

Customer Requirement Specification OPUS A5 WE	Project:	OPUS A5
	Originator:	DT
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Operator Panel OPUS - A5 WE



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1 Introduction

1.1 Overview

This document indicates the basic hardware and performance specifications for the Wachendorff Opus A5 Console. The document describes the Opus A5 Console in microprocessor power, RAM memory, Flash Memory, display resolution and size, as well as USB master capability, RS232 interface, Bluetooth, video and audio-output.

This specification is broken into 3 sections. It includes a Hardware section (mechanical and electronic), a software section and a performance and environmental section.

A reference to further applicable documents, a list of abbreviations, a revision log and a table of approval completes this document.

2 Hardware

2.1 Mechanical data

2.1.1 Material:

Housing Material : BAYBLEND T88-4N

2.1.2 Dimensions, design and versions:

Dimensions: 270,6 x 140 x 67,5

Dimensions without encoder : 255 x 140 x 67,5

The orientation will be landscape.

Structure of surface: EDM-structure VDI 3400 - Ref 33

2.1.3 Colors:

Front	dark grey
Back housing	dark grey
Encoder knob	dark grey
Encoder knob top	white aluminum
Keys	white aluminum
Rubber flap	dark grey

Definitions of color codes:

- dark grey: RAL Design 000 25 00
- white aluminum: RAL 9006

2.1.4 Mounting:

according to RAM-mount RAM-202 with 4 bushings M5, DIN 16903S in rear housing.

Position: horizontal and vertical centered.

Drilling template: 38 x 30 mm.

Usable thread depth of bushing: 5,5 +/- 0,5 mm

Max. mounting torque: 5 +/- 0,5 Nm

2.1.5 Glass:

Antireflective coated glass in front of the display.

Thickness of glass: 3 mm

Color of the antireflective coating: green.

Light transmission will be 92%

2.1.6 Venting:

Goretex membrane in the flange area on the back of the housing.

Opening Diameter: 4 mm

2.1.7 Brand labeling

An area for brand labeling is provided (optional).

The brand labeling area is in the lower right corner at the front of the terminal and cover the beeper and light sensor. The standard label is the Wachendorff-Logo. As an option, there could be a customer logo applied.

2.1.8 Keys

15 keys plastic keypad:

6 keys aligned on the right side of the display with reference to the Display

6 keys aligned on the left side of the display with reference to the Display

3 keys at the lower right of the display will perform an Escape function, an ISO working set master scroll function and a home function

Touchable click-feedback if key is pressed.

Printing: Right/Left keys without symbols. Plain border for illumination.

Printing: lower keys: fully printed, symbols without printing (will be illuminated)

Key-backlight: night design with amber colored LEDs, PWM controlled

Nominal actuation force: 6 N +/- 1,2

Key drop: 0,6 mm

Max. allowable actuation force: 20 N

Minimum lifetime: > 100.000 keystrokes without error

Layout:

1>>	<<7
2>>	<<8
3>>	<<9
4>>	<<10
5>>	<<11
6>>	<<12

“Home” ISO ESC

As option, it's possible to change the key- layout

2.2 Indicator:

1 front facing multi color LED-Indicator

Position: on the upper right side of the display

Design: covered by dark cap with illumination if LED is powered

activation/colors: can be set via software to off, red, yellow, green, blue, magenta, orange

2.3 Rotary encoder with Push button:

1 mechanical encoder with 16 incremental pulses/rev and push button.

Position: sideways on the upper right end of the housing

one raster per pulse

Dynamic incremental input, acceleration algorithm by software

Nominal rotation force: 1,5 Ncm +/-1 Ncm

Nominal actuation force for pushbutton: 6 N +/-1,2 N (max. value 20 N)

Minimum rotation lifetime: 1 million single full rotations and return without electronically failure. Rotation force will decrease.

Minimum pushbutton lifetime: 1 million actuations without electronically failure.

2.4 Data Exchange interface:

2.4.1 SD-Card

Provided is 1 SD-Card-Slot.

Insertion from the side.

Position is at the right side of the terminal

Slot is closed by hard/rubber cover, sealed to IP6k5 in closed condition

Covering the slot is possible even is the SD-card is mounted

One amber LED inside slot as illumination.

Door status switch indicates opened/closed cover

SD card extend 3-4 mm in locked position and min. 6 mm in unlocked position. In the unlocked position there is at least 10 mm clearance to the bottom side and to the top side of the card.

2.4.2 USB-Slot

Provided is 1 USB 1.1 host (VCC, D-, D+, GND)

Compatibility: 2.0 compatible

Performance: full speed, 12 Mbit/s

Position is on the right side behind SD-Card slot

Slot is closed by hard/rubber cover, sealed to IP6k5 in closed condition.

Covering the slot is only be possible even no USB-periphery is mounted.

USB-Slot is not for permanent use, because of reservations in protection caused by the open door and endurance limit depending on the load of USB-periphery.

Customer has to avoid (via door switch), that the door is permanently open.

Door status switch indicates opened/closed cover

2.5 Buzzer:

Piezo – Buzzer, high sound output

Position: facing to front side, estimated place: right side of the Display

min. output level 80 dBA ($\pm 10\%$) in 60 cm distance to front side

output volume software adjustable in 6 steps

frequency app. 3,5 kHz

Nominal lifetime: 1000 hours continuously

2.6 Light sensor:

One front facing light sensor, for software controlled automatic adaptation of display back light and key back light, depending on environment light.

2.7 Processor:

Technology:	PowerPC / 32Bit
Type:	MPC5200B
Supplier:	Freescale
Performance:	400 MHz, 760 MIPS

2.8 Memory:

SD-RAM:	256 Mbyte@133MHz for Processor
FLASH:	64 Mbyte
EEPROM:	32 Kbyte
Mass storage:	1G x 8 Bit NAND Flash Memory,

2.9 Graphic-Controller:

Supplier/Type:	Fujitsu lime MB86276
GPU- SDRAM:	32MByte@133MHz

2.10 Display:

Transflective display:	
Screen size:	7"
Aspect ratio:	15:9
Resolution:	800*480 pixels
Number of colors:	262.144 colors
Brightness:	typ. 220 cd/m ²
Contrast Ratio:	typ. 400
Interface:	LVDS Interface
Backlight:	LED backlight, dimmable by software from 0 to 100%
Operation temp.:	-30 up to +80°C
Storage temp.:	-40 up to +85°C
Surface:	matt or antireflective surface
viewing angle hor.:	typ. +/- 70 degree
viewing angle vertical:	typ. +/- 55 degree

2.11 Communication Interfaces on main connector:

2.11.1 CAN-Bus Interface:

2 x CAN - Bus Interface according to ISO/DIS 11898, CAN - specification 2.0 B active, up to 1 Mbit, EMC-optimized, with transceiver for hardware filtering, non isolated, short circuit protected against Vcc and GND.

2.11.2 USB-Interface:

Provided is one USB 1.1 host (VCC, D-, D+, GND)
Compatibility: 2.0 compatible
Performance: full speed, 12 Mbit/s

2.11.3 Serial Interface EIA232 (RS232):

1 x EIA232 (only RxD, TxD, GND) for GPS
Speed: max. 230 Kbps
Application: for GPS input

2.11.4 Audio-Out Interface (Option):

1 x Audio-out, stereo (Left, Right, GND)
AC97-compatible
Output power: appr. 50 mW

2.12 Inputs / Outputs on main connector

2.12.1 Frequency Input:

1 x digital frequency input, H active
 minimum Hi level > 6.3V
 maximum Lo level < 1.5V
 duty cycle of input signal: 20...80%
 frequency range maximum 10 kHz
 load impedance > 3kOhms
 internal pull up resistor 4.7 kOhms to ignition input voltage

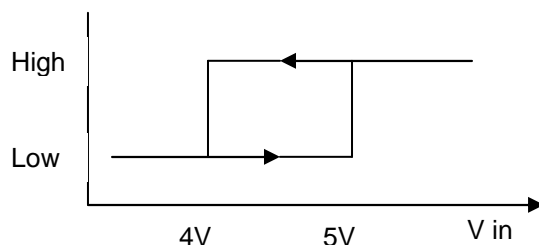
2.12.2 Analog Input:

1 x analog input
 Load impedance > 3kOhms
 Resolution 8bit
 Input Range: 0 to 12 V, protected up to 50 VDC
 This Input can be configured as digital (Boolean) or analog (multi-function input for simulation of 8 levels) input

1 x analog input
 Load impedance > 3kOhms
 Resolution 8bit
 internal pull-up resistor 4.7 kOhms to ignition input voltage
 Input range: 0 to 12 V, protected up to 50 VDC

2.12.3 Digital Input:

3 x digital inputs, nominal 12 V, short circuit protected, protected against over voltage up to 48V.



2.12.4 Digital Output:

2 x digital outputs
 Type: Open Collector
 I_{max}: 300mA
 with voltage snubbing for relay coil if output is off
 Maximum supply voltage: 50 VDC, short circuit protected to 36 VDC
 R_{dson}: max. 1 Ohm

2.13 Real Time Clock:

Real Time Clock buffered 2 weeks with Gold Cap
 Accuracy: +/-1 sec/day

2.14 Video-Input on Video-Connector (Option):

1 x Composite video input acc. to PAL/CCIR- spec. Signal Level 1 V_{pp}, 75 Ohms impedance

Video picture can be mirrored in horizontal orientation (projectable, in development)

Video screen is displayed up to 640x480 pixel

Scaleable to smaller sizes with aspect ratio of 4:3 to be kept

no stretch, no cut off of the picture

Total video can be positioned anywhere on the screen (total picture is always visible)

Overlay: is done by the graphic controller.

1 layer is used for video

1 layer is used for background/static information (specially ment to fill remaining display space)

1 layer is used for foreground (on top of video and background information)

Camera supply output for camera:

Voltage: 12 V fixed (max supply voltage = power supply voltage – 3V)

Short circuit protected against max. 50V VCC and GND

Maximum load 1.2 A

Software controlled on/off.

2.15 Power Supply:

Power supply on Main connector: VCC, Ignition Input, GND, Car GND

Designed for: 12 V (13,6 V nom.) and 24 V (27,2 V nom.)

Operation Voltage : 8 to 48 V without disturbances

Current (continuous) @ 12 VDC: max. 2,5 A (without camera)

Current at power on @ 24 VDC: < 20A for the first 2 ms

With switched power supply, non isolated.

Protected against over voltage: up to 48V

Protected against reverse polarity up to – 48 V

2.15.1 Operating Voltage:

Test method for operating Voltage according to ISO 15003 – 5.14.1

- Test procedure for 12 V system:
 - 8 h operation at 10,5 V
 - 8 h operation at 13,6 V
 - 8 h operation at 16 V
- Test procedure for 24 V system:
 - 8 h operation at 21 V
 - 8 h operation at 27,2 V
 - 8 h operation at 36 V

2.15.2 Over voltage:

Test method for over-voltage according to ISO 15003 – 5.14.2:

- Test method for 12 V system: 5 min operation at 26 V
- Test method for 24 V system: 5 min operation at 48 V

2.15.3 Under voltage:

Test method for under-voltage test:

- Test method for 12 V Systems: 5 min sweeping from 0 to 10,5 V. DUT shall not be damaged. DUT does not have to be operational
- Test method for 24 V Systems: 5 min sweeping from 0 to 21 V. DUT shall not be damage. DUT does not have to be operational

2.15.4 Reverse polarity:

Test method for reverse polarity according to ISO 15003 – 5.14.3:

- Test method for 12 V system: 5 min operation at - 26 V
- Test method for 24 V system: 5 min operation at - 48 V

2.15.5 Accessory noise:

Test method for accessory noise according to ASAE EP 455 - 5.11.1:
The DUT shall operate properly when a voltage defined by the equation:
 $V = 14.0 + 1.5 (\sin 2\pi f (t))$ with f defined as $50\text{Hz} < f < 10\text{KHz}$ is applied through a resistive impedance of 1 ohm for 5 minutes to the power supply line of the DUT.

2.15.6 Batteryless operation:

Test method for batteryless operation according to ISO 15003 - 5.14.5:

- Test method for 12 V system: 6000 fast ramps between 10V and 20V within 5 min.
- Test method for 24 V system: 6000 fast ramps between 18V and 38V within 5 min.

2.15.7 Load dump:

Test method for load dump according to ISO 7637-2 – 5.6.5 (pulse 5a):

- 5 pulses with 50V @ 400ms: functional status class A
- 5 pulses with 70V @ 400ms: functional status class C

2.16 Bluetooth (Option)

Definition: Set of technologies providing audio and data transfer over short-range radio connections.

Bluetooth V2.0 with EDR is available as an option.
Data rates up to max. 3 Mbps
Class 2, max. output power 2.5 mW
Antenna: integrated in terminal, behind enclosure.

2.17 Connectors:

2.17.1 Main Connector:

Supplier/Type: AMP, SuperSeal Connector: 1437288-6 with 26 pins
Position: rear facing, below RAM-Mount
Mating connector for customer: AMP 3-1437290-7
Mating crimp contact for customer: AMP 3-1447221-4

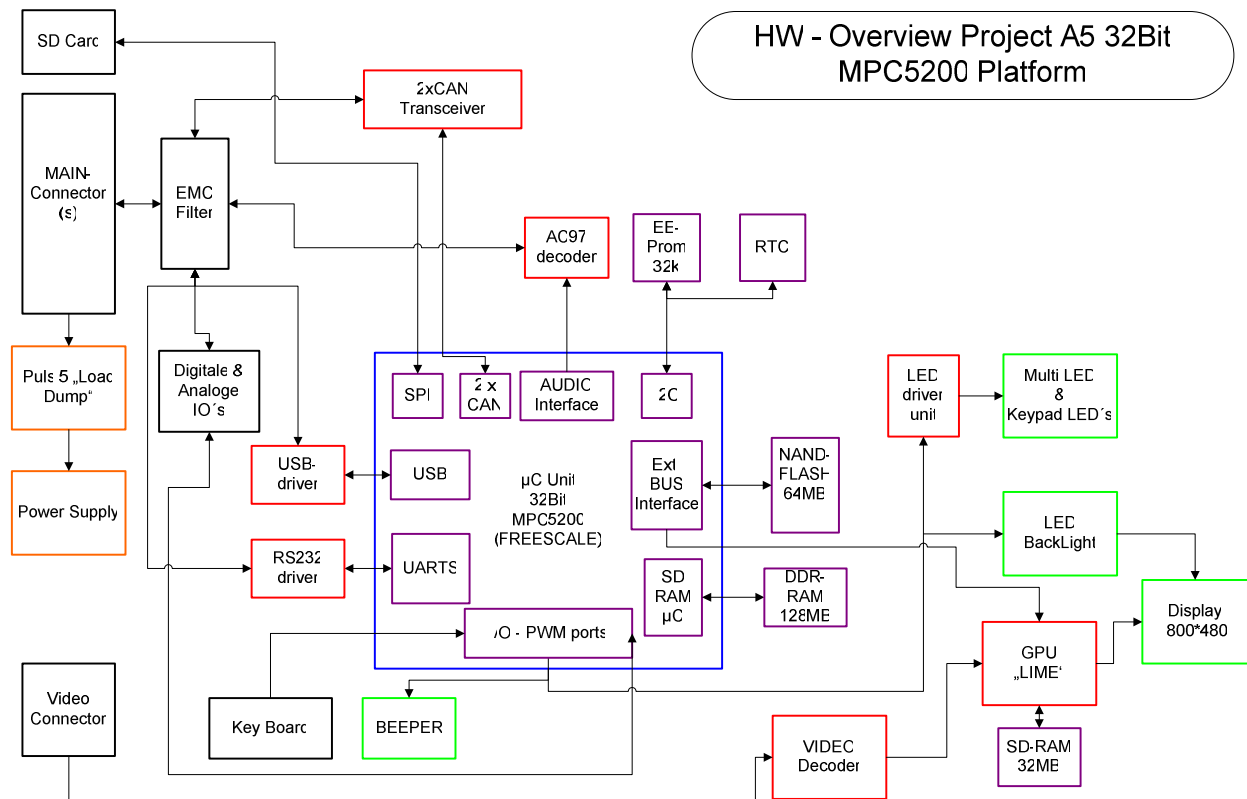
Pin assignment		
Pin	assignment	description
1	VCC	Power Supply: Steady Plus, Klemme 30
2	Ignition Input	Power Supply: Ignition Plus, Klemme 15
3	GND	Power Supply: Battery Ground, Klemme 31
4	CarGND	Power Supply: Vehicle Chassis Ground
5	Audio: L	Audio: Left Audio Signal, Option
6	Audio: R	Audio: Right Audio Signal, Option
7	Audio: GND	Audio: Ground, Option
8	CAN1H	CAN: CAN 1 Hi
9	CAN1L	CAN: CAN 1 Lo
10	CAN2H	CAN: CAN 2 Hi
11	CAN2L	CAN: CAN 2 Lo
12	not connected	
13	not connected	
14	not connected	
15	not connected	
16	RS232: RxD	EIA232: RxD: Receive Date

17	RS232: TxD	EIA232: TxD: Transmit Data
18	RS232: GND	EIA232: GND: Ground
19	Frequency Input	I/Os: Digital frequency Input for TECU
20	Analog Input 1	I/Os: Analog Input for TECU
21	Analog Input 2	I/Os: Analog Input for Keyboard Navigator
22	Digital Input 1	I/Os: Digital Input for Keyboard Navigator
23	Digital Input 2	I/Os: Digital Input for Keyboard Navigator
24	Digital Input 3	I/Os: Digital Input for Keyboard Navigator
25	Digital Output 1	I/Os: Digital Output for TECU
26	Digital Output 2	I/Os: Digital Output for TECU

2.17.2 Video Connector:

Escha M12 x 1 round connector, Code EC-FSFD4.5

Pin Assignment Video Connector	
Pin	assignment
Pin 1	Video-Signal
Pin 2	Car-Ground
Pin 3	Camera supply
Pin 4	Camera ground
Pin 5	Video-ground

2.18 Block Diagram:


3 Software

3.1 Operating System

As operating system, the device includes an open source linux. The version of the kernel is 2.6. There will be no royalties per device.

3.2 Board Support Package

Wachendorff will also provide a working board support package. This will include support for all relevant hardware components mentioned in the block diagram. As a special feature, the board support package will support High-Speed Can and Full Speed USB.

3.3 X11 Server

Wachendorff equip the BSP software with window system "X11"

3.4 Sleep mode

Wachendorff is implementing a configurable power manager. Details are available soon.

3.5 Interfaces, Driver and Projecting-tools

Under development:

- Generic Driver
- CANfreestyle
- CANopen
- J1939
- ISO11783
- CoDeSys

4 Environmental Specifications

Unless specific conditions, the general conditions are:

- Temperature 23°C +/- 5°C
- Humidity 60% +/- 15%
- Pressure 100000Pa ± 4000Pa (14.5 psi ± .58 psi)
- Supply voltage 13.5VDC ± 0.5VDC
- Ripple voltage sinus 0.2V peak, 100kHz max

Definition of DUT's functional behaviour

- Function-State A:
DUT operates during and after the test according to the specifications.
- Function-State B
DUT operates during the test, but not according to the specifications, after the test DUT resumes to normal operation according to the specifications without operator access.
Microprocessor works without restrictions, data will be 100% retended

- Outputs will keep defined values
- CAN-Bus operates regular
- Screen which was displayed before the test remains after the test
- **Function-State C**
 - DUT doesn't operate or operates faulty during the test. After the test DUT resumes to normal operation according to the specifications without operator access.
 - Microprocessor doesn't operate or operates faulty, data may be lost
 - Outputs will keep defined values
 - CAN-Bus doesn't operate regular
 - EUT will reset after the test
- **Function-State D**
 - DUT doesn't operate or operates faulty during the test. After the test DUT resumes to normal operation according to the specifications after operator access.
 - Microprocessor doesn't operate or operates faulty, data may be lost
 - Outputs will keep defined values
 - CAN-Bus doesn't operate regular
 - DUT will operate after repowering according the specifications.
- **Function-State E**
 - DUT will be damaged during the test and stays damaged after the test.

4.1 Temperature Range

4.1.1 Ambient Operating :

-30°C ... +65°C

4.1.2 Low Storage Temperature similar to IEC 60068-2-2Bb:

Test method: -40°C @ 16 hours. Afterwards the unit is returned to ambient temperature at a rate of 0.5°C/minute. DUT will be powered on at -30°C with 13.5V.

4.1.3 High Storage Temperature similar to IEC 60068-2-2Bb:

Test method: 85°C @ 16 hours. Afterwards the unit is returned to ambient temperature at a rate of 0.5°C/minute. DUT will be powered on at 65°C with 13.5V.

4.1.4 Changes of temperature with specified rate of change:

Test method: 3 cycles in 24h with -40°C@3h to +65°C@3h. DUT is switches off during cold period and operating with 13,5V during warm period.

4.1.5 Temperature Shock according to ISO 15003 – 5.2.2 and IEC 60068-2-14:

Test method: DUT will be transferred (within less 1 minute) from -40°C to +85°C, will be stored for 0,5 h and vice versa for 10 cycles. DUT is switched off.

4.1.6 Damp heat (cyclic) according to ISO 15003 – 5.4 and IEC 60068-2-30

Test method: DUT stored without power applied for a cycle duration of 24h in high humidity (>90%) at temperatures between 25°C and 40°C (Test level 1), two cycles.

4.2 Air pressure (Altitude) acc. to ISO 15003-5.9 and IEC 60068-2-13

Test method: DUT is operating for 7.5h at lower pressure at 80 kPa (appr. 1700m attitude) and 3.5h at normal pressure. 2 cycles.

4.3 Mechanical stress

4.3.1 Vibration (sinusoidal), acc. to ISO 15003-5.6, IEC 60086-2-6, -2-47, -2-64

Test method for each of three axis:

1. Subject the DUT to a resonance search with an acceleration of 50m/s^2 from 10Hz to 2000Hz without power applied. Duration 150h each axis.

4.3.2 Vibration (random) according to ISO 15003 – 5.6, IEC 60068-2-6, -2-47

Test method: DUT operating in 3 orthogonal axis, each for 8h at Level 1 in a frequency range of 10 to 350 Hz (Level 1)

4.3.3 Mechanical shock according to ISO 15003 – 5.5.2 and IEC 60068-2-27

Test method: DUT operating during sinusoidal shocks with a peak acceleration of 300m/s^2 and a duration of 11ms (Level 1).

Quantity: 3 shocks in each of three mutually perpendicular axis.

4.4 Chemical brush or spray according to ISO 15003 – 5.10

Apply once a day, for three days, the following chemicals with a brush over the exposed surface. Inspect without rinsing immediately afterwards and after 100h.

- Alcohol
- Antifreeze liquid (Ethylglycol)
- Diesel oil
- Domestic Ammonia
- Gasoline
- Hydraulic oil 10 W 40
- Liquid lime
- Motor oil
- NPK Chemical fertilizers 20 10 20
- Windscreen cleaning mixture
- Ammonium Nitrate and Ammonium Phosphate fertilizers.
- Bovine Effluent – (up to 5% propionic acid).
- Brake fluid – both mineral and vegetable types.
- Diesel fuel.
- STOU (Super Tractor Universal Oil) lubricating oil.

4.5 Protection

4.5.1 Wash according to ASAE EP455, Section 5.6.

IP6k5

4.6 Corrosive Atmosphere acc. ISO 15003-5.7 and IEC 60068-2-11

Test method: DUT operating for 16h in corrosive atmosphere @ 35°C and afterwards 100h in normal environment without rinsing (Level 1).

4.7 Solar radiation (ultraviolet) according to ISO 15003 – 5.11

Test method: Subject the DUT to alternating UV exposure and humidity exposure for 1500h. The UV exposure time shall be 8h at 60°C and the humidity exposure time shall be 4h with condensing humidity at 50°C

4.8 Short circuit protection according to ISO 15003 – 5.14.4:

- test method for 12V system: short each external connection to ground for 5 min and then to 16V for 5 min
- test method for 24V system: short each external connection to ground for 5 min and then to 36V for 5 min.

4.9 Conducted Immunity acc. to ISO 7637-2 and ISO 7637-3

- ISO 7637-2 – 5.6.1: inductive load switching - pulse 1
- ISO 7637-2 – 4.6.2: inductive load switching – pulse 2a/2b
- ISO 7637-2 – 5.6.3: mutual coupling - pulse 3a/3b
- ISO 7637-2 – 4.6.4: crancing - pulse 4
- ISO 7637-2 – 5.6.5: load dump - pulse 5: see 2.16.7

4.10 Reset Test

after reset (0,1s...1s) during the initializing stage (0,1s...1s), the DUT shall return from reset to normal operation.

4.11 Electrostatic Discharge according to ISO 10605:

- Test method during handling: ± 8 kV electrostatic discharge between each connector pin and enclosure or ground.
- Test method during operation: ± 15 kV electrostatic discharge on the areas accessible by the operator, including users interface.

4.12 EMC Emission

4.12.1 Conducted Emission according to CISPR 25-3 (class 3):

Frequency range 150KHz – 108 MHz, divided in radio bands

4.12.2 Radiated Emission according to RL2004-104 EG, type approval:

Enhanced measuring method according to type approval E1, similar CISPR25
Both limits (wideband and narrowband) must be kept.

4.12.3 Electromagnetic susceptibility according to RL2004-104 EG, type approval:

Enhanced measuring method according to type approval E1
Frequency range 20Mhz – 2000Mhz, 30V/m (radiated), up to 800 MHz amplitude modulated and over 800MHz pulse modulated

4.12.4 “E” field - 50/60Hz according to ASAE EP455 5.16.4

4.13: Type approval: “e1”

the specified versions of OPUS A5 is released with the “e”-mark approval for devices which is related to the european community. The “e”-mark is on the label

4.14: “CE”-mark:

the specified versions of OPUS A5 is released with the “CE”-mark approval. The “CE”-mark is on the label.

5 Configuration overview:

	Standard	Full
Video		X
Bluetooth		X
Audio Out		X
Mass-Storage	1 GB	1 GB
RAM	256 MB	256 MB

List of abbreviations	
Abbreviation	Description
BIOS	Basic operating system software
CAN	Computer Area Network for automotive and off-highway vehicle use
CH	Challenger
EDR	Enhanced data rate
DUT	Device under test
ISO	International Standards Organization
ISOBUS	Marketing name for devices conforming to ISO 11783 communication standard
ISO-FS	File server conforming to ISO 11783 Part 13
ISO-TC	Task controller conforming to ISO 11783 Part 10
ISO-VT	Virtual terminal conforming to ISO 11783 Part 6
LED	Light emitting diode
MF	Massey Ferguson
PWM	Pulse width modulated
RAM	Random access memory
SD-Card	Secure digital flash card

Applied standards		
Standard	Date	Description
ASAE EP455	FEB 2003	Environmental considerations in development of mobile agricultural electrical/electronic components
CISPR 25-3	2004	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices – limits and methods measurement
IEC 60068-2-2	1994	Basic environmental testing procedures – Test B: Dry heat
IEC 60068-2-5	1975	Basic environmental testing procedures – Test Sa: Simulated solar radiation at ground level
IEC 60068-2-6	1995	Basic environmental testing procedures – Test Fc: Vibration (sinusoidal)
IEC 60068-2-9	1975	Basic environmental testing procedures - Guidance for solar radiation testing
IEC 60068-2-14	1994	Basic environmental testing procedures – Test N: Change of temperature
IEC 60068-2-11	1981	Basic environmental testing procedures – Test Ka: Salt mist
IEC 60068-2-13	1983	Basic environmental testing procedures – Test M: Low air pressure
IEC 60068-2-27	1987	Basic environmental testing procedures – Test Ea and guidance: Shock
IEC 60068-2-30	1980	Basic environmental testing procedures – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)
IEC 60068-2-32	1994	Basic environmental testing procedures – Test Ed: Free fall
IEC 60068-2-47	2005	Basic environmental testing procedures – Mounting of specimens to vibration, impact and similar dynamic tests
IEC 60068-2-64	1993	Basic environmental testing procedures – Test Fh: Vibration, broadband random (digital control) and guidance
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)
IEC 60801 - 2	1991	Electromagnetic compatibility for industrial process measurement and control equipment – electrostatic discharge requirements
ISO 7637 - 2	2004	Road vehicles – Electrical disturbances from conduction and coupling Part 2: Electrical transient conduction along supply lines
ISO 10605	2001	Road vehicles – Electrical disturbance from electrostatic discharge
ISO 14982	1998	Agricultural and forestry machinery – electromagnetic compatibility – test methods and acceptance criteria
ISO 15003	2006	Agricultural engineering – Electrical and electronic equipment – Testing resistance to environmental conditions
RL2004-104 EG	2004	Richtlinie über die Funkentstörung von Fahrzeugen

