

A89199KEV Evaluation Board User Guide

DESCRIPTION

The Allegro A89199 is the next-generation revision of the popular Allegro A4918. The A89199 is an N-channel power MOSFET driver capable of controlling MOSFETs connected in a three-phase bridge arrangement. It is specifically designed for automotive applications with high-power inductive loads, such as brushless direct-current (BLDC) motors.

A unique charge-pump regulator provides the supply for the MOSFET gate drive for battery voltages down to 7 V and allows the A89199 to operate with a reduced gate drive down to 4.5 V. Gate-drive voltage and strength are programmable to help reduce electromagnetic compatibility (EMC) issues. A bootstrap capacitor is used to provide the above-battery supply voltage required for N-channel MOSFETs with an additional above-battery charge pump to ensure that the bootstrap capacitors remain charged when held in the on state.

(Continued on next page)

FEATURES

- 3-phase MOSFET driver
- Bootstrap gate drive for N-channel MOSFET bridge
- Cross-conduction protection with adjustable dead time
- Charge pump for low-supply-voltage operation
- ASIL Compliant: ASIL D safety element out-of-context (SEooC) developed in accordance with ISO 26262, when used as specified in the safety manual



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EVALUATION BOARD CONTENTS

- APEK89199KEV evaluation board



Figure 1: A89199KEV Evaluation Board

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Table 1: A89199KEV Evaluation Board Configurations

Configuration Name	Part Number	I/O Logic	Fitted Jumper Links
APEK89199KEV-3	A89199KEVTR-3-T	3.3 V	J1, J2, J6
APEK89199KEV-5	A89199KEVTR-5-T	5 V	J1, J2, J4, J5, J6

DESCRIPTION (cont.)

Full control is provided over all six power MOSFETs in the three-phase bridge. This allows motors to be driven with block commutation or sinusoidal excitation. The power MOSFETs are protected from shoot-through by integrated crossover control and optional programmable dead time.

Integrated diagnostics indicate the occurrence of multiple internal faults, system faults, and power-bridge faults, if any. These diagnostics can be configured to protect the power MOSFETs in most short-circuit conditions. For safety-critical systems, the integrated diagnostic operation can be verified under control of the serial interface.

The serial interface is provided to alter programmable settings and to read back detailed diagnostic data.

The A89199 is supplied in a 48-terminal wettable-flank quad-flat no-lead (QFN) package (suffix EV) and a 48-pin quad-flat package (QFP) (suffix JP), both with exposed thermal pad. These packages are lead (Pb) free with 100% matte tin leadframe plating.

FEATURES (cont.)

- Strong pumped regulator terminal voltage (V_{REG}) charge pump supports up to 50 mA average gate-switching current and enables external 410 nC MOSFETs to be driven at 20 kHz
- Top-off charge pump for 100% pulse-width modulation (PWM)
- Programmable gate-drive voltage and strength
- 4.5 to 50 V supply-voltage operating range
- Integrated logic supply
- Three programmable current-sense amplifiers
- SPI-compatible serial interface
- Bridge control by direct logic inputs or serial interface
- Extensive programmable diagnostics
- Diagnostic verification
- Safety-assist features
- Automotive AEC-Q100 qualified

USING THE EVALUATION BOARD

This section describes the equipment needed to use the evaluation board and provides step-by-step instructions for initial setup, as well as the power-up and power-down operations.

Equipment Required

- DC motor (assumed load of $3 \times 18R$ on a heat sink with a star-point flying lead)
- Power-supply unit (PSU; $V_{BB} = 13.5\text{ V}$, 0.8 A-capable), referred to as “13.5 V supply”.
 - APEK89199KEV-03-T configuration board only: To supply VL, a second 3.3 V PSU is required
- Meter, V_{DC} , digital voltage multimeter (DMMV)
- Meter, I_{DC} , digital ammeter multimeter (DMMA)
- Oscilloscope (“scope”)
- Volt probe ($\times 2$), CH1 and CH2, both probes set to $10 \times$
- Pulse generator (square wave, 1 kHz, 1 ms period, 0 to 4.5 VDC [TTL compatible]) (scope check, CH1: 0.5 ms/div, 1 V/div, trig CH1)
- A89199 graphical user interface (GUI) equivalent to A4918-A GUI and drivers
- FTDI USB cable TL-232R
- Personal computer for USB control

Setup

1. Connect the FTDI cable to X4 (SIL6), and connect the PC to the USB-A port.
2. Place the DMMA (1 A fused) inline from the 13.5 V PSU (for V_{BB}) positive terminal to the X1 V_{BB} lead, and fit the jumpers based on the version of the board used:
 - APEK89199KEV-05-T: Fit jumpers J1, J2, J4, J5 and J6.
 - APEK89199KEV-03-T: Fit jumpers J1, J2, and J6.
3. Set all S1 dual-inline-plug (DIP) switches to the off state.
4. For APEK89199KEV-05-T, proceed to the next step.
For APEK89199KEV-03-T, ensure J2 is not fitted and apply 3.3 V to the VL connector from a second PSU
5. Set the PSU voltage limit to 0.8 A, and connect it to X2.

6. Set the PSU voltage, motor voltage V_{BB} to 13.5 V, and ensure the PSU remains in the off state.
7. Connect the meter to the VL test point.
8. Connect the FTDI cable or the USB-C cable.
9. Connect the motor to X2 and the star-point flying lead to the negative PSU terminal.

CAUTION: Do not connect or disconnect the motor if the outputs are enabled and V_{BB} voltage is in the on state. Doing so risks permanent damage to the A89199 part and the evaluation board and could cause them to malfunction. To connect or disconnect the motor safely, either the outputs must be disabled or the V_{BB} voltage must be in the off state.

Power-Up

1. Switch the 13.5 V PSU to the on state (DMMA reads approximately 18 to 25 mA).
2. Switch RESETn to the on state (DMMA reads approximately 15 to 20 mA).
3. Open the GUI and clear any fault flags.
4. Within the GUI Bridge Current tab, set DOO to Disabled, On DIAG1 MASK all xLO, and xHO.
5. Scope, 0.4 ms/div: Set CH1 5 V/div to monitor test point SA; and set CH2 5 V/div to monitor test point SAL and to trigger on CH1.
6. Ensure the voltage at J4 is approximately 5 V.

The motor draw is approximately 400 mA.

Power-Down

CAUTION: Do not connect or disconnect the motor if the outputs are enabled and V_{BB} voltage is in the on state. Doing so risks permanent damage to the A89199 part and the evaluation board and could cause them to malfunction. To connect or disconnect the motor, either the outputs must be disabled or the V_{BB} voltage must be in the off state.

1. Set all S1 switches to the off state.
2. Switch the PSU to the off state.
3. Disconnect the PSU and the motor.

HARDWARE

Hardware and connections of the evaluation board, jumper locations, and other related information are provided in Figure 2, Figure 3, and Table 2.

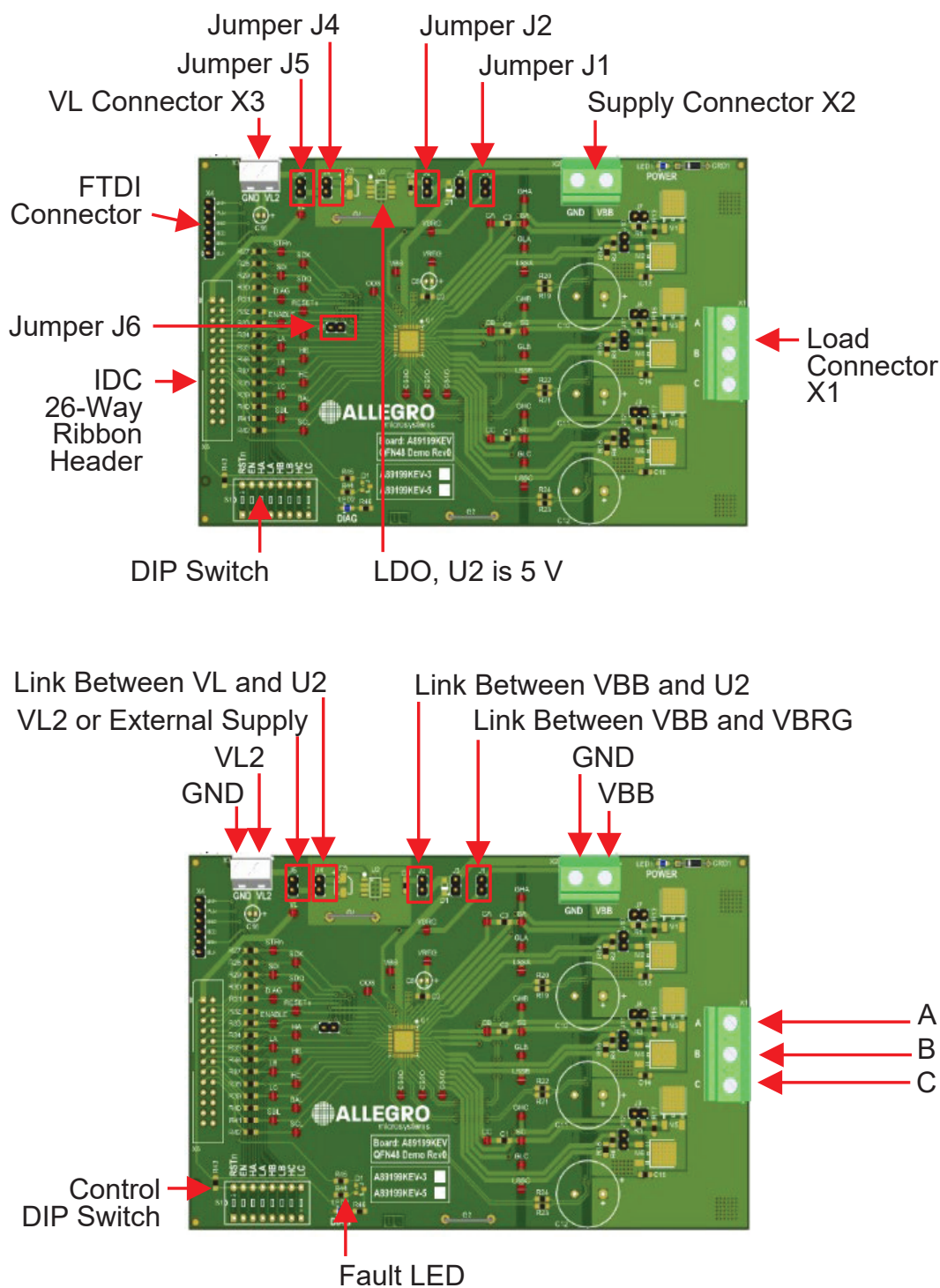


Figure 2: Evaluation Board Inputs and Outputs

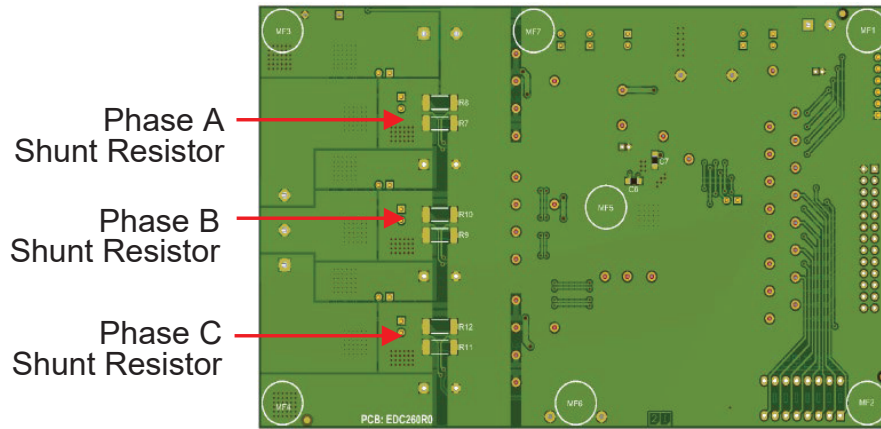


Figure 3: Shunt Resistor Connection

Table 2: Jumper Default Settings

Jumper	Terminal Detail	Default Setting
J1	Provides link between VBB and VBRG pins	ON
J2	Provides link between VBB and U2 (external regulator)	ON
J3	Allows bypass of diode current protection	OFF
J4	For logic voltage supply (VL): If 5 V logic is used and an external supply is not present at VL, connect this jumper	ON
J5	For external logic voltage supply (VL): If an external supply is not used at VL, connect this jumper	ON
J6	Fault LED	ON
J7	Resistor 1, R1, bypass to M1	OFF
J8	Resistor 3, R3, bypass to M3	OFF
J9	Resistor 5, R5, bypass to M5	OFF
J10	Resistor 2, R2, bypass to M2	OFF
J11	Resistor 4, R2, bypass to M4	OFF
J12	Resistor 6, R6, bypass to M6	OFF

SCHEMATIC

The A89199KEV evaluation board schematic is shown in Figure 4.

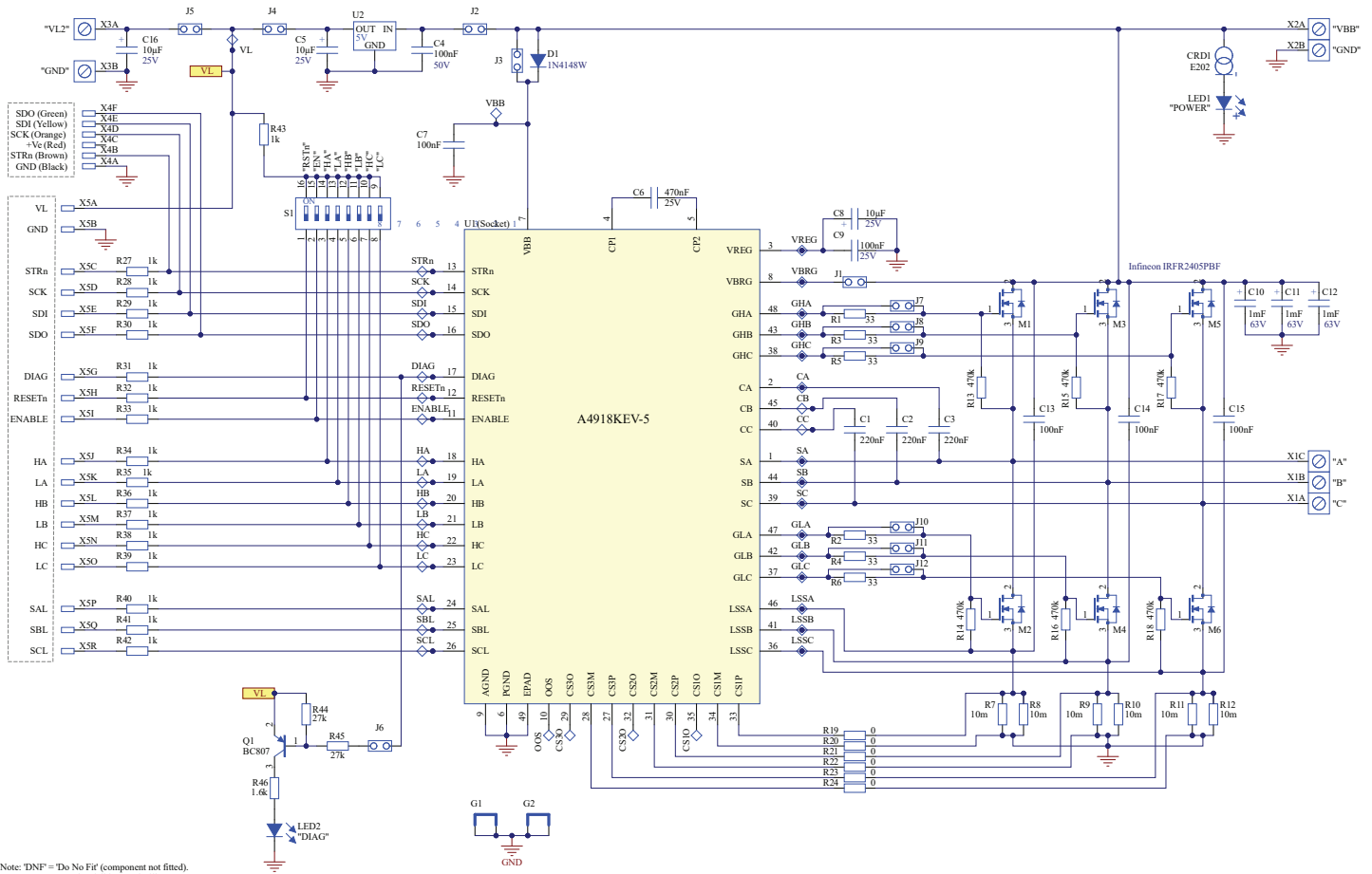


Figure 4: A89199KEV Evaluation Board Schematic

LAYOUT

The layout of the A89199KEV evaluation board PCB is shown in Figure 5 and Figure 6.

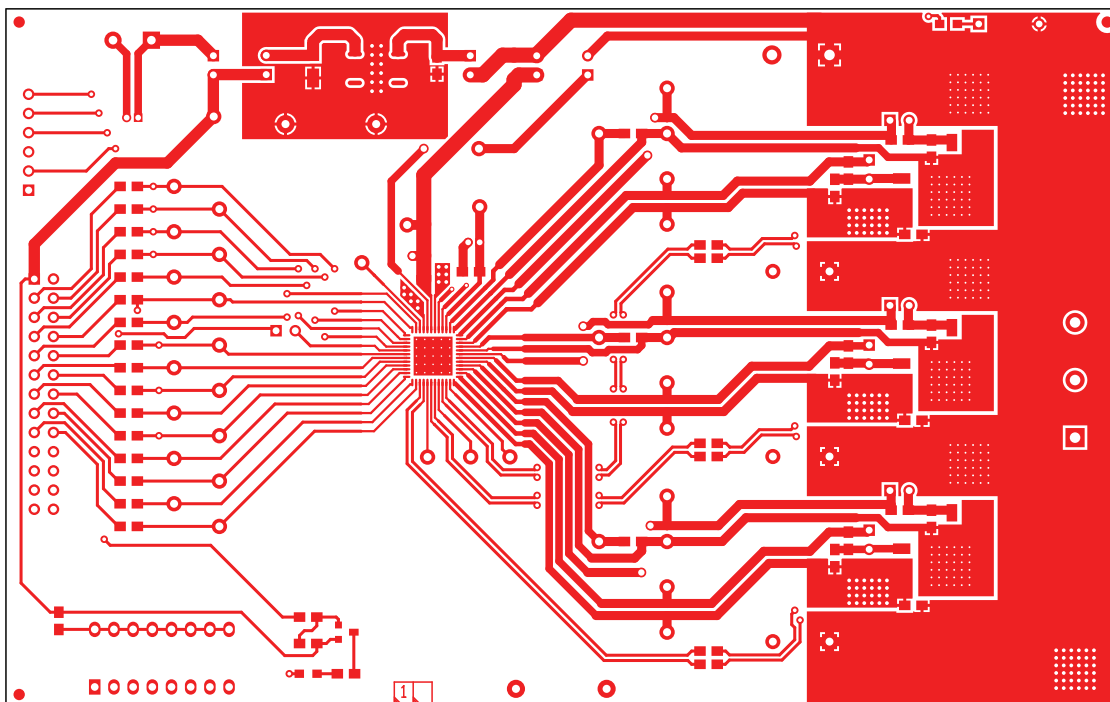


Figure 5: A89199KEV Evaluation Board PCB, Top Layer

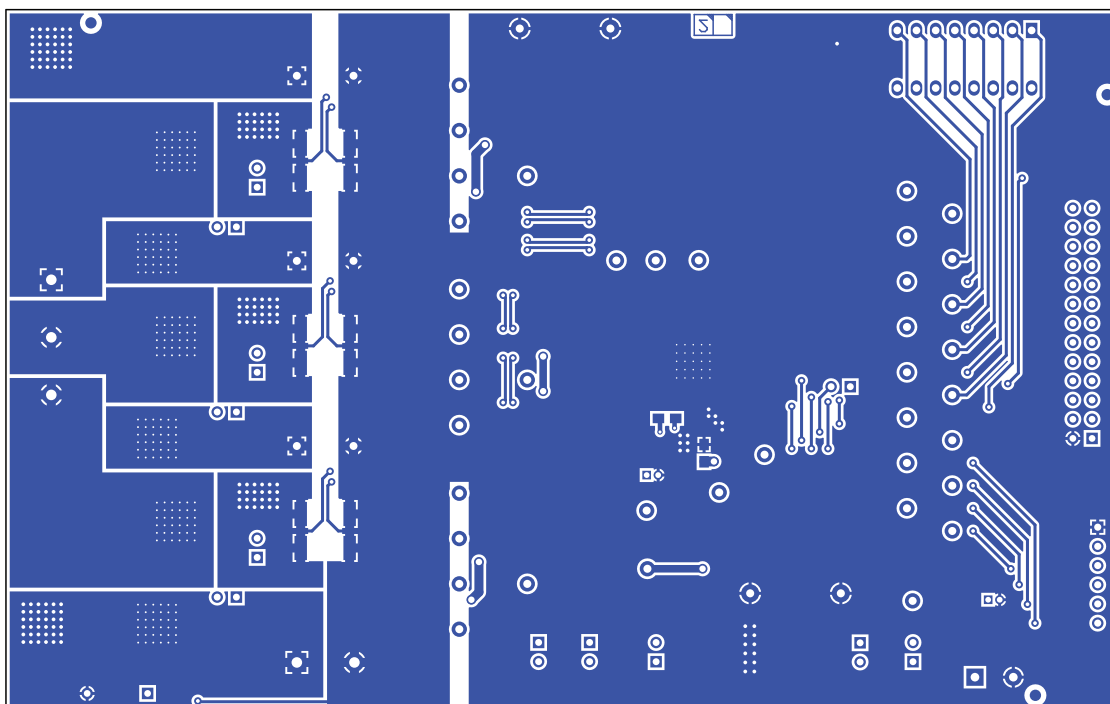


Figure 6: A89199KEV Evaluation Board PCB, Bottom Layer

BILL OF MATERIALS (BOM)

Table 3: A89199KEV Version Evaluation Board Bill of Materials

ELECTRICAL COMPONENTS						
Designator	Quantity	Value	Description	Manufacturer	Manufacturer Part Number	Footprint
C1, C2, C3	3	0.22 μ F	Capacitor: Ceramic chip	KEMET	C0805X224K5RACTU	0805
C10, C11, C12	3	1000 μ F	Capacitor: Aluminum, electrolytic, radial	Vishay	MAL214258102E3	0.8 mm diameter
C4	1	0.1 μ F	Capacitor: Ceramic chip	KEMET	C0805C104K5RACTU	0805
C5	1	10 μ F	Capacitor: Aluminum, electrolytic surface-mount technology (SMT)	Panasonic	EEE-FP1E100AR	–
C6	1	0.47 μ F	Capacitor: Ceramic chip	Murata	GCJ21BR71H474KA12L	0805
C7, C13, C14, C15	4	0.1 μ F	Capacitor: Ceramic chip	Kyocera AVX	08051C104KAT2A	0805
C8, C16	2	10 μ F	Capacitor: Aluminum, electrolytic, radial	Multicomp	MCMR25V106M4X7	0.5 mm diameter
C9	1	0.1 μ F	Capacitor: Ceramic chip	KEMET	C0805C104K5RACTU	0805
CA, CB, CC, CS10, CS20, CS30, DIAG, ENABLE, GHA, GHB, GHC, GLA, GLB, GLC, HA, HB, HC, LA, LB, LC, LSSA, LSSB, LSSC, OOS, RESETn, SA, SAL, SB, SBL, SC, SCK, SCL, SDI, SDO, STRn, VBB, VBRG, VL, VREG	39	–	Test point: 1.4 mm round loop, red	Keystone Electronics	5000	1 mm diameter
CRD1	1	–	Diode: Current regulation, 100 V, 2 mA	Semitec	E-202~E-562	0.6 mm diameter
D1	1	–	Diode: Standard, 100 V, 150 mA, SOD123	Diodes	1N4148W-7-F	SOD123
G1, G2	2	–	Terminals and hardware: Shorting link plug, gold, uninsulated	Harwin	D3082-05	1.05 mm diameter
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12	12	–	Jumper: Header, male, 2-pin	Harwin	M20-9990246	0.64 mm diameter
LED1, LED2	2	–	LED: 2-pin, red, 2 mA	Kingbright	KPTD-2012LVSURCK	0805
M1, M2, M3, M4, M5, M6	6	–	MOSFET: N-Channel, 56 A, 55 V	Infineon	IRFR2405TRPBF	DPAK
Q1	1	–	Transistor, P-N-P, 45 V, 0.5 A TO-236AB	Nexperia	BC807-25,215	TO-236AB
R1, R2, R3, R4, R5, R6	6	33 Ω	Resistor: Ceramic chip	Yageo	RC0805FR-0733RL	0805
R13, R14, R15, R16, R17, R18	6	470 k Ω	Resistor: Ceramic chip	TE Connectivity	CRGCQ0805F470K	0805
R19, R20, R21, R22, R23, R24	6	0 Ω	Resistor: Ceramic chip	Multicomp	MC0805S8F0000T5E	0805
R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43	17	1 k Ω	Resistor: Ceramic chip	Multicomp	MCMR08X1001FTL	0805

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ELECTRICAL COMPONENTS (cont.)						
Designator	Quantity	Value	Description	Manufacturer	Manufacturer Part Number	Footprint
R44, R45	2	27 k Ω	Resistor: Ceramic chip	TE Connectivity	CRG0805F27K	0805
R46	1	1.6 k Ω	Resistor: Ceramic chip	Vishay	CRCW08051K60FKEA	0805
R7, R8, R9, R10, R11, R12	6	0.01 Ω	Resistor: Ceramic chip	Bourns	CRA2512FZR010ELF	2512
S1	1	–	Switch: DIL16, 8-way, raised actuator	Grayhill	78B08ST	–
U1	1	–	Device: Allegro motor driver	Allegro MicroSystems	A89199KEV-5	eQFN-48
U2	2	–	Device: Voltage regulator 5 V ($V_{IN} < 60$ V)	TI National Semiconductor	LM2936HVMA-5.0/NOPB	SOIC-8

OTHER COMPONENTS						
Designator	Quantity	Value	Description	Manufacturer	Manufacturer Part Number	Footprint
MF1, MF2, MF3, MF4, MF5, MF6, MF7	7	–	Mount foot: Adhesive rubber	Essentra	RBS-34	–
X1	1	–	Connector: Screw terminal, 3-way, 30 A	Phoenix Contact	1731734	3-pin screw-down connector
X2	1	–	Connector: Screw terminal, 2-way, 30 A	Phoenix Contact	1731721	2-pin screw-down connector
X3	1	–	Connector: Screw terminal, 2-way, 20 A	Weidmuller	PM5.08/2/90BLK	2-pin screw-down connector
X4	1	–	Connector: 6-way header, unshrouded	Molex	90120-0766	–
X5	1	–	Connector: IDC 26-way ribbon header	TE Connectivity	1761681-9	–

RELATED LINKS

The GUI is available from the Allegro Software Portal. Registration for the A89199 is required.

To register for, or log in to, the Allegro Software Portal, visit: <https://registration.allegromicro.com/login>. For access to the GUI interface, download the A89199 GUI.

APPLICATION SUPPORT

For application support, visit <https://www.allegromicro.com/en/about-allegro/contact-us/technical-assistance> and navigate to the appropriate page.

Revision History

Number	Date	Description
–	March 6, 2026	Initial release

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