DomeCtrl

Domestic installation **ControlBox**

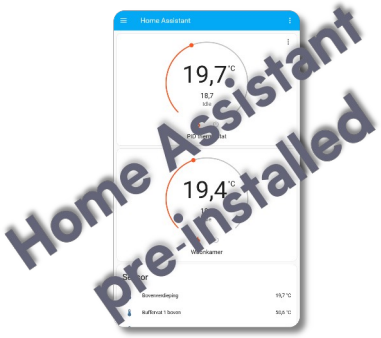


Features

- Robust, **industrial** grade electronic **interfaces**
- IP30 Enclosure with **convenient mounting** flanges
- **Pluggable** screw terminals
- **Raspberry-Pi header** for control via pre-installed privacy-respecting local **Home Assistant**
- **W32-ESP01 header** for control via **ESPHome**
- **100-240VAC** wide range IEC-320 C-14 **inlet**
- **16x 24VDC** solid-state relay **output**
  - Potential-free max 60V or 24VDC
- **4x GRID-powered** solid-state relay **output**
- **1-Wire bus** for sensors over long cable distance
  - 2 channels, one driver per channels
  - Connect up to 30 temperature sensors
- **32 PWM** controlled **LED outputs**
- **3x** opto-isolated **input 5-24V**
- **2x** opto-isolated **PWM output**
  3x opto-isolated **output**
  - Isolated 5V or 12V, or no pull-up for outputs
- Half duplex **RS485 bus**
- **433MHz** receiver & transmitter
- Extendable with **Home Assistant** compatible hardware

Applications

- **Domotics** / Home automation
- Heater installation **control**
- Light / **LED** strip control
- **Saving energy** by **smart integration** of different renewable energy devices like solar collectors, photo-voltaic installations, heat pumps, hydraulic pumps & valves.
- **Saving energy** by **smarter scheduling** of room temperatures



Description

ControlBox can be used to control various types of domestic installation devices. Specifically, it is designed to control up to 16 floor heater thermal valves, hydraulic (PWM) pumps, hydraulic valves and various other installation devices.
It can read up to 30 (depending on the setup even more) DS18B20-PAR temperature sensors over long cables (>6m). All in- and outputs are protected with fuses and/or EDS-suppressing diodes.

Integration with the Home Assistant automation platform is made by providing a Raspberry-Pi compatible header. This allows Home Assistant to use Direct-IO for all integrated functions in a reliable, economic and efficient way. If using Direct-IO is not preferred, the end-user can run Home Assistant on any provided hardware, and connect to ControlBox via the W32-ETH01 Ethernet-supporting ESPHome module. A header for this ESP32 board is provided as well.

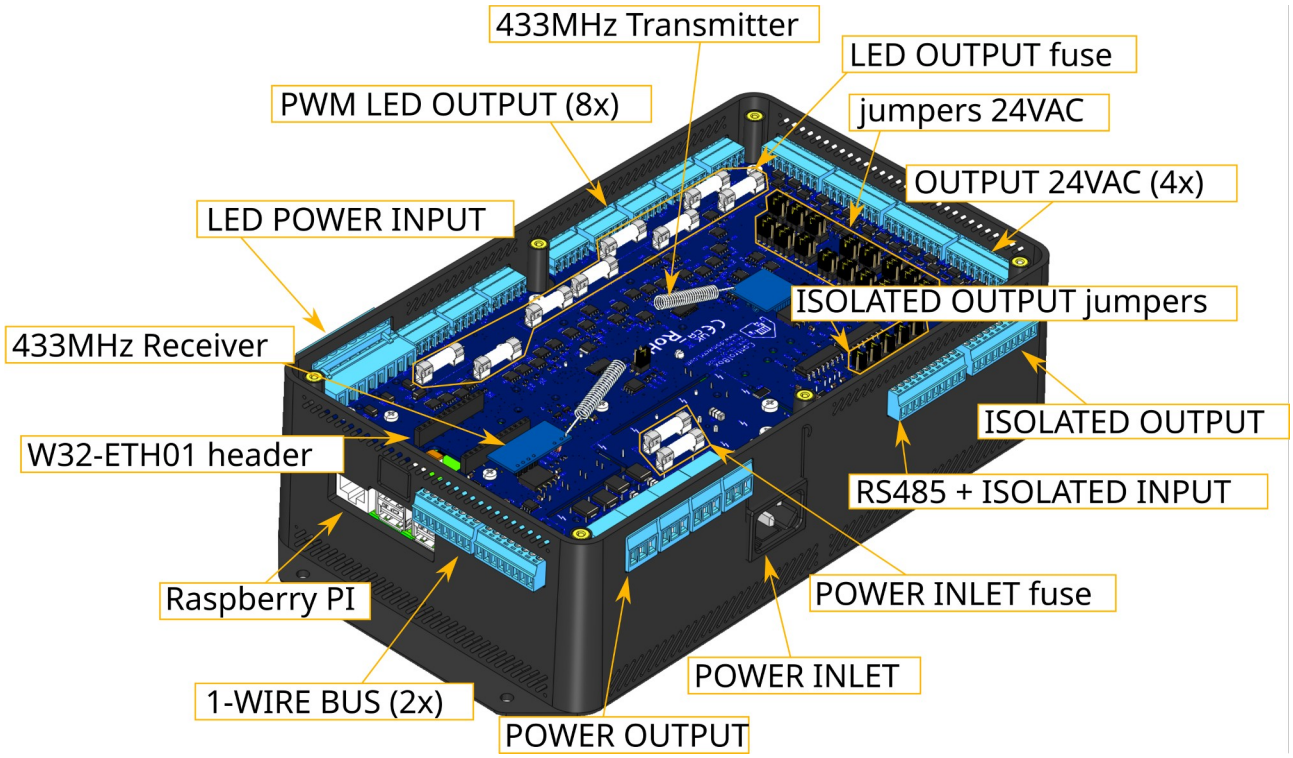
Besides the control of installation devices, ControlBox also supplies a 32-channel brightness controller for LED-strips. The 32-channels are distributed over 8 connectors. Depending on the configuration of Home Assistant, the outputs can be used as single-color, RGB or RGBW lights. Each of the 8 connectors can supply up to 6A current at a maximal voltage of 48VDC.

With the integrated 433MHz transmitter and receiver it will be easy to integrate additional devices to Home Assistant. Examples are 'ClickOnClickOff' devices, curtain rails, screens, garage doors, etc. If required, the Home Assistant Connect ZBT 1 or 2 can be plugged in the Raspberry Pi USB ports to further expand the users possibilities with ZigBee and Matter support.

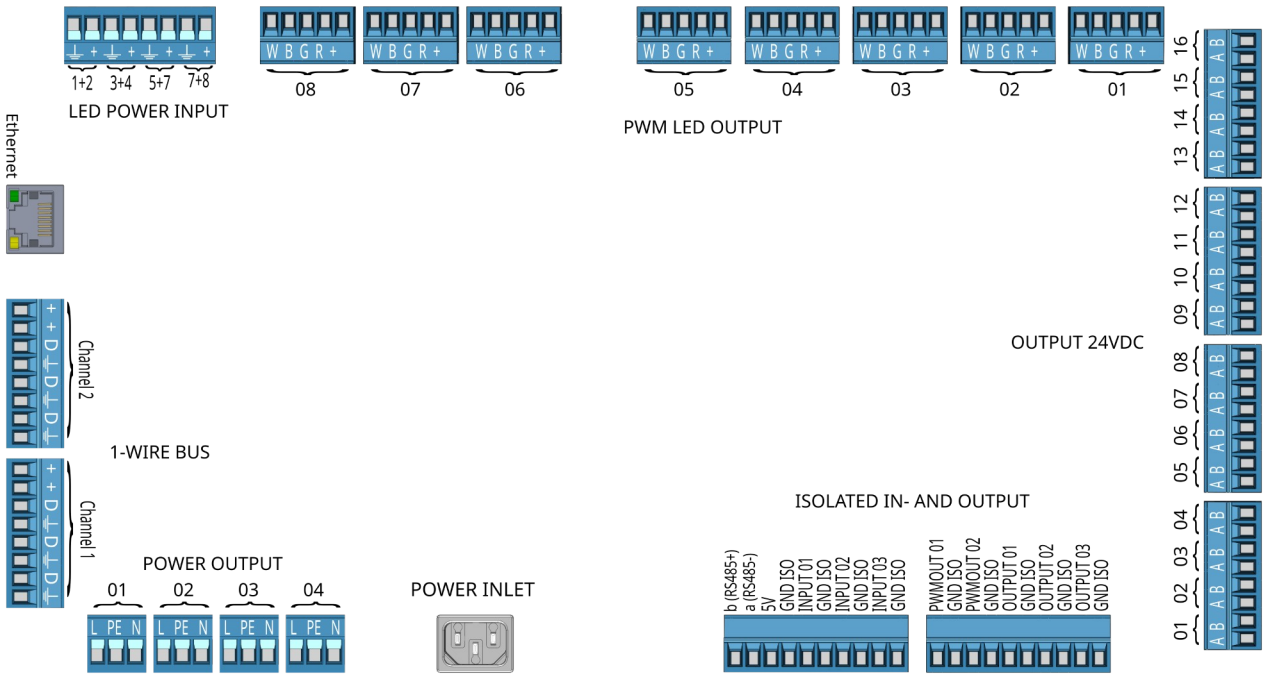
Typical usage

- Implement a software thermostat per room; no additional hardware is required as the user can use a the native Home Assistant app on a smartphone to control the temperatures.
- Schedule floor heater systems according to internet-accessible scheduler. This may include automatic pre-heating, so that rooms are on comfortable temperature when required. The other periods they will be on as-low-as-possible temperatures. This will reduce energy consumption. If temperature can be lowered up to 3°C over 12 hours per day, this might already reduce energy consumption by 7% in winter time.
- Automatically switch off the pumps for floor heater systems when there is no heat requested in order to save even more energy.
- More efficient regulation of solar collectors by optimizing the switch-on moment and using a software PID regulator. It is proven in practice that a vacuum-tube collector performed more efficient, especially on cold & cloudy days, when controlled by ControlBox & Home Assistant.
- Automatically switching off floor heaters in a room when wood stove starts burning.

Connector & header location



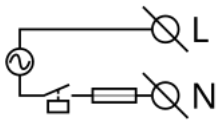
Pin assignment

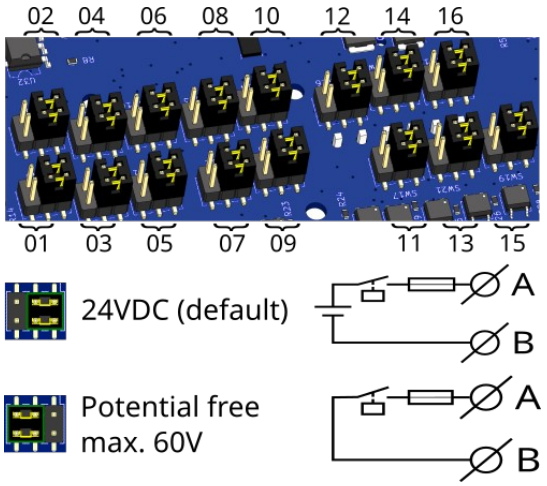
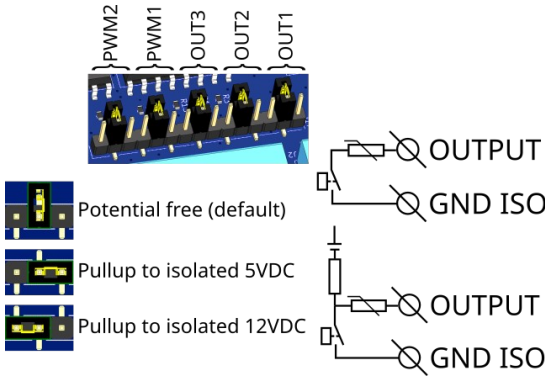


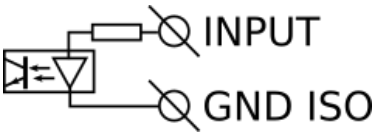
Connector & Header specifications

Screw-in plugs have 5mm pitch (LED POWER INPUT and POWER OUTPUT) and 3.5mm pitch (other connectors). Wire & mounting specification for those screw-plugs is as following:

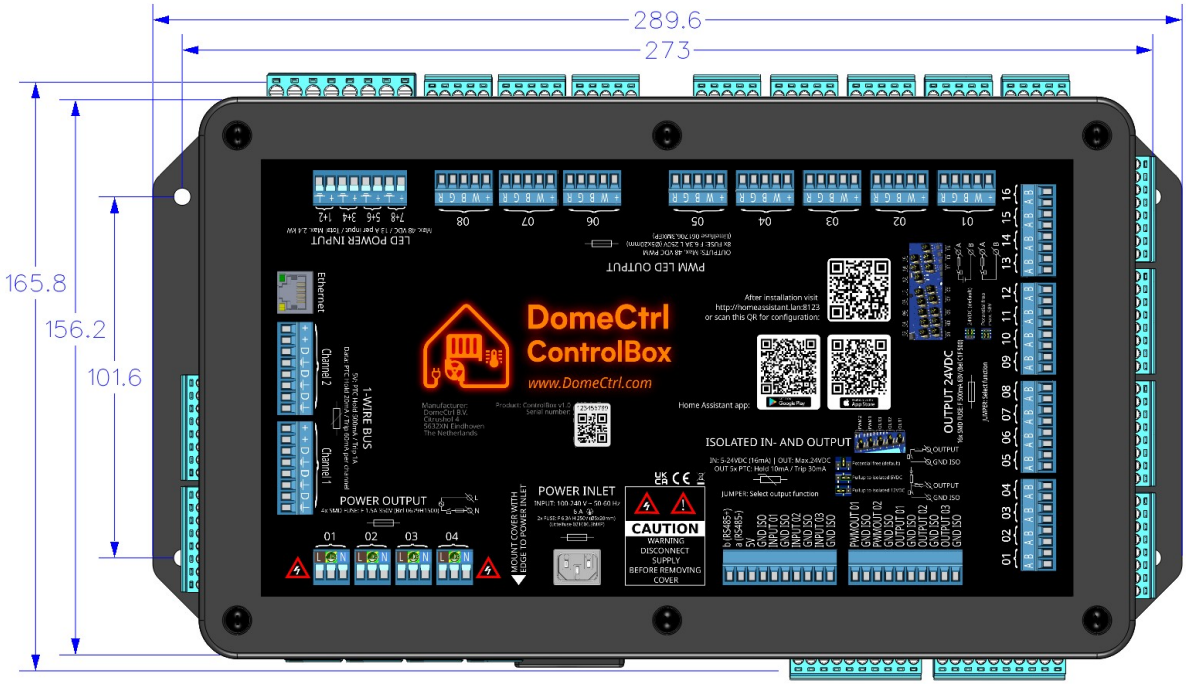
	5mm pitch		3.5mm pitch	
	UL	*IEC*	*UL*	*IEC*
Wire range	28-12 AWG	0.5-2.5mm^2	28-16 AWG	0.5-1.5mm^2
Strip length	7-8mm		6-7mm	
Screw size	M3		M2	
Screw torque	0.5 N·m		0.2 N·m	

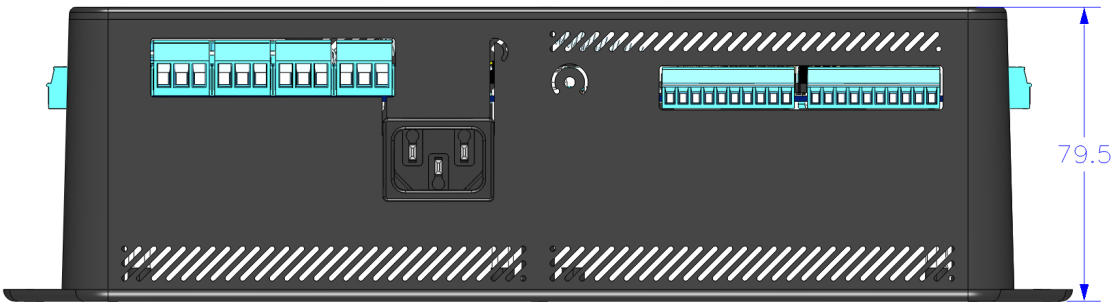
Header	Specification	Typical use
POWER INLET	100-240VAC IEC-320 C-14 inlet. Dielectric withstand voltage: 2.5 kV AC Electrical Insulation Class Class I (Symbol: ⏚) 2x FUSE: F 6.3A H 250V (⌀5x20mm glass tube clip-mounted on the PCB). Fuse manufacturer & type: Littelfuse 021606.3MXP *Typical power usage using a Raspberry Pi model 5 running Home Assistant and no activated hardware: ca. 6W. Please make sure the combined load of the power outputs, 24VDC outputs and the Raspberry Pi stays below 6.3A (ca. 1400W) or the fuses will blow.*	Net power input
POWER OUTPUT	4x 100-240VAC solid-state relay output. Switching is synchronized @ zero crossing. ESD protection IEC 61000-4-2 ESD 30kV(Air), 30kV (Contact). 4x SMD FUSE: F 1.5A 350V (6.1x2.6x2.6 mm ceramic soldered on PCB) Fuse manufacturer & type: Bel Fuse 0679H1500. Schematic output function: 	Hydraulic pumps and other devices, <1.5A For 240VAC: <300W For 110VAC: <150W

Header	Specification	Typical use
OUTPUT 24VDC	16x 24VDC solid-state relay output. Use with internal 24VDC power supply, or use potential free up to 58VDC or 58VAC peak. ESD protection by clamping @ 58VAC. 16x SMD FUSE: F 500mA 63V (3.2x1.6x0.6 mm ceramic soldered on PCB) Fuse manufacturer & type: Bel Fuse C1F 500. *The 24VDC is generated by a separate power supply unit. In order to save energy when not in use, a grid-voltage switch is provided to disable this unit.* Function of the outputs can be configured with jumpers: 	Floor heating thermal wax actuators/valves. With external transformer via potential free contact: 24VAC hydraulic valves.
ISOLATED OUTPUT	3x opto-isolated GPIO output, 2x opto-isolated PWM output, max 24VDC. ESD protection IEC 61000-4-2 ESD 15kV(Air), 8kV (Contact). PWM frequency configurable, default 1kHz. Output protection: 5x PTC: Hold 10mA / Trip 30mA Output pull-up can be selected with jumpers: 	PWM output: set speed of PWM controlled hydraulic pumps. GPIO output: Isolated IO communication to external devices.

Header	Specification	Typical use
ISOLATED INPUT	3x opto-isolated GPIO intput. Voltage: 5-24VDC. Max current 16mA. ESD protection IEC 61000-4-2 ESD 15kV(Air), 8kV (Contact). Input current limited by 1.5kΩ resistor. *Due to a limited amount of GPIO, INPUT3 is not available when using the W32-ETH01 module.* Schematic input function: 	Isolated IO communication from external devices.
LED POWER INPUT	4x Power input for PWM LED ouputs. Max. 48 VDC / 13 A per input / Total max. ca 2.4 kW ESD protection IEC 61000-4-2 ESD 15kV(Air), 8kV (Contact). Current is limited per PWM LED output connector, each pin is connected to 2 PWM LED output connectors containing 4 (RGBW) channels.	Connect this to a high-current DC power supply to provide power to your LED strips.
PWM LED OUTPUT	32 PWM controlled outputs for LED strips. Max. voltage: 48VDC, max current 6.3A per connector. PWM frequency configurable, default 200Hz. *By default configured as 8 RGBW lights, but can be configured to any Home Assistant supported light type.* 8x FUSE: F 6.3A L 250V (⌀5x20mm glass tube clip-mounted on the PCB). Fuse manufacturer & type: Littelfuse 061706.3MXEP	Connect a RGBW LED strip per connector, or use one connector to create multiple LED strip lights.
1-WIRE BUS	2 channels to 1-Wire line drivers. Each connector: 3x data pin, 2 x 5V pin, 3x GND pin. ESD protection IEC 61000-4-2 ESD 20kV. Output protection: 5V: PTC Hold 500mA / Trip 1A. Data: PTC Hold 20mA / Trip 60mA per channel ((parasitic mode allowed).	Reading 1-Wire temperature sensors like the DS18B20 and DS18B20-PAR.
RS485 BUS	Half-duplex RS485 communication bus. Protection by isolated MAX22027FAWA+ driver. Bus voltage 5V. Minimal allowed baud rate: 250kbps	Auxiliary devices, e.g. solar inverters or DMX controllers.
433MHz HEADERS	2 headers to plug in 433Mhz Superheterodyne transmitter & receiver modules. Power supplies of the modules are stabilised with a capacitor, and for the receiver an additional ferrite bead.	'ClickOnClickOff' devices, curtains screens, garage doors, etc.

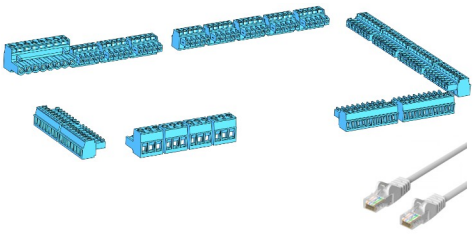
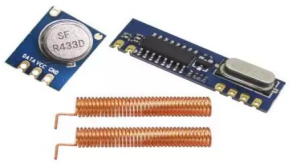
Mechanical specifications







Ordering information

Order code	Description	
CTRL_BOX	Bare ControlBox. *No Raspberry Pi or W32_ETH0 included.* *No connector plugs included, no cables included.*	
CTRL_BOX_PI CTRL_BOX_PI+	ControlBox with pre-installed Home Assistant on a RPi 5 4GB + 128GB NVMe SSD. *Default: no connector plugs included, no cables included.* *User should cut out the pre-defined connector openings on usage.* +: CTRL_BOX_CONN and CTRL_BOX_433 included.	
CTRL_BOX_ESP CTRL_BOX_ESP+	ControlBox with pre-programmed ESPHome at W32_ETH0 board. *Default: no connector plugs included, no cables included.* +: CTRL_BOX_CONN and CTRL_BOX_433 included.	
CTRL_BOX_CONN	Connector kit w/o mains cable: - Ethernet cable 0.5m E - 4x SameSky TBP04P1-500-03BE - 1x SameSky TBP04P1-500-08BE - 8x SameSky TBP03P3-350-05BE - 6x SameSky TBP03P3-350-08BE - 2x SameSky TBP03P3-350-10BE	
CTRL_BOX_EU_MAINS CTRL_BOX_US_MAINS	C13 net cable 0.5m	
CTRL_BOX_433	433MHz kit with CE-certified superheterodyne receiver and transmitter module G-Nice RF SRX887 & STX882.	

Regulatory & Standards Compliance

ControlBox is designed in accordance with the following regulations, norms and standards:

Category / Standard	Description
Global Conformity & Directives	
CE Marking	The product carries the CE mark, and is full compliant with all applicable European Union directives (including LVD, EMC, and RED where applicable).
UKCA Marking	The product carries the UKCA mark and is full compliant with relevant UK statutory instruments.
RoHS Compliance	The product is fully compliant with the RoHS Directive (2011/65/EU and amendments) regarding the restriction of hazardous substances.
Product Safety & Electrical Controls	
EN-IEC 60730-1	Automatic electrical controls — Part 1: General requirements.
EN-IEC 60730-2-11	Automatic electrical controls — Part 2-11: Particular requirements for energy regulators.
EN-IEC 61347-2-13	Controlgear for electric light sources — Safety — Part 2-13: Particular requirements for electronic controlgear for LED light sources.
IEC 60664-1	Insulation coordination for equipment within low-voltage supply systems — Part 1: Principles, requirements and tests.
IEC 60529 (IP Code)	The product enclosure is rated IP30 (protected against solid foreign objects ≥ 2.5 mm, no protection against liquids).
Electromagnetic Compatibility (EMC) — Generic Standards	
EN 61000-6-1	Generic standards — Immunity standard for residential, commercial and light-industrial environments.
EN 61000-6-3	Generic standards — Emission standard for equipment in residential environments.
Electromagnetic Compatibility (EMC) — Emissions & Harmonics	
EN 61000-3-2	Limits for harmonic current emissions.
EN 61000-3-3	Limitation of voltage changes, fluctuations and flicker.
FCC CFR 47 Part 15	Radio Frequency Devices (Conducted and Radiated Emissions).
Electromagnetic Compatibility (EMC) — Immunity (Basic Standards)	
EN 61000-4-2	Electrostatic discharge (ESD) immunity test.
EN 61000-4-3 / -4-4 / -4-6 / -4-8	Radiated, electrical fast transient, conducted disturbances, and magnetic field immunity tests.
EN 61000-4-5	Surge immunity test.
EN 61000-4-11	Voltage dips, short interruptions and variations immunity tests.

Category / Standard	Description
Radio & Wireless Spectrum	
EN 300 220-2 / EN 300 440-2	Harmonised Standards for access to radio spectrum for Short Range Devices (SRD).
Electrical Installations & Switchgear Assemblies	
IEC 60073:2002 / IEC 60445:2017 / IEC 60665-1	Principles for man-machine interface, marking, identification, and component specifications.
IEC 61439-1:2021	Low-voltage switchgear and controlgear assemblies — General rules.
PCB Design & Manufacturing	
IPC-2221 / IPC-2221B	Generic Standard on Printed Board Design. This product is designed according to class 2.
Material & Flammability Requirements	
UL94 V-0	All plastics used in the construction of the product comply with a flammability rating of UL94 V-0 or higher (materials self-extinguish within 10 seconds without flaming drips).

Manufacturer information

This product is designed and produced by:

DomeCtrl B.V.
Citrushof 4
5632XN Eindhoven
domectrl.com

This document describes version 1 of ControlBox.

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Version information

Date	Author	Description
17-11-2023	AWV	Initial document
21-03-2024	AWV	- Added 110VAC config option for USA market - Added RPi5 with SSD option
31-10-2024	AWV	- Updated fuse information - Removed SD-card option; SDD is much more reliable.
07-10-2026	AWV	- Modified design to fulfil regulatory requirements for CE certification - Added norms & regulations used for design - Due to regulatory requirements: 24VAC outputs changed to 24VDC Power input is now wide range 100-240VAC
23-10-2026	AWV	Typographic improvements