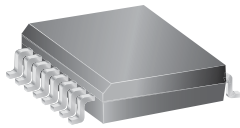


## DMOS Full-Bridge Motor Driver

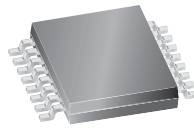
### Features and Benefits

- Single supply operation
- Very small outline package
- Low  $R_{DS(ON)}$  outputs
- Sleep function
- Internal UVLO
- Crossover current protection
- Thermal shutdown protection

### Packages:



Package LB, 16-pin SOIC with internally fused pins



Package LP, 16-pin TSSOP with exposed thermal pad

Not to scale

### Description

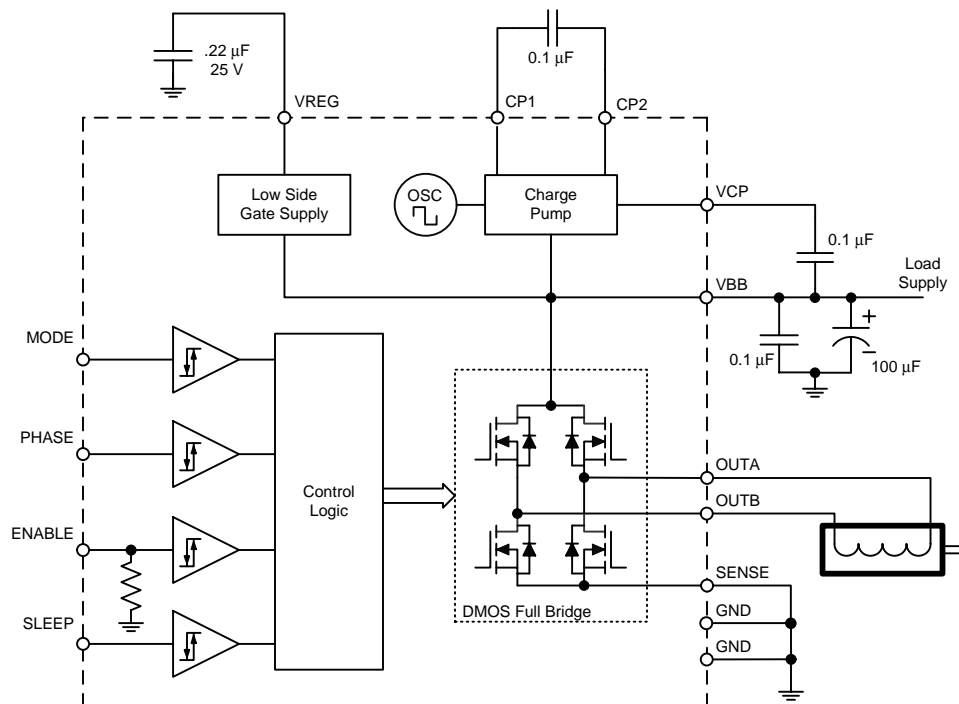
Designed for PWM (pulse width modulated) control of dc motors, the A3949 is capable of peak output currents to  $\pm 2.8$  A and operating voltages to 36 V.

PHASE and ENABLE input terminals are provided for use in controlling the speed and direction of a dc motor with externally applied PWM control signals. Internal synchronous rectification control circuitry is provided to reduce power dissipation during PWM operation.

Internal circuit protection includes thermal shutdown with hysteresis, undervoltage monitoring of  $V_{BB}$  and  $V_{CP}$ , and crossover current protection.

The A3949 is supplied in a choice of two power packages, a 16-pin plastic SOIC with a copper batwing tab (part number suffix *LB*), and a low profile (1.1mm) 16-pin TSSOP (suffix *LP*) with exposed power tab. Both packages are lead (Pb) free, with 100% matte tin leadframes.

### Functional Block Diagram



## Selection Guide

Part Number	Package	Packing
A3949SLB-T	16-pin, SOIC	47 per tube
A3949SLBTR-T	16-pin, SOIC	1000 per reel
A3949SLP-T	16-pin, TSSOP	96 per tube
A3949SLPTR-T	16-pin, TSSOP	4000 per reel

## Absolute Maximum Ratings

Characteristic	Symbol	Notes	Rating	Units
Load Supply Voltage	$V_{BB}$		36	V
		Peak < 2 $\mu$ s	38	V
Logic Input Voltage	$V_{IN}$		-0.3 to 7	V
Sense Voltage	$V_{SENSE}$		0.5	V
Output Current, Repetitive	$I_{OUT}$	Output current rating may be limited by duty cycle, ambient temperature, and heat sinking. Under any set of conditions, DO NOT exceed the specified $I_{OUT}$ or $T_J$ .	$\pm 2.8$	A
Operating Ambient Temperature	$T_A$	Range S	-20 to 85	$^{\circ}$ C
Maximum Junction Temperature	$T_J(max)$		150	$^{\circ}$ C
Storage Temperature	$T_{stg}$		-55 to 150	$^{\circ}$ C

## Package Thermal Characteristics\*

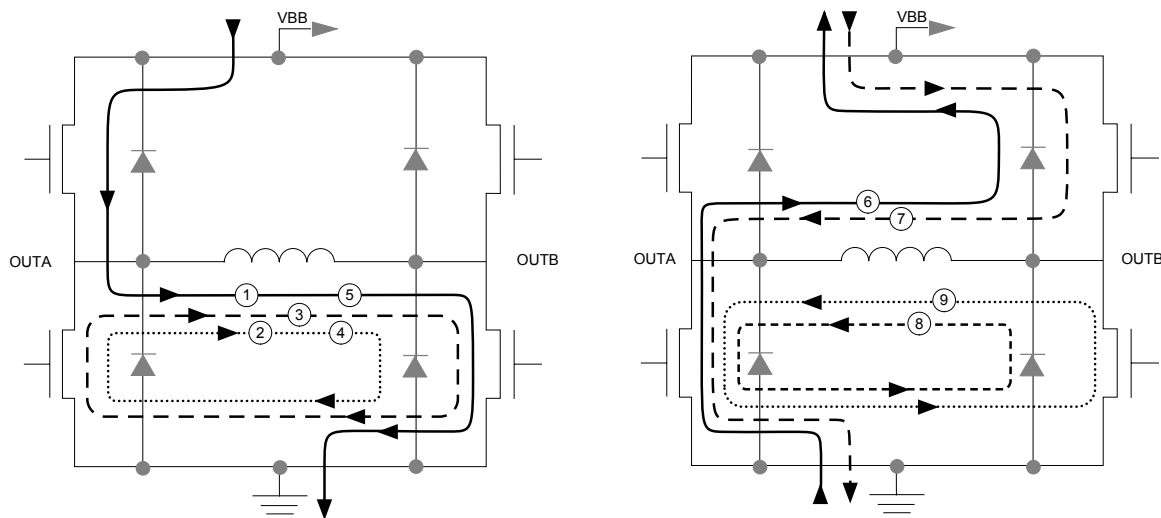
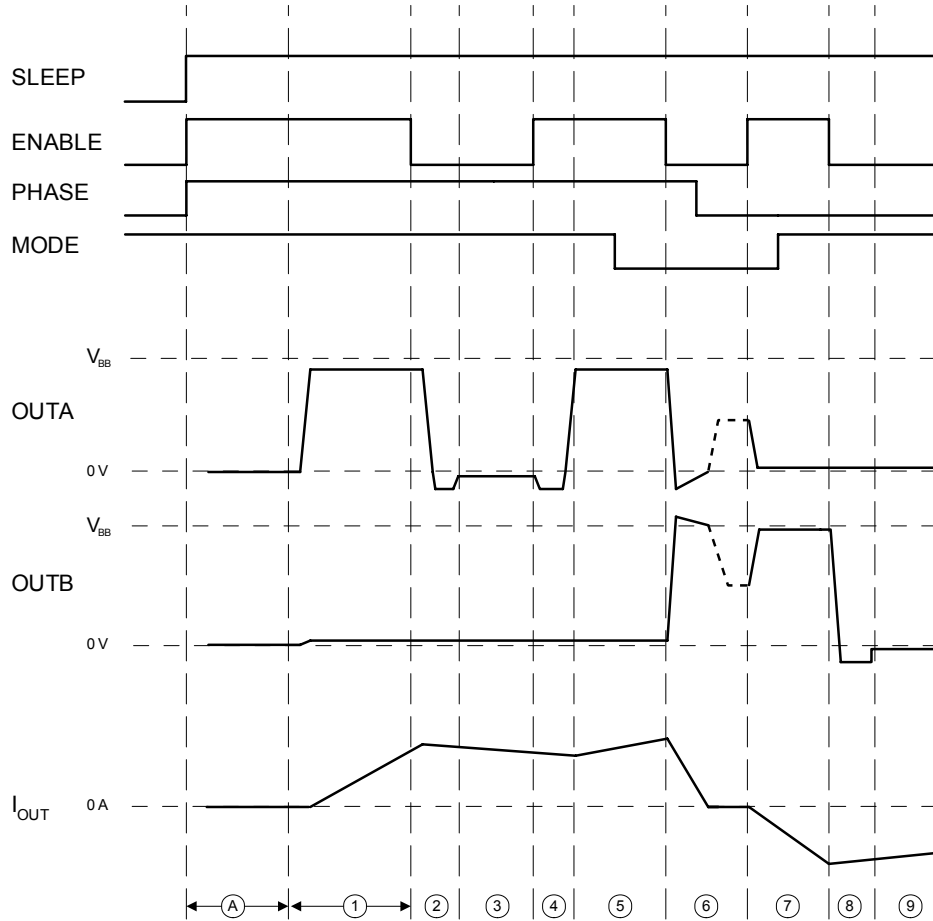
Characteristic	Symbol	Note	Rating	Units
Package Thermal Resistance	$R_{\theta JA}$	LB package, measured on 2-layer PCB with 2 in <sup>2</sup> 2-oz. copper each side	52	$^{\circ}$ C/W
		LP package, measured on 4-layer PCB based on JEDEC standard	34	$^{\circ}$ C/W

\*Additional information is available on the Allegro [website](#)

**ELECTRICAL CHARACTERISTICS** at  $T_A = 25^\circ\text{C}$ ,  $V_{BB} = 8\text{ V}$  to  $36\text{ V}$  (unless otherwise noted)

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Output-On Resistance	$R_{\text{DSON}}$	Source driver, $I_{\text{OUT}} = -2.8\text{ A}$ , $T_J = 25^\circ\text{C}$	–	.4	.48	$\Omega$
		Source driver, $I_{\text{OUT}} = -2.8\text{ A}$ , $T_J = 125^\circ\text{C}$	–	.68	–	$\Omega$
		Sink driver, $I_{\text{OUT}} = 2.8\text{ A}$ , $T_J = 25^\circ\text{C}$	–	.3	.43	$\Omega$
		Sink driver, $I_{\text{OUT}} = -2.8\text{ A}$ , $T_J = 125^\circ\text{C}$	–	.576	–	$\Omega$
Body Diode Forward Voltage	$V_F$	Source diode, $I_F = -2.8\text{ A}$	–	1.1	1.3	V
		Sink diode, $I_F = 2.8\text{ A}$	–	1	1.3	V
Motor Supply Current	$I_{\text{BB}}$	$f_{\text{PWM}} < 50\text{ kHz}$	–	6	8.5	mA
		Charge pump turned on; outputs disabled	–	3	4.5	mA
		Sleep mode	–	–	10	$\mu\text{A}$
Logic Input Voltage PHASE, ENABLE, MODE	$V_{\text{IN}(1)}$		2.0	–	–	V
	$V_{\text{IN}(0)}$		–	–	0.8	V
Logic Input Voltage SLEEP	$V_{\text{IN}(1)}$		2.7	–	–	V
	$V_{\text{IN}(0)}$		–	–	0.8	V
Logic Input Current PHASE, MODE pins	$I_{\text{IN}(1)}$	$V_{\text{IN}} = 2.0\text{ V}$	–	< 1.0	20	$\mu\text{A}$
	$I_{\text{IN}(0)}$	$V_{\text{IN}} = 0.8\text{ V}$	–	< -2.0	-20	$\mu\text{A}$
Logic Input Current ENABLE pin	$I_{\text{IN}(1)}$	$V_{\text{IN}} = 2.0\text{ V}$	–	40	100	$\mu\text{A}$
	$I_{\text{IN}(0)}$	$V_{\text{IN}} = 0.8\text{ V}$	–	16	40	$\mu\text{A}$
Logic Input Current SLEEP pin	$I_{\text{IN}(1)}$	$V_{\text{IN}} = 2.7\text{ V}$	–	27	50	$\mu\text{A}$
	$I_{\text{IN}(0)}$	$V_{\text{IN}} = 0.8\text{ V}$	–	< 1	10	$\mu\text{A}$
Propagation Delay Times	$t_{\text{pd}}$	From PWM change to source or sink turn on	–	600	–	ns
		From PWM change to source or sink turn off	–	100	–	ns
Crossover Delay	$t_{\text{COD}}$		–	500	–	ns
<b>Protection Circuitry</b>						
UVLO Enable Threshold		VBB rising	–	6	–	V
UVLO Hysteresis			–	250	–	mV
Thermal Shutdown Temp.	$T_J$		–	170	–	$^\circ\text{C}$
Thermal Shutdown Hysteresis	$\Delta T_J$		–	15	–	$^\circ\text{C}$

PWM Control Timing Diagram



(A) Charge pump and VREG power-up delay (approximately 200 us)

## Functional Description

**VREG.** This supply voltage is used to operate the sink-side DMOS outputs. VREG is internally monitored and in the case of a fault condition, the outputs of the device are disabled. The VREG pin should be decoupled with a 0.22  $\mu\text{F}$  capacitor to ground.

**Charge Pump.** The charge pump is used to generate a supply above VBB to drive the source-side DMOS gates. A 0.1  $\mu\text{F}$  ceramic monolithic capacitor should be connected between CP1 and CP2 for pumping purposes. A 0.1  $\mu\text{F}$  ceramic monolithic capacitor should be connected between VCP and VBB to act as a reservoir to run the high side DMOS devices. The VCP voltage is internally monitored, and in the case of a fault condition, the outputs of the device are disabled.

**Shutdown.** In the event of a fault due to excessive junction temperature, or low voltage on VCP or VREG, the outputs of the device are disabled until the fault condition is removed. At power-up, the UVLO circuit disables the drivers.

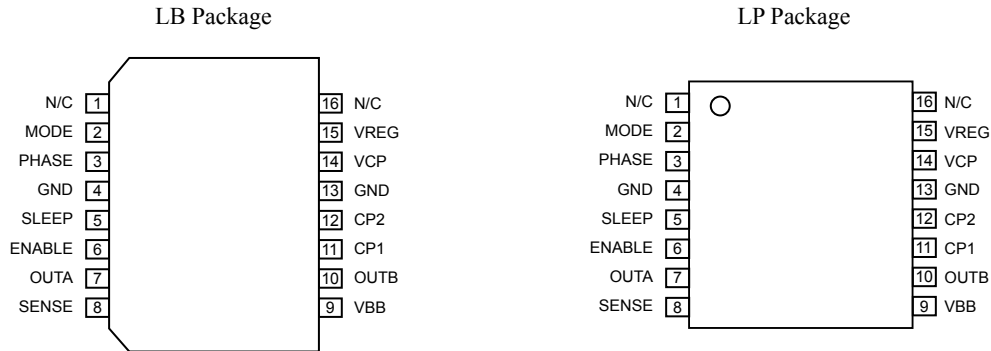
**Sleep Mode.** Control input SLEEP is used to minimize power consumption when the A3949 is not in use. This disables much of the internal circuitry, including the low-side gate supply and the charge pump. A logic low on this pin puts the device into Sleep mode. A logic high allows normal operation. After coming out of Sleep mode, the user should wait 1 ms before applying PWM signals, to allow the charge pump to stabilize.

**Braking.** The braking function is implemented by driving the device in slow decay mode via the MODE pin, and applying an enable chop command. Because it is possible to drive current in both directions through the DMOS switches, this configuration effectively shorts out the motor-generated BEMF, as long as the enable chop mode is asserted on the ENABLE pin. The maximum current can be approximated by  $V_{\text{BEMF}}/R_L$ . Care should be taken to insure that the maximum ratings of the device are not exceeded in worse case braking situations of high speed and high inertial loads.

Control Logic Table

PHASE	ENABLE	MODE	SLEEP	OUTA	OUTB	Function
1	1	X	1	H	L	Forward
0	1	X	1	L	H	Reverse
X	0	1	1	L	L	Brake (slow decay)
1	0	0	1	L	H	Fast decay SR*
0	0	0	1	H	L	Fast decay SR*
X	X	X	0	Hi-Z	Hi-Z	Sleep mode

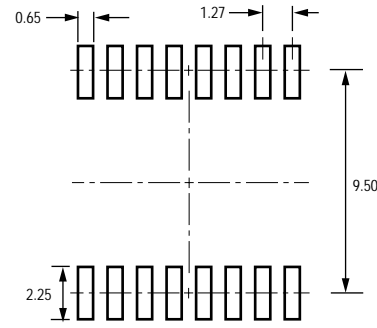
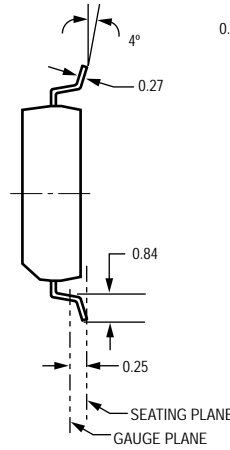
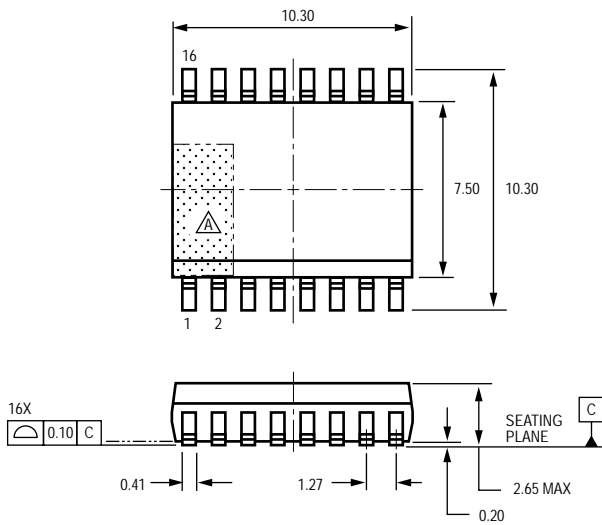
\* To prevent reversal of current during fast decay SR (synchronous rectification), the outputs go to the high impedance state as the current approaches zero.



Name	Description	Number	
		TSSOP-16	SOIC-16
N/C	Not used	1	1
MODE	Logic input	2	2
PHASE	Logic input for direction control	3	3
GND	Ground	4*	4*
SLEEP	Logic input	5	5
ENABLE	Logic input	6	6
OUTA	Output A for full bridge	7	7
SENSE	Power return	8	8
VBB	Load supply voltage	9	9
OUTB	Output B for full bridge	10	10
CP1	Charge pump capacitor	11	11
CP2	Charge pump capacitor	12	12
GND	Ground	13*	13*
VCP	Reservoir capacitor	14	14
VREG	Low side gate supply decoupler	15	15
N/C	Not used	16	16

\*For the TSSOP package, connect pins 4 and 13 to the exposed thermal pad via the PCB layout. In the SOIC package, the pins are internally connected.

LB 16-Pin SOICW

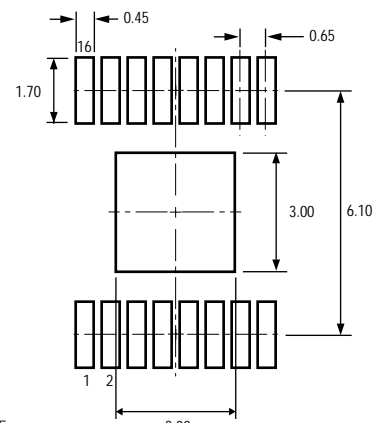
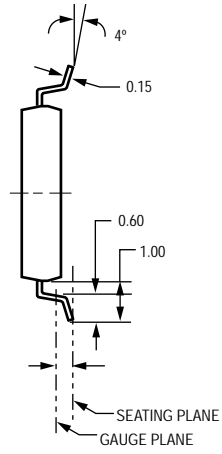
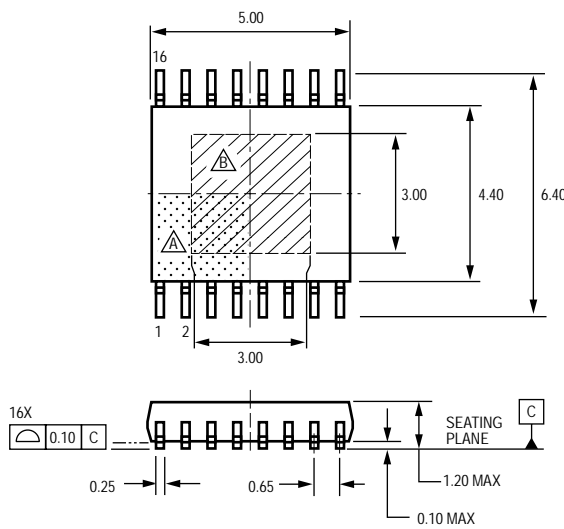


**PCB Layout Reference View**

All dimensions nominal, not for tooling use  
 Dimensions in millimeters  
 (reference JEDEC MS-013 AA)  
 Dimensions exclusive of mold flash, gate burrs, and dambar protrusions  
 Exact case and lead configuration at supplier discretion within limits shown  
 Pins 4 and 13 fused internally

**A** Terminal #1 mark area  
**B** Reference pad layout (reference IPC SOIC127P1030X265-16M)  
 All pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances

Package LP 16-Pin TSSOP



**PCB Layout Reference View**

All dimensions nominal, not for tooling use  
 (reference JEDEC MO-153 ABT)  
 Dimensions in millimeters  
 Dimensions exclusive of mold flash, gate burrs, and dambar protrusions  
 Exact case and lead configuration at supplier discretion within limits shown

**A** Terminal #1 mark area  
**B** Exposed thermal pad (bottom surface)  
**C** Reference land pattern layout (reference IPC7351 SOP65P640X110-17M);  
 All pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances; when mounting on a multilayer PCB, thermal vias at the exposed thermal pad land can improve thermal dissipation (reference EIA/JEDEC Standard JESD51-5)

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