APEK89500GEJ-01-T

A89500 Evaluation Board User Guide

DESCRIPTION

This board provides the basic components required to use the A89500 to drive a motor. The motor can be controlled via an externally supplied PWM signal input on the logic input terminals.

The maximum current limit for the board is 10 A. It is essential to keep the maximum current below this value.

All information on how to use this board is described in this guide as well as the full circuit schematic.

FEATURES

- 2-layer board with 2 oz. copper and high temp FR4
- 10-lead DFN A89500GEJTR-T gate driver
- 2× fast switching, low-$R_{DS(ON)}$ MOSFETs in half-bridge
- configuration
- 5 V on-board voltage regulator
- High-current 3-way connector for motor connection
- High-current 2-way connector for supply connection
- 4-position DIP switch for manual control of logic inputs

EVALUATION BOARD CONTENTS

A89500 Evaluation Board

Figure 1: A89500 Evaluation Board

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Table 1: A89500 Evaluation Board Configurations

Configuration Name	Part Number
APEK89500GEJ-01-T	A89500GEJTR-T

Table 2: General Specifications

Specification	Min.	Nom.	Max.	Units
Board current limitation	–	10	20 (peak)	A

USING THE EVALUATION BOARD

Board Set-Up and Operation

In order to run a motor using the A89500 evaluation board, the following items are required:

- A89500 evaluation board
- External motor supply (≤100 V)
- V_{CC} Power Supply (8 to 15 V)
- External method of switching the outputs (e.g., PWM signal generator)

A typical connection diagram is shown in Figure 2. The A89500 evaluation board can be used in conjunction with an external microcontroller using the logic input terminals.

Board Connections

The A89500 evaluation board has four connectors.

- A single 2-way screw connector for the main supply (X1)
- A single 2-way screw connector for the bridge supply (X2)
- A 5-way pin header connector to interface to an external microcontroller (X3)
- A single 2-way connector to provide optional external 5V logic supply input (X4)
- A single 2-way screw connector for the motor connections (X5)

Power Connections

Connect a positive supply between 8 and 15 V to X1 (labelled VCC). The supply return is labelled GND at X1. The A89500 supply voltage V_{CC} must not exceed 15 V in any conditions, otherwise permanent damage may occur to the A89500.

The bridge supply can be provided via connector X2. A positive supply up to 100 V can be applied to X2.1 (labeled VBAT). The supply return is labelled GND at X2. The power source for the motor phase current must be capable of providing the necessary continuous input current at the required input voltage to drive the motor up to the board current limit plus any inrush current.

The motor supply voltage must not exceed 100 V in any conditions, otherwise permanent damage may occur to the external MOSFETs, other components on the board and the A89500. In normal operation, set the current limit of the supply to twice the maximum operating current for the motor being driven.

Logic supply to the part inputs is provided via either the on-board 5 V regulator, or externally via the two-way connector X4 with its positive terminal being labeled as V5 and its return as GND, depending on the position of J3. Voltage on the logic supply can be measured on test point V5.

Load Connections

Load can be connected through the 2-way screw terminal, X5, labelled S. The two terminals are connected together.

The MOSFET half bridge from the main supply connected to X2 provides the current to drive the motor.

Control Connections

The control of the evaluation board can be achieved by an externally generated PWM signal applied to connector X3. Connect the positive signal level to one of the X3 terminals, either X3.4 or X3.2 according to which channel needs to be driven. Connect the return path to the respective GND terminal (X3.1) of the connector.

Alternatively, there is an on-board DIP switch, S1, which sets the control logic inputs, HS and LS.

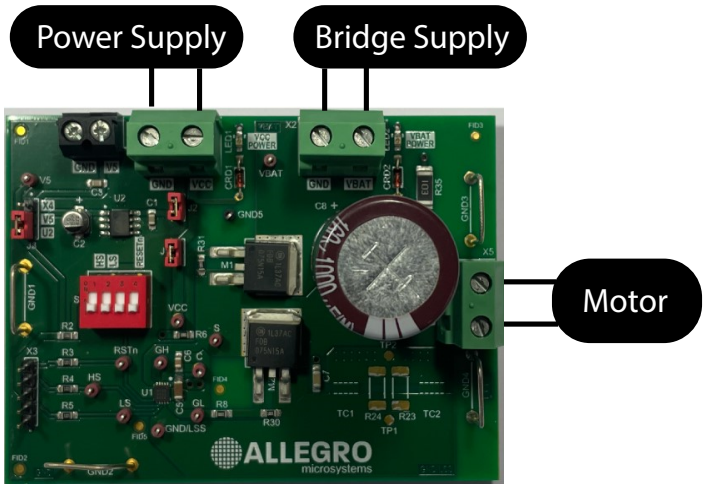

Figure 2: Connection diagram for motor and supply connections

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Setting Up for First Time Use

Before first-time operation of the evaluation board, set the board into a safe condition to avoid overcurrent stress to any components or attached load. Ensure that the jumpers in their default position as shown in Table 1 and all switches on S1 are in the "Off" position.

Set the Supply Current to the Minimum

Before connecting the supply for the first time, ensure the supply current limit is set to a low value to avoid unexpected current caused by any component or load problems. Once the motor is connected, the recommended limit is 300 mA.

After connecting the power supply to VCC (connector X1), the expected power supply current maximum is less than 3 mA at 12 V without any load/motor connected.

Once the supply voltage and current have been checked, the board is ready for use.

INITIAL FUNCTIONALITY CHECK

Before connecting the motor to the board, an initial check of the board supplies will confirm that connections are correct. This can be accomplished following the sequence below:

1. Power-up the part via VCC (start with 12 V).
2. Power-up the board via VBAT (start with 20 V).
3. Check VCC supplies the correct voltage to VCC terminal. You can do that by measuring on the VCC test point.
4. Check VBAT supplies the correct voltage to the power rail by measuring the voltage on terminal "VBAT".
5. Set S1 DIP 4 (RESETn) to the "on" position and confirm RESETn terminal is at approximately 5 V.
6. Check the state of the control logic inputs corresponds to their respective S1 DIP switch setting.

For example, when HS is commanded on (S1 DIP 1 is in the "on" position or PWM signal being high), then the HS terminal will go to "high" (5 V) and when it is commanded off (S1 DIP 1 is in the "off" position, or PWM signal being low, then the HS terminal will go to "low", or 0 V).

If all of the above are as expected and specified within the product datasheet, the next step is to connect the motor to the board.

Important Additional Notes

- To bring the part out of the sleep mode, S1 DIP 4 (RESETn) needs to be set to high.
- The S1 DIP 1 (HS) will not turn the high side output on unless the bootstrap capacitor is adequately charged. Either the low side MOSFET needs to turn on (switching interchangeably high side and low side) which will charge it or an external supply keeping the bootstrap capacitor (C to S) should be applied. The voltage for the latter needs to be approximately V_{CC} – 1.2 V.

Controlling the Motor

The A89500 can control the brush motor by switching the outputs on and off. There are two ways to achieve this, either by controlling the inputs of the A89500 via a PWM signal or via the S1 DIP switch which will keep the outputs continuously on or off (see "Important Additional Notes").

Before driving the A89500, ensure that the PWM signal is set up according to the user timing requirements, i.e., frequency, duty etc. The expected outputs for a PWM control are shown in Figure 3.

Table 3: Default Jumper Connections

Jumper	Terminal Detail	Default Setting
J1	Connects the VCC supply to the A89500	Short
J2	VCC supply to on-board 5V regulator	Short
J2	Select between external V5 input (X4) and on-board regulator (U2) to supply VL to X3 and VPU to S1	Short (pins 2 and 3)

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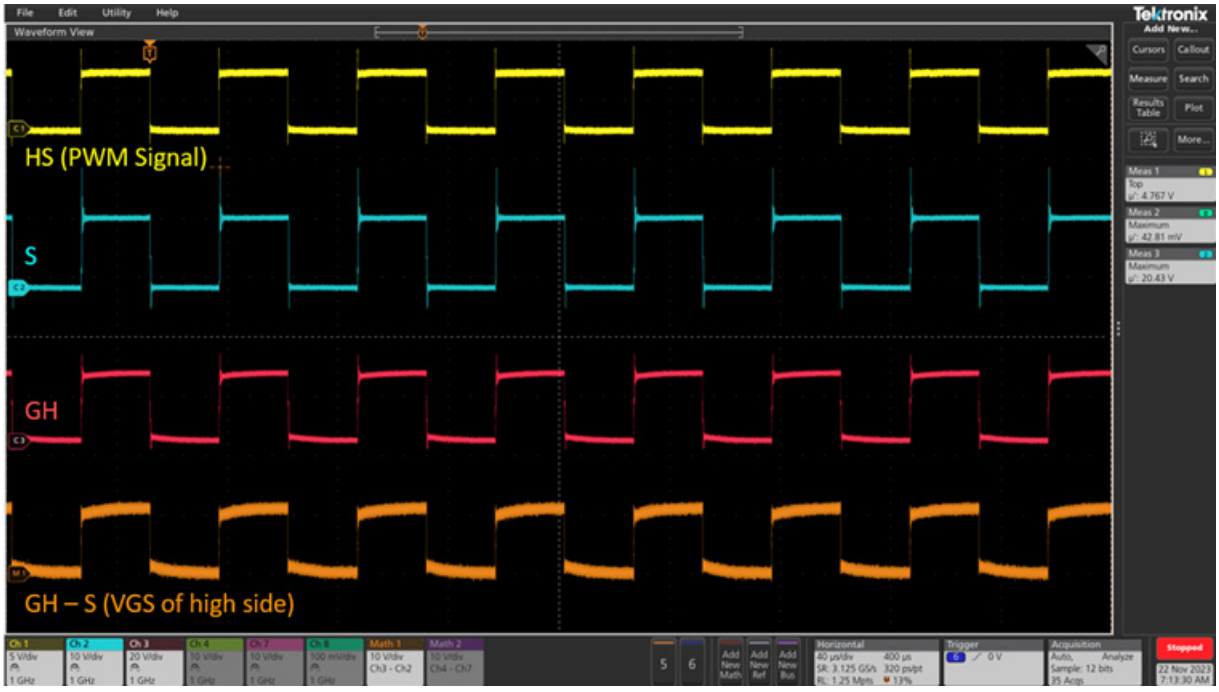

Figure 3: Correct operation showing the high-side driver

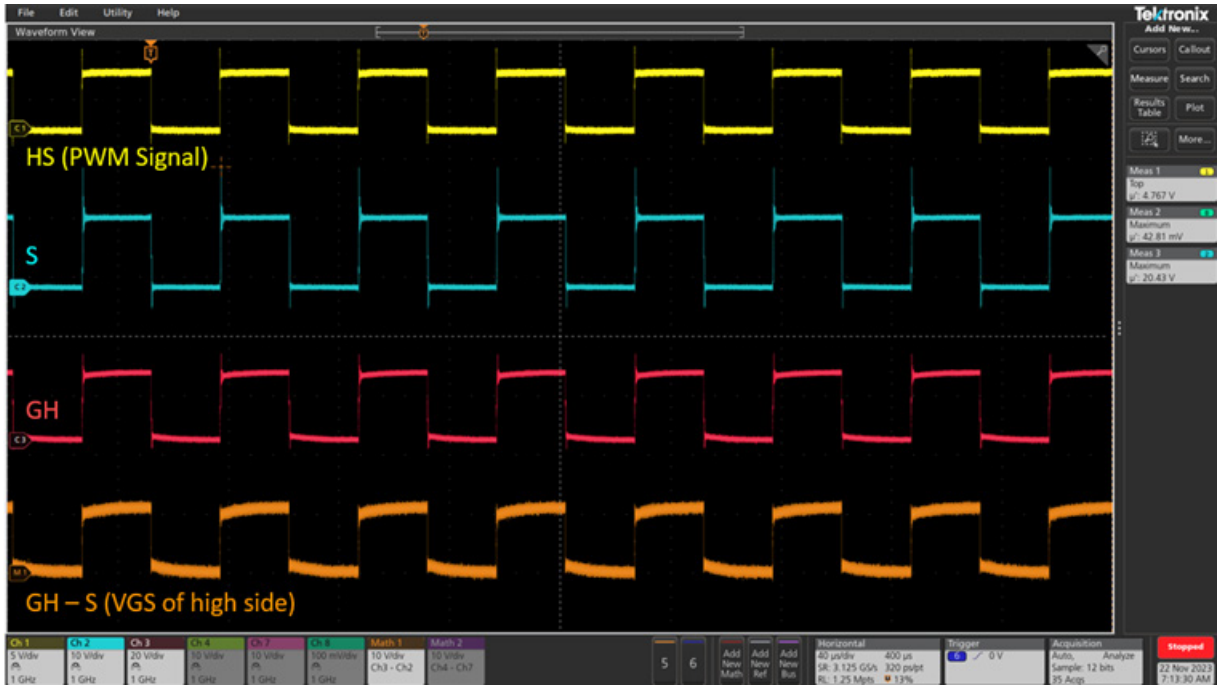

Figure 4: Correct operation showing the low-side driver

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EVALUATION BOARD PERFORMANCE DATA

The board is rated for up to 10 A of DC current. Do not exceed this value.

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SCHEMATIC

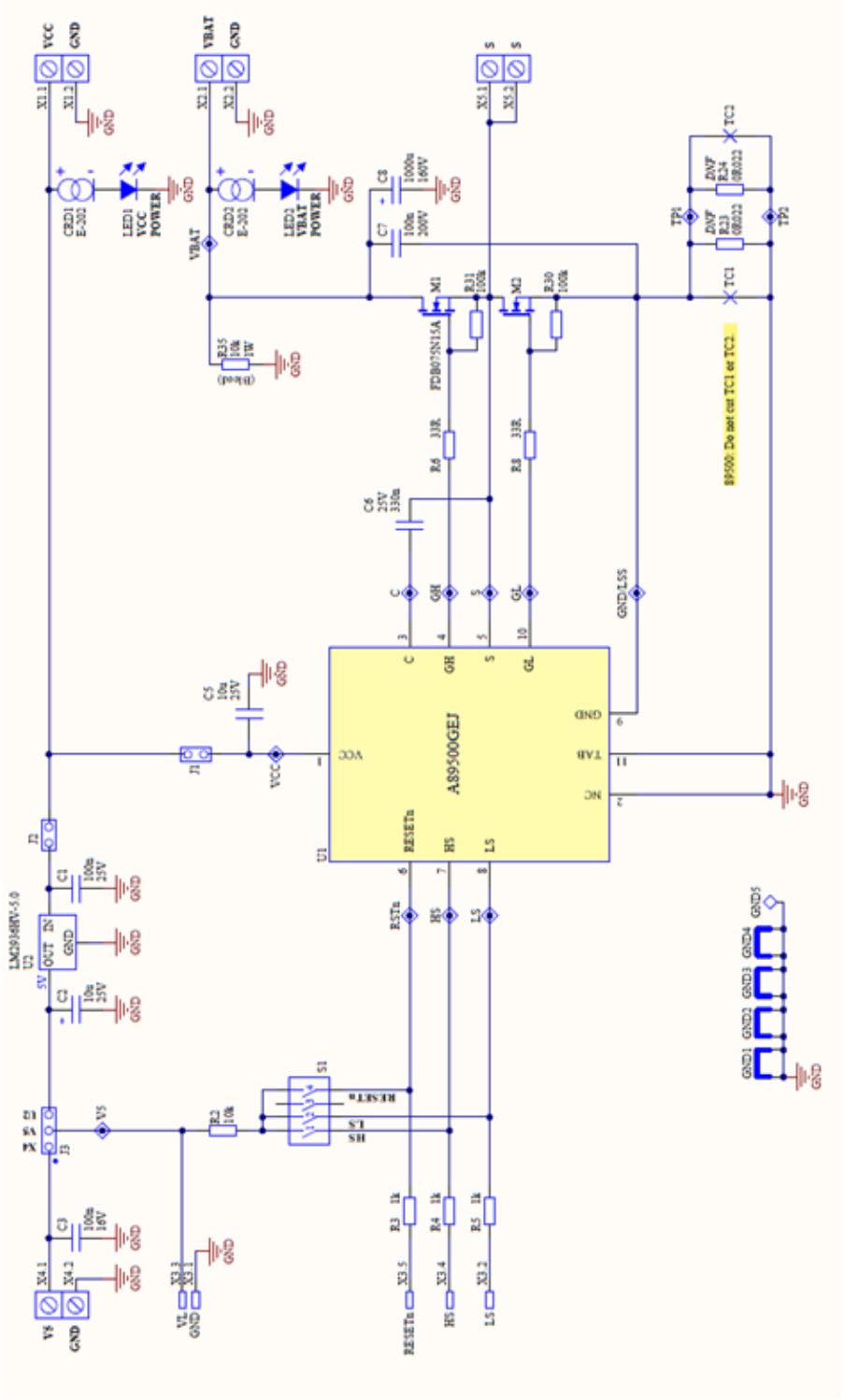

Figure 5: A89500 evaluation board schematic

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LAYOUT

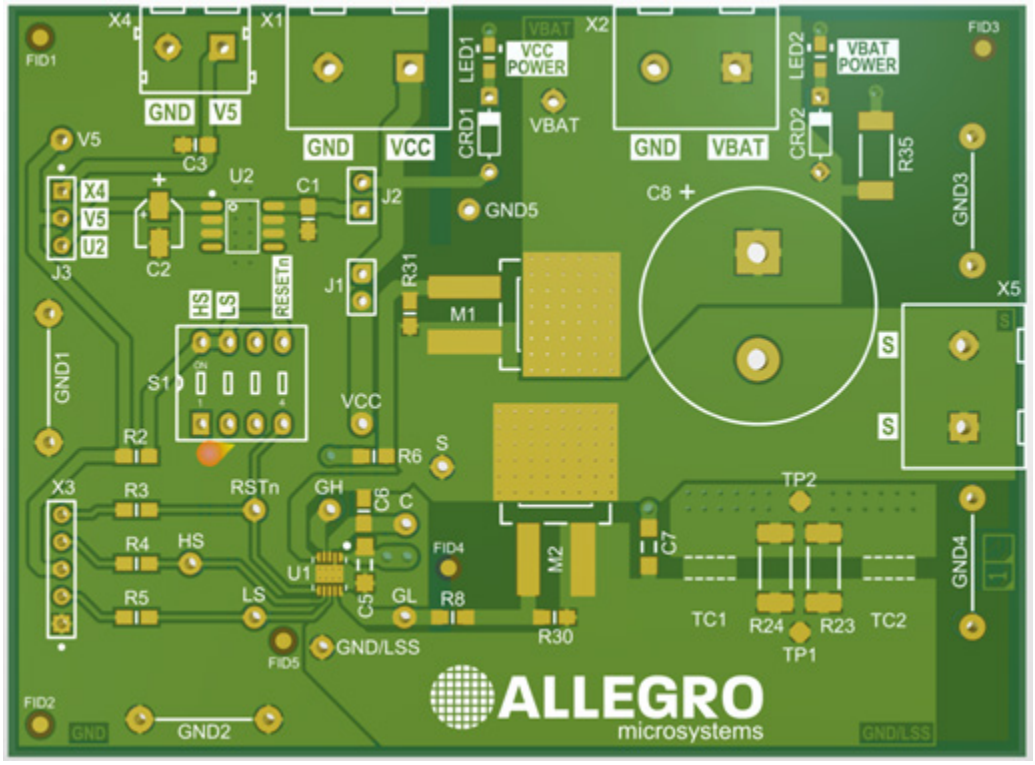

Figure 6: A89500 evaluation board layout

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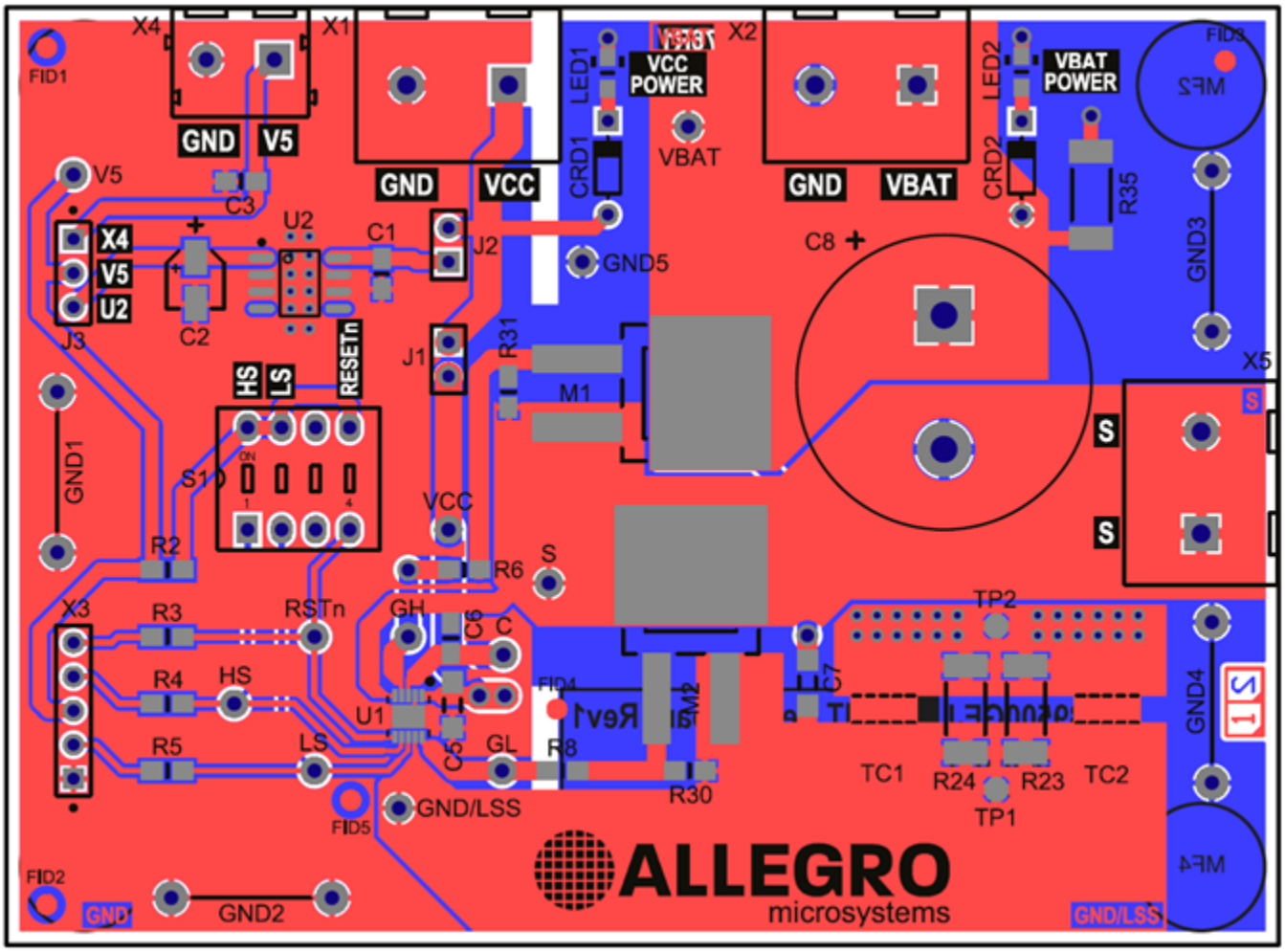

Figure 7: A89500 top and bottom silk layout

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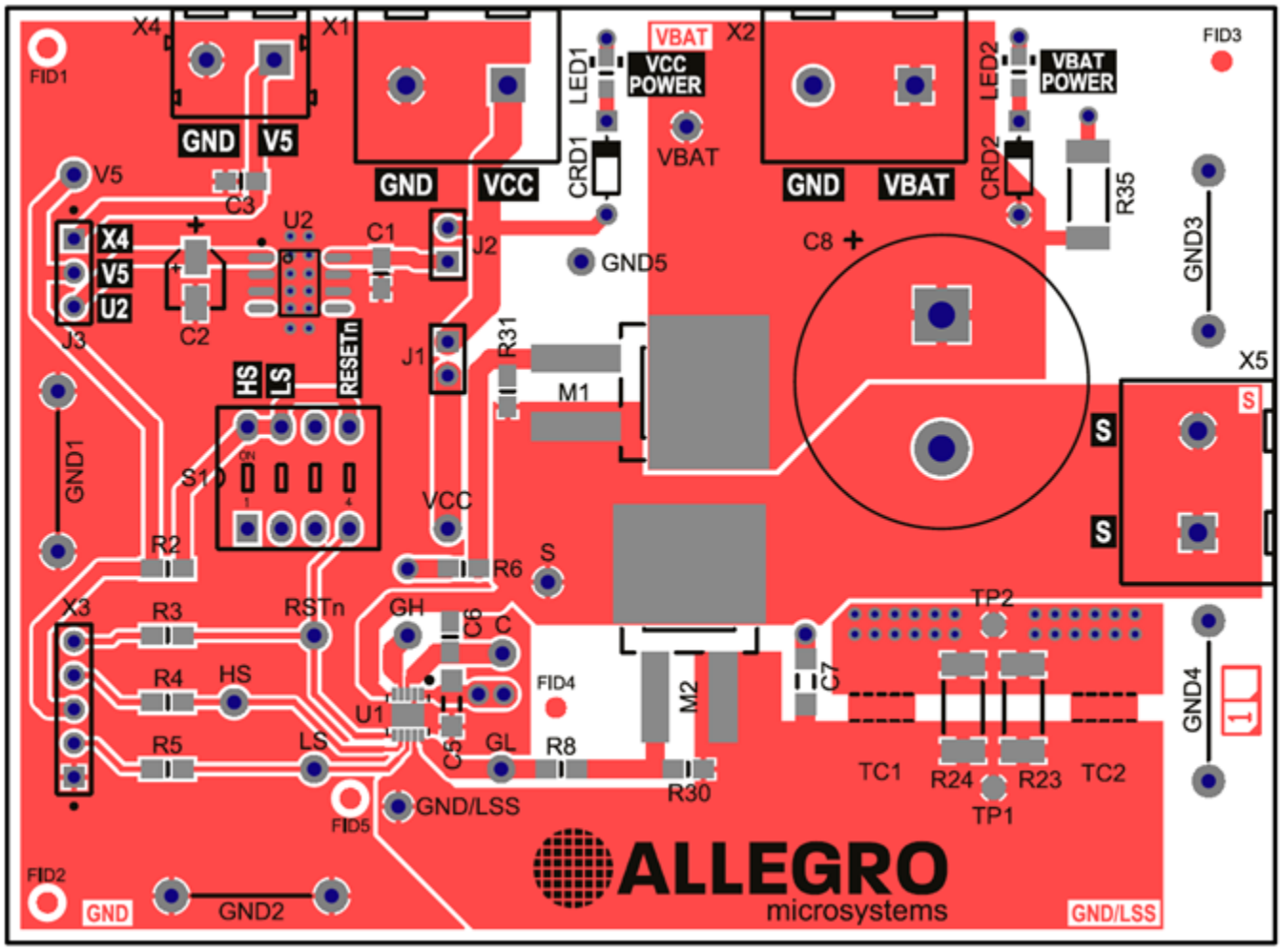

Figure 8: A89500 top silk layout

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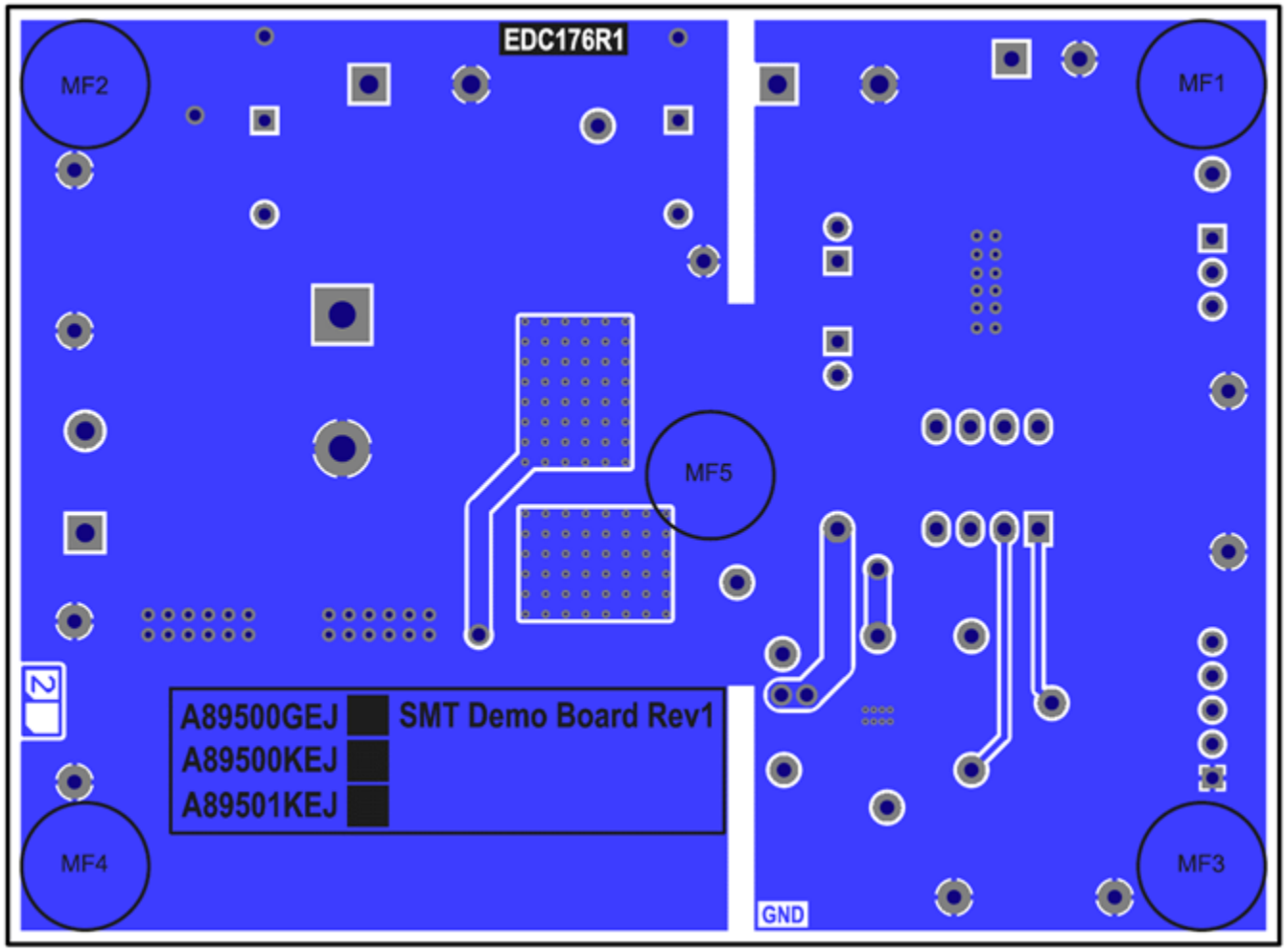

Figure 9: A89500 bottom silk layout

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BILL OF MATERIALS

Table 4: A89500 Evaluation Board Bill of Materials

ELECTRICAL COMPONENTS					
Designator	**Quantity**	**Description**	**Manufacturer**	**Manufacturer Part Number**	**PCB Label**
[ESDBAG]	1	FINALSHEET__BOM-ONLY_ESDBAG_5x8	Desco	13430	[ESDBAG]
C1	1	Capacitor: Ceramic Chip	KEMET	C0805C104K5RACTU	C1
C2	1	Capacitor: Alu Electrolytic SMT	Panasonic	EEEFP1E100AR	C2
C3	1	Capacitor: Ceramic Chip	KEMET	C0805C104K5RACTU	C3
C4	1	Capacitor: Ceramic Chip	TDK	C0805C104K5RACTU	C4
C5	1	Capacitor: Ceramic Chip	KEMET	CGA5L1X7R1E106K160AC	C5
C7	1	Capacitor: Ceramic Chip	Wurth Electronics	8.85342E+11	C7
C8	1	Capacitor: Alu Electrolytic Radial	United Chemi-Con	EKMQ161VSN102MP40S	C8
C, GH, GL, GND/LSS, HS, LS, RSTn, S, V5, VBAT, VCC	11	Test Point: 1.4 mm Round Loop, Red	Keystone Electronics	5000	C, GH, GL, GND/LSS, HS, LS, RSTn, S, V5, VBAT, VCC
CRD1, CRD2	2	Diode: Current Regulation, 100 V, 2 mA	Semitec	E-202	CRD1, CRD2
GND1, GND2, GND3, GND4	4	Hook-Up Wire 19AWG Tinned Copper SingleCore 113.5 ft (34.6 m) 0.04 in (0.91 mm)	RS	355063	GND1, GND2, GND3, GND4
GND5	1	Test Point: 1.4 mm Round Loop, Black	Keystone Electronics	5001	GND5
J1, J2	2	Jumper: Header Male 2-pin	Harwin	M20-9990246	J1, J2
J3	1	Jumper: Header Male 3-pin	Amphenol	G800W305018EU	J3
JMP_SHORT_R1, JMP_SHORT_R2, JMP_SHORT_R3	3	Jumper Short Link: Red	Harwin	M7566-05	JMP_SHORT_R1, JMP_SHORT_R2, JMP_SHORT_R3
LED1, LED2	2	LED: 2-pin, Red, 2 mA	Rohm	SML-211UTT86	LED1, LED2
M1. M2	2	Mosfet: N Channel, 130 A, 150 V	ON Semiconductor/ Fairchild	FDB075N15A	M1, M2
MF1, MF2, MF3, MF4, MF5	5	Mount Foot: Adhesive Rubber	Multicomp VOLTREX	2565	MF1, MF2, MF3, MF4, MF5
PCB	1	PCB, as from TED-0004299	Allegro MicroSystems	PCB	PCB
R2	1	Resistor: Ceramic Chip	Panasonic	ERJ-6ENF1002V	R2
R3, R4, R5	3	Resistor: Ceramic Chip	Multicomp	MCMR08X1001FTL	R3, R4, R5
R6, R8	2	Resistor: Ceramic Chip	Multicomp	MCSR08X33R0FTL	R6, R8
R23. R24	2	Resistor: Ceramic Chip	TE Connectivity CGS	TLM3ADR022FTE	R23, R24
R30, R31	2	Resistor: Ceramic Chip	TT Welwyn	ASC0805-100KFT5	R30, R31
R35	1	Resistor: Ceramic Chip	TE Connectivity	CRGCQ2512F10K	R35
S1	1	Switch: DIL, 4-way, Raised Actuator	Grayhill	78B04T	S1
U1	1	Device: Allegro Gate Driver	Allegro MicroSystems	A89500GEJ	U1
U2	1	Device: Voltage Regulator 5 V (Vin <60 V)	Texas Instruments	LM2936HVMA-5.0/NOPB	U2
OTHER COMPONENENTS					
X1. X2, X5	3	Connector: Screw Terminal, 2-way, 30 A	Pheonic Contact	1731721	X1, X2, X5
X3	1	Connector: 5-way Header Unshrouded	TE Connectibity	825433-5	X3
X4	1	Connector: Screw Terminal, 2-way, 20 A	Weidmuller	PM5.08/2/90BLK	X4

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Revision History

Number	Date	Description
–	February 19, 2024	Initial release

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