

DUAL DMOS FULL BRIDGE MOTOR DRIVER

PRELIMINARY DATA

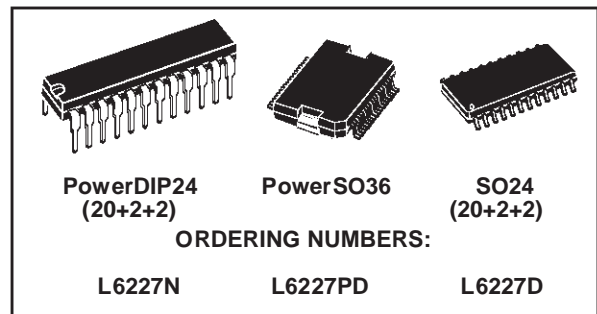
- OPERATING SUPPLY VOLTAGE FROM 8 TO 52V
- 2.8A PEAK CURRENT (1.4A DC)
- $R_{DS(ON)}$ 0.73 Ω TYP. VALUE @ $T_j = 25^\circ\text{C}$
- BUILT-IN CONSTANT OFF TIME PWM CURRENT CONTROL
- HIGH SIDE OVER CURRENT PROTECTION 2.8A TYP
- CROSS CONDUCTION PROTECTION
- THERMAL SHUTDOWN
- OPERATING FREQUENCY UP TO 100KHz
- INTRINSIC FAST FREE WHEELING DIODES
- UNDER VOLTAGE LOCKOUT
- INHIBIT FUNCTION FOR LOW POWER CONSUMPTION

TYPICAL APPLICATIONS

- STEPPER MOTOR
- DUAL OR QUAD DC MOTOR

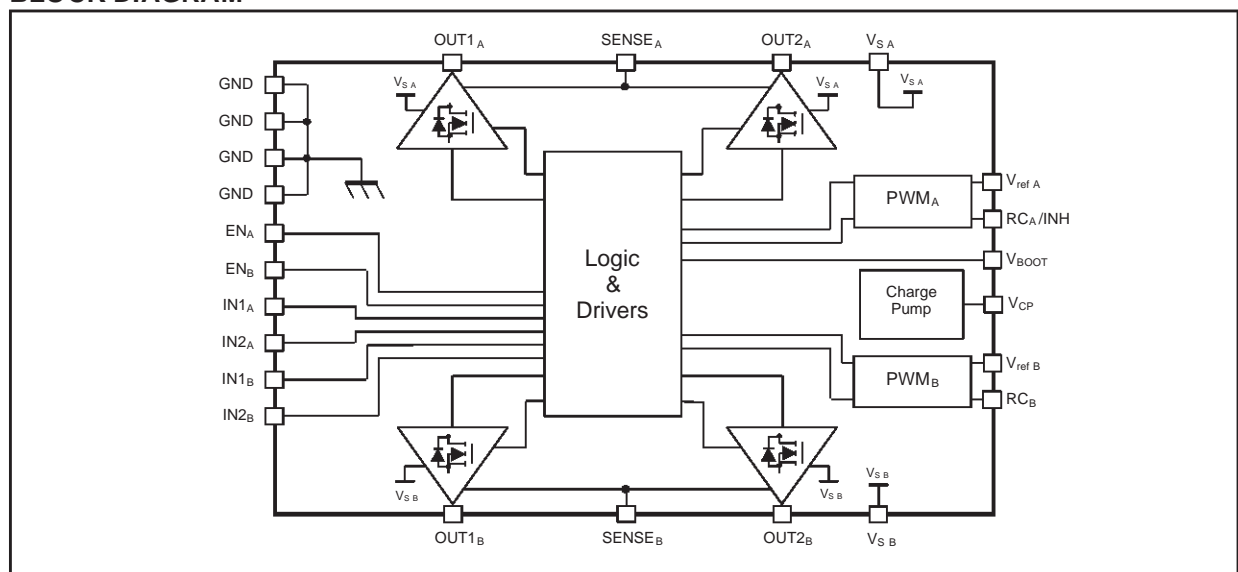
DESCRIPTION

The L6227 is a dual full bridge driver for motor control

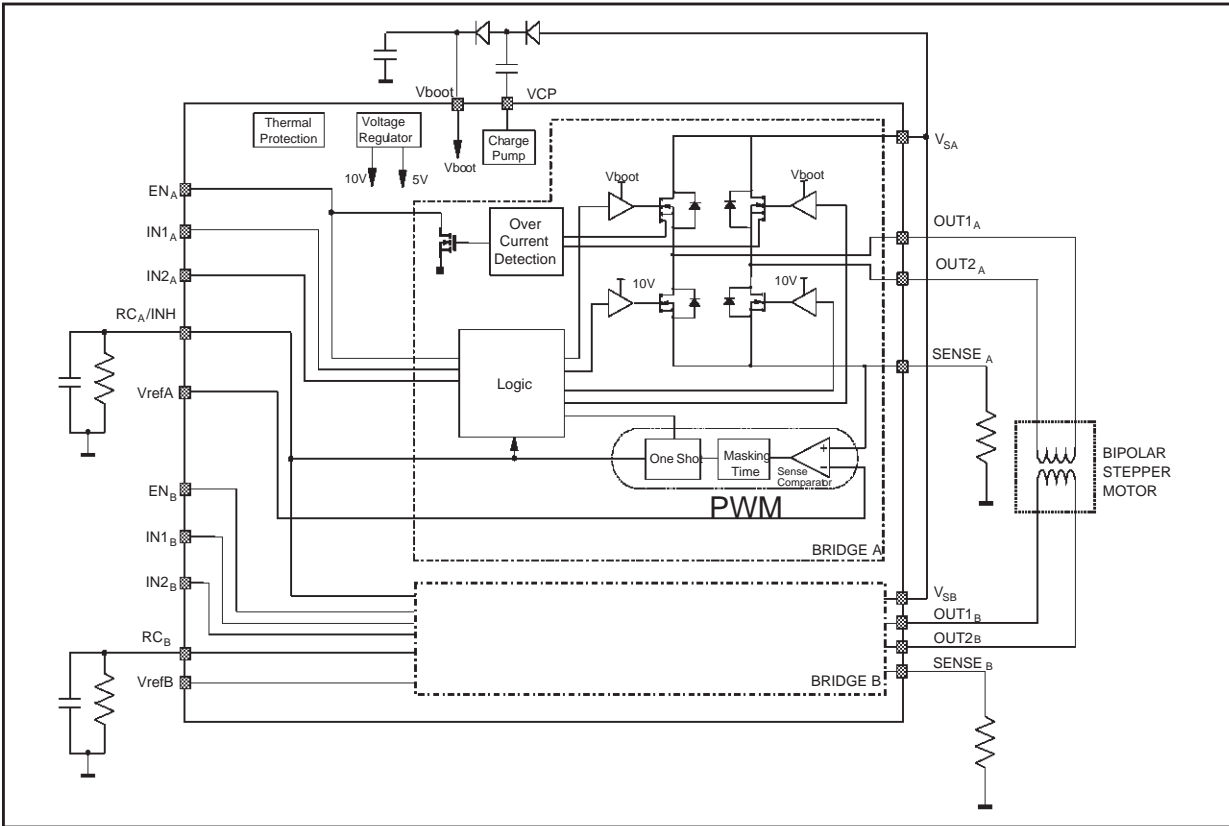


manufactured with Multipower BCD technology which combines isolated DMOS power transistors with CMOS and bipolar circuits on the same chip. The Logic Inputs are CMOS/TTL and μP compatible. Additional circuitry to realize a constant off time PWM control has been implemented for each bridge. Each full bridge is controlled by a separate Enable and has a sense pin for the current sense resistor insertion. Other features are the protection of the high side switches against unsafe over current conditions, the thermal shutdown and the inhibit function that allows to disable all bridges and to reduce the quiescent current to very low values (typ. 1.1mA). The L6227 is assembled in PowerDIP24(20+2+2), PowerSO36 and SO24(20+2+2) packages.

BLOCK DIAGRAM



FUNCTIONAL BLOCK DIAGRAM



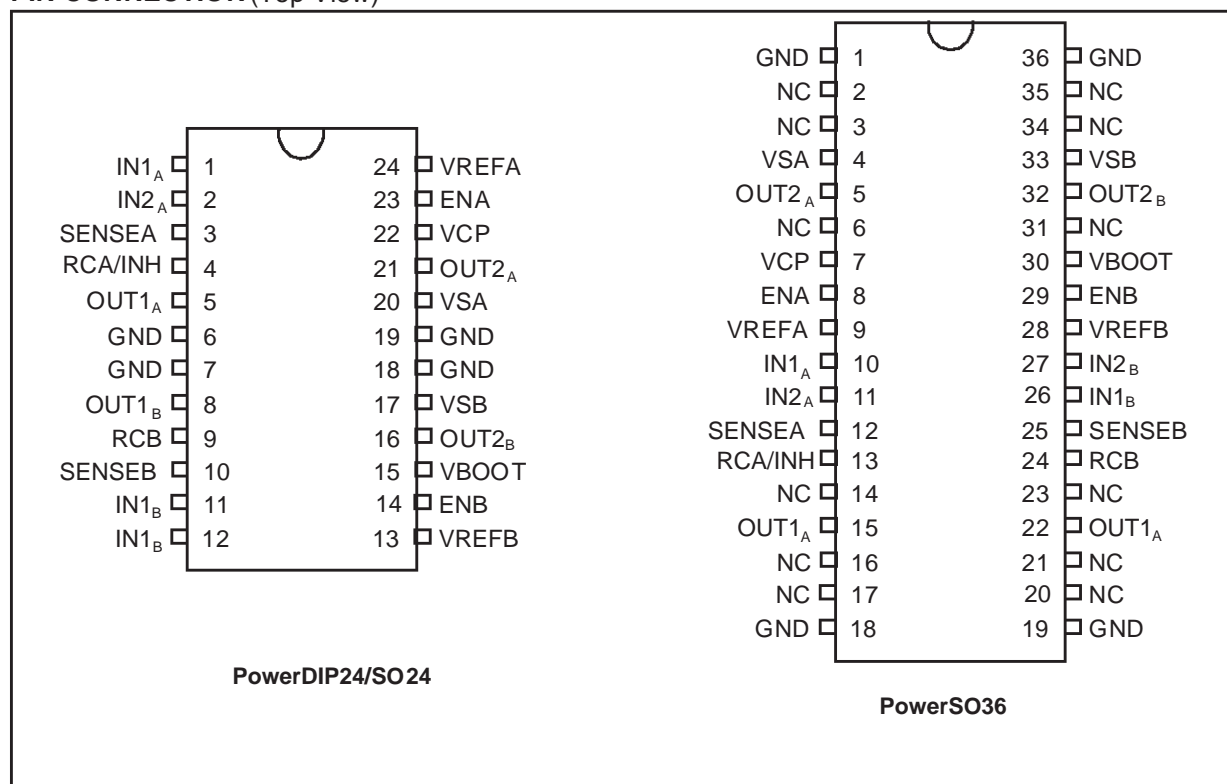
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Test conditions	Value	Unit
V_S	Supply Voltage		60	V
V_{IN}, V_{EN}	Input and Enable Voltage Range		-0.3 to +7	V
V_{refA}, V_{refB}	Voltage Range at V_{ref} pins		-0.3 to +7	V
V_{RCA}, V_{RCB}	Voltage Range at RC_A/INH and RC_B pins		-0.3 to +7	V
V_{SENSE}	DC Sensing Voltage Range		-1 to +4	V
V_{BOOT}	Bootstrap Peak Voltage		$V_S + 10$	V
$I_{S(peak)}$	Pulsed Supply Current (for each V_S pin), internally limited by the overcurrent protection	$t_{PULSE} < 1ms$	3.55	A
I_S	DC Supply Current (for each V_S pin)		1.4	A
V_{OD}	Differential Voltage Between $V_{SA}, OUT1_A, OUT2_A, SENSE_A$ and $V_{SB}, OUT1_B, OUT2_B, SENSE_B$		60	V
T_{stg}, T_{OP}	Storage and Operating Temperature Range		-40 to 150	°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	MIN	MAX	Unit
V_S	Supply Voltage	12	52	V
V_{OD}	Differential Voltage Between V_{S_A} , $OUT1_A$, $OUT2_A$, $SENSE_A$ and V_{S_B} , $OUT1_B$, $OUT2_B$, $SENSE_B$		52	V
V_{SENSE}	Sensing voltage (pulsed $tw < t_{rr}$) (DC)	-6 -1	6 1	V V
V_{ref}	V_{ref} Operating Voltage	-0.1	5	V
I_{OUT}	DC Output Current		1.4	A
T_j	Operating Junction Temperature	-25	+125	°C
f_{sw}	Switching Frequency		100	kHz

PIN CONNECTION (Top View)



PIN DESCRIPTION

Name	PowerSO36	PowerDIP24/ SO24	Function
V _{SA}	4	20	Supply Voltage of the Bridge A.
V _{SB}	33	17	Supply Voltage of the Bridge B. This pin must be connected to V _{SA} .
OUT1 _A OUT2 _A	15 5	5 21	Bridge A outputs.
OUT1 _B OUT2 _B	22 32	8 16	Bridge B outputs.
SENSE _A	12	3	Sense resistor for the bridge A.
SENSE _B	25	10	Sense resistor for the bridge B.
GND	1,18,19,36	6,7,18,19	Common ground terminals. In Powerdip and SO packages, these pins are also used for heat dissipation toward the PCB.
EN _A	8	23	Enable of the Bridge A. A LOW logic level applied to this pin switches off all the power DMOSs of the related bridge. The OCSA open drain is internally connected to this pin.
EN _B	29	14	Enable of the Bridge B. A LOW logic level applied to this pin switches off all the power DMOSs of the related bridge. The OCSB open drain is internally connected to this pin.
IN1 _A IN2 _A	10 11	1 2	Logic inputs of the Bridge B. Provided the ENA signal is HIGH, a HIGH logic level applied to any of these pins switches on the related high side power DMOS, while a logic LOW switches on the related low side power DMOS.
IN1 _B IN2 _B	26 27	11 12	Logic inputs of the Bridge B. Provided the ENB signal is HIGH, a HIGH logic level applied to any of these pins switches on the related high side power DMOS, while a logic LOW switches on the related low side power DMOS.
V _{CP}	7	22	Bootstrap Oscillator. Oscillator output for the external charge pump.
V _{BOOT}	30	15	Supply voltage to overdrive the upper DMOSs.
RC _A /INH	13	4	A parallel RC network connected to these pins sets the OFF time of the low-side power DMOS of the correspondent bridge. The pulse generator is a monostable triggered by the output of the sense comparator of the bridge ($t_{OFF} = 0.69 RC$). Pulling the RC _A /INH pin to ground switches all the BRIDES off and reduces the quiescent current to 1.1mA typ.
RC _B	24	9	
V _{ref A}	9	24	A voltage applied to these pins sets the reference voltage of the sense comparators, determining the output current in PWM current control.
V _{ref B}	28	13	

THERMAL DATA

Symbol	Description	PowerDIP24	SO24	PowerSO36	Unit
R _{th-j-pins}	Maximum Thermal Resistance Junction-Pins	19	15	-	°C/W
R _{th-j-case}	Maximum Thermal Resistance Junction-Case	-	-	2	°C/W
R _{th-j-amb1}	Maximum Thermal Resistance Junction-Ambient ⁽¹⁾	43	51	-	°C/W
R _{th-j-amb1}	Maximum Thermal Resistance Junction-Ambient ⁽²⁾	-	-	36	°C/W
R _{th-j-amb1}	Maximum Thermal Resistance Junction-Ambient ⁽³⁾	-	-	16	°C/W
R _{th-j-amb2}	Maximum Thermal Resistance Junction-Ambient ⁽⁴⁾	59	78	63	°C/W

(1) Mounted on a multilayer FR4 PCB with a dissipating copper surface on the bottom side of 6 cm² (with a thickness of 35 μm).

(2) Mounted on a multilayer FR4 PCB with a dissipating copper surface on the top side of 6 cm² (with a thickness of 35 μm).

(3) Mounted on a multilayer FR4 PCB with a dissipating copper surface on the top side of 6 cm² (with a thickness of 35 μm), 16 via holes and a ground layer.

(4) Mounted on a multiplayer PCB without any heatsinking surface on the board..

ELECTRICAL CHARACTERISTICS

(T_{amb} = 25 °C, V_S = 48V, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V _S	Supply Voltage		8		52	V
I _S	Quiescent Supply Current	All Bridges OFF; -25°C<T _j <125°C		5.5	10	mA
T _j	Thermal Shutdown Temperature		150			°C

Output DMOS Transistors

I _{DSS}	Leakage Current	V _S = 52V			1	mA
R _{DS(ON)}	High-side + Low-side Switch ON Resistance	T _j = 25 °C		1.47	1.69	Ω
		T _j = 125 °C		2.35	2.7	Ω

Source Drain Diodes

V _{SD}	Forward ON Voltage	I _{SD} = 1.4A, EN = LOW			1.2	V
t _{rr}	Reverse Recovery Time	I _f = 1.4A		300		ns
t _{fr}	Forward Recovery Time			200		ns

Switching Rates

t _{D(on)EN}	Enable to out turn ON delay time ⁽⁵⁾	I _{LOAD} = 1.4 A		250		ns
t _{D(on)IN}	Input to out turn ON delay time ⁽⁵⁾			600		ns
t _{ON}	Output rise time ⁽⁵⁾		20	105	300	ns
t _{D(off)EN}	Enable to out turn OFF delay time ⁽⁵⁾			450		ns
t _{D(off)IN}	Input to out turn OFF delay time ⁽⁵⁾			500		ns
t _{off}	Output fall time ⁽⁵⁾		20	78	300	ns
t _{dt}	Dead time protection			1		μs
t _{blank}	Internal blanking time on SENSE pins			1	1.5	μs
f _{CP}	Charge pump frequency	-25°C<T _j <125°C		0.75	1	MHz

ELECTRICAL CHARACTERISTICS (continued)(T_{amb} = 25 °C, V_S = 48V, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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UVLO comp

V _{th(ON)}	Turn ON threshold		6.6	7	7.4	V
V _{th(OFF)}	Turn OFF threshold		5.6	6	6.4	V

Logic Input

V _{INL}	Low level logic input voltage		-0.3		0.8	V
V _{INH}	High level logic input voltage		2		7	V
I _{INH}	High level logic input current	V _{IN} , EN = 5 V			70	μA
I _{INL}	Low level logic input current	V _{IN} , EN = GND			-10	μA

Over Current Protection

I _{S OVER}	Input supply over current protection threshold	-25°C < T _J < 125°C	2	2.8	3.55	A
V _{DIAG}	Open drain low level output voltage	I = 4 mA			0.4	V

Comparator and Monostable

I _{RCA} , I _{RCB}	Source current at RC _A /INH and RC _B pins	V _{RCA/INH} , V _{RCA} = 2.5 V	3	5		mA
V _{ref}	Input common mode comparator voltage range		-0.1		5	V
V _{th}	Comparator threshold voltage on SENSE pins	V _{ref A} , B = 0.5 V	V _{ref} - 5mV		V _{ref} + 5mV	
t _{prop}	Turn OFF propagation delay ⁽⁶⁾	V _{ref A} , B = 0.5 V	0.1	0.2	0.3	μs
t _{OFF}	PWM Recirculation time	20 kΩ < R < 100 kΩ 0.1 nF < C < 100 nF	0.67RC	0.69RC	0.71RC	s
I _{bias}	Input bias current at V _{ref} pins			0.2		μA

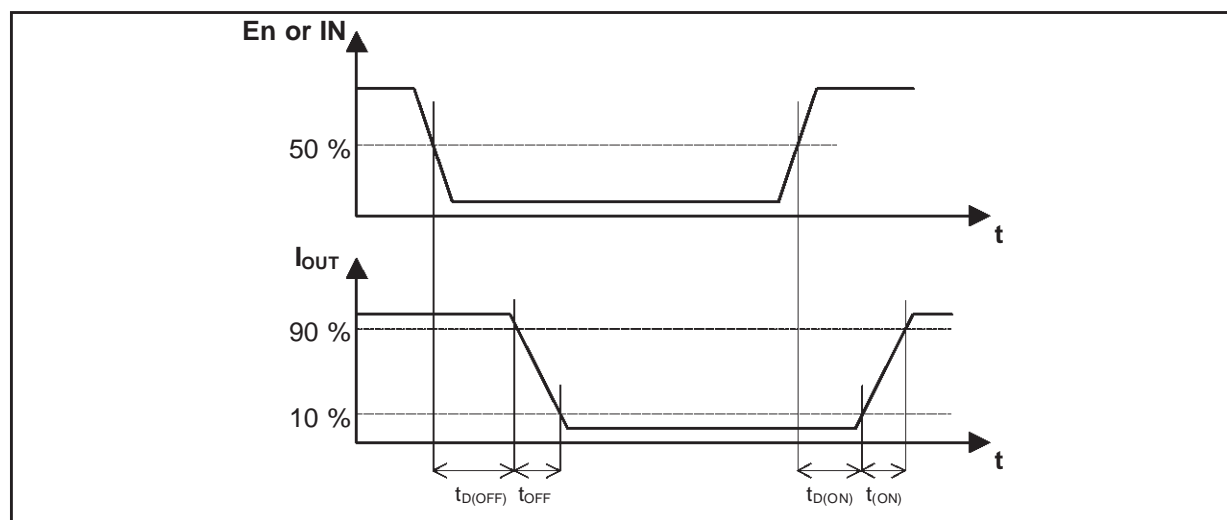
Inhibit

INH _{th}	Voltage threshold at the RC _A /INH pin to enable the inhibit function	-25°C < T _J < 125°C	1	1.25	1.5	V
t _{dINHON}	Delay time to enable the inhibit function			1.25	1.5	μs
t _{dINH-OFF}	Delay time to disable the inhibit function	R = 20kΩ C = 1μF		50		μs
I _{inh}	Quiescent current in inhibit condition	V _{RCA/INH} < 0.4V		1.1		mA
I _{RCA}	Source current at RC _A /INH pin	V _{RCA/INH} = 5V V _{RCA/INH} < 0.35V		500 100		μA μA
I _{RCB}	Source current at RC _B pin	V _{RCB} = 5V, Inhibit inactive V _{RCB} = 5V, Inhibit active		500	1	μA μA

(5) Resistive load used. See Fig. 1.

(6) Defined as the time between the voltage at the input of the current sense reaching the V_{ref} threshold and the lower DMOS switch beginning to turn off. The voltage at SENSE pin is increased instantaneously from V_{ref} -10 mV to V_{ref} +10 mV.

Figure 1. Switching rates definition



CIRCUIT DESCRIPTION

The L6227 is a dual full bridge IC designed to drive DC or Stepper motors and other inductive loads. Each bridge has 4 power DMOS transistors with a typical $R_{DS(ON)}$ of 0.73 Ohm. Any of the 4 half bridges can be controlled independently by means of the 4 TTL/CMOS compatible inputs IN1A, IN2A, IN1B, IN2B, and 2 enable ENA, ENB.

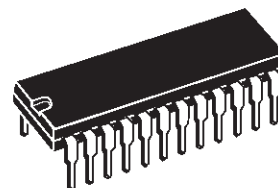
External connections are provided so that sensing resistor can be added for constant current chopping application. A non dissipative current sensing on the supply rails of the high side power DMOSs of each bridge, together with an Internal Reference and an internal open drain, with a pull down capability of 4mA (typical value) will pull to GND the ENABLE pin of the bridge under fault conditions, turning OFF all the four PowerMOSs. This ensures a protection against Short Circuit to GND and between two phases of each of the two independent full bridges. By using an external R-C on the EN pins, the off time before recovering normal operation conditions after a fault can be easily programmed, by means of the accurate threshold of the logic inputs. Note that protection against short to the supply rail is typically provided by the external current control circuitry. The trip point of this protection is internally set at 2.8A (typ value). For each of the two independent bridges a monostable and a comparator can be used to perform a constant t_{off} current control.

The L6227 also features an inhibit function to put the device in stand-by mode, reducing the current consumption to 1.1mA typ.

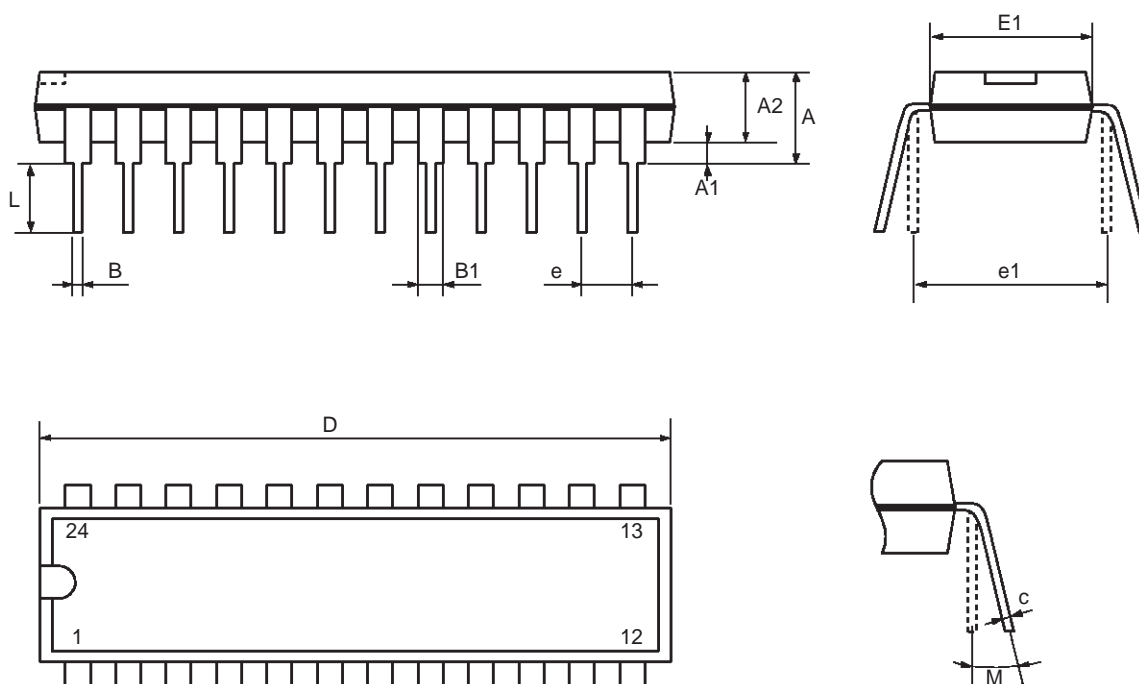
These features makes the L6227 a complete bipolar stepper motor driver, or a Dual DC Motor Driver, that outperforms the component currently available on the market.

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			4.320			0.170
A1	0.380			0.015		
A2		3.300			0.130	
B	0.410	0.460	0.510	0.016	0.018	0.020
B1	1.400	1.520	1.650	0.055	0.060	0.065
c	0.200	0.250	0.300	0.008	0.010	0.012
D	31.62	31.75	31.88	1.245	1.250	1.255
E	7.620		8.260	0.300		0.325
e		2.54			0.100	
E1	6.350	6.600	6.860	0.250	0.260	0.270
e1		7.620			0.300	
L	3.180		3.430	0.125		0.135
M	0° min, 15° max.					

OUTLINE AND MECHANICAL DATA



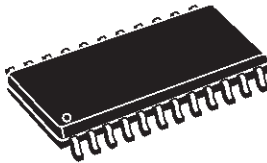
Powerdip 24



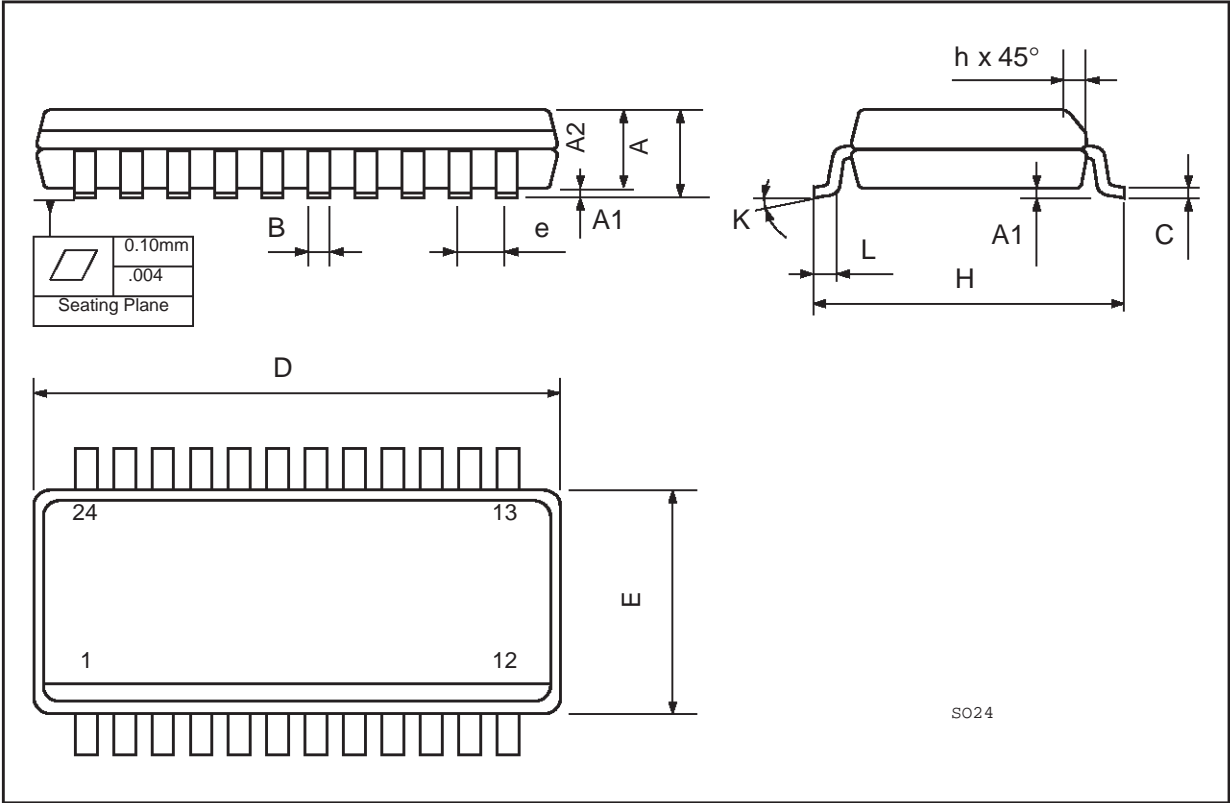
SDIP24L

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
A2			2.55			0.100
B	0.33		0.51	0.013		0.0200
C	0.23		0.32	0.009		0.013
D	15.20		15.60	0.598		0.614
E	7.40		7.60	0.291		0.299
e		1.27			0,050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
k	0° (min.), 8° (max.)					
L	0.40		1.27	0.016		0.050

**OUTLINE AND
MECHANICAL DATA**



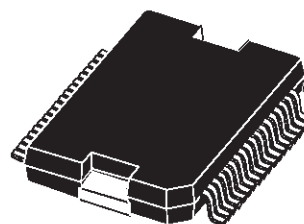
SO24



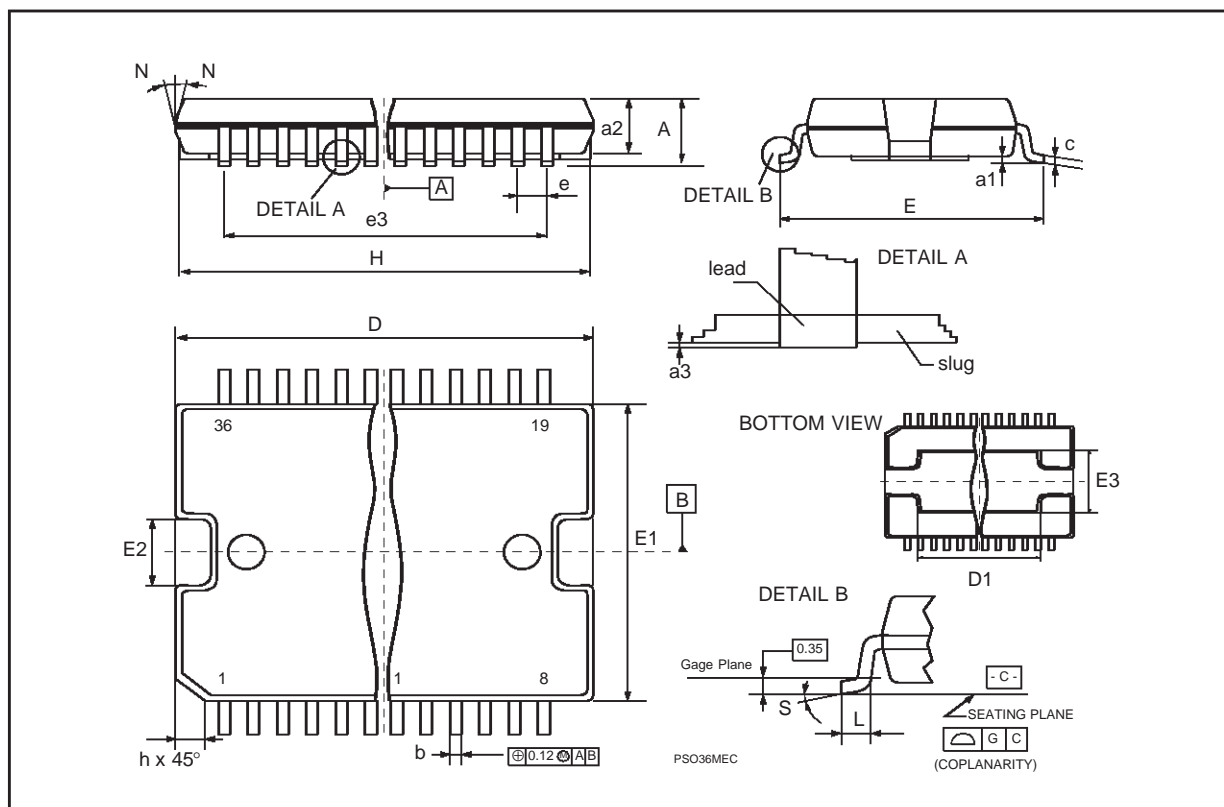
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			3.60			0.141
a1	0.10		0.30	0.004		0.012
a2			3.30			0.130
a3	0		0.10	0		0.004
b	0.22		0.38	0.008		0.015
c	0.23		0.32	0.009		0.012
D (1)	15.80		16.00	0.622		0.630
D1	9.40		9.80	0.370		0.385
E	13.90		14.50	0.547		0.570
e		0.65			0.0256	
e3		11.05			0.435	
E1 (1)	10.90		11.10	0.429		0.437
E2			2.90			0.114
E3	5.80		6.20	0.228		0.244
E4	2.90		3.20	0.114		0.126
G	0		0.10	0		0.004
H	15.50		15.90	0.610		0.626
h			1.10			0.043
L	0.80		1.10	0.031		0.043
N	10°(max.)					
S	8 °(max.)					

(1): "D" and "E1" do not include mold flash or protrusions
 - Mold flash or protrusions shall not exceed 0.15mm (0.006 inch)
 - Critical dimensions are "a3", "E" and "G".

OUTLINE AND MECHANICAL DATA



PowerSO36



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