

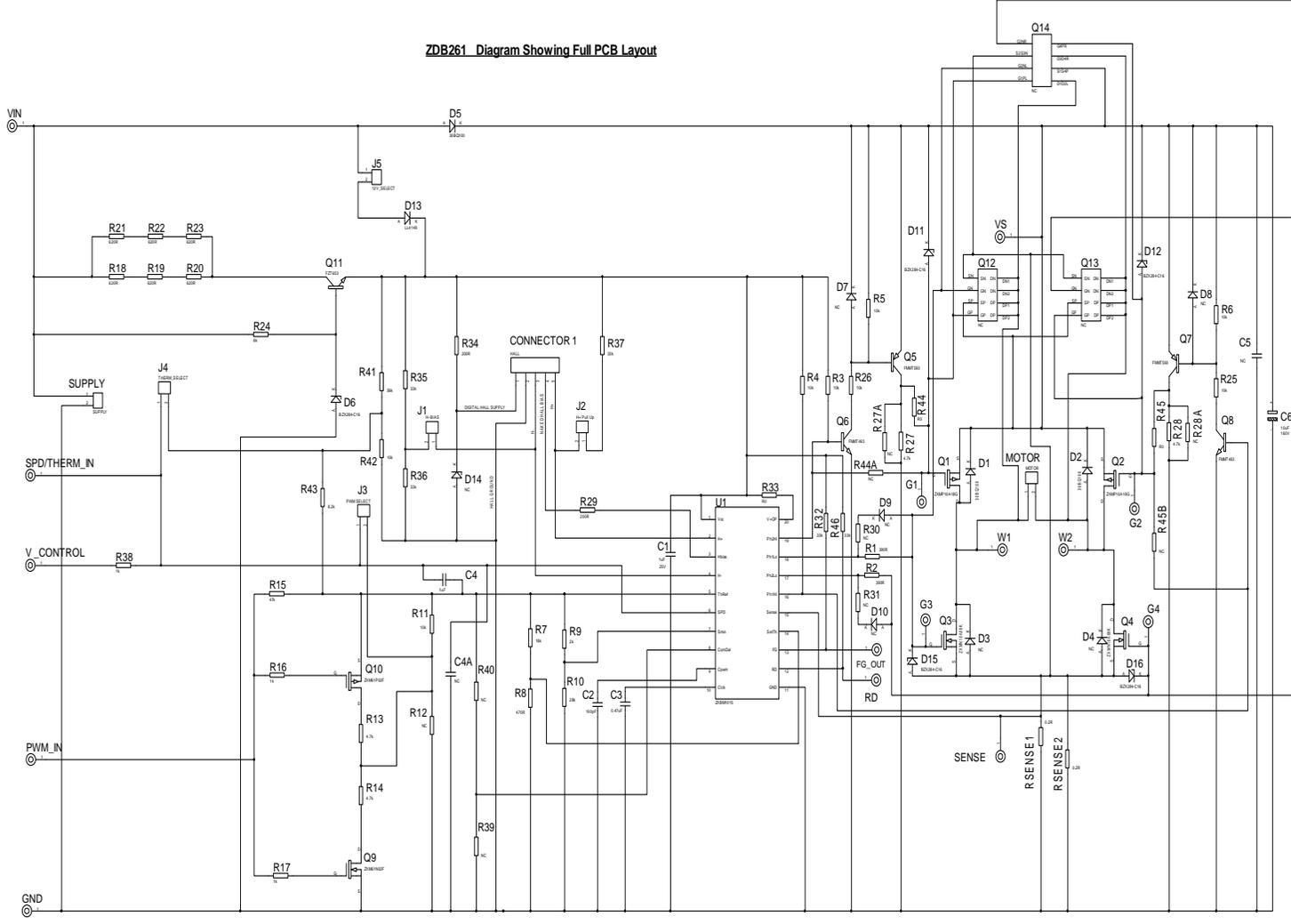
ZXBM1015EV1

REFERENCE DESIGN

ZXBM1015EV1 is configured to the reference design below.

For other reference designs or further applications information please refer to the ZXBM1015 datasheet.

Schematic Diagram

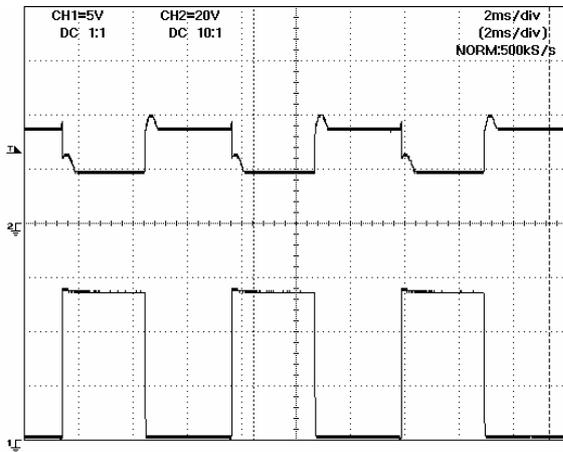


Bill of Materials

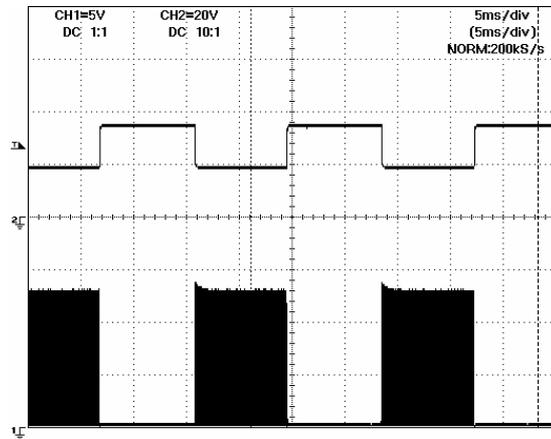
Quantity	Identification	Value	Description	Suggested Source
2	R1,R2	390R	SMD 0805 1% generic	
8	R3-R6,R11,R25,R26,R42	10K	SMD 0805 1% generic	
1	R7	18K	SMD 0805 1% generic	
1	R8	470R	SMD 0805 1% generic	
1	R9	2K	SMD 0805 1% generic	
1	R10	27K	SMD 0805 1% generic	
2	R13,R14	4.7K	SMD 0805 1% generic	
2	R27,R28	4.7K	SMD 1206 1% generic	
1	R15	47K	SMD 0805 1% generic	
3	R16,R17,R38	1K	SMD 0805 1% generic	
1	R33	0R	SMD 1206 1% generic	
6	R10-R23	620R	SMD 1210 1% generic	
1	R24	6K2	SMD 1206 1% generic	
2	R29,R34	200R	SMD 0805 1% generic	
5	R32,R35-R37,R46	33K	SMD 0805 1% generic	
1	R41	56K	SMD 0805 1% generic	
1	R43	8.2K	SMD 0805 1% generic	
2	R44,R45	0R	SMD 0805 1% generic	
2	RSENSE1,RSENSE2	0R2	1206 5% Welwyn LR120602J	Farnell 774-6148
1	C1	1 μ F	25V 1206 X7R	Farnell 471-6620
1	C2	100pF	50V 0805 COG	RS 211-3108
1	C3	0.47 μ F	16V 0805 X7R	Farnell 422-7116
1	C4	1 μ F	16V 0805 X7R	RS 451-5770
1	C6	10 μ F	160V Electrolytic 10Dia 5Pitch	Rs 365-4565
1	U1	ZXBM1015TS20	Motor Controller	Zetex Semiconductors
2	Q1,Q2	ZXMP1018G	SOT223 P MOSFET	Zetex Semiconductors
2	Q3,Q4	ZXMN10A09K	DPAK N MOSFET	Zetex Semiconductors
2	Q5,Q7	FMMT593	SOT23 PNP Bipolar	Zetex Semiconductors
2	Q6,Q8	FMMT493	SOT23 NPN Bipolar	Zetex Semiconductors
1	Q9	ZXM61N02F	SOT23 N MOSFET	Zetex Semiconductors
1	Q10	ZXM61P02F	SOT23 P MOSFET	Zetex Semiconductors
1	Q11	FZT653	SOT223 NPN Bipolar	Zetex Semiconductors
3	D1,D2,D5	30BQ100	SMC Diode, 3A 100V	RS 254-0695
5	D6,D11,D12,D15,D16	BZX284C16	SOD110 16V Zener Diode	Farnell 935-700
1	D13	LL4148	MINIMELF Diode	Farnell 739-182

PERFORMANCE

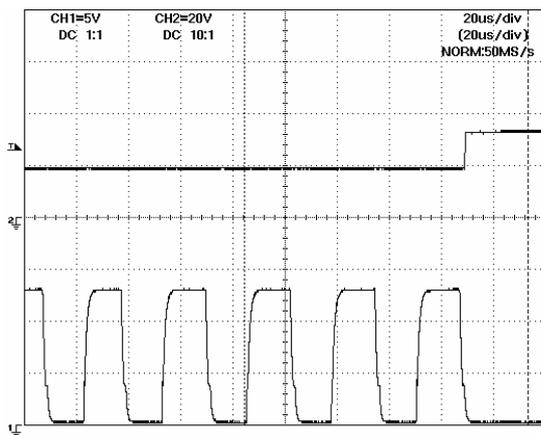
Test Point Waveforms



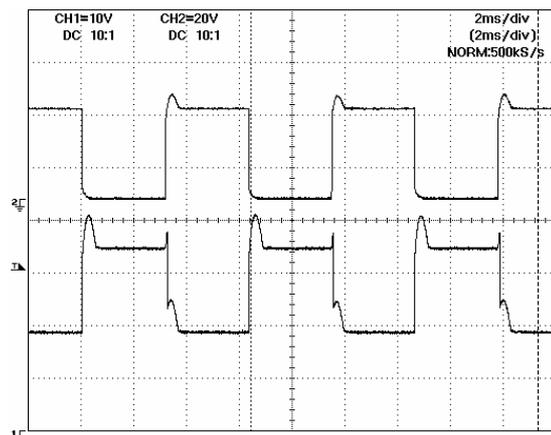
Trace 1 above is G3 and trace 2 is G2. These are the gate drives to MOSFETs Q3 and Q2. Motor is running at full speed.



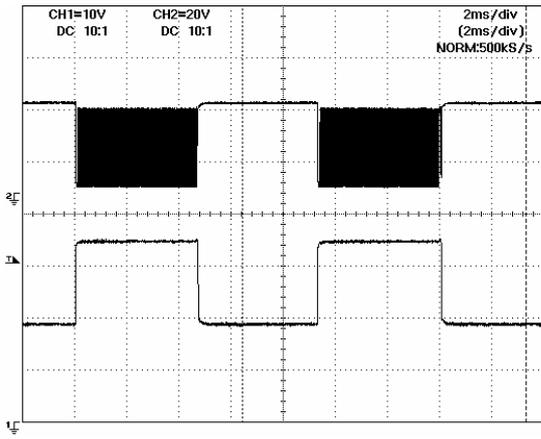
Trace 1 above is G3 and trace 2 is G2. These are the gate drives to MOSFETs Q3 and Q2. Input to the PWM_IN pin is 50%.



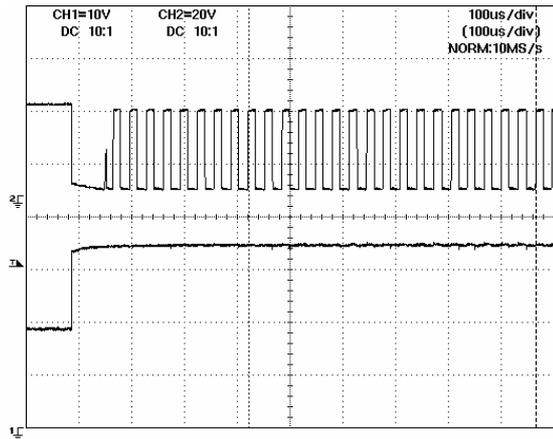
Trace 1 above is G3 and trace 2 is G2. These are the gate drives to MOSFETs Q3 and Q2. Input to the PWM_IN pin is 50%. Time base has been expanded to show the PWM switching waveform.



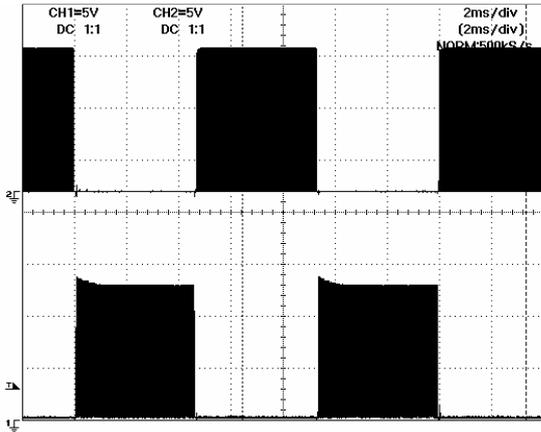
Trace 1 above is G1 showing the voltage on the gate of transistor 1 and trace 2 is voltage on motor winding W1. Motor is running at full speed.



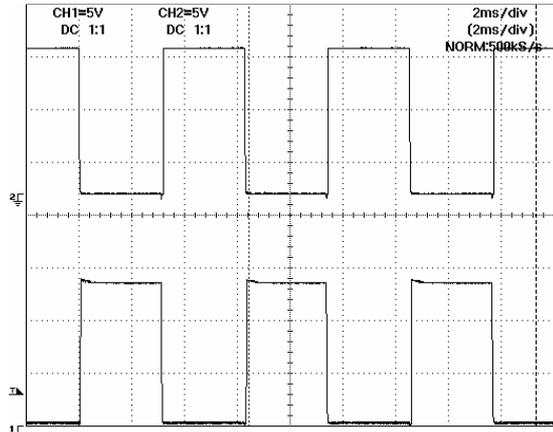
Trace 1 above is G1 showing the voltage on the gate of transistor 1 and trace 2 is voltage on motor winding W1. Motor is running at 50% PWM_IN input.



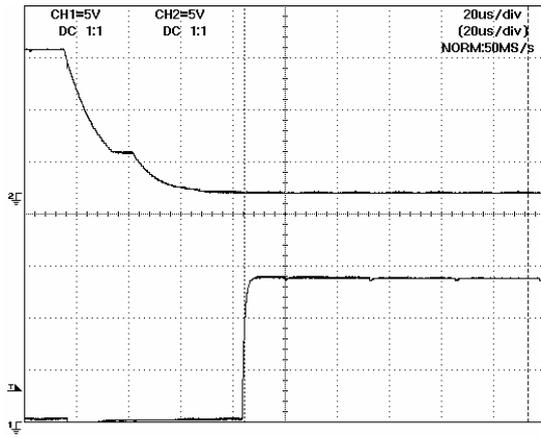
Trace 1 above is G1 showing the voltage on the gate of transistor 1 and trace 2 is voltage on motor winding W1. Motor is running at 50% PWM input. Time base has been expanded to show PWM switching.



Trace 1 is MOSFET gate G3 and Trace 2 is MOSFET gate G4. Motor is running at 50% PWM_IN input.



Trace 1 is MOSFET gate G3 and Trace 2 is MOSFET gate G4. Motor is running at full speed.



Trace 1 is MOSFET gate G3 and Trace 2 is MOSFET gate G4. Motor is running at full speed. Time base has been expanded to show commutation delay.

ZXBM1015EV1 OPERATION

Specification

Input voltage (Vcc)	48V (Min 24V, Max 70V)
Input voltage (Vcc) with modification	12V (Min 6V, Max 18V)
Maximum Current	3A
PWM output frequency	200Hz to 100kHz (25kHz nominal)
PWM output duty cycle	0% to 100%
PWM input frequency	200Hz to 100kHz (25kHz nominal)
PWM input voltage	3V to 5V
PWM input duty cycle	0% to 100%
Thermistor Input	10k Ω NTC, 100K Ω NTC
SPD input voltage	1V to 3V

Terminals

VIN	+Supply input voltage
GND	Supply 0V
W1	Motor coil connection
W2	Motor coil connection
H+	Hall sensor positive input
H-	Hall sensor negative input (four pin naked Hall only)
Hall Bias	Hall sensor supply (four pin naked Hall only)
Hall Vcc	Hall sensor supply (three pin digital Hall only)
FG out	Motor speed output signal
PWM_IN	External PWM control input
G1- G4	MOSFET gate drive terminals (or Bipolar Transistor base drive terminals)

Jumpers

J1 (H-BIAS) - Select when using 3 pin Hall Sensor. Connects R35, R36 potential divider to H- pin.

J2 (H+ Pull Up) - Select when using 3 pin Hall Sensor with open collector (or drain) output.

J3 (PWM SELECT) – Selects external PWM input control option.

J4 (THERM_SELECT) – Selects 10K thermistor linearization resistor network. Leave open for 100K thermistor.

J5 (12V_SELECT) – Selects low voltage (12V to 18V) input option. Other modifications required as described later.

Terminals and Jumpers Positions

Figure 1 below shows the positions on the PCB of the terminals and jumpers described above.

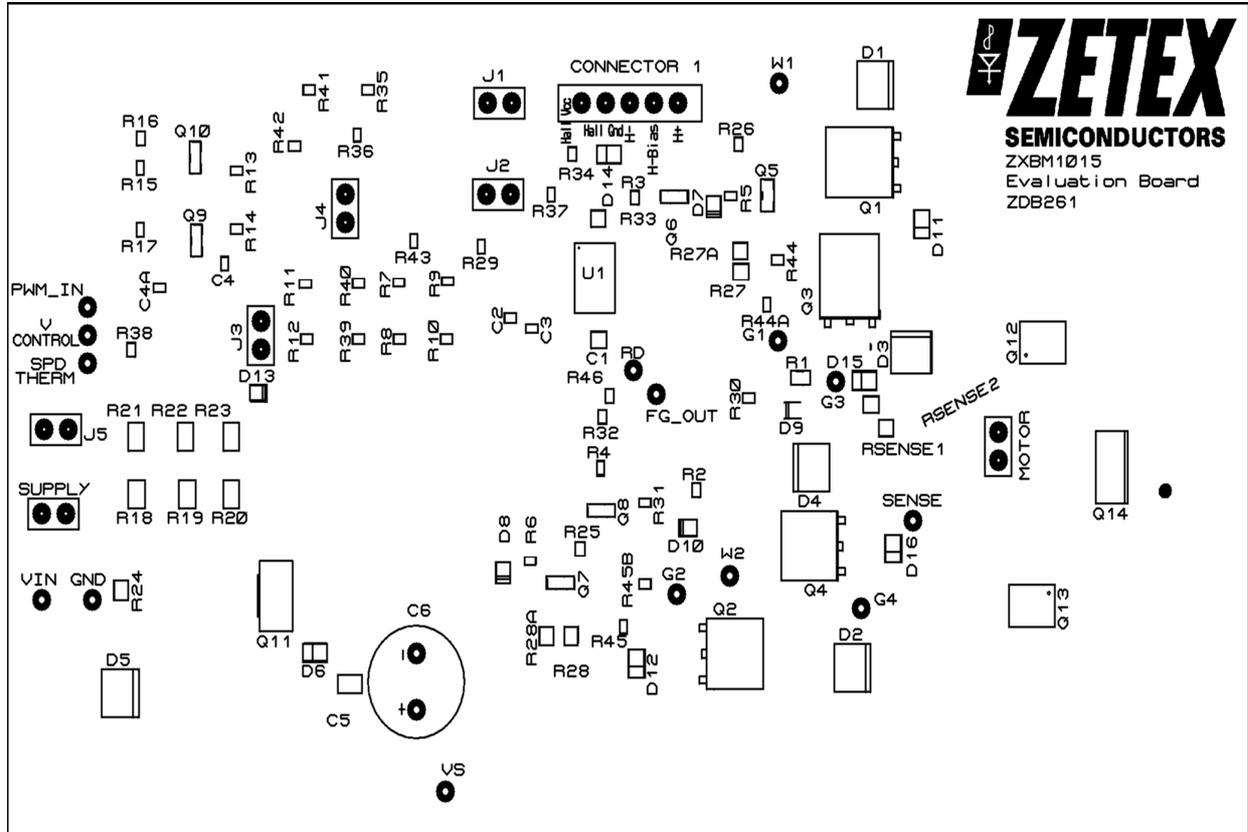


Figure 1

Voltage Control

For voltage control, connections to the PCB are illustrated in Figure 2 below. A digital (buffered) Hall Sensor with open collector output is used in this example.

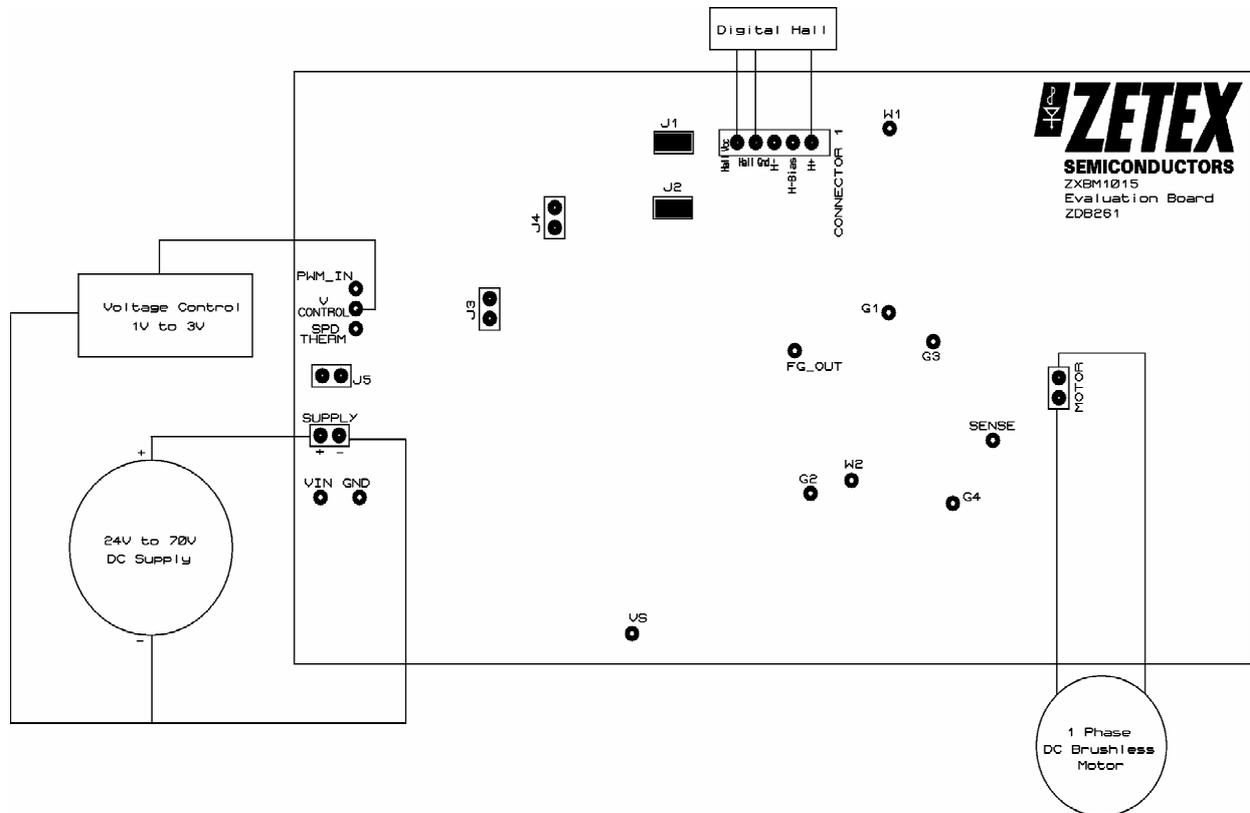


Figure 2

The control voltage is varied from 3V (0% PWM) to 1V (100% PWM). The ZXBM1015 has a linear voltage to PWM response. The speed response varies for different motor designs.

Thermistor Control

For thermistor control, connections to the PCB are illustrated in Figure 4 below. A digital (buffered) Hall Sensor with open collector output is used in this example.

The thermistor is 10KΩ NTC and J3 selects the linearization resistor network. For 100KΩ thermistor J3 would be left open and all other connections would remain as below.

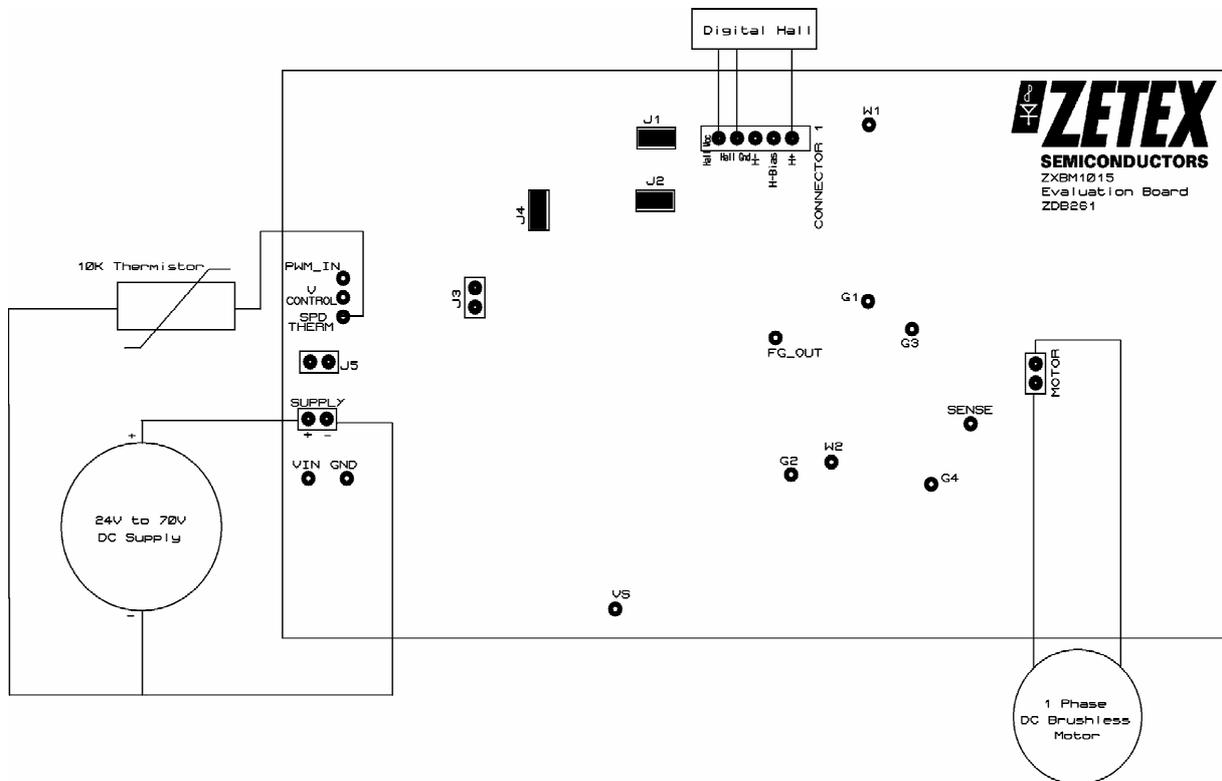


Figure 4

The circuit for the above configuration is Figure 5 below.

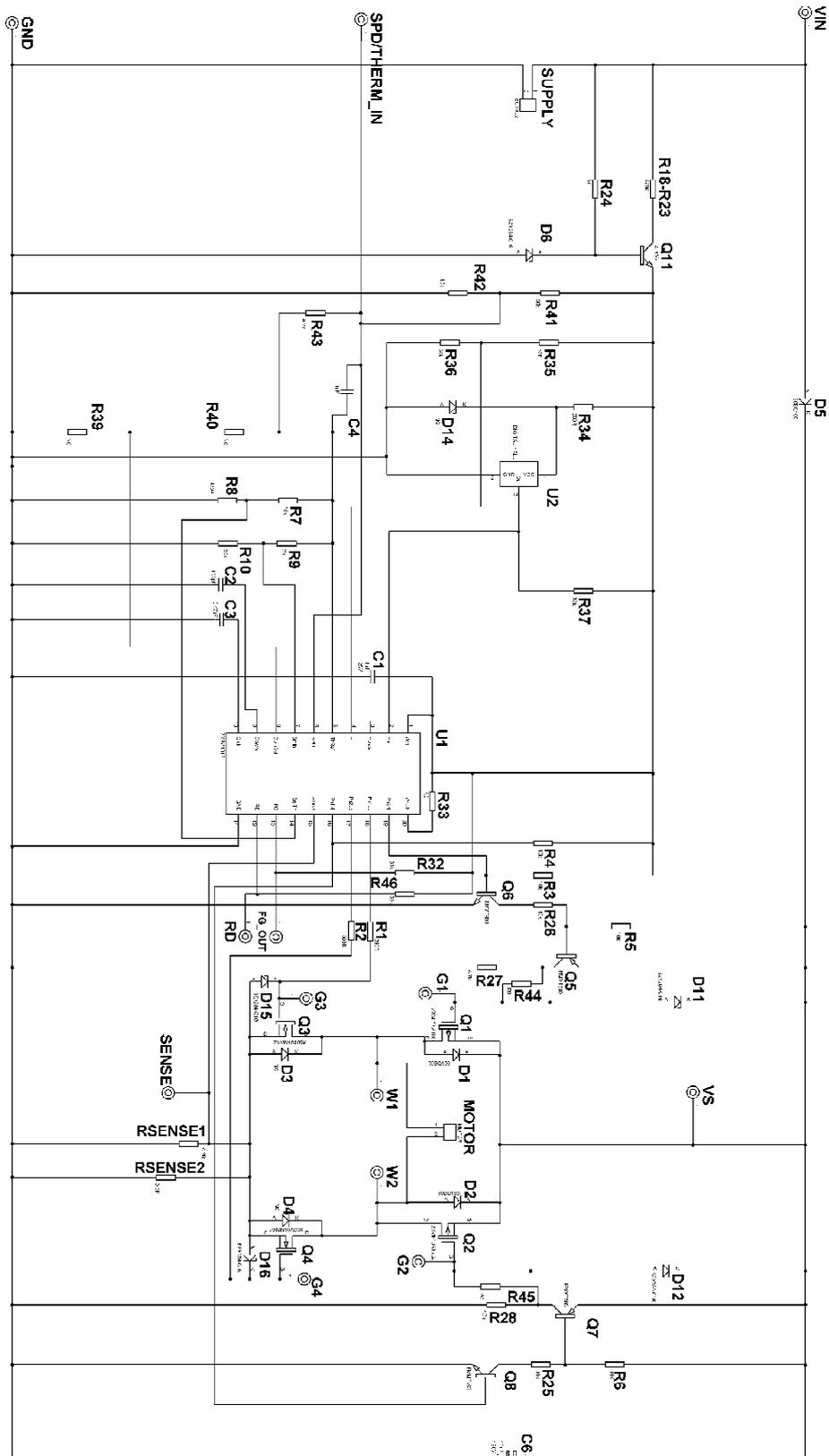


Figure 5

PWM Control

For PWM control, connections to the PCB are illustrated in Figure 6 below. A Naked Hall Sensor is used in this example.

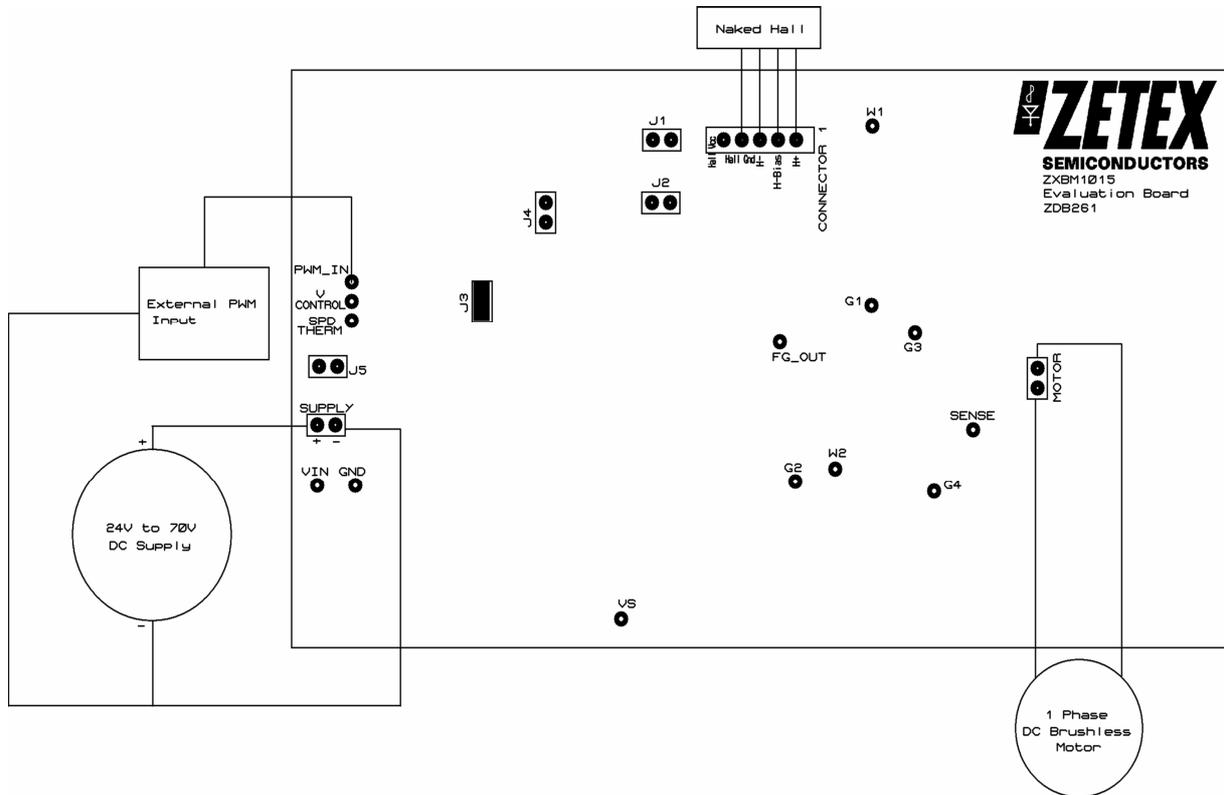


Figure 6

Zetex application note AN42 details the adjustment of resistors R11, R12, R13 and R14 in order to get the required response.

Configuration for Low Voltage (6V to 18V) Input

For input voltages below 18V the input regulator and the output level shift transistors need to be bypassed. This is done as follows: Remove (de-solder) transistors Q6, Q8, resistors R24, R44 and R45. Connect jumper J5 (12V select). Insert resistors R44A and R45B (both 47Ω 0805).

Half Bridge and Full Bridge Options

The board layout enables the use of two complementary half bridge devices in SO8 packages (e.g. ZXMC6A09DN8) or one full bridge device in SM8 package (e.g. ZXHMC6A07T8). The pin-out for the half bridge devices follows the industry standard. Full bridge devices are not common and the pin-out is for the current Zetex standard which may be changed for future products.

Layout considerations

PCB tracks should be kept as short as possible to minimize ground bounce, and the ground pin of the device should be soldered directly to the ground plane.

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