LA6538T



# Single-Phase Full-Wave Fan Motor Driver

### **Overview**

The LA6538T is optimal for use as a fan motor driver in equipment, such as notebook personal computers and electronic game units, that requires miniaturization and low noise levels. This device achieves highly efficient single-phase bipolar fan motor drive by providing a low saturation voltage BTL output.

### **Functions and Features**

- BTL output single-phase full-wave linear drive (gain resistance: 180 to 500 kΩ, 360×)
  - Since this device generates no switching noise, it is optimal for fan drive in audio equipment, electronic games, and notebook personal computers.
- Supports low-voltage operation and features a wide usable voltage range ( $V_{CC} = 2.5$  to 9.5 V).
- Low saturation voltage output (Upper side + lower side saturation voltage: V<sub>O</sub>sat(total) = 0.2 V (typ),
  - $I_0 = 100 \text{ mA}$ )
  - This device achieves a high coil efficiency for low current drain, and generates minimal heat in the IC itself.
- Constant-voltage Hall bias output.
  - The Hall element is regulated at 2.1 V, and the device provides a stable Hall output with excellent temperature characteristics.
- FG output
  - The LA6538T provides a speed detection output (an open-collector output).
- Built-in thermal protection circuit
  - This circuit limits the drive current to prevent damage to or destruction of the IC when the IC chip temperature exceeds 180°C due to excessive output current caused by load shorting or other problem.

- Ultraminiature package
  - (MSOP-8:  $3.0 \times 4.9 \times 0.93 \text{ mm}^3$ )
  - Allows the circuit board to be miniaturized and a large heat sink to be used.

Reference materials:

T package (MSOP-8) series fan motor drivers

LB1964T: 3 and 5 V operation, low saturation voltage switching single-phase bipolar drive, FG output

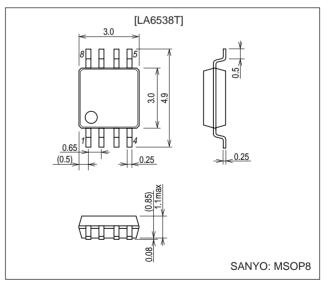
LB11963T: 5 and 12 V operation, switching singlephase bipolar drive, restart circuit, lock detection, 1/2 FG output

LB11964T: 5 and 12 V operation, switching singlephase bipolar drive, restart circuit, lock detection, FG output

### **Package Dimensions**

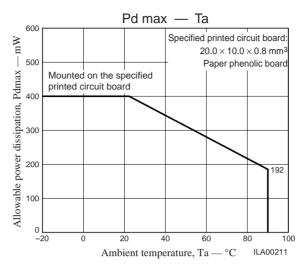
unit: mm

#### 3245-MSOP8



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### **Specifications** Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		10	V
Allowable power dissipation	Pd max	Mounted on the specified printed circuit board*	400	mW
OUT pin output current	I <sub>OUT</sub> max		0.3	A
OUT pin output voltage handling	V <sub>OUT</sub> max		9.5	V
FG output voltage handling	V <sub>FG</sub> max		10	V
FG output current	I <sub>FG</sub> max		5	mA
Operating temperature	Topr		-20 to +90	°C
Storage temperature	Tstg		-55 to +150	°C

Note: \* Specified printed circuit board:  $20.0 \times 10.0 \times 0.8 \text{ mm}^3$  paper phenolic board, wiring density: 20%.

### Recommended Operating Conditions at $Ta=25^{\circ}C$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V <sub>CC</sub>		2.5 to 9.5	V
Hall input common-mode input voltage range	V <sub>ICM</sub>		0.9 to V <sub>CC</sub> – 1	V

### Electrical Characteristics at Ta = $25^{\circ}$ C, V<sub>CC</sub> = 5 V

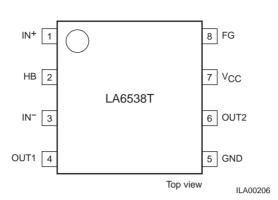
Parameter	Symbol	Conditions	Ratings			Unit
	Symbol	Conditions	min	typ	max	
Circuit current	I <sub>CC</sub>	$IN^{-} = 2.6 V, IN^{+} = 2.4 V, R_{L} = \infty$		10	15	mA
OUT pin output low-level voltage	V <sub>O</sub> L	I <sub>O</sub> = 100 mA		0.1	0.2	V
OUT pin output high-level voltage	V <sub>O</sub> H	I <sub>O</sub> = 100 mA		0.1	0.2	V
Hall bias voltage	V <sub>HB</sub>	RH = 360 Ω + 91 Ω	1.9	2.1	2.3	V
Hall amplifier gain	VG		47	50	53	dB
Hall amplifier input resistance	V <sub>INR</sub>		400	500	620	Ω
FG output low-level voltage	V <sub>FG</sub>	I <sub>FG</sub> = 3 mA		0.2	0.3	V
FG output leakage current	I <sub>FGL</sub>	V <sub>FG</sub> = 7 V			30	μA
Thermal protection circuit	T-TSD	Design guarantee*	150	180	200	°C

Note: \* Design guarantee: Indicates a design target value. These parameters are not tested in the independent IC.

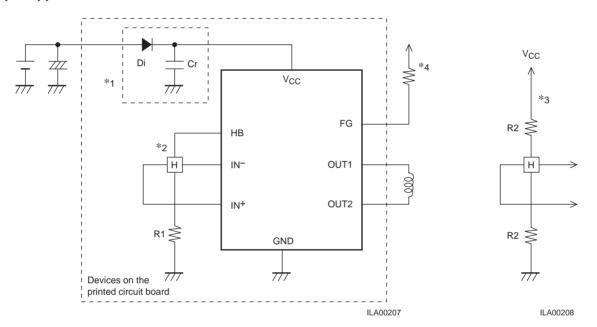
#### **Truth Table**

IN-	IN+	OUT1	OUT2	FG	Mode
Н	L	Н	L	L	Motor opproting
L	Н	L	Н	off	Motor operating
_	—	off	off	—	Thermal protection activated

#### **Pin Assignment**

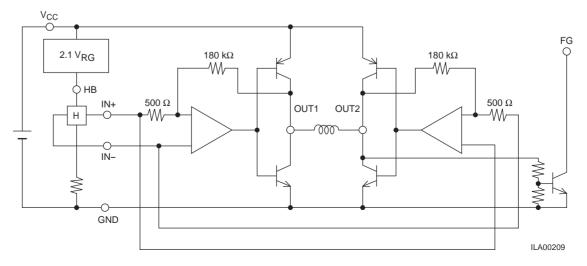


#### Sample Application Circuit

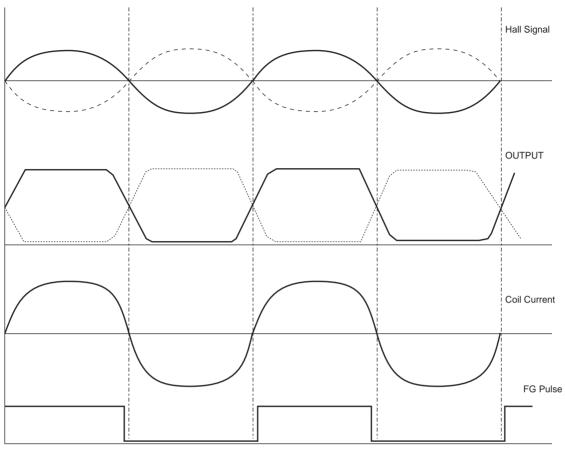


- Notes: 1. When the diode Di is used to prevent device destruction from reverse connection, the capacitor Cr must be inserted to assure a path for regenerative currents. Similarly, if there are no nearby capacitors on the fan power supply line, the capacitor Cr is also required to increase reliability.
  - 2. The Hall element is biased at a constant voltage of approximately 2.1 V from the HB pin. Thus the LA6538T provides a stable Hall output with excellent temperature characteristics. The resistor R1 adjusts the Hall output amplitude.
  - The LA6538T implements linear drive by amplifying the Hall output and applying voltage control to the motor coils. Startup characteristics and efficiency are improved by using a higher Hall device output. However, the motor can be made to operate more quietly by adjusting the Hall device. 3. If the Hall bias is taken from V<sub>CC</sub>, bias the Hall device at 1/2 V<sub>CC</sub> as shown in the figure.
  - 4. This pin must be left open if unused.

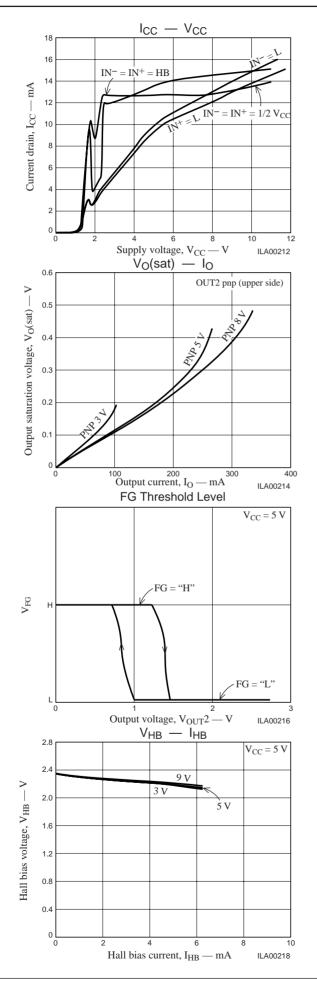
#### **Block Diagram**

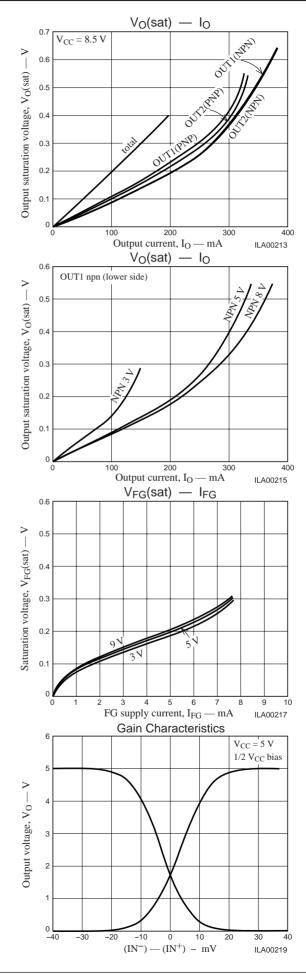


## **Timing Chart**



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