

Product Specification Document

of RFID Reader

Prodrive Technologies BV

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Document history

Rel.	Date	Status	Changes
R01	2016-08-24	Concept	First release, internal review
R02	2016-09-05	Concept	Updates after review
R03	2018-05-25	Concept	Excluded HID iCLASS (13.56MHz) card support. Updated Radio Compliance according to RED. Referred to software specification for card support Removed CAN interface option Removed sleep mode feature (supported by CAN only) Added labelling info
R04	2021-04-01	Concept	Added FCC ID and IC ID. Added environmental and EMC test specifications Updated RFID dimensions Added mass of the product
R05	2021-07-06	Concept	Updated PWR rating on label
R06	2021-08-10	Concept	Added 10A external fuse requirement to conditions of use list

5

Distribution list

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Open Issues

Issue	Section	Description	Due Date
1	6	Complete environmental tests and specification.	21-05-2021
2	6	Complete EMC and Radio tests and specification.	
3	5.4	Perform FCC and ISED certification.	

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References

Referenced

- | | | |
|-------|--------------------|---|
| [1.1] | Title: | Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications |
| | Author (Company): | SAE International |
| | ID, Version, Date: | J1455, 2006-06 |
| | File: | http://orionfs.prodrive.nl:60001/getdoc?pn=600106135101 |
| [2.3] | Title: | SPD: SW RFID Card Reader |
| | Author (Company): | Martijn Bumann |
| | ID, Version, Date: | 6873-1600-0803, R03, 2018-02-12 |

File: <https://orionfs.app.local/pn/687316000803>

1. Introduction

This specification document describes the hardware-level specification for the RFID Reader.

1.1. Background and context

The RFID Reader is designed to operate in industrial vehicles. The objective of the RFID Reader is to support operator identification and access control.

Figure 1-1 shows the context diagram of the RFID Reader. The RFID Reader shall be mounted in an accessible area in a vehicle. After powering up, it accepts RFID cards. Once it detects the RFID, the data read from the card or device will be sent to the master controller over RS232 port.

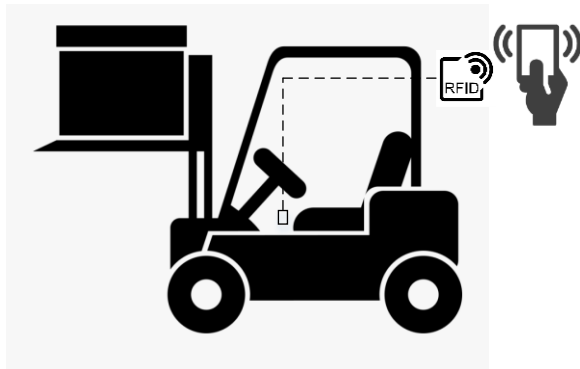


Figure 1-1: Context diagram of the RFID Reader

1.2. Intended audience and document goal

The intended audience of this specification document consists of:

- Customers; for whom it constitutes a technical user manual and datasheet.

It is assumed that the reader of this document is familiar with common IT and electronics terminology, and has knowledge of analogue and digital electronic designs and similar products.

1.3. Definitions and Abbreviations

1.3.1. Definitions

Text marking

Marked text

Text needs to be changed or completed.

Marked text

Text has changed compared to the previous release.

Numbers

'a'

Numeric binary notation (a can be multiple 0s or 1s). E.g. '010' is a 3-bit value representing the binary number two. This kind of notation implies a specific bit length.

'aa.aaaa'

Numeric binary notation with '.' separations for clear reading of long binary numbers.

0xa

Numeric hexadecimal notation (a can be a digit 0 through 9, A through F). E.g. 0x1A is hexadecimal number twenty-six. This kind of notation does not directly imply a bit length.

0xaa.aaaa

Numeric hexadecimal notation with '.' separations for clear reading of long hexadecimal numbers.

ad

Numeric (explicit) decimal notation. This kind of notation does not directly imply a bit length.

X[b:a]

Vector notation for vector X with bit range b downto a (little endian notation).

Text style

SIGNAL_THIS

Italic capticals with optional underscore. Represent an active high signal.

	'F'alse (de-asserted) represents an electrical low 'T' rue (asserted) represents an electrical high
<i>SIGNAL_THIS_n</i>	Italic capitals with _n (lower case). Represent an active low signal. 'F'alse (de-asserted) represents an electrical high 'T' rue (asserted) represents an electrical low In case of differential signals the positive half should be defined as <i>SIGNAL_THIS_p</i>
<i>VarOrBits</i>	Italic camelcasing. Names of register, bits and variables
< <i>VarOrBits</i> >	Variables embraced in '<' and '>' indicates substitution (indirect reference) E.g. < <i>Registerbits</i> > means the content/value of that bit, not the bit itself
DefineThisUnit	Camelcasing. A definition of a design unit (mnemonic). E.g. Block diagram units
DEFINE_THIS	Capitals with optional underscores. Other definitions. E.g. Connector mnemonic or register value constant, e.g. 'INACTIVE'
<u>Other</u>	
Number sign	A positive current flows into the 'product'. A negative current flows out of the product. Min, typ and max specifications of negative currents apply to the absolute current value; E.g. a max specification of -10mA defines that no more than 10mA will flow out.
Min/max values	When a parameter is specified as a negative value, confusion may exist if it should be a min or max specification. The min/max definitions do not apply to the mathematical value, but to the semantic meaning of the parameter. Examples:

Parameter	Specification	Clarification
Current flowing 'in' of 10[mA] or less	Max 10[mA]	Max refers to <u>maximum magnitude of current</u>
Current flowing 'out' of 10[mA] or less	Max -10[mA]	Max refers to <u>maximum magnitude of current</u> , not the negative number
Receiver sensitivity of at least -22[dBm]	Min -22[dBm]	Min refers to <u>minimal power</u> and not the (negative) number
Isolation of at least -40dB	Min -40[dB]	Min refers to <u>minimal isolation</u> attenuation and not the (negative) number
Crosstalk of maximum -40dB (Note that this equals isolation of at least -40dB)	Max -40[dB]	Max refers to the <u>maximum crosstalk</u> and not the (negative) number.

1.3.2. Abbreviations

HBM	Human Body Model
HW	Hardware
ITA	International Type Approval
NA	Not Applicable
NC	Not Connected
NFCIP	Near Field Communication Interface and Protocol
PCB	Printed Circuit Board
PSD	Power Spectral Density
PSK	Pre-Shared Key
RED	Radio Equipment Directive
RFID	Radio Frequency Identification
SMT	Surface Mount
SPD	Specification Document
S&V	Shock and Vibration
SW	Software
TBD	To Be Defined

2. Features

The following list shows the features of the RFID Reader. This list is informative for the purpose of a global technical overview. It has been compiled with care, but no rights may be derived from this list. Refer to the various sections that describe the context and conditions for the features.

- 5
 - Micro Controller
 - ARM Cortex 32-bit series
 - Interfaces
 - 1x RS232
- 10
 - RFID 13.56MHz reader supporting
 - Multiprotocol RFID + NFC transceiver
 - RFID 125kHz reader
 - Mechanics
 - IP69K enclosure
- 15
 - Supply Voltage Input
 - 6..36VDC
 - Environmental
 - Operating temperature -30 to 75°C
- 20

3. Functional description

This section contains the functional description of the RFID Reader. The interfaces can be found in Section 4, mechanical specifications in Section 5 and environmental specifications in Section 6.

3.1. Top level block diagram

- 5 Figure 3-1 shows the global block diagram of the RFID Reader with a functional level of detail showing only main connections.

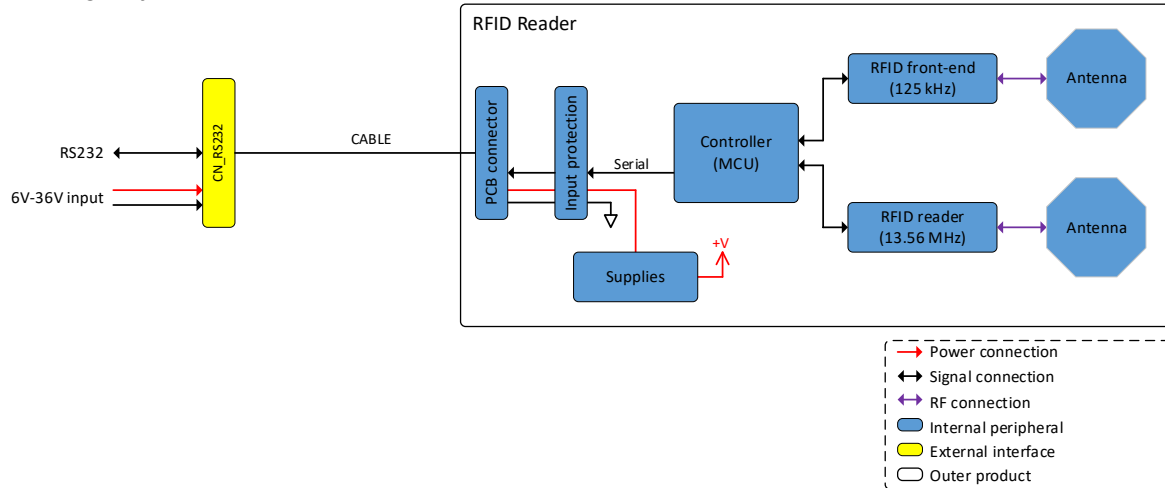


Figure 3-1: Main block diagram

3.2. Controller

- 10 The RFID Reader contains an AMR Cortex 32-bit controller with 64kB flash, part number: STM32F302K8U6.

3.3. RS232

The RFID Reader contains one serial RS232 interface, included in CN_RS232 (§4.1) for communication with the control system.

- 15
- The RS232 interface is non-isolated.
 - The RS232 pins are ESD protected: +/-15kV HBM
 - Serial interface characteristics are listed in Table 3-1.

Table 3-1: RS232 performance

Mnemonic	Description	Min.	Typ.	Max.	Unit	Remarks
fDR RS232	RS232 interface speed			115.2	kbps	

3.4. RFID

The RFID Reader supports contactless communication of RFID tags based on the 13.56 MHz and the 125 kHz system.

3.4.1. RFID 13.56MHz

The 13.56MHz RFID system supports:

- 25
- ISO14443 A/MIFARE
 - ISO14443 B
 - ISO15693
 - NFCIP-1
 - Supported cards: refer to software specification [2.3]
- 30
- Write mode is not supported
 - The expected range is listed in Table 3-2

Table 3-2: RFID range

Mnemonic	Description	Min.	Typ.	Max.	Unit	Remarks
RFID_RANGE	RFID range	20			mm	Applicable only for supported cards. Range depends on RFID tag size and environmental objects. The RFID_RANGE holds when the product is mounted as described in section 0 and starts counting from the enclosure surface.

3.4.2. RFID 125 kHz

- 5 The 125 kHz RFID technology is unregulated, therefore no standards apply. The RFID reader includes a 125 kHz front-end with following features:
- Antenna driver with carrier frequency of 125 kHz
 - Data reception by AM demodulation of the antenna signal modulation induced by the transponder
 - 10 • Modulation encoding: Manchester – RF/64 data rate
 - Supported cards: refer to software specification [2.3]
 - Write mode is not supported
 - The expected range is listed in Table 3-2

3.5. Power supply and consumption

- 15 The RFID Reader has to be supplied through CN_RS232 connector. Table 3-3 lists the power supply requirements.

Table 3-3: Power supply operating conditions

Mnemonic	Description	Min.	Typ.	Max.	Unit	Remark
V _{IN}	Nominal input voltage range	6		36.0	V	

The RFID Reader power consumption is specified by Table 3-4.

20 Table 3-4: Power consumption

Mnemonic	Description	Condition	Min.	Typ.	Max.	Unit	Remark
PWR_OP	Maximum RMS operational power consumption	V _{IN} = 12VDC T _{ambient} = 23°C	-	200	-	mA	

4. External interfaces

This section describes the external interface properties.

4.1. CN_RS232

- Function: Connection to the control system. This connection contains power and RS232 connection.
- Type: Deutsch DT04-4P Dual Row 4 Circuits receptacle connector
- Properties:
- Sealed male connector
 - Cable mount
 - Circuits: 4 (2px2)
 - Nickel receptacle pins: Deutsch 0460-202-16141
 - Pin wedge: Deutsch W4P (color code green)
- Durability: tLIFE_CN_RS232 = 25 cycles
- Reference: For power input details refer to section 3.5
For details on the RS232 interface refer to section 3.3

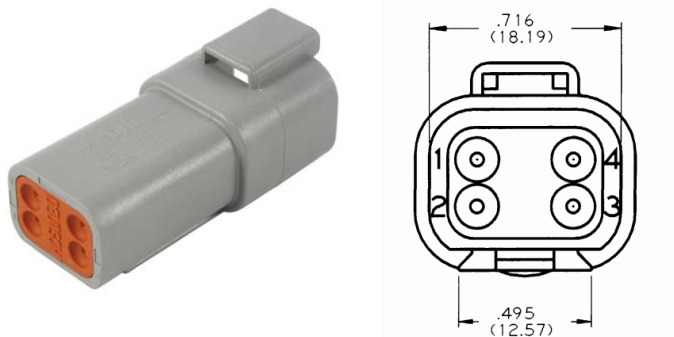


Figure 4-1: CN_RS232 (left: overview, right: rear view pinning)

5 Table 4-1: CN_RS232 connector – pins

Pin	Mnemonic	Dir	Type
1	PWR	-	PWR
2	GND	-	GND
3	RS232_TX	O	DATA
4	RS232_RX	I	DATA

4.2. CABLE

- Function: Connects CN_RS232 connector to the baseboard of the RFID Reader
- Properties:
1. Length: 510mm±15mm
 2. Wires: 0.5mm²

5. Mechanical

The specified mechanical properties of the RFID Reader can be found in this chapter.

5.1. Dimensions and Orientation

An illustration of the RFID Reader and its relevant outer dimensions can be found in Figure 5-1 and Table 5-1.

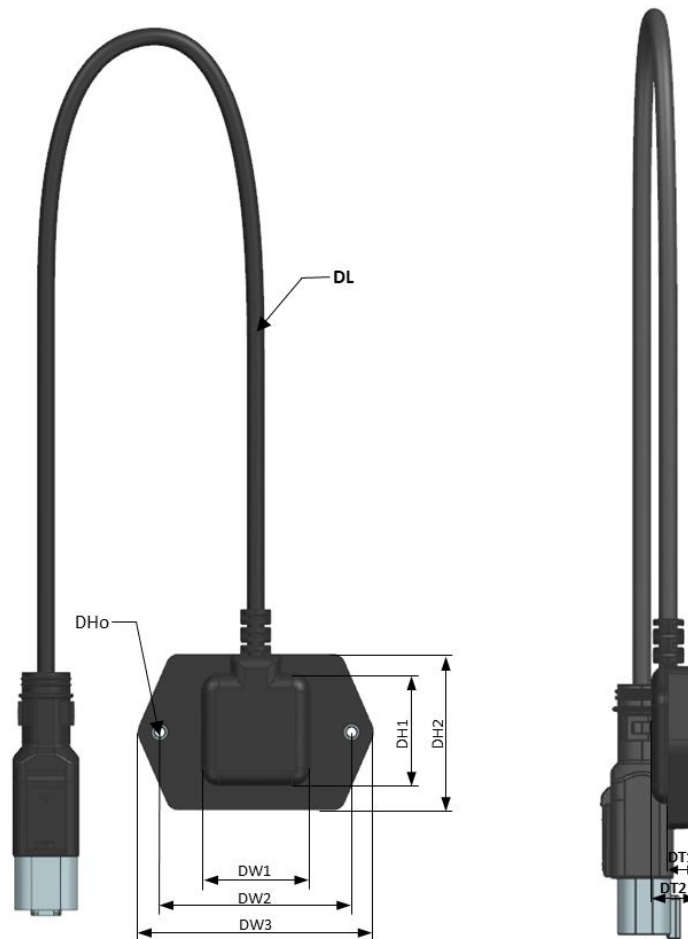


Figure 5-1: RFID Reader illustration (for reference only) and outer dimensions overview

Table 5-1: RFID Reader dimensions

Parameter	Description	Min	Typ	Max	Unit	Remarks
DL	Length cable	495	510	525	[mm]	
DH1	Base height	37	37.35	37.7	[mm]	
DH2	Total height	51.5	52	52.5	[mm]	
DW1	Width base housing	36	36.35	36.7	[mm]	
DW2	Width mounting holes	63.7	64	64.3	[mm]	
DW3	Width mounting plate	78	78.5	79	[mm]	
DT1	Thickness mounting plate	8.5	8.7	8.9	[mm]	
DT2	Total Thickness	13.5	14.1	14.6	[mm]	
DHo	Hole diameter	-	M4	-	[mm]	M4x0.7 tapped hole

5.2. Mass

Table 5-2: Product mass

Item	Description	Min.	Typ.	Max.	Unit	Remark
Mass	Total mass of the product		100		g	

5.3. Material, Finishing and Design

Figure 5-2 shows the RFID Reader mechanical part overview and its specified properties can be found in Table 5-3.

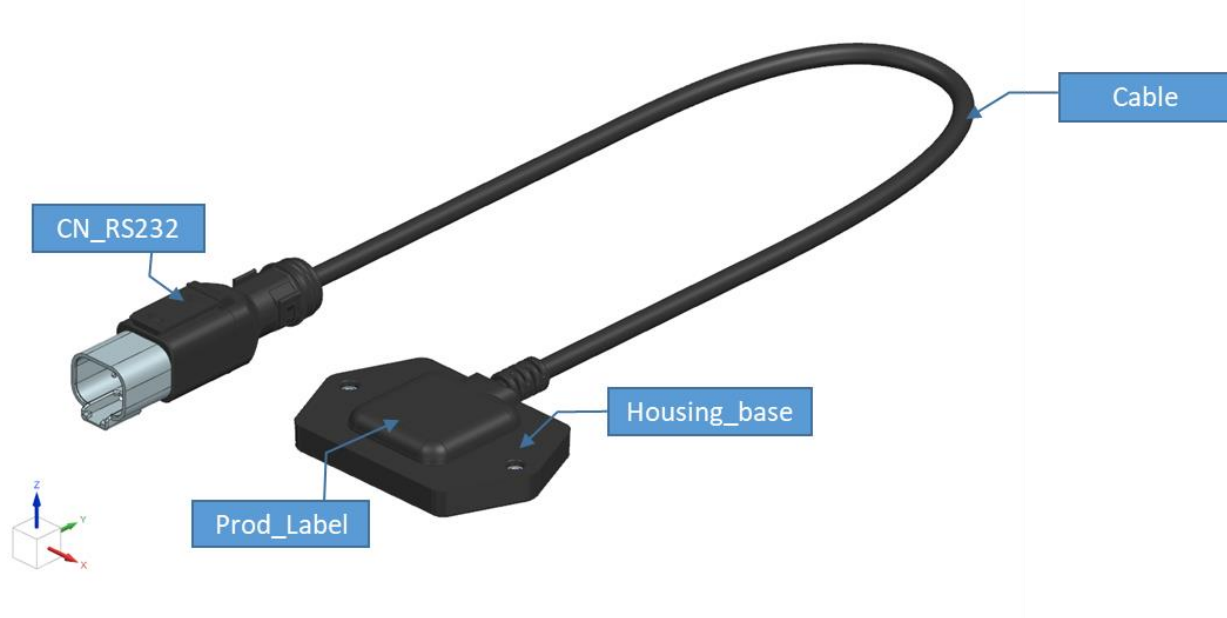


Figure 5-2: RFID Reader part overview

Table 5-3: Material, Finishing and Design

Mnemonic	Description	Property	Value	Remarks
CN_RS232	Connector	-	-	See §4.1
Cable	Cable	Material cable jacket	PUR	UL recognized
		Colour	Black	
Housing_Base	Overmoulded housing for electronics	Material	PA (Technomelt 6208)	UL recognized UL94V-0
		Colour	Black	
		Texture	SPI D-2	Visual surfaces only
Prod_Label	Product label	Material	-	See §5.4
		Colour	Laser marking	

5.4. Identification & Labelling [Open Issue #3]

This section describes the content which will be labelled to the product.

- The RFID Reader label layout and orientation is according to Figure 5-4 and placed in a 26x26mm area.
- The text on the label is in Arial 6 format.

Logos are placed in ID_LOGO_AREA. Logos are 5mm high.

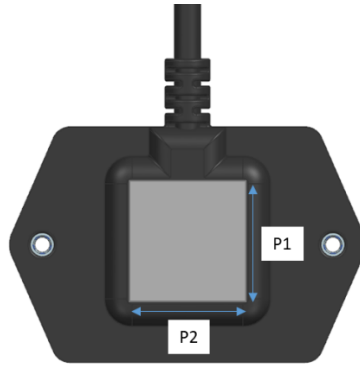


Figure 5-3 The RFID Reader top part dimensions overview

Table 5-4 RFID Reader top part dimensions

Parameter	Description	Min	Typ	Max	Unit	Remarks
P1	Base width	26.65	26.75	26.85	[mm]	
P2	Base height	27.65	27.75	27.85	[mm]	

5

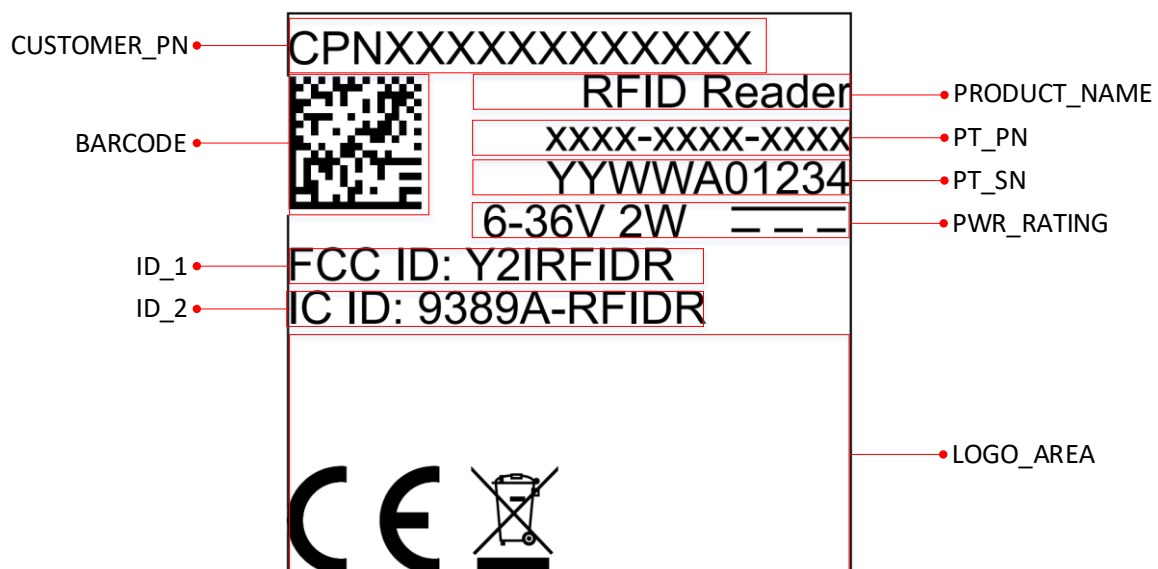


Figure 5-4: Label layout (26x26mm)

10 Table 5-5 lists the content which will be labelled to the product for identification.

Table 5-5: Identification and labelling content description

Mnemonic	Value "Example"	Dependencies	Remarks
CUSTOMER_PN	CPNXXXXXXXXXXXX	-	Max. 15 characters
PRODUCT_NAME	RFID Reader	-	
PT_PN	xxxx-xxxx-xxxx	Customer ID	
PT_SN	YYWWA01234 "1740A01234"	YY=calendar year WW=calendar week	
PWR_RATING	Rating 6-36V 2W ---	-	
BARCODE		String with prefix "21" followed by PT_PN and PT_SN: 21<PT_PN><PT_SN>	Data matrix format Size: min. 6x6mm

LOGO_AREA	Refer to Table 5-6	-	Reserved area for logos which can be country dependent.
ID_1	FCC ID: Y2IRFIDR	-	
ID_2	IC ID: 9389A-RFIDR		

Table 5-6 shows the unique identifiers and logos for each variant.

Table 5-6: ID_LOGO_AREA content

Product	ID_LOGO_AREA	
RFID Reader		CE compliance mark
		WEEE compliance mark

5.5. Installation and Mounting

The RFID Reader can be mounted from the bottom side with M4 bolts (See Figure 5-5) or from the top side with M3 bolts (see Figure 5-6). The maximum mounting torque of the RFID reader for both options can be found in table 5-6.

5

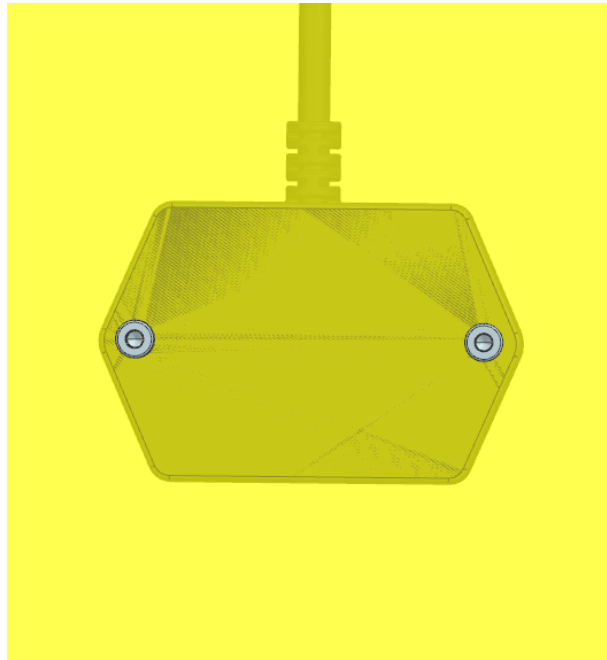


Figure 5-5: RFID Reader bottom-side mounting illustration



Figure 5-6: RFID Reader top-side mounting illustration

Table 5-7: RFID Reader mounting torque

Parameter	Description	Min	Typ	Max	Unit	Remarks
T_M4	Mounting torque M4	-	1.6	2	[Nm]	As shown in Figure 5-5
T_M3	Mounting torque M4	-	1.6	2	[Nm]	As shown in Figure 5-6

10

6. Environmental [Open Issue #1, #2]

6.1. Conducted Transients

Table 6-1: Electrical test requirements

Standard	Description	Levels	Port	Perf. Criteria	Remark
ISO 16750-2:2012	Reverse Polarity	12V system: -14V 24V system: -28V	Supply Lines	C	
ISO 16750-2:2012	Load dump	24V system: Us = 202V Ri = 1Ω td = 350ms	Supply Lines	B	24V load dump test is worst case.
-	Starting profile Cold crank	V _{min} = 6V	Supply Lines	A	Product has been designed to operate from minimum voltage of 6V.

6.2. Climatic

5 6.2.1. Climatic conditions

Table 6-2: Operational and storage temperature conditions

Description	Min	Typ.	Max.	Unit	Remark
Operational temperature range	-30		75	°C	
Storage temperature range	-40		105	°C	

6.2.2. Climatic compliance tests

Table 6-3: Operational climate test

Standard	Parameters	Remarks
SAE J1455 3 Hour Humidity Cycle	Upp temp (T _{heat}) Low temp (T _{cold}) Rel. hum (R _H) Cycles Cycle time	+85°C -40°C 93% +/-3% 20 3 hours
NEN-EN-IEC 60068-2-14:2009 (Nb) Thermal Cycling Operational	Upp temp (T _A) Low temp (T _B) t ₁ dT/dt Cycles	-40°C +85°C 40 min. 10 +/-0.2 °C/min 300

Table 6-4: Non-operational climate test

Standard	Parameters	Remarks
NEN-EN-IEC 60068-2-14:2009 (Na) Thermal Shock Non-operational	Upp temp (T _A) Low temp (T _B) t ₁ t ₂ Cycles:	-40°C +105°C 20 min. <60s 100
Thermal storage (cycling test) Non-operational	Upp temp (T _A) Low temp (T _B) Dwell time dT/dt Cycles	-40°C +105°C 30 min. 3-10 °C/min 10

10 6.3. Mechanical compliance tests

Table 6-5: Operational mechanical test

Standard	Description	Parameters	Remarks
NEN-EN-IEC 60068-2-64:2008	Random Vibration Operational	Axis Duration Accel. Frequency range	X,Y,Z 8h per axis 4.95 gRMS 5-1000Hz
NEN-EN-IEC 60068-2-27:2008	Shock test Operational	Axis Duration	+/-X,+/-Y,+/-Z 5 shocks per axis

		Pulse Severity	Half sine 30 G, 11ms	
--	--	----------------	-------------------------	--

Table 6-6: PSD for random vibration

Frequency (Hz)	PSD (g ² /Hz)
5	0.015
10	0.5562
15	0.1799
20	0.0763
50	0.0179
75	0.0095
90	0.0237
150	0.1549
200	0.0078
300	0.0064
400	0.0128
500	0.0042
600	0.0177
700	0.0331
800	0.0500
900	0.0126
1000	0.0003

Table 6-7: Non-operational mechanical test

Standard	Description	Parameters	Remarks
ISO 16750-3 3th editon 2012	Drop test Non-operational	Height 1.0m	

6.4. Ingress Protection

Table 6-8: Ingress protection test

Standard	Description	Parameters	Remarks
ISO 20653	IP rating from all directions Non-operational	IP69K	

5 6.5. UV / Chemical / Salt spray

Table 6-9: Non-operational mechanical test requirements

Standard	Description	Parameters	Remarks
ISO4892	UV test Non-operational	500 hours dE < 3	
EN 60068-2-52	Salt spray Non-operational	Severity 5	
-	Chemical test (brush test) Non-operational	Engine oil Diesel fuel Antifreeze/water solution Brake fluid	

6.6. EMC

6.6.1. Emission

Table 6-10: Emission standards

Standard	Description	Limits	Remark
CISPR 25:2016-10	Radiated Emission		ALSE method
CISPR 25:2016-10	Conducted Emission	EN 301 489-1 Table 5	Voltage method

10 6.6.2. Immunity

Table 6-11: Immunity standards

Standard	Description	Limits	Remark
ETSI EN 301 489-1 V2.2.3	General requirement	Vehicular use equipment	

ETSI EN 301 489-03 v2.1.1 (Draft)	SRD 9kHz to 246GHz	Vehicular use equipment	
EN 61000-4-2	Electrostatic discharge	Level 4 8kV contact / 15kV air	Additional test, not mandatory for product certification
EN 61000-4-3	Radiated Immunity	80MHz – 1GHz: 20V/m	Additional test, not mandatory for product certification
EN 61000-4-6	Conducted Immunity	150kHz – 80MHz 17Vrms	Additional test, not mandatory for product certification

6.6.3. Classification

Port classification is according to Table 6-12 for emission and Table 6-13 for immunity.

Table 6-12: Port classification emission

Port classification	Connection	EMC shielded	Remarks
Enclosure port	Enclosure	-	
Mains port	-	-	
Telecommunications port	-	-	
	-	-	

Table 6-13: Port classification immunity

Port classification	Connection	Cable length	EMC shielded	Remarks
Enclosure port	Enclosure	-	-	

5 6.7. Safety

This section mentions the applied safety standards.

6.7.1. Standards

Table 6-14: Safety standards

Standard	Description	Remark
IEC 62368-1	Audio/video, information and communication technology equipment - Part 1: Safety requirements	

6.7.2. Classification

10 6.7.3. Insulation / grounding concept

The RFID Reader does not contain hazardous voltages. Therefore safety isolation is not required. Furthermore functional isolation is not required by the customer. As a result the RFID Reader is constructed with a single ground plane.

6.8. Radio

15 The applicable radio standards for the RFID receivers are listed by Table 6-15.

Table 6-15: RFID - applicable radio standards

Directive/Standard	Region	Description	Remark
ETSI EN 300 330-2 V2.1.1	Europe	Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU	Used for both 125kHz and 13.56MHz reader
EN 62311:2008	Europe	Electromagnetic field	
FCC/ISED 47 CFR Part 15.225	North America	Radio Frequency Devices – Intentional Radiators	RFID 13.56MHz
FCC 47 CFR Part 15.209 ISED RSS-Gen	North America	Radio Frequency Devices – Intentional Radiators	RFID 125kHz
ISED RSS-102	Canada	Electromagnetic field	

6.9. Conditions of Use

This section lists the requirements and conditions to consider during installation of the RFID Reader.

- 5 1. The RFID Reader shall be used with an external fuse or current limiter with a maximum rating of 10A.