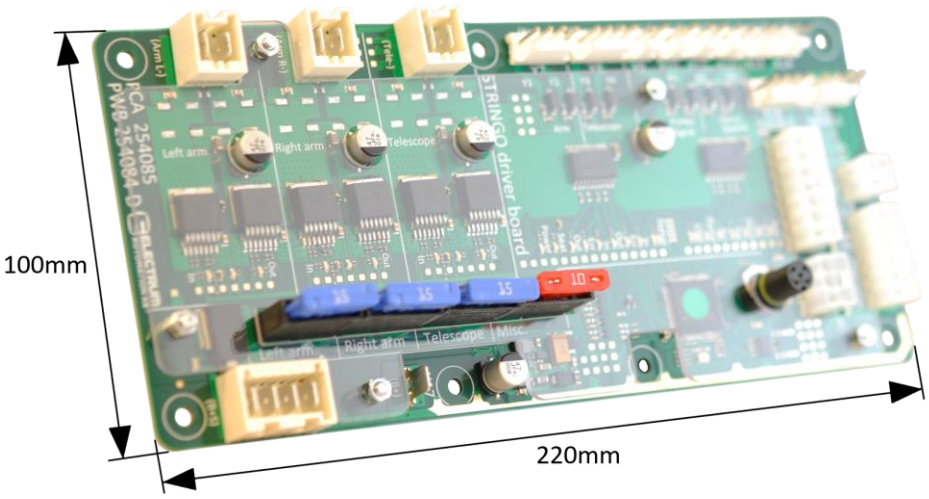
CHL Motor Control Board
FULL MANUAL

Introduction

The CHL board drives three 12A DC motors, withstanding large peak currents with no cooling. Eight additional 3A outputs can drive hydraulic valves, relays, lamps etc.

Control and status monitoring is done via the CAN bus, using the CANopen protocol.



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Product Overview

Technical data

- Three >12A reversible DC motor H-bridge driver outputs
- Eight 3A driver outputs for resistive or inductive loads
    - Each output pair must not be loaded with more than 4.3A in total
    - Outputs 1-4 must not be loaded with more than 6.5A in total
    - Outputs 5-8 must not be loaded with more than 6.5A in total
- Single open collector output, max 0.2mA
- Supply voltage range: 8-32VDC
- Overvoltage and reverse polarity protection
- On board temperature monitor
- Individual fuses for the DC motor H-bridge outputs
- Common fuse for the eight 3A outputs
- Status indicator LEDs

Applications

- DC motor control

Mechanical data

- Physical dimensions: 220x100x31 mm

Communication

- Supports CAN 2.0A and 2.0B with bus speed up to 1Mbit/s
- CAN-bus, using the CANopen protocol

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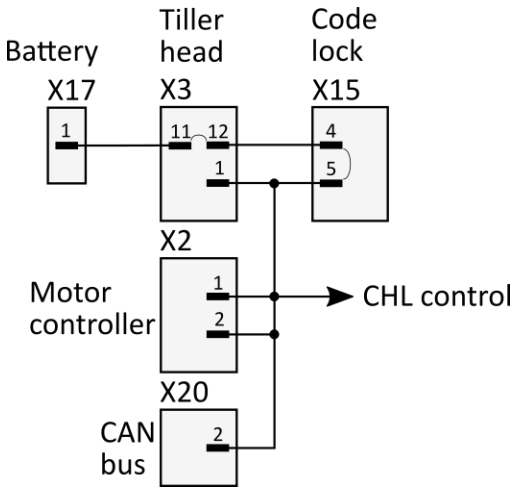
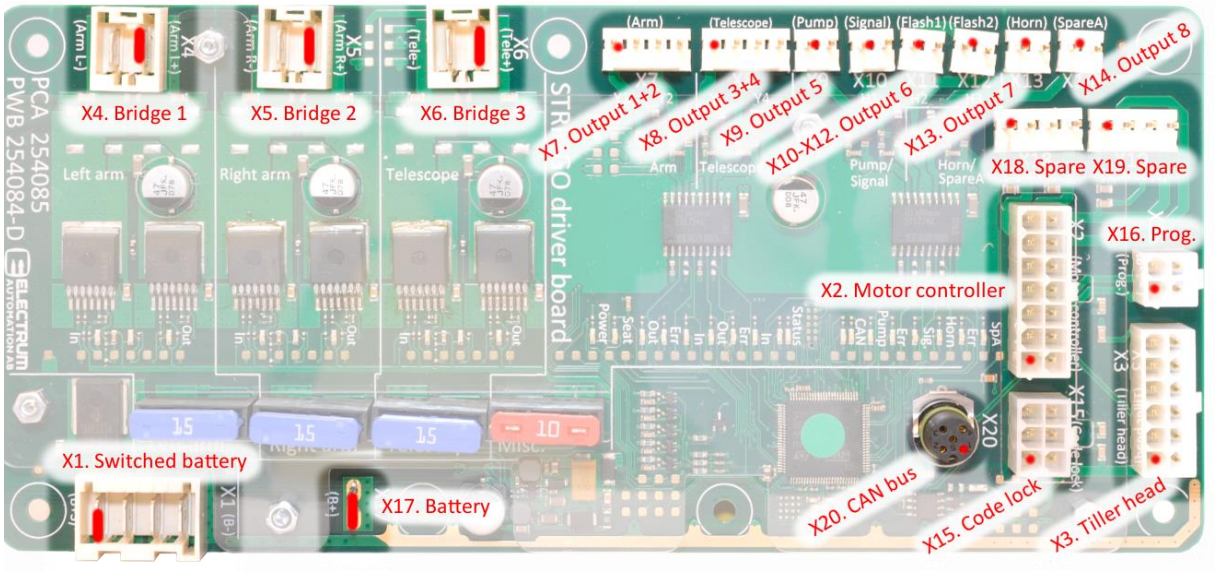
1 Power connections

The CHL board is intended to distribute incoming battery power to several controllers. The figure below shows how the control battery power connection is to be wired through connectors X3 and X15 before reaching the CHL controller and being distributed to connectors X2, X3 and X20.



2 Connectors

The image below shows the CHL board connectors, where pin 1 is marked in red. Each connector is explained in the following sections.



2.1 Switched battery connector (connector X1: B+S/B-)

This connector is the power input to all output drivers. As the sum of all output currents may become quite large, the connections are doubled. That is, there are two ground pins and two positive supply voltage pins.

As this power input is separated from the control logic supply input, the control logic can be powered up before power to the output drivers is enabled. For example, a contactor may be inserted between the battery and this board as an extra safety measure.

X1, Switched battery connector pin list

Pin	Function
1	Battery power positive terminal (B+ switched)
2	Battery power positive terminal (B+ switched)
3	Battery power negative terminal (B-)
4	Battery power negative terminal (B-)

2.2 Motor controller (connector X2:Motor controller)

The CAN master (e.g. a motor controller PLC) can be connected to this connector. Key switch power and the CAN bus are available here. Other signals are distributed to connectors X3, X16, X18 and X19.

X2, Motor controller connector pin list

Pin	Function
1	Key switch power positive terminal (KSI), connected to X15
2	Key switch power positive terminal (KSI), connected to X15
3	Motor controller serial port RX, connected to X16
4	Motor controller I/O ground, connected to X3 and X16
5	Motor controller driver common positive terminal (Coil return). Connected to X18 and X19
6	Motor controller driver output SpareB, connected to X18
7	Motor controller driver output SpareC, connected to X18
8	CAN bus positive terminal. Connected to X3, X20 and the CHL controller
9	CAN bus negative terminal. Connected to X3, X20 and the CHL controller
10	Motor controller serial port TX, connected to X3 and X16
11	Motor controller +12V, connected to X3 and X16
12	Motor controller driver common positive terminal (Coil return). Connected to X18 and X19
13	Motor controller driver output SpareD, connected to X19

14	Motor controller driver output SpareE, connected to X19

2.3 Tiller head (connector X3:Tiller head)

Key switch power, the CAN bus and connections to an emergency switch are available here.

Power to the control circuit of this board is supposed to pass through this connector from pin 11 back to pin 12. By connecting an emergency switch between these pins, power to the control circuit can be switched off. Opening the switch will thus force all driver outputs to an inactive state.

X3, Tiller head connector pin list

Pin	Function
1	Key switch power positive terminal (KSI), connected to X15
2	Battery negative terminal (B-)
3	Not connected
4	Motor controller I/O ground, connected to X2
5	Not connected
6	Not connected
7	CAN bus positive terminal. Connected to X2, X20 and the CHL controller
8	CAN bus negative terminal. Connected to X2, X20 and the CHL controller
9	Motor controller serial port TX, connected to X2
10	Motor controller +12V, connected to X2
11	Battery power positive terminal (B+ unswitched), connected to X17. An emergency stop switch can be connected between this pin and pin 12.
12	Code lock positive supply terminal, connected to X15. An emergency stop switch can be connected between this pin and pin 11.

2.4 H-bridge outputs 1-3 (connectors X4:Arm L+/-, X5:Arm R+/-, X6:Tele+/-)

These are connectors for the H-bridge driver outputs, being able to drive one reversible DC motor each.

X4-X6, H-bridge driver output connector pin list

Pin	Function
1	Nominal direction positive terminal (Arm L+/Arm R+/Tele+)

2	Nominal direction negative terminal (Arm L-/Arm R-/Tele-)

2.5 Outputs 1+2 and 3+4 (connectors X7:Y1/Y2, X8:Y3/Y4)

These connectors can drive two resistive or inductive loads each.

X7-X8, Dual driver output connector pin list

Pin	Function
1	Output 1/3 positive terminal (Y1/Y3)
2	Battery negative terminal (B-)
3	Output 2/4 positive terminal (Y2/Y4)
4	Battery negative terminal (B-)

2.6 Output 5 (connector X9:Y5)

This connector can drive a single resistive or inductive load.

X9, Single driver output connector pin list

Pin	Function
1	Output 5 positive terminal (Pump)
2	Battery negative terminal (B-)

2.7 Output 6 (connectors X10:H1, X11:H2, X12:H3)

These three connectors are all connected to the same driver output, output 6.

X10-X12, Single driver output connector pin list

Pin	Function
1	Output 6 positive terminal (H1/H2/H3)
2	Battery negative terminal (B-)

2.8 Output 7 (connector X13:Horn)

This connector can drive a single resistive or inductive load.

X13, Single output connector pin list

Pin	Function
1	Output 7 positive terminal (Horn)
2	Battery negative terminal (B-)

2.9 Output 8 (connector X14:SpareA)

This connector can drive a single resistive or inductive load.

X14, Single output connector pin list

Pin	Function
1	Output 7 positive terminal (SpareA)
2	Battery negative terminal (B-)

2.10 Code lock or key switch connector (connector X15:Code lock)

Power to the control circuit of this board is supposed to pass through this connector from pin 4 to pin 5. A simple key switch or a code lock can be connected. Positive and negative supply voltage for a code lock is provided, as well as a programmable activity indicator output.

X15, Code lock/key switch connector pin list

Pin	Function
1	Code lock positive supply terminal (B+ through the emergency switch), connected to X3
2	Battery power negative supply terminal (B-)
3	Programmable activity indicator open collector output to the code lock (Seat switch)
4	Switch terminal 1 (power from the battery through the emergency stop switch), connected to X3
5	Switch terminal 2 (key switch power and power to the board's control circuit), connected to X2, X3 and X20
6	Not connected

2.11 Motor controller programming connector (connector X16:Prog.)

This connector provides access to the motor controller connectors serial port pins.

X16, Motor controller programming connector pin list

Pin	Function
1	Motor controller serial port RX
2	Motor controller I/O ground
3	Motor controller serial port TX
4	Motor controller +12V

2.12 Battery (connector X17:B+)

Power to the control circuit of this board, as well as to any other control logic is supposed to be connected here. This pin is connected to the tiller head connector.

X17, Battery connector pin list

Pin	Function
1	Battery power positive terminal (B+ unswitched), connected to X3

2.13 Spare outputs B and C (connector X18:SpareB,C)

This connector provides access to the motor controller connectors SpareB and SpareC pins.

X18, Spare B/C output connector pin list

Pin	Function
1	Spare B-E common positive terminal (Coil return), connected to X2
2	Spare B output negative terminal (SpareB), connected to X2
3	Spare B-E common positive terminal (Coil return), connected to X2
4	Spare C output negative terminal (SpareC), connected to X2

2.14 Spare outputs D and E (connector X19:SpareD,E)

This connector provides access to the motor controller connectors SpareD and SpareE pins.

X19, Spare D/E output connector pin list

Pin	Function
1	Spare B-E common positive terminal (Coil return), connected to X2
2	Spare D output negative terminal (SpareD), connected to X2
3	Spare B-E common positive terminal (Coil return), connected to X2
4	Spare E output negative terminal (SpareE), connected to X2

2.15 CAN bus diagnostic connector (connector X20:CAN bus)

Tools for CAN bus diagnostics can be connected here.

X20, CAN bus connector pin list

Pin	Function
1	Not connected
2	Key switch power positive terminal (KSI), connected to X15
3	Battery negative terminal (B-)

4	CAN bus positive terminal. Connected to X3, X20 and the CHL controller
5	CAN bus negative terminal. Connected to X3, X20 and the CHL controller

2.16 Mating connectors

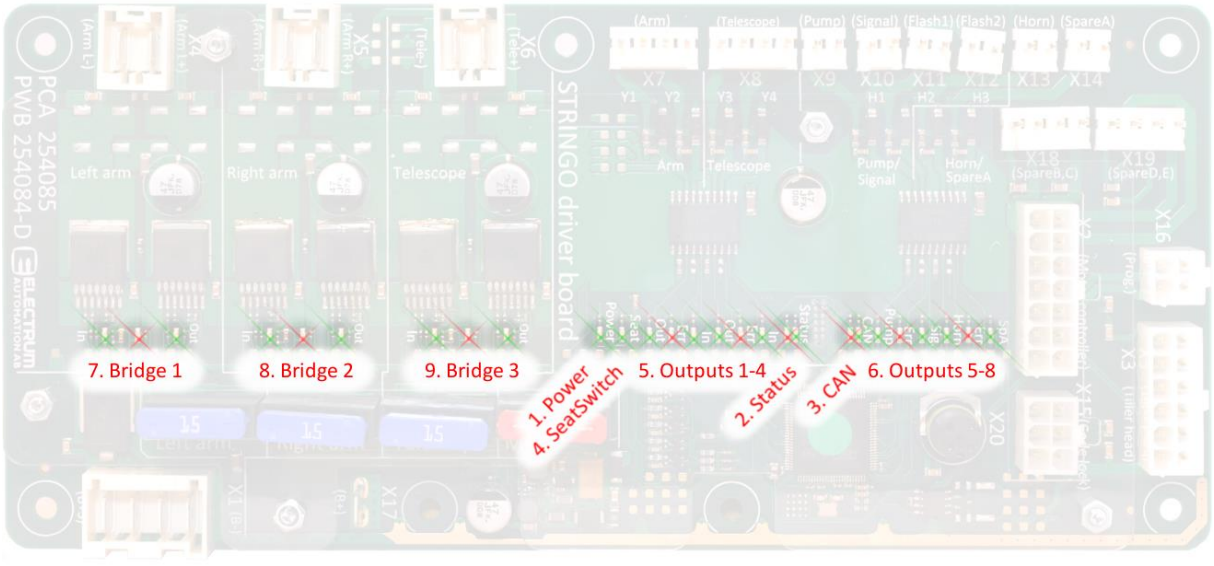
The table below show a list of connector part numbers, which are suitable for mating with the connectors on the PCB.

Mating connector list

Connector	Manufacturer	Part number	Description
X1	Tyco Electronics	3-928344-4	4-position RAST 5.0 female header
X2	Molex	39-01-2140	14-position Minifit female header
X3	Molex	39-01-2120	12-position Minifit female header
X4-X6	Tyco Electronics	928344-2	2-position RAST 5.0 female header
X7, X8	Tyco Electronics	0-770849-4	4-position SL-156 female header
X9-X14	Tyco Electronics	0-770849-2	2-position SL-156 female header
X15	Molex	39-01-2060	6-position Minifit female header
X16	Molex	39-01-2040	4-position Minifit female header
X17	Tyco Electronics		Standard 6.3mm FASTON terminal
X18, X19	Tyco Electronics	0-770849-4	4-position SL-156 female header
X20	Hirschmann	ELWIKA 5012 PG7	5-pin M12 male connector

3 Status indicator LEDs

The image below shows the seven groups of indicator LEDs on the PCB. The indicator functions are explained in detail in the following sections.



3.1 Power LED (1)

This green LED is lit when key switch power is connected to the CHL board.

3.2 Board overall status LEDs (2)

These are the board overall green and red status LEDs. When green, the board is powered on and no error has been detected. When flashing red, the other red error LEDs will indicate the reason of the error.

3.3 CAN bus status LEDs (3)

These green and red LEDs show green when the CANopen state of the board has been set to operational.

The LED may be flashing red due to one of the following reasons:

- There are CAN bus errors
- The CHL board has not received any NMT start command to enter operational state
- The CHL board has not received bus master heartbeat messages within the configured period

3.4 Seat switch LED (4)

This green LED is lit when the code lock seat switch output signal is activated.

3.5 Output driver LEDs (5 and 6)

There is one green LED for each single output driver. The LED is lit whenever the corresponding output is on.

For each pair of outputs there is one red error LED. It is lit in the following cases:

- An output driver is activated and overloaded
- The MISC fuse is blown
- The supply voltage is below 8V and any bridge or single output driver is activated

This implies that if the MISC fuse is blown, all four output driver error LEDs will be lit. If the supply voltage is below 8V and any driver is active, all seven error LEDs will be lit.

3.6 H-bridge output LEDs (7, 8 and 9)

There are two green LEDs for each DC motor H-bridge driver. The right LED marked “Out” is lit when the output is on with nominal polarity. That is, when the “+” output terminal is connected to the “B+S” power input terminal.

The left green LED marked “In” is lit when the output is on with reverse polarity. That is, when the “+” output terminal is connected to the “B-” power input terminal.

For each H-bridge output there is one red error LED. It is lit when either:

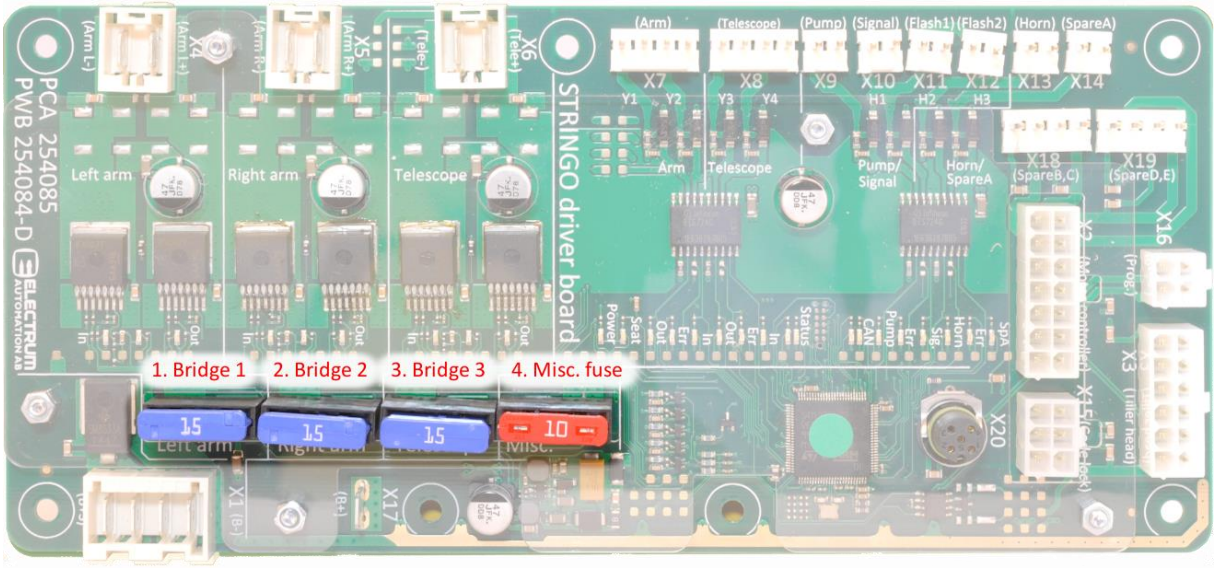
- The H-bridge output is on and the driver is overloaded

- The driver IC temperature exceeds 100 degrees Celcius
- The fuse associated with the H-bridge output is blown
- The supply voltage is below 8V and any bridge or single output driver is activated

This implies that if the supply voltage is below 8V and any driver is active, all seven error LEDs will be lit.

4 Fuses

The image below shows the four fuses on the board. They are all standard automotive ATO blade type fuses. The fuses are explained in the following sections.



4.1 Motor H-bridge driver 1-3 fuses (fuse 1-3)

These fuses are used for protecting the H-bridge drivers and the DC motors they drive from prolonged over currents. By default 15A slow fuses are mounted.

In case the fuse is blown, the red error LED of the H-bridge driver will be lit.

4.2 Miscellaneous driver fuse (fuse 4)

This fuse is used for protecting outputs 1-8 and their drivers from prolonged over currents. By default a 10A slow fuse is mounted.

In case the fuse is blown, all four red error LEDs for outputs 1-8 will be lit.

5 Electrical characteristics

5.1 Absolute maximum ratings

Stresses above those listed in the table below may cause permanent damage to the device. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Electrical characteristics, absolute maximum ratings

Parameter	Condition	Min.	Max.	Unit
Supply voltage		-0.3	33	V_{DC}
Input voltage CAN_L and CAN_H		-25.4	25.4	V_{DC}
H-bridge output high side output current(1)	T_A = 25°C; t_P < 100ms	-40	(2)	A
	T_A = 25°C; t_P < 8.3ms	-70	(2)	A
H-bridge output low side output current(1)	T_A = 25°C; t_P < 100ms	-40	26	A
	T_A = 25°C; t_P < 8.3ms	-70	42	A
	T_A = 25°C; t_P < 1ms	-120	67	A
Single output current(1)	T_A = 25°C; t_P < 3µs	-40	(2)	A
	T_A = 25°C; t_P < 6ms	-10	(2)	A

Note: 1. Single pulse
2. Internally limited

5.2 Functional range

Electrical characteristics, functional range

Parameter	Condition	Min.	Typ.	Max.	Unit
Supply voltage(1)		8	24	32	V_{DC}
Power consumption(2)	8V < V_{IN} < 30V		0.4	0.7	W
Operating temperature		-40	25	85	°C
Input voltage CAN_L and CAN_H		-7		12	V
Max H-bridge output continuous output current	T_A = 25°C; No heat sink		12		A
	T_A = 25°C; Heat sink mounted		15		A
Max total output current for single outputs 1-4 and 5-8	One output on	3.0	3.3		A
	Two outputs on	4.3	4.7		A
	Four outputs on	6.5	7.3		A
Open collector output impedance (Seat switch)			4.7k		Ω

Note: 1. Module fully operational
2. No output signal active.

6 CANopen communication

6.1 CANopen default behaviour

The CHL module is configured to act as a regular CANopen slave. By default it operates at the CAN baud rate 250 kbit/s.

The CHL module will periodically (by default every 250ms) send out a heartbeat with the module status according to the CANopen standard. The heartbeat has the following format:

CAN identifier: **0x750** (0x700 + CANopen node id)
DLC : **1**
IDE: **0** (11bit identifier)
RTR: **0**
Data[0]: module status (see table below)

- **0x00** = Bootup
- **0x04** = Stopped
- **0x05** = Operational
- **0x7F** = Pre-operational

On power-up the CHL module status will be Pre-operational. The CANopen master will have to start the module by sending a NMT start CAN packet to the node.

The NMT start packet will have the following format:

CAN identifier: **0x0** (NMT)
DLC : **2**
IDE: **0** (11bit identifier)
RTR: **0**
Data[0]: Command (see table below)

- **0x01** = Start
- **0x02** = Stop
- **0x80** = Set Pre-operational
- **0x81** = Restart

Data[1]: Node-id

- Could be set to **0x50** to only address the CHL module or **0x00** to talk to all CANopen nodes on the CAN bus

The CHL module expects a heartbeat from the CANopen master (Node id 0x01) every 500ms. If the module fails to receive this packet within this time, it will automatically revert to Pre-operational and enter a safe-state (all outputs disabled).

6.2 CANopen object dictionary

Index	S-idx	Name	Type		Default	Description	Savable
0x1000	0x00	Moduletype	ro	u32	0x00003232	Nonstandard description of this module.	
0x1001	0x00	Error register	ro	u8	0x00		
0x1005	0x00	COB ID SYNC	rw	u32	0x00000080		x
0x1008	0x00	Module name	ro	str	Electrum CHL		
0x1009	0x00	Revision HW	ro	str	REV X	Starting at char ”A”.	
0x100A	0x00	Revision SW	ro	str	REV X.X.X	270007 revision	
0x1011	0x00	Number of restore options	ro	u8	0x01		
	0x01	Restore default parameters	rw	u32	0x00000001	Restores all parameters to default values if string ’load’ is written to this entry. The default values are valid after the device is reset or power cycled.	
0x1016	0x00	Number of monitored devices	ro	u8	0x01		
	0x01	Consumer heartbeat time	rw	u32	0x000101F4	Heartbeat monitoring time for node n monitoring only one node is supported. 0x00nn**tttt** = monitoring time (ms) 0x0**nn**tttt = node number (If nn or tttt = 0, no monitoring is carried out.)	x
0x1017	0x00	Producer heartbeat time	rw	u16	0x00FA	Time interval (ms) where the module generates a producer heartbeat.	x
0x1018	0x00	Number of identity objects	ro	u8	0x04		
	0x01	Vendor ID	ro	u32	0x00000356		
	0x02	Product code	ro	u32	0x00000000		
	0x03	Revision number	ro	u32	0x00000000		
	0x04	Unique ID nr	ro	u32	0x????????	Used to identify the CHL (ID).	

Index	S-idx	Name	Type		Default	Description	Savable
0x1400	0x00	Receive PDO 1 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x200 + $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x
0x1401	0x00	Receive PDO 2 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x80000300 + $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit Time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x
0x1402	0x00	Receive PDO 3 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x80000400 + $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x
0x1403	0x00	Receive PDO 4 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x80000500 + $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x

Index	S-idx	Name	Type		Default	Description	Savable
0x1600	0x00	Receive PDO 1 Mapping Parameter	rw	u8	0x05	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x62000108	H-Bridge 1	x
	0x02	PDO Mapping Entry 2	rw	u32	0x62000208	H-Bridge 2	x
	0x03	PDO Mapping Entry 3	rw	u32	0x62000308	H-Bridge 3	x
	0x04	PDO Mapping Entry 4	rw	u32	0x62000408	Output 1-8	x
	0x05	PDO Mapping Entry 5	rw	u32	0x62000508	Code lock seat-switch	x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1601	0x00	Receive PDO 2 Mapping Parameter	rw	u8	0x00	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x00000000		x
	0x02	PDO Mapping Entry 2	rw	u32	0x00000000		x
	0x03	PDO Mapping Entry 3	rw	u32	0x00000000		x
	0x04	PDO Mapping Entry 4	rw	u32	0x00000000		x
	0x05	PDO Mapping Entry 5	rw	u32	0x00000000		x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1602	0x00	Receive PDO 3 Mapping Parameter	rw	u8	0x00	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x00000000		x
	0x02	PDO Mapping Entry 2	rw	u32	0x00000000		x
	0x03	PDO Mapping Entry 3	rw	u32	0x00000000		x
	0x04	PDO Mapping Entry 4	rw	u32	0x00000000		x
	0x05	PDO Mapping Entry 5	rw	u32	0x00000000		x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1603	0x00	Receive PDO 4 Mapping Parameter	rw	u8	0x00	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x00000000		x
	0x02	PDO Mapping Entry 2	rw	u32	0x00000000		x
	0x03	PDO Mapping Entry 3	rw	u32	0x00000000		x
	0x04	PDO Mapping Entry 4	rw	u32	0x00000000		x
	0x05	PDO Mapping Entry 5	rw	u32	0x00000000		x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x

Index	S-idx	Name	Type		Default	Description	Savable
0x1800	0x00	Transmit PDO 1 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x180 + $NODEID		x
	0x02	Transmission type	rw	u8	255		x
	0x03	Inhibit Time	rw	u16	300		x
	0x05	Event timer	rw	u16	100		x
0x1801	0x00	Transmit PDO 2 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x280+ $NODEID		x
	0x02	Transmission type	rw	u8	255		x
	0x03	Inhibit time	rw	u16	300		x
	0x05	Event timer	rw	u16	100		x
0x1802	0x00	Transmit PDO 3 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x80000380+ $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x
0x1803	0x00	Transmit PDO 4 Communication Parameter	ro	u8	0x05	Number of entries	
	0x01	COB-ID used by PDO	rw	u32	0x80000480+ $NODEID		x
	0x02	Transmission type	rw	u8	0		x
	0x03	Inhibit time	rw	u16	0		x
	0x05	Event timer	rw	u16	0		x

Index	S-idx	Name	Type		Default	Description	Savable
0x1A00	0x00	Transmit PDO 1 Mapping Parameter	rw	u8	0x06	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x60000108	H-bridge 1-3 short circuit	x
	0x02	PDO Mapping Entry 2	rw	u32	0x60000208	Output 1-8 short circuit	x
	0x03	PDO Mapping Entry 3	rw	u32	0x60000308	Fuse status 1-4	x
	0x04	PDO Mapping Entry 4	rw	u32	0x64040110	VCC voltage	x
	0x05	PDO Mapping Entry 5	rw	u32	0x64040208	Board temperature	x
	0x06	PDO Mapping Entry 6	rw	u32	0x64040308	H-Bridge driver IC max temperature	x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1A01	0x00	Transmit PDO 2 Mapping Parameter	rw	u8	0x03	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x64040408	H-Bridge 1 driver IC temperature	x
	0x02	PDO Mapping Entry 2	rw	u32	0x64040508	H-Bridge 2 driver IC temperature	x
	0x03	PDO Mapping Entry 3	rw	u32	0x64040608	H-Bridge 3 driver IC temperature	x
	0x04	PDO Mapping Entry 4	rw	u32	0x64040708	H-Bridge 1 driver output current (HW version D only)	x
	0x05	PDO Mapping Entry 5	rw	u32	0x64040808	H-Bridge 2 driver output current (HW version D only)	x
	0x06	PDO Mapping Entry 6	rw	u32	0x64040908	H-Bridge 3 driver output current (HW version D only)	x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1A02	0x00	Transmit PDO 3 Mapping Parameter	rw	u8	0x00	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x00000000		x
	0x02	PDO Mapping Entry 2	rw	u32	0x00000000		x
	0x03	PDO Mapping Entry 3	rw	u32	0x00000000		x
	0x04	PDO Mapping Entry 4	rw	u32	0x00000000		x
	0x05	PDO Mapping Entry 5	rw	u32	0x00000000		x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x
0x1A03	0x00	Transmit PDO 4 Mapping Parameter	rw	u8	0x00	Number of entries	x
	0x01	PDO Mapping Entry 1	rw	u32	0x00000000		x
	0x02	PDO Mapping Entry 2	rw	u32	0x00000000		x
	0x03	PDO Mapping Entry 3	rw	u32	0x00000000		x
	0x04	PDO Mapping Entry 4	rw	u32	0x00000000		x
	0x05	PDO Mapping Entry 5	rw	u32	0x00000000		x
	0x06	PDO Mapping Entry 6	rw	u32	0x00000000		x
	0x07	PDO Mapping Entry 7	rw	u32	0x00000000		x
	0x08	PDO Mapping Entry 8	rw	u32	0x00000000		x

Index	S-idx	Name	Type		Default	Description	Savable
0x20F2	0x00	CAN baud rate	rw	u16	0x00FA	Baud rate in kbit/s	x
0x20F3	0x00	CAN baud rate, safety register	rw	u16	0x00FA	Baud rate in kbit/s. Note 1: Before writing to this index, index 0x20F2 must first be written with the same baud rate Note 2: Writing to this index takes effect immediately, possibly before the SDO write acknowledge.	x
0x3000	0x00	CANopen node ID	rw	u8	0x50	CANopen node ID (1-127)	x

Index	S-idx	Name	Type		Default	Description	Savable
0x6000	0x00	Read Output short-circuit state	ro	u8	0x03	Number of entries	
	0x01	H-Bridge 1-3 short-circuit	ro	u8	-	Mappable	
	0x02	Output 1-8 short-circuit	ro	u8	-	Mappable	
	0x03	Fuse status 1-4	ro	u8	-	Mappable	
0x6200	0x00	Set output state	ro	u8	0x05	Number of entries	
	0x01	H-Bridge 1	wo	u8	-	Mappable	
	0x02	H-Bridge 2	wo	u8	-	Mappable	
	0x03	H-Bridge 3	wo	u8	-	Mappable	
	0x04	Output 1-8	wo	u8	-	Mappable	
	0x05	Code lock seat-switch	wo	u8	-	Mappable	
0x6404	0x00	Manufacturer-specific Analog input	ro	u8	0x03	Number of entries	
	0x01	VCC voltage in millivolt	ro	u16	-	Mappable	
	0x02	Board temperature in degrees Celsius	ro	s8	-	Mappable	
	0x03	H-Bridge driver IC max temperature in degrees Celsius	ro	s8	-	Mappable	
	0x04	H-Bridge 1 driver IC temperature in degrees Celsius	ro	s8	-	Mappable	
	0x05	H-Bridge 2 driver IC temperature in degrees Celsius	ro	s8	-	Mappable	
	0x06	H-Bridge 3 driver IC temperature in degrees Celsius	ro	s8	-	Mappable	
	0x07	H-Bridge 1 driver IC output current in amperes	ro	u8	-	Mappable. Only reported for hardware revision D	
	0x08	H-Bridge 2 driver IC output current in amperes	ro	u8	-	Mappable. Only reported for hardware revision D	
	0x09	H-Bridge 3 driver IC output current in amperes	ro	u8	-	Mappable. Only reported for hardware revision D	

6.3 CANopen PDO

The following tables show the default mapping of transmit and receive PDOs.

TX	ID	Data							
		0	1	2	3	4	5	6	7
PDO1	0x180+Node ID	H-Bridge 1-3 short-circuit	Output 1-8 short-circuit	Fuse status 1-4	VCC voltage		Board temp.	H-Bridge IC max temp.	-

H-Bridge 1-3 short-circuit can be read as a bit pattern where the least significant bit is H-bridge 1 (0b00000001).

- Bit is 0 = Output ok
- Bit is 1 = Output is short-circuited or overloaded.

Output 1-8 short-circuit can be read as a bit pattern where the least significant bit is output 1 (0b00000001).

- Bit is 0 = Output ok
- Bit is 1 = Output is short-circuited or overloaded.

Fuse status 1-4 can be read as a bit pattern where the least significant bit is fuse 1 (0b00000001).

- Bit is 0 = Fuse ok
- Bit is 1 = Fuse blown

Fuses 1-3 are assigned one each to the H-bridges. Fuse 4 is assigned to all outputs 1-8.

VCC voltage is the supply voltage to the CHL module. The value can range from 0 to 65535mV. Byte 3 is the least significant byte and byte 4 is the most significant byte of the value.

Board temperature indicates the board temperature at the processor in degrees Celsius.

H-Bridge IC maximum temperature indicates the board temperature at the hottest H-bridge driver IC, in degrees Celcius.

TX	ID	Data							
		0	1	2	3	4	5	6	7
PDO2	0x280+Node ID	H-Bridge 1 IC temp.	H-Bridge 2 IC temp.	H-Bridge 3 IC temp.	H-Bridge 1 current	H-Bridge 2 current	H-Bridge 3 current	-	-

H-Bridge IC temperature indicates the board temperature at the specific H-bridge driver IC, in degrees Celcius.

H-Bridge current indicates the output current in amperes. Only reported for hardware revision D.

RX	ID	Data							
		0	1	2	3	4	5	6	7
PDO1	0x200+Node ID	H-bridge 1	H-bridge 2	H-bridge 3	Output 1-8	Code lock seat-switch	-	-	-

H-bridge 1 - H-bridge 3 is used to configure the H-bridge:

- 0x00 = H-bridge off
- 0x01 = H-bridge on (Positive)
- 0x02 = H-bridge on (Negative)

Output 1-8 should be set as a bit pattern where the least significant bit is Output 1 (0b00000001).

- Bit is 0 = Output off
- Bit is 1 = Output on

Code lock seat-switch is a bit indicating whether the seat-switch indication to the code lock shall be activated or not.

- Bit is 0 = Seat-switch signal inactive
- Bit is 1 = Seat-switch signal active

7 Document history

Document revision	Description	Release date
A	Initial release	2014-12-19
B	• Reflect hardware changes (revision B) • Added mating connector list • CANopen error register description • CANopen node ID setting • Individual H-bridge driver IC temperatures reported	2015-09-04
C	• Reflect hardware changes (revision D) • Updated CANopen PDO2 default mapping • Added CANopen H-bridge output current reading	2021-09-03

For latest revision of this document please visit www.electrumab.se

8 Contact us

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