APEK3921KLP-01-T, APEK3941KLP-01-T

A3921 and A3941 Evaluation Board User Guide

DESCRIPTION

The A3921 or A3941 (A3921/41) is a full-bridge controller for use with external N-channel power MOSFETs and is specifically designed for automotive applications with high-power inductive loads, such as brush DC motors.

A unique charge-pump regulator provides full (> 10 V) gate drive for battery voltages down to 7 V and allows the A3921/41 to operate with a reduced gate drive, down to 5.5 V.

A bootstrap capacitor provides the above-battery supply voltage required for N-channel MOSFETs. An internal charge pump for the high-side drive allows DC (100% duty cycle) operation.

The full bridge can be driven in fast or slow decay modes using diode or synchronous rectification. In the slow decay mode, current recirculation can be through the high-side or the low-side FETs. The power FETs are protected from shoot-through by resistor adjustable dead time.

Integrated diagnostics provide indication of undervoltage, overtemperature, and power bridge faults, and can be configured to protect the power MOSFETs under most short-circuit conditions.

The A3921/41 is supplied in a 28-pin TSSOP power package with an exposed thermal pad (suffix LP). The A3921/41 is fully described in the datasheet. For further information, consult the datasheet in conjunction with this user guide.

FEATURES

- High-current gate drive for N-channel MOSFET full bridge.
- High-side or low-side PWM switching
- Charge pump for low supply voltage operation
- Top-off charge pump for 100% PWM
- Cross-conduction protection with adjustable dead time
- 5.5 to 50 V supply voltage range
- Integrated 5 V regulator
- Diagnostics output
- Low-current sleep mode
- AEC-Q100 qualified

EVALUATION BOARD CONTENTS

- APEK3921 or APEK3941 evaluation board

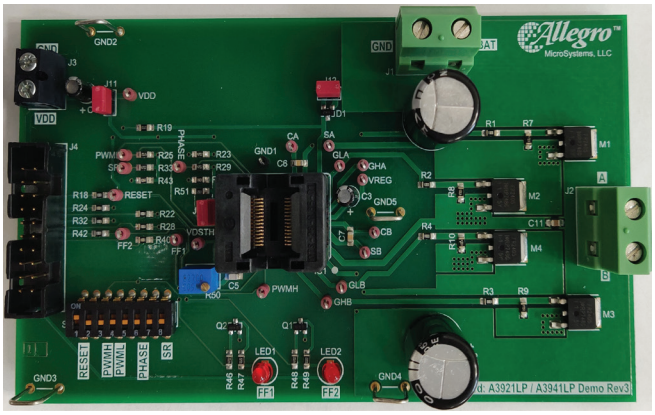

Figure 1: A3921 Evaluation Board

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Table 1: A3921 and A3941 Evaluation Board Configurations

Configuration Name	Part Number
APEK3921KLP-01-T	A3921LP
APEK3941KLP-01-T	A3941LP

USING THE EVALUATION BOARD

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

Equipment Required

- DC motor
- Power supply unit, PSU (4 A capable)
- Digital voltage meter

Setup

1. Set the S1,4 PWML, S1,6 PHASE, S1,8 SR to OFF.
2. Set S1,3 PWMH, and S1,1 RESET to ON.
3. Ensure jumpers J11, J12, and J13 are fitted.
4. Set the PSU supply current limit to 4 A.
5. Set the PSU voltage, motor voltage VBAT, to 13.5 V. The PSU remains off until the A3921/41 is fitted.

Power-up

1. Mount the A3921/41 device in the socket.
2. Set S1,1 RESET to OFF. Set S1,6 PWMH to OFF. Ensure all S1 switches are set to OFF.
3. Connect the meter to test point TP VDSTH. Adjust R50 to the intended value.
4. Connect the motor to J2.
5. Use the meter to measure the voltage at TP GLA. The meter reads approximately 13 V. The motor draws approximately 1.3 A.

Power-down

1. Switch S1,1 RESET ON, and remaining S1 switches OFF.
2. Switch PSU OFF.
3. Disconnect the PSU, motor, and remove the A3921/41.

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SCHEMATIC

Figure 2 shows the evaluation board schematic.

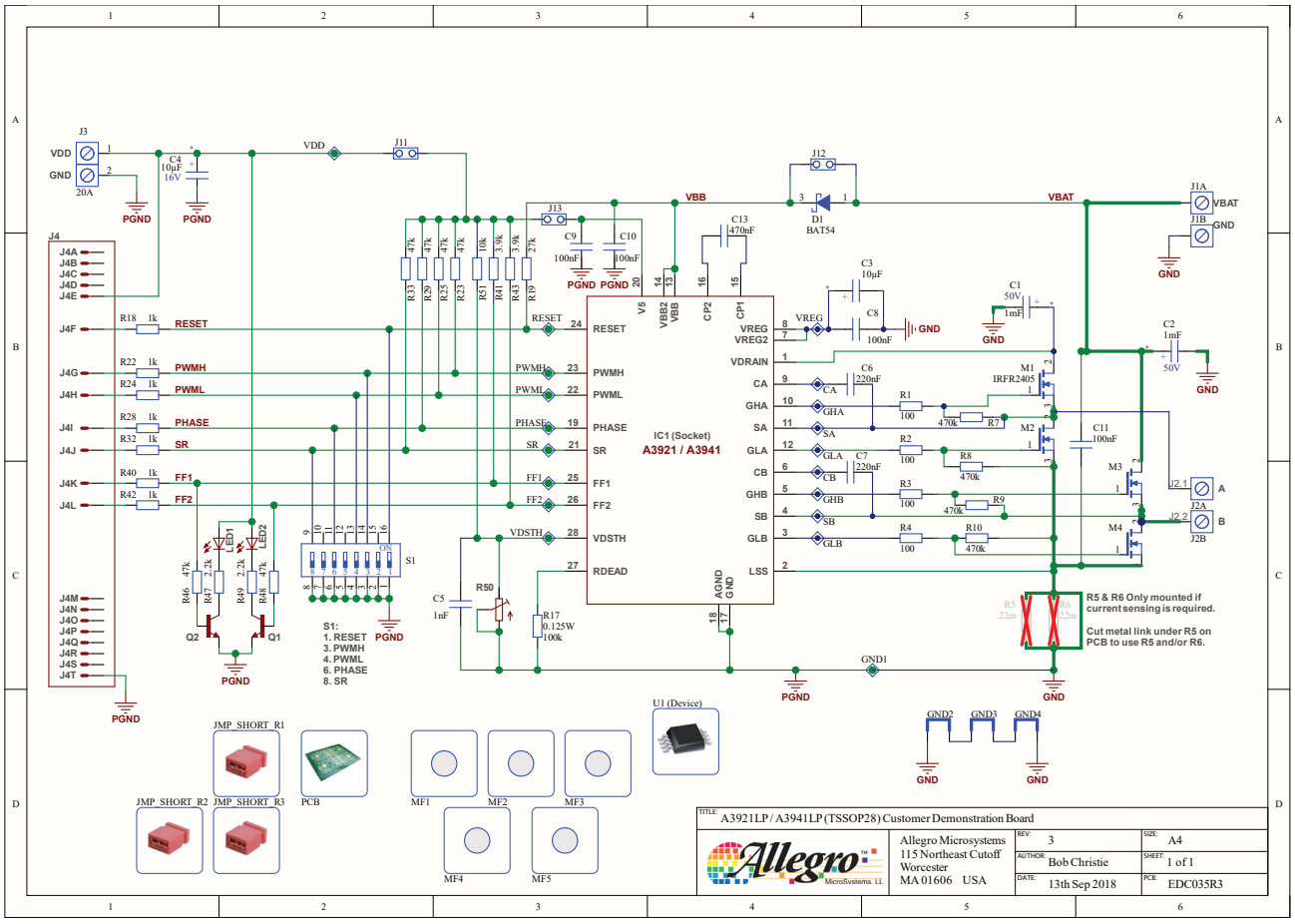

Figure 2: A3921 Evaluation Board Schematic

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LAYOUT

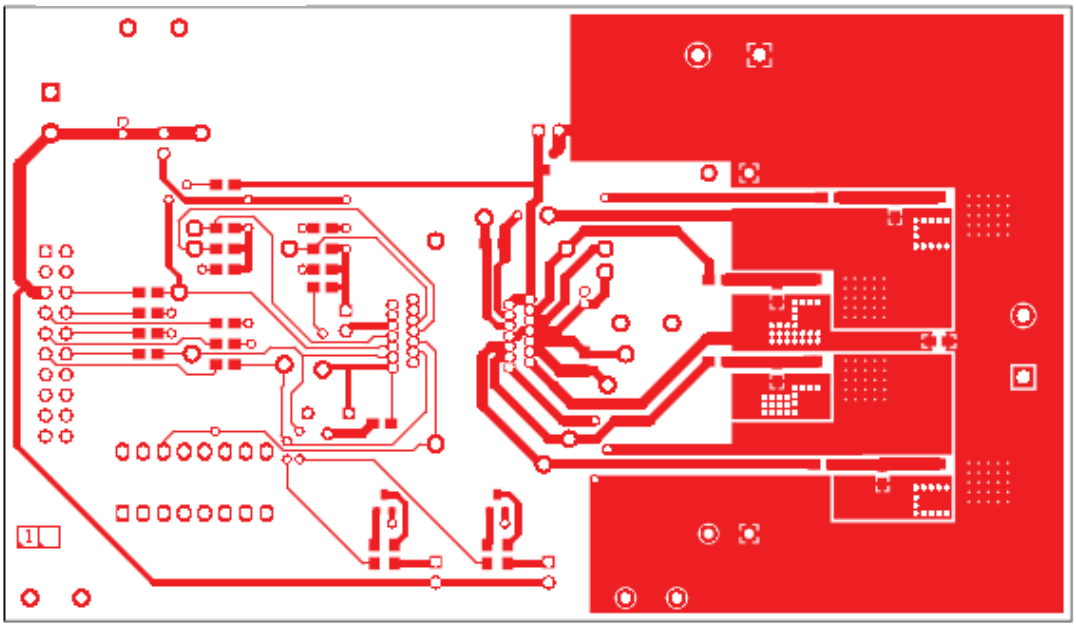

Figure 3: Evaluation Board Top Layer

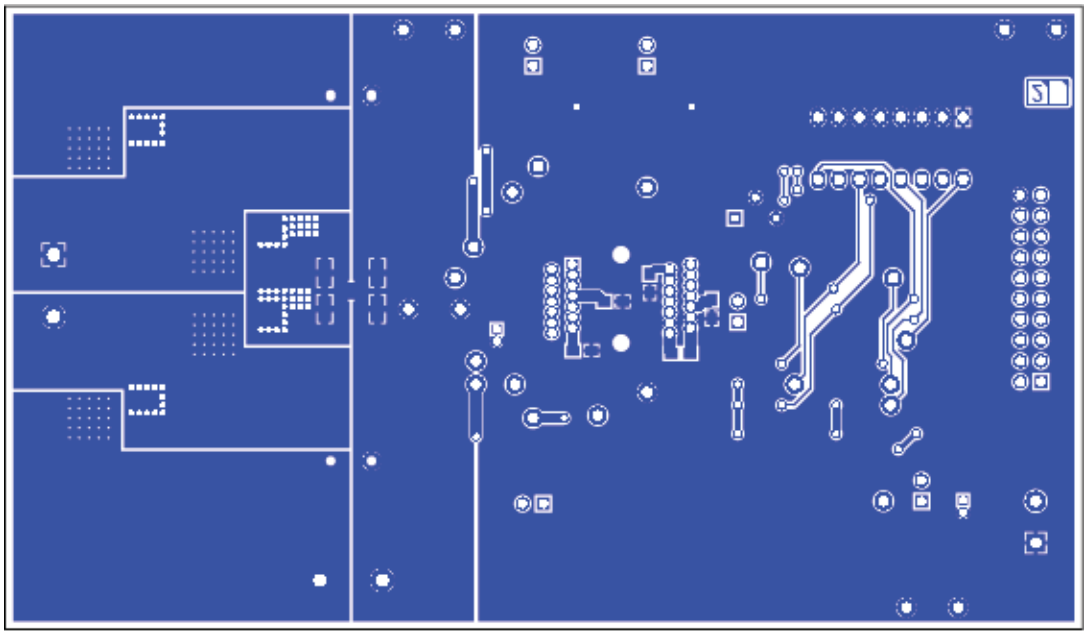

Figure 4: Evaluation Board Bottom Layer

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BILL OF MATERIALS

Table 2: A3921/41 Evaluation Board Bill of Materials

Designator	Quantity	Value	Description	Manufacturer	Manufacturer Part Number	Footprint
ELECTRICAL COMPONENTS						
C1, C2	2	1000 µF	CAP 1000 µF	Panasonic	ECA-1HHG102	12.5 mm, 5 mm pitch
C3, C4	2	10 µF, 16 V	CAP 10 µF, 16 V	Panasonic	EEA-GA1C100	4 mm diameter, 1.5 mm pitch
C5	1	1000 µF, 100 V	Capacitor, ceramic chip	Multicomp	33R0628	0805
C6, C7	2	0.22 µF, 100 V	Capacitor, ceramic chip	Murata	GRM21BR71H224KA01L	0805
C8, C9, C10, C11	4	0.1 µF, 100 V	Capacitor, ceramic chip	Keyocera	KGM21AR72A104KU	0805
C13	1	0.47 µF, 50 V	Capacitor, ceramic chip	Murata	GCJ21BR71H474KA12L	0805
CA, CB, FF1, FF2, GHA, GHB, GLA, GLB, PHASE, PWMH, PWML, RESET, SA, SB, SR, VDD, VDSTH, VREG	18	–	Test Point, 1.4 mm round loop, red	Keystone Electronics	5000	1.02 mm hole diameter
D1	11	30 V, 0.2 A	Diode, Schottky, 30 V, 0.2 A	Nexperia	BAT54,215	TO-236AB
GND1	3	–	Test point, 1.4 mm round loop, black	Keystone Electronics	5001	1.02 mm hole diameter
GND2, GND3, GND4	1	–	Ground Bar, tinned copper wire	Belden	8020-000-1000	1.02 mm hole diameter
IC1 (Socket)	1		Socket, (TSSOP28)	Enplas	OTS-28-0.65-01	TSSOP28 socket
J1, J2	2	–	Connector, screw terminal, 2-way, 30 A	Phoenix Contact	1731721	7.62 mm (300 mil) pitch
J3	1	–	Connector, screw terminal, 2-way, 20 A	Weidmuller	PM5.08/2/90BLK	5.08 mm (200 mil) pitch
J4	1	–	Connector, IDC20, 10×2, symbol per pin	3M	N2520-6002RB	2 × 10 pins, 2.54 mm pitch
J11, J12, J13	3	–	Jumper, header, male, 2-pin	Harwin	M20-9990246	2 × 1 mm, 2.54 mm pitch
JMP_SHORT_R1, JMP_SHORT_R2, JMP_SHORT_R3	3	–	Jumper, short link, red	Harwin	M7566-05	–
LED1, LED2	2	2.1 V Red	LED, OSRAM, - CHIPLED	Ledtech Electronics	L4RR3000G1EP4	0.5 mm diameter square lead, 2.54 mm pitch
M1, M2, M3, M4	4	56 A, 55 V	MOSFET, N-channel, 56 A, 55 V	Infineon	IRFR2405TRPBF	DPAK (TO252AA)
PCB	1	–	PCB	Allegro MicroSystems		–
Q1, Q2	2	45 V, 0.5 A	NPN transistor	Nexperia	BC817,215	TO-236AB
R1, R2, R3, R4	4	100 Ω, 0.125 W	Resistor, ceramic chip	TE Connectivity	CRG0805F100R	0805
R7, R8, R9, R10	4	–	Resistor, ceramic chip	Multicomp	MCMR08X4703FTL	0805
R17	1	–	Resistor, ceramic chip	TT Welwyn	ASC0805-100KFT5	0805
R18, R22, R24, R28, R32, R40, R42	7	–	Resistor, ceramic chip	Multicomp	MCMR08X1001FTL	0805
R19	1	–	Resistor, ceramic chip	TE Connectivity	CRG0805F27K	0805
R23, R25, R29, R33, R46, R48	6	3.9 kΩ, 0.125 W	Resistor, ceramic chip	TE Connectivity	CRG0805F47K	0805
R41, R43	2	3.9 kΩ, 0.125 W	Resistor 0805	TE Connectivity	CRG0805F3K9	0805
R47, R49	2	2.2 kΩ, .125 W	Resistor, ceramic chip	TE Connectivity	CRG0805F2K2	0805
R50	1	50 kΩ, 0.25 W	Trim resistor	Bourns	3266W-1-503LF	0.76 mm diameter, 2.54 mm pitch
R51	1	10 kΩ, 125 mW, 150 V	Resistor, ceramic chip	Multicomp	MCMR08X1002FTL	0805

Continued on next page...

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Table 2: A3921/41 Evaluation Board Bill of Materials (continued)

S1	1	–	Switch, DIL16, 8-way, raised actuator	Grayhill	78B08ST	DIL-16
U1	1	–	Gate driver	Allegro MicroSystems	A3921KLP or A3941KLP	–
OTHER COMPONENTS						
Designator	**Quantity**	**Value**	**Description**	**Manufacturer**	**Manufacturer Part Number**	**Footprint**
MF1, MF2, MF3, MF4, MF5	5	–	Mount foot, adhesive rubber	Multicomp VOLTREX	2565	–

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Revision History

Number	Date	Description
–	March 6, 2025	Initial release
1	March 2, 2026	Added A3941 (APEK3941; formerly documented in MCO-0001847) and made minor editorial changes (all pages)

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