APEK4919GET-01-T

A4919 Evaluation Board User Guide

DESCRIPTION

This board provides the basic components required to use the A4919 to drive a motor. The motor can be controlled via an externally supplied PWM signal input on the logic input terminals. The circuit diagram is shown on page 6 of this guide.

The maximum current limit for the board is 10 A, and it is important 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. The component placement and layout are shown on pages 7 through 9.

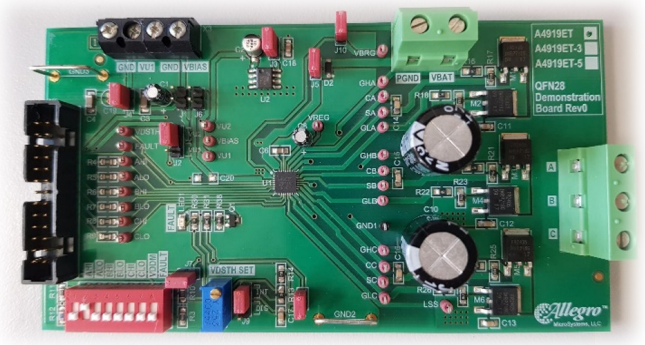

Figure 1: A4919 Evaluation Board

FEATURES

- 28-pin QFN package A4919GETTR-T gate driver
- 5 V on-board voltage regulator
- High-current three-way connector for motor connection
- High-current two-way connector for supply connection
- Fault display LED
- Eight-position DIP switch for manual control of logic inputs

EVALUATION BOARD CONTENTS

A4919 evaluation board with A4919 device soldered on.

Table of Contents

Table 1: General Specifications

Specification	Min.	Nom.	Max.	Units
Board Current Limit	–	10	20 (peak)	A

USING THE EVALUATION BOARD

Board Setup and Operation

In order to run a motor using the A4919 evaluation board, the following items are required:

- A4919 evaluation board
- External motor supply (5.5 to 50 V)
- External method of switching the outputs (e.g., PWM signal generator)

A typical connection diagram is shown in Figure 2. The A4919 evaluation board can be used in conjunction with an external microcontroller using the logic input terminals.

Board Connections

The A4919 evaluation board has four connectors.

- X1: A single three-way screw connector for the motor connections
- X2: One two-way screw connector for the main supply
- X3: One two-way connector that provides the supply from the 5 V on-board voltage regulator
- X5: A 26-pin IDC cable connector to interface to an external microcontroller (X5)

Note : X4 connector is not used for this product variant.

Power Connections

A positive supply between 5.5 and 50 V should be connected to X2 (labelled VBAT). The supply return is labelled PGND 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 an inrush current. The motor supply voltage must not exceed 50 V in any conditions, otherwise permanent damage may occur to the A4919, other components on the board and possibly the motor. In normal operation, the current limit of the supply should be set to twice the maximum operating current for the motor being driven.

The two-way connector X3 provides an output for the 5 V LDO voltage for biasing external circuitry. The voltage of this connector can be measured via the VBIAS test point. If this voltage is not required, then J1 can be removed from the evaluation board.

The VDDM pin is a logic voltage monitor input, and this pin must be connected to the on-board 5 V regulator U2. The voltage of the regulator can be sensed on the VU2 test point.

Load Connections

A three-phase BLDC motor is connected through the three-way screw terminal, X1, labelled A, B, and C. Each letter represents the phase connection and has the same potential as the respective Sx terminal.

The current to drive the motor is provided via the three-phase MOSFET bridge from the main supply connected to X2.

Control Connections

The control of the evaluation board can be achieved by an externally generated PWM signal applied to connector X5. The positive signal level needs to be connected to any of the X5 terminals: X5.9, X5.10, X5.11, X5.12, X5.13, X5.14, according to which channel needs to be driven. The return path must be connected to any GND terminals of the evaluation board namely GND2 or GND3.

Alternatively, there is an on-board DIP switch, S1, which might be used to set the control logic inputs AHI, ALO, BHI, BLO, CHI, and CLO.

More information on how to use the board can be found in the next sections.

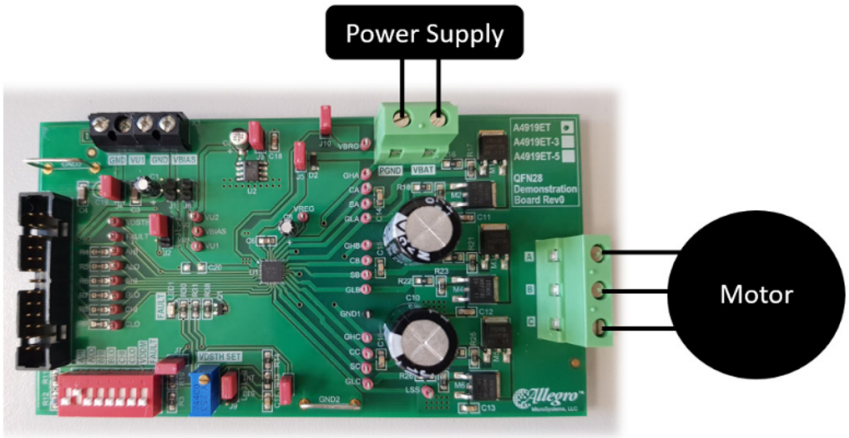

Figure 2: Connection diagram for motor and supply connections

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Setting up for First-Time Use

Before operating the evaluation board for the first time, it should be set into a safe condition to avoid overcurrent stress to any components or attached load. The jumpers should be in their default position as shown in Table 1 and all switches on S1 should be 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—300 mA is recommended when the motor is connected.

After connecting the power supply to VBAT (connector X2), the power supply current should be less than 5 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 your connections are correct. This can be accomplished following the sequence below:

1. Power-up the board via VBAT (start with 12 V).
2. Check VBAT supplies the correct voltage to VBB. This can be done by measuring either the positive side of the C5, or the side connected to the VBB pin from the J5 jumper.
3. Check VBAT supplies the correct voltage to VBRG, by measuring the voltage on terminal VBRG. This will also confirm that J10 is correctly placed.
4. Set S1 DIP 7 (VDDM) and S1 DIP 1 (AHI) to the on position and confirm V_{REG} is within the datasheet specification by measuring the voltage on the VREG test point.
5. Confirm LED1 FAULT is not illuminated. Faults are explained under the Diagnostics section of the product datasheet.
6. Check the state of each control logic input corresponds to its respective S1 DIP switch setting.
   For example, when AHI is commanded on (S1 DIP 1 is in the on position or PWM signal being high), then the AHI terminal should go to high (5 V) and when it is commanded off (S1 DIP 1is in the off position, or PWM signal being low, then the AHI terminal should be low (0 V).

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

Important Additional Notes

For the A4919 to come out of sleep mode and operate, two conditions should be satisfied.

1. A voltage greater than the gate drive disable threshold V_{GDD} (typically 1.5 V as defined in the Electrical Characteristics table of the A4919 datasheet) should be present on pin 20 (VDDM). Otherwise, the charge pump is turned off and all gate drive outputs will remain disabled.
2. One or more logic inputs should be switched on, either via the S1 DIP switch or an external PWM signal.

Table 2: Default jumper connections

Jumper	Terminal Detail	Default Setting
J1	Enable output to connector X3	Short
J2	Configures V_{BIAS} as 5 V	VU2 position
J3	V_{BB} supply to on-board 5 V regulator	Short
J4	Enable output to connector X4	Open
J5	Supply voltage to VBB input	Short
J6	Connect VU1 to VDDM	Short
J7	Fault pin pullup; if a fault is present, the internal pull-down is off, and the FAULT output is pulled up to approximately V_{BIAS}	Short
J8	Enable input to VDSTH programming pin	Short
J9	V_{DSTH} programming selection: Internal hardwired value / Disabled / Voltage select using pot R15	INT position
J10	V_{BB} supply to VBRG pin	Short

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Controlling the Motor

The A4919 can control the motor by switching the outputs on and off. There are two ways to achieve this: either by controlling the inputs of the A4919 via a PWM signal or via the S1 DIP switch which will keep the outputs 100% on or off.

Before driving the A4919, 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.

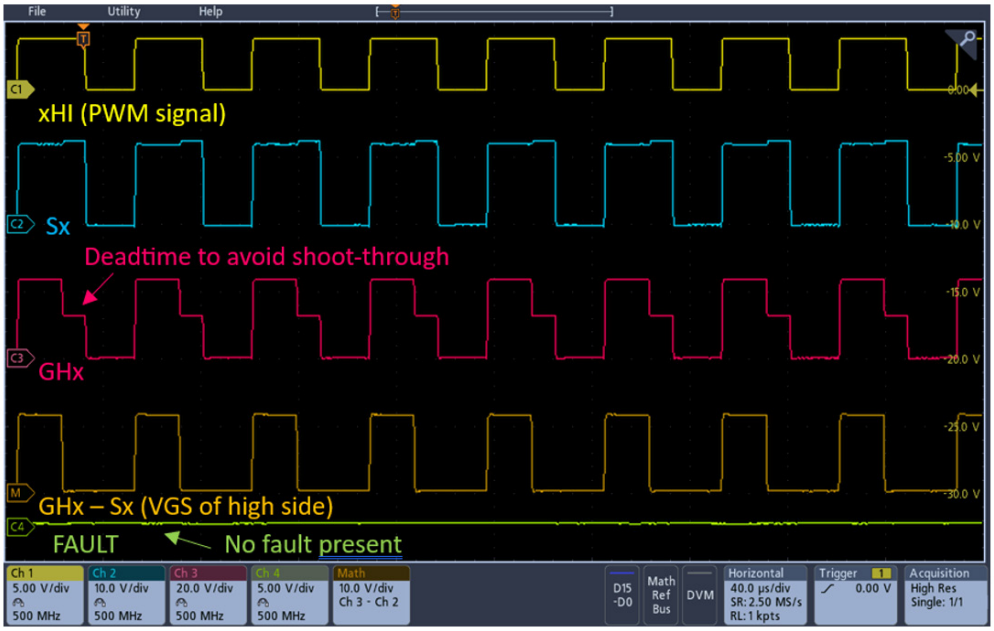

Figure 3a: Correct operation showing the high-side driver

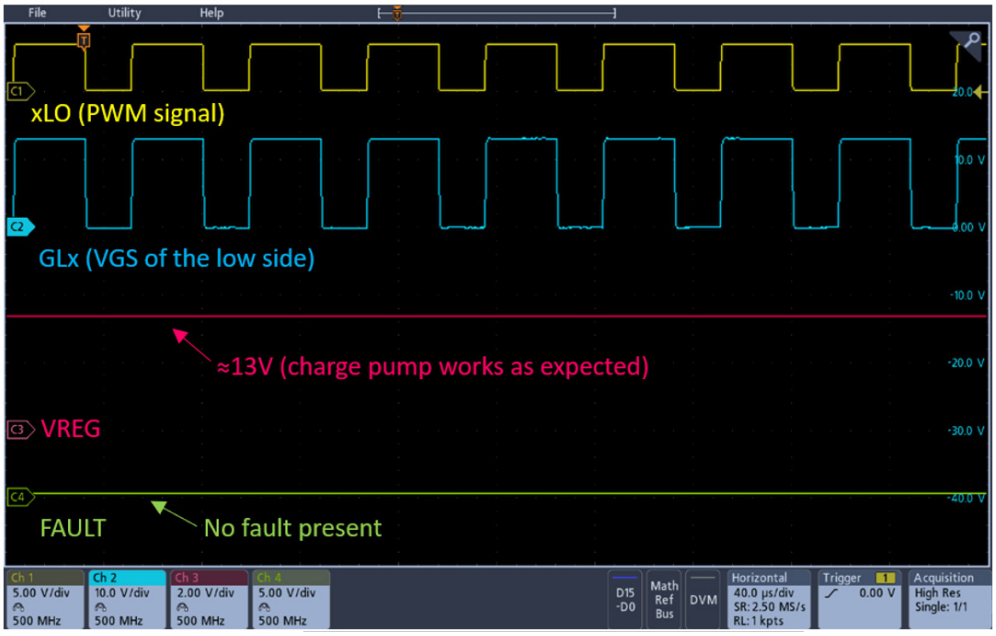

Figure 3b: Correct operation showing the low-side driver

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EVALUATION BOARD PERFORMANCE DATA

The board is rated for up to 10 A of DC current. This value should not be exceeded.

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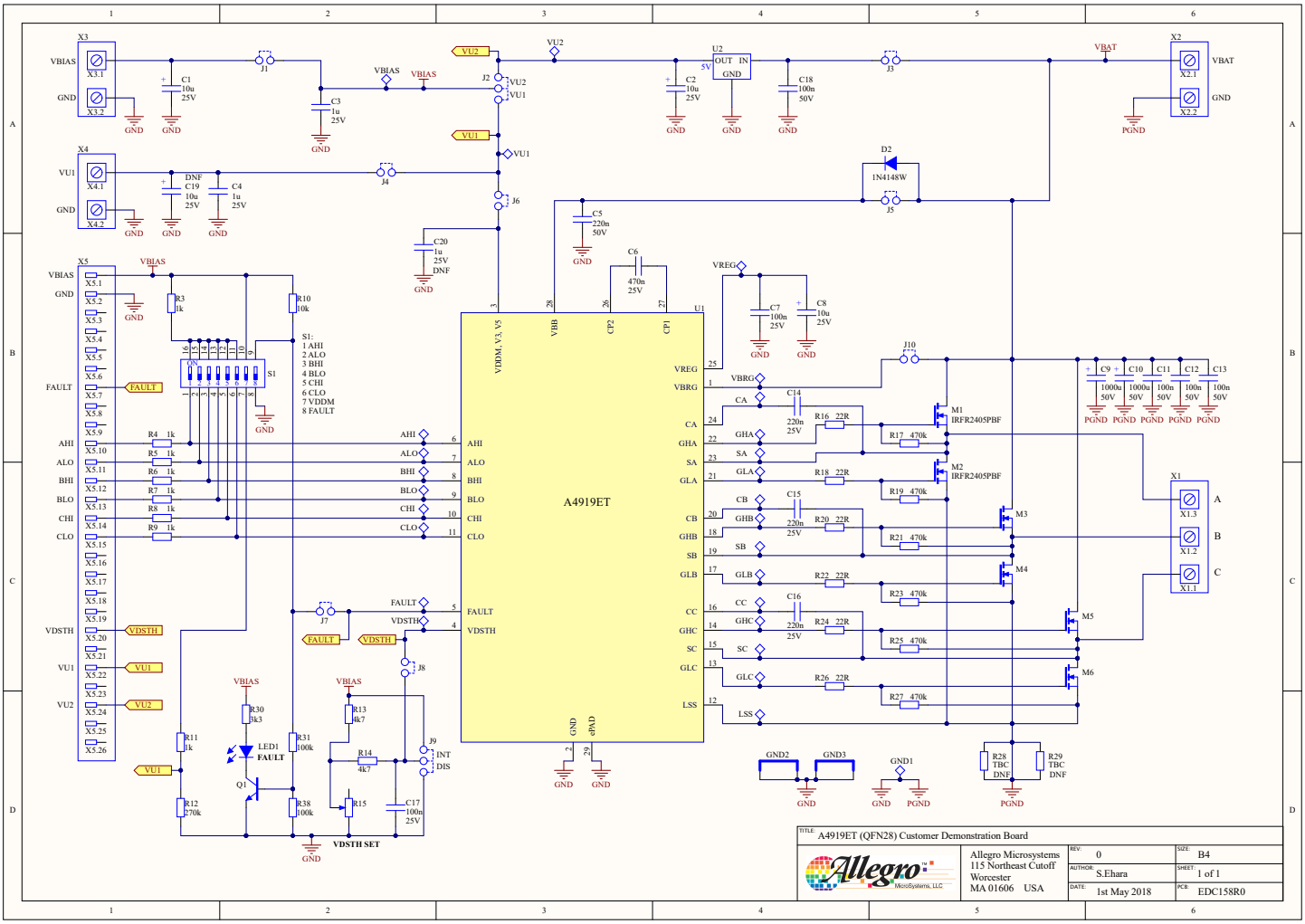
SCHEMATIC



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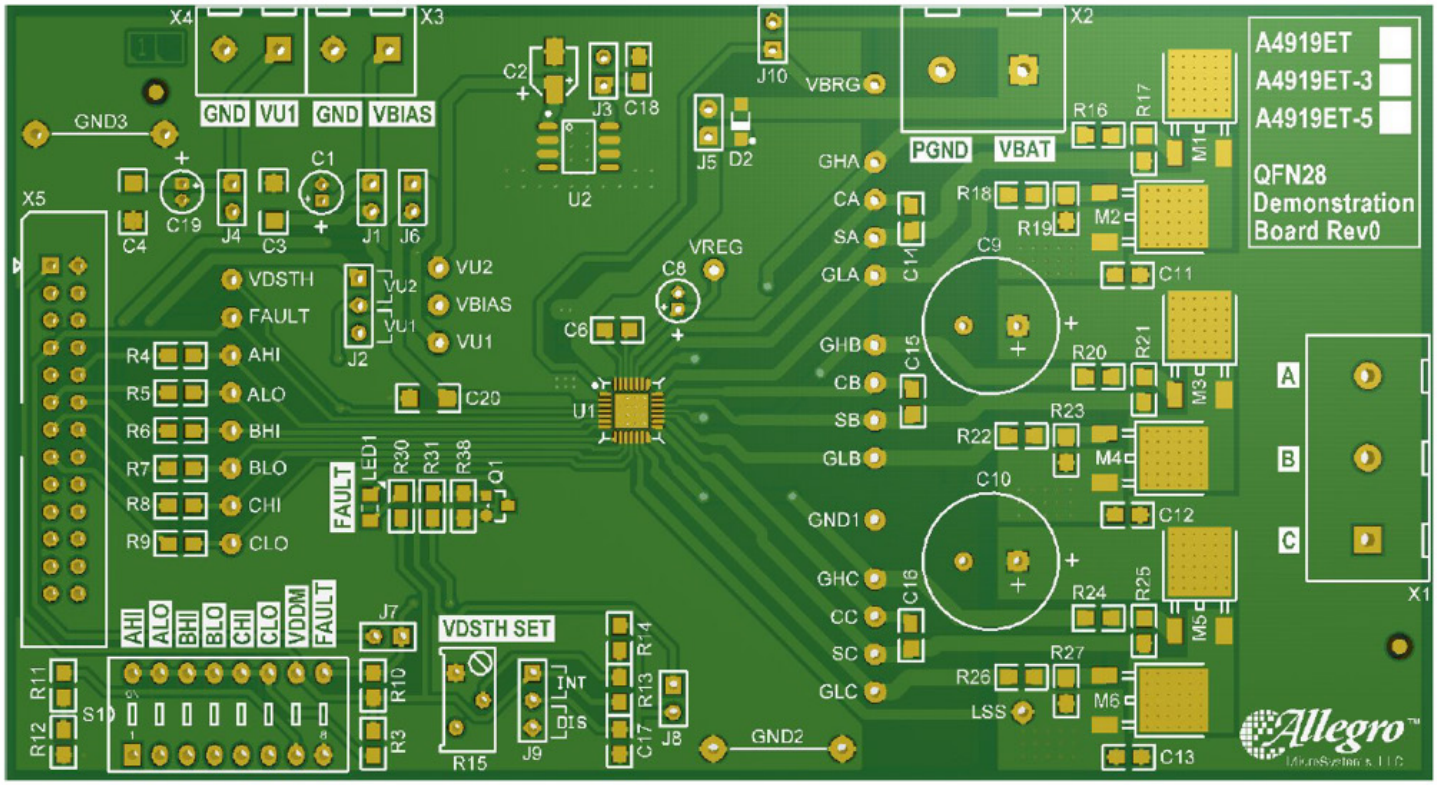
LAYOUT



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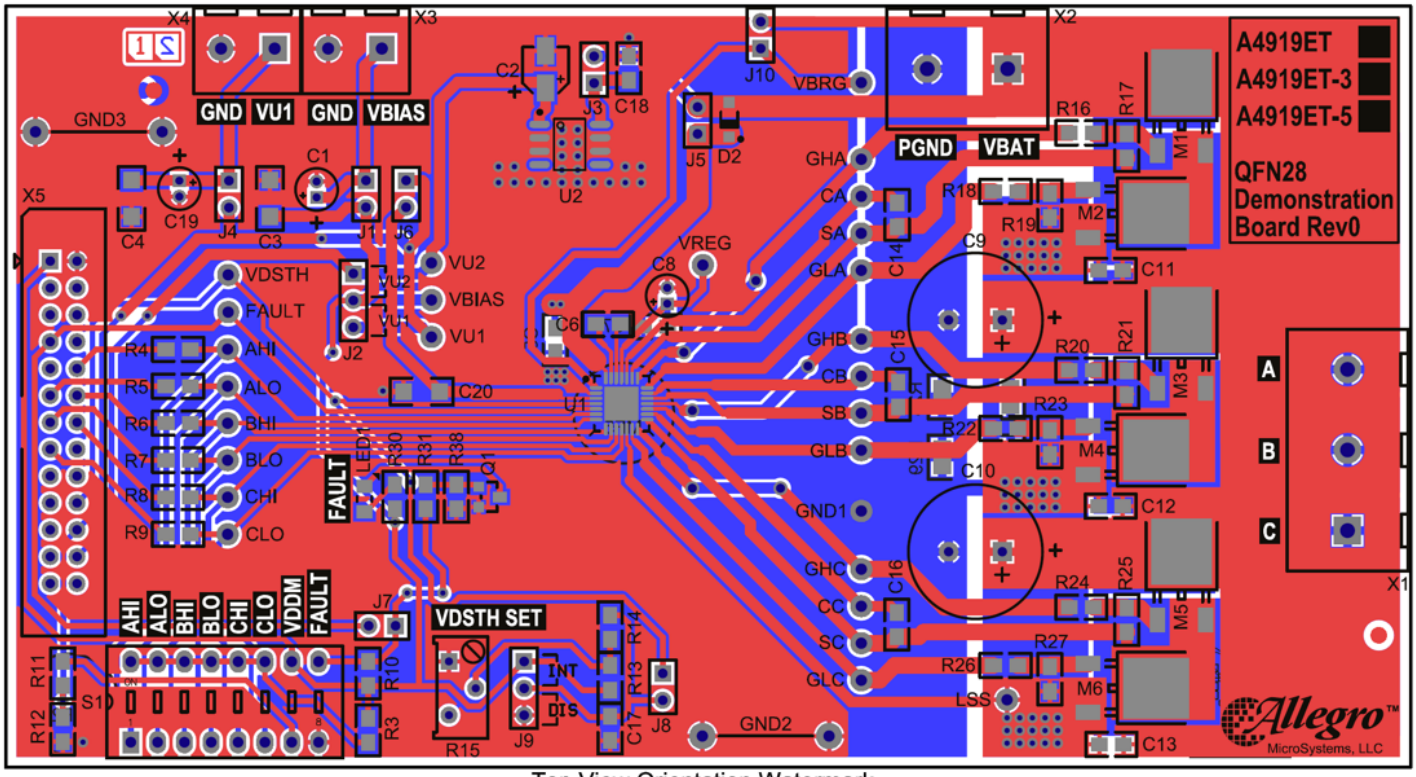
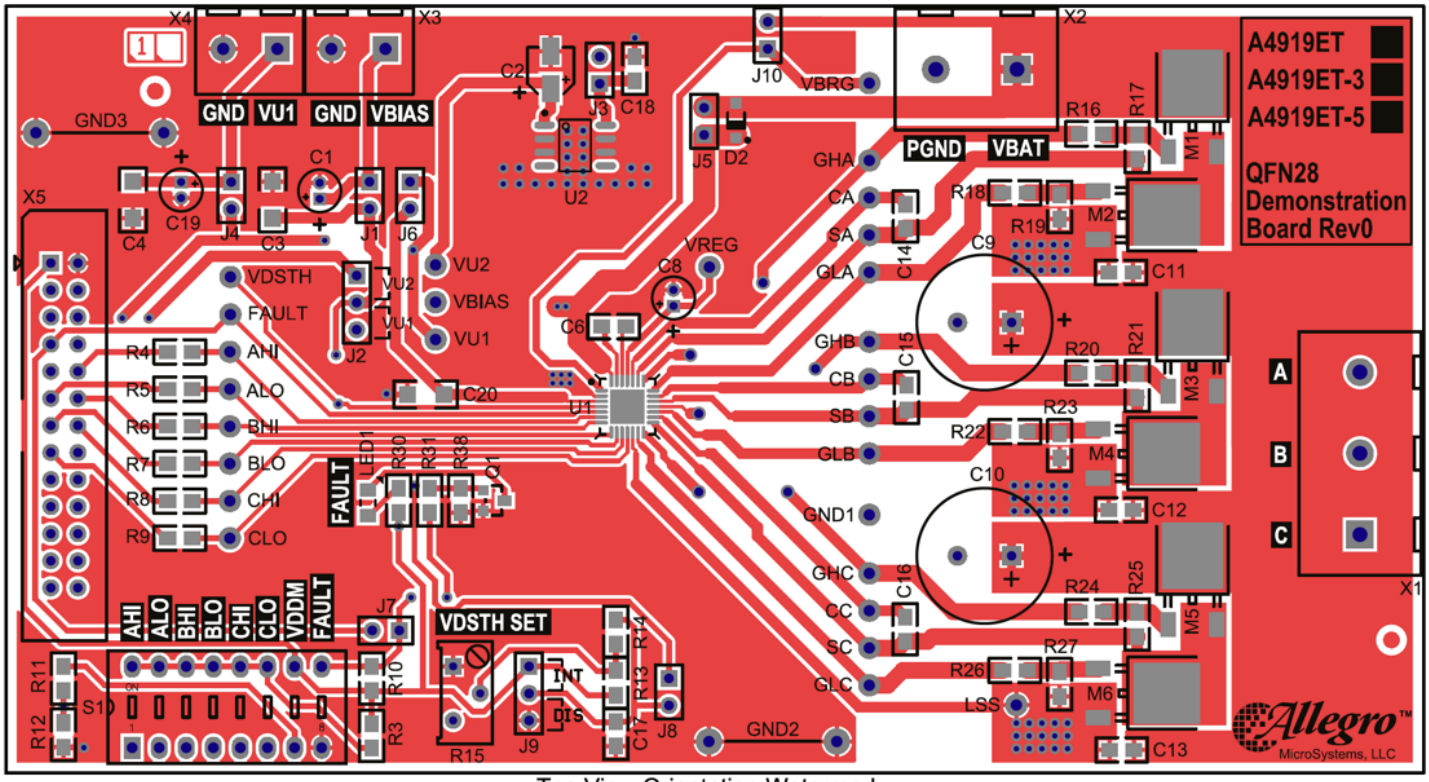
Top Paste Top Silk Top Layer (L1) Btm Layer (L2) Btm Silk Btm Paste



Top View Orientation Watermark

Top Paste Top Silk Top Layer (L1)



Top View Orientation Watermark

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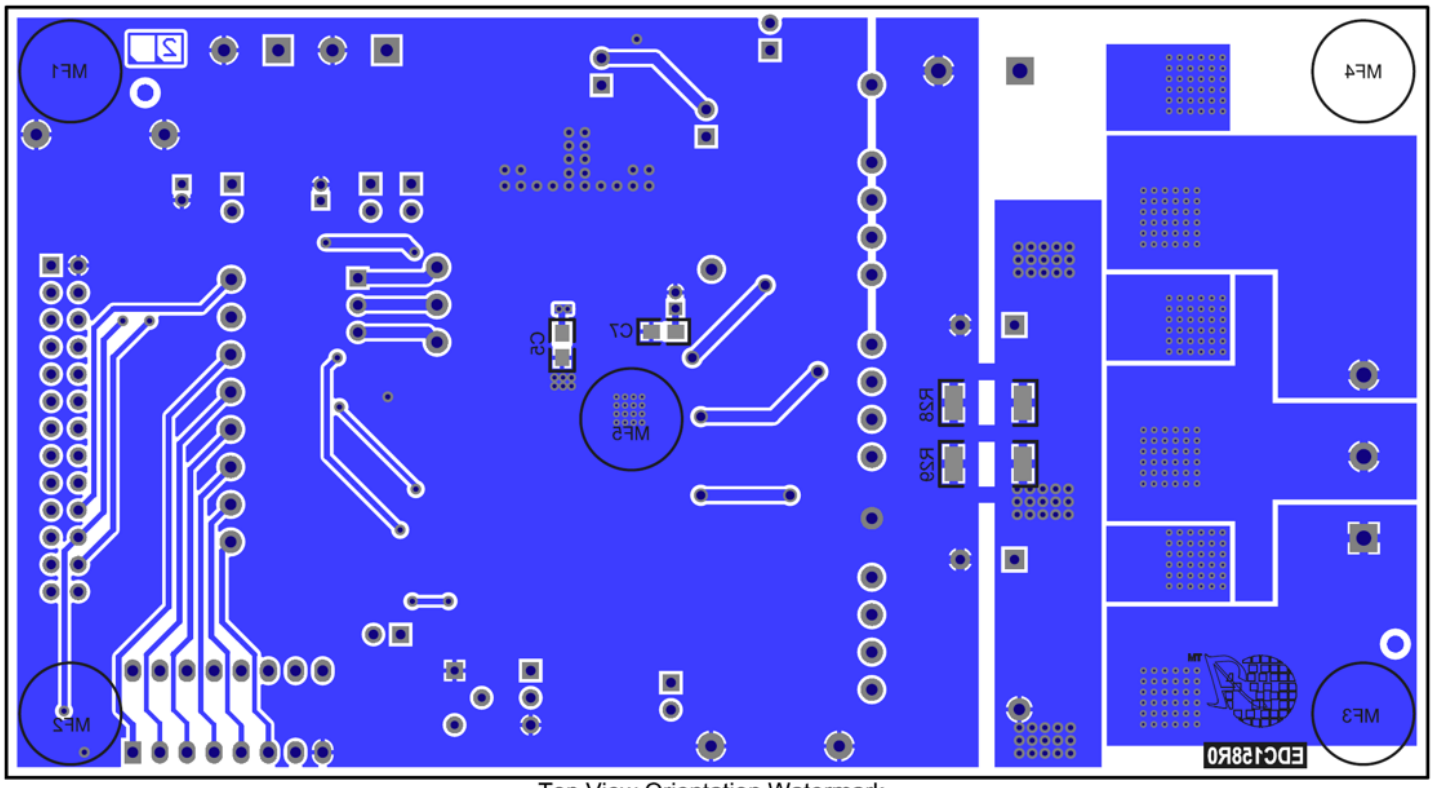
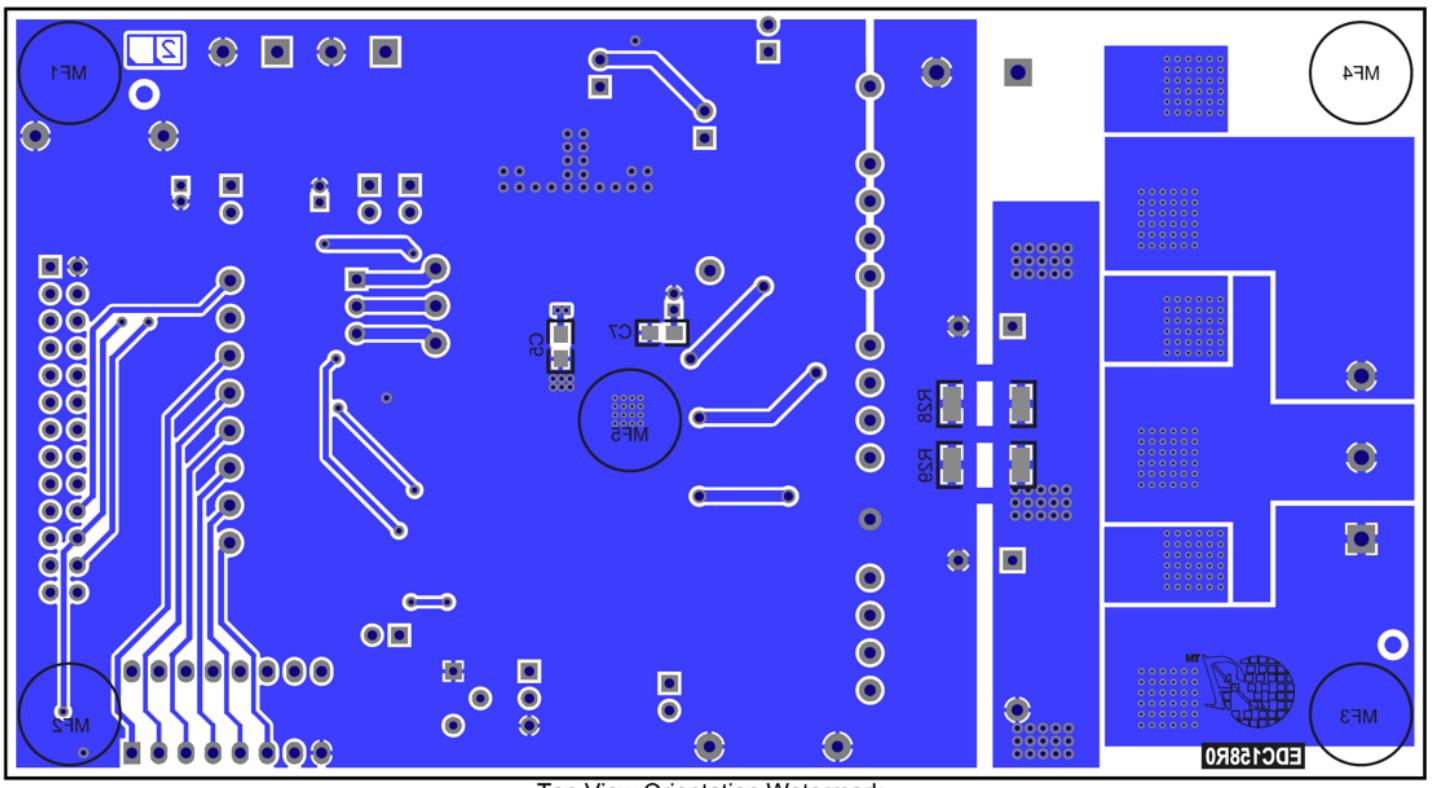
Btm Layer (L2) Btm Silk Btm Paste



Top View Orientation Watermark

Btm Layer (L2) Btm Silk Btm Paste



Top View Orientation Watermark

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BILL OF MATERIALS

Table 3: Axxxxx Version Evaluation Board Bill of Materials

ELECTRICAL COMPONENTS					
Designator	**Quantity**	**Description**	**Manufacturer**	**Manufacturer Part Number**	**PCB Label**
C1, C8	2	Capacitor: Alu Electrolytic Radial	Multicomp	MCMR25V106M4X7	C1, C8
C2	1	Capacitor: Alu Electrolytic SMT	Panasonic	EEEFP1E100AR	C2
C3, C4	2	Capacitor: Ceramic Chip	Multicomp	MC1206B105K250CT	C3, C4
C5	1	Capacitor: Ceramic Chip	KEMET	C0805X224K5RACTU	C5
C6	4	Capacitor: Ceramic Chip	Murata	GRM21BR71H224KA01L	C6
C7, C17	1	Capacitor: Ceramic Chip	Murata	GCJ21BR71H474KA12L	C7, C17
C9, C10	2	Capacitor: Ceramic Chip	KEMET	C0805C104K5RACTU	C9, C10
C11, C12, C13, C18	2	Capacitor: Ceramic Chip	Panasonic	ECA1HHG102	C11, C12, C13, C18
C14, C15, C16	3	Capacitor: Ceramic Chip	KEMET	C0805X224K5RACTU	C14, C15, C16
D2	4	Diode: 100 V, 0.15 A	Diodes	1N4148W-7-F	D2
GND1	1	Test Point: 1.4 mm Round Loop, Black	Keystone Electronics	5001	GND1
GND2, GND3	1	Ground Bar: Tinned Copper Wire	Multicomp	TCW20 500G	GND2, GND3
J1, J3, J4, J5, J6, J7, J8, J10	2	Jumper: Header Male 2-pin	Harwin	M20-9990246	J1, J3, J4, J5, J6, J7, J8, J10
J2, J9	8	Jumper: Header Male 3-pin	Amphenol	G800W305018EU	J2, J9
LED1	2	LED: SMT, 2-pin, Red	ams OSRAM	LS M676-P2S1-1	LED1
M1, M2, M3, M4, M5, M6	1	MOSFET: N-Channel, 56 A, 55 V	Infineon	IRFR2405TRPBF	M1, M2, M3, M4, M5, M6
PCB	6	PCB: A4919GET Demo Board EDC158R0			PCB
Q1	5	Transistor: NPN, 50 V, 0.5 A	Nexperia	BC817-25,215	Q1
R3, R4, R5, R6, R7, R8, R9, R11	1	Resistor: Ceramic Chip	Multicomp	MCMR08X1001FTL	R3, R4, R5, R6, R7, R8, R9, R11
R10	1	Resistor: Ceramic Chip	Multicomp	MCMR08X1002FTL	R10
R12	8	Resistor: Ceramic Chip	TT Welwyn	WCR0805-270KFI	R12
R13, R14	1	Resistor: Ceramic Chip	Multicomp	MCMR08X4701FTL	R13, R14
R15	1	Resistor: Trim Pot, 3296Y, 25 kΩ	Bourns	3296Y-1-253LF	R15
R16, R18, R20, R22, R24, R26	2	Resistor: Ceramic Chip	Multicomp	MCMR08X22R0FTL	R16, R18, R20, R22, R24, R26
R17, R19, R21, R23, R25, R27	1	Resistor: Ceramic Chip	Multicomp	MCMR08X4703FTL	R17, R19, R21, R23, R25, R27
R30	1	Resistor: Ceramic Chip	Multicomp	MCSR08X3301FTL	R30
R31, R38	2	Resistor: Ceramic Chip	Multicomp	MCSR08X1003FTL	R31, R38
S1	1	Resistor: Ceramic Chip	Grayhill	78B08ST	S1
U1	1	Allegro Motor Driver	Allegro Microsystems	A4919ET	U1
U2	1	Voltage Regulator 5 V	TI	LM2936HVBMA-5.0/NOPB	U2

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Table 3: Axxxxx Version Evaluation Board Bill of Materials (continued)

OTHER COMPONENTS					
Designator	**Quantity**	**Description**	**Manufacturer**	**Manufacturer Part Number**	**PCB Label**
X1	1	Connector: Screw Terminal, 3-way, 30 A	Phoenix Contact	1731734	X1
X2	1	Connector: Screw Terminal, 2-way, 30 A	Phoenix Contact	1731721	X2
X3, X4	2	Connector: Screw Terminal, 2-way, 20 A	Weidmuller	PM5.08/2/90BLK	X3, X4
X5	1	Connector: IDC 26-way Ribbon Header	3M	N2526-6002-RB	X5
AHI, ALO, BHI, BLO, CA, CB, CC, CHI, CLO, FAULT, GHA, GHB, GHC, GLA, GLB, GLC, LSS, SA, SB, SC, VBIAS, VBRG, VDSTH, VREG, VU1, VU2	26	Test point	Keystone Electronics	5000	AHI, ALO, BHI, BLO, CA, CB, CC, CHI, CLO, FAULT, GHA, GHB, GHC, GLA, GLB, GLC, LSS, SA, SB, SC, VBIAS, VBRG, VDSTH, VREG, VU1, VU2
JMP_ SHORT_R	10	Jumper Short Link: Red	Harwin	M7566-05	
ESDBAG_6x8	1	ESD bag 6" × 8"	Desco SCS	10068	

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Revision History

Number	Date	Description
–	June 26, 2023	Initial release

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