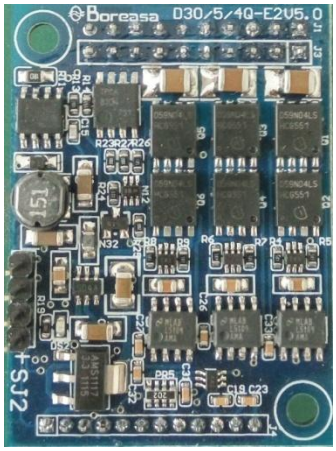
The D30/7.5/4Q-E2 is a small 4-quadrant digital controller for the control of brushless Boreasa blower up to 225 W. The blowers must be equipped with digital Hall sensors. This driver is designed to be integrated into the customer's electronic board. It is also compatible with Boreasa D50/5/4Q-M2 evaluation board.

Features:



- Digital speed control - operates as «closed loop» speed controller
- Maximum speed 60'000 rpm (motor with 1 pair of poles)
- Set value input through PWM or external analogue voltage (0 ... +3.3 V)
- 4 different speed ranges selectable
- Direction of rotation preset by a digital signal
- The output stage can be enabled or disabled
- Maximum output current limit adjustable up to 15 A
- Motor speed can be monitored with the «FG» output
- Status indication via «Ready» output
- Motor blocked protection (current limit for blocked motor)
- Protective functions: undervoltage, overvoltage and short circuit protection
- Standardized connector strip, pitch 2.54 mm and 2 mm
- The built-in shunt regulator is designed to limit the supply voltage of the controller.
- An analogue input can be used to detect the temperature of the motor

A sturdy PI speed controller design is an ideal premise for immediate operation.
The well-priced and miniaturized OEM module seamlessly integrates into many applications.
For developments Boreasa offers a comprehensive Interface/Evaluation Board: the D50/5/4Q-M2 board.

Contents

1. Safety Instructions

Skilled Personnel

Installation and starting of the equipment shall only be performed by experienced, skilled personnel.

Regulatory Considerations

You must observe any regulation applicable in the country and/or at the site of implementation with regard to health and safety/accident prevention and/or environmental protection!

For CE compliance, this driver is considered as partly completed machinery according to EU Directive 2006/42/EC, Article 2, Clause (g) and is intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment.

Load Disconnected

For primary operation the motor should be free running, i.e. with load disconnected.

Additional Safety Equipment

Any electronic apparatus is, in principle, not fail-safe. Machines and apparatus must therefore be fitted with independent monitoring and safety equipment. If the equipment breaks down, if it is operated incorrectly, if the control unit breaks down or if the cables break, etc., it must be ensured that the drive or the complete apparatus is kept in a safe operating mode.

Repairs

Repairs may be made by authorized personnel only or by the manufacturer. Improper repairs can result in substantial dangers for the user.

Non Hot-Swap

All cable connections should only be connected or disconnected when the power is switched off.

Max. Supply voltage

Make sure that the supply voltage is between 10 and 35VDC. Voltage higher than 36 VDC or wrong polarity will destroy the unit.

Short Circuit and Earth Fault

The driver is not protected against short circuits between winding and ground safety earth and/or GND!

Electrostatic sensitive device (ESD)

This is an ESD sensitive device. Handle in compliance with ESD protection best practices.

2. Technical Data

2.1 Electrical data

Nominal supply voltage +V_{CC}	10 to 32 V_{DC}
Absolute maximum supply voltage +V_{CC} max	35 V_{DC}
Max. output voltage	0.95 * V_{CC}
Continuous output current I_{Cont}	5 A
Max. output current I_{max}	15 A
Switching frequency	50 kHz
Max. speed (motor with 1 pole pair)	60,000 rpm
Shunt Regulator output	max. 10 A

2.2 Inputs

Speed control input «V_{CC}»	Analogue input (0 to +3.3 V); Resolution: 4096 steps
Enable «EN»	+2.4 to +15 V (R_i = 2 kΩ) or switch against V_{CC}
«CCW/CW» control	+2.4 to +15 V (R_i = 2 kΩ) or switch against V_{CC}
Speed range «DigIN1»	+2.4 to +3.3 V (no pull-up resistance)
Speed range «DigIN2»	+2.4 to +3.3 V (no pull-up resistance)
Gain setting «DigIN3»	+2.4 to +3.3 V (no pull-up resistance)
Gain setting «DigIN4»	+2.4 to +3.3 V (no pull-up resistance)
Current limiting «V_{CL}»	Analogue input (0 to +3.0 V)
Hall sensors	Hall sensor A «H_A», Hall sensor B «H_B», Hall sensor C «H_C»
Motor temperature «IT »	Analogue input (0 to +3.3 V)

2.3 Output

Motor speed «FG»	Digital output signal, 3.3 V
Status indication «Ready»	Digital output signal, 3.3 V

2.4 Voltage output

Hall sensor power «V_{Hall+}»	+10 V_{DC}, max. 35 mA
Shunt Regulator output «PR»	max. 10 A

2.5 Motor connections

Motor connections	Motor winding 1 «U», Motor winding 2 «V», Motor winding 3 «W»

2.6 Ambient temperature

Operation	-10 to +45 °C
Storage	-40 to +85 °C

2.7 Humidity range

Non condensating	20 to 80 %

2.8 Protective functions

Current limitation (cycle-by-cycle)	adjustable up to maximum 15 A
Blockage	Motor current limitation if motor shaft is blocked for longer than 1.0 s
Undervoltage shutdown	shutdown if V_{CC}< 9.5 V_{DC}
Overvoltage shutdown	shutdown if V_{CC}> 35 V_{DC}
Thermal overload protection of power stage	shutdown if $T_{power\ stage}$ > 100 °C

2.9 Mechanical data

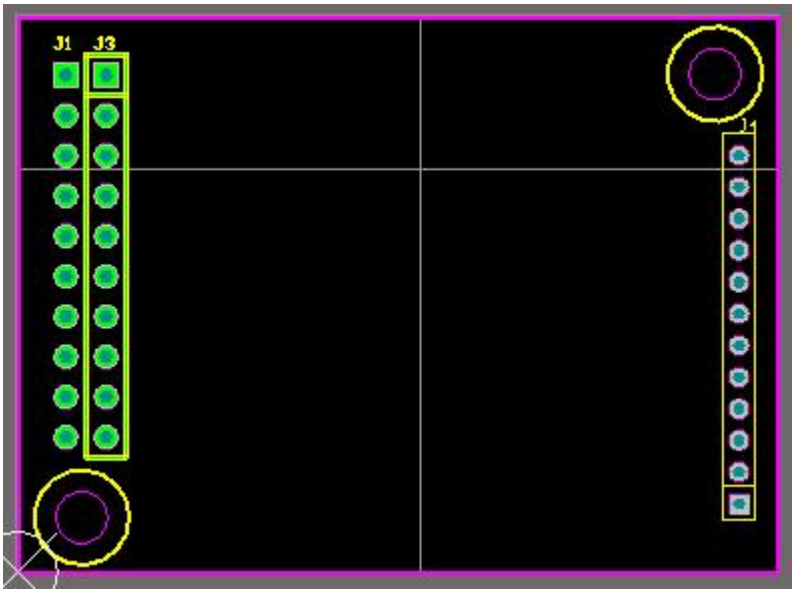
Weight	approx. 9 g
Dimensions (L x W x H)	48 x 35 x 12.7 mm

2.10 Terminals

Pin header 1	2 x 10 pins
	double row, pitch 2.54 mm (0.1 inch)
Pin header 2	10 pins
	single row, pitch 2 mm (0.08 inch)

3. Pin assignment D30/7.5/4Q-E2

Top view



Pin assignment

Pin	Signal	Description
1	U	Motor winding 1
2	U	Motor winding 1
3	V	Motor winding 2
4	V	Motor winding 2
5	W	Motor winding 3
6	W	Motor winding 3
7	$+V_{cc}$	Supply voltage10 to 50 V_{DC}
8	$+V_{cc}$	Supply voltage10 to 50 V_{DC}
9	GND	Ground
10	GND	Ground
11	GND	Ground
12	GND	Ground
13	PR	Shunt regulator output
14	PR	Shunt regulator output
15	GND	Ground
16	V_{Hall+}	+10 V_{DC} output voltage
17	H_A	Hall sensor A
18	H_B	Hall sensor B
19	T-IN	Motor Temperature input
20	H_C	Hall sensor C

Pin	Signal	Description
21	V_{CC}	Reference voltage +3.3 V
22	DigIN4	Digital input 4
23	DigIN3	Digital input 3
24	DigIN2	Digital input 2
25	DigIN1	Digital input 1
26	Ready	Status indication output
27	EN	Enable input
28	CCW/CW	CCW/CW control input
29	FG	Frequency generator output
30	V_{SP}	Speed control input
31	V_{CL}	Set current limit input
32	GND	Ground

4. Commissioning Instructions

Power supply layout

Any available power supply can be used, as long as it meets the minimum requirements shown below.
During set up and adjustment phases, we recommend to mechanically separate the motor from the machine to prevent damage due to uncontrolled motion!

Power supply requirements

Nominal output voltage	24 V_{DC}	
Absolute maximum output voltage	35 V_{DC}	
Output current	Depending on load:	Continuous: max. 5 A
		Acceleration: short-time max.15 A

The required supply voltage can be calculated as follows:

Known values

⇒ Operating torque M_B [mNm]
⇒ Operating speed n_B [rpm]
⇒ Nominal motor voltage U_N [V]
⇒ Motor no-load speed at U_N, n_0 [rpm]
⇒ Speed/torque gradient of the motor Δn/ΔM [rpm/mNm]

Sought value

⇒ Supply voltage V_{CC} [V]

Solution

$$V_{CC} = \frac{U_N}{n_0} \cdot \left(n_B + \frac{\Delta_n}{\Delta_M} \cdot M_B\right) \cdot \frac{1}{0.95} + 0.3V$$

Select a power supply capable of supplying this calculated voltage under load. The formula takes into account a maximum PWM duty cycle of 95% and a 0.3 V maximum voltage drop (at maximum output current) of the power stage.
What speed can be reached with a given power supply:

$$n_B = 0.95 \cdot \left[(V_{CC} - 0.3V)\frac{n_0}{U_N}\right] - \left[\frac{\Delta_n}{\Delta_M} \cdot M_B\right]$$

Note

⇒ During controlled deceleration, the power supply must be able to buffer the back-fed energy e.g. in a capacitor.
⇒ The under voltage protection switches off the D30/7.5/4Q-E2, as soon as the supply voltage V_{CC} falls below 9.5 V. Therefore, at low supply voltage $V_{CC,}$ attention has to be paid to the voltage drop over the power cord.

5. Functional Description of Inputs and Outputs

5.1 Inputs

5.1.1 Speed range and mode selection with «DigIN1» und «DigIN2»

The digital inputs «DigIN1» and «DigIN2» determine both, the operation mode (digital speed controller or digital speed actuator) and the speed range in speed set value mode.

		Motor Type			
DigIN1	DigIN2	**1 pole pair**	**2 pole pairs**	**4 pole pairs**	**8 pole pairs**
ON	ON	1,000 – 60,000 rpm	500 – 30,000 rpm	250 – 15,000 rpm	125 – 7,500 rpm
ON	OFF	1,000 – 40,000 rpm	500 – 20,000 rpm	250 – 10,000 rpm	125 – 5,000 rpm
OFF	ON	1,000 – 20,000 rpm	500 – 10,000 rpm	250 – 5,000 rpm	125 – 2,500 rpm
OFF	OFF	1,000 – 10,000 rpm	500 – 5,000 rpm	250 – 2,500 rpm	125 – 1,250 rpm

Please note

⇒ If the signal level of the digital inputs DigIN1 and DigIN2 are changed, the new levels are adopted by a disable-enable procedure.

If the input «DigIN» is not connected (floating) or a voltage higher than 2.4 V is applied, the input is active.

Logic 1	Logic 1 Input not connected (floating) Input voltage > 2.4 V	Input active

If the input «DigIN» is set to ground potential or a voltage lower than 0.8 V is applied, the input is inactive

Logic 0	Input set to GND Input voltage < 0.8 V	Input inactive

The inputs «DigIN1»and «DigIN2» are connected to DSP.

Digital input 1	Pin number [25] «DigIN1»
Digital input 2	Pin number [24] «DigIN2»
Input voltage range	0 to +3.3 V

5.1.2 Speed control input «V_{SP}»

The external analogue set value is predetermined at the «V_{SP}» input [30]. The « V_{SP} » input sets the rotational speed of the motor shaft, according to values pre-set as described in 5.1.1.

Speed control input voltage	**Description**
0 V to 3.3 V	Linear speed adjustment

The actual speed value is calculated according the following formula:

Known values

⇒ Minimum speed (see table above) n_{min} [rpm]

⇒ Maximum speed (see table above) n_{max} [rpm]

⇒ Set value voltage V_{SP} [V] respectively speed n [rpm]

Sought value

⇒ speed n [rpm]

Sought value

⇒ Set value voltage V_{SP} [V]

Solution

$$n = [(n_{max} - n_{min}) * V_{SP}]/3.3(V) + n_{min}$$

$$V_{SP}[V] = (n - n_{min}) * 3.3(V) / (n_{max} - n_{min})$$

The «V_{SP}» input is protected against over voltage.

Speed control input	Pin number [30] «V_{SP}»
Input voltage range	0 to +3.3 V (referenced to GND)
Resolution	4096 steps (8 mV)

Additional Possible Adjustment

With DigIN3 and DigIN4, the gain of the speed is selected.

DigIN3	DigIN4	**Gain Setting**
ON	ON	Maximal Gain
ON	OFF	High Gain
OFF	ON	Low Gain
OFF	OFF	Minimal Gain

Note:

- Start from "Minimum gain" and increase to get the fastest response speed while the motor runs stable.
- DIP can be switched with power on, but the change will not take effect until the driver powered off and back on.
- Use maximal gain only for motors with low speed constant and if very fast response of speed regulator is required. Reduce gain if motor oscillates or does not run smoothly.
- Higher gain: faster response, but less stable; Lower gain: slower response, but more stable
- Default DigIN3 and DigIN4: OFF

5.1.3 «Enable»

The «Enable» input enables or disables the power stage.

If a voltage lower than 0.8 V is applied to the «Enable» input, the amplifier is activated (Enable). A speed ramp will be performed during acceleration.

Enable	Input voltage < 0.8 V Input set to GND	Motor shaft running

If the input is not connected (floating) or high potential is applied to the «Enable» input, the power stage is high impedance and the motor shaft freewheels and slows down (Disable).

Disable	Input not connected (floating) Input voltage > 2.4 V	Power stage switched off

The «Enable» input is protected against overvoltage.

Enable	Pin number [27] «Enable»
Input voltage range	0 to +3.3 V
Input impedance	2 kΩ (in range 0 to +3.3 V)
Continuous over voltage protection	0 to +15 V
Delay time	max. 40 ms

5.1.4 CCW/CW control «CCW/CW»

The direction is factory set to match the supplied Boreasa blower.

The « CCW/CW » input determines the rotational direction of the motor shaft. When the level changes, the motor shaft slows down with a ramp to standstill, and accelerates with a speed ramp in the opposite direction, until the nominal speed is reached again.

If a voltage lower than 0.8 V is applied to the « CCW/CW » input, the motor shaft runs clockwise (CW).

Clockwise (CW)	Input voltage < 0.8 V Input set to GND

If the input is not connected (floating) or high potential is applied to the « CCW/CW » input, the motor shaft runs counter-clockwise (CCW).

Counter-clockwise (CCW)	Input not connected (floating) Input voltage > 2.4 V

The «CCW/CW» input is protected against overvoltage.

CCW/CW control	Pin number [28] «CCW/CW»
Input voltage range	0 to +3.3 V
Input impedance	2 kΩ (in range 0 to +3.3 V)
Continuous over voltage protection	0 to +15 V
Delay time	max. 40 ms

5.1.5 Set current limit «V_{CL}»

The current limit is factory set to match the supplied Boreasa blower ratings.

The « V_{CL}» inputs is used for setting the continuous output current limitation in the range of 0.5 to 15 A.

The current applied at the input « V_{CL} » will stay available for an indefinite period of time.

Note

⇒ The limiting value should be below the rated motor current (max. continuous current) as shown on the motor data sheet.

Set value current	Pin number [31] « V_{CL} »
Referenced to Ground	Pin number [32] «GND»

To parameterize the preferred current limiting value, an external voltage between current limiting input «V_{CL}» Pin [31] and ground «GND» Pin [32] must be added.

Current limit value	Voltage value
15 A	3.00 (V)
13A	2.60 (V)
10 A	2.10 (V)
8 A	1.65 (V)
6 A	1.20 (V)
4 A	0.75 (V)
1.5A	0.30 (V)
0.5 A	0.15 (V)

5.1.6 Hall sensor A «H_A», Hall sensor B «H_B», Hall sensor C «H_C»

Hall sensors are needed for detecting rotor position and actual speed.
The Hall sensor inputs are protected against overvoltage.

Hall sensor A	Pin number [17] «H_A»
Hall sensor B	Pin number [18] «H_B»
Hall sensor C	Pin number [20] «H_C»
Input voltage range	0 ... +15 V
Input impedance	2 kΩ pull-up resistor to 3.3 V
Voltage level «low»	max. 0.8 V
Voltage level «high»	min. 2.4 V
Continuous over voltage protection	0... +15 V

Suitable for Hall sensor IC's with Schmitt-Trigger behavior and open collector outputs.

5.2 Outputs

5.2.1 +10V_{DC} output voltage «V_{HALL+}»

An internal auxiliary voltage of +10 V_{DC} is provided for:
⇒ Hall sensor supply voltage « V_{HALL+}»
The output is thermal overload protected against short circuit.

+10 V_{DC} output voltage	Pin number [16] « V_{HALL+}»
Referenced to Ground	Pin number [15] «GND»
Output voltage	+10 V_{DC} ± 5 %
Max. output current	35 mA

5.2.2 Motor speed monitor «FG»

The «FG» output gives information on the actual speed of the motor shaft. The actual speed is available as a digital frequency signal (High/Low). The output « FG» is connected to the DSP.

Motor speed monitor	Pin number [29] «FG»
Output voltage range	0 to +3.3 V

Known values
⇒ Number of pole pairs of motor z_{pol}
⇒ Frequency at «FG» output [Hz] respectively Speed n [rpm]

Sought value
⇒ Frequency at «FG» [Hz]
Solution

$$f_{FG} = \frac{n \cdot z_{pol}}{20}\ [Hz]$$

Sought value
⇒ Speed n [rpm]
Solution

$$n = \frac{f_{FG} \cdot 20}{z_{pol}}\ [min^{-1}]$$

5.2.3 Status indication «Ready»

The «Ready» output can be used to report the state of operational readiness or a fault condition to a master control unit. The output «Ready» is connected to the DSP.

In normal cases (no fault) the output is logic “0”.

Ready (no fault) 0 V

In case of a fault the output is logic “1”.

Fault (not ready) +3.3 V

Possible reason for a fault message:

Undervoltage	Fault message occurs in case supply voltage $+V_{cc} < 9.5\ V_{DC}$. To reset the fault condition the amplifier must be disabled and the supply voltage $+V_{cc}$ must be higher than 9.5 V_{DC}.
Overvoltage	Fault message occurs in case supply voltage $+V_{cc} > 35\ V_{DC}$. To reset the fault condition the amplifier must be disabled and the supply voltage $+V_{cc}$ must be lower than 35 V_{DC}.
Thermal overload	Fault message occurs in case power stage temperature exceeds > 100°C. To reset the fault condition the amplifier must be disabled and the power stage temperature must fall below 80 °C
Invalid Hall sensor signals	The amplifier recognizes invalid conditions in the Hall sensor inputs during the power-up. To reset the fault condition the amplifier must be disabled and the Hall sensors must be wired correctly.
Blockage	A lower speed than 415 rpm (motor with 1 pole pair) occurs for longer than 1.0 s. To reset the fault condition the driver must be powered off and back on after reducing the motor load.

5.2.4 Shunt regulator output «PR»

The built-in shunt regulator is designed to limit the supply voltage of the controller.

4-quadrant controllers are able to feed back brake energy into the supply and therefore work like a generator. Thus a long braking process can cause the supply voltage to rise due to the feedback energy. The task of the shunt regulator is to limit the voltage increase up to a permissible value and to transform the excess energy into heat, thus to protect the power supply.

Connector	PIN13, PIN14, Power Resistance
Type of Output	PNP Output
Max. input voltage	32 V_{DC}
Max. load current	10 A
Threshold	Supply voltage 4 V over Power Supply

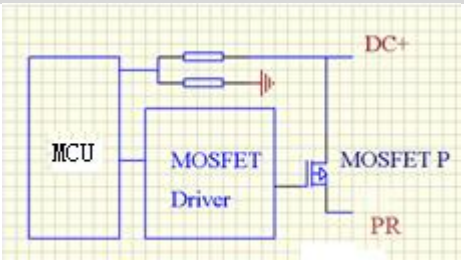


Figure 6: Shunt regulator output circuit

The driver will adjust the threshold voltage based on the voltage of the power supply. The shunt regulator is activated when the voltage of DC bus is 4 V higher than the voltage of power supply and the PMOSFET is on as figure 7. The energy feedback from motor will be consumed by the resistance.

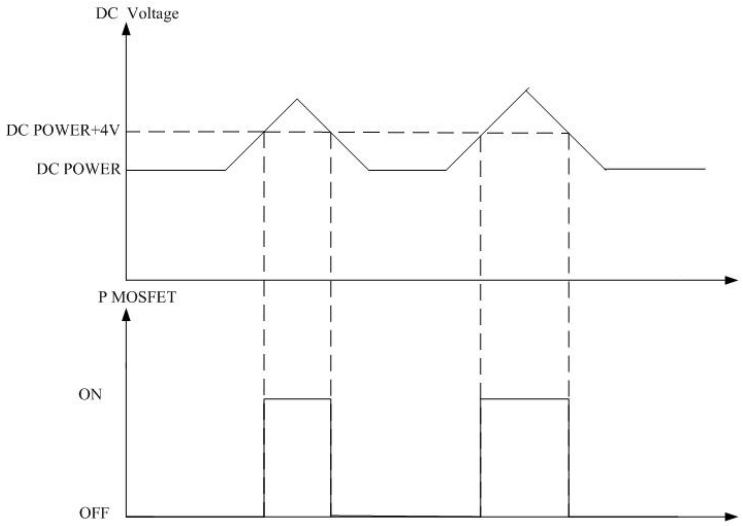


Figure 7: Shunt regulator running curve

The value of resistance is recommended as follows.

Resistance	Voltage of power supply
10 Ω/20 W	+24 V

6. Protective functions

6.1 Undervoltage protection

The power stage will be disabled in case the supply voltage $+V_{CC}$ gets lower than 9.5 V_{DC}.
To reset the fault condition the amplifier must be disabled and the supply voltage $+V_{CC}$ must be higher than 9.5 V_{DC}.
⇒ fault message occurs at the «Ready» output if undervoltage protection is active.

6.2 Overvoltage protection

The power stage will be disabled in case the supply voltage $+V_{CC}$ gets higher than 35V_{DC}.
To reset the fault condition the amplifier must be disabled and the supply voltage $+V_{CC}$ must be lower than 35 V_{DC}.
⇒ fault message occurs at the «Ready» output if overvoltage protection is active.

6.3 Thermal overload protection

The power stage will be disabled in case the power stage temperature exceeds higher than 100 °C.
To reset the fault condition the amplifier must be disabled and the power stage temperature must fall below 80 °C.

6.4 Invalid Hall sensor signals

The power stage will be disabled in case invalid conditions in the Hall sensor inputs during power-up.
To reset the fault condition the amplifier must be disabled and the Hall sensors must be wired correctly.
⇒ fault message occurs at the «Ready» output if invalid hall sensor signals is active.

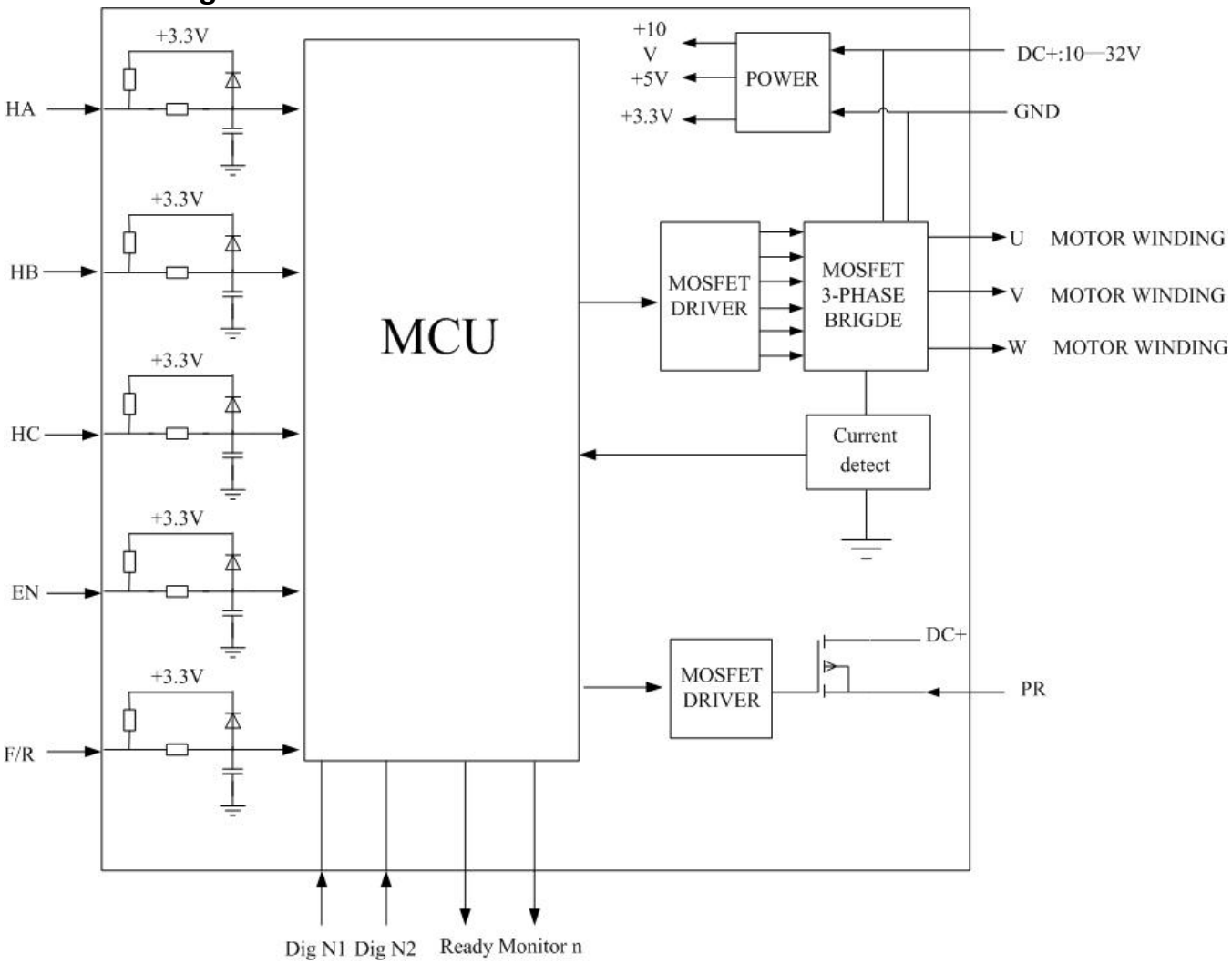
6.5 Blockage protection

If the motor shaft is blocked for longer than 1.0 s, the current limit is set to the predetermined value at the «Set current limit» input.
Definition «Motor shaft blocked»: A lower speed than 415 rpm (motor with 1 pole pair) occurs for longer than 1.0 s.
Note
⇒ fault message occurs at the «Ready» output if blockage protection is active.

6.6 Current limitation

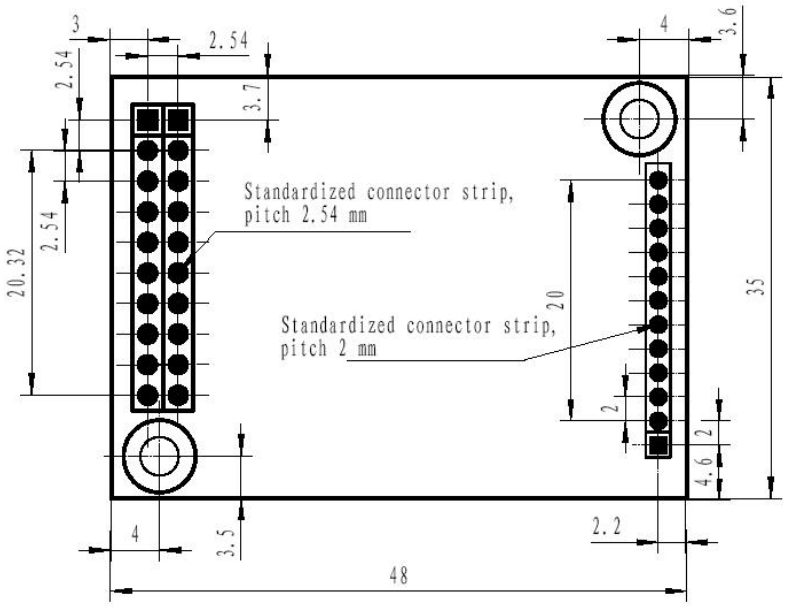
The motor current will be restricted to 0.5 … 15 A depending on the value applied to the input «Set current limit» by means of a cycle-to-cycle limitation
(see chapter «5.1.5 «V_{CL}»).
Note
⇒ No fault message occurs at the «Ready» output if current limitation is active.

7. Block Diagram



8. Dimensional Drawing

Dimensions in [mm]



9. Accessories (not included in delivery)

D50/5/4Q-M2	Module Evaluation Board

10. Appendix «Motherboard Design Guide»

10.1 Introduction

The present documentation «Motherboard Design Guide» contains helpful information on the integration of the D30/7.5/4Q-E2 into printed circuit boards. Contained therein are recommendations for possibly needed 3rd party components, suggestions on layout, terminal assignment as well as circuit samples.

Warning:

Development of printed circuits boards requires specific qualification and should only be performed by experienced electronics engineers. The present brief instruction is intended to serve as supporting aid only and does not claim completeness. Upon request, Boreasa is glad to assist and to offer customer-specific motherboard designs.

10.2 External components

10.2.1 Pin socket

The connector arrays used in the D30/7.5/4Q-E2 permits two possible types of connections. The module can either be mounted on socket terminal strips or soldered directly into the printed circuit board.

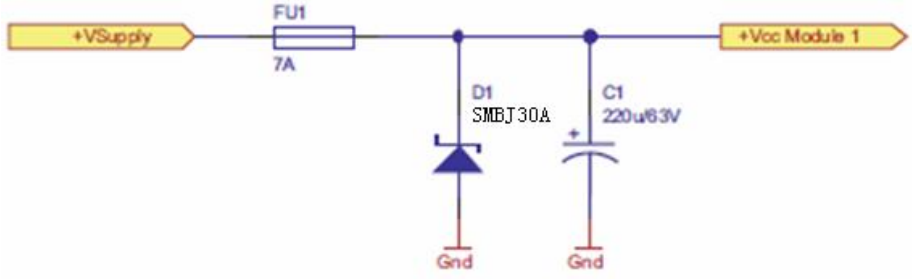
Pin socket recommendations:

Specifications:

- Pin socket vertical, double row, mates with pin header 0.63 x 0.63 mm, pitch 2.54 mm, 2 A, contact material gold or brass
- Pin socket vertical, single row, mates with pin header 0.5 x 0.5 mm, pitch 2 mm, 2 A, contact material gold or brass

10.2.2 Supply voltage

To protect the D30/7.5/4Q-E2 from damage an external fuse, a TVS-diode and a capacitor in the power supply voltage line are recommended



Fuse FU1:

To protect against reverse polarity, place a fuse at the entry of the power supply. Together with the TVS-diode, the fuse breaks an occurring reverse current.

Recommendations for the fuse:

- Littlefuse 154 Series OMNI-BLOK® fuse holder with SMD NANO$_2$ ® Fuse installed:
  154007, 7 A very fast-acting

TVS-Diode D1:

To protect against overvoltage due to supply transients or the braking energy, connect a transient voltage suppressor diode to the power supply voltage.

Recommendations for the TVS-diode:

- Vishay SMBJ30A
  U_R=30 V, U_{BR} = 33…36 V @1 mA, U_C = 44.6 V @ 12 A

Capacitor C1:

An external capacitor is not mandatory for the function of the D30/7.5/4Q-E2. To reduce the voltage ripple in addition a electrolyte capacitor can be connect to the power supply voltage.

Recommendations for the capacitor:

- Panasonic EEUFC1J221S

Rated voltage 63 V, Capacitance 220 µF, Ripple Current 1285 mA
- Rubycon 63ZL220M10X23
  Rated voltage 63 V, Capacitance 220 µF, Ripple Current 1120 mA
- Nichicon UPM1J221MHD
  Rated voltage 63 V, Capacitance 220 µF, Ripple Current 1300 mA

10.2.3 Motor phase

The D30/7.5/4Q-E2 has no built-in choke per phase.
For the most motors and applications no additional motor chokes are necessary. In case of high power supply voltage $+V_{CC}$ and a motor with very low inductance the current ripple will become too high, additional chokes on the motherboard are needed. The minimum inductance of each choke can be calculated with the formula below.

$$L_{Phase} \geq \frac{1}{2} \cdot \left(\frac{V_{CC}}{6 \cdot f_{PWM} \cdot I_N} - 0.3 \cdot L_{Motor} \right)$$

L_{Phase} [H] External inductance per phase

V_{CC} [V]	Power supply voltage $+V_{CC}$
f_{PWM} [Hz]	PWM frequency = 50 000 Hz
I_N [A]	Nominal motor current
L_{Motor} [H]	Terminal inductance phase to phase of the motor

If the result of the formula is negative, no additional chokes are needed.
The chokes must have an electromagnetic shield, high saturation current, low losses and a rated current higher than the continuous motor current.
Recommendation for the motor choke:
- Würth Elektronik WE-PD-XXL 7447709220
  LN = 22 µH, RDC = 23.3 mΩ, IDC = 5.3 A, Isat = 6.5 A, shielded
- Coiltronics DR127-220
  LN = 22 µH, RDC = 39.1 mΩ, IDC = 4.0 A, Isat = 7.6 A, shielded
- Würth Elektronik WE-PD-XXL 7447709150
  LN = 15 µH, RDC = 21 mΩ, IDC = 6.5 A, Isat = 8.0 A, shielded
- Sumida CDRH129RNP-150MC
  LN = 15 µH, RDC = 16 mΩ, IDC = 6.0 A, Isat > 6.0 A, shielded
- Coiltronics DR127-150
  LN = 15 µH, RDC = 25 mΩ, IDC = 5.0 A, Isat = 9.7 A, shielded
- Bourns SRR1280-150M
  LN = 15 µH, RDC = 28 mΩ, IDC = 5.2 A, Isat > 5.2 A, shielded
- Würth Elektronik WE-PD-XL 744770115
  LN = 15 µH, RDC = 24 mΩ, IDC = 5.0 A, Isat = 6.0 A, shielded
- Sumida CDR127/LDNP-150M
  LN = 15 µH, RDC = 20 mΩ, IDC = 5.7 A, Isat > 5.7 A, shielded

10.3 Design rules

To help customers designing an application specific motherboard and for correct and save function of the D30/7.5/4Q-E2 these rules can be followed.

10.3.1 Ground

The ground (GND) pins of the D30/7.5/4Q-E2 are internally connected (same electrical potential). It is common practice to place a ground plane on the motherboard and it is necessary to connect pins [9], [10], [11], [12], [15] and [32] with thick tracks to the power supply voltage ground.

Pin	Signals	Description
9	GND	Ground
10	GND	Ground
11	GND	Ground
12	GND	Ground
15	GND	Ground

32	GND	Ground

If ground safety earth is available, connect the ground plane over some parallel capacitors to the ground safety earth. Ceramic capacitors with 10 nF and 100 V are suggested.

10.3.2 Layout

Motherboard layouts for D30/7.5/1Q-E2 should follow these rules:

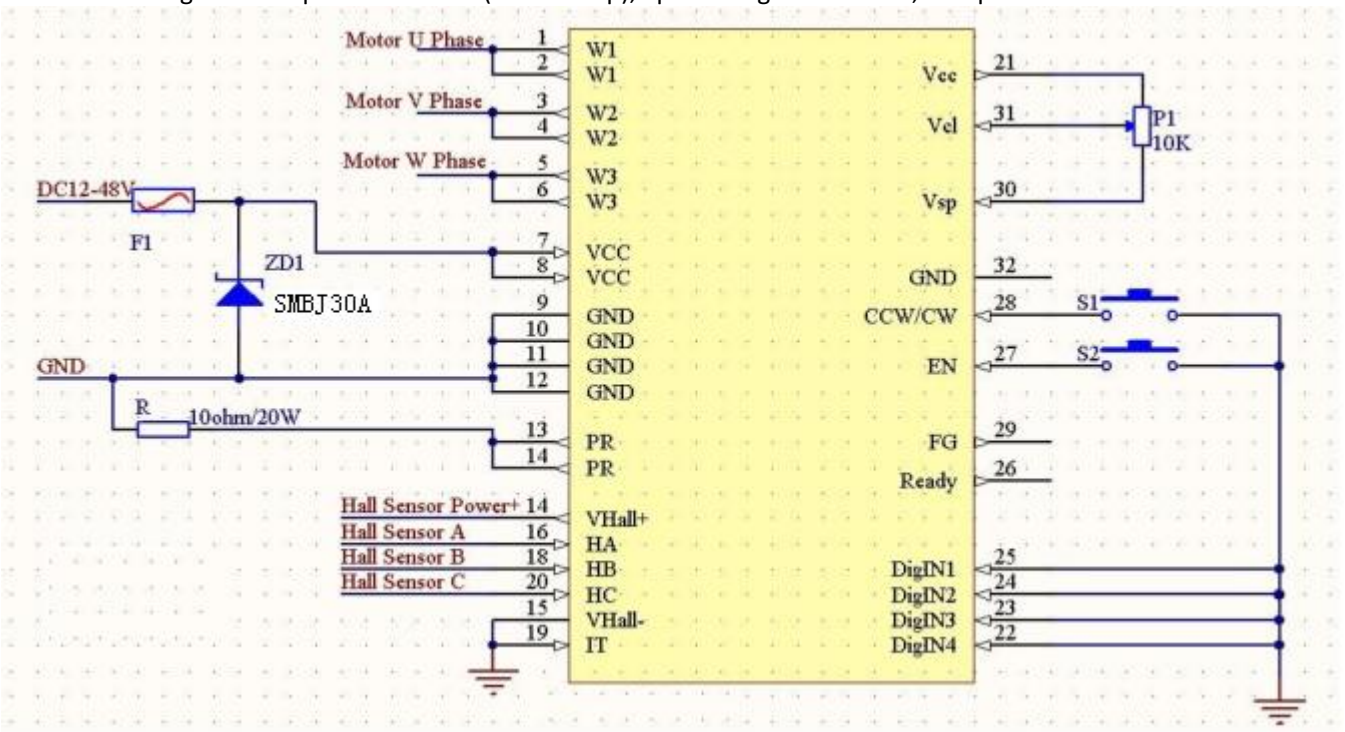
- Pins [7] and [8] +VCC: Use thick track to connect to the fuse.
- Pins [9], [10], [11], [12], [15] and [32]: Use thick tracks to connect to supply voltage's ground (GND).
- The width and copper plating thickness of the power supply voltage and motor winding traces depend on the maximum current expected in the application. A minimum of 75 mil width at 70 µm thickness is recommended.

10.4 Schematic examples

10.4.1 Minimum external wiring

Power supply (10 to 32 V_{DC}); Boreasa blowers with Hall sensors; External set value speed potentiometer (10 kΩ); Enable switch

Configuration: Speed controller (closed loop); Speed range 1000 to 60,000 rpm.



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