CCpilot VI

Technical Manual

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Contents

Revision history

Revision	Date	Issued by	Comments
2.0.0	2018-10-19	Lars Olsson	
2.0.1	2021-10-12	Mats Kjellberg	Clarification on what product models the manual is applicable for
2.0.2	2022-02-14	Finn McGuirk	Clarification on Voltages
2.0.3	2023-12-15	Finn McGuirk	Clarification on ventilation membrane

1. Introduction

CCpilot VI is a 3.5" full-colour display with Linux operating system. The open LinX software platform offers a choice of powerful tools for application development. This, together with a QVGA high brightness display and hardware accelerated 2D, 3D and vector graphics, enables fast design of premium user interfaces.

With 4 freely configurable, backlit soft keys, operators can interact efficiently with the system. *CCpilot VI* has multifunctional capability and can be used as instrumentation display, machine control HMI, electronic manual and more.

This technical manual provides important information regarding the product's hardware and its basic usage. For software and operating system specifics, please see additional documentation.

1.1. Product models

This documentation is applicable for COTS versions of the product. This means the base hardware with Linux, P/N C000144-05, as well as versions using the same hardware but having different software package installed, using the P/N syntax SXXX144-05.

The base product design is re-used in custom OEM products. Such customizations can include e.g. branding, de-population of I/O and use of the Bluetooth feature which is inherently supported in the base product design. Per definition, such custom OEM products are not available COTS but this manual may describe such features because the manual is used as documentation also for custom OEM product versions.

1.2. Document conventions

This document uses the following conventions:

Description	Appearance	
Important information	!	(exclamation symbol)
Differences between product models	🔍	(observe' symbol)

Text formats used in this document are described in the table below:

Format	Use
Italics	*Names, designations, and references*
Bolded	**Important information**

1.3. Identification

Each device has identification labels with serial number, part number and revision which identifies your unique device. This information is required when communicating with CrossControl regarding Technical support and Service/Repair needs.

Figure 1: Identification labels

1.4. Environmental resistance

The *CCpilot VI* product has been designed to manage tough environmental demands. Much effort has been put into designing and selecting system components to provide a reliable and robust device.

Thorough testing has been performed in order to ensure compliance to a broad range of applicable regulatory requirements and to meet the user expectations of a ruggedized product for machinery control.

A complete list of standards to which the product has been tested for compliance can be found in chapters 7.2 and 7.3.

2. Product overview

This chapter contains illustrations of the *CCpilot VI* showing the location of external connectors, indicators etc. Connectors are described in more detail in chapter 6. Additional mechanical information can be found in chapter 7.4.

2.1. Front side view

The product has a 3.5" widescreen display protected by an anti-glare treated top glass. There are also 4 freely configurable, backlit soft keys.

Soft keys with user configurable functionality.

Soft key numbering.

Display with anti-glare glass
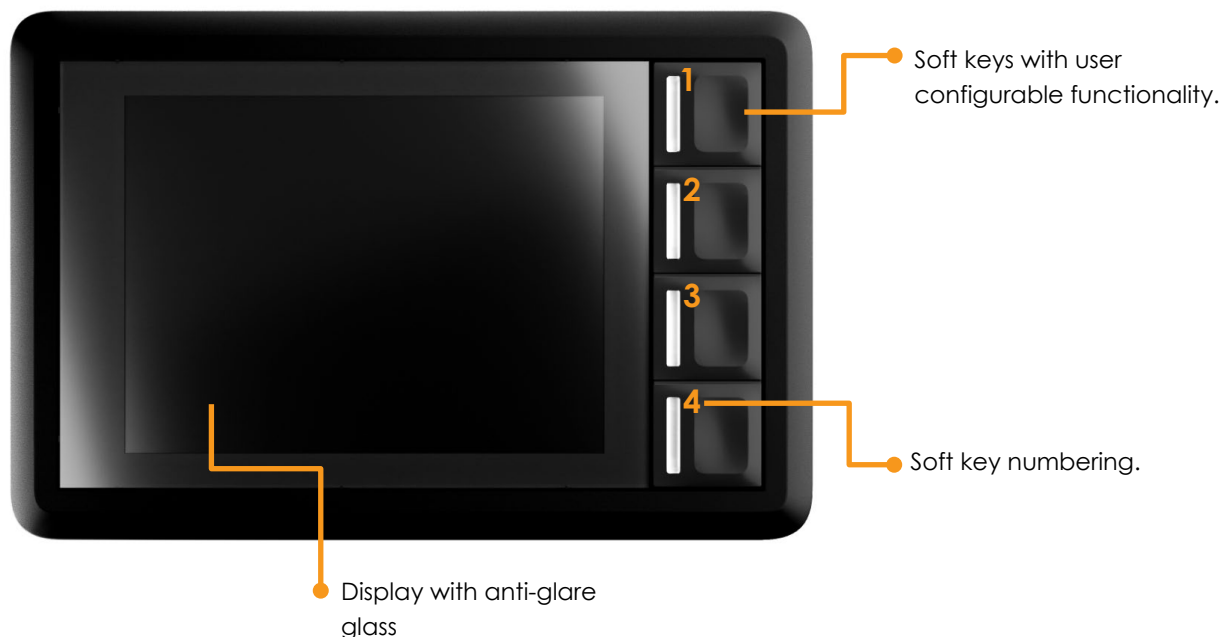
Figure 2: CCpilot VI front side view

2.2. Rear side view

The product has 2 connectors for external interfaces. Connectors are of type Deutsch DTM-12. On the rear side you also find the buzzer sound outlet, a Gore-Tex ventilation membrane and mounting holes for either a fastener in accordance with AMPS hole pattern (RAM 2.43" x 1.31" Diamond Base) or a bracket for panel mounting.

Sound exit hole under mount for added protection

External connectors Deutsch DTM

GORE-TEX membrane, under mount for added protection

Figure 3: CCpilot VI rear side view

3. Mounting and handling

This chapter contains recommendations for installation, handling and maintenance of the product.

3.1. Mounting

CCpilot VI supports two different mounting methods, a RAM mount or a panel mount. These two mounting methods are described separately below.

For both fastening methods, use the appropriate M5 x 0.8 button head screw of type MRT (Torx) The recommended torque for the screws is 1.5-2.0 Nm. Using f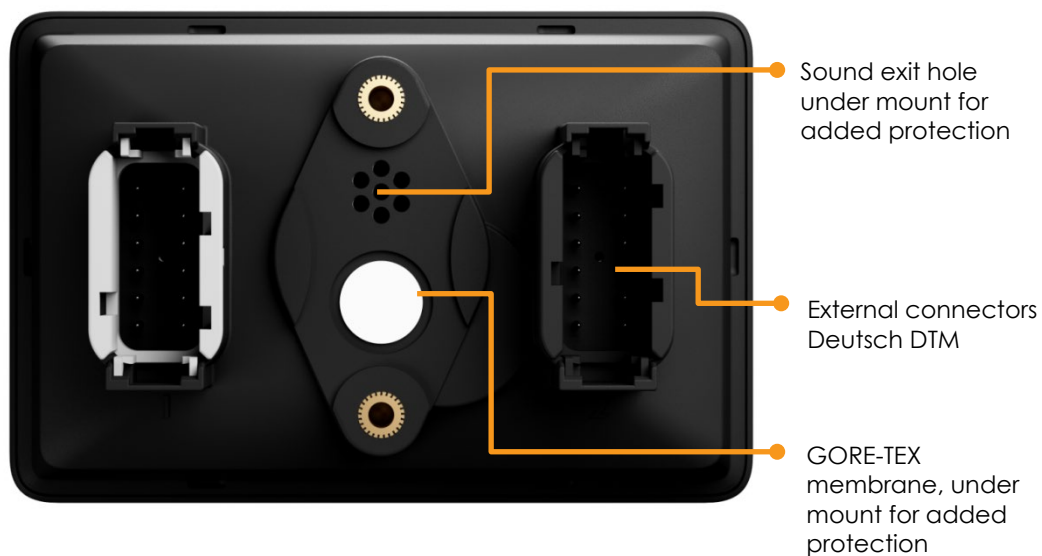luid locker or locking washers (split ring, toothed lock, etc.) is required for proper mounting. Ensure that the M5 mounting screws are clean and dry before mounting.

Note that the depth of the threaded holes is 8 mm. Be careful not to use too long screws which may damage the device when tightened.

3.1.1. RAM mount

CCpilot VI is preferably mounted using a RAM-B-238U Mount which allows adjustment of the display's position and angle. Screw length should be 12mm.

3.1.2. Panel mount

Panel mounting requires a bracket (P/N C000135-81) and a rubber frame(P/N C000144-44) see pictures below. The mounting bracket is designed for min 1,5mm and max 3mm panel thickness. Screw length should be 10mm.
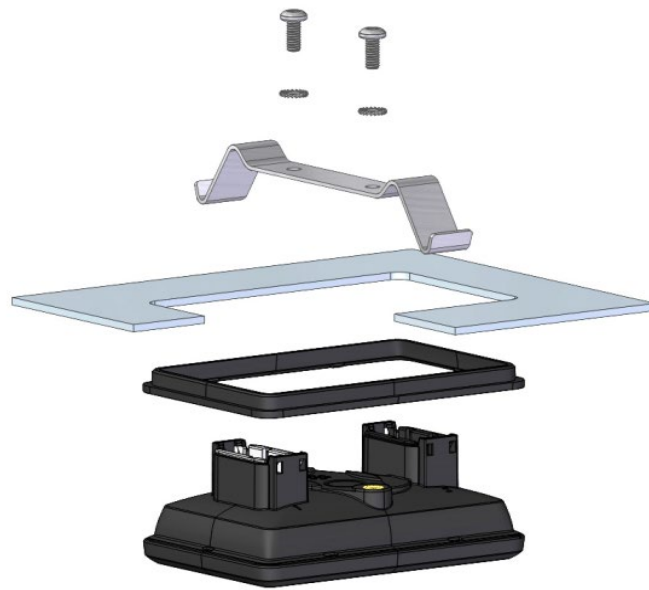
⚠️ Ensure that *CCpilot VI* is mounted to a smooth, flat surface. Fastening the unit to an uneven surface may stress the enclosure, damage the outer flange or possibly even flex the circuit board inside, leading to a premature failure.

Panel cut-out information available in dxf-format upon request for precision cutting of panels.

1:1 (A3 paper) scale panel cutout for panel installation
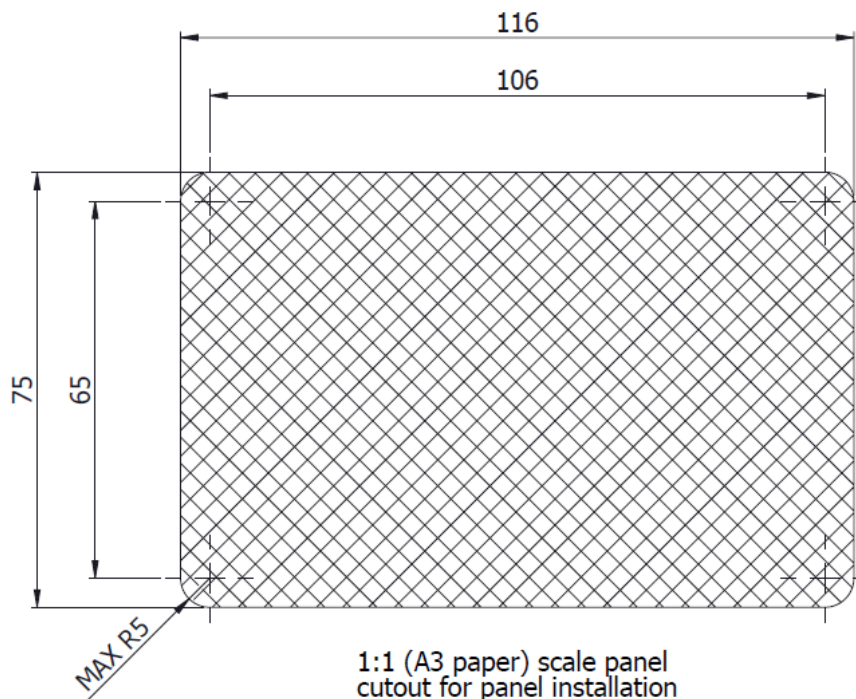
3.2. Connecting to power supply

This chapter describes how the *CCpilot VI* is preferably connected to the power supply of the equipment it is installed in. The principle is the same for vehicular and stationary installations.

⚠ Carefully read through the following sub-chapters. They are critical for designing and adapting the electrical system of the equipment in which the *CCpilot VI* is installed. Connector pinouts are found in chapter 6.

3.2.1. Wire gauge

Wire gauge for the power supply should be dimensioned with respect to the current and voltage at cranking.

- Current consumption of the *CCpilot VI* device is found in chapter 7.1.

- Power consumption of external loads driven by the *CCpilot VI* device should also be taken into account.

- The wire gauge for the power supply is recommended to be at least 0.75 mm^2 /AWG 18 for "normal" loads.

- The DTM connectors accept wire gauges between 0.75 and 3.3 mm^2 /AWG 12 to 18.

3.2.2. External fuse

⚠ To prevent cable fire in case of short circuit, an external fuse must always be used when powering the device from a high current capable power source, for example a vehicle battery.

- The fuse shall be located as close to the battery/power source as practically possible.

- Fuse rating shall be dimensioned with respect to wire gauge, maximum current consumption and the inrush current of the device. Refer to chapter 7.1 for fuse rating details.

- As a guideline, a slow acting fuse with 2-3 A current rating should be used.

- Remember to also apply fusing for the on/off control wiring, see chapter 3.2.4.

3.2.3. External key switch signal

The device's key switch signal should be connected to the positive supply line via the vehicle's ignition key switch.

- The wire gauge for the key switch signal shall be dimensioned to handle the total switch current and the fuse type and rating shall be selected to prevent cable fire in case of cabling short circuit.

- As a guideline, a slow acting fuse in the range of 100-1000 mA for the key switch signal should be sufficient for most practically usable wire gauge.

3.2.4. Application example

Below is an application example schematic of the *CCpilot VI* power supply connection.

If the system has a main switch for completely disconnecting the battery (S1 in schematic below), the device's power supply and key switch signal shall be connected after the main switch.

⚠ It is **not** recommended to disconnect the battery without shutting down the device first - since doing so will immediately switch off all internal voltages, regardless of ongoing operations. Any information which was not saved to flash memory will be lost when disconnecting the battery. However, no physical damage will be caused to the device by disconnecting the battery.

Figure 4: Schematic example for power supply installation of a CCpilot VI device in a vehicle. The ignition switch (S2) can be shared by several devices (Device X, Y, …)

By connecting the power supply according to the example above, the *CCpilot VI* device will automatically start up when the key switch (S2) is closed and shut down when the switch is opened.

⚠ Note that the on/off behavior of the *CCpilot VI* described here is the default configuration. Its response to the on/off signal may be altered using the CCAux API, see chapter 4.1 for more details.

⚠ Be advised that the device consumes a small amount of power from the main supply also when shutdown (55 µA at 12V, 0.31mA at 24V) or suspended (36mA at 12V, 20mA at 24V). Therefore, if the device has been attached for a long period of time without the vehicle motor running, the battery may be drained, resulting in inability to start up the vehicle. A main switch for disconnecting the device's main supply is highly recommended in such situations.

3.3. Cable installation

Cables shall be installed in such a way that they do not run any risk of being damaged, pinched or worn.

- Avoid excessive bending and twisting of cables.

- Use strain-relief on cables near the device to minimize stress on cables and connectors.

- Properly snap the connectors to give reliable contact and sealing and to avoid unnecessary strain.

- Shielded cables are recommended and in some cases necessary to ensure reliable communication and appliance with agricultural EMC standards.

3.3.1. Recommendations for cable shields

To achieve electromagnetic compliance and stable operation of the system, shielded cables are required for Ethernet and USB interfaces.

When using shielded cables for Ethernet, the shield is preferably connected/grounded at the other end of the cable (and remains unconnected close to the *CCpilot VI* device).

Below are recommendations for inserting cable shields and coaxial cables into Deutsch DTM plugs to achieve robust connections and retaining IP classification of the device.

- Splice the cable shield (or coaxial inner and outer conductors) outside of the DTM plug and use regular, round cables for insertion into the plug.

- Minimize distance between cable joints and the DTM plugs for best shielding effect.

3.4. Special considerations

To ensure proper and reliable operation and to retain IP-classification of the device, below recommendations must be followed:

- The device should be placed in a way that prevents direct and continuous exposure to water or close proximity to hot-air vents.

- To enable sufficient cooling, the device must be installed in a way that allows ambient air to circulate around it. A clearance of at least 50 mm around the device is recommended.

- To maintain IP classification, all Deutsch DTM connectors must have a mating external connector attached. Blind connector plugs must be used if a connector does not have a mating external connector. Please note that the protective caps mounted on the DTM connectors are for transportation protection only.

- The device has a ventilation membrane, refer to Figure 3 for the location. For proper ventilation of the device, dirt and water must be prevented from accumulating and covering the membrane. Be cautious not to insert objects which may puncture the membrane. Doing so will violate the IP-classification and void the warranty of the device.

- The CCpilot VI lacks optical display bonding, which means that in rare cases there is a risk of fogging forming on the inside of the glass. Fogging will not damage the device. The risk of fogging can be further reduced by setting the display brightness to 100% and ensuring that the ventilation membrane on the back of the display has enough breathing room to function properly.

- Install the device and any cables attached in a way that they are not subject to excess vibrations or other potentially harmful stress.

- Loose fasteners is a common cause for excessive vibration. Fasteners may come loose due to improper mounting techniques such as omitting thread lockers (fluid locker or locking washers) or by over/under-tightening. Proper tightening requires dry, clean fasteners and a torque wrench.

- If the device is exposed to chemicals, water, dirt or other pollutants, it is recommended to have it cleaned off as soon as possible. See chapter 3.5.1 for cleaning instructions.

3.5. Handling and maintenance

Handle the device with care and pay attention to the following handling instructions:

- Disconnect all cables to the device during welding or when performing other service to the machine imposing a risk of damaging electronic devices.

- Service and repair to the device shall only be made by authorized personnel. If the device is opened by unauthorized personnel, its warranty will be void.

- Scratches or other damages may occur to the display surface if it is exposed to sharp objects, abrasives or heavy impacts. This must be avoided to increase the longevity of the screen.

- The internal eMMC flash storage has a limited number of write cycles. Therefore it is recommended that the amount of writing to flash is limited within software applications.[1]

- Always consider personal safety when installing and operating the product. For example, in vehicle installations, CrossControl does not recommend that the product is being actively operated by the driver when a risk of injury to people or damage to property is present.

3.5.1. Cleaning

To ensure proper and reliable functionality over time, pay attention to the following cleaning instructions and precautions:

- Wipe the device clean from dirt using a soft damp cloth, preferably of microfiber type. Larger amount of dry dust may be swept off using a soft brush before wiping clean.

- Avoid using alkaline, alcoholic or other potentially adverse chemicals for cleaning as doing so may damage the device. However, small amount isopropyl alcohol may be used for removing harsh stains.

- Avoid spraying or by other means applying larger amount of water or alcohol directly to the device. Instead, lightly dampen a cloth before using it for cleaning the device.

- After cleaning, make sure that the device surface is left dry.

- Never use high-pressure air, vacuum, water or steam to clean the device.

3.5.2. Real time clock battery

Time and date information is stored in a memory sustained by an internal back-up battery. The battery is a 3V 1000mAh high operating temperature Poly-carbonmonofluoride Lithium battery. The expected life time of the battery is approximately 20 years. The battery is not replaceable.

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[1] The eMMC is used in pseudo SLC mode and implements both static and dynamic wear levelling to reach the best reliability. The number of program/erase cycles is between 20k to 60k depending on the manufacturer and temperature. Our recommendation for the application software is to temporary cache in RAM and to write larger chunks of data to the eMMC. This recommendation is not specific to eMMC but is applicable to all flash memories.

3.6. Transportation

When transporting the device it is recommended to use the original packaging. Make sure that protective caps are used on all non-mated connectors. The storage temperature interval [-30°C to +80°C] must be met.

4. Basic operation

This section covers basic operation of the product such as start-up, shut-down, suspend, resume, display operation and status notification.

Observe that the behaviour of on/off controls (external on/off control and soft keys) is user configurable in terms of:

- Enabling/disabling functionality

- Which soft keys that shall hold the on/off functionality

- Configurable timing parameters

- External on/off control edge or level triggered

The soft keys present status notifications during start up by flashing the soft keys backlight or beeping with the buzzer in different patterns.

The status notification behaviour in the operational state of the device is configurable by user applications. Described herein are the factory default behaviours of the on/off controls and the status notification.

4.1. Turning ON

The *CCpilot VI* product can be started up in different ways:

1. By connecting the external on/off control signal to positive supply input (or above approximately 5V).

   o When started this way, the on/off signal must remain asserted. De-assertion of this signal will shut down the device unless configured otherwise.

2. By a short-press on the soft key configured for on/off control.

   a. Note that this function is enabled on soft key 1 as factory default.

3. It is possible to configure the device to automatically start up whenever external power is applied (i.e. without using any on/off control).

   a. Note that this function is disabled as factory default.

For resuming the device from suspend mode, see chapter 4.2.

While starting up the device, it will give a short beep and the soft key backlight will flash with 2 Hz. When the device enters operational state the soft key backlight will stop flashing and be turned on.

4.2. Turning OFF and suspending

There are several ways to turn off the *CCpilot VI* device and also alternatives to enter suspend mode instead of completely shutting down the device.

4.2.1. Shutting Down

There are a number of ways to shut down the device, provided that it is in normal operational state when the action occurs:

1. By disconnecting the external on/off control for more than a specified time, i.e. using the turn-key functionality.

    o The time-out is user configurable and defaults to 4 seconds.

    o If the on/off signal is brought back high again while the device is shutting down, it won't restart automatically. A low-to-high transition must occur after the device has fully shut down to make a restart.

2. By using the soft keys (action configurable for either short-press or long-press of the soft key)

    o The time used for detecting long-presses is user configurable and defaults to 4 seconds.

    o A prolonged long-press (more than 8 seconds) gives a forced shutdown where the internal voltages are shut off immediately.

    o By factory default, a long press on soft key 1 triggers a shutdown event.

4. By operating system shutdown requests.

To ensure that data does not get lost or the flash memory becomes corrupt, it is recommended that all necessary data shall be saved and all programs closed before the device is shut down.

Note that the device won't shut down from Suspend mode by these actions. See chapter 4.2.2 for details of Suspend mode and wakeup.

When performing any of the above, the *CCpilot VI* device will shut down. The soft key backlight will flash and the device will beep to indicate that releasing the soft key configured for shutting down will result in the device starting to shut down.

4.2.2. Suspending/resuming

Suspending and resuming are faster alternative to shutting down and starting up the device. In suspend mode, the data remains in RAM memory and the device must be connected to external power supply to maintain its state.

Suspend mode can be entered in a number of ways:

1. By disconnecting the external on/off control, i.e. using the turn key functionality.

    o By factory default, disconnecting the external on/off control is configured to shut-down the device.

2. By using the soft keys (action configurable for either short-press or long-press of the soft key)

    o By factory default, a short press on soft key 1 triggers a suspend event.

3. By selecting the operating systems suspend alternative.

Observe that the product current consumption in suspend mode is higher than in shut-down mode.

To prevent a vehicles or machines battery from draining when the device is suspended, a user configurable time-out can be set for how long the unit shall stay in Suspend mode before it automatically shuts down. The default Suspend time-out is set to 60 minutes.

Resuming from Suspend mode can be done by one of the following events:

1. By a low-to-high transition of the external on/off control, i.e. using the turn-key functionality.

2. By pressing a soft key configured for resuming from suspend (configured as start-up trigger).

    o   By factory default, a short press on soft key 1 will wake up the device.

Configuration of how to wake up from suspend is done through the CCSettingsConsole application or using the CCAux API. See the software guide for details.

4.2.3. Forced Shutdown

If the *CCpilot VI* is not responding, a forced shutdown can be performed by pressing and holding soft keys 1 and 4 simultaneously until the device is switched off.

*   The soft key-press time for performing a forced shutdown is 10 seconds.

A forced shutdown immediately shuts down the device, regardless of its operational state. Any information which was not saved will be lost when performing a forced shutdown. Any ongoing writing to the flash memory will be disrupted which may lead to a corrupted file system.

*   Therefore it is **not** recommended to use the forced shutdown feature unless absolutely necessary.

4.3. Adjusting the screen brightness

With the *CCpilot VI* product it is possible to configure soft keys as dedicated backlight brightness soft keys to gradually increase or decrease the display brightness. By default, soft key 3 is configured as backlight increase, and soft key 4 as backlight decrease.

The screen brightness can also be controlled from software.

4.4. Status notification

The soft keys present status notifications during start up and operational state by flashing the soft keys backlight or beeping with the buzzer in different patterns.

The table below describes the *default* behaviour of the status notification for different operational states. Note that the soft key backlight status notification can be configured to be turned off completely.

Operational state	Soft key backlight behavior
Device off	Off
Starting up	Flashing, 2 Hz
Operating (started up)	Constant on
Shutting down	Flashing, 2 Hz
Suspended	Flashing 0.2 Hz
Entering forced shutdown - After 8 seconds	Flashing 10 Hz for 3 seconds, then Off (device is

switched off)

Observe that the status notification behaviour in both the *start-up* and *operating* states is configurable by user applications running on the device.

4.5. Error codes

The internal buzzer is used for signalling error codes when the device cannot start due to a hardware failure. When this happens, the device will remain shut off, but indicates the failure reason by beeping the buzzer in a special pattern. The pattern is a certain number of beeps followed by a longer pause after which the sequence is repeated. The number of beeps is important information if the device is sent in for service/repair. The table below lists the different error codes.

Number of beeps	Error code	Likely problem cause
1	errCodeReadErrEEPROM	Corrupted configuration settings in SS FRAM.
2	errCodeWriteErrEEPROM	Corrupted configuration settings in SS FRAM.
3	errCodeDriverInit	SS FRAM or temp sensor malfunction.
4	errCodeInternalVoltageOutOfLimits_NoBlinks	Internal voltages is outside allowed limits.
5	errCodeMPDoneTimeoutErr	Faulty or unprogrammed NAND Flash (OS image) or hardware error.
6	errCodeTimeOutWaitingForVoltages	Unstable internal voltages.
7	errCodeTEMPOutOfLimits	Temperature sensor malfunction or extreme operating conditions.
10	errCodeRCCInit	SS clock crystal malfunction or SS processor failure.
11	errCodeSSSState	SS processor failure or programming bug.
12	errCodeManageDiagnostics	Corrupted configuration settings in SS FRAM.
13	errCodeManageActDeAct	SS processor failure or programming bug.
14	errCodeTickTimeOutTimer	SS processor failure or programming bug.
15	errCodeOperateModeStateError	SS processor failure or programming bug.
16	errCodeHALIOReadErr	SS processor failure or programming bug.
17	errCodeHALIOWriteErr	SS processor failure or programming bug.

5. Interface overview

This section describes the various interfaces of the product. Main part of these interfaces can be accessed via software APIs. These are described in the *CCpilot VI Software Guide*.

5.1. Front panel

5.1.1. Soft keys

CCpilot VI has four (4) software configurable soft keys. The soft keys may be used for user application input, turning the unit on/off or controlling the backlight. Reference to the software documentation for details on how configuration is done.

5.2. Buzzer

CCpilot VI has a built-in buzzer that can be used for audible notifications. The buzzer is software controllable with configurable volume and frequency.

For buzzer location see Figure 3. See chapter 4.4 for buzzer notification events. Refer to the *CCpilot VI Software guide* for details about controlling the buzzer from user applications.

5.3. CAN

CCpilot VI has one (1) CAN port that meets CAN ISO 11898 2.0B (29-bit extended identifier) and supports bit rates up to 1 Mbps.

⚠ Note that Internal EMI filters on CAN High/Low signals have a capacitance of 100 pF (typ) which deviates from the ISO 11898 standard and implies some limitations on the CAN bus topology (maximum bus length, number of CAN nodes etc.) when running at high bit-rates, i.e. above 250 kbps.

The ports feature highly protected CAN transceivers which are tolerant for bus short-circuits to main supply voltage and ground.

CAN shield connections are according to J1939-11 with capacitive coupling to ground. There is no device-internal CAN bus termination, therefore bus termination must be applied externally.

5.4. Ethernet

CCpilot VI has one (1) Ethernet interface supporting 10BASE-T/100-BASE-TX and Auto-MDIX with $500V_{AC}/707V_{DC}$ galvanic isolation.

⚠ Observe that:

- The Ethernet interface has *function isolation* only and must be connected to other SELV (Safety Extra Low Voltage) circuits only; i.e. local network without routing to outside plant.

- Shielded cables shall be used for this port to ensure reliable communication and electromagnetic compliance. The shield should be left unconnected on the Deutsch DTM-12 connector i.e. *CCpilot VI* side of the Ethernet cable.

- Connecting the device to a public network environment may impose a security threat.

5.5. USB

CCpilot VI has one (1) USB port. This port supports an USB OTG interface, i.e. acting as both host and device. Using the port in USB device mode is only for OS updates through a connected PC with appropriate tool installed.

In USB host mode, it can be used for application data transfer or the connection of a peripheral such as a mouse or keyboard.

Due to the multipin connector specification, USB data signal integrity cannot be guaranteed with higher speeds than full-speed USB (12 Mbps). However, hi-speed operation is supported by the USB host controller.

The USB port can supply up to 500 mA. The USB port is internally over current and short circuit to ground protected. Shielded cables shall be used to ensure reliable communication and electromagnetic compliance. Depending on installation the shield could be connected to USB ground or left unconnected on the Deutsch DTM-12 connector, i.e. CCpilot VI, side of the cable.

5.6. Configurable inputs

CCpilot VI has four (4) configurable inputs.

Each input can be configured for:

- voltage measurement

- frequency measurement

- resistance measurement

- digital input

  o switched to battery (internal pull-down)

  o switched to ground (internal pull-up)

The operating specifications for the various operating modes are provided below:

Mode	Range	Accuracy	Resolution
Voltage	5 V range: 0 V-5.5 V$_{DC}$(typ) 5.3 V(min)	±0.5% ±5mV	1.4mV
Resistive	0-500 Ω	<1Ω, non linear	<1Ω, non linear
Frequency	0.1-50000 Hz	100 ppm time base	0.1 Hz up to 2.19 kHz, 1 Hz at 6.93 kHz, 2 Hz at 9.80 kHz, 4 Hz at 13.86 kHz, 52 Hz at 50.00 kHz. (f^2/48MHz)
Switched to battery	11.1 kΩ pull-down	-	-
Switched to ground	9.1 kΩ pull-up to internal 3.3V through diode	-	-

Note that the input ground is internally joined with main supply ground. Precautions should be made to avoid ground-loops between input ground and main supply ground. Ground-loop currents may affect readings.

The co-processor handles the configurable input and adds features such as averaging for frequency measurements. Measurement results are accessible to user applications through software APIs. Refer to the *CCAux API documentation* for programming details. Each input mode is described more in chapters 5.6.1 and 5.6.2 below.

5.6.1. Digital input and frequency measurement

Digital and frequency input modes can be used for connecting simple logical signals (for example switch to battery/ground or various logic output sensors) or frequency-output sensors commonly used in industrial applications.

The input can be set as either pull-down to ground or internal pull-up to 3V. This makes the input compatible with a wide range of sensors with different output types.

Frequency measurement is implemented by timer captures at a time-base of 48 MHz (100 ppm). This time-base gives a theoretical frequency resolution of approximately 0.02 Hz at 1 kHz and 4.7 Hz at 15 kHz (better resolution at lower frequencies). Refer to the *CCAux API documentation* for details about available configurations.

See chapter 7.1 for electrical characteristics such as absolute maximum voltage, digital threshold levels, pull-up strength, frequency range and accuracy.

5.6.2. Voltage measurement

The configurable inputs can be used for measuring DC-voltages in range of 0-5.3 V.

See chapter 7.1 for electrical characteristics such as impedance and accuracy.

5.6.3. Resistance measurement

The configurable inputs can be used for measuring resistive loads up to 500 Ω. The resistance measurement mode bias the configurable input through an internal 124 Ω resistor connected to internal 3V for measurement of the external resistance.

5.7. Analog inputs

CCpilot VI has three (3) fixed analog inputs with 0-5V range and 25 kΩ input impedance to ground.

5.8. Low side outputs

CCpilot VI has two (2) low side outputs. These two self-protected, low-side switched PWM outputs have a maximum current rating of 1 A and can be used to control external loads such as a buzzer, relay or indicator lamps. PWM duty cycle and frequency is adjustable via API/software.

⚠ Since the outputs are low sided, a duty cycle of 90% means 90% low, 10% high output.

⚠ For inductive loads it is important to have an external free-wheel diode at the load to protect the output.

The low side outputs utilize Diodes Inc ZXMS6005N8 self-protected low side switch with the following specification:

- Continuous drain source voltage 60 V
- On-state resistance 200 mΩ
- Clamping energy 120 mJ
- Short circuit protection with auto restart

- Thermal shutdown with auto restart
- Current limit typically 5A

Note, the low side outputs are inappropriate to be used for safety related functions. A cable fault resulting to a ground connection means unintended activation of the output.

Observe that high continuous current through several I/O channels simultaneously adds internal heating of the device. At high ambient temperatures, this may cause I/Os to switch off because of thermal protection in their internal circuitry. Normal function will be restored when temperature is within acceptable level again. Note, if this occurs frequently it's recommended to improve the ventilation around the device or if possible reduce the load on the outputs.

5.9. Bluetooth

The *CCpilot VI* base design has inherent support for integration of a Bluetooth module to facilitate wireless communication to and from the device. The Linux based operating system in the *CCpilot VI* includes a software Bluetooth stack for easy application development including Bluetooth functionality. The Bluetooth option is not available in COTS product models but can be used in custom OEM solutions.

Refer to the *CCpilot VI Programmers manual guide* for details about implementing Bluetooth functionality in user applications.

Bluetooth chip and communication specification:

Items	Specification
Radio certificates	CE, IC, FCC
Antenna Type	Internal
Wireless specification	802.11 b/g
Bluetooth version	V4.0 Dual Mode HCI module (Classic and Low Energy)
Frequency range	2.402 – 2.480 GHz
Temperature range	The Bluetooth module is operational in the *CCpilot VI*'s full temperature range
Range	Circa 100 meters
Max Transmit Power	Class 1 +8dBm from antenna

6. Connectors

The two connectors for external interfaces are accessible on the rear side of the unit. The connectors are twelve pin moulded-in Deutsch DTM series connectors marked with a 1(J1) and a 2(J2).
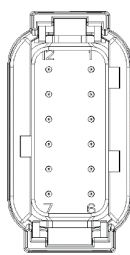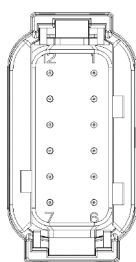
Use caution and avoid plugging/unplugging of connectors when the device is powered up. Always replace damaged cables. If a connector pin becomes bent the interface may not function correctly and the device should be returned to CrossControl for repair.

6.1. Connector layout

Note that descriptions herein refer to the connectors located on the device and not the cable-side connectors which are attached to the device. However, the pinout numbering and signal descriptions are the same.

Pin	Function (DTM06-12SA)	Pin	Function (DTM06-12SB)
J1-1	Constant Power +12/24	J2-1	Configurable Input 1
J1-2	Power Ground	J2-2	Configurable Input 2
J1-3	Switched Power +12/24	J2-3	Configurable Input 3
J1-4	Switched Output 1	J2-4	Configurable Input 4
J1-5	Switched Output 2	J2-5	Analog Ground
J1-6	CAN 1 Shield	J2-6	Analog input 1
J1-7	CAN 1+	J2-7	Analog input 2
J1-8	CAN 1 -	J2-8	Analog input 3
J1-9	USB Ground	J2-9	Ethernet RD+
J1-10	USB Data -	J2-10	Ethernet RD-
J1-11	USB Data +	J2-11	Ethernet TD+
J1-12	USB Vbus	J2-12	Ethernet TD-

6.2. Deutsch DTM connectors, general

⚠ Use caution and avoid plugging/unplugging Deutsch DTM connectors while the device is powered up. If a connector pin becomes bent the interface may not function correctly and the device should be returned to the manufacturer for repair.

⚠ Pay close attention to the coding; violence or excessive force should not be used when mating the connectors.

The connector pins are rated for 7.5 A continuous current.

⚠ The DTM connector pins are made of tin-plated brass. It is recommended to use tin-plated receptacles in the mating connectors. Using different plating in the cable connectors might cause galvanic corrosion.

⚠ Note that all three Deutsch DTM connectors must be mated with its corresponding cable connector or a proper blind plug to maintain the IP-classification.

7. Specifications

7.1. Technical data

Temperature specification	
Operating	-25 to +70 °C
Storage	-30 to +80 °C

Kernel	
Main Processor	NXP™ i.MX6 SoloX: ARM 32-bit, 800 MHz, Cortex®-A9
Co-processor	STMicroelectronics STM32F071VB, Cortex®-M0
Data storage	2 Gbyte, Industrial grade eMMC[Note]
RAM memory	512 Mbyte, DDR3

⚠ Note: The eMMC is used in pseudo SLC mode and implements both static and dynamic wear levelling to reach the best reliability. The number of program/erase cycles is between 20k to 60k depending on the manufactures and temperature. Our recommendation for the application software is to temporary cache in RAM and to write larger chunks of data to the eMMC. This recommendation is not specific to eMMC but is applicable to all flash memories.

Power Supply	
Supply voltage	
Nominal	12 V_{DC} or 24 V_{DC}
Extreme	6 V_{DC}…32 V_{DC}
Power consumption	
	Vin = 12 V_{DC} **Vin = 24 V_{DC}**

Typical, operating	340 mA (typ)	180 mA (typ)
Max, operating	670 mA	350 mA
Suspend to RAM	35.7 mA (typ)	20.0 mA (typ)
Shutdown	55 µA (typ)*	0.31 mA (typ)*

* This assumes that the ignition signal is disconnected from supply voltage.

Input capacitance

Inrush current

	Vin = 12 V$_{DC}$	Vin = 24 V$_{DC}$
Duration ca 2 ms	< 0.5 A	< 0.5 A

External fuse recommendation

Current rating	2-3 A*	(including maximum external loads)

* This assumes that the fuse is in accordance with IEC 20127 i.e. can be continuously operated at 100% of rated current.

CAN interfaces

Type	Non-isolated, ISO 11898-2, CAN 2.0B with cable shield decoupling according to J1939-11. Supports ISOBUS
CAN transceiver	NXP TJA1051T/3
Baud Rate	20 – 250 kbps (up to 1 Mbps)* * Internal CAN bus filters have a capacitance of 100pF (typ) as stated in the J1939 specification. This puts restrictions on the CAN bus topology considering bus length, number of CAN nodes etc. when running at bit-rates higher than 250 kbps.
Protection	Short circuit protected to -32V to +32V

USB interfaces

Type	1x USB 2.0 compatible host ports
Speed	Full-speed (12 Mbps) and Hi-speed USB (480 Mbps) is supported.
VBUS supply	5.0 V, 0.5 A per port, internally over-current (typically 0.7 A) and short-circuit to ground protected.

Ethernet

Type	10/100 Mbps Ethernet compatible with 10BASE-T and 100BASE-TX Ethernet standards. Auto-MDIX support.
Insulation voltage	500V$_{AC}$/707V$_{DC.}$

Configurable Inputs

Number of inputs	4
Input voltage tolerance	+36.0 V (max), referred to main supply ground - 0 V (min), referred to main supply ground (inputting voltages greater than specified may damage the device)
Digital input levels	applies to both Digital and Frequency modes
Rising threshold	1.7 V (typ)
Falling threshold	1.5 V (typ)
Hysteresis	0.2 V (typ)
Impedance pull-up	9.1 kΩ (± 2 %) to internal 3.3V through diode.

Impedance pull-down	11.1kΩ (± 2 %) to ground
Frequency measurement	Input amplitude ranges according to above.
Frequency range	0.1 Hz – 50 kHz
Duty-cycle range	40-60%
	Exceeding above duty-cycle limits may cause inaccurate readings.
Time base	48 MHz (± 100 ppm)
Resolution	$Frequency^2/48000000$ Hz
Accuracy	Mainly limited by resolution
Voltage measurement	
Range (min)	0 – 5.3 V_{DC}
Accuracy	± (0.5% + 5 mV)
Resolution	1.4 mV
Input Impedance	11,1kΩ (± 2 %)
Resistance measurement	
Range (min)	0 – 500 Ω
Accuracy (typ)	<1Ω
Resolution	<1Ω, non linear, higher at low values

Analog Inputs	
Number of inputs	3
Input voltage tolerance	+36.0 V (max), referred to main supply ground - 36.0 V (min), referred to main supply ground *(inputting voltages greater than specified may damage the device)*
Voltage measurement	
Range (min)	0 – 5.3 V_{DC}
Accuracy	± (0.5% + 5 mV)
Resolution	1.4 mV
Input Impedance	25 kΩ (± 0.2 %)

Low-side digital outputs	
Number of channels	2
Load capability	Resistive Capacitive Inductive (external free-wheel diode required at load)
Drain source voltage	60 V (min) continuous
Current	1 A (min) continuous
Current limit	2.2 A (min), 5 A (typ)
Protection	Short circuit protection with auto restart Thermal shutdown with auto restart Overcurrent Protection
Over-temp. detection	
Turn-off Threshold	+175 °C typ (min 150 °C)
Hysteresis	10 °C
ON-state resistance	170 mΩ (typ) (+25°C)
Rise/Fall times	
Rise time:	14 µs (typ) (12V 0.5A)
Fall time:	19 µs (typ) (12V 0.5A)
OFF-state leakage	2 µA (max) (+25°C)

Buzzer	
Frequency range	1 – 20 kHz (SPL peak at 4000 Hz)

SPL range
   with VESA mount
   without VESA mount
	30 dBA (min) 87 dBA (max) at 0.1 meter (typ, 4000 Hz)
	39 dBA (min) 100 dBA (max) at 0.1 meter (typ, 4000 Hz)
	The buzzer is located on the back (connector side) of the device and the effective SPL varies dependent on the acoustic properties of the installation environment.

Soft key and Status notification	
Soft keys	4 soft keys, configurable function. Dimmable LED illumination and tactile feedback.
Status notification	Soft key backlight is used for status notification, such as blinking at 2 Hz during start-up, etc.

Software	
Operating system	CCLinux, Kernel version 4.1.38
Additional software	CCAux API, CCSettingsConsole. Refer to the *CCpilot VI Software Guide* and P*rogrammer's guide* for details.

Display	

Size
   Diagonal size
   Active area
   Pixel pitch
	
	3.5 inch widescreen
	71.5 x 53.6 mm
	223 x 223 µm

Type
   Aspect ratio
   Resolution
   Colour depth
   Contrast ratio
   Viewing angle
	TFT IPS
	4:3
	QVGA, 320x240
	18 bit (262 000 colors)
	650:1 (min), 1000:1 (typ)
	Horizontal: ± 85°
	Vertical: ± 85°

Backlight
   Type
   Brightness
   LED Life time
	LED
	410 cd/m^2 (min), 520 cd/m^2 (typ)
	50 000 h (typ) before brightness is reduced with 50 % (when operated with full brightness at 25 °C)
	(Note that higher operating temperatures affects LED life time.)

Cover glass
   Protective glass thickness
   Coating
   Surface Hardness
	
	1.8 mm
	Anti-Glare
	5H

7.2. Environmental specifications

Environmental Test	Test standard	Notes
Dry Heat	IEC 60068-2-2:2007	Operating: +70°C, 24h Storage: +80°C, 24h
Damp Heat	IEC 60068-2-30:2005	Operation: +25°C / +55°C

		>95% RH 6*24h
Cold	IEC 60068-2-1:2007	Operating: -25°C, 24h Storage: -40°C, 24h
Change of temperature	IEC 60068-2-14:2009	-25°C to +70°C, 5°C/min 1hr hold time, 20 cycles
Vibration	IEC 60068-2-64:2008	0.02 g²/Hz 5-500 Hz 3x3h
Shock	IEC 60068-2-27:2008	± 50 g / 11ms ±3x3 impulses
Enclosure Ingress Protection	IEC 60529:2014	IP66, IP67

⚠️ Any changes or modifications to the device not expressly approved by CrossControl could void the environmental classification, warranty, and user's authority to operate the equipment.

7.3. EMC specification

The *CCpilot VI* device has been tested for Electromagnetic Compatibility according to the following standards.

EMC Test	Test standard	Notes		
Electrical Transients	ISO 7637-2:2011 12 V system	**Pulse** 1 2 3a 3b 4 5	**Level** -75V +37V -112V +75V -6V +65V, Ri = 2Ω	
	24 V system	1 2a 2b 3a 3b 4 5	-450V +37V +20V -150V +150V -12V +123V, Ri = 2Ω	
ESD immunity	ISO 10605:2008	Air Contact	± 8 kV ± 6 kV	
Radiated RF immunity [1]	ISO 11452-2:2004	**MHz** 200-2000	**Level** 30 V/m	**Modulation** 80%AM, 1kHz
Induces RF immunity[1]	ISO 11452-4:2005/Cor.1:2009 (BCI)	**MHz** 20-200	**Level** 60 mA	**Modulation** 80%AM, 1kHz
Radiated RF emission [1]	ISO 13309:2010	**MHz** 30-75 75-400 400-1000	**Narrow-b. dBµV/m** 54-44 44-55 55	**Broad-b. dBµV/m** 64-54 54-65 65

(1) Compliance to RF immunity and RF emission standards require use of shielded cables for Ethernet, USB and Video interfaces.

EMC tests are performed at 24 V$_{DC}$ supply voltage unless other levels are specified in test standards.

System level compliance to EMC standards may be affected by external factors like mounting, omitting the use of shielded cables etc.

7.4. Weight and dimensions

Attribute	Description	Comments
Dimensions	119,9 x 79,6 x 49 mm	(W x H x D)

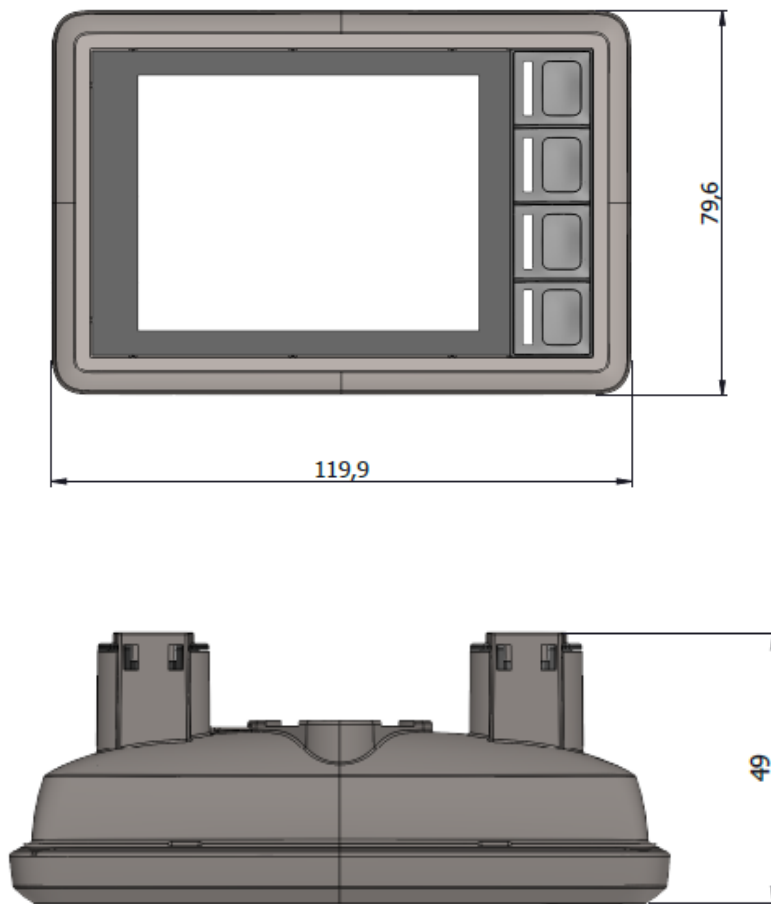|	
Weight	0.250kg
Mounting holes	RAM-B-238U
Spacing	48.5 mm
Thread dimension	M5
Thread depth	7.7 mm
Enclosure material	PBT + PC plastic, impact modified and flame retarted

Figure 5: CCpilot VI dimensions.

Technical support

Contact your reseller or supplier for help with possible problems with your device. In order to get the best help, you should have your device in front of you and be prepared with the following information before you contact support.

- Part number and serial number of the unit, which you find on the identification label, see Figure 1.

- Date of purchase, which is found on the invoice.

- The conditions and circumstances under which the problem arises.

- Error codes signaled by the internal buzzer.

- Possible error messages which are shown.

- Device log files (if possible).

- Information regarding possible external equipment which is connected to the device.

- Additional sources of information are available on the CrossControl support site: http://support.crosscontrol.com

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