



User and Installer Manual

Octopus KDS-2 Series Electrochromic Glass Controllers

KDS-2 · KDS-2 Mini · KDS-2 Nano · KDS-2 Nano 2026

NEW MODEL

Octopus KDS-2 Nano 2026

Hardware revision Nano Rev 4.0 · integrated RX480E · firmware 3.00

DOCUMENT REVISION

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CONTENTS

Contents	2
General Information.....	3
Controller Specifications	3
Main Controller Functions	3
Octopus KDS-2 Nano 2026, hardware revision 4.0 (Nano Rev 4.0)	4
Differences from the Previous KDS-2 Nano	4
Main Rev 4.0 Terminal Groups	4
Installation Recommendations	4
Connecting Electrochromic Glass to the Controller	5
6-Wire Connection	5
4-Wire Connection	6
User Configuration	6
General Context	6
User Settings Context.....	7
Demo Mode Settings	8
Control Input Settings	8
Integrated RX480E Radio Receiver	9
Configuring Controller Modes by Bus CAN.....	12
Command Mode	15
Command Mode via the Serial Port	15
Command mode with application CAN-tyres	16
Differences Between the Control Algorithms	17
Control Inputs	18
Controller Operating Procedure	18
InfinityTint	19
Relaxation Procedure	20
Automatic Tinting Procedure	20
Faults and Emergency Conditions	20
Appendix 1. Diagrams	22
Octopus KDS-2 Nano 2026 (Nano Rev 4.0)	26
Appendix 2. CAN Bus Messages	28
Controller Status Message Structure	28
Controller Operating-Hours Message Structure.....	31

GENERAL INFORMATION

The Octopus KDS-2, KDS-2 Mini, KDS-2 Nano, and KDS-2 Nano 2026 are electronic controllers designed to provide stable control of electrochromic glass, maximize optical switching speed between states, and extend the service life of electrochromic devices. The controllers are intended for vehicles with a 12 V DC electrical system. They may also be used in other applications, provided that all specified operating conditions are met.

The design of the controller, the algorithms used, firmware, as well as the means and methods of preparing parameters for controllers are protected by copyright law and patent.

CONTROLLER SPECIFICATIONS

Supply voltage: 6-14.5 V DC (up to 24 V for certain versions)

Rated continuous output current per channel: up to 2 A

Peak output current per channel: up to 3 A

Output voltage per channel: 0 to 4 V DC

Controller no-load current consumption: less than 100 mA

Ambient temperature during operation: from -50 to +50 °C

Number of glass tinting/clearing cycles: at least 50,000

Radio interface: receive-only. The controller incorporates a radio receiver and has no radio-frequency transmit circuitry. The controller is not capable of intentional radio transmission.

MAIN CONTROLLER FUNCTIONS

The KDS-2, KDS-2 Mini, KDS-2 Nano, and KDS-2 Nano 2026 controllers supply electrochromic glass with 0 to 4 V DC of either polarity. Each channel supports up to 2 A continuously and up to 3 A for no more than 30 seconds in any 10-minute period. The KDS-2 has two independent, separately controlled channels. The KDS-2 Mini and KDS-2 Nano are single-channel controllers. Connect only one electrochromic glass unit to each controller channel.

Each controller supports firmware updates through the SWD interface and configuring parameters through the USART interface.

Controllers may be operated using momentary pushbuttons, latching buttons or switches, half-step or full-step rotary incremental encoders (including encoders with an integrated pushbutton), the USART interface, the standardized CAN interface, an external radio receiver, or the integrated radio receiver provided on KDS-2 Nano revision 4.

Each controller is equipped with the following set of control sensors and systems:

- Internal temperature sensor for monitoring controller temperature and compensating the voltage applied to the load.
- Inputs for electrochromic-glass temperature sensors, used for voltage compensation and glass-temperature monitoring.
- Remote voltage-sense inputs minimize voltage-drop errors when long, small-gauge conductors are used to connect the electrochromic glass.
- Built-in open-circuit detection for the load wiring.
- Built-in protection against incorrect connection of the remote voltage-sense leads.
- Built-in hardware short-circuit protection at the load outputs.
- Built-in reverse-polarity protection at the controller power input.
- Built-in hardware protection against excessive voltage being applied to the electrochromic glass.
- Mandatory relaxation system for safely dissipating residual charge from the electrochromic glass.
- Internal voltmeter for monitoring the controller supply voltage.

Octopus KDS-2 Nano 2026, hardware revision 4.0 (Nano Rev 4.0)

The Octopus KDS-2 Nano 2026 is a single-channel controller with an integrated four-channel RX480E radio receiver. It allows the electrochromic glass to be operated from a remote control without an external receiver module.

The model retains the standard control algorithms, individual factory calibration for a specific glass unit, temperature and voltage monitoring, protective functions, and USART, SWD, and CAN interfaces. The new radio-control functions are available with firmware version 3.00 and later.

Differences from the Previous KDS-2 Nano

Parameter	KDS-2 Nano 2026	Previous Previous post: KDS-2 Nano
Radio channel	RX480E integrated into controller	Remote control required an external radio receiver or wired control
Hardware platform	Nano Rev 4.0	Previous hardware revision
firmware	Version 3.00 and the command SETRADIOMODULE (RADIOMODULE)	Built-in radio module command was missing
Remote scripts	Momentary/Toggle; single button or individual on and off buttons	Depended on the scheme of the external block
Main channel of glass	One; factory setting for a specific glass is retained	One; factory setting for a specific glass

The RADIOMODULE and ONEBUTTON settings are mutually exclusive. On the dual-channel KDS-2, radio-module settings may be saved, but the firmware ignores them during operation.

Main Rev 4.0 Terminal Groups

NOTE The layout of the controller terminals is shown in Appendix 1 in Figure 8. The RX480E radio receiver is part of the controller and does not require the connection of an external unit to the encoder inputs.

Group	Designations	Function
Nutrition	IN_V+, IN_GND	Positive and negative controller power terminals
electrochromic glass	POWER_OUT_1/2, SENS_OUT_1/2	Power outputs and external voltage measurement lines
Thermometer	T_SENS, T_GND	Connecting the glass temperature sensor
Conducting management	ENC_A, ENC_B, ENC_C (Button), ENC_GND	encoder or button according to the selected scheme
USART	U_RX, U_TX, U_GND	Configuration and diagnosis
CAN	CAN_H, CAN_L	Connection to CAN bus
Service	SWDIO, SWCLK, RESET, GND	Update firmware and service operations

INSTALLATION RECOMMENDATIONS

Each KDS-2, KDS-2 Mini, KDS-2 Nano, and KDS-2 Nano 2026 controller is individually factory-calibrated for a specific electrochromic glass unit. Use each glass unit only with its assigned controller. When connecting a dual-channel KDS-2, verify which channel has been calibrated for each glass unit.

When connecting electrochromic glass to a controller without factory-installed connectors, observe the specified polarity. Incorrect polarity accelerates degradation and may cause premature glass failure.

Controllers KDS-2, KDS-2 Mini and KDS-2 Nano are manufactured in accordance with the standards of electronics used on vehicles, printed circuit boards are additionally coated with protective varnish to avoid corrosion. However, the controllers do not come in a waterproof enclosure and cannot be installed in places

where moisture or any other liquid enters the device body. Controllers are recommended to be installed in a place protected from moisture, away from heat sources, air conditioning systems.¹

When choosing the location of the installation of dual-channel KDS-2 controllers, it is recommended to arrange them in such a way as to minimize the length of the cables from the controller to the electrochromic glass. The KDS-2 Mini and KDS-2 Nano single-channel controllers are designed to be installed directly into the car door, which avoids the time-consuming operation of stretching cables around the cabin.

To connect the controller to the power supply, it is recommended to use a flexible copper cable with a cross section from 0.75 mm² to 1.5 mm². To protect the supply line from short circuit, when using a cable with a section of 0.75 mm², it is recommended to use a fuse with a nominal value of not more than 7.5 A, and when using a cable with a section of 1 mm² and above, it is recommended to use a fuse not more than 10 A.

For all electrical connections, use flexible copper cable that is resistant to oil and fuel and maintains its properties over the full operating-temperature range. Suitable examples include KGVVA-series cables and cables with equivalent characteristics.

Connect cables to the dual-channel KDS-2 using its spring-clamp terminals, which provide a reliable electrical connection under vibration. If a KDS-2 Mini/Nano does not have a factory-installed connector, solder the leads using non-corrosive flux and protect each joint with an insulating sleeve, such as heat-shrink tubing. Do not allow any cable to remain under mechanical tension.

For control inputs, pushbuttons, and encoders, use conductors with a cross-sectional area of at least 0.12 mm², for example KGVVA or KSPVG cable. For control lines longer than 2.5 m, use a larger conductor cross-section.

Since electrochromic glass has a photovoltaic effect, under the influence of light it generates a slight potential at the power terminals. Therefore, it is recommended to connect the glass to a controller (KDS-2, KDS-2 Mini, KDS-2 Nano) that provides a short circuit of the power terminals of the glass in a de-energized state, or it is necessary to forcibly close the power terminals of the glass supply, if the glass is not in the transport packaging.

Connecting Electrochromic Glass to the Controller

electrochromic glass works at ultra-low DC voltages, so it is important to use a high-quality electrochromic glass connection to the controller using conductors that provide a minimum voltage drop between the controller and electrochromic glass.

When ordered with connectors, the controller and electrochromic glass are supplied as a matched connectorized set. The standard version uses sealed JST 06R-JWPF-VSLE-S and 06T-JWPF-VSLE-S connectors or equivalent parts.

Controllers KDS-2, KDS-2 Mini and KDS-2 Nano allow you to connect electrochromic glass on 4 and 6 wired circuits. The choice of the connection scheme is made depending on the section of the cable used and the length of the feed conductor.

In general, it is always recommended to use a 6-wire connection using a 0.75 mm² cable. When using a 6-wire connection circuit and a cable with a cross section of 0.75 mm² and above, the electrochromic glass is precisely controlled with maximum performance. The minimum allowable cross-section of the electrochromic glass cable used is 0.12 mm².

6-Wire Connection

Use this connection method when the power cable between the controller and glass has a cross-sectional area below 0.75 mm² and is longer than 1.2 m, or when a 0.75 mm² cable is longer than 2.5 m.

¹ Despite the fact that the controller KDS-2 Nano is made in the case with improved properties for protection against moisture, however, the controller has no classes for protection against moisture and can not be used with full or partial immersion in the liquid.

4-Wire Connection

This method is permitted with a power cable of 0.75 mm² or larger and a cable length up to 2.5 m. It is also permitted with cables of at least 0.12 mm² when the cable length does not exceed 1.2 m.

In all cases, with a cable length of up to 2.5 meters, mixed connection is allowed, when a cable with a larger cross-section is used for power supply of glass, and a smaller cross-section cable is used for sensor outputs.

In the standard version, electrochromic glass and controllers come with installed sealed connectors with a 6-wire connection system.

USER CONFIGURATION

Controllers KDS-2, KDS-2 Mini, KDS-2 Nano allow updating of the firmware, as well as some functions of the controllers can be configured to ensure full compliance with the wishes of the end user. The procedure for updating the firmware and the required equipment for performing the configuration procedure are described in the document “Instructions for updating the microcode and methods for configuring the Octopus KDS-2 controllers”.

The main functions of the controller, such as voltage and current parameters, time frames of actuators, electrochromic glass power algorithms, are specified at the manufacturer's factory for each specific electrochromic glass and are not available for modification by the user.

To perform the configuration procedure, you must connect to the controller via a USART-UART connection. When loading the controller, a brief information about the controller is displayed, namely the firmware version, the user settings version, the factory settings version and the configuration data array. In addition, the controller serial number, the electrochromic glass control algorithm and other statistical information are displayed on the screen.

```
-----
Octoglass Advanced Controller KDS2 for electrochromic glass
Version           : v2.14b.12.15.2
Core version      : 1.8.0.0
Core clock, Hz    : 72000000
Compiled at       : Sun Apr 19 19:29:28 2020
Controller S/N    : 05D5FF37-35324242-57188812
Working alorythm  : SmartSimple
Demo mode autorun : disabled
Start-ups         : 220
Total work, h     : 61
Time since boot   : 000:00:01
-----
```

Figure 1. Controller startup information displayed after a reboot.

Normal operation of the controller is signaled by a control LED mounted on the controller board and flashing at a frequency of 1 Hz.

Two controller command contexts are available through USART at a default baud rate of 115200: the general context and the user-settings context. Enter all commands in uppercase Latin characters and press Enter to submit a command.

General Context

The general context provides commands with system-wide functions.

STAT is a command to output advanced information about the current state of the controller, the state of voltage generation, sensor data.

REBOOT is the command to reboot the controller.

INFO is a summary of the number of errors that occurred during the operation of the controller and accumulated statistics, the command can be useful in diagnosing faults of the controller, its connection.

DEMO - Launch of the demonstration mode.

ECHO x – Disable and enable screening of characters in terminal mode. If x is 0, then the instant screening of characters entered through the terminal on the screen is turned off, screening is performed only when translating the line, otherwise screening is carried out after each entered character.

TEST is a procedure for checking the controller hardware, connected buttons, encoder. For the test, it is recommended to use a resistor with a resistance of 4 Ohms and a power of 2 W or more as a load. It is not recommended to carry out the test procedure with the electrochromic glass connected.

When calling the TEST command, button connections, encoder, performance of the controller relay switches, voltage generation, flash and EEPROM of the controller memory, CAN bus, buzzer, voltage and temperature sensors are consistently checked.

In general, pressing Enter causes the current test block to be missed and pressing Esc to exit the test procedure. After the test procedure is completed, it is desirable to reboot the controller using the REBOOT command.

In the LED test, the performance of LEDs is checked at direct polarity, at reverse polarity and in the off state. When testing relay switches, clicks of electromechanical relays installed on the controller board should be heard. When testing the ability to generate voltage by the controller, the generation of voltage equal to 0.25 V, 0.5 V and 1 V DC is successively checked. In case of detection of problems during the test procedure, you should contact the supplier for clarification and not connect electrochromic glass to the controller.

User Settings Context

In this context, settings of control elements, user characteristics of the controller are available. All changes introduced have an immediate effect and are stored until the controller is restarted, unless previously saved. The main commands of the user context:

CONFIG enters the user-settings context. After entering this context, the command prompt changes to CONFIG.

EXIT is an exit from the context of user settings.

SAVECONFIG saves all user context settings.

LISTCONFIG – displaying user context settings on the screen.

PRINTCONFIG outputs all current user settings as commands for subsequent download to the controller.

SETPWD sets a password to access the user configuration. After setting the password, you need to save the user configuration.

DELETEPWD – remove the password from the user configuration. After deleting the password, the user configuration must be saved.

When in user context mode, the following commands can be applied:

ALWAYSMAX 1/0 - changes the voltage generation mode of the controller. When using the ALWAYSMAX 1 command, the controller will switch electrochromic glass states only between the "Maximum Dimming" - "Maximum Lightening" (binary mode) modes. When using the ALWAYSMAX 0 command, the controller will switch sequentially between the following "maximum dimming" modes – "medium dimming" – "minimum dimming" – "maximum lighting".

LEDINVERSE 1/0 - changes the mode of operation of control LEDs of normal state. When using parameter 0, the indication of the normal state corresponds to the LED on, the switching of modes is accompanied by a short-term switching off of the LED. When using parameter 1, the logic of the normal state indication is inverted: when operating, the LED is turned off, when switching modes, the LED is briefly turned on.

ONELED 1/0 - The parameter includes the ability to display the emergency state of one of the channels at once on the LEDs of two channels. It makes sense to install only one LED and control only one button or encoder on a dual-channel controller. The default value is 0, the function is disabled. This function is not recommended because it does not identify the channel where the fault occurred, such as a wire break. Disabling an fault condition on one of the channels, if it occurred simultaneously on two channels, for example, hypothermia of the glass below the operating range, will not be displayed by the LED indicator.

DARKLED 1/0 - the parameter controls the glow mode of LEDs. Default value 0. When the parameter is equal to one, green LEDs remain off without generating voltage, otherwise they remain on when the controller is powered.

MINFEEDINGVOLTAGE x - sets the minimum threshold of the supply voltage controller to turn off the power on the electrochromic glass, is installed in volts. When the supply voltage of the controller is below the set value for 30 seconds or more, an emergency power outage of the electrochromic glass occurs to save the battery charge of the car. The switching of electrochromic glass control modes is blocked. When the voltage is restored, further electrochromic glass control is possible.

ZUMMER 1/0 w x y z - Configure the signals of the confirming buzzer. Parameter 1 - includes the buzzer mode, 0 - disables. The parameter w determines the frequency in Hz of a single confirming signal (double confirming signal has a frequency of 200 Hz higher), x is the duration of a single confirming signal in ms (double confirming signal is shorter by 5 ms, but not less than 10 ms). The parameter y determines the frequency of the error signal in Hz, and z determines the duration of the error signal in ms. Default values: 1 5000 15 1400 500.

EXTENDEDOUTPUT 1/0 - setting the long output of statistics, analogous to the STAT command when restarting the controller (1), the abbreviated output (0) is used by default.

AUTOREBOOTTIME x sets the automatic reboot mode of the controller, x is the value in minutes. The maximum possible value for installation is 43200, which means 30 days from the start of the controller. The reboot procedure is required for the controller's internal timers to function properly. If the controller maintains the tinted state of electrochromic glass at the time the timer is triggered to restart, or performs any other procedure for generating voltage, the reset process will be postponed until all procedures are completed, but for a period of no more than 1 hour. After this period, the controller will be restarted in any case.

AUTOTINT 1/0 – The setting is responsible for automatically enabling the first tinting mode when the controller (1) is turned on, the default state (0) awaits a command from the user to start the tinting process. This feature should be used with caution, as it can conflict with the automatic start of the demo mode.

AUTOTINTAFTER X Y – If the parameters are different from zero, then automatic tinting is activated after X hours by Y minutes. All values from 0 to 254.

USECOLOR 1/0 - Configuration is responsible for outputting (1) messages, alerts, errors to a serial controller port. By default, the output with color is enabled. It is recommended to disable this function in order to facilitate communication if data is exchanged between two controllers via a serial port or with external devices.

Demo Mode Settings

Within the context of user settings, it is possible to configure the demo mode. Demonstration mode can be started in three ways: through prolonged pressing of two control buttons (KDS-2 only), through the DEMO command, when the controller starts automatically. The performance of the demo mode is also affected by other controller settings, for example, ALWAYS MAX. Exit from the demonstration mode is carried out by pressing the control button, or after the number of cycles of the demonstration mode.

DEMOSTARTUP 1/0 - Starting the demo mode when the controller is loaded (value 1), waiting for commands (value 0).

DEMOMODECYCLE xxx, yyy – where xxx is the duration of one cycle of the demo mode in seconds (first press of the virtual button), and yyy delay in seconds until the next press of the virtual button. When using intermediate degrees of dimming, there will be a gradual switching over all of these degrees. If you do not specify the yy parameter, both values become the same.

DEMOMODEMAXCYCLES xxx is the maximum number of demonstration cycles. After passing all cycles, the controller goes into the waiting mode of user commands.

DEMOMODEMIX 1/0 - Alternating controller-channel switching (KDS-2 only).

Control Input Settings

Since the controller can be controlled in a variety of ways, appropriate adjustments must be made for the control elements to function correctly.

Customization of button management is carried out by the following commands:

BUTTON y z - the y parameter determines the time in ms of the length of the button press, the default value is 900 ms. The parameter z determines the duration of the debounce procedure in ms. The default value is 30 ms. If, when pressing the button, the controller's operating modes "jump" occurs, it is recommended to increase the value of z.

ONEBUTTON 1/0 is a command that determines the ability to control any button with two channels (KDS-2 only). By pressing the channel 1 button, you can change the mode of operation of channel 1 and channel 2. Similarly, the channel 2 button can be controlled by two channels simultaneously. At the same time, the indication, including the emergency, is divided by channel LEDs. Customization is rejected on single-channel models (Mini, Nano), starting with firmware 3.00.

BUTTONRELEASE 1/0 is a command that determines how to press a button. With a value of 0, pressing is fixed directly when pressing the button, with a value of 1 - when releasing it.

USEROCKERSWITCH 1/0 is a command that includes (1) or disables (0) the use of latching buttons or switches. If this mode (1) is used, all other button management and encoder modes are disabled, and ALWAYSMAX 1 mode is automatically applied. When switching off, the previous ALWAYSMAX setting is not restored. If the switch is switched on, the controller starts the relaxation mode, then the automatic activation of the tinting mode does not occur after starting the relaxation mode, it is necessary to turn off and turn on the switch. When using the control mode of the two-channel controller with the help of latching buttons or switches, it is possible to further adjust the amount of light transmission of electrochromic glass using encoder. At the same time, the lock button or switch must be connected to one channel and the encoder to another. In addition, you need to activate the control modes of one button and one encoder.

Configuring rotary encoder as controls is carried out by the following commands:

ENCODER w x y z - the parameter w determines the number of "clicks" of the encoder per press. Default value 1. When using small encoder knobs is recommended to increase this value. When using large encoder knobs, it is recommended to leave this value equal to 1. The x parameter is the type of encoder used. The value of 0 implies the use of a half-step encoder, the value of 1 implies the use of a full-step encoder. The parameter y determines the duration of the debounce procedure in ms for encoder contacts, the default value is 10 ms. The z parameter specifies the minimum threshold in ms to determine the duration of the rapid turn of the encoder, the default value of 50 ms.

ONEENCODER 1/0 is a parameter that determines the possibility of using two channels to control one encoder connected to any of the channels. The value of 1 includes the function, the value of 0 disables.

INFINITYTINT z is a parameter that determines the order of using encoder to obtain a smooth switch between the degrees of tinting glass from the largest to the smallest. The z parameter determines the number of clicks of the encoder to change the tinting value in the range from the darkest to the lightest, can take the value from 1 to 254, the default value is 12. When used on a dual-channel controller and using encoder, it is recommended either not to enable single-button management (ONEBUTTON) or also to use single-encoder management (ONEENCODER) to avoid channel desynchronization.

SEPOFF x y is a separate control mode for switching on and off tinting mode using pins designed to connect encoder. The parameter x means the channel number, if the parameter y is 1, then when one of the encoder A and B terminals is closed, a command will be given to turn on and off the tinting mode of the controller. This function can be used to connect external control modules with unreliable communication to the controller, for example, control units over a radio channel. The encoder C output is used to connect buttons and switches using the usual control scheme.

Integrated RX480E Radio Receiver

This section refers to the KDS-2 Nano 2026. firmware 3.00 converts RX480E signals into virtual button presses and releases, so the mode recorded in RX480E must match the SETRADIOMODULE command mode setting.

Compatibility and Reference Specifications

Parameter	Value/requirement
Type	Four-channel superheterodyne receiver with code training
Operating frequency	433.92 MHz; the remote and receiver must have the same frequency
Modulation and coding	ASK/OOK; a console with fixed code EV1527 (1527 Learning Code) is recommended
Powering the RX480E itself	3.3-5 V from the controller fee
Current/power consumption	No more than 5 mA at rest; calculated no more than 25 mW at 5 V
Radiofrequency power	RX480E is only a receiver and does not emit. Power is given by the remote; for example, KT16-4: +13 dBm (about 20 mW)

Parameter	Value/requirement
Sensitivity	-108 dBm (module manufacturer reference value)
Range.	For the RX480E stated from 15 m; for the remote KT16-4 – up to 50 m in the open space. In the car and near the metal range is usually less
Exits	D0-D3, logical levels of CMOS; in firmware they correspond to button numbers 0-3

Remote-Control Operating Modes

Regime.	What does RX480E do?	How does the controller work?
Momentary/impulsive	Dn output is active while the remote button is held	firmware simulates normal tapping and letting go. Specify mode=1. This is the recommended mode for the new installation.
Toggle/trigger	The first press fixes Dn=1, the next - Dn=0	firmware tracks the change of state and generates a completed virtual press. Specify mode=2
One button, scheme=0	Use one output of buttonOn	Each correct press switches/cyclically changes state according to the general controller settings. buttonOff should be 255
Separately on/off, scheme=1	There are two outputs: buttonOn and buttonoff.	The first button turns on the tinting mode, the second starts clearing. Intermediate levels and accelerated stages are determined by ALWAYSMAX and the factory algorithm.

DO NOT use Interlocked (Latched) RX480E and mixed modes selected by 3-7 presses of the service button, firmware 3.00 is not supported. For two separate buttons, use scheme=1 in firmware and leave RX480E in Momentary or Toggle.

Changing the RX480E Operating Mode

The operation is performed with the controller enabled by the LEARN service button on the RX480E module. Work insulated tools, do not touch live parts and observe protective measures against static electricity.

Action with the LEARN button	The result	The firmware parameter
1 short press	Transition to Momentary Learning	mode=1
2 short presses	Transition to learning in Toggle mode	mode=2
3-7 short presses	Interlocked or mixed modes	Not supported
8 short presses	Delete all previously saved remote codes	Re-training is required after cleaning

When changing Momentary to Toggle or back, first clear the RX480E memory with eight taps, then retrain in the selected mode and change the mode in SETRADIOMODULE. The discrepancy of modes can be perceived as a pass, double pressing or saving a command after releasing the remote.

Programming the Remote Control

- Make sure the remote is running at 433.92 MHz and uses EV1527 encoding or RX480E compliant.
- If the controller was previously used with another remote or you need to change mode, press LEARN eight times and wait for a series of flashes of the indicator - the remote memory will be cleared.
- For Momentary, press LEARN once; for Toggle, twice. Wait for the indicator to go into training mode.
- Press any programmable remote button. Three flashes of the RX480E indicator confirm successful learning.
- Check all the buttons used and match them with the logical outputs D0-D3, that is, the numbers 0-3 in SETRADIOMODULE.
- Write the configuration via USART, execute SAVECONFIG and restart the controller.

2-Button and 4-Button Remote Controls

The RX480E learns the remote ID after pressing any button. In a standard four-button remote, code bits 1, 2, 4 and 8 correspond to outputs D0, D1, D2 and D3. Inscriptions A/B/C/D or 1/2/3/4 on the housings of different consoles are not standardized, so actual compliance should be checked after training.

Remote/task	Recommended scheme	Example of selected exits
2 buttons; one button controls the entire cycle	scheme=0; assign the desired output as buttonOn, buttonOff=255. The second button is not used	SETRADIOMODULE 1 1 0 255 0 25
2 buttons; individual on and off	scheme=1; assign different outputs to buttonOn and buttonOff	SETRADIOMODULE 1 1 0 1 1 25
4 buttons; one button controls the controller	scheme=0; select any of the outputs 0-3, the rest ignored	SETRADIOMODULE 1 1 2 255 0 25
4 buttons; individual on and off	scheme=1; select two buttons, the remaining two controller ignores	SETRADIOMODULE 1 1 0 1 1 25
Toggle; one button	Translate RX480E to Toggle, specify mode=2 and scheme=0	SETRADIOMODULE 1 2 0 255 0 25

In all examples, the numbers 0, 1 and 2 are examples of outputs D0, D1 and D2. If the desired physical remote button is associated with another output, replace the parameter number without changing the other values.

One Remote Control with Multiple Controllers

The same remote can be used with two controllers. In direct radio control, each RX480E receives the signal and executes the assigned command independently; in CAN control, the radio channel is switched on only on the master controller.

Script	Setting up	Outcome and features
Same buttons on two controllers	Train both RX480Es to the same remote. On both controllers, set the same mode, scheme, buttonOn and buttonOff.	One button at scheme=0 or the same pair of buttons at scheme=1 controls both controllers. Momentary or separate On/Off is preferred to exclude desynchronization; in Toggle, a missed radio packet can leave controllers in different states.
Different buttons of the same remote	Teach both RX480Es the same remote, but assign different output numbers. Example: the first controller - buttonOn=0, buttonOff=1; the second - buttonOn=2, buttonOff=3.	The D0/D1 button controls the first controller and the D2/D3 controls the second. Unassigned buttons are ignored by each controller.
One controller by radio, the rest by Slave over CAN	On the master controller, turn on SETRADIOMODULE and set CANSETCOMMANDMODE 2 111. Turn off the radio channel and set CANSETCOMMANDMODE 3 111. The CAN speed and the identifier type must match.	The remote controls the master controller, and the slave repeats commands via the CAN. Similarly, you can connect several slave controllers.

When direct control of two controllers with the same buttons, bring both controllers to the same initial state in advance. In a variant with a CAN, the master controller is a single radio control point, which ensures coordinated switching of slave devices.

SETRADIOMODULE Command

```
SETRADIOMODULE enabled [mode] [buttonOn] [buttonOff] [scheme] [debounce]
RADIOMODULE enabled [mode] [buttonOn] [buttonOff] [scheme] [debounce]
```

Both records are equivalent. For the initial setting, it is recommended to specify all parameters, even if some of them have default values.

Parameter	Permissible values	Function
enabled	0 or 1	0 - radio channel turned off; 1 - on
mode	1 or 2	1 - Momentary; 2 - Toggle. The value must match the RX480E mode.
buttonOn	0-3	The output number D0-D3 used to enable or share a button
buttonOff	0-3 or 255	Shutdown exit number. For scheme=0, please specify 255.
scheme	0 or 1	0 – one button to turn on and off; 1 – separate buttons
debounce	milliseconds	Software anti-drunk; default value of 25 ms

Starting from 3.00 SETRADIOMODULE and ONEBUTTON are mutually exclusive. Before turning on the radio channel, perform ONEBUTTON 0. On dual-channel controllers, the SETRADIOMODULE command does not work, ONEBUTTON is given priority.

Complete Configuration Example

```
CONFIG
ONEBUTTON 0
SETRADIOMODULE 1 1 0 255 0 25
SAVECONFIG
LISTCONFIG
REBOOT
```

An example includes Momentary and a single-button circuit at the output D0. LISTCONFIG is used to check stored parameters before restarting.

To turn off the radio channel, log in to CONFIG, execute SETRADIOMODULE 0, then SAVECONFIG and REBOOT.

Testing and Troubleshooting

- No response: check firmware 3.00 or later, enabled=1, SAVECONFIG save, remote frequency and encoding, RX480E training, and correct D0-D3 number.
- The wrong command works: change buttonOn/buttonOff according to the actual button binding of the remote.
- Double or spontaneous switching: Make sure mode matches RX480E mode; moderately increase debounce if necessary and repeat the check.
- The command is held after release: RX480E is probably configured in Toggle, and in firmware mode=1 is specified, or unsupported Interlocked is selected.
- Short range: check the remote battery, the antenna (pull it so that it is not shielded by metal door towards the interior of the car), the absence of metal shielding and interference; test the open door and then in the standard layout.
- After changing ONEBUTTON, the radio channel stopped working: return ONEBUTTON 0 and re-save the configuration.

Configuring Controller Operation via the CAN Bus

KDS-2 controllers are equipped with the ability to connect directly to the CAN bus (ISO 11898). Performance with buses other than the standard and incompatible with it is not ensured. The following operating speeds are supported: 10, 20, 50, 83, 100, 125, 250, 500, 800 and 1000 kb/s. As a rule, cars use several CAN buses at different speeds, and each tire is responsible for servicing a particular segment of the car.

Different segments of one CAN bus or different CAN bus in a car can be connected by a repeater that translates some parameters from one bus segment to another. Before connecting the controller to the CAN bus of the car, it is necessary to pre-diagnose with the help of external hardware and software tools, such as CanHacker or similar, to select the right segment / bus / connection location and ensure the broadcast of the required packets. When connected to the OBDII diagnostic connector, on some cars, only the basic diagnostic parameters transmitted by the CAN bus of the car can be accessed.

When connecting the controller to the CAN bus, you need to make sure that the controller's power is also coming from the onboard circuit of the same vehicle, and not from an external power source. If it is not possible to transmit or receive messages by the controller over the CAN bus, it is necessary to make sure that the conductors are connected correctly and the connection speed is selected according to the speed in the CAN bus used. In some cases, it may be necessary to turn on the CAN bus terminal resistors on the controller, for which it is necessary to install jumpers on the paired terminals near the terminals for connecting the CAN bus on the controller board.

A feature of working with CAN bus is the constant transmission of messages on the bus from all connected devices. Each of the devices with a certain regularity sends a message to the bus about its state. The state of the device is encoded by a set of 8 bytes. In the event of a certain event, for example, pressing a button connected to the comfort unit, one or more bits of the corresponding byte state of the device are changed. Automakers do not publicly publish information about the value of bits and bytes in CAN bus messages, so the search and determination of the desired event and the desired message is carried out through reverse research using CAN bus analyzers (for example, CanHacker or similar).

Device addresses in the CAN standard can be implemented in standard mode (11 bits per identifier) and in extended mode (29 bits per identifier). When configuring a controller to work with a CAN bus, it is necessary to use the identifiers standard used in a particular CAN bus. When selecting the address(s) of the controller, it is necessary to ensure that any addresses intended for data transmission in the CAN bus are unique. If the addresses coincide, there may be interruptions in the operation of other devices using the CAN bus. The frequency of sending state messages to the CAN bus is configurable. However, you should not install too frequent sending, as this can lead to excessive loading of the CAN bus and interruptions in the operation of both the controller and other devices connected to the same bus. When choosing the address of the broadcast address, it is necessary to adhere to the rule of choice of address. The smaller the address number (identifier) the higher its priority in the transfer. In order to prevent interruptions in the work of standard equipment of the car, it is recommended to use the highest possible addresses from the available address space. In general, it is desirable to connect controllers to the least responsible segments or CAN bus to avoid interference with the main systems of the car. When connecting the controller to the CAN bus, a twisted conductor must be used to minimize interference on the CAN bus.

Since a large amount of data is transmitted by CAN bus in real conditions, hardware filtering is used to receive control sequences in controllers at sender addresses (identifiers). Unless absolutely necessary, do not completely disable the filtering of incoming messages.

Below is a list of commands to manage the CAN bus settings in the controller. All manipulations are done in the context of user settings.

CANSETMODE xxxx is a quick set of controller settings for the CAN bus. As a parameter, the command perceives a bitmask, where each bit takes 0 (function disabled) or 1 (function enabled), with the following value (numbering from left to right):

- 4 - Use of the extended address identifier: 1 - extended, 0 - normal;
- 3 - command mode role: 1 - Master, 0 - Slave;
- 2 - Enabling the command mode: 1 - on, 0 - off;
- 1 - sending messages to the CAN bus: 1 - on, 0 - off;
- 0 - Enabling CAN bus work: 1 - on, 0 - off.

These parameters can be changed by individual commands.

CANSTART and CANSTOP are commands that turn on and off CAN bus, respectively.

CANUSEEXTID 1/0 - if the parameter is 1, then the use of an extended 29-bit address identifier is enabled, if the parameter is 0, then an 11-bit identifier is used.

CANSETBITRATE x - sets the data exchange rate with the CAN bus in kbit/s, the permissible values of 10, 20, 50, 83, 100, 125, 250, 500, 800 and 1000.

CANSETSTATTIMER x - the period of sending messages to the CAN bus about the state of the controller is set, this parameter also affects the command mode over the CAN bus. The value is set in milliseconds. The default value is 1000, which means 1 second. If it is impossible to send messages within a certain number of messages, the CAN block of the controller is re-initiated.

CANSETINFOTIMER x - the period of sending messages to the CAN bus about the operation of the controller, accumulated errors is set. The value is set in seconds. The default value is 60 seconds. If it is impossible to send messages within a certain number of messages, the CAN block of the controller is re-initiated.

CANSENDSTATUS 1/0 - enabling (parameter 1) or disabling (parameter 0) data transmission in the CAN bus about the state of the controller and information about the performance of the controller.

CANSETTXID x is the initial controller address identifier for sending messages to the CAN bus. There are 19 consecutive addresses starting with x. The entire address range should be free in the address space used by the CAN bus, and no other devices should be registered or connected to these addresses. The parameter x must be entered in a hexadecimal representation and according to the addressing dimension of the CAN bus used (11 or 29 bits).

Structures of messages about the status and performance of the controller are given in Annex 2.

Configuring CAN Bus Message Analysis

When connected to a CAN bus, the controller is able to receive messages not only from other controllers or specialized devices (Command Mode), but also analyze messages from regular devices on the CAN bus of the vehicle. Under certain conditions, the analysis data can be used to control the controller. Thus, the control function of the controller of the standard buttons or switches of the vehicle can be implemented.

`CANSETFILTER x y` is a command that specifies filters for listening to the CAN bus. In total, 3 filters can be consistently specified. The parameter `y` can take the value of 0 (use of an 11-bit, short address) or 1 (use of a 29-bit, long address), the parameter `x` takes the address (identifier) to receive messages.

`CANCLEARFILTERS` clears all filters configured with `CANSETFILTER`.

`CANPRINTMESSAGES 1/0 1/0` is a command that includes (1) or disables (0) the display of CAN bus messages received by the controller (first parameter) and transmitted by the controller (second parameter). Messages are only received from identifiers entered using `CANSETFILTER` and `CANEVENT`. This command can be used to debug the controller with the CAN bus, in the absence of a separate CAN bus analyzer.

`CANEVENT a b c d e f` configures a CAN bus event to which the controller will respond. If messages are received in the sequence and format defined by this command, the controller emulates a control-button press and changes the glass operating mode according to the active control settings. Command parameters:

(a) Type of event:

1 is a repeated message from one address (identifier), such as pressing and releasing a button in a car.

2 - messages from different addresses (identifiers) in a certain order. For example, successively pressing a button, turning on lighting devices, changing the settings of the electric drive of the seats.

3 - a set of messages from different addresses (identifiers).

b - identifier (address) of the source of messages. This identifier does not need to be entered in the address list specified by the `CANSETFILTER` command.

c is the byte number in the message to which the reaction occurs. Typical numbering in analysis programs is from 7 (leftmost byte) to 0 (rightmost).

d is a bit mask. It consists of 8 positions, each of which can be 0, 1 or *. If a specific position is set to 0 or 1, then an event is considered "caught" only if these positions in the message are set to such values. The symbol * in the meaning of the position means that this position is not controlled and in this position in the message can be absolutely any value. For event types 1 and 2 (parameter a), it is necessary not only to "catch" the event (button pressed), but also to receive the subsequent message from the same identifier (address) that does not fall under the mask (button released).

e is an event type modifier (parameter a):

a = 1 - e sets the number of messages "button released", after this value, a virtual "click" on the control button is generated.

a = 2 - e specifies the serial number of the message in the sequence.

a = 3 - e specifies the status of the "button"(events), if e = 1, then the message should not change until all other messages are tracked (the pressed button is not released), if e > 1, then the message that does not fall under the event filter should follow (the pressed button was released).

f is an optional parameter that allows you to set a channel (1 or 2) on a multichannel controller and thereby control each channel separately. If the parameter is not specified, then the value of 1 is used.

`CANEVENT` command examples:

`CANEVENT 1 7ff 5 *01*1*** 3 - 3 events ("clicks" on the button) from the address 7ff and 5 bytes should be 0 in 6 bits and 1 in 5 and 3 bits (counted with 0).`

In the following example, a sequence of 3 events ("clicks" on the button followed by its "release") from addresses 123, 124, 125 and, accordingly, a significant byte 5 (counted with 0):

```
CANEVENT 2 0x123 5 *0101*** 1
```

```
CANEVENT 2 0x124 5 *0101*** 2
```

```
CANEVENT 2 0x125 5 *0101*** 3
```

This example displays the setting to activate when pressing and holding one “button” and pressing with releasing another “button” (messages from the first address are the same, from the second change):

```
CANEVENT 3 0x123 5 *0101*** 1
```

```
CANEVENT 3 0x124 5 *0101*** 2
```

Addresses can be specified as 0x123 or just 123. In addresses where letters are used (hexadecimal notation), you can use both lowercase and uppercase letters.

CANSETTIMEOUT x - The command sets a timeout in seconds to execute sequences of "catch" events and means the time from the first event in the sequence to the last. The default value is 10 seconds.

CANPRINTEVENTS displays the events configured with CANEVENT.

CANCLEAREVENTS x - The command clears the specified events by the CANEVENT command on the channel specified by x. If x is omitted, channel 1 is used.

Command Mode

In addition to the usual control mode via buttons or encoder, command mode allows you to control the controller via an external device by transmitting commands via a serial port or over a CAN bus.

Command mode can operate in either Master or Slave mode. In Master mode, the controller transmits mode-switching commands. In Slave mode, the controller receives and executes those commands.

When controllers operate in Master/Slave mode, their operating-mode settings must be identical to prevent desynchronization.

Command Mode via the Serial Port

Only two controllers may be connected in serial-port command mode. One must be configured as the Master and the other as the Slave. The Master receives input from its connected pushbuttons, encoders, or switches. The Slave executes commands received from the Master through the USART-UART connection as though the same input had been applied locally. Operating controls connected directly to the Slave may therefore desynchronize the two controllers.

To connect the two controllers, it is necessary to connect their standard USART-UART connectors with the crosshairs of the TX-contact of the “Lead” controller and the RX-contact of the “Lead” controller. Contacts RX “Master” and TX “Vedomoy” remain unconnected. Contacts 3.3 V, if any, should not be connected. GND contacts must be connected.



Figure 2. Cross-connected UART link between two controllers: Master on the left, Slave on the right.

When connecting controllers through the serial port command mode, it is necessary to use a reliable connection, use a shielded cable and place it away from sources of interference. If there is instability of two controllers connected in command mode via a serial port, it is necessary to check the quality of the conductor used for the connection, reduce the total length of the USART-UART cable or switch to another type of connection for the command mode.

Enable, change, or disable serial-port command mode from the user-settings context using SETCOMMANDMODE. Use SETCOMMANDMODE 2 for Master mode, SETCOMMANDMODE 3 for Slave mode, and SETCOMMANDMODE 0 to disable command mode.

In the event of a command impulse on the "Main" controller, it sends the corresponding control sequence to the serial port. The sequence consists of 10 bits, where each bit can take a value of 1 or 0. Numbering starts on the left. Assignment of sequence bits:

- 09 – the switch button is released;
- 08 – the off button is released;
- 07 - button pressed;
- 06 - the switch is switched off;
- 05 - the switch is switched on;
- 04 – turn the encoder to the right;
- 03 – turn the encoder to the left;
- 02 - button released;
- 01 - button pressed;
- 00 – channel number (0 – channel 1, 1 – channel 2).

All bits starting with 1 and ending with 9 take the value of 1 only in the event of an event. Otherwise, the corresponding bits remain zero. Examples of command mode operation on the "Main" controller:

- 0000001001 – turn the encoder left on channel 2;
- 0000010001 – turn the encoder right on channel 2
- 0000000011 – a button is pressed on channel 2;
- 0000000101 – a button on channel 2 is released;
- 0000000010 – a button is pressed on channel 1;
- 0000000100 – a button on channel 1 is released;
- 0010,000,000 – The button on channel 1 is pressed.

Command Mode via the CAN Bus

CAN bus command mode supports more controllers and is more reliable than serial-port command mode. On the CAN bus, a controller may operate as a Master and broadcast its state, or as a Slave and monitor the bus for changes in control messages from the Master. As with serial-port command mode, the Master may also be an external device that transmits control messages in response to defined events.

Enable CAN bus command mode from the user-settings context with `CANSETCOMMANDMODE`. Specify the operating mode and the CAN device identifier (address). Use a valid standard or extended identifier, as selected for the vehicle CAN bus, and ensure that this identifier is unique on the bus. Examples:

```
CANSETCOMMANDMODE 0 - disabling command mode using CAN bus;  
CANSETCOMMANDMODE 2 111 - enable Master mode with identifier 111 (standard addressing);  
CANSETCOMMANDMODE 3 111 - enable Slave mode with identifier 111 (standard addressing).
```

When enabling Slave mode, specify the identifier (address) of the Master device.

The first parameter of `CANSETCOMMANDMODE` is the CAN bus command mode:

- 0 - Mode off;
- 1 - reserved;
- 2 - Master mode; transmits its state to the CAN bus;
- 3 - Slave mode; monitors the CAN bus.

The second parameter identifier (address). In the case of the "Master", this is the address from which the broadcast will be conducted. When choosing an address, it must be unoccupied in the tyre of the particular vehicle. In the case of Vedomosti, this is the address from which command mode messages (packets) will be expected to be received.

The command mode message takes 8 bytes with the following byte distribution, numbered on the right:

- 6+7 – Encoder state on channel 2
- 5 – the state of the algorithm on channel 2;
- 4 – channel number = 2, second channel;
- 2+3 is the encoder state on channel 1.
- 1 is the state of the algorithm on channel 1;
- 0 = channel number = 1, first channel.

In the case of a single-channel controller, bytes from 4 to 7 are zero. Examples of command mode messages on CAN bus:

- 00 00 00 02 00 00 00 01 – channels 1 and 2 are disabled;
- 00 00 03 02 00 00 06 01 – channel 1 is in the 6th stage of the control algorithm, channel 2 is in the 3rd stage of the control algorithm;
- 00 02 06 02 00 00 06 01 – Channel 1 is in the 6th stage of the control algorithm, channel 2 is in the 6th stage of the control algorithm and encoder is in position 2.

When using a single-channel controller, such as the KDS-2 Mini or KDS-2 Nano, the 4-7 bytes remain zero. The frequency of publication of the command mode message by the "Master" controller is set by the frequency of sending messages about the status of the controller (CANSETSTATTIMER command).

DIFFERENCES BETWEEN THE CONTROL ALGORITHMS

In the KDS-2 family controllers, several electrochromic glass control algorithms are implemented. The choice of the algorithm and its configuration is carried out by the manufacturer of electrochromic glass and is made in accordance with the characteristics of the load at the manufacturer's factory. The current algorithm used to control the glass is displayed when the controller is initially loaded or when the STAT command is called. The following algorithms are available:

Simple is the simplest algorithm that provides the minimum possible set of tools for controlling electrochromic glass and is intended for use in stationary conditions, for example, in a laboratory or in a demonstration room.

SmartSimple is a further development of the Simple algorithm using temperature adjustment (increase and decrease) of the load supply voltage.²

BlackJack is an improved electrochromic glass control algorithm that provides the highest performance due to a slight, about 20%, reduction in the controller's resource.³

Since each controller is equipped with several electromechanical relays, it is normal to have light clicks when switching some modes.

² Actual stress on a load depends on many factors, not just temperature.

³ The resource of the controller is determined by the resource of the electromechanical relays used. Normal algorithms switch relays twice per tinting/clearing cycle. Automotive-grade relays used in controllers have at least 100,000 failure cycles, so the minimum number of tinting/clearing cycles is 50,000 cycles. And even a 20% reduction in life leaves at least 40,000 cycles, which is more than enough for daily use for a long period.

CONTROL INPUTS

Controller modes may be changed using pushbuttons, switches, encoders, USART, or CAN. On a dual-channel controller, one pushbutton or encoder may control both channels simultaneously using ONEBUTTON or ONEENCODER. The pushbutton or encoder may be connected to either channel. A pushbutton and encoder may be connected in parallel to the same channel, or an encoder with an integrated pushbutton may be used.

The controller supports both momentary pushbuttons and latching buttons or switches. To use a latching control, configure USEROCKERSWITCH. ALWAYS MAX 1 is recommended with a latching control; this limits operation to the maximum-transparency and maximum-tint states without intermediate tint levels.

On request, the controller may be supplied with a Well Buying PS001-N11NAWURUG momentary pushbutton or equivalent, featuring an integrated two-color LED. Other compatible pushbuttons may be used. Before vehicle installation, verify clean, reliable button operation. If a press skips an operating mode, increase the debounce interval using parameter z of the BUTTON command. Parameter y sets the press duration recognized as a long press. On a dual-channel controller, a long press of both channel buttons starts demo mode.

When using encoder, the encoder type is configured. It can be either full-step or half-step. Full-step encoder in one click of the turn of the pen encoder transmit two pulses to the controller, half-hearted only one pulse. When using an encoder with a different type of setting in parameters, it is possible either to jump through the steps of the algorithms, or there is a need for more revolutions of the encoder shaft to trigger the transition of the algorithm to the next step. When properly configured, it may be necessary to additionally set the number of revolutions of the encoder shaft necessary to carry out the transition of the controller control algorithm to the next step. When using a small pen, encoder is recommended to set an increased value, and when using a large one, on the contrary, a reduced one. Together with the controller, at the request of the consumer, encoder PEC12R-4220F-S0024 produced by Bourns or their analogue can be supplied.

In addition to buttons and encoder, the movement between the stages of the control algorithm can be carried out using signals from an external remote control unit. The external remote power supply can be equipped with both pulsed relays (simulation of button pressing) and stable relays (simulation of switch operation). Connecting relay outputs is similar to connecting buttons. Parallel connection of buttons, encoder and remote control units is allowed.

When connecting buttons, they must be connected to the outputs of the GND and encoder C controllers (see Appendix 1). When encoder is connected, the connection is made to the outputs of GND, encoder C (for encoder with a push button), encoder B, encoder A.

To indicate the state of the controller, it is possible to use LEDs with a consumption current of up to 20 mA. As a rule, green and red LEDs connected on the opposite side are used.

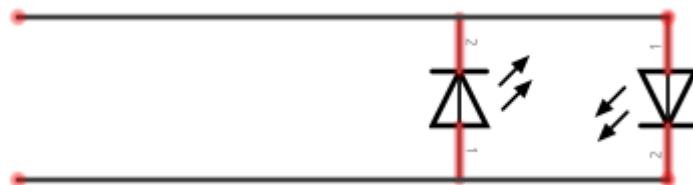


Figure 3. Indicator LED wiring diagram.

Connect the LEDs to the controller terminals labeled LED.

CONTROLLER OPERATING PROCEDURE

Under the influence of external control, for example, pressing buttons, or after the expiration of internal timers, the controller performs the transition procedures through the internal stages of the electrochromic

glass control algorithm. Depending on the algorithm used, the number of steps can be different. The current state of the controller terminals, as well as the step of the glass control algorithm, can be obtained by calling the STAT command.

Stage 0 corresponds to maximum glass transparency, with no voltage applied. Pressing the control button or rotating the encoder advances the controller to the maximum-tint stage. For pushbutton control, press the button once. For encoder control, rotate it by the configured number of detents in the direction that increases tint. This direction depends on how the encoder A and encoder B terminals are wired.

Each push of the button is accompanied by a visual confirmation LED indicator and a built-in buzzer signal. If the operation requested by the user is currently unacceptable, then there is an audible confirmation of the impossibility of performing the operation. The change in state when turning encoder is accompanied only by sound accompaniment. When the maximum or minimum state is reached when using encoder, a double confirmation signal is provided, in other cases, if the voltage supply mode is turned on on the electrochromic glass, a single confirmation sound signal is provided, in other cases, the rotation of the encoder shaft does not cause a change in state and, accordingly, there is no confirmation indication.

When using several degrees of tinting glass, the subsequent pressing of the control button will transfer the controller algorithm to the stage that provides the average state in terms of the degree of tinting electrochromic glass. Another tap will switch the controller to the lower tinting step. The next tap will put the controller algorithm into accelerated clearing mode. During Accelerated Clearing, the controller cannot be transferred to any other mode until the procedure is completed. During the accelerated clearing procedure, the LED light flashes.

When changing the degree of tinting of glass, it is necessary to take into account that the actual change in the state of the degree of tinting of glass does not occur instantly, it takes some time to change the state of the degree of tinting.

When the controller binary control mode is enabled, when only maximum transparency and maximum dimming mode are available, the controller algorithm can only switch between these two modes sequentially (also including accelerated clearing mode).

If no voltage is applied to the controller, it is transferred to the smooth clearing glass mode.

InfinityTint

InfinityTint is the proprietary technology of Octoglass for smooth and accurate adjustment of the required level of light transmission electrochromic glass. This technology is used when using encoder in conjunction with buttons or using encoders with an additional button function.

Change tinting glass with InfinityTint technology or three-step change through the control button does not give a full gradient of light transmission contrast. The tinting can be changed only in a certain range: from the maximum depth to a certain level at which the tinting uniformity is maintained. This range is set by the manufacturer and depends on the design of the glass, its geometry and the characteristics of the electrochromic material used.

When using the InfinityTint function, push buttons, including the encoder button, are used to turn on and off tinting glass modes. The encoder is used to change the depth of tinting glass within the limits possible for this product.

When using InfinityTint, verify the encoder-type setting and configure the tint-level adjustment resolution with the INFINITYTINT command. Higher parameter values provide finer adjustment. Changing tint depth takes time; the selected tint level is reached only after the switching process is complete.

Encoder rotations affect the degree of tinting depth only in accelerated tinting or tinting glass maintenance modes. In these modes, when turning encoder, sound confirmation of the turn of the encoder shaft is performed. When the minimum or maximum set of tinting levels is reached, double audible confirmation is used.

On dual-channel KDS-2 controllers, it is allowed to share a button with a fix or switch and an encoder. In this case, for proper operation, the encoder connects to one channel and the switch to another. Additionally,

control modes for one button, one encoder and switch control are included. On KDS-2 Mini single-channel controllers, sharing a lock button or switch and encoder is not possible.

Relaxation Procedure

After the manufacturer-defined maximum continuous tinting time, the controller disconnects the electrochromic glass to prevent degradation. This mandatory process is called the relaxation procedure and is not a fault. The maximum operating time is stated in the glass datasheet and is also shown by the STAT command. When relaxation begins, the glass may be switched back to tinting mode if required.

Automatic Tinting Procedure

Using the AUTOTINTAFTER X Y command of the user context, an automatic tinting glass mode can be set when it is connected to a controller that is under constant power but not in use for a long time. Automatic tinting is activated X hours after the last windows are turned off or the controller is turned on for Y minutes. This feature is designed to maintain the maximum speed of tinting glass in rare use. When using the function, constant power on the controller is required.

FAULTS AND EMERGENCY CONDITIONS

Controllers KDS-2, KDS-2 Mini, KDS-2 Nano are complex electronic devices designed for the safe management of electrochromic glass. Safety is ensured not only through the use of specialized algorithms, but also thanks to a variety of sensors that minimize the occurrence of dangerous situations.

The device constantly monitors the voltage of its power supply. In the event that the supply voltage falls below the value set by the MINFEEDINGVOLTAGE command for 30 seconds, the controller stops any voltage generation and blocks its inclusion. The mode is confirmed by an LED indicator. When the supply voltage is restored to the normal level, the emergency mode is turned off and the possibility of switching the controller control algorithms is unlocked. This condition is not erroneous or emergency and is intended to protect the vehicle battery from discharge.

The controller uses automotive-grade components and supports a wide operating-temperature range. Its internal temperature may nevertheless exceed ambient temperature by at least 10 °C. If controller temperature falls below or rises above the permitted range, voltage generation stops and remains locked out until temperature returns to normal; the LED indicates this condition. Install the controller away from heaters and from direct hot or cold airflow.

electrochromic glass is a complex technical product, the long-term and trouble-free operation of which depends on many factors, one of which is the permissible temperature conditions of operation. Since the controller is customized for a specific electrochromic glass, the temperature limits at which the glass can be used are also set by the manufacturer. If the glass temperature goes beyond the established limits, the generation of voltage for the glass is blocked, and the glass itself is detonated. Blocking is confirmed by an LED indicator. When the glass temperature is restored to the permitted range, the lock is removed. The temperature limits of electrochromic glass performance are indicated in the product passport.

Controllers KDS-2, KDS-2 Mini, KDS-2 Nano are equipped with hardware protection (ATAC) from the supply of increased voltage to electrochromic glass, as well as from overcurrent at load outputs (for example, with a short circuit that can lead to fire). When any of these events occur, voltage generation is turned off and does not resume until the controller is restarted. The operation of hardware protection is an fault condition for the controller and it is recommended to visit an installer to fix a potential problem.

A harbinger of a short circuit may be a break of contacts to the glass. In this case, even before the short circuit occurs, an error associated with an unconnected electrochromic glass may occur. The error is confirmed by the LED indicator, and the voltage generation on the affected channel is turned off before the controller is restarted.

If the external sensors of the voltmeter are incorrectly connected (for example, polarity is confused), it is impossible to correct the generated voltage. Under any generation conditions, the controller will receive incorrect data about the actual voltage. If such a situation is detected, the generation on the affected channel is turned off before the controller is restarted.

The controller firmware is designed with the best practices of software development for the transport industry in mind and undergoes multiple checks before being installed in the controllers. However, in some situations, such as the degradation of the controller microchips, the presence of previously undetected hidden manufacturing defects in the chips, errors in the hardware platform, etc., it is possible incorrect behavior of the controller, leading to its “hang”. In this case, in order to avoid possible damage to the connected electrochromic glass, the controller is rebooted with the power generation turned off, if any, at the time of “hang”.

If a non-critical error occurs, the action of which extends to the moment before the elimination of the factor that led to the error, a contrast LED indicator is turned on and 5 error signals are given. If an error occurs, which can only be turned off when the controller is restarted, the contrast LED indicator is turned on and 10 error signals are sent. The reboot of the controller can be carried out both by means of the REBOOT command submitted via USART, and when the controller power is turned off and re-enabled. Information about accumulated errors can be obtained through the INFO command.

APPENDIX 1. DIAGRAMS

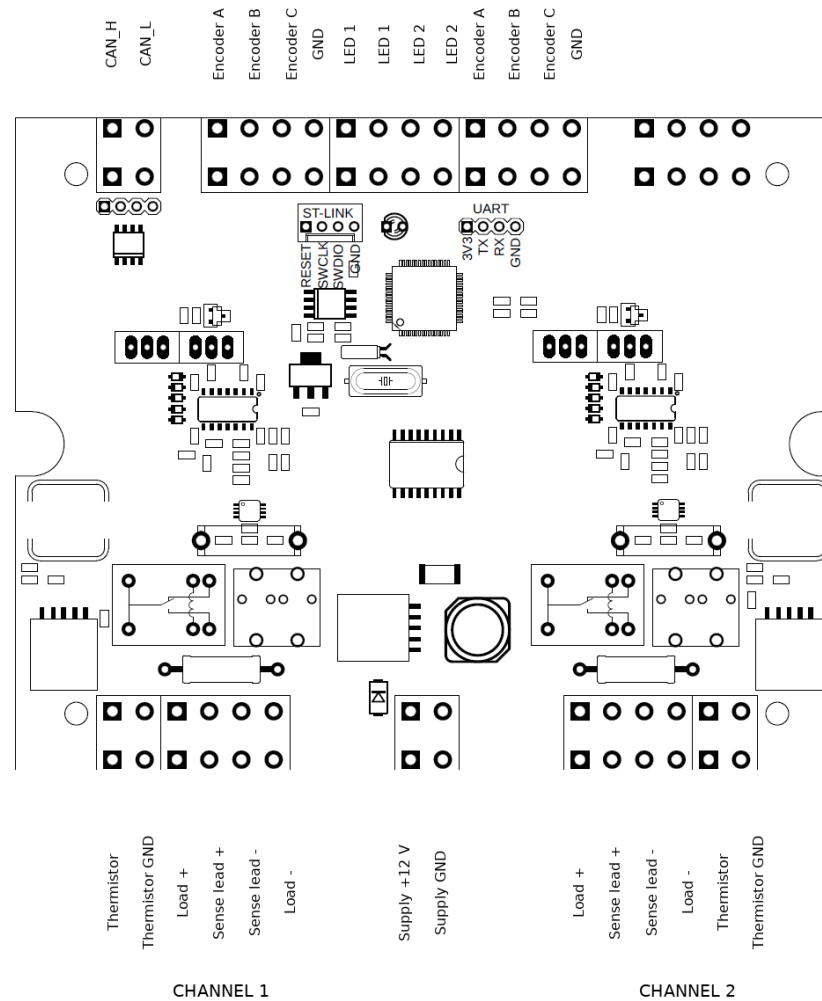


Figure 4. KDS-2 controller pinout.

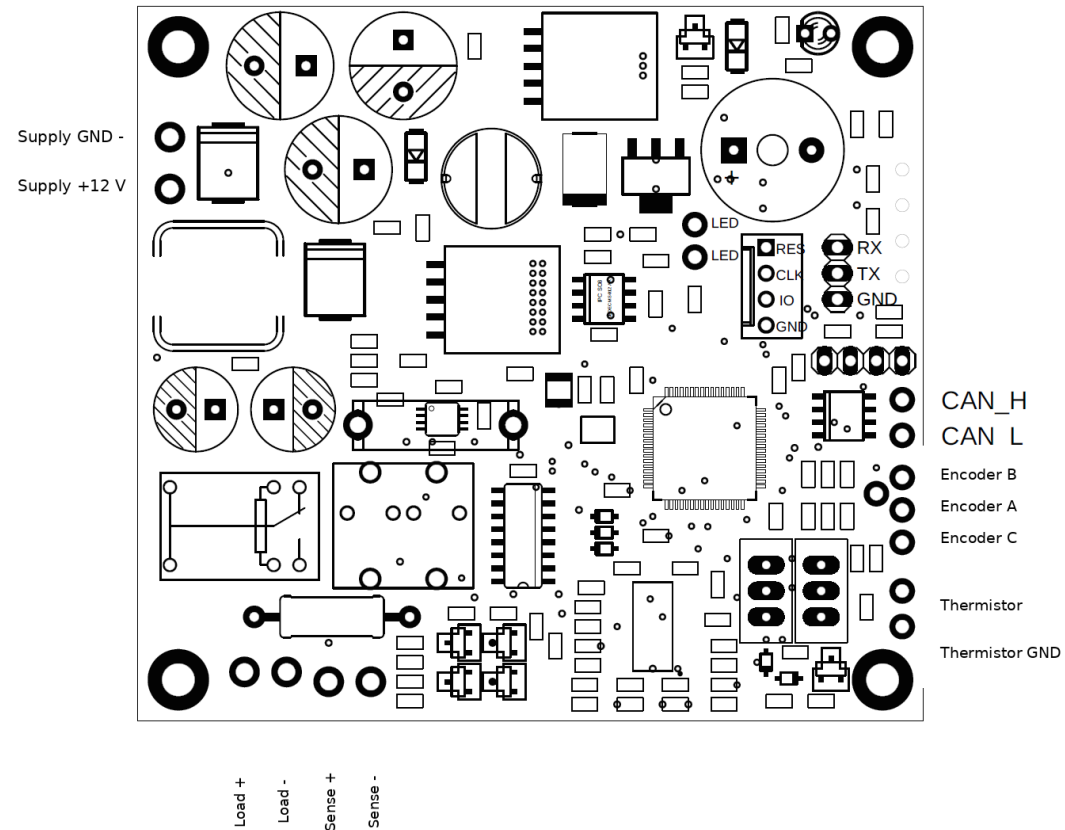


Figure 5. KDS-2 Mini revision 2.1 controller pinout.

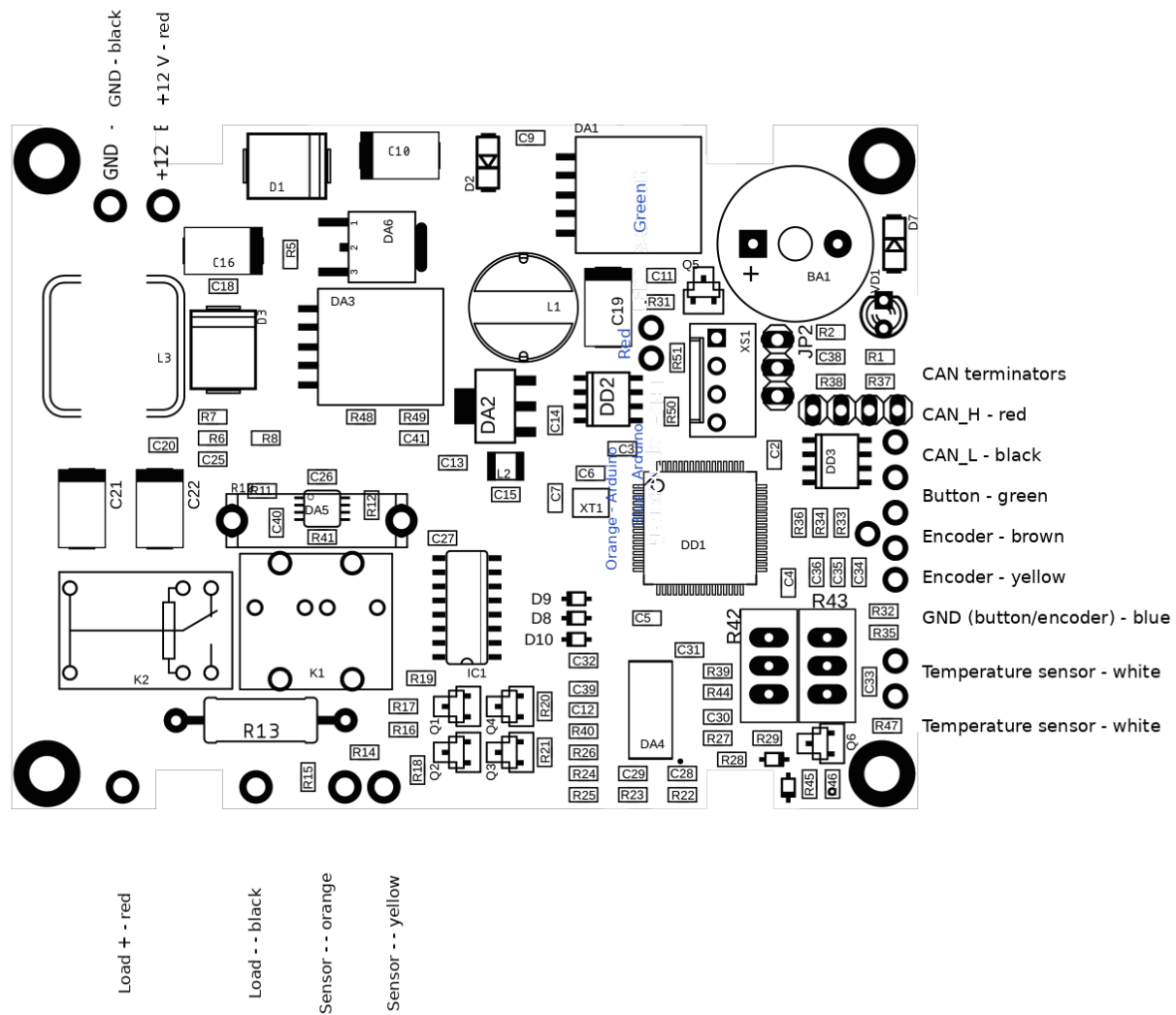


Figure 6. KDS-2 Mini revision 2.2 controller pinout.

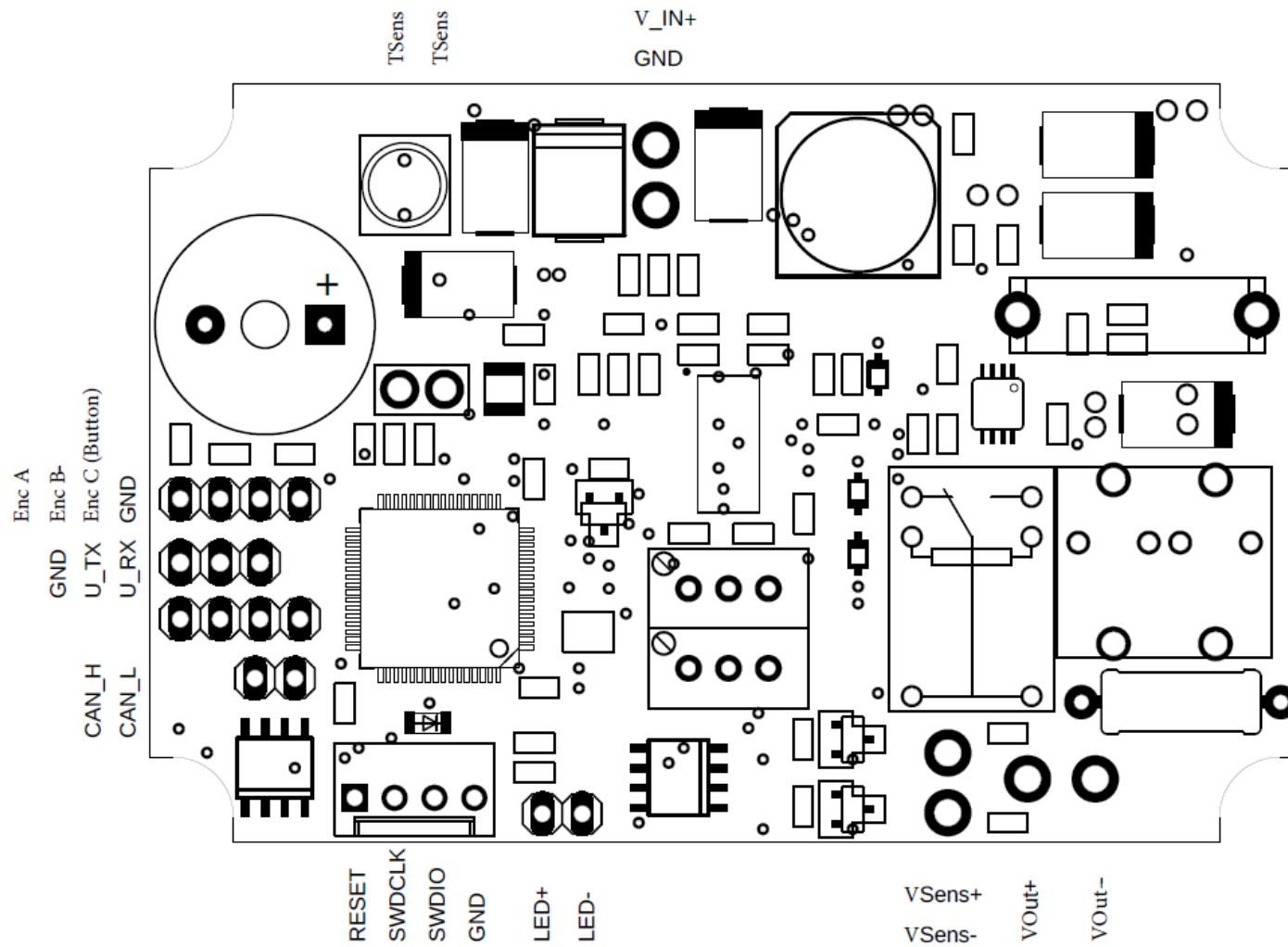


Figure 7. KDS-2 Nano wiring diagram.

Octopus KDS-2 Nano 2026 (Nano Rev 4.0)

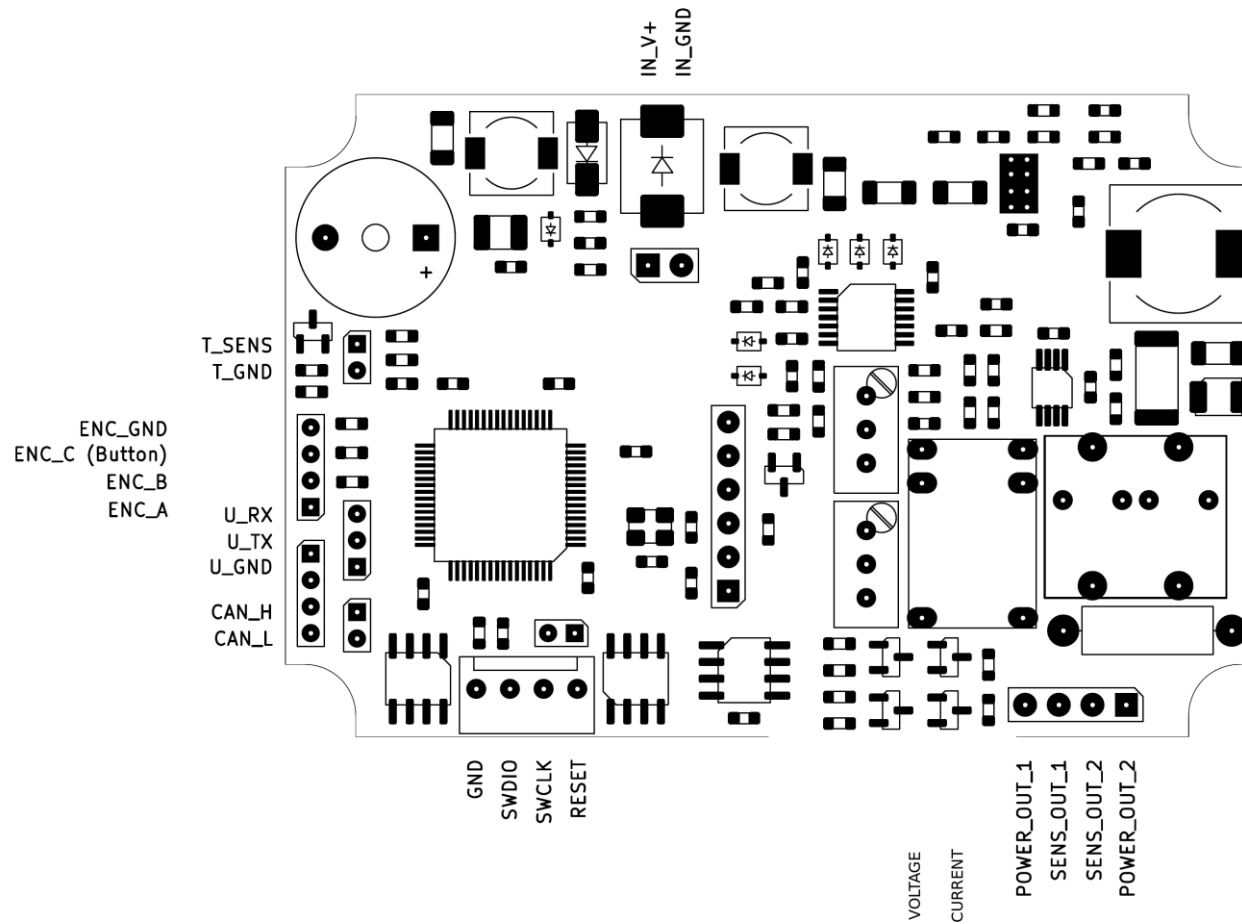


Figure 8. Octopus KDS-2 Nano 2026 (Nano Rev 4.0) controller pinout.

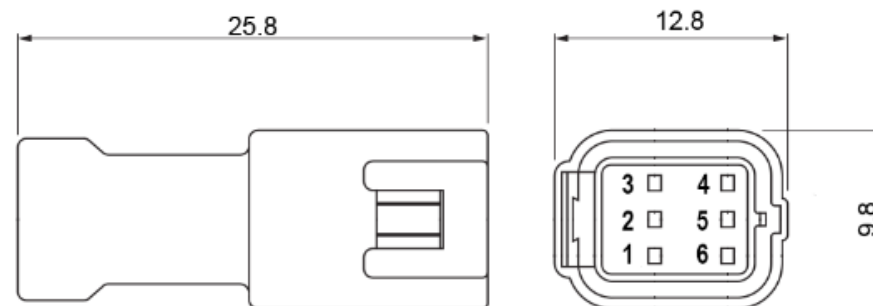
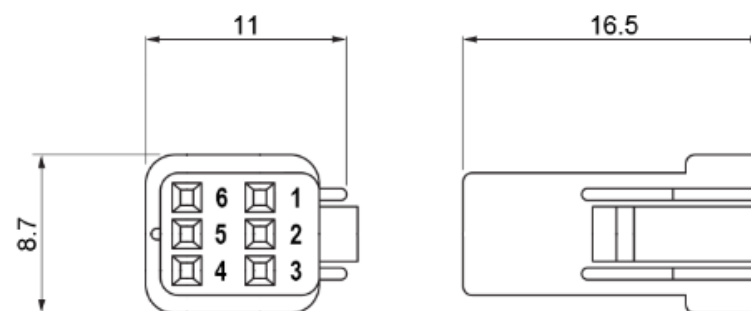
06T-JWPF-VSLE-D**06R-JWPF-VSLE-D**

Figure 9. Pin assignment for 06R-JWPF-VSLE-S and 06T-JWPF-VSLE-S connectors.

Table 1. Basic pin assignment for JWPF-VSLE connectors

Pin No.	Function	Wire color
1	Load +	Pink
2	Voltage sense +	Red
3	Temperature sensor	Green
4	Temperature sensor	White
5	Voltage sense -	Black
6	Load -	Brown

APPENDIX 2. CAN BUS MESSAGES

Controller Status Message Structure

The controller status message takes up 9 messages transmitted sequentially over the CAN bus. Messages differ by address identifier starting from the address established through CANSETTXID. The numbering of bytes begins from right to left, the zero byte is the rightmost.

Table 2. Description of byte status messages of the controller

Identifier address	Byte number	Meaning
CANSETTXID + 0	0	Time elapsed from the start of the controller, with
	1	
	2	
	3	
	4	Controller CPU supply voltage, mV
	5	
	6	Controller supply voltage, mV
	7	
CANSETTXID + 1	0	Error of supply voltage: 0 - no error, 1 - low voltage
	1	Controller CPU temperature error: 0 - no error, 1 - CPU overheating, -1 - hypothermia
	2	Controller CPU temperature in degrees Celsius
	3	
	4	Current mode of demonstration: 0 - disabled, 1 - enabled
	5	Enabling demonstration mode at start-up: 0 – disabled, 1 – enabled
	6	Bitmask (possibly a combination of bits) command modes: 00000000 – all modes are disabled; 00000010 – “Main” command mode is enabled via serial port; 00000011 – Enabled command mode via serial port; 00010000 – “Lead” command mode is enabled via CAN bus; 00011000 – Enabled command mode via CAN bus; Example: 00100011 - Enables "Main" command mode via CAN bus and "Wed" via serial port.
	7	Control algorithm used: 0 – control disabled, 1 – Simple, 2 – SmartSimple, 3 – BlackJack.
CANSETTXID + 2	Channel 2	
	0	Reserved.
	1	Bitmask error: 00000 - no errors; 00000001 - Unknown error 00000011 - overheating of glass; 00000101 - supercooling of glass; 00001001 – The ATAC system is activated.

Identifier address	Byte number	Meaning
	2	Bitmask of voltage and polarity: 00000000 – voltage generation is turned off and negative polarity is turned on; 00000001 – Voltage generation is enabled and negative polarity is enabled; 00010000 – voltage generation is turned off and positive polarity is turned on; 00010001 – Voltage generation is enabled and positive polarity is enabled.
	3	Stage of the power algorithm
	Channel 1	
	4	Reserved.
	5	Bitmask error: 00000 – no errors; 00000001 - Unknown error 00000011 - overheating of glass; 00000101 - supercooling of glass; 00001001 – The ATAC system is activated.
	6	Bitmask of voltage and polarity: 00000000 – voltage generation is turned off and negative polarity is turned on; 00010001 – Voltage generation is enabled and positive polarity is enabled; 00010000 – voltage generation is turned off and positive polarity is turned on; 00010001 – Voltage generation is enabled and positive polarity is enabled.
	7	Stage of the power algorithm
Channel 1		
CANSETTXID + 3	0	Time to relaxation procedure in minutes
	1	
	2	
	3	Glass temperature, in degrees Celsius
	4	
	5	Current, ma.
	6	
	7	Voltage, mV
CANSETTXID + 4	0	Total charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	1	
	2	
	3	
	4	Charge accumulated by the glass during accelerated tinting, in coulombs. The value is represented as a floating-point number.
	5	
	6	
	7	
CANSETTXID + 5	0	Negative charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	1	
	2	
	3	

Identifier address	Byte number	Meaning
	4	Positive charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	5	
	6	
	7	
Channel 2		
CANSETTXID + 6	0	Time to relaxation procedure in minutes
	1	
	2	Glass temperature, in degrees Celsius
	3	
	4	Current, ma.
	5	
	6	Voltage, mV
	7	
CANSETTXID + 7	0	Total charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	1	
	2	
	3	
	4	Charge accumulated by the glass during accelerated tinting, in coulombs. The value is represented as a floating-point number.
	5	
	6	
	7	
CANSETTXID + 8	0	Negative charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	1	
	2	
	3	
	4	Positive charge accumulated by the glass, in coulombs. The value is represented as a floating-point number.
	5	
	6	
	7	

For multi-byte values, the least-significant byte is transmitted first (little-endian byte order). For example, message data 3F 0A 00 00 C8 0C 58 2F from address CANSETTXID + 0 contains operating time 3F 0A 00 00. Reverse the byte order to 00 00 0A 3F, then convert from hexadecimal to decimal: 2623 seconds. Likewise, microcontroller supply voltage C8 0C becomes 0C C8, or 3272 mV. The remaining value 58 2F becomes 2F 58, or 12,120 mV controller supply voltage. In another example, CANSETTXID + 4 contains 0A D7 63 3F B8 1E C5 3F. Bytes 0-3, B8 1E C5 3F, represent 1.54 coulombs; bytes 4-7, 0A D7 63 3F, represent 0.89 coulombs. Decode each value as a standard 4-byte IEEE 754 floating-point number using its exponent and mantissa.⁴

In the case of a single-channel controller, CANSETTXID + 6, CANSETTXID + 7 and CANSETTXID + 8 are not transmitted.

⁴ For translation, for example, you can use an online calculator (<https://gregstoll.com/~gregstoll/floattohex/>).

Controller Operating-Hours Message Structure

The controller status message takes up 9 messages transmitted sequentially over the CAN bus. Messages differ by address identifier starting with the address established via CANSETTXID + 10. The numbering of bytes begins from right to left, the zero byte is the rightmost.

Identifier address	Byte number	Meaning
CANSETTXID + 10	0	Number of controller launches
	1	
	2	
	3	
	4	Operating controller in 15 minute intervals Number of controller starts
	5	
	6	
	7	
CANSETTXID + 11	0	The number of controller freeze protections and error states (Watchdog).
	1	
	2	
	3	
	4	Number of automatic reboots
	5	
	6	
	7	
CANSETTXID + 12	0	Number of overheating of the controller CPU
	1	
	2	
	3	
	4	The amount of cooling of the controller CPU
	5	
	6	
	7	
Channel 1		
CANSETTXID + 13	0	Number of ATAC errors
	1	
	2	
	3	
	4	Number of 'glass not connected' errors
	5	
	6	
	7	
CANSETTXID + 14	0	Number of incorrect-glass-connection errors
	1	
	2	
	3	
	4	Number of glass overtemperature errors
	5	
	6	
	7	
CANSETTXID + 15	0	Reserved.
	1	
	2	
	3	
	4	Number of glass undertemperature errors
	5	
	6	
	7	
Channel 2		

Identifier address	Byte number	Meaning
CANSETTXID + 16	0	Number of 'glass not connected' errors
	1	
	2	
	3	
	4	Number of ATAC errors
	5	
	6	
	7	
CANSETTXID + 17	0	Number of glass overtemperature errors
	1	
	2	
	3	
	4	Number of incorrect-glass-connection errors
	5	
	6	
	7	
CANSETTXID + 18	0	Reserved.
	1	
	2	
	3	
	4	Number of glass undertemperature errors
	5	
	6	
	7	

In the case of a single-channel controller, CANSETTXID + 16, CANSETTXID + 17 and CANSETTXID + 18 are not transmitted.