Demonstration Board for the SA306

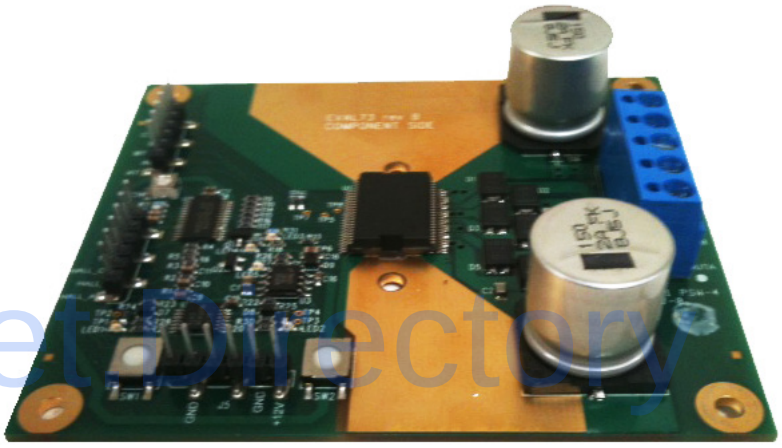
INTRODUCTION

The DB73HR is designed to demonstrate the capabilities of the SA306 3 phase brushless DC (BLDC) motor driver IC. This fully assembled demonstration allows the user to directly control the speed and direction of the motor. An onboard controller decodes HALL Effect sensor inputs for commutation in either direction and provides four quadrant PWM signals to control the power outputs of the SA306. LEDs provide visual feedback for motor control status and fault indications. Provisions on the DB73HR allow the user to bypass the onboard control circuit and directly interface with the SA306 brushless motor driver.

The DB73HR demonstrates proper layout techniques for the SA306 high current switching amplifier. The economical construction uses only a two-sided PCB and allows the SA306 to dissipate up to 5W.

THERMAL CONSIDERATIONS

The SA306 is offered in a surface mount package which can deliver peak power of over 1kW. This presents an obvious and significant thermal challenge. The DB73HR offers a compact design which can deliver 17A peak current. The DB73HR assembly can dissipate approximately 5W in still air at 25ºC ambient temperature. To use the DB73HR in higher power applications, use of a fan is recommended. Although the SA306 is rated for operation from -25 to +85ºC, the other components on the DB73HR are limited to 0 to 70ºC ambient temperature.



DataSheet Directory

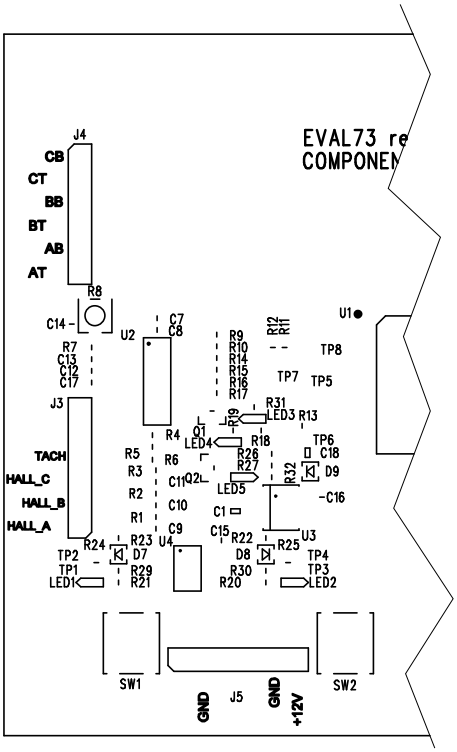
CIRCUIT OPERATION

The DB73HR control circuit receives power via two terminal block connections. The Vs connection supplies power to drive the motor and must be above the under-voltage lockout threshold of the SA306, approximately 8.3V. The control circuit requires 12V for proper operation. A regulator on the DB73HR provides the 5V logic supply for the SA306. There are no special considerations for sequencing the two supplies.

Figure 1 shows the user control features of the DB73HR. The PWM duty cycle is controlled with the potentiometer. LED5 will illuminate when the 12V supply is connected. The DB73HR will power up with the SA306 disabled. SW2 will toggle the SA306 on and off with LED2 illuminating to indicate the enable status. Direction of the motor is similarly controlled with SW1 and is indicated by the LED1.

The DB73HR monitors the Temperature warning status pin of the SA306. If this pin goes high LED4 illuminates and the enable circuit is forced to a disable status. The temperature LED is not latched and may stay illuminated only briefly while the temperature of the SA306 is above 135ºC. The temperature decrease rapidly via the heatsink once the SA306 is disabled. The SA306 current limit feature is set to limit at approximately 15A to provide a demonstration of the full capabilities of the SA306. LED3 will illuminate if the SA306 cycle-by-cycle current limit circuit engages. The thermal and current limit features are robust, but will not protect the SA306 in all circumstances. The user must consider the worst case thermal and power dissipation conditions.

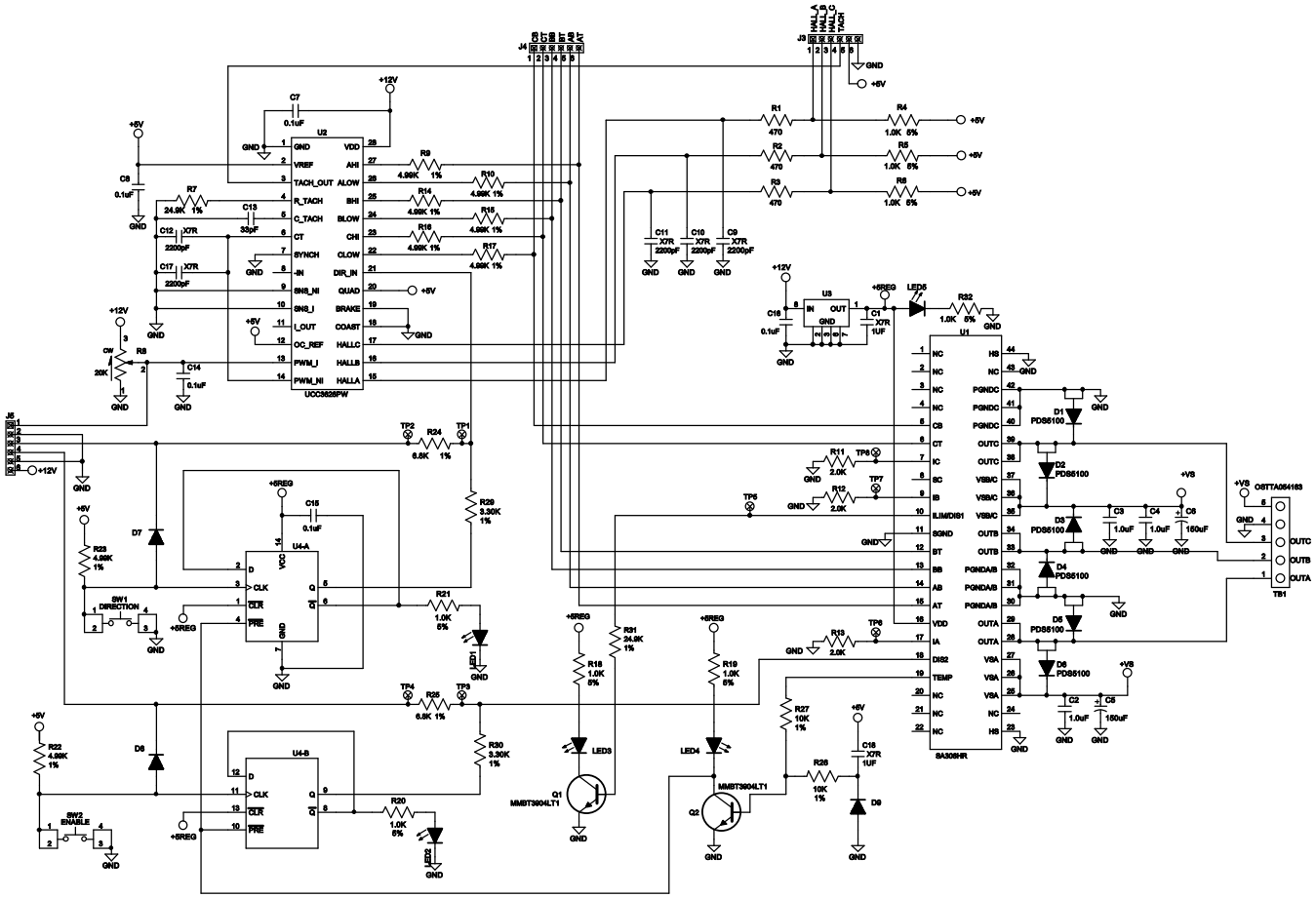
Figure 1 – User Control Features



Copyright © Apex Microtechnology, Inc. 2012
(All Rights Reserved)

Hall Effect inputs to connector J3 are required to commutate the motor correctly. Filtering networks and 5V pull-up are provided for glitch-free operation. The Hall sensor connector, J3, also includes a tachometer output which is based on the commutation signals from the Hall inputs. Power for the Hall sensors is provided by U2 in figure 3, an integrated brushless motor controller IC. The controller decodes the Hall sensor inputs and generates six PWM control signals directly to the SA306. Push-button switches 1 and 2 trigger latches (U4) for direction and enable control, respectively. Diodes D7 & D8 and resistors R24, 25, 29 & 30 provide a means of bypassing the DB73HR control circuit. The 5V regulator, U3, provides 5V to the SA306, the latches and the status LEDs.

Figure 2 – Schematic



ENHANCING & BYPASSING THE DB73HR CONTROL CIRCUIT

Connector J5 allows the user to bypass many of the manual control features of the DB73HR. A signal generator can control the duty cycle with a 2.5 to 7.5V signal, overriding the control potentiometer. A rising 5V edge on pin 3 or 4 of connector J5 will toggle the Direction or Enable latches, respectively. By jumping resistors R24 & R25, the latches are bypassed completely and the logic signals on pins 3 & 4 will directly control the direction and enable functions of the DB73HR. With these resistors jumped, the direction and enable LEDs will not represent the states of the DB73HR and the push buttons will have no effect on the operation. The Temperature disable feature of the DB73HR will also not function, although the LED will continue to provide over-temperature status.

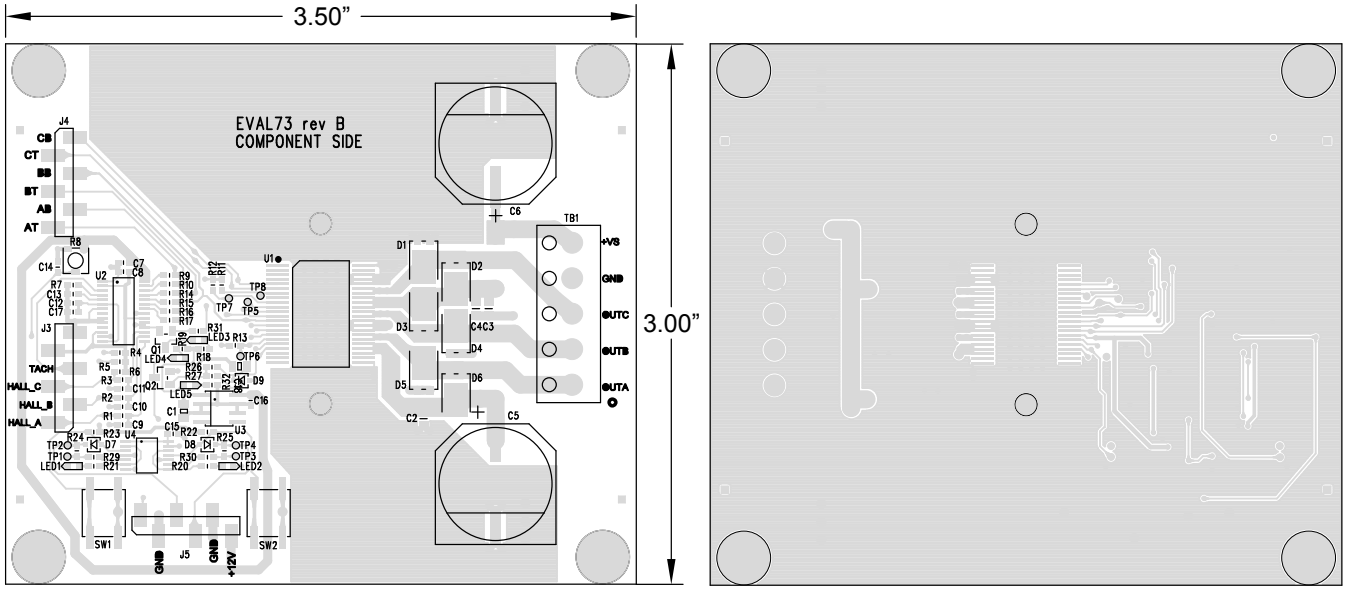
Connector J4 is connected directly to the PWM input pins of the SA306. This connector may be used to monitor the signals or to bypass the control IC on the DB73HR. The enable function is not controlled via these pins, although pulling all six input pins low provides the same effect. The Enable push button and the connection via J5 are also effective as previously described. The circuit shown in figure 2 in the dashed box is a simple circuit that allows the user to monitor and control the enable or direction status remotely. Either feature can be toggled on the falling edge of the signal at the node labeled TOGGLE.

LAYOUT CONSIDERATIONS

A simple two layer construction is sufficient because of the convenient pinout of the SA306 HSOP package. Input signals are routed into one side of the package and high power output signals are routed from the other side in 2 ounce copper. This eliminates the need to route control signals near motor connections where noise may corrupt the signals. Filling top and bottom layers with copper reduces inductive coupling from the high current outputs. 1nF capacitors with excellent high frequency characteristics bypass the Vs motor supplies on each phase. Two 150µF electrolytic capacitors provide a local, low inductance source to accommodate surge currents up to 17A. Six 100V Schottky diodes conduct the commutation current via low forward voltage paths which reduces the power dissipation in the SA306. These diodes are rated for 5A continuous and are mounted close to the SA306 to reduce inductance in the commutating current loop. For applications with continuous currents less than 5A, the Schottky diodes may not be necessary if the higher forward voltage internal body diodes and the associated power dissipation are manageable during commutation cycles.

Figure 3 shows the top and bottom layouts of the EVAL73. Gerber files for the circuit board are available upon request.

Figure 3 – PCB Layout (not to scale)



TOP SIDE BOTTOM SIDE

BILL OF MATERIALS

Designation	Description	P/N
C1,C18	CAP, 1.0uF, 16V	Kemet, C0805C105K4RAC
C13	CAP, 33pF, 50V	Kemet C0603C330J5GACTU
C2,C3,C4	CAP, 1.0nF,100V	Kemet,C0805C102J1GACTU
C5,C6	CAP, 150uF, 100V	Panasonic, EEVFK2A151M
C7,C8,C14,C15,C16	CAP, 0.1uF, 16V	GRM188F51C104ZA01D
C9,C10,C11,C12,C17	CAP, 2.2nF, 50V	GRM188R71H222KA01D
D1,D2,D3,D4,D5,D6	Diode, 5A Schottky	Diodes Inc. DS5100
D7,D8,D9	IN4148	Vishay, 1N4148WS-V-GS08
J3,J4,J5	Conn, 6 pin .100 ctrs	Samtec TSM-106-01-T-SV
LED1, LED2, LED3, LED4, LED5	LED, Red	Lite-On LTST-C190CKT
Q1,Q2	XTR, NPN, 40V	MMBT3904LT1
R1,R2,R3	RES, 470, 5%	RK73B1JTTDD471J
R11,R12,R13	RES 2.0K, 1%	Vishay,CRCW06032K00FKEA
R24,R25	RES, 6.8K	Vishay,CRCW06036K80FKEA
R26,R27	RES, 10K	Vishay,CRCW060310K0FKEA
R29,R30	RES, 3.3K	Vishay,CRCW06033K30FKEA
R4,R5,R6,R18,R19,R20,R21,R32	RES, 1.0K, 5%	RK73B1JTTD102J
R7,R31	RES, 24.9K,1/10W, 1%	RK73H1JTTD2492F
R8	POT, 20K	PVG3A203C01R00
R9,R10,R14,R15,R16,R17,R22,R23	RES, 4.99K	Vishay,CRCW06034K99FKEA
SW1,SW2	Pushbutton, SPST-NO	Panasonic, EVQ-Q2B01W
TB1	Term. Blk., 5.08mm Vert. 5 pos, PCB	OSTTA054163
U1	SA306HR-FH	Apex Microtechnology, SA306HR-FH
U2	UCC3626	Texas Instruments, UCC3626PW
U3	LM78L05	National Semiconductor, LM78L05ACMX/NOPB
U4	74AC74	Texas Instruments, SN74AC74PW
	Heatsink	Apex Microtechnology, HS36, 2.8ºC/W
	PCB, 3.0" x 3.5"	Apex Microtechnology, EVAL73
	Screw, #4-40 x 1/2”	18-8 SS Pan Head Phillips 91772A110
	Solder	Paste INDC121NCSMQ90 83% MTL MSH-325+500

DB73HR Quick Start Guide

1. Connect the following:

Connection	Location	Indicator	Comment
Vs	TB1		9-60V
Ground	TB1		
Vctrl	J5-6	LED 2	12V
Motor Phase A	TB1		
Motor Phase B	TB1		
Motor Phase C	TB1		
Hall Sensor A	J3-1		
Hall Sensor B	J3-2		
Hall Sensor C	J3-3		
Hall 5V	J3-5		Output from PCB
Hall ground	J3-6		

2. Apply 12V to Vctrl. LED5 should light.
3. Apply voltage to Vs based on rated motor voltage, normally 12-48V.
4. Press ENABLE SW2. LED2 will light and motor should start.

ORDERING INFORMATION

DB73HR Demonstration Board includes one populated EVAL73 rev B PCB and one SA306HR-FH sample

NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

For all Apex Microtechnology product questions and inquiries, call toll free 800-546-2739 in North America.
For inquiries via email, please contact apex.support@apexanalog.com.
International customers can also request support by contacting their local Apex Microtechnology Sales Representative.
To find the one nearest to you, go to www.apexanalog.com

IMPORTANT NOTICE

Apex Microtechnology, Inc. has made every effort to insure the accuracy of the content contained in this document. However, the information is subject to change without notice and is provided "AS IS" without warranty of any kind (expressed or implied). Apex Microtechnology reserves the right to make changes without further notice to any specifications or products mentioned herein to improve reliability. This document is the property of Apex Microtechnology and by furnishing this information, Apex Microtechnology grants no license, expressed or implied under any patents, mask work rights, copyrights, trademarks, trade secrets or other intellectual property rights. Apex Microtechnology owns the copyrights associated with the information contained herein and gives consent for copies to be made of the information only for use within your organization with respect to Apex Microtechnology integrated circuits or other products of Apex Microtechnology. This consent does not extend to other copying such as copying for general distribution, advertising or promotional purposes, or for creating any work for resale.

APEX MICROTECHNOLOGY PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN PRODUCTS USED FOR LIFE SUPPORT, AUTOMOTIVE SAFETY, SECURITY DEVICES, OR OTHER CRITICAL APPLICATIONS. PRODUCTS IN SUCH APPLICATIONS ARE UNDERSTOOD TO BE FULLY AT THE CUSTOMER OR THE CUSTOMER'S RISK.

Apex Microtechnology, Apex and Apex Precision Power are trademarks of Apex Microtechnolgy, Inc. All other corporate names noted herein may be trademarks of their respective holders.

Copyright © Apex Microtechnology, Inc. 2012
(All Rights Reserved)