TTControl
HYDAC INTERNATIONAL

Vision 312

User Manual

Product Version 00.09

Original Instructions

Document type:	User Manual
Document number:	D-156-G-02-001
Document revision:	0.7.1
Document date:	2020-03-16
Security:	Corporate confidential
Status:	Released

TTControl GmbH
Schoenbrunner Str. 7, A-1040 Vienna, Austria,Tel. +43 1 585 34 34 – 0, Fax +43 1 585 34 34 – 90, office@ttcontrol.com

Table of Contents

Legal Disclaimer

THE INFORMATION GIVEN IN THIS DOCUMENT IS GIVEN AS A SUPPORT FOR THE USAGE OF THE PRODUCT AND SHALL NOT BE REGARDED AS ANY DESCRIPTION OR WARRANTY OF A CERTAIN FUNCTIONALITY, CONDITION OR QUALITY OF THE PRODUCT. THE RECIPIENT OF THIS DOCUMENT MUST VERIFY ANY FUNCTION DESCRIBED HEREIN IN THE REAL APPLICATION. THIS DOCUMENT WAS MADE TO THE BEST OF KNOWLEDGE OF TTCONTROL GMBH. NEVERTHELESS AND DESPITE GREATEST CARE, IT CANNOT BE EXCLUDED THAT MISTAKES COULD HAVE CREPT IN. TTCONTROL GMBH PROVIDES THE DOCUMENT FOR THE PRODUCT “AS IS” AND WITH ALL FAULTS AND HEREBY DISCLAIMS ALL WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OR COMPLETENESS, OR OF RESULTS TO THE EXTENT PERMITTED BY APPLICABLE LAW. THE ENTIRE RISK, AS TO THE QUALITY, USE OR PERFORMANCE OF THE DOCUMENT, REMAINS WITH THE RECIPIENT. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW TTCONTROL GMBH SHALL IN NO EVENT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES WHATSOEVER (INCLUDING BUT NOT LIMITED TO LOSS OF DATA, DATA BEING RENDERED INACCURATE, BUSINESS INTERRUPTION OR ANY OTHER PECUNIARY OR OTHER LOSS WHATSOEVER) ARISING OUT OF THE USE OR INABILITY TO USE THE DOCUMENT EVEN IF TTCONTROL GMBH HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

IF THE PRODUCT IS MARKED AS “PROTOTYPE”, THE DELIVERED PRODUCT IS A DEVELOPMENT SAMPLE (“SAMPLE”). THE RECIPIENT ACKNOWLEDGES THAT THEY ARE ALLOWED TO USE THE SAMPLE ONLY IN A LABORATORY FOR THE PURPOSE OF DEVELOPMENT. IN NO EVENT IS THE RECIPIENT ALLOWED TO USE THE SAMPLE FOR THE PURPOSE OF SERIES MANUFACTURING.

TTCONTROL GMBH PROVIDES NO WARRANTY FOR ITS PRODUCTS OR ITS SAMPLES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW DISCLAIMS ALL LIABILITIES FOR DAMAGES RESULTING FROM OR ARISING OUT OF THE APPLICATION OR USE OF THESE PRODUCTS OR SAMPLES. THE EXCLUSION OF LIABILITY DOES NOT APPLY IN CASES OF INTENT AND GROSS NEGLIGENCE. MOREOVER, IT DOES NOT APPLY TO DEFECTS WHICH HAVE BEEN DECEITFULLY CONCEALED OR WHOSE ABSENCE HAS BEEN GUARANTEED, NOR IN CASES OF CULPABLE HARM TO LIFE, PHYSICAL INJURY AND DAMAGE TO HEALTH. CLAIMS DUE TO STATUTORY PROVISIONS OF PRODUCT LIABILTY SHALL REMAIN UNAFFECTED.

ANY DISPUTES ARISING OUT OF OR IN CONNECTION WITH THIS DOCUMENT SHALL BE GOVERNED SOLELY BY AUSTRIAN LAW, EXCLUDING ITS CONFLICT OF LAW RULES AND THE UNITED NATIONS CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS. SUCH DISPUTES SHALL BE DECIDED EXCLUSIVELY BY THE COURTS OF VIENNA, AUSTRIA.

ALL PRODUCT NAMES AND TRADEMARKS MENTIONED IN THIS USER MANUAL ARE THE PROPERTY OF THEIR RESPECTIVE OWNERS, WHICH ARE IN NO WAY ASSOCIATED OR AFFILIATED WITH TTCONTROL GMBH.

User Manual

Document version **0.7.1** of 2020-03-16

Document number: **D-156-G-02-001**

1 General description

1.1 Introduction

This document refers to the following products of the Vision 312 family:

- Vision 312
- Vision 312Plus

For information about the version history, please see the related Release Note document.

This User Manual is intended for qualified engineers.

1.2 Notation

In the context of this document, the term *Vision 312* (or *Vision 312* family) refers to the family and *all* its products.

The Vision 312 products of the Vision 312 family are referred to as *Vision 312 products*.

The Vision 312Plus products of the Vision 312 family are referred to as *Vision 312Plus products*.

1.3 Advanced programming possibilities

Vision 312 runs a Linux operating system on an ARM Cortex-A9 processor. The unit can be programmed using CODESYS. CODESYS is an IEC 61131-3 compliant development environment for application development on a Microsoft Windows PC.

Alternatively, the unit can be programmed with C/C++ using the Linux Yocto distribution and the Qt5 framework. For this purpose, a Software Development Environment (SDE) with a virtual machine is provided.

Customer applications can be downloaded via

- Ethernet
- a USB flash drive connected to the USB OTG port
- a PC connected to the USB OTG port

The device firmware is updated via a USB flash drive connected to the USB OTG port.

For the latest SW releases and the Release Note documents for the Vision 312 devices, please see our TTControl Service Area website https://www.ttcontrol.com/service-area/. The Release Note documents also contain known issues. We recommend checking the service area regularly for new SW releases and to use the latest available SW release.

Document Number:
D-156-G-02-001

1.4 Features

The following tables compare the features of the Vision 312 family products:

1.4.1 System components

	Vision 312	Vision 312Plus
CPU	i.MX 6Solo Processor 800 MHz – ARM Cortex-A9 (single core)	i.MX 6QuadPlus Processor 1 GHz – ARM Cortex-A9 (quad core)
DDR3 RAM	512 MB	2 GB
eMMC Flash	4 GB	8 GB
Display	12.1”, 1280x800 500 cd/m^2 luminance, 1000:1 contrast ratio	12.1”, 1280x800 1000 cd/m^2 luminance, 1000:1 contrast ratio
Touchscreen	Yes	Yes
Bonding	Fully bonded	Fully bonded
Speaker	Integrated loudspeaker	Integrated loudspeaker
Real-time clock (super-capacitor buffered)	1	1
Non-volatile memory	32 kByte EEPROM	32 kByte EEPROM

1.4.2 Interfaces

	Vision 312	Vision 312Plus
CAN	2	4 (1 ISOBUS compliant)
Analog video input	2 (PAL/NTSC)	4 (PAL/NTSC)
USB	1 (OTG)	2 (1 OTG, 1 HOST)
Ethernet	1 (100BASE-T1)	1 (100BASE-TX)
RS-232	1	1
Terminal 15	1	1
Wake-up	1	1
Temperature sensor	2	2
Status LED	1 (RGB)	1 (RGB)
Ambient light sensor	1	1

1.4.3 Physical specifications

- Dimensions:
  - Width: 306 mm
  - Height: 212 mm
  - Depth[1]: 34 mm
  - Depth, incl. connector[2]: 46 mm
- Operating ambient temperature: -30 to +70 °C
- Storage temperature: -30 to +85 °C
- IP6K5 rated housing

Other device dimensions, including tolerances, weight and other physical specifications for Vision 312 can be found in the Product Drawing (PD) [1]. Additional physical specifications, including thermal requirements, can be found in the Mounting Requirements Document (MRD) [2].

1.4.4 Block diagrams

1.4.4.1 Vision 312

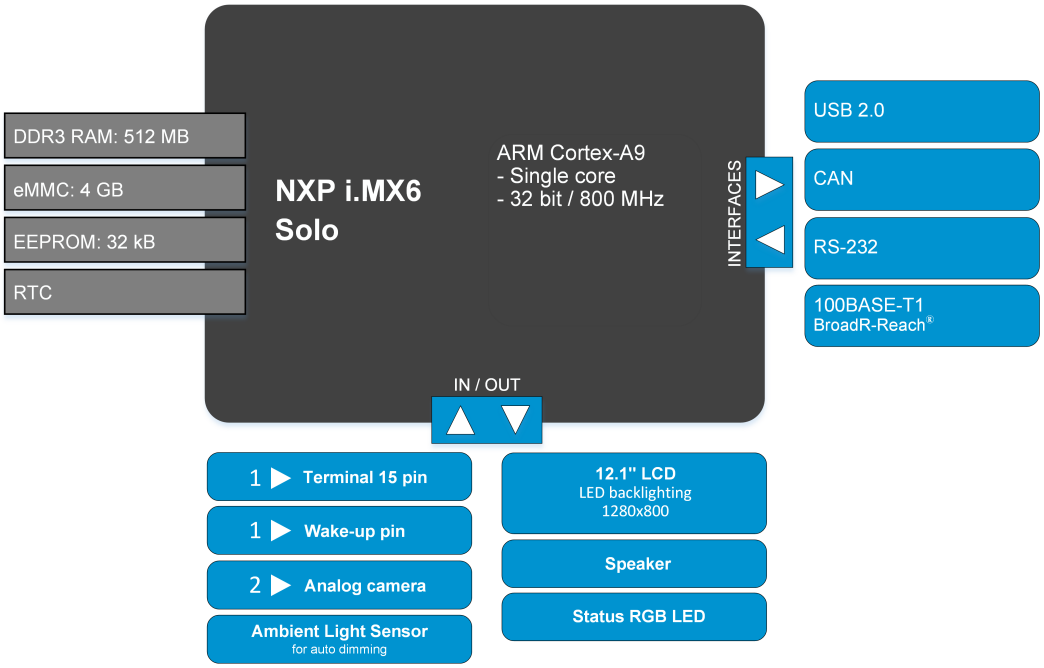


Figure 1: *Block diagram for Vision 312 products*

1. from front side of display to mounting surface of arm mount at the rear
2. from front side of front frame to the back side of the main connector

Document Number:
D-156-G-02-001

1.4.4.2 Vision 312Plus

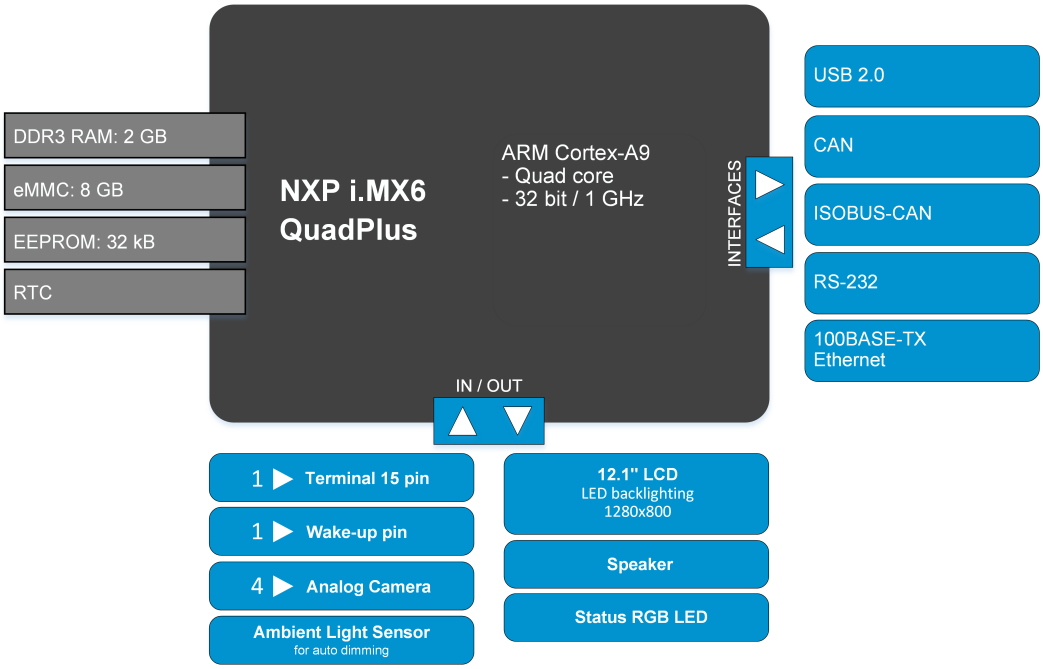


Figure 2: *Block diagram for Vision 312Plus products*

2 Instructions for safe operation

2.1 General

- Carefully read, understand, and follow the instructions and specifications listed in this document before operating the device. Failure to comply with these instructions or operation of the device outside the intended field of operation may result in serious damage to machinery and may seriously affect the safety of users. TTControl cannot be held liable for any personal injury or property damage resulting from improper installation or use of the device, non-compliance with the instructions in this document, or non-compliance with the intended field of operation. Non-compliance will result in the exclusion of any liability and warranty.
- Different regulations and standards may apply to the off-highway machinery, depending on the use and field of operation. Ensure that the Vision 312 device fulfills all requirements and standards for the intended use and field of operation by comparing with the TTControl Declaration of Conformity, Road Certification, and Summary of Compliance Test Documentation of the corresponding Vision 312 devices.
- Always operate the product within the electrical and environmental specifications and follow the handling and mounting instructions provided by TTControl. Usage of the product outside the specifications may be hazardous to persons or property.
- Only skilled and trained personnel are allowed to operate this device.
- The device must be stored, handled, and installed carefully.
- The surface of the device can reach high temperatures. Ensure that there is enough heat dissipation on the back side of the device. Avoid touching the metal parts of the housing.
- High sound pressure levels! Avoid getting close to the device loudspeaker when using at high volumes.
- Choose a location for the display that prevents ergonomic hazard to the user, and adjust the monitor position to minimize reflections and reduce glare.
- Do not use hard, sharp, or spiky objects to operate the touchscreen as this will damage the protection glass.
- The protection glass surface shall be kept clean of abrasive particles (e.g. sand, metal swarf) at all times. Operation of the touchscreen with abrasive particles will roughen the surface. Over time this will affect the visibility of the display as it will render the screen dull and fuzzy.
- The device must be mounted and operated using the type of connectors specified in this document.
- The label on the housing contains important information. The label must not be destroyed or made unreadable.
- All firmware, bootloaders, or CODESYS runtime environments used with the device must be authorized by TTControl. Any modifications made to the firmware, bootloader, or CODESYS runtime enviroment must be authorized by TTControl.
- The device hardware does not require maintenance activities.
- The device is delivered with a protection foil. This foil is intended for transportation and handling purposes. We highly recommend removing this foil from the device at incoming goods inspection.
- Check regularly if updated versions of this document or additions to it are available.

Document Number:
D-156-G-02-001

2.2 Intended use

The Vision 312 family products are programmable and robust visualization and operator interaction units, to be used for parameter-setting and operation in vehicles and mobile machinery for construction, agricultural, forestry, and municipal applications.

2.3 Improper use

- Opening and/or modifying the device is not permissible. Failure to comply may result in serious damage to machinery and may seriously affect the safety of users, or reduce the lifetime or operability of the device. Opening the device will result in the exclusion of any liability and warranty claims.
- Operation of the device in an environment that violates the specified range is not permissible.
- Use in explosive areas is not permissible.
- Any use of the product other than as described in section 2.2 is considered to be improper.
- TTControl is not liable for damages resulting from improper use.

ATTENTION!

The device must not be used for safety-critical tasks!

2.4 Checks to be done before commissioning the device

- Check the supply voltage before connecting the device.
- Check that the device connector and the cable harness are free of defects.
- Check the correct dimensioning of the wires in the cable harness.
- Always disconnect the power supply before conducting any maintenance or repair work to the machine where the device is mounted (for example, welding or maintenance of the battery system).
- Choose a mounting location for the device so that the operating temperature of the device does not exceed the maximum allowed operating temperature.
- A protective fuse must be installed between the vehicle's battery and the power supply input (BAT+) of the device.
- The device is water-resistant according to IP6K5. Ingress protection is given only when all connectors are plugged in, or the device has blind plugs installed.
- Refer to the MRD [2] for further guidelines and instructions.

2.5 Disposal

Disposal of the device must be performed in accordance with prevailing national environmental regulations.

3 Standards and guidelines

Vision 312 was developed in compliance with the following international standards and guidelines:

CE-Mark	2014/30/EU
E-Mark	ECE 10R-05
FCC	Title 47, Part 15B
EMC	ISO 13766 EN 13309 ISO 7637-3
ESD	ISO 13766 ISO 10605
Electrical	ISO 16750-2 ISO 7637-3
Ingress Protection	EN 60529 IP65 ISO 20653 IP6K5
Climatic	ISO 16750-4
Mechanical	ISO 16750-3
Irradiance	ISO 4892-2
Chemical	ISO 16750-5

4 Standard compliance

Vision 312 conforms to the following standards:

- CE
- E-mark
- FCC (Federal Communications Commission)

4.1 Regulatory information

This device 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.

This equipment 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 this equipment 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.

NOTE Changes or modifications made to this equipment not expressly approved by TTControl may void the FCC authorization to operate this equipment.

Document Number:
D-156-G-02-001

5 Connectors and pins

Vision 312 is equipped with a 34-pin main connector and up to 4 HSD connectors. The main connector is compatible with the TYCO Super Seal 1 mm series.

This section defines the pinouts of the connectors, while section 10 lists the mating connectors and their manufacturer part numbers. The detailed description of signals is described in section 6.

5.1 Available connectors

Depending on whether the device is a Vision 312 or Vision 312Plus product, the device is equipped with the Main Connector (C1) and the connectors A, B, C, and D — or a subset of them. Figure 3 shows the backside of a Vision 312 device equipped with *all* connectors. Table 5 shows the available connectors for the various products.

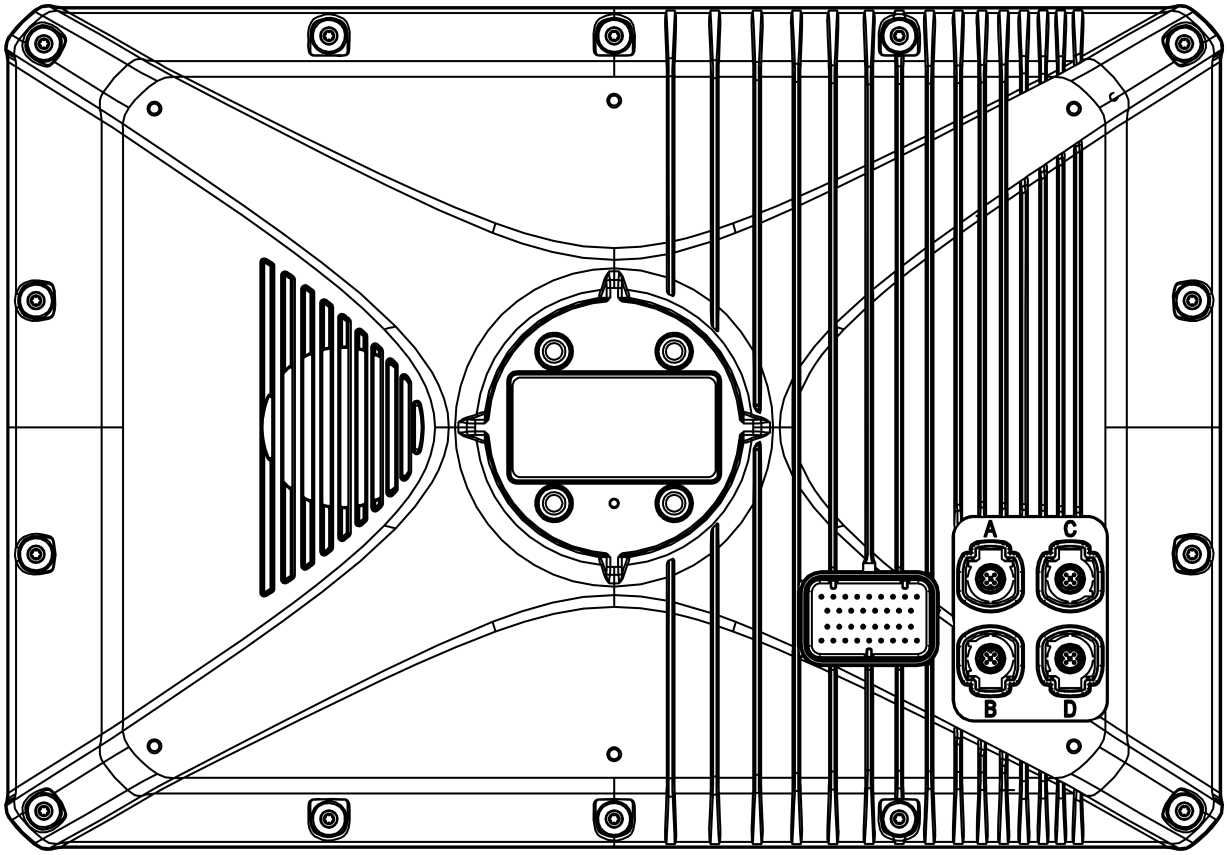


Figure 3: *Vision 312Plus device with all connectors — backside view*

The available connectors for the various Vision 312 family products are:

Products	Connectors				
	C1	A	B	C	D
Vision 312	Yes	Yes	Yes	No	No
Vision 312Plus	Yes	Yes	Yes	Yes	Yes

Table 5: *Supported connectors for the various Vision 312 family products*

Document Number:
D-156-G-02-001

5.2 Main Connector (C1)

Mates with: TE Connectivity 4-1437290-0

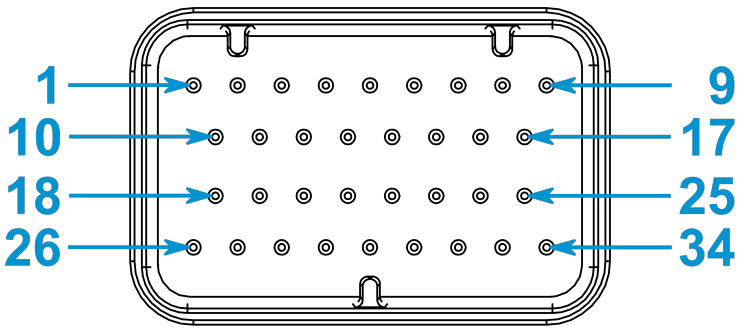


Figure 4: *Main Connector C1 pinout*

	Vision 312		Vision 312Plus	
Pin no.	Direction	Function	Direction	Function
26		BAT+		BAT+
27	in	Service	in	Service
18	in	Terminal 15	in	Terminal 15
10	in	Wake-up	in	Wake-up
1		BAT-		BAT-
2		BAT-		BAT-
8	in	Video 1 Signal	in	Video 1 Signal
16		Video 1 GND		Video 1 GND
9	out	Camera 1 Supply	out	Camera 1 Supply
17		Camera 1 GND		Camera 1 GND
6	in	Video 2 Signal	in	Video 2 Signal
14		Video 2 GND		Video 2 GND
7	out	Camera 2 Supply	out	Camera 2 Supply
15		Camera 2 GND		Camera 2 GND
29			in	Video 3 Signal
31				Video 3 GND
28			out	Camera 3 Supply
23				Camera 3 GND
21			in	Video 4 Signal
22				Video 4 GND
20			out	Camera 4 Supply

19				Camera 4 GND
13	bidirectional	CAN 0 High	bidirectional	CAN 0 High
5	bidirectional	CAN 0 Low	bidirectional	CAN 0 Low
12	bidirectional	CAN 1 High	bidirectional	CAN 1 High
4	bidirectional	CAN 1 Low	bidirectional	CAN 1 Low
11			bidirectional	CAN 2 High
3			bidirectional	CAN 2 Low
24			bidirectional	CAN 3 High
32			bidirectional	CAN 3 Low
25	out	RS-232 TX	out	RS-232 TX
33		RS-232 GND		RS-232 GND
34	in	RS-232 RX	in	RS-232 RX

For more information on recommended connectors and wires to interface with a Vision 312 device, refer to section 10.

5.3 100BASE-T1 and 100BASE-TX connector (A)

100BASE-T1 is supported by the Vision 312 products.

100BASE-TX is supported by the Vision 312Plus products.

The connector A is color-coded black.

Mates with: Rosenberger D4K14A-1D5A5-A

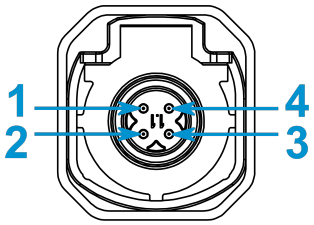


Figure 5: *Connector A pinout*

Pin no./Shield (Coding A)	Name (100BASE-T1)	Name (100BASE-TX)
1	BRR-TRX-P	ETH_TX+
2	Not connected	ETH_RX-
3	BRR-TRX-N	ETH_TX-
4	Not connected	ETH_RX+
Shield	Not connected	SHIELD

5.4 USB OTG connector (B) and USB HOST connector (D)

The USB OTG is supported by all products of the Vision 312 family.

The USB HOST is supported by Vision 312Plus products.

The connectors B and D are color-coded brown.

Mates with: Rosenberger D4K14A-1D5A5-F

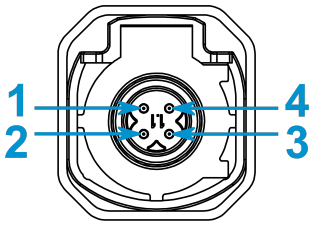


Figure 6: *Connector D pinout*

Pin no./Shield (Coding F)	Name
1	USB D+
2	USB VBUS
3	USB D-
4	USB GND
Shield	SHIELD

5.5 Connector (C)

Reserved for future use.

6 Specification of inputs and outputs

6.1 Positive power supply (BAT+)

6.1.1 Pinout

Connector	Pin no.	Function
C1	26	Battery power supply input (BAT+)

6.1.2 Functional description

Nominal supply voltage for full operation is 8 to 32 V, including both voltage ranges for 12 V and 24 V battery systems.

6.1.2.1 Undervoltage

Below 7.5 V, the following peripherals will be switched off:

- display backlight
- USB Host
- USB OTG
- camera supply

The CPU is powered and operational down to 6 V power supply (as defined in ISO 7637, Part 1 for 12 V systems).

6.1.3 Maximum ratings

Symbol	Parameter	Note	Min	Max	Unit
$V_{BAT+\ max}$	Permanent non-destructive supply voltage		-33	33	V
$V_{BAT+\ lim}$	Peak non-destructive supply clamping voltage	1	-40	40	V
$I_{BAT+\ lim}$	Peak non-destructive supply clamping current	1	-10	+100	A
$I_{BAT+\ max}$	Permanent input current at V_{BAT+} = 8 V, 25 °C	2		2.3	A
T_d	Load dump protection according to ISO 7637-2, Pulse 5, Level IV (superimposed 174 V, R_i = 2 Ω)	1		350	ms

Note 1 The control unit is protected by an active load dump protection circuit

Note 2 Without external loads

6.1.4 Characteristics

For the whole Vision 312 family.

Symbol	Parameter	Note	Min	Typ	Max	Unit
CBAT+	Capacitance load at input				700	µF
V_{BAT+}	Supply voltage for full operation	1	8		32	V
V_{BAT+}	Supply voltage for CPU operation	2	6		32	V
T_{rise}	Supply voltage rise time	3			3	s

Note 1 Display with full backlight brightness

Note 2 Ultra low voltage operation during cranking, the display backlight may be turned off if V_{BAT+} < 8 V

Note 3 The time it takes for V_{BAT+} to get higher than 8 V

6.1.4.1 Vision 312

Supply current characteristics for the Vision 312 device.

Symbol	Parameter	Note	Min	Typ	Max	Unit
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 8 V	1		800	1200	mA
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 12 V	1		600		mA
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 24 V	1		600		mA
$I_{BAT+\ STBY}$	Standby supply current at V_{BAT+} = 12 V, 25 °C	2, 3		250		µA

Note 1 Without external loads

Note 2 Terminal 15 is off, device is shut down, and RTC capacitor is fully loaded

Note 3 Current consumption can reach up to 2.5 mA if a connected BroadR-Reach master continually sends out wake-up requests to the device, even if the BroadR-Reach wake-up source is disabled.

6.1.4.2 Vision 312Plus

Supply current characteristics for the Vision 312Plus device.

Symbol	Parameter	Note	Min	Typ	Max	Unit
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 8 V	1		1500	1900	mA
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 12 V	1		1100		mA
$I_{BAT+\ idle}$	Supply current at V_{BAT+} = 24 V	1		600		mA
$I_{BAT+\ STBY}$	Standby supply current at V_{BAT+} = 12 V, 25 °C	2		115		µA

Note 1 Without external loads

Note 2 Terminal 15 is off, device is shut down, and RTC capacitor is fully loaded

6.2 Negative power supply (BAT-)

6.2.1 Pinout

Connector	Pin no.	Function
C1	1, 2	Battery power supply input (BAT-)

6.2.2 Functional description

The pin for negative power supply. Always use all pins on the connector to distribute the current load.

6.2.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
$I_{BAT-max}$	Permanent supply current at V_{BAT-} = 8 V, 25 °C		2.3	A

6.3 Ignition on switch input (Terminal 15)

6.3.1 Pinout

Connector	Pin no.	Function
C1	18	Terminal 15 Input

6.3.2 Functional description

Terminal 15 switches the power supply of the Vision 312 device.

6.3.3 Power on/off sequence

The device boots if

- Terminal 15 is powered (typically BAT+) or
- Wake-up input is powered (typically BAT+)

Once the device has started, the application software is responsible for saving all data to flash memory before it powers down the device. This is necessary to ensure data integrity.

6.3.4 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{in}	Permanent (DC) input voltage	-33	33	V
V_{in}	Transient peak input voltage 500 ms	-50	50	V
V_{in}	Transient peak input voltage 1 ms	-200	200	V

6.3.5 Characteristics

Symbol	Parameter	Min	Max	Unit
C_{in}	Pin input capacitance	8	12	nF
R_{pu}	Pull-down resistor to GND	10	12	kΩ
V_{IL}	Input voltage for low level	-1	2	V
V_{IH}	Input voltage for high level	3	32	V
τ_{in}	Input low-pass filter	0.1	0.3	ms

6.4 External Wake-up

6.4.1 Pinout

Connector	Pin no.	Function
C1	10	External Wake-up

6.4.2 Functional description

External Wake-up provides the possibility to wake up the Vision 312 device from the Suspend mode or Power-off mode by an external event (see figure 10).

6.4.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{in}	Permanent (DC) input voltage	-33	33	V
V_{in}	Transient peak input voltage 500 ms	-50	50	V

6.4.4 Characteristics

Symbol	Parameter	Min	Max	Unit
C_{in}	Pin input capacitance	8	12	nF
R_{pu}	Pull-down resistor to GND	100	120	kΩ
V_{IL}	Input voltage for low level	-1	2	V
V_{IH}	Input voltage for high level	3	32	V
τ_{in}	Input low-pass filter	0.1	0.3	ms

6.5 Service Enable

6.5.1 Pinout

Connector	Pin no.	Function
C1	27	Service Enable

6.5.2 Functional description

t.b.d.

6.5.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
$V_{in\ max}$	Permanent (DC) input voltage	-1	33	V

6.5.4 Characteristics

Symbol	Parameter	Min	Max	Unit
C_{in}	Pin input capacitance	8	12	nF
V_{IL}	Input voltage for low level	-1	2	V
V_{IH}	Input voltage for high level	3	32	V

6.6 100BASE-TX interface

Supported by the Vision 312Plus products.

6.6.1 Pinout

Connector	Pin no./Shield	Function
A	1	Ethernet TX+
A	2	Ethernet RX-
A	3	Ethernet TX-
A	4	Ethernet RX+
A	Shield	Ethernet SHIELD

6.6.2 Functional description

The 10/100 Mbit full-duplex Ethernet port is compliant with IEEE 802.3.

Use cabling that is compliant with the Ethernet standard; at least Ethernet CAT5 cable for 100 Mbit/s, and Ethernet CAT3 cable for 10 Mbit/s transmission speed. In a noisy environment it is recommended to use shielded cables. In this case, the connector's shield must be connected to the shield of the Ethernet cable.

6.6.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
$V_{in\text{-}CMM}$	Input common mode range DC or AC-peak with line frequency (max 60 Hz)		200	V

6.7 100BASE-T1 interface

Supported by the Vision 312 products.

6.7.1 Pinout

Connector	Pin no./Shield	Function
A	1	BRR-TRX-P
A	2	Not connected
A	3	BRR-TRX-N
A	4	Not connected
A	Shield	Not connected

6.7.2 Functional description

The standardized 100BASE-T1 Ethernet (also known as BroadR-Reach) link is an extension of the IEEE 802.3 100Base-TX Fast Ethernet standard and was standardized by OPEN ALLIANCE. It uses a single unshielded twisted pair cable (UTP). The 100BASE-T1 Ethernet link is capable of 100 Mbit/s full-duplex transmission rate.

6.7.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{BRR}	Bus voltage under overload conditions (short circuit to supply voltages)	-33	33	V

6.8 USB OTG interface

Supported by all Vision 312 family products.

6.8.1 Pinout

Connector	Pin no./Shield	Function
B	1	USB D+
B	2	USB V_{bus}
B	3	USB D-
B	4	USB GND
B	Shield	USB SHIELD

6.8.2 Functional description

The USB OTG interface is compliant with the USB 2.0 standard.

Be sure to use an appropriate cable for the USB connection. For the USB data lines, a twisted pair connection must be used. In a noisy environment the data line pair should be shielded separately. In this case, connect the cable shielding to USB shield.

If the USB interface is used to connect a removable device, provide a connector compliant with the USB standard. This ensures that the pins of the USB interface are connected in the correct order (first shield, then ground (GND), then V_{bus}, then the data lines), thus preventing the interface from getting damaged.

For power supply below 7.5 V, see section 6.1.2.1.

6.8.3 Maximum ratings

Symbol	Parameter	Note	Min	Max	Unit
L_{max}	Maximum cable length	1, 2		5	m
V_{usb}	Maximum voltage on V_{bus}, D+ and D-		-0.5	5.5	V
I_{max}	Maximum current on V_{bus}			1000	mA
I_{off}	Overcurrent protection on V_{bus}		1000	1600	mA
V_{in-CMM}	Input common mode range DC or AC-peak with line frequency (max 60Hz)	3	-0.05	0.5	V
V_{in-CMM}	Input common mode range DC or AC-peak with line frequency (max 60Hz)	4	0.8	2.5	V

Note 1 The maximum cable length depends on the type of cable used, the number of connectors between the devices, the environment where the cable is installed, as well as the used USB transmission speed mode. As a rule of thumb, each connector pair decreases the maximum cable length by 0.5 meters if a USB conform connector is used. If an arbitrary connector is used, the length penalty will be higher.

Note 2 A USB high speed (HS) connection is more sensitive than an USB full speed (FS) or low speed (LS) connection. Hence, the maximum possible cable length also depends on the kind of peripheral connected to the USB interface.

Note 3 For High Speed USB.

Note 4 For Low Speed USB and Full Speed USB.

6.9 USB Host interface

Supported by Vision 312Plus products.

6.9.1 Pinout

Connector	Pin no./Shield	Function
D	1	USB D+
D	2	USB V_{bus}
D	3	USB D-
D	4	USB GND
D	Shield	USB SHIELD

6.9.2 Functional description

The USB Host interface is compliant with the USB 2.0 standard.

Be sure to use an appropriate cable for the USB connection. For the USB data lines, a twisted pair connection must be used. In a noisy environment the data line pair should be shielded separately. In this case, connect the cable shielding to USB shield.

If the USB interface is used to connect a removable device, provide a connector compliant with the USB standard. This ensures that the pins of the USB interface are connected in the correct order (first shield, then ground (GND), then V_{bus}, then the data lines), thus preventing the interface from getting damaged.

For power supply below 7.5 V, see section 6.1.2.1.

6.9.3 Maximum ratings

Symbol	Parameter	Note	Min	Max	Unit
L_{max}	Maximum cable length	1, 2		5	m
V_{usb}	Maximum voltage on V_{bus}, D+, and D-		-0.5	5.5	V
I_{max}	Maximum current on V_{bus}			500	mA
I_{off}	Overcurrent protection on V_{bus}		500	1000	mA
$V_{in\text{-}CMM}$	Input common mode range DC or AC-peak with line frequency (max 60Hz)	3	-0.05	0.5	V
$V_{in\text{-}CMM}$	Input common mode range DC or AC-peak with line frequency (max 60Hz)	4	0.8	2.5	V

Note 1 The maximum cable length depends on the type of cable used, the number of connectors between the devices, the environment the cable is installed, as well as the USB transmission speed mode used. As a rule of thumb, each connector pair decreases the maximum cable length by 0.5 meters if a USB conform connector is used. If an arbitrary connector is used, the length penalty will be higher.

Note 2 A USB high speed (HS) connection is more sensitive than a USB full speed (FS) or low speed (LS) connection. Hence, the maximum possible cable length also depends on the kind of peripheral connected to the USB interface.

Note 3 For High Speed USB.

Note 4 For Low Speed USB and Full Speed USB.

6.10 RS-232 interface

6.10.1 Pinout

Connector	Pin no.	Function
C1	25	RS-232 TX – serial interface output
C1	34	RS-232 RX – serial interface input
C1	33	RS-232 GND – serial interface ground signal

6.10.2 Functional description

The RS-232 interface is a RS-232 compatible asynchronous full duplex serial interface. No handshake lines (like RTS or CTS) are provided.

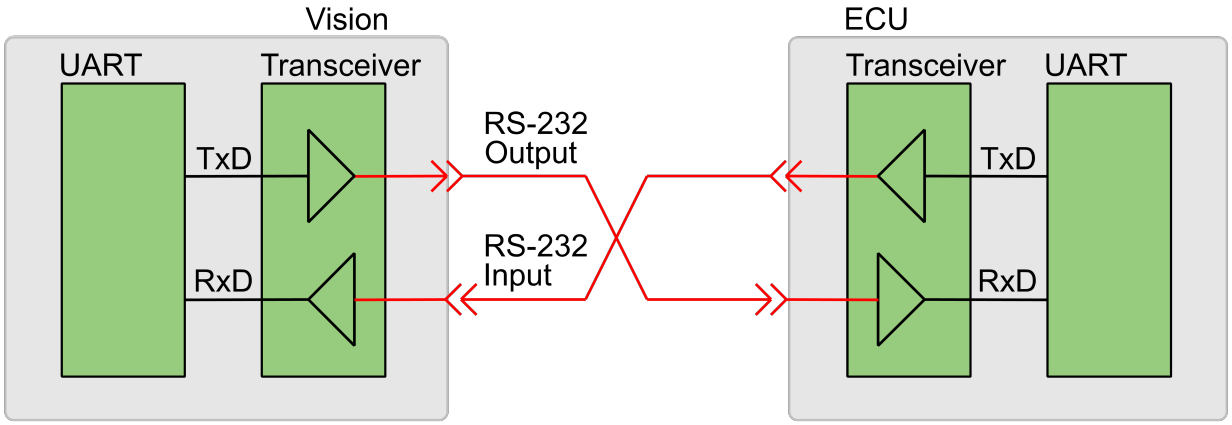


Figure 7: *RS-232 interface wiring*

Note that a proper ground connection is necessary for the RS-232 operation. It is recommended to use the RS-232 GND pin for this purpose. When connecting with an external device (for example, a PC with RS-232 interface) make sure that the maximum voltage ratings are not violated.

6.10.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{RS-232_TxD}, V_{RS-232_RxD}	Bus voltage under overload conditions (that is, short circuit to supply voltages)	-15	33	V

6.10.4 Characteristics

Symbol	Parameter	Min	Max	Unit
C_{out}	Pin output capacitance	100	200	pF
V_{IL}	Input voltage for low level	-15	+0.8	V
V_{IH}	Input voltage for high level	+2.7	+15	V
R_{pd}	Input resistor (to GND)	5	9	kΩ
V_{OL}	Output voltage for low level	-9	-5	V
V_{OH}	Output voltage for high level	+5	+9	V
S_{Tr}	Data rate		115	kBd

Document Number:
D-156-G-02-001

6.11 CAN interface

6.11.1 Pinout

Connector	Pin no.	Note	Function
C1	13	1	CAN Interface 0 – High Line
C1	5	1	CAN Interface 0 – Low Line
C1	12	1	CAN Interface 1 – High Line
C1	4	1	CAN Interface 1 – Low Line
C1	11	1, 3	CAN Interface 2 – High Line
C1	3	1, 3	CAN Interface 2 – Low Line
C1	24	1, 2, 3	CAN Interface 3 – High Line – ISOBUS
C1	32	1, 2, 3	CAN Interface 3 – Low Line – ISOBUS

Note 1 According to ISO 11898

Note 2 According to ISO 11783

Note 3 Only for Vision 312Plus products

6.11.2 Functional description

CAN implements a bidirectional twisted pair bus for high speed serial data transfer up to 1 Mbit/s. The bus must be terminated with 120 Ω at each end to prevent wave reflection. If the Vision 312 device is connected at the end of a CAN bus, it is necessary to use external termination resistors as the device is not equipped with internal termination. See figure 8 below for details.

Note that a common ground (chassis) or a proper ground connection is necessary for CAN operation. When connecting with an external device (for example, a PC with CAN interface for downloading software), make sure that the maximum voltage ratings are not violated when connecting to or disconnecting from the CAN bus.

The CAN interface is fully ISO 11898-2/-5 compliant.

6.11.3 CAN 3

Due to the requirements of the ISOBUS standard [3], the internal protection circuit of CAN 3 differs from the other CAN interfaces of the device. To achieve good RF immunity, it is recommended to use CAN 3 with external termination. It is recommended to implement the termination based on the equivalent circuit shown in figure 9 below.

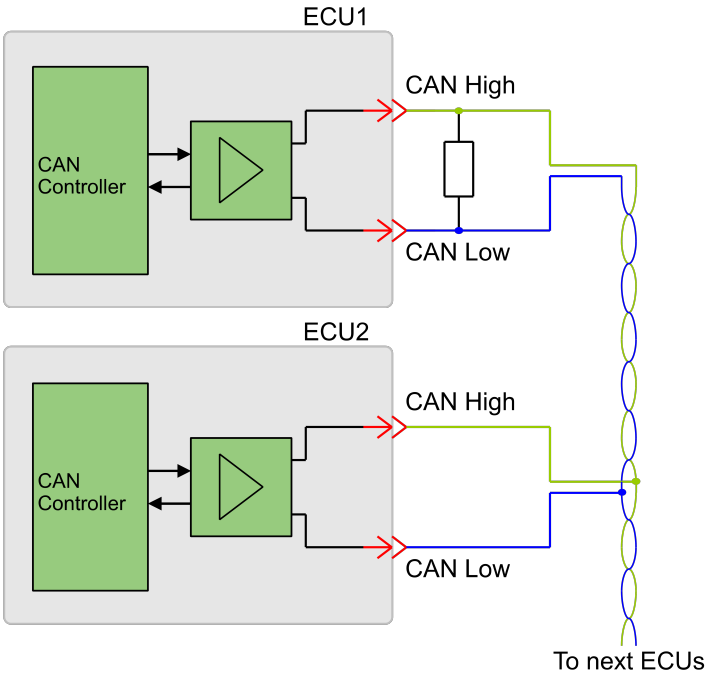


Figure 8: *CAN interface wiring*

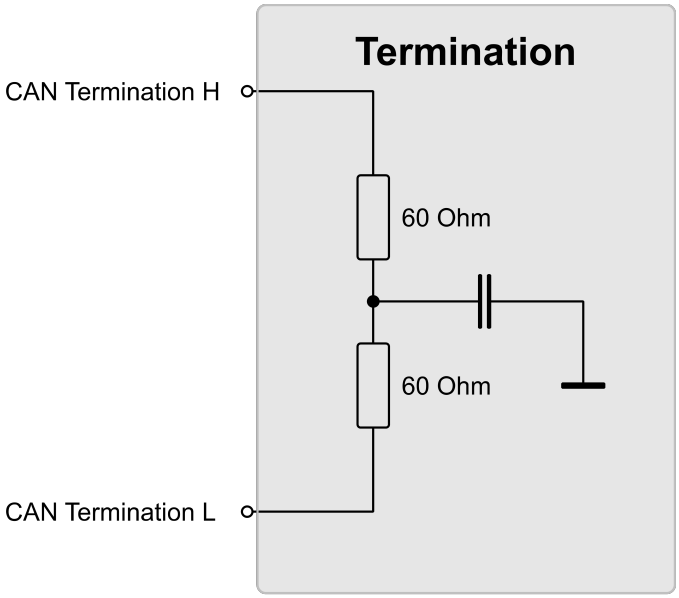


Figure 9: *CAN termination*

6.11.4 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{CAN_CN}	Bus voltage under overload conditions (short circuit to supply voltages)	-58	58	V

6.11.5 Characteristics

Symbol	Parameter	Note	Min	Max	Unit
C_{out}	Pin output capacitance			100	pF
$V_{in\text{-}CMM}$	Input common mode range	1	-12	12	V
$V_{in\text{-}dif}$	Differential input threshold voltage ($V_{CAN\_CNH} - V_{CAN\_CNL}$)		0.5	0.9	V
$V_{out\text{-}dif}$	Differential output voltage dominant state ($V_{CAN\_CNH} - V_{CAN\_CNL}$)		1.5	3.0	V
$V_{out\text{-}dif}$	Differential output voltage recessive state ($V_{CAN\_CNH} - V_{CAN\_CNL}$)		-0.1	+0.1	V
V_{CAN_CNL}, V_{CAN_CNH}	Common mode idle voltage (recessive state)		2	3	V
I_{CAN_CNL}	Output current limit		-40	-100	mA
I_{CAN_CNH}	Output current limit		40	100	mA
S_{Tr}	Bit rate	2,3	25	1000	kbit/s

Note 1 Due to possible high currents in the wiring harness the individual ground potential of control units may differ up to several volts. This difference will also appear between a transmitting and receiving control unit as common mode voltage and does not influence the differential bus signal if the common mode voltage is within the common mode limits.

Note 2 The arbitration process will allow 1 Mbit/s operation only in small networks and reduced wire length. As example a so-called *private CAN*, a short point-to-point connection (less than 10 m) between only two nodes can be operated at 1 Mbit/s.

Note 3 For typical network size and topology (network with stub wires) and more than two nodes the practical limit is 500 kbit/s.

6.12 Analog video input

6.12.1 Pinout

Connector	Pin no.	Note	Function
C1	8		Video 1 Signal
C1	16		Video 1 GND
C1	6		Video 2 Signal
C1	14		Video 2 GND
C1	29	1	Video 3 Signal
C1	31	1	Video 3 GND
C1	21	1	Video 4 Signal
C1	22	1	Video 4 GND

Note 1 Only for Vision 312Plus products.

6.12.2 Functional description

The Vision 312 is compatible with PAL B/G/H/I/D (standard PAL) and NTSC-M (standard NTSC) composite video signals (CVBS). The standard for use with the device can be selected in the application configuration.

Up to four video sources can be displayed simultaneously. All four video sources will be configured for use with the selected standard.

6.12.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{in}	Video in permanent (DC) input voltage	-1	33	V

6.12.4 Characteristics

Symbol	Parameter	Min	Max	Unit
V_{in}	Video in voltage level	0.5	2	V_{pp}

6.12.5 General advice

To avoid noise on the video signals, the following is highly recommended:

- use 75 Ω shielded coaxial cables (RG59, RG179 or likewise – depending on cable length)
- minimize connector and junction count
- use separate cable harnesses for the video signals and camera supplies

6.13 Camera supply

6.13.1 Pinout

Connector	Pin no.	Note	Function
C1	9		Camera 1 Supply
C1	17		Camera 1 GND
C1	7		Camera 2 Supply
C1	15		Camera 2 GND
C1	28	1	Camera 3 Supply
C1	23	1	Camera 3 GND
C1	20	1	Camera 4 Supply
C1	19	1	Camera 4 GND

Note 1 Only for Vision 312Plus products.

6.13.2 Functional description

A 12 V supply is provided to power external cameras.

6.13.3 Maximum ratings

Symbol	Parameter	Min	Max	Unit
V_{sc}	Short circuit voltage range	-1	33	V

6.13.4 Characteristics

Symbol	Parameter	Note	Min	Max	Unit
V_{cam}	Output voltage	1	0	0	V
V_{cam}	Output voltage	2	V_{BAT+} -1.7	0.9*V_{BAT+}	V
V_{cam}	Output voltage	3	11.7	12.5	V
I_{out}	Overall output current	4		1500	mA
I_{out}	Overall output current	5		2500	mA

Note 1 V_{BAT+} < 7.5 V (for power supply below 7.5 V, see section 6.1.2.1.)

Note 2 7.5 V ≤ V_{BAT+} ≤ 13.3 V

Note 3 V_{BAT+} > 13.3 V

Note 4 For Vision 312

Note 5 For Vision 312Plus

7 Internal structure

This section gives an overview of the internal structure of a Vision 312 device.

7.1 Temperature sensors

To allow monitoring of the internal temperature, the Vision 312 device is equipped with two temperature sensors. One measures the ambient air temperature within the housing (PCBA sensor). The other sensor is integrated in the i.MX6 CPU to measure the core temperature (on-die sensor).

7.1.1 Characteristics

Symbol	Parameter	Note	Min	Max	Unit
T_{op}	Measure temperature range		-40	+125	°C
$T_{PCBA, acy}$	PCBA sensor temperature accuracy at -25 °C to 100 °C		-2	+2	K
$T_{PCBA, acy}$	PCBA sensor temperature accuracy at -55 °C to 125 °C		-3	+3	K
$T_{on\text{-}die, acy}$	On-die sensor accuracy	1	-7	+7	K

7.2 Speaker

A loudspeaker is mounted within the Vision 312 housing. It is activated via software.

7.2.1 Characteristics

Symbol	Parameter	Min	Max	Unit
SPL	Sound pressure level, 0.5 m distance, from freely mounted housing	t.b.d.		dBA

7.3 Real-time clock (RTC)

The Vision 312 device includes a real-time clock with a backup power system. When the device is connected to the vehicle's battery via the main connector's (C1) BAT+ pin, the real-time clock is supplied by the vehicle's battery regardless of whether the device is operational or not.

If the BAT+ pin is disconnected, the real-time clock is supplied by an internal super-capacitor. The super-capacitor provides approximately 14 days of backup time, if fully charged. The capacitor is charged to 90% after 2 hours, and fully charged after 5 hours. It is charging if the BAT+ pin is connected to the vehicle's battery.

7.3.1 Characteristics

Symbol	Parameter	Note	Min	Max	Unit
Δ min/year	Time variation per year at 25 °C		-5	+5	min/year
t_{pr}	RTC power reserve	1	14		days

Note 1 If the super-capacitor has been charged for at least 5 hours with V_{BAT+} > 9 V.

7.4 Memory

The Vision 312 device provides the following storage memory types:

- eMMC NAND-flash storage (large and fast memory array)
- EEPROM storage

7.4.1 Characteristics

Memory	Parameter	Note	Typ	Unit
eMMC flash memory available for user data		1	2	GB
eMMC flash memory available for user data		2	6	GB
EEPROM memory available for user data			32	kB
EEPROM data retention		3	50	years
EEPROM erase/write cycles	per byte		$1.2*10^6$	cycles

Note 1 Only for Vision 312 products.

Note 2 Only for Vision 312Plus products.

Note 3 At 85 °C.

8 Power modes

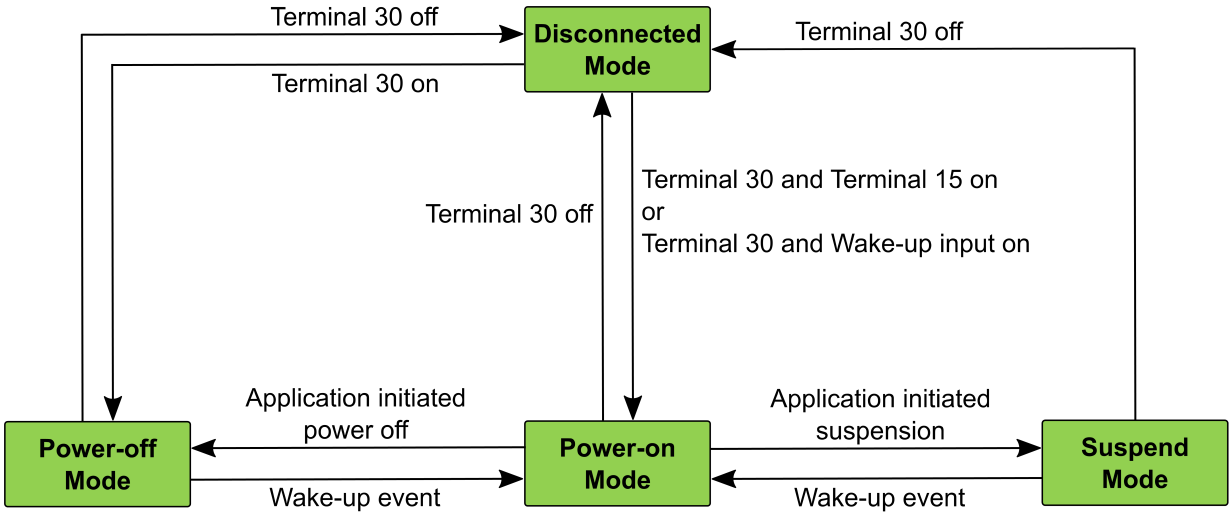


Figure 10: *Power modes*

The Vision 312 device has four power modes:

- In *Disconnected Mode*, Terminal 30 is disconnected from the power supply. Only the real-time clock is powered (until the internal energy buffer is drained).
- In *Power-off Mode*, Terminal 30 is connected to the power supply, but the RAM content is lost. Only the real-time clock is running and gets charged, the rest of the device is off.
- In *Suspend Mode*, Terminal 30 is connected to the power supply and the RAM content is preserved, but the device is mostly inactive.
- In *Power-on Mode*, Terminal 30 is connected to the power supply and the device is fully operational.

The mode transitions can be triggered as follows:

Power mode transition	Note	Trigger
Disconnected → Power-off		Terminal 30 connected to power supply
Disconnected → Power-on		Connected to power supply: • Terminal 30 and Terminal 15 • Terminal 30 and Wake-up input • Terminal 30, Terminal 15, and Wake-up input

Document Number:
D-156-G-02-001

Power-off → Power-on	1	Wake-up event: • rising edge on Terminal 15 signal • rising edge on Wake-up signal • reception of wake-up pattern on a wake-up enabled CAN interface • reception of wake-up pattern on a wake-up enabled 100BASE-T1 interface • real-time clock with configured alarm-time and date
Power-on → Suspend		At application request
Power-on → Disconnect	2	Terminal 30 disconnected from power supply
Suspend → Power-on		Wake-up event: • rising edge on Terminal 15 signal • rising edge on Wake-up signal • reception of wake-up pattern on a wake-up enabled CAN interface • reception of wake-up pattern on a wake-up enabled 100BASE-T1 interface • real-time clock with configured alarm-time and date • touch event
Suspend → Disconnect	2	Terminal 30 disconnected from power supply

Note 1 Ensure that the device remains disconnected for a minimum of one second when switching the device off and on again (corresponds to power mode transistion: *Power-off → Disconnect → Power-on*).

Note 2 Performing this mode transistion is *not* recommended as all unsaved data will be lost, and all operations running will be terminated in an uncontrolled manner. Users are advised to power-off by setting Terminal 15 to low, and waiting until the application performs a controlled shut down of the device.

9 Device front

The status LED and the ambient light sensor are on the front side as shown in figure 11 below.

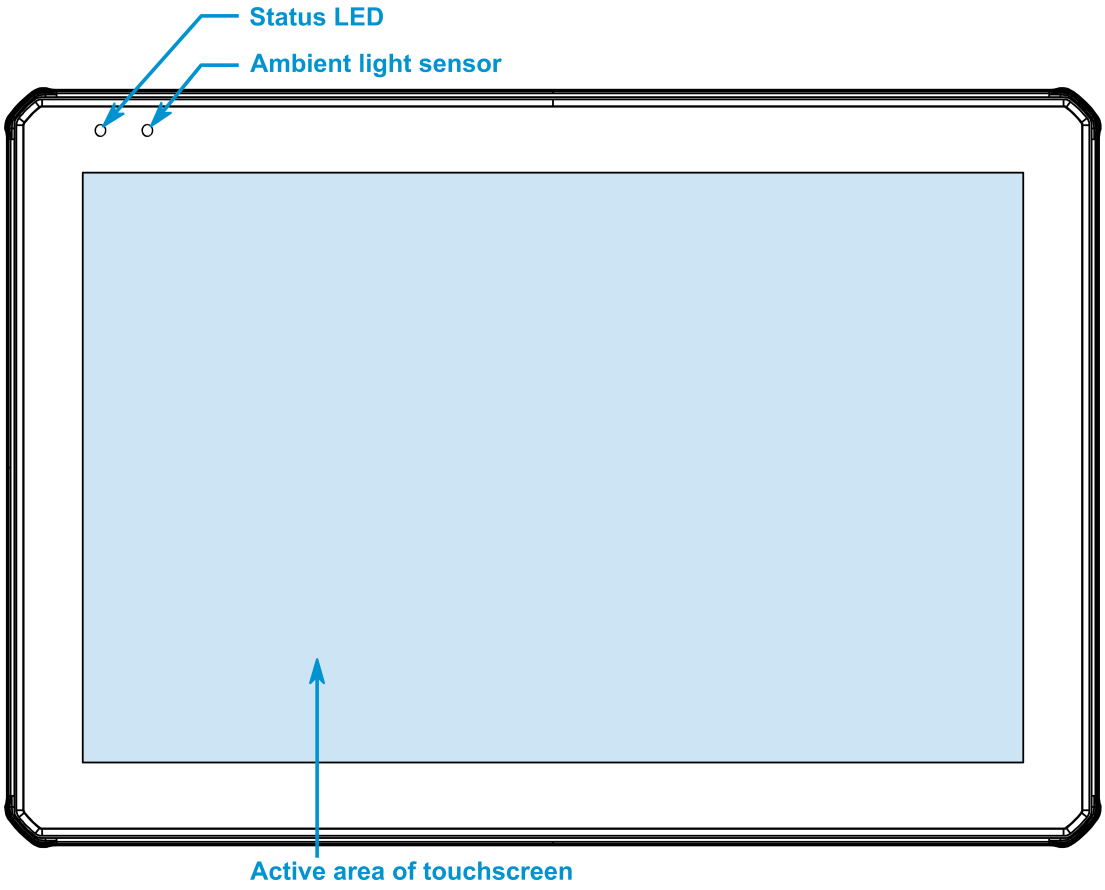


Figure 11: *Front view of the Vision 312 device*

9.1 Display

The Vision 312 device is equipped with a 12.1 inch TFT LCD module with a resolution of 1280 x 800 pixels (WXGA) and a LED backlight unit.

9.1.1 Characteristics

Symbol	Parameter	Note	Min	Typ	Unit
L_C	Center luminance of white	1		500	cd/m^2
L_C	Center luminance of white	2		1000	cd/m^2
CR	Contrast ratio		800	1000	
t_L	LED lifetime of backlight unit	3	50000		hours

Note 1 Only for the Vision 312 products.

Document Number:
D-156-G-02-001

Note 2 Only for the Vision 312Plus products.

Note 3 The lifetime of a LED, when operated at an ambient temperature of 25 ±2 °C, is defined as the time until the brightness reaches less than 50% of its original value. Note that the LED lifetime will be shorter than specified in this document if the LED operates in a higher ambient temperature.

For power supply below 7.5 V, see section 6.1.2.1.

9.2 Ambient light sensor

The ambient light sensor detects the ambient light intensity and adjusts the LCD brightness via application software.

9.2.1 Characteristics

Symbol	Parameter	Min	Max	Unit
E_V	Illuminance	0.0	65k	lx

9.3 Status LED

The Status LED is an RGB LED. The color is programmable by the customer and its brightness is adjustable.

9.4 Touchscreen

The Vision 312 device is equipped with a projective capacitive touchscreen designed to be used as an input device for the application running on the device. It can be operated with bare fingers and gloves. The touchscreen supports multi-touch gestures with two fingers.

Water drops do not trigger touch functions. The touchscreen also supports palm suppression (the palm on the touchscreen does not lead to erratic behavior).

Parameter		Note	Min	Unit
Accuracy for 10 mm target	≤ 2 mm away from edge of active area		±2	mm
	> 2 mm away from edge of active area		±1	mm
Reporting rate for single touch		1	>100	Hz
Response time	from idle mode		50	ms
	from active mode		25	ms
Pinch separation	in X and Y direction diagonal		10	mm
	diagonal		14	mm

Note 1 Depending on configuration and noise conditions.

9.5 Optical bonding

The protection glass, the touch sensor glass, and the LCD display are optically bonded (the small gap between these elements is filled with an optical-grade transparent filling material). The protection glass is anti-glare treated.

Optical bonding reduces reflections in the optical system and increases the contrast of the display. This improves the readability of the display, especially in very bright environments. Fogging (dew condensation) is prevented by optical bonding as no air gap is present.

9.6 Appearance

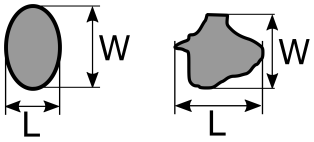
9.6.1 Acceptance criteria for dot-shaped foreign material and bubbles

The following table specifies acceptance criteria for dot-shaped foreign material and bubbles in the viewing area of the tempered glass and touchscreen.

Specification (mm)	Acceptable quantity
diameter ≤ 0.3	≤ 10
0.3 < diameter ≤ 0.5, distance > 5	≤ 5
diameter > 0.5	0

Definition: diameter = (L + W) / 2

Examples:

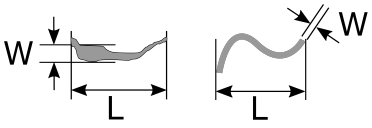


9.6.2 Acceptance criteria for line-shaped foreign material and scratches

The following table specifies acceptance criteria for line-shaped foreign material and scratches in the viewing area of the tempered glass and touchscreen.

Specification (mm)	Acceptable quantity
W ≤ 0.05, L ≤ 10	≤ 5
0.05 < W ≤ 0.1, L ≤ 10, distance > 5	≤ 5
W > 0.1 or L > 10	0

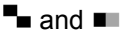
Examples:



9.6.3 Acceptance criteria for LCD pixel errors

The following table specifies the acceptance criteria for bright and dark pixels in the viewing area of the touchscreen.

Pixels	Note	Acceptable quantity
Bright pixels		2
Dark pixels		3
Total number of bright pixels and dark pixels		3
Bright adjacent pixels	1	0
Dark adjacent pixels	1	1
Adjacent pixels with a bright pixel and a dark pixel	1	0

Note 1 Examples of two adjacent pixels:  and

9.7 Cleaning

For cleaning of the device consider the following instructions:

- Use a soft, lint-free cloth (for example, soft cotton or microfiber cloth). Do not use paper towels or paper tissues (they contain wood fibers and will scratch the plastic surface).
- The cloth may be used dry, or lightly dampened (not wet) with water.
- Wipe the surface gently, do not use excessive force.
- If needed, a mild and pH neutral cleaner can be used.
- Do not use acidic/alkaline cleaners or organic chemicals such as paint thinner, acetone, toluene, xylene, propyl alcohol, isopropyl alcohol, or kerosene.
- Do not apply a cleaner directly to touch panel or any other surface. In case a cleaner is spilled onto the device soak it up immediately with absorbent cloth.

Use of inappropriate cleaners or cleaning methods can result in optical degradation of the touchscreen/protection glass and/or affect its functionality.

10 Connectors and cable specifications

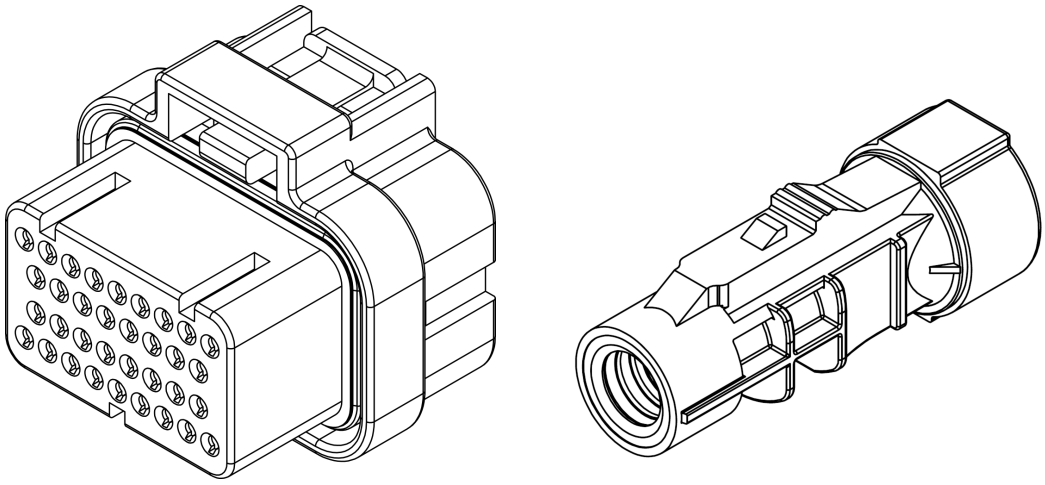
This section lists recommended plug housings for *mating* connectors, cables, receptable contacts, cavity plugs, and blind plugs. For specifications of the Vision 312 device connectors, see section 5.

For detailed specifications, please contact the supplier or refer to the supplier's website.

10.1 Plug housings

TTControl recommends the following plug housings for mating connectors:

Connector	Description	Mating connector part no.	Supplier
C1	Main connector	4-1437290-0	TE Connectivity
A	Ethernet	D4K14A-1D5A5-A	Rosenberger
B	USB OTG	D4K14A-1D5A5-F	Rosenberger
C	reserved for future use	D4K14A-1D5A5-C	Rosenberger
D	USB HOST	D4K14A-1D5A5-F	Rosenberger



(a) ***Main connector*** (b) ***Connectors A, B, C, D***

Figure 12: *Plug housings*

10.2 Receptacle contacts

TTControl recommends the following receptacle contacts for mating connectors:

Connector	Description	Note	Part no.	Supplier
C1	For stranded wire with 0.50 mm^2 cross sectional area [AWG20]	1	3-1447221-4	TE Connectivity
C1	For stranded wire with 0.75 mm^2 to 1.25 mm^2 cross sectional area [AWG18 –16]	1	3-1447221-3	TE Connectivity

Note 1 Superseal 1.0 mm socket crimp contact.

10.3 Cavity plugs and blind plugs

TTControl recommends:

Connector	Description	Part no.	Supplier
C1	Cavity plugs for unconnected pins	4-1437284-3	TE Connectivity
A, B, C, D	Blind plug for the connector	D4Z023-002Z	Rosenberger

NOTE Connectors and/or cavity and blind plugs must be installed to ensure that the device is water tight.

10.4 Tools

Connector	Description	Note	Part no.	Supplier
C1	CERTI-CRIMP straight action hand tool with fixed dies	1	1454509-1	TE Connectivity
A, B, C, D	Repair Tool Kit RosenbergerHSD	2	D4W006-SET	Rosenberger

Note 1 TTControl recommends the instruction sheet 411-78017 from TE Connectivity.

Note 2 TTControl recommends ordering the cable harnesses for connectors A, B, C, and D from a professional cable harness manufacturer.

10.5 Cables

TTControl recommends the following cables for mating connectors:

Connector	Function	Article description	Type designation	Recommendation
C1	CAN	Single twisted pair, 120 Ω, 2x0.35 mm^2	FLRY 2x35-A H=20 GE/GR	Automotive standard
C1	Video signals	Shielded video cable (Coax type, 75 Ω impedance, signal cable)		Lapp 2170010, Helu 40010, Medi 2270187
C1	all other functions	0.75 mm^2	0.75 mm^2	Automotive standard
A	100BASE-T1 100BASE-TX	unshielded twisted pair (-T1 with one pair) (-TX with two pairs)	4x0.14 Cu SF/TQ.	RosenbergerHSD LD5-105-xxxx-A-x
B, D	USB OTG USB Host	Standard USB cable	4x0.14 Cu SF/TQ	RosenbergerHSD LD5-105-xxxx-F-x
C	reserved for future use			

11 References

[1] Vision 312 Product Drawing, *D-156-C-20-003*. TTControl GmbH.

[2] Vision 312 Mounting Requirements Document, *D-156-G-20-010*. TTControl GmbH.

[3] ISO. ISO 11783-2:2012(E) (see section 11.1).

11.1 Referenced norms and standards

Documement no.	Rev.	Document title
ISO 16750-1	2006	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General
ISO 16750-2	2012	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads
ISO 16750-3	2012	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads
ISO 16750-4	2010	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads
ISO 16750-5	2010	Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads
CISPR 25	2016	Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of on-board receivers
ECE R10 Rev.05	2014	Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
ISO 11452-1	2015	Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology
ISO 11452-2	2004	Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Absorber-lined shielded enclosure
ISO 11452-4	2011	Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 4: Harness excitation methods
ISO 11452-5	2002	Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 5: Stripline
ISO 11783-2	2018	Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 2: Physical layer
ISO 10605	2008	Road vehicles — Test methods for electrical disturbances from electrostatic discharge
ISO 7637-2	2011	Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only

ISO 7637-3	2016	Road vehicles — Electrical disturbances from conduction and coupling — Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines
IEC 60068-2-1	2007	Environmental testing — Part 2-1: Tests — Test A: Cold
IEC 60068-2-2	2007	Environmental testing — Part 2-2: Tests — Test B: Dry heat
IEC 60068-2-6	2007	Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)
IEC 60068-2-14	2009	Environmental testing — Part 2-14: Tests—Test N: Change of temperature
IEC 60068-2-27	2008	Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock
IEC 60068-2-30	2005	Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)
IEC 60068-2-31	2008	Environmental testing — Part 2-31: Tests — Test Ec: Rough handling shocks, primarily for equipment-type specimens
IEC 60068-2-64	2008	Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance
IEC 60068-2-78	2012	Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state
ISO 20653	2013	Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access
EN 13309	2010	Construction machinery. Electromagnetic compatibility of machines with internal power supply
EN 62262	2002	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
EN 55025	2016	Vehicles, boats and internal combustion engines. Radio disturbance characteristics. Limits and methods of measurement for the protection of on-board receivers (IEC/CISPR 25:2016)
ISO 13766-1	2018	Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 1: General EMC requirements under typical electromagnetic environmental conditions
ISO 13766-2	2018	Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 2: Additional EMC requirements for functional safety
ISO 4892-3	2016	Part 3: Fluorescent UV lamps
ISO 14982	2009	Agricultural and forestry machines — Electromagnetic compatibility — Test methods and acceptance criteria

12 Glossary

Abbr./Term	Meaning
100BASE-T1	also known as BroadR-Reach
AC	Alternating Current
eMMC	embedded MultiMediadCard
CAN	Controller Area Network
CPU	Central Processing Unit
CVBS	Composite Video Baseband Signal
DC	Direct Current
DDR3	Double Data Rate 3
EEPROM	Electrically Erasable Programmable Read-Only Memory
HSD	High Speed Data
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MB	Megabyte
MRD	Mounting Requirements Document
NTSC	National Television System Committee
OTG	On-The-Go
PAL	Phase Alternting Line
PCBA	Printed Circuit Board Assembly
PD	Product Drawing
RAM	Random Access Memory
RF	Radio Frequency
RTC	Real-Time Clock
RX	Reception
SDE	Software Developement Environment
SW	Software
TFT	Thin-Film Transistor
TX	Transmission
USB	Universal Serial Bus
WXGA	Wide Extended Graphics Array