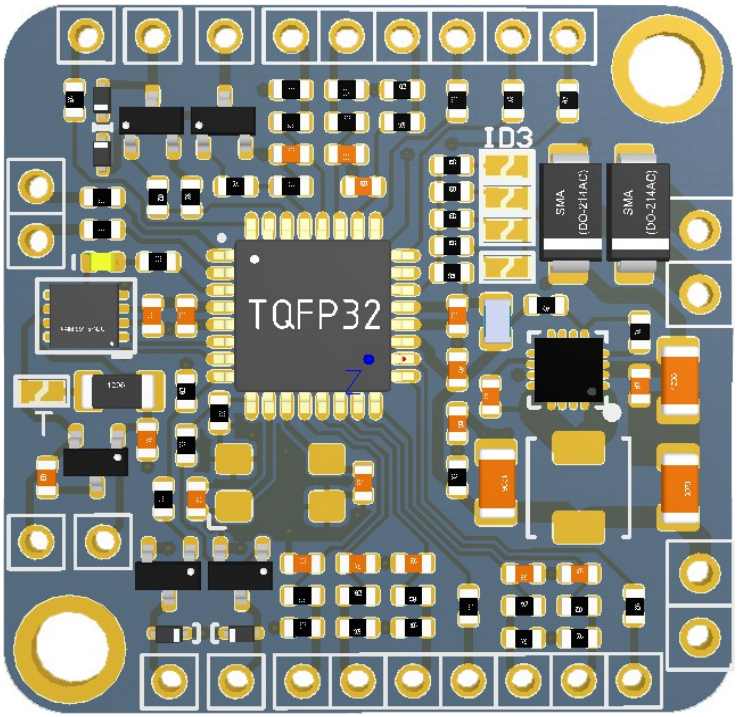
CAN SWITCH BOARD
V3



Version 1.3

PRODUCT INFORMATION

CAN switch board is a device that sends information about state of the following channels via CAN Bus:
- 8 switch inputs (switched to ground),
- 8 analog inputs (analog voltages of signals from potentiometers, pressure sensors, resistive sensors, etc)
- 4 low side outputs

CAN switch board can be used to send information from steering wheel buttons and rotary switches, as well as an analog inputs / switches. The module also doubles as a low side output expansion for the ECU or other CAN bus compatible devices.

This manual refers to CAN switch board version 3. This hardware version is reverse compatible with version 1 (version 2 was not released commercially) along with new functionality.

SPECIFICATION	
Temperature range	AECQ GRADE1 (-40C to +125C)
Operating voltage	6-22V, immunity to transients according to ISO 7637
Analog inputs	8 analog inputs, 0-5V, 10 bits resolution, 12V tolerant
Switch inputs	8 switch inputs, switched to ground
Outputs	4 low side outpus, 0.5A resistive and inductive loads
CAN	CAN 2.0 A/B – 125, 250, 500, 1000 kbps

WARNING!

THIS PRODUCT IS INTENDED FOR CLOSED-COURSE RACING ONLY

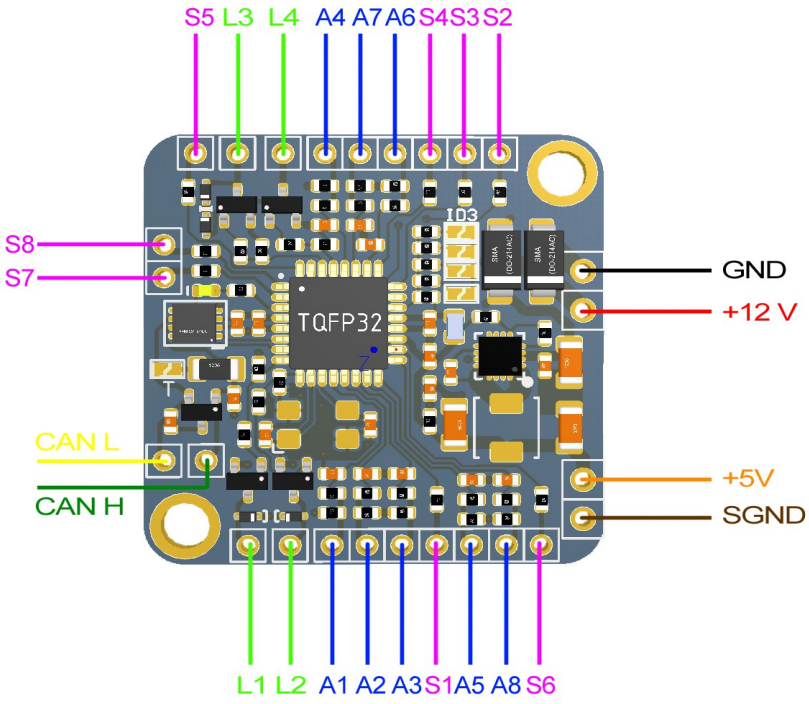
CONNECTION

The board requires +12V switched power (not constant, just when the ignition switch is on). The +5V supply terminal may be used for powering potentiometers or analog sensors. Sensor ground (SGND) should be used for switches, sensors and potentiometers. All switch inputs are active when switched to ground.

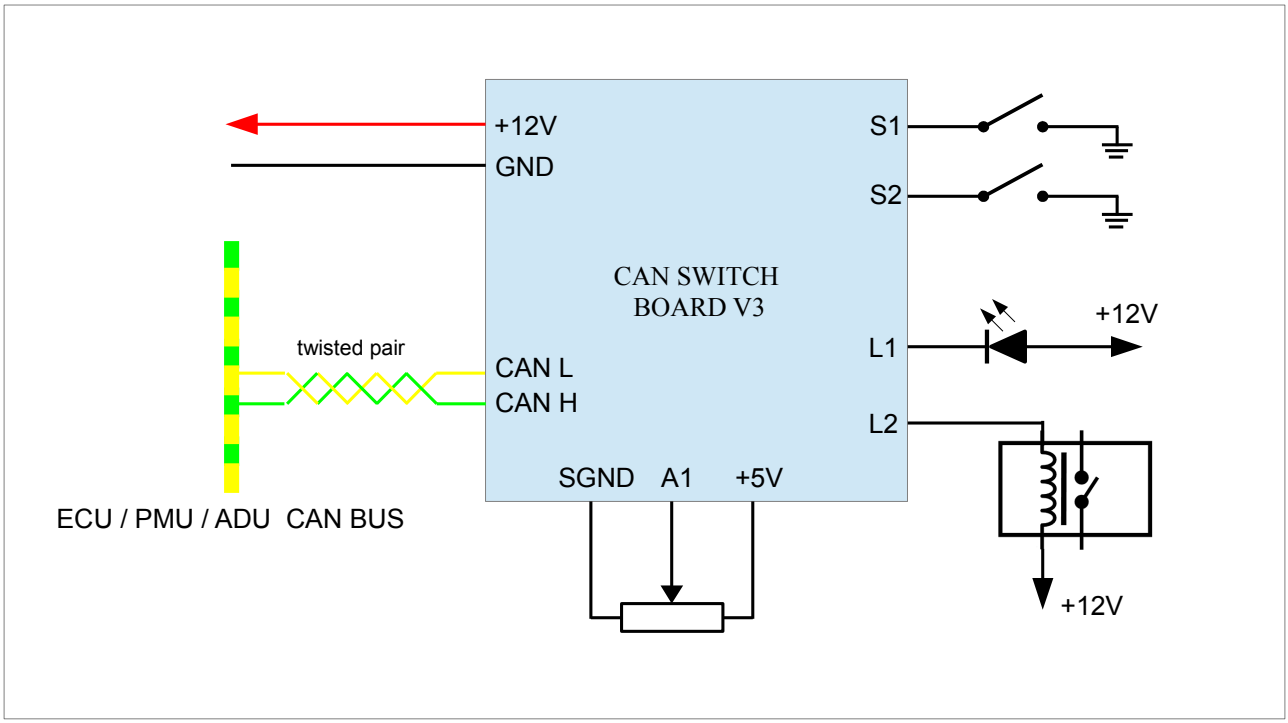
L1 - L4 - low side outputs, up to 0.5A each

A1 - A8 - analog inputs, 0-5V, 10 bits

S1 - S8 - switch inputs, switched to ground

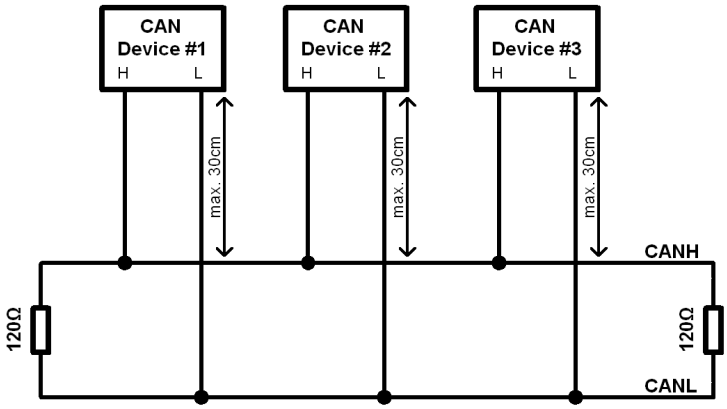


Sample connection diagram



The CAN (*Control Area Network*) bus was developed to communicate between devices in automotive environments. Its construction is very simple (only two wires) and its immunity to interference is very high. In a modern car, there may be dozens of different electronic modules communicating on a CAN bus.

Data frames are sent on the network. The network topology should look like the following:



In automotive applications, typical data transmission speeds on the CAN bus are 1Mbps, 500 Kbps and 250 Kbps. Depending on the speed, the following conditions must be met:

For a speed of 1Mbps:

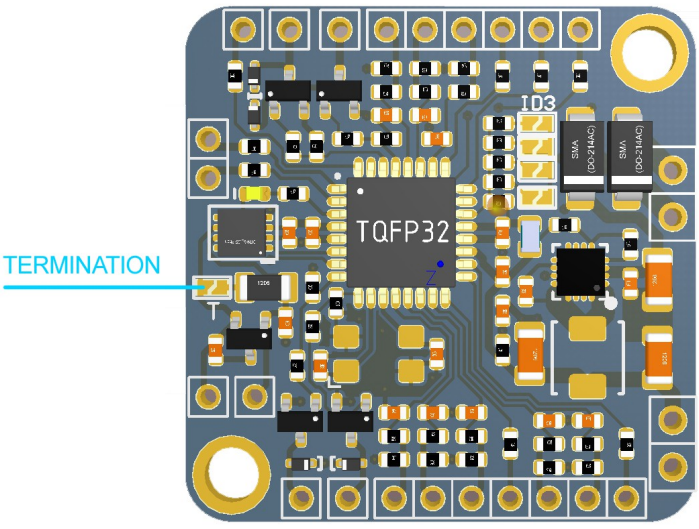
- the length of the connection cable between the bus and the node must not exceed 30 cm.
- the maximum bus length is 40 m
- the maximum number of nodes is 30

For a speed of 500kbps:

- the length of the connection cable between the bus and the node must not exceed 30 cm.
- the maximum bus length is 100m
- the maximum number of nodes is 30

Regardless of the speed, the CAN bus must have 120 Ohm termination resistors at both ends. Additionally, all connections within the bus must be made using twisted pair wires. It is critical that the data transfer speed on a bus is identical for all devices.

It is possible to enable a 120 Ohm terminator directly on the CAN Switch Board, by closing a jumper.

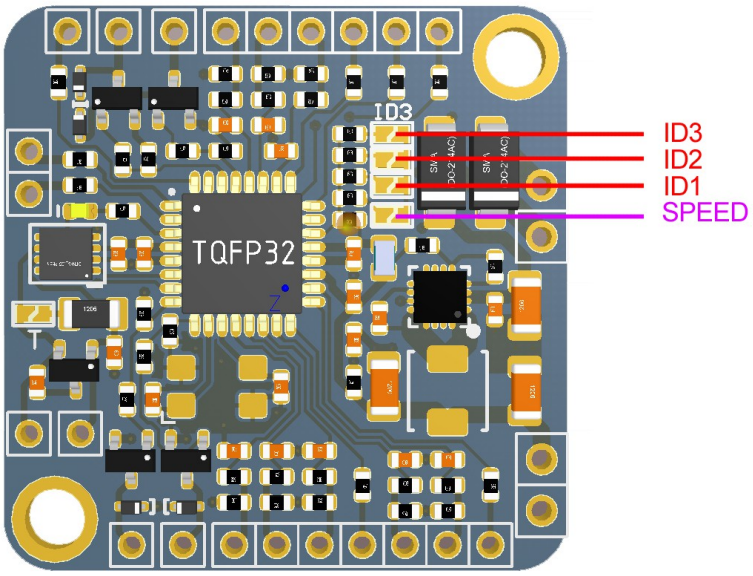


CONFIGURATION

There are two options for the device configuration: manually using solder joints, or using the Light Client application over CAN BUS. The first mode is intended for use when backward compatibility with version V1 is required, or for users who do not have access to a supported CAN interface (ECUMASTER USB TO CAN, Kvaser, Peak PCAN System). On the picture below there is a list of the available jumpers.

Jumper ID3 is responsible for entering compatibility mode. If it is open then CAN Switch Board is configurable using Light Client (speed, base ID, rotary switch configuration) software and the device sends data using new V3 data format. The default speed is 500 kbps and base ID is 0x640.

When the ID3 jumper is closed with a solder joint, the device enters backward compatibility mode and can be configured using jumpers.



ID1	ID2	ID3	Descritpion
X	X	Open	Software configuration by Ligth Client
Open	Open	Closed	Data Format 0 (comaptibile with CAN Switch Board V1)
Closed	Open	Closed	Data Format 1 (comaptibile with CAN Switch Board V1)
Open	Closed	Closed	Data Format 2 (comaptibile with CAN Switch Board V1)
Closed	Closed	Closed	Data Format 3 (comaptibile with CAN Switch Board V1)

The jumper SPEED is responsible for manual selection of the device speed. If the ID3 jumper is closed and SPEED jumper is closed, then configuration of device is possible with Light Client but a firmware upgrade is not possible. We strongly recommend using the Light Client software to configure device parameters as well as device speed.

ID3	SPEED	Descritpion
Open	Open	Speed defined by Light Client. Default 500 kbps
Open	Closed	1 Mbps fixed, no firmware upgrade possible
Closed	Open	500 kbps fixed
Closed	Closed	1Mbps fixed

BACKWARD COMPATIBILITY MODES (V1)

DATA FORMAT 0

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x334	8	Analog#1(mV)		Analog#2 (mV)		CALPOT 1	CAL POT 2	Switch mask	Heartbeat

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x335	8	CALPOT 1	SW#1	SW#2	SW#3	SW#4	SW#5	SW#6	SW#7

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x336	8	CALPOT 2	SW#8						

Parameter	Description
Analog#1	Voltage value from analog #1 input 0-5000mV, big endian
Analog#2	Voltage value from analog #2 input 0-5000mV, big endian
Switch mask	Bit mask of pressed switches (1 means pressed)
CAL POT #1	The discrete value of analog #1 input. The voltage for each value is multiplication of 384mV
CAL POT #2	The discrete value of analog #2 input. The voltage for each value is multiplication of 384mV
Heartbeat	Counter incremented every sent message

Data transmition rate is 20Hz

DATA FORMAT 1

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x334	8	Analog#1(mV)		Analog#2 (mV)		CALPOT 1	CAL POT 2	Switch mask	Heartbeat

Parameter	Description
Analog#1	Voltage value from analog #1 input 0-5000mV, big endian
Analog#2	Voltage value from analog #2 input 0-5000mV, big endian
Switch mask	bit mask of pressed switches (1 means pressed)
CAL POT #1	The discrete value of analog #1 input. The voltage for each value is multiplication of 384mV
CAL POT #2	The discrete value of analog #2 input. The voltage for each value is multiplication of 384mV
Heartbeat	Counter incremented every sent message

Data transmition rate is 20Hz

DATA FORMAT 2

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x666	8	Analog#1(mV)		Analog#2 (mV)		CALPOT 1	CAL POT 2	Switch mask	Heartbeat

Parameter	Description
Analog#1	Voltage value from analog #1 input 0-5000mV, big endian
Analog#2	Voltage value from analog #2 input 0-5000mV, big endian
Switch mask	bit mask of pressed switches (1 means pressed)
CAL POT #1	The discrete value of analog #1 input. The voltage for each value is multiplication of 384mV
CAL POT #2	The discrete value of analog #2 input. The voltage for each value is multiplication of 384mV
Heartbeat	Counter incremented every sent message

Data transmition rate is 20Hz

DATA FORMAT 3

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0xA1BA2f1	8	Analog#1(mV)		Analog#2 (mV)		CALPOT 1	CAL POT 2	Switch mask	Heartbeat

Parameter	Description
Analog#1	Voltage value from analog #1 input 0-5000mV, big endian
Analog#2	Voltage value from analog #2 input 0-5000mV, big endian
Switch mask	bit mask of pressed switches (1 means pressed)
CAL POT #1	The discrete value of analog #1 input. The voltage for each value is multiplication of 384mV
CAL POT #2	The discrete value of analog #2 input. The voltage for each value is multiplication of 384mV
Heartbeat	Counter incremented every sent message

Data transmition rate is 20Hz

NEW DATA FORMAT (V3)

The default BASE ID is 0x640 and can be changed using Light Client software

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
BASE ID	8	Analog#1(mV)		Analog#2 (mV)		Analog#3 (mV)		Analog#4 (mV)	
BASE ID+1	8	Analog#5(mV)		Analog#6(mV)		Analog#7 (mV)		Analog#8 (mV)	
BASE ID+2	8	R1	R2	R3	R4	R5	R6	R7	R8	SW_MASK	AS_MASK	LS_MASK	Heartbeat

Parameter	Description
Analog #1 to #8	Voltage value from analog #X input 0-5000mV, big endian
R1 to R8	Rotary switch position connected to the given analog input. The rotary switch position is represented by 4 bits, two rotary switches are combined in each byte.
SW_MASK	Bit mask representing state of each switch input. The switch 1 is represented by bit 0, the switch 2 is represent by bit 1, and so on
AS_MASK	Mask representing state of analog inputs. If the given analog input value is lower than 2V the representing bit is 0, else if value is higher than 3V representing bit is 1
LS_MASK	The bitmask representing the state of the low side outputs. Low side output 1 is represented by bit 0, output 2 by bit 1 and so on
Heartbeat	Counter incremented every sent message

The data transmission rate is user defined (the default value is 20Hz)

LOW SIDE OUTPUTS CONTROL

When the new data format is used (V3) the low side outputs are controlled by the message BASE ID + 3 (default value is 0x643)

The message format is:

ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
BASE ID + 3	>= 4	**L1 ctrl**	**L2 ctrl**	**L3 ctrl**	**L4 ctrl**	0	0	0	0

When the backward compatibility modes are used the control of low side outputs is as follow:
The message ID is as follow:

Base ID	LED control ID
0x334	0x434
0x666	0x766
0xA1BA2f1	0xa1ba2f2

The message format is:

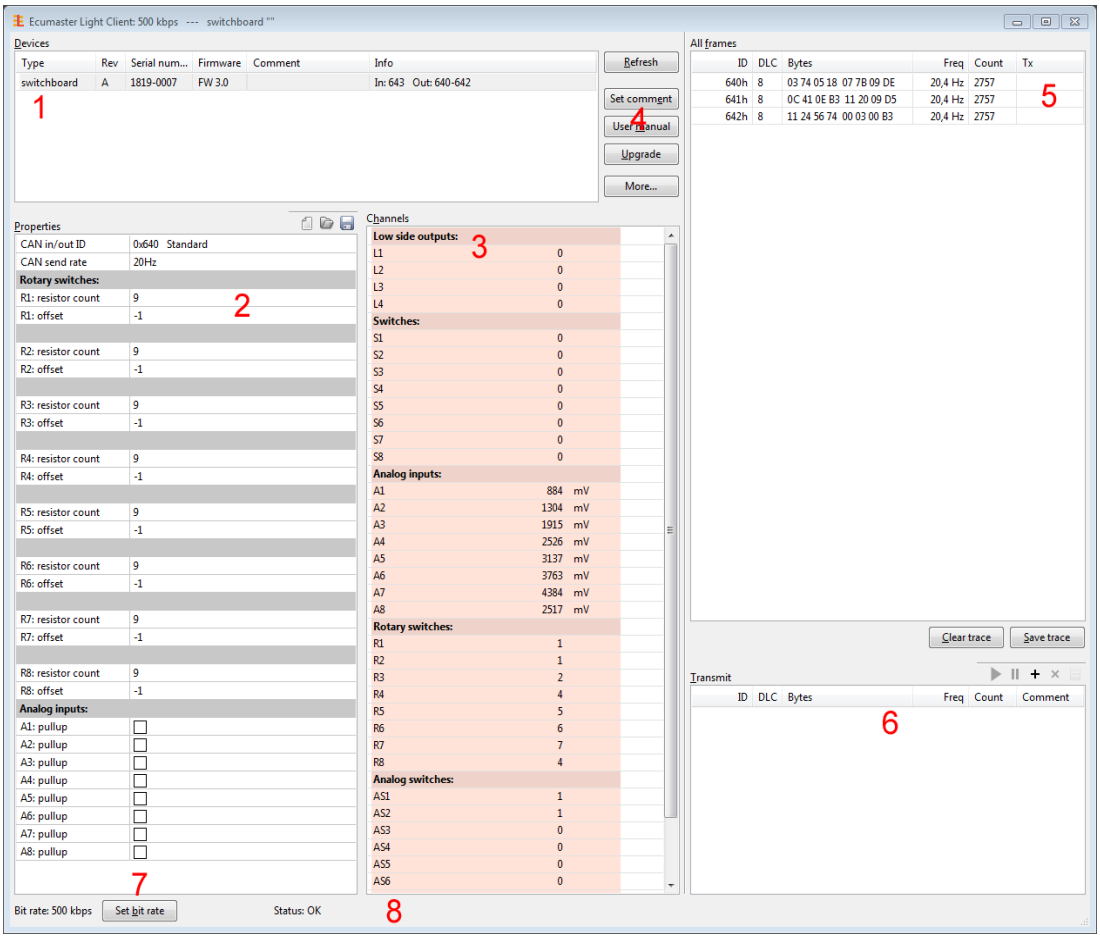
ID	DLC	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	>= 4	**L1 ctrl**	**L2 ctrl**	**L1 state**	**L2 state**	0	0	0	0

To control particular L output, L control flag must be set to 1 and then L state is set. For example:

To turn on L1: 0x766, 8, 1,0,1,0 must be send
To turn off L2: 0x766, 8, 0,1,0,0 must be send
To turn on L1 and L2 : 0x766, 8, 1,1,1,1 must be send

LIGHT CLIENT CONFIGURATION

It is possible to reconfigure the device's settings using a CAN BUS interface and the ECUMaster Light Client application. In order to do this, jumper ID 3 must be open. When the application is started and connected to the CAN Switch Board, the following screen should appear.



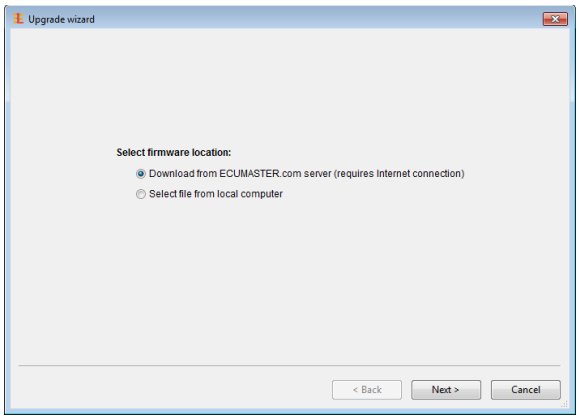
In the ***Devices*** section of the application (1) there is a list all *Light Client* compatible devices found on the given CAN BUS. There is also an information about each device with the name, hardware revision, serial number, firmware version and additional information about used CAN IDs. In this case it is: switchboard, hardware revision A, serial number 1819-0007, FW 2.1, and information about used CAN IDs (output: 0x640 to 0x642, and input 0x643). In the ***Properties*** section (2) there is a list of user configured parameters.

Parameter	Description
CAN In/Out ID	The BASE ID of the device. CAN Switch Board uses the following IDs: BASE ID + 0 to BASE ID + 2 as output IDs and BASE ID + 3 as an input ID. By default the BASE ID is equal to 0x640
CAN send rate	This parameter defines how often the device sends information to the CAN BUS
R#: resistors count	This parameter defines the number of the resistors in resistor network used for rotary switch for given analog input. It is used for calculating the position of the rotary switch
R#: offset	The offset for calculated rotary switch position
A#: pullup	Enable the 20-50K pullup resistor for given analog input. Use this pullup resistor if you want to use analog input for a ground activated switch.

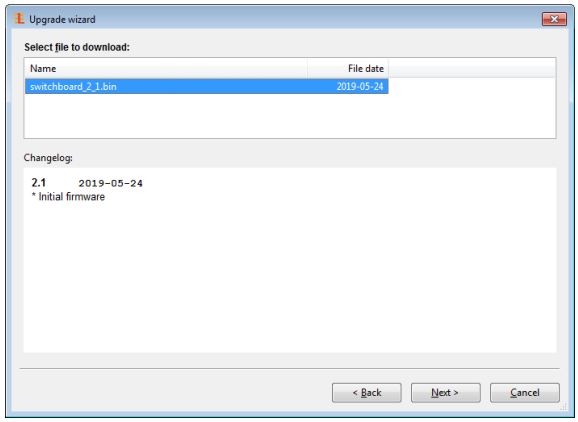
The section ***Channels*** (3) is used for monitoring of the status of device inputs and outputs.

Parameter	Description
L1 - L4	The status of low side outputs
S1 - S8	The status of switch inputs
A1 - A8	The voltage (in mV) of analog inputs
R1 - R8	The position of rotary switches connected to the analog inputs
AS1-AS8	The status of analog inputs. Status is equal 1 when the voltage is greater than 3.0V. and 0 when the voltage is lower than 1.0V

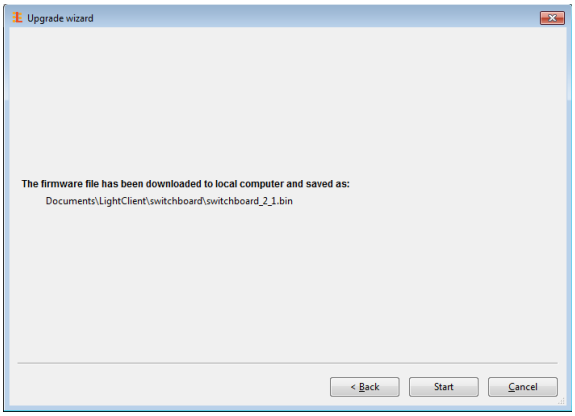
The *Light Client* application allows you to upgrade the connected device's firmware to the latest version. To do this, press the *Upgrade* button (4). The following screen will appear:



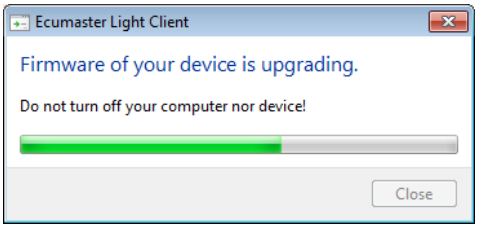
It is strongly recommended that you always download the latest driver from the ECUMaster server (requires internet connection). When you press the "Next" button, the following dialog should appear, allowing you to download the selected firmware:



When you press the "Next" button again, the application should display a download confirmation.

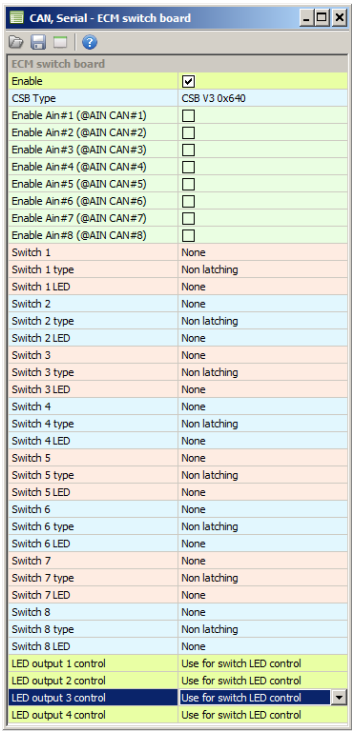


Next, press the “Start” button to upgrade the firmware. During the upgrade process do not turn off your PC or interrupt power to the device!



USING CAN SWITCH BOARD V3 WITH EMU BLACK

The EMU BLACK has built in support for CAN SWITCH BOARD V3 using 0x640 base ID. Options for CAN SWITCH BOARD are located in the *"CAN, Serial / ECM switch board"* menu.



Parameter	Description
Enable	Enables support of CAN SWITCH BOARD
CSB Type	Allow to select CSB type V1 or V3
Enable Ain#X	Overwrite the CAN analog input with the value from the CAN SWITCH BOARD
Switch X	Assing CSB switch input to EMU BLACK CAN switch
Switch X type	Type of the switch (latching, non latching, multistate)
Switch X LED	Allows to assign CSB low side output that will be active when the switch is pressed
LED output X control	Allows to control CSB low side outputs with the EMU BLACK parametric outputs

REVISION HISTORY

Revision	Date	Changes
1.0	12.07.2019	Initial revision
1.1	31.07.2019	ID2 must be Open for Data Format 0 (comaptibile with V1). Changed description of LS_MASK.
1.2	10.02.2020	Changed the description of “A#: pullup” resistors for analog inputs.
1.3	14.02.2020	Formatting of the document has been corrected.