CAN BUS EXTENSION

TurboCorse.at
Electronics

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Functions of the extension board

The TurboCorse can bus extension board serves as I/O extension for the Megasquirt (2-3) engine management system.

If the extension board is fully assembled it has the following functions:

- 8x Thermocouple type k
- 4x 0-5v Sensor or ntc temp sensor. (selectable through soldering jumper)
- 4x NPN Mosfet output 3A per channel
- 2x Frequency or normally input. (max voltage is 5v)
- 2x Tactile switches
- 3x Led for status information's
- Lcd interface
- TTL (USB, BLUETOOTH) interface 115200 Baud
- Can bus interface 500k Baud (terminating resistor through jumper selectable)
- TWI interface
- ISP interface
- JTAG interface

Megasquirt is a registered trademark from B&G
Tuner Studio is a registered trademark from Efi Analytics

Terminal and connector layout

Terminal X1:

Pinout terminal X1. (orange or gray one)
You will have always 2 gnd wires within one terminal. Therefore we have 12 terminals for 8 sensors.

Connection	Function
Terminal 1	Thermocouple 1 +
Terminal 2	Thermocouple 1 / 2-
Terminal 3	Thermocouple 2 +
Terminal 4	Thermocouple 3 +
Terminal 5	Thermocouple 3 / 4 -
Terminal 6	Thermocouple 4 +
Terminal 7	Thermocouple 5 +
Terminal 8	Thermocouple 5 / 6 -
Terminal 9	Thermocouple 6 +
Terminal 10	Thermocouple 7 +
Terminal 11	Thermocouple 7 / 8 –
Terminal 12	Thermocouple 8 +

Table 1

Connector X2:

Pinout connector X2. (frontal connector)
You will find the needed connector and crimp terminals within the package.

Connection	Function	Connection	Function	Connection	Function
A1	Gnd Out 3 / 4	**C1**	Analog In 4	**E1**	Analog In 2
A2	Out 4	**C2**	Digital In 2	**E2**	Can Gnd
A3	Out 3	**C3**	Digital In 1	**E3**	Can H
B1	Gnd Out 1 / 2	**D1**	Analog In 3	**F1**	Analog In 1
B2	Out 2	**D2**	+5V Out	**F2**	Gnd In
B3	Out 1	**D3**	Can L	**F3**	+12V In

Table 2

Electrical connection of the board

Power supply:

Connect the pins F2 / F3 (Gnd / +12V) of the X2 connector (the black one) with a 3A fuse to the key switch power supply. Maximum allowed input voltage is around 17V. If the power supply is okay, the green led should be on.

Outputs 1-4:

If you will use the outputs 1-4 it's needed to connect the A1, B1 pins to GND. The NPN Mosfet's switch to corresponding GND pin. The internal GND is not connected to the outputs.
The maximum load for each output is around 3A.

Analog inputs:

The analog inputs 1-4 can be used for 0-5V or NTC sensor inputs
If the input is used for 0-5V signals the solder jumper must be open.
If you will connect ntc sensors close the solder jumper for the specific input. This will attach the 2200 ohm bias resistor.

To calibrate the ntc sensor you can use the same function as for the Megasquirt.
This is only possible if you are connected to the serial port of the board. It is not possible if you use can pass through.
You will find the function under Tools→Calibrate Thermistor Tables.

Digital inputs:

The digital inputs 1-2 can be used as generic inputs. Maximum voltage is 5V.
You can use them for frequency signal. The frequency in Hz is recorded.

You can use input 1 for a switch to change the page at the display.
The state from the inputs will be transmitted to the Megasquirt. (CANIN6 / CANIN7)

Thermocouple:

The thermocouple's (maximum 8) are connected at the terminal X1.
You will find the layout at table 1.

Push the white lever down, this will open the terminal and you can clamp the wire from the thermocouple.
The wires from the thermocouple go through the nozzle at the back from the housing.

Only typ k sensors are supported. If you will use another type let me know. It's needed to fit another chip.

The temperature range which the board will detect goes from 0°C to 1023°C.

The board detects automatically how many sensors are attached.

Can bus:

The pins E2, E3 are for can bus connection.
There is also a termination resistor located at the board. (JP1)
If you connect the two pins together the 120Ohm resistor is terminating the can bus.
This is needed at the first and the last device at the can bus.

The can bus speed is 500kbaud. All messages will be sent with this speed.

The default ID for communication within the Megasquirt can bus system is 12.

It is recommended to twist the CanH and CanL wires together

If you use the extension board with the Megasquirt 2, 3 be sure that the internal can bus connection is made.
JS6 (CanH) goes to SPR1 and JS8 (CanL) goes to SPR2

Serielle interface:

You can use the serial TTL interface to connect the board with Tuner Studio.
During startup the board sends the actual firmware signature and version.
You need some kind of TTL<->RS232 or TTL<->USB converter.

Connection settings are 38400 Baud, 8 Data Bits and 2 Stop Bits.
 (From pcb version v1.1.1 onwards 115200 baud are used.)

Display:

It is possible to connect a 16x2 LCD display to the board.

The board requests the data from the Megasquirt and shows them at the display.
You have 5 pages with 4 values per page.

If the „BarGraph" function is enabled there is another page, so you have a maximum of 6 pages.

At page 6 you have only RPM and Lambda. And the bar graph for the RPM.

If the „ShiftRpm" function is enabled the background light from the display will flash if you exceed the RPM threshold.

Connect the display to the LCD connector. In the table below you can find the layout.

Anschluss	Funktion	Anschluss Display	Farbe
1	+5V	VCC (2)	white
2	GND	GND (1), R/W(5)	braun
3	RS	RS (4)	green
4	E	E (6)	yellow
5	D4	D4 (11)	gray
6	D5	D5 (12)	pink
7	D6	D6 (13)	blue
8	D7	D7 (14)	red
9	LED+	A (15)	black
10	LED-	K (16)	purple

Table 3

Under certain circumantations a series resistor is needed for the backlight of the LCD
If no one is directly at the LCD you can fit one in R22 next to the LCD connector.

You can calculate the needed value with the following formula.
(Supply Voltage [v] – LCD Led Forward Voltage [v]) / Forward current [A]

The maximum current for the backlight is 30mA!!!

I have made a display adapter pcb. You can solder the lcd display to the pcb and connect the 10 way connectors together.

Can bus broadcast

Every 65ms a broadcast message stream is send to the can bus.

The message format is according CAN 2.0A 11 bit identifier.

Here you can see the layout of the broadcast messages.

B2U =   Big Endian (Motorola Format) , 2 Bytes, Unsigned
B2S =   Big Endian (Motorola Format), 2 Bytes, Signed
1U =   1 Byte, Unsigned

ID (Hex)	Offset (Bytes)	Format	Comment
760	0	B2U	Thermocouple 1 [0..1023°C]
	2	B2U	Thermocouple 2 [0..1023°C]
	4	B2U	Thermocouple 3 [0..1023°C]
	6	B2U	Thermocouple 4 [0..1023°C]
761	0	B2U	Thermocouple 5 [0..1023°C]
	2	B2U	Thermocouple 6 [0..1023°C]
	4	B2U	Thermocouple 7 [0..1023°C]
	6	B2U	Thermocouple 8 [0..1023°C]
762	0	B2U	Analog In 1 [0..1023]
	2	B2U	Analog In 2 [0..1023]
	4	B2U	Analog In 3 [0..1023]
	6	B2U	Analog In 4 [0..1023]
763	0	B2S	Analog Temperature 1 [1/10°C]
	2	B2S	Analog Temperature 2 [1/10°C]
	4	B2S	Analog Temperature 3 [1/10°C]
	6	B2S	Analog Temperature 4 [1/10°C]
764	0	B2U	Frequency input 2 [Hz]
	2	B2U	Frequency input 2 [Hz]
	4	1U	Runtime [0..255 H]
	5	1U	Runtime [0..59M]
	6	1U	Runtime [0..59S]
	7	1U	Output Status [Binary]
765	0	B2U	Runtime [0..65535MS]
	2	1U	Input Status [Binary]
	3	1U	Active Thermocouples [Binary]
	4	1U	Thermocouple counter [0..7]
	5	1U	Analog counter [0..3]
	6	B2U	Main Loops per second

Table 4

Led's and tactile switches

At the board there are 3 different LED's every one with a special meaning.

Green:

The green one is on if the board has power supply.

Red:

The red one is blinking if the board is communication through the can bus.
If the can bus is not connected or the board didn't get any answers or the board is the only device attached to the can bus the board turn on the led after ~1s.
So if the red led is on it means no can bus connection / answer.

Yellow:

The yellow one changes the status every time a thermocouple channels is readed.
Every 125ms (8Hz) a thermocouple value is collected.

If the led flashes fast no thermocouple is reconized by the automatic detection algorithm. (20Hz)

Switch 1-2:

Status for switch 1 / 2 is forwarded to the MS as CANIN1 / CANIN2

You can use S1 to change the page at the LCD.

With S1 you can restore the standard config.

Offsets for can bus connection to the megasquirt (2-3)

Here you can find the table offset fort he supported values
Standard canbus ID = 12

B2U = Big Endian (Motorola Format) , 2 Bytes, Unsigned
**B2S** = Big Endian (Motorola Format), 2 Bytes, Signed
1U = 1 Byte, Unsigned

| Table	Offset (Bytes)	Format	Comment
2	0-39	B2U	Display variables
	40	S2U	Thermocouple 1 [0..1023°C]
	42	S2U	Thermocouple 2 [0..1023°C]
	44	S2U	Thermocouple 3 [0..1023°C]
	46	S2U	Thermocouple 4 [0..1023°C]
	48	S2U	Thermocouple 5 [0..1023°C]
	50	S2U	Thermocouple 6 [0..1023°C]
	52	S2U	Thermocouple 7 [0..1023°C]
	54	S2U	Thermocouple 8 [0..1023°C]
	56	B2U	Analog In 1 [0..1023]
	58	B2U	Analog In 2 [0..1023]
	60	B2U	Analog In 3 [0..1023]
	62	B2U	Analog In 4 [0..1023]
	64	B2U	Frequency input 1 [Hz]
	66	B2U	Frequency input 2 [Hz]
	68	B2U	Frequency input 1 Delta Count [Incements]
	70	B2U	Frequency input 2 Delta Count [Incements]
	72	S2S	Analog Temperature 1 [1/10°C]
	74	S2S	Analog Temperature 2 [1/10°C]
	76	S2S	Analog Temperature 3 [1/10°C]
	78	S2S	Analog Temperature 4 [1/10°C]
	80	1U	Output Status [Binary]
	80.0	1U	Out 1 (CANout 01)
	80.1	1U	Out 2 (CANout 02)
	80.2	1U	Out 3 (CANout 03)
	80.3	1U	Out 4 (CANout 04)
	81	1U	Input Status [Binary]
	81.0	1U	Switch S 1 (CANIN1)
	81.1	1U	Switch S2 CANIN2)
	81.5	1U	Input 1 (CANIN6)
	81.6	1U	Input 2 (CANIN7)

Table 5

Configuration MS2

Standard config for MS2.
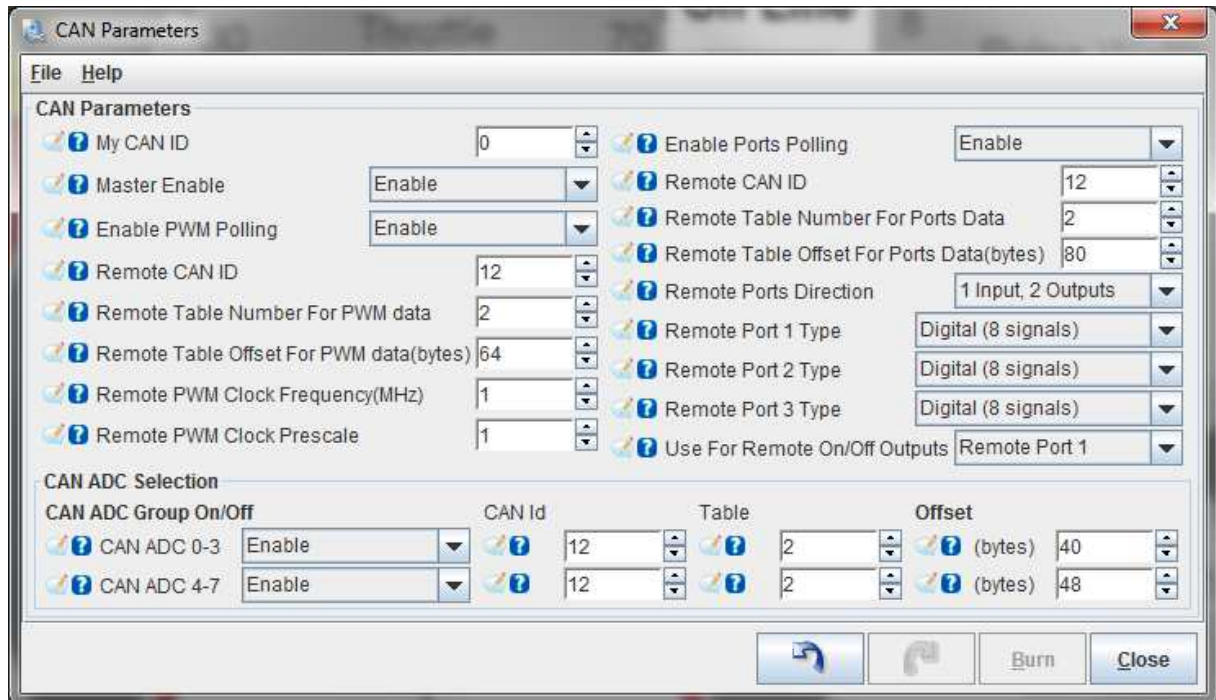
Configuration MS3

Standard config for MS3.
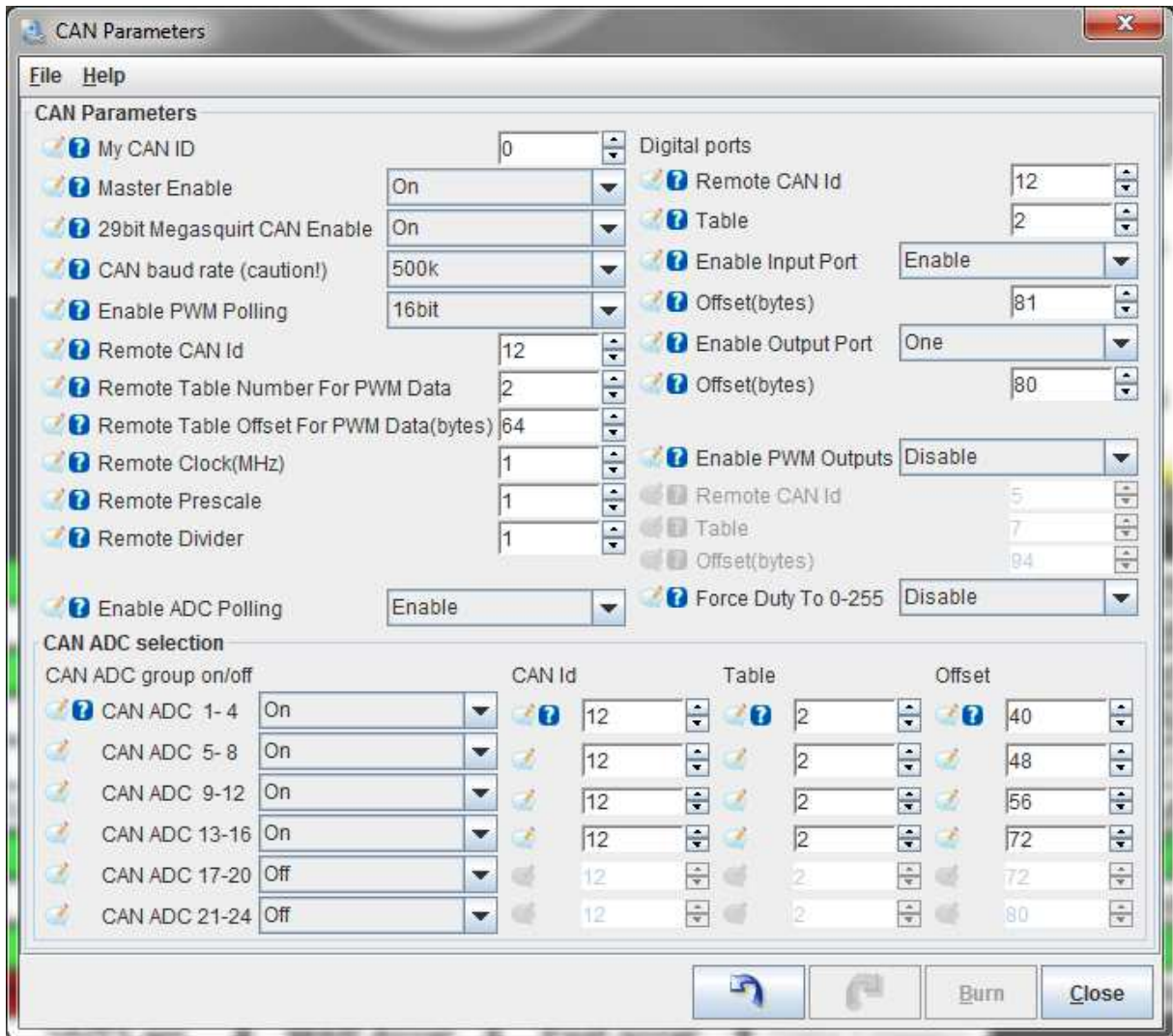
Configuration to act as a can device within tuner studio

Connect the io board as can device in TS.

Following steps are required:
- Open your TS project.
- Projekt Settings. File→Vehicle Project→Project Properties, or by press CTRL + P.
- Menu „CAN Devices".
- With button „+" you can add a new device.
- Fill in the device description .
- Check „Disable Runtime Data".
- Under „Connected Device" chose the can id. (Normally = 12)
- Under „Device Configuration File" chose the ini file.
- Click „Ok" to finish the settings.
- TS restarts the project then you have a drop down list on the left menu bar
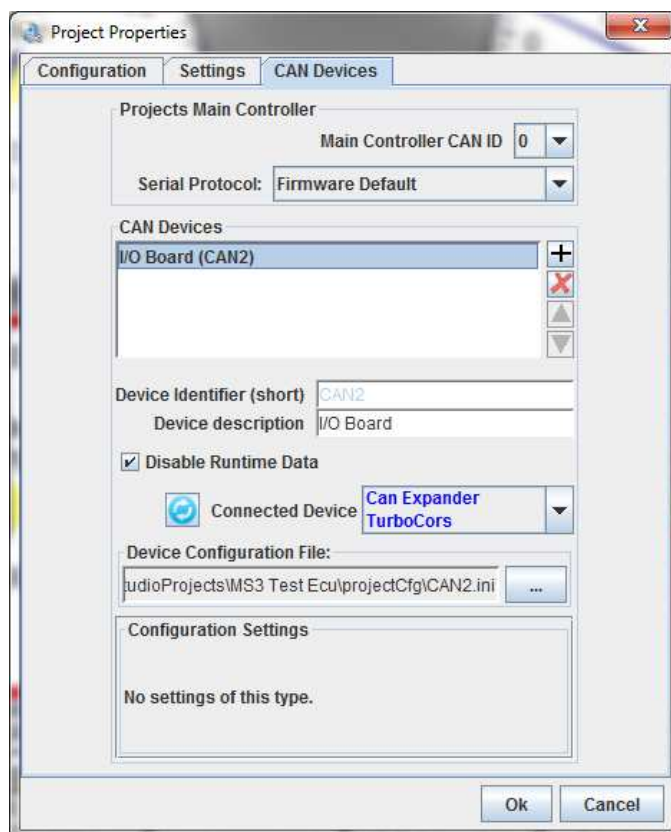
Update firmware

You can update the firmware over serial. The io board has an bootloader.

If you have bluetooth installed you are the lucky guy and can go forward.
If not a RS232<->TTL or USB<->TTL cable is required.

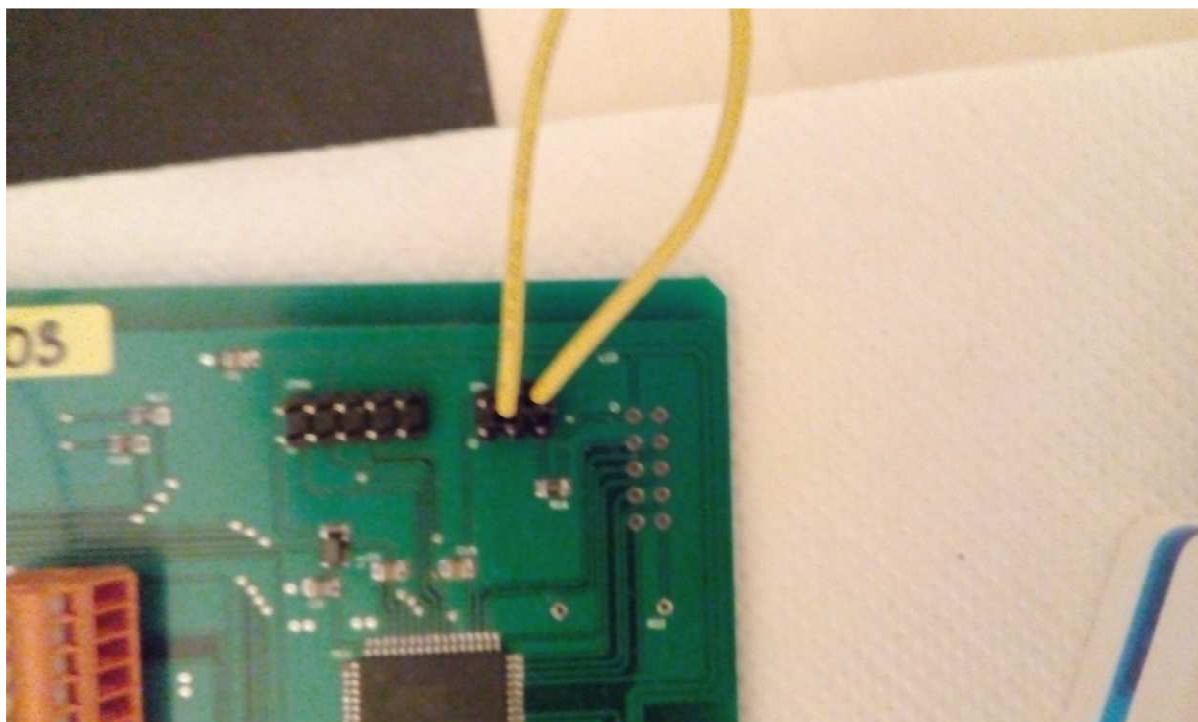Connect it to terminals RxD_S / TxD_S/GND_S.

Install the jumper according the picture below.

Open TurboCorseLoader folder.
Within the folder there must be the desired hex file" don't change the name.

Start „Firmware_Loader.bat".
Fill in the com port for example "Com1" and press enter.

Restore default configuration

You can restore the default settings bay following steps:

- Turn oft he io board
- Pess and hold button S1.
- Turn on io board, yellow and red led are on for about 500ms.
- Now you have restored the default settings.

Revisions

V1.0	17.04.2019	First edition (translation form german to english)