMV3000 ERROR STATUS

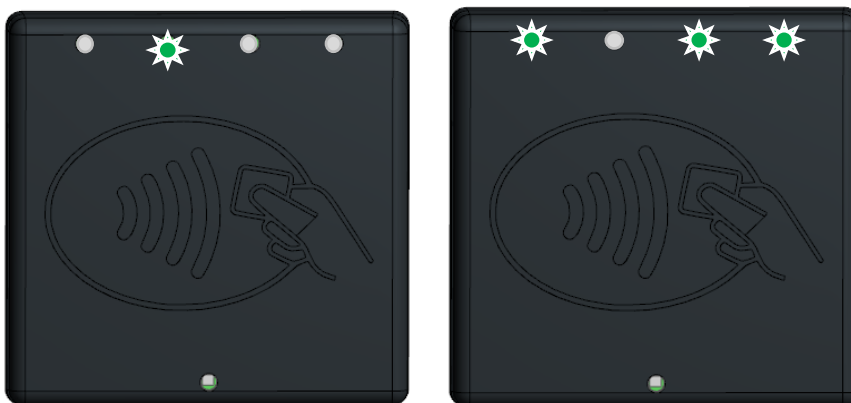
### 8.1 EMV3000 Tamper status (1) error



Period	Time (s)	LED 1	LED2	LED3	LED4
1	3	ON	OFF	OFF	OFF
2	3	OFF	ON	ON	ON
Period 1 and 2 repeats					

Figure 8: Tamper status (1) error

### 8.2 EMV3000 Tamper status (2) error



Period	Time (s)	LED 1	LED2	LED3	LED4
1	3	OFF	ON	OFF	OFF
2	3	ON	OFF	ON	ON
Period 1 and 2 repeats					

Figure 9: Tamper status (2) error

### 8.3 EMV3000 Boot error



Period	Time (s)	LED 1	LED2	LED3	LED4
N/A	N/A	OFF	OFF	OFF	ON

Figure 10: Boot error

### 8.4 EMV3000 Start-up error



Period	Time (s)	LED 1	LED2	LED3	LED4
N/A	N/A	OFF	OFF	ON	ON

Figure 11: Start-up error

End of document.