L6219DS

DUAL FULL-BRIDGE PWM MOTOR DRIVER

Dwg. PP-005-3

ABSOLUTE MAXIMUM RATINGS
at $T_J \leq 150°C$

Motor Supply Voltage, V_{BB} .... **45 V**
Output Current, I_{OUT}
    (Peak) .... **+1.0 A**
    (Continuous) .... **+750 mA**
Logic Supply Voltage, V_{CC} .... **7.0 V**
Logic Input Voltage Range,
    V_{IN} .... **-0.3 V to +7.0 V**
Output Emitter Voltage, V_{SENSE} .... **1.5 V**
Package Power Dissipation,
    P_D .... **See Graph**
Operating Temperature Range,
    T_A .... **-20°C to +85°C**
Storage Temperature Range,
    T_S .... **-55°C to +150°C**

Output current rating may be limited by duty cycle, ambient temperature, and heat sinking. Under any set of conditions, do not exceed the specified peak current rating or a junction temperature of +150°C.
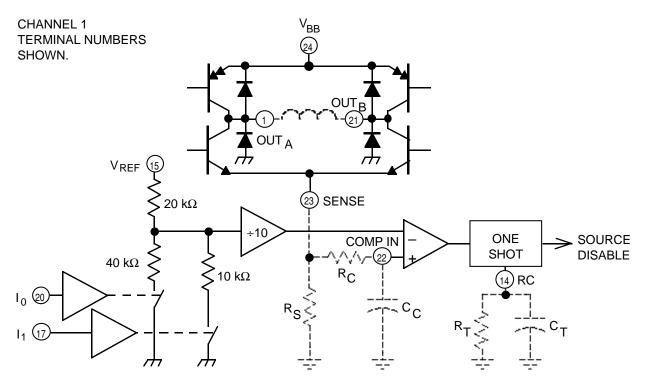
The L6219DS motor driver is designed to drive both windings of a bipolar stepper motor or bidirectionally control two dc motors. Both bridges are capable of sustaining 45 V and include internal pulse-width modulation (PWM) control of the output current to 750 mA. The outputs have been optimized for a low output saturation voltage drop (less than 1.8 V total source plus sink at 500 mA).

For PWM current control, the maximum output current is determined by the user's selection of a reference voltage and sensing resistor. Two logic-level inputs select output current limits of 0, 33, 67, or 100% of the maximum level. A PHASE input to each bridge determines load current direction.

The bridges include both ground clamp and flyback diodes for protection against inductive transients. Internally generated delays prevent cross-over currents when switching current direction. Special power-up sequencing is not required. Thermal protection circuitry disables the outputs if the chip temperature exceeds safe operating limits.

The L6219DS is supplied in a 24-lead surface-mountable SOIC. Its batwing construction provides for maximum package power dissipation in the smallest possible construction. This device is also available on special order for operation from -40°C to +85°C or to +105°C.

FEATURES

■ Interchangeable with SGS L6219DS

■ 750 mA Continuous Output Current

■ 45 V Output Sustaining Voltage

■ Internal Clamp Diodes

■ Internal PWM Current Control

■ Low Output Saturation Voltage

■ Internal Thermal Shutdown Circuitry
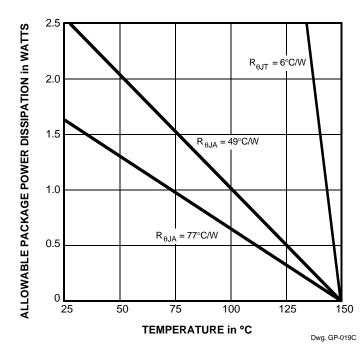
■ Similar to Dual PBL3717, UC3770

Always order by complete part number, e.g., **L6219DS**.

Allegro® MicroSystems, Inc.

L6219DS
DUAL FULL-BRIDGE MOTOR DRIVER

PWM CURRENT-CONTROL CIRCUITRY

CHANNEL 1
TERMINAL NUMBERS
SHOWN.

Dwg. EP-007-5

ALLOWABLE PACKAGE POWER DISSIPATION in WATTS

TEMPERATURE in °C

Dwg. GP-019C

TRUTH TABLE

PHASE	OUT$_A$	OUT$_B$
H	H	L
L	L	H

$R_{\theta JA}$ is measured on typical two-sided PCB with minimal copper ground area (77°C/W) or with 3.57 in^2 copper ground area (49°C/W). See also, Application Note 29501.5, *Improving Batwing Power Dissipation*.

ELECTRICAL CHARACTERISTICS at T_A = +25°C, $T_J \leq$ 150°C, V_{BB} = 45 V, V_{CC} = 4.75 V to 5.25 V, V_{REF} = 5.0 V (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits Min.	Limits Typ.	Limits Max.	Units
Output Drivers (OUT$_A$ or OUT$_B$)						
Motor Supply Range	V_{BB}		10	—	45	V
Output Leakage Current	I_{CEX}	V_{OUT} = V_{BB}	—	< 1.0	50	μA
		V_{OUT} = 0	—	<-1.0	-50	μA
Output Sustaining Voltage	$V_{CE(sus)}$	I_{OUT} = ±750 mA, L = 3.0 mH	45	—	—	V
Output Saturation Voltage	$V_{CE(SAT)}$	Sink Driver, I_{OUT} = +500 mA	—	0.4	0.6	V
		Sink Driver, I_{OUT} = +750 mA	—	1.0	1.2	V
		Source Driver, I_{OUT} = -500 mA	—	1.0	1.2	V
		Source Driver, I_{OUT} = -750 mA	—	1.3	1.5	V
Clamp Diode Leakage Current	I_R	V_R = 45 V	—	< 1.0	50	μA
Clamp Diode Forward Voltage	V_F	I_F = 750 mA	—	1.6	2.0	V
Driver Supply Current	$I_{BB(ON)}$	Both Bridges On, No Load	—	20	25	mA
	$I_{BB(OFF)}$	Both Bridges Off	—	5.0	10	mA
Control Logic						
Input Voltage	$V_{IN(1)}$	All inputs	2.4	—	—	V
	$V_{IN(0)}$	All inputs	—	—	0.8	V
Input Current	$I_{IN(1)}$	V_{IN} = 2.4 V	—	<1.0	20	μA
		V_{IN} = 0.8 V	—	- 3.0	-200	μA
Reference Voltage Range	V_{REF}	Operating	1.5	—	7.5	V
Current Limit Threshold (at trip point)	V_{REF}/V_{COMPIN}	$I_0 = I_1$ = 0.8 V	9.5	10	10.5	—
		I_0 = 2.4 V, I_1 = 0.8 V	13.5	15	16.5	—
		I_0 = 0.8 V, I_1 = 2.4 V	25.5	30	34.5	—
Thermal Shutdown Temperature	T_J		—	170	—	°C
Total Logic Supply Current	$I_{CC(ON)}$	$I_0 = I_1$ = 0.8 V, No Load	—	40	50	mA
	$I_{CC(OFF)}$	$I_0 = I_1$ = 2.4 V, No Load	—	10	14	mA

L6219DS
DUAL FULL-BRIDGE MOTOR DRIVER

APPLICATIONS INFORMATION

PWM CURRENT CONTROL

The L6219DS dual bridge is designed to drive both windings of a bipolar stepper motor. Output current is sensed and controlled independently in each bridge by an external sense resistor (R_S), internal comparator, and monostable multivibrator.
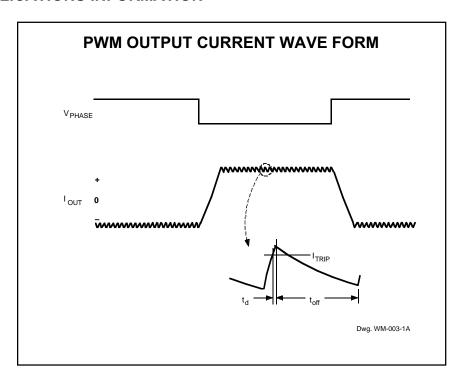
When the bridge is turned on, current increases in the motor winding and it is sensed by the external sense resistor until the sense voltage (V_{COMPIN}) reaches the level set at the comparator's input:
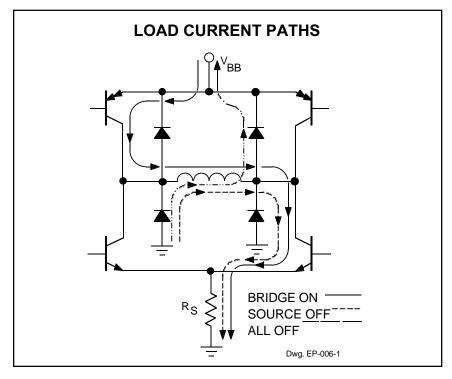
$$I_{TRIP} = V_{REF}/10 \ R_S$$

The comparator then triggers the monostable which turns off the source driver of the bridge. The actual load current peak will be slightly higher than the trip point (especially for low-inductance loads) because of the internal logic and switching delays. This delay (t_d) is typically 2 μs. After turn-off, the motor current decays, circulating through the ground-clamp diode and sink transistor. The source driver's off time (and therefore the magnitude of the current decrease) is determined by the monostable's external RC timing components, where $t_{off} = R_T C_T$ within the range of 20 kΩ to 100 kΩ and 100 pF to 1000 pF.

When the source driver is re-enabled, the winding current (the sense voltage) is again allowed to rise to the comparator's threshold. This cycle repeats itself, maintaining the average motor winding current at the desired level.

Loads with high distributed capacitances may result in high turn-on current peaks. This peak (appearing across R_S) will attempt to trip the comparator, resulting in erroneous current control or high-frequency oscillations. An external $R_C C_C$ time delay should be used to further delay the action of the comparator. Depending on load type, many applications will not require these external components (SENSE connected to COMP IN).

PWM OUTPUT CURRENT WAVE FORM

Dwg. WM-003-1A

LOAD CURRENT PATHS

BRIDGE ON ———
SOURCE OFF – – – –
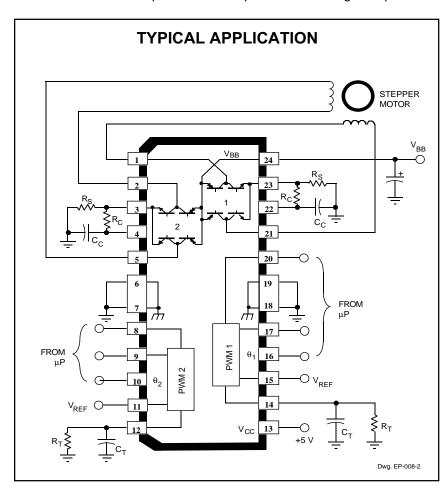ALL OFF

Dwg. EP-006-1

LOGIC CONTROL OF OUTPUT CURRENT

Two logic level inputs (I_0 and I_1) allow digital selection of the motor winding current at 100%, 67%, 33%, or 0% of the maximum level per the table. The 0% output current condition turns off all drivers in the bridge and can be used as an OUTPUT ENABLE function.

CURRENT-CONTROL TRUTH TABLE

I_0	I_1	Output Current
L	L	$V_{REF}/10\ R_S = I_{TRIP}$
H	L	$V_{REF}/15\ R_S = 2/3\ I_{TRIP}$
L	H	$V_{REF}/30\ R_S = 1/3\ I_{TRIP}$
H	H	0

These logic level inputs greatly enhance the implementation of µP-controlled drive formats.

During half-step operations, the I_0 and I_1 allow the µP to control the motor at a constant torque between all positions in an eight-step

sequence. This is accomplished by digitally selecting 100% drive current when only one phase is on and 67% drive current when two phases are on. Logic highs on both I_0 and I_1 turn off all drivers to allow rapid current decay when switching phases. This helps to ensure proper motor operation at high step rates.

The logic control inputs can also be used to select a reduced current level (and reduced power dissipation) for 'hold' conditions and/or increased current (and available torque) for start-up conditions.

GENERAL

The PHASE input to each bridge determines the direction motor winding current flows. An internally generated deadtime (approximately 2 µs) prevents crossover currents that can occur when switching the PHASE input.

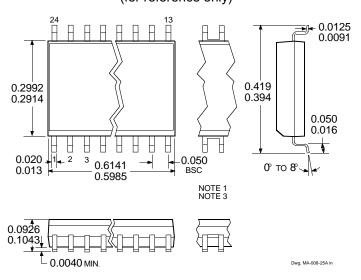All four drivers in the bridge output can be turned off between steps ($I_0 = I_1 \geq 2.4$ V) resulting in a fast current decay through the internal output clamp and flyback diodes. The fast current decay is desirable in half-step and high-speed applications. The PHASE, I_0, and I_1 inputs float high.

Varying the reference voltage (V_{REF}) provides continuous control of the peak load current for microstepping applications.

Thermal protection circuitry turns off all drivers when the junction temperature reaches +170°C. It is only intended to protect the device from failures due to excessive junction temperature and should not imply that output short circuits are permitted. The output drivers are re-enabled when the junction temperature cools to +145°C.
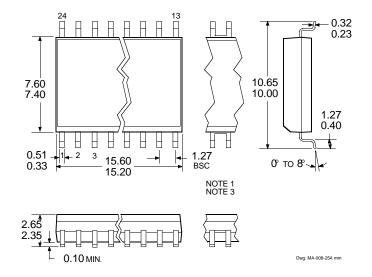
The L6219DS output drivers are optimized for low output saturation voltages—less than 1.8 V total (source plus sink) at 500 mA. Under normal operating conditions, when combined with the excellent thermal properties of the batwing package design, this allows continuous operation of both bridges simultaneously at 500 mA.

TYPICAL APPLICATION

Dwg. EP-008-2

L6219DS
DUAL FULL-BRIDGE
MOTOR DRIVER

Dimensions in Inches
(for reference only)

24   13

0.2992
0.2914

0.020
0.013   1 2 3   0.6141   0.050
0.5985   BSC

NOTE 1
NOTE 3

0.419
0.394

0.0125
0.0091

0.050
0.016

0° TO 8°

0.0926
0.1043

0.0040 MIN.

Dwg. MA-008-25A in

Dimensions in Millimeters
(controlling dimensions)

24   13

7.60
7.40

0.51
0.33   1 2 3   15.60   1.27
15.20   BSC

NOTE 1
NOTE 3

10.65
10.00

0.32
0.23

1.27
0.40

0° TO 8°

2.65
2.35

0.10 MIN.

Dwg. MA-008-25A mm

NOTES: 1. Webbed lead frame. Leads indicated are internally one piece.
2. Lead spacing tolerance is non-cumulative.
3. Exact body and lead configuration at vendor's option within limits shown.
4. Supplied in standard sticks/tubes of 31 devices or add "TR" to part number for tape and reel.

Allegro®
MicroSystems, Inc.

115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

BRIDGE & HALF-BRIDGE DRIVERS

IN ORDER OF 1) OUTPUT CURRENT AND 2) OUTPUT VOLTAGE

Output Ratings *			Features			
mA	**V**	**Description**	**Internal Diodes**	**Outputs**	**Internal Protection**	**Part Number †**
±500	18	dual PWM full bridge	X	DMOS	X	3965
±650	30	dual PWM full bridge	X	bipolar	X	3966
	30	dual PWM full bridge	X	bipolar	X	3968
±750	30	dual microstepping full bridge	X	Darlington/Satlington™	X	3967
	45	dual PWM full bridge	X	bipolar	X	2916
	45	dual PWM full bridge	X	bipolar	X	2919
	45	dual PWM full bridge	X	bipolar	X	6219
±800	33	dual PWM full bridge	X	bipolar	X	3964
±1300	50	PWM full bridge	X	bipolar	X	3953
±1500	45	dual PWM full bridge	X	bipolar	X	2917
	50	PWM full bridge	sync rect	DMOS	X	3948
	50	microstepping full bridge	X	Darlington/Satlington™	X	3955
	50	microstepping full bridge	X	Darlington/Satlington™	X	3957
	50	dual PWM full bridge	sync rect	DMOS	X	3974
±2000	50	PWM full-bridge	X	Darlington	X	3952
	50	PWM full-bridge	sync rect	DMOS	X	3958
±2500	35	dual microstepping full bridge	sync rect	DMOS	X	3977
±3000	50	3-Ø PWM driver	sync rect	DMOS	X	3936
—	50	PWM full-bridge	sync rect	DMOS	X	3959
—	28	3-Ø MOSFET controller	–	DMOS	X	3933
—	40	3-Ø MOSFET controller	–	DMOS	X	3935
—	50	3-Ø MOSFET controller	–	DMOS	X	3932
—	50	3-Ø MOSFET controller	–	DMOS	X	3938

* Current is maximum specified test condition, voltage is maximum rating. See specification for sustaining voltage limits or over-current protection voltage limits.

† Complete part number includes additional characters to indicate operating temperature range and package style.

L6219DS
DUAL FULL-BRIDGE MOTOR DRIVER