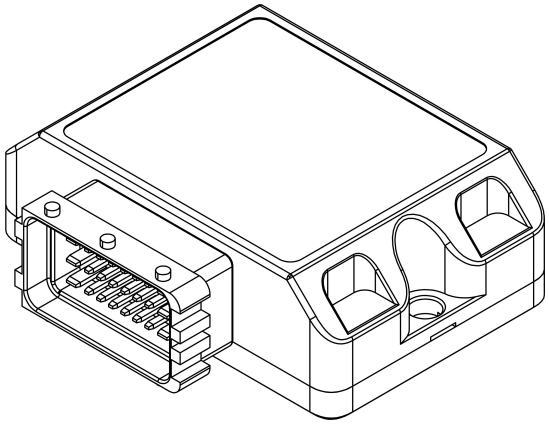
CAN H-Bridge 10A

Manual

Revision 7.1

(Firmware 7.x)



1 Device description

The CAN H-Bridge device contains two independent H-Bridges with over-current and short circuit protection, capable of 10A continuous current and 30A peak current. H-Bridges can be controlled via device inputs or CAN bus messages.

- Voltage range: 6V - 24V (12V automotive installations)
- Output current: 10A continuous, 30A peak @ 4kHz output PWM frequency
- 4 analog (0-5V) / digital (35Hz - 200Hz PWM) inputs
- Output PWM: 12bit 3.9kHz - 20kHz

The CAN H-Bridge device can be used to supply protected low side (GND) or high side (VBat) supply independently to each of 4 outputs for bidirectional DC motor control. Low side outputs can be PWM modulated on per-bridge basis.

Common use cases are:

- Electric windows
- High current electronic throttle body amplifier
- Position control - electric wastegate actuator

2 Operation principles

Each H-Bridge has three control variables, where "n" is the bridge number:

- DIRnA - Polarity of output nA - GND or VBat
- DIRnB - Polarity of output nB - GND or VBat
- PWMn - Duty cycle of H-Bridge n low side switch - 0% - 100% (High-Z - output Polarity)

Current control has four parameters:

- Inrush current - current value that when exceeded causes the H-Bridge to turn off
- Continuous current – high current limit after "Inrush time". Exceeding this value will cause the H-Bridge to turn off
- Inrush time - time period for “Inrush Current” limit to be active. After this period, “Continuous Current” limit is used.
- Retry time – Wait time after an over-current event when the device will try to turn the H-Bridge on again

PWM is in the same phase on both H-Bridges. If higher current is needed H-Bridges outputs can be paired or all joined together.

3 Input configuration

All inputs can be configured to work in analog or digital mode in 0-5V voltage range.

In analog mode voltage is read in 10bit resolution and sent over CAN bus in 1mV/bit format

In digital mode 0-5V PWM signal Duty Cycle is read in 12bit resolution and sent over CAN bus in 100% / 0xFFF format

Input frequency of PWM should be between 35-200Hz. **Connecting a higher frequency signal to a digital input could disrupt device operation. Unused inputs should be configured as analog inputs.**

4 CAN input frame

Device receives one 8 byte can frame in Big Endian format at the ID defined by "CAN Input ID" field.

Byte	0	1	2	3	4	5	6	7
Data	B1	B2	B3	B4	W1		W2	

B1 - B4 - unsigned 8bit

W1 - W2 - signed 16bit

5 Setting up control variable sources

All control variables (DIR and PWM) can have user selected sources. Also DIR can be inverted and PWM can be offset.

DIR sources:

Source	Source range for GND	Source range for VBat
GND	-	-
VBat	-	-
Can Byte B1-B4	B <= 127	B > 127
Can Word W1-W2	W <= 0	W > 0
Input - analog mode	0 - 2.5V	2.5V - 5V
Input - digital mode	0 - 50%DC	50 - 100%DC
Ecumaster PMU Key (CAN ID 0x662)	Key State = 0	Key State > 0
Position control 1-2	Closed loop controlled	Closed loop controlled

When polarity is set to inverted, GND source range is switched with VBat source range.

To switch polarity when using "Can Byte" source. The value must go above 127. If you are using switch changing value from 0 to 1, you should multiply it by 255 in the message transmitter.

PWM sources:

Source	Input	PWM Duty Cycle
0%	-	0%
MAX%	-	Duty cycle limit
Can Byte B1-B4	0 - 255	0% - 100%
Can Word W1-W2	-4095 - 0 - 4095	100% - 0% - 100%
Input in analog mode	0V - 5V	0% - 100%
Input in analog mode with offset	0V - 2.5V - 5V	100% - 0% - 100%
Input in digital mode	0%DC - 100%DC	0% - 100%
Input in digital mode with offset	0%DC - 50%DC - 100%DC	100% - 0% - 100%
Position control 1-2	Closed loop controlled	Closed loop controlled

PWM duty cycle from any source is clamped to value entered in "Duty cycle limit" fields.

Offset option is useful when you need bi-directional DC motor control from one input.

PMW source set to 0% basically means that the H-Bridge output is disabled! To use the channel change it to other setting.

6 Position control

H-Bridge has two independent PID controllers that can be used to achieve closed loop position control. Setpoint can be sourced from CAN-bus or from the device inputs. Feedback signal is sourced from the device analog inputs. Feedback signal input should be configured to analog mode.

To use position controller on H-Bridge, relevant control inputs should be configured. DIR1A/B polarity could be swapped to achieve correct actuator direction.

Control inputs:	
DIR1A	Position control 1
DIR1A polarity	Direct
DIR1B	Position control 1
DIR1B polarity	Inverted
[illegible]	[illegible]
[illegible]	[illegible]
PWM1	Position control 1
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

6.1 Position control configuration

Setpoint source - source of information about desired position

Position source - source of feedback signal

Min / Max valid voltage - when feedback voltage is out of this range, output is disabled.

Min / Max voltage - voltage range for position control range.

Lower / Upper margin - position margin to avoid hitting end positions by controller overshoot.

kP, kI, kD - PID controller coefficients.

kD filter - increase filter value to reduce rattle associated with PID derivative term.

Position control 1:	
Setpoint source	CAN Byte B1
Position source	Analog Input 1
Min valid voltage	50 mV
Min voltage	1000 mV
Max voltage	4000 mV
Max valid voltage	4950 mV
Lower margin	10 %
Upper margin	10 %
kP	4.00
kI	1.00
kD	0.20
kD filter	4

6.2 Setpoint details

Setpoint is computed from source according to table:

Source	Input	Setpoint
Can Byte B1-B4	0 - 255	0% - 100%
Can Word W1-W2	0 - 4095	0% - 100%
Input in analog mode	0V - 5V	0% - 100%
Input in digital mode	0%DC - 100%DC	0% - 100%

6.3 Position feedback details

Position is calculated by comparing analog input voltage with input Min / Max voltage range reduced by Lower / Upper margin values.

7 Example configurations

Minimum electrical connections for any configuration are as follows:

PIN	FUNCTION	DESCRIPTION
C8	VBAT	Voltage positive supply
C1	Power GND	Power GND supply
A1	GND	Digital GND supply

7.1 High current Electronic Throttle Bodies for EMU

Electrical connection:

Signal	CAN H-Bridge pin
Motor +	H-Bridge 1A
Motor -	H-Bridge 1B
Stepper motor output	Input 1

Control inputs:	
DIR1A	INPUT 1
DIR1A polarity	Direct
DIR1B	INPUT 1
DIR1B polarity	Inverted
[illegible]	[illegible]
[illegible]	[illegible]
PWM1	INPUT 1
PWM1 offset	Middle offset
[illegible]	[illegible]
[illegible]	[illegible]
Inputs config:	
input1 mode	Digital

7.2 Electric windows

Electrical connection:

Signal	CAN H-Bridge pin
Motor +	H-Bridge 1A
Motor -	H-Bridge 1B
Push button UP	Input 1 and +5V output
Push button DOWN	Input 2 and +5V output

Inrush currents:	
H-Bridge 1	35.00 A
[illegible]	[illegible]
Contin. currents:	
H-Bridge 1	10.00 A
[illegible]	[illegible]
Inrush times:	
H-Bridge 1	1.00 s
[illegible]	[illegible]
Retry times:	
[illegible]	[illegible]
[illegible]	[illegible]
Reset Method:	
H-Bridge 1	DIR change
[illegible]	[illegible]
Control inputs:	
DIR1A	INPUT 1
DIR1A polarity	Direct
DIR1B	INPUT 2
DIR1B polarity	Direct
[illegible]	[illegible]
[illegible]	[illegible]
PWM1	100%

Inrush current should be above the DC motor stall current. Continuous current should be between motor stall current and working current. Holding one of buttons (UP or DOWN) will cause the window to move. When window reaches the end of it's movement range, motor current will go over the Continuous Current Limit and the output will switch off to prevent motor overheating. The device will retry the motor after releasing and pressing the switch again (DIR change).

7.3 Electric windows with CAN-BUS control

Connection:

Signal	CAN H-Bridge pin / CAN frame
Window 1 - Motor +	H-Bridge 1A
Window 1 - Motor -	H-Bridge 1B
Window 2 - Motor +	H-Bridge 2A
Window 2 - Motor -	H-Bridge 2B
Push button - window 1 - UP	CAN ID 0x773 Byte B1 = button state [0 1] * 255
Push button - window 1 - DOWN	CAN ID 0x773 Byte B2 = button state [0 1] * 255
Push button - window 2 - UP	CAN ID 0x773 Byte B3 = button state [0 1] * 255
Push button - window 2 - DOWN	CAN ID 0x773 Byte B4 = button state [0 1] * 255

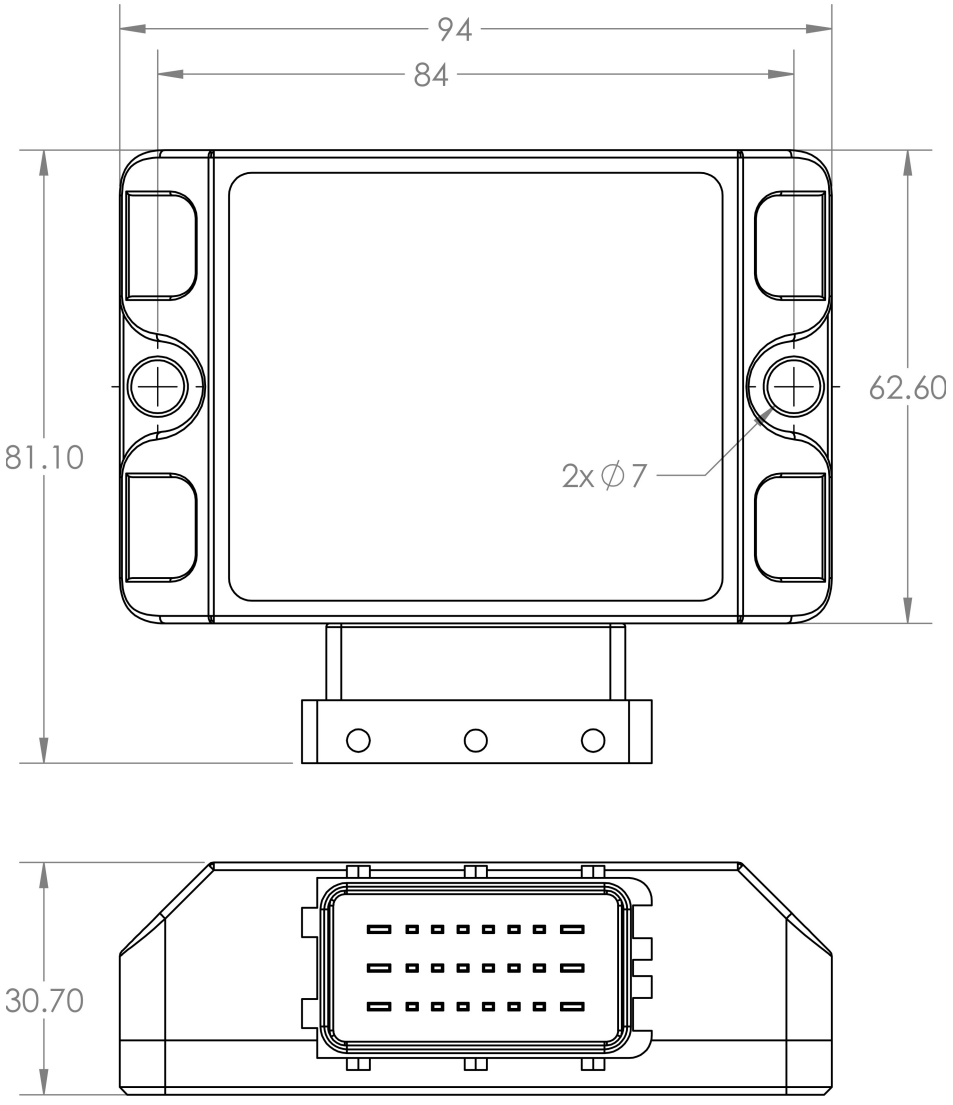
CAN ID	0x770 Standard
Inrush currents:	
H-Bridge 1	35.00 A
H-Bridge 2	35.00 A
Contin. currents:	
H-Bridge 1	10.00 A
H-Bridge 2	10.00 A
Inrush times:	
H-Bridge 1	1.00 s
H-Bridge 2	1.00 s
Retry times:	
H-Bridge 1	1.00 s
H-Bridge 2	1.00 s
Reset Method:	
H-Bridge 1	DIR change
H-Bridge 2	DIR change
Control inputs:	
DIR1A	CAN Byte B1
DIR1A polarity	Direct
DIR1B	CAN Byte B2
DIR1B polarity	Direct
DIR2A	CAN Byte B3
DIR2A polarity	Direct
DIR2B	CAN Byte B4
DIR2B polarity	Direct
PWM1	100%
PWM2	100%
CAN Input ID	0x773 Standard

8 Electrical pinout

PIN	Type	Description
A1	Supply Input	GND
A2	Input	Input 1
A3	Input	Input 3
A4	Output	H-Bridge 1 A
A5	Output	H-Bridge 1 B
A6	Output	H-Bridge 2 A
A7	Output	H-Bridge 2 B
A8	Supply Input	VBAT
B1	Supply Input	Power GND
B2	Input	Input 2
B3	Input	Input 4
B4	Output	H-Bridge 1 A
B5	Output	H-Bridge 1 B
B6	Output	H-Bridge 2 A
B7	Output	H-Bridge 2 B
B8	Supply Input	VBAT
C1	Supply Input	Power GND
C2	Supply Output	Sensor GND
C3	Supply Output	Sensor +5V
C4	-	-
C5	-	-
C6	Communication	CAN Low
C7	Communication	CAN High
C8	Supply Input	VBAT

Power GND and VBAT pins are capable of 25A per pin.
H-Bridge output pins are 15A per pin.
You should connect as many duplicate pins as you need to meet your current demand.

9 Dimensions



10 Revision history

Revision	Date	Changes
	11.07.2018	Product specification updated to indicate that only low side outputs can be PWM modulated
	27.07.2018	Table pinout added. Electric window application screenshot updated.
	9.01.2019	Revised by Zach Denney
1.0	14.06.2019	Revision number added
1.1	11.07.2019	Electric windows with CAN-BUS control - example configuration added
1.2	12.11.2019	PWM frequency information. PWM and polarity configuration notes. Drawings
1.3	25.05.2020	Firmware 7.0 new functions description - position controller
7.1	13.01.2023	Clarified that the device only works in 12 V installations