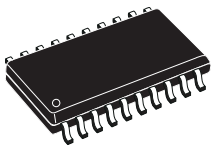
L9339

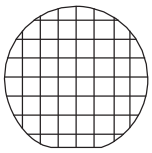
Quad low side driver

Features

- Wide operating supply voltage range from 4.5 V up to 32 V for transient 45 V
- Very low stand-by quiescent current < 2 µA
- Input to output signal transfer function programmable
- High signal range from -0.3 V up to 32 V for all inputs
- TTL and CMOS compatible inputs
- Defined output off state for open inputs
- Four open drain DMOS outputs, with R_{DSon} = 1.5 Ω for V_S > 6 V at 25 °C
- Output current limitation
- Controlled output slope for low EMI
- Over temperature protection for each channel
- Integrated output clamping for fast inductive recirculation V_{FB} > 45 V
- Status monitoring for
  - Over temperature
  - Disconnected ground or supply voltage



SO20



BARE DIE

Description

The L9339 is a monolithic integrated quad low side driver. It is intended to drive lines, lamps or relays in automotive or industrial applications.

Table 1. Device summary

Order code	Package	Packing
L9339	SO20	Tube
L9339DIE1	DIE	Bare die
L9339MD(1)	SO20	Tube

1. Obsolete order code.

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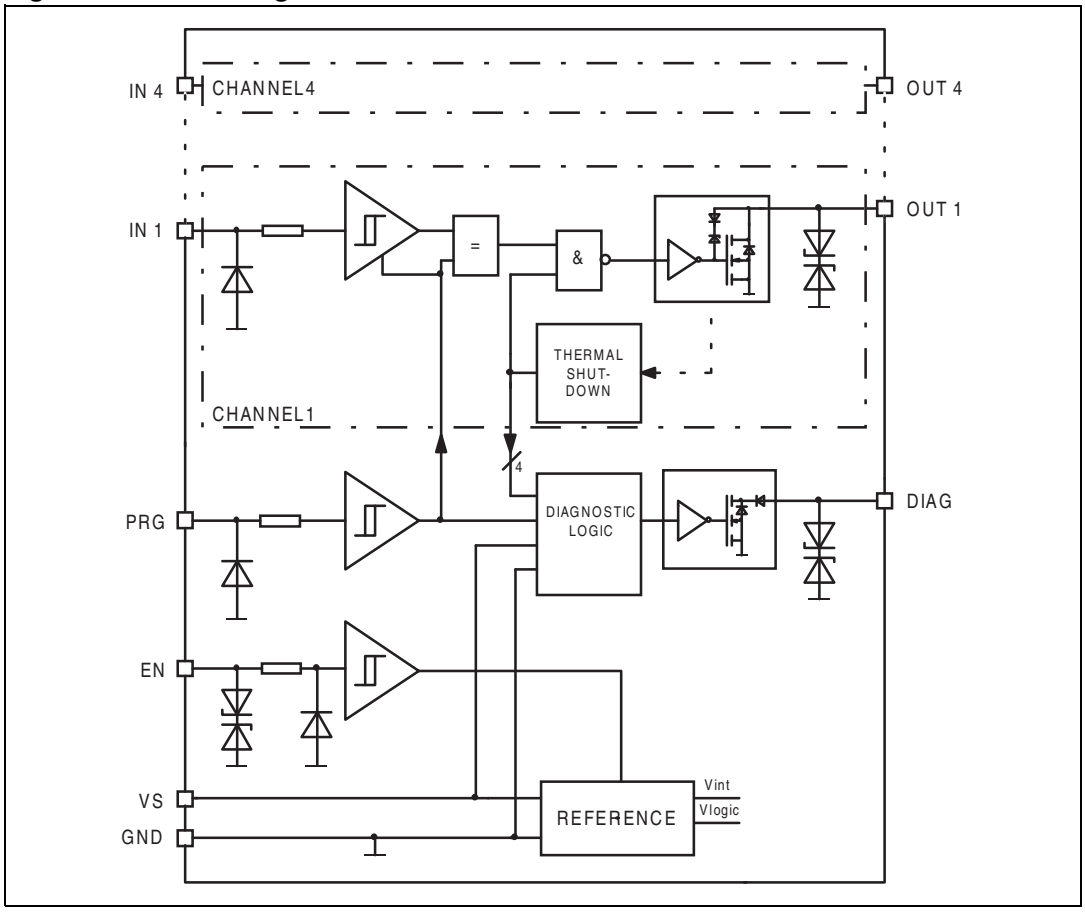
1 Block diagram

Figure 1. Block diagram



2 Pins description

Figure 2. Pins connection (top view)

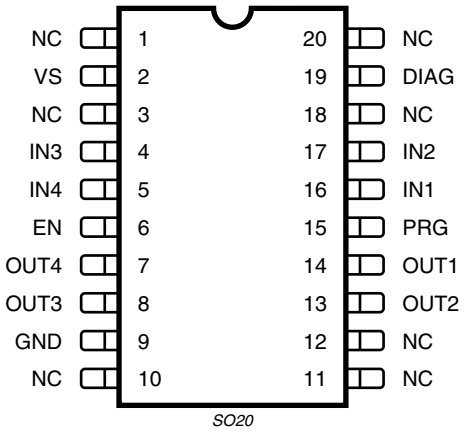


Table 2. Pins function

Pins #	Pin Name	Description
2	VS	Supply Voltage
9	GND	Ground
6	EN	Enable
15	PRG	Programing
19	DIAG	Diagnostic
16	IN 1	Input 1
17	IN 2	Input 2
4	IN 3	Input 3
5	IN 4	Input 4
14	OUT 1	OUTPUT 1
13	OUT 2	OUTPUT 2
8	OUT 3	OUTPUT 3
7	OUT4	OUTPUT4
1,3,10,11,12,18,20	NC	Not Connected

3 Electrical specifications

3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_S	Supply voltage	DC Pulse (T ≤ 400 ms)	-0.3 to 32 -0.3 to 45	V
dV_S/dt	Supply voltage transient		-10 to +10	V/µs
V_{IN}, V_{PRG}	Input, Programming Input, Programming	DC voltage Pulse (T ≤ 400 ms)	-0.3 to 32 -0.3 to 45	V
I_{IN}	Negative input current		-10	mA
V_{EN}	Enable voltage Enable voltage	DC Pulse (T ≤400ms)	-24 to 32 -24 to 45	V
V_{OUT}	Output voltage		-0.3 to 45 (1)	V
I_{OUT}	Negative output current Positive output current		-1 internal limited	A
V_{DIAG}	Diagnostic output voltage Diagnostic output voltage	DC Pulse (T ≤ 400ms)	-0.3 to 32 -0.3 to 45	V

1. In flyback phase the output voltage can reach 60 V.
ESD according to MIL 883C; tested at 2 kV; corresponds to maximum energy dissipation 0.2 mJ.

3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Min.	Typ.	Max.	Unit.
T_{JSDon}	Temperature shutdown switch-on-threshold	160		200	°C
T_{JSDoff}	Temperature shutdown switch-off-threshold	140		180	°C
$R_{th\ j\text{-}amb}$	Thermal resistance junction to ambient (1))			97	°C/W

1. Mounted on SMPCB2 board

3.3 Electrical characteristics

The electrical characteristics are valid within the below defined operating conditions, unless otherwise specified. The function is guaranteed by design until T_{JSDon} switch-on-threshold.

V_S = 4.5 to 32 V; T_j = -40 to 150 °C; T_{amb} = -40 to 125 °C; Ambient test temperature = -40 to 125 °C.

Table 5. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Supply						
I_Q	Quiescent current	-0.3 V ≤ V_{EN} ≤ 0.5 V; V_S = 14 V; T_a ≤ 125 °C		< 2	10	µA
		-0.3 V ≤ V_{EN} ≤ 0.5 V; V_S = 14 V; T_a ≤ 150 °C			50	µA
		V_{EN} ≥ 3.2 V; V_S ≤ 14 V		1.5	2	mA
Inputs, IN1 - IN4; Programming, PRG						
V_{INlow}	Input voltage low		-0.3		2.0	V
V_{INhigh}	Input voltage high		2.8		32	V
I_{IN}	Input current	V_{IN} = 0 to 32V	-15		25	µA
Enable EN						
V_{ENlow}	Input voltage low		-24		1	V
V_{ENhigh}	Input voltage high		3.2		V_S	V
R_{EN}	Input impedance	-24 V < V_{IN} < 2.5 V	10			kΩ
I_{EN}	Input current	2.5 V ≤ V_{IN} ≤ 32 V		20	80	µA
Outputs OUT1- OUT4						
R_{DSon}	Output ON-resistor	V_S ≥ 6 V, I_O = 0.3 A		1.7	3.8	Ω
I_{OLeak}	Leakage current	V_O =V_S = 14 V; T_a ≤ 125 °C		≤1	5	µA
		V_O=V_S = 14 V; T_a ≤ 150 °C			25	µA
V_{OClamp}	Output voltage during clamping	time < 200 µs 10 mA ≤ I_O ≤ 0.3 A	45	52	60	V
I_{OSC}	Short-circuit current	4.5V ≤ V_S ≤ 6 V	0.3		1	A
		V_S > 6 V	0.4	0.7	1	A
C_O	internal output capacities	V_O ≥ 4.5 V			100	pF
Diagnostic output DIAG						
V_{Dlow}	Output voltage LOW	I_{DL} ≤ 0.6 mA			1.3	V
I_{Dmax}	Maximum output current	internal current limitation V_D = 14 V	1	5	15	mA

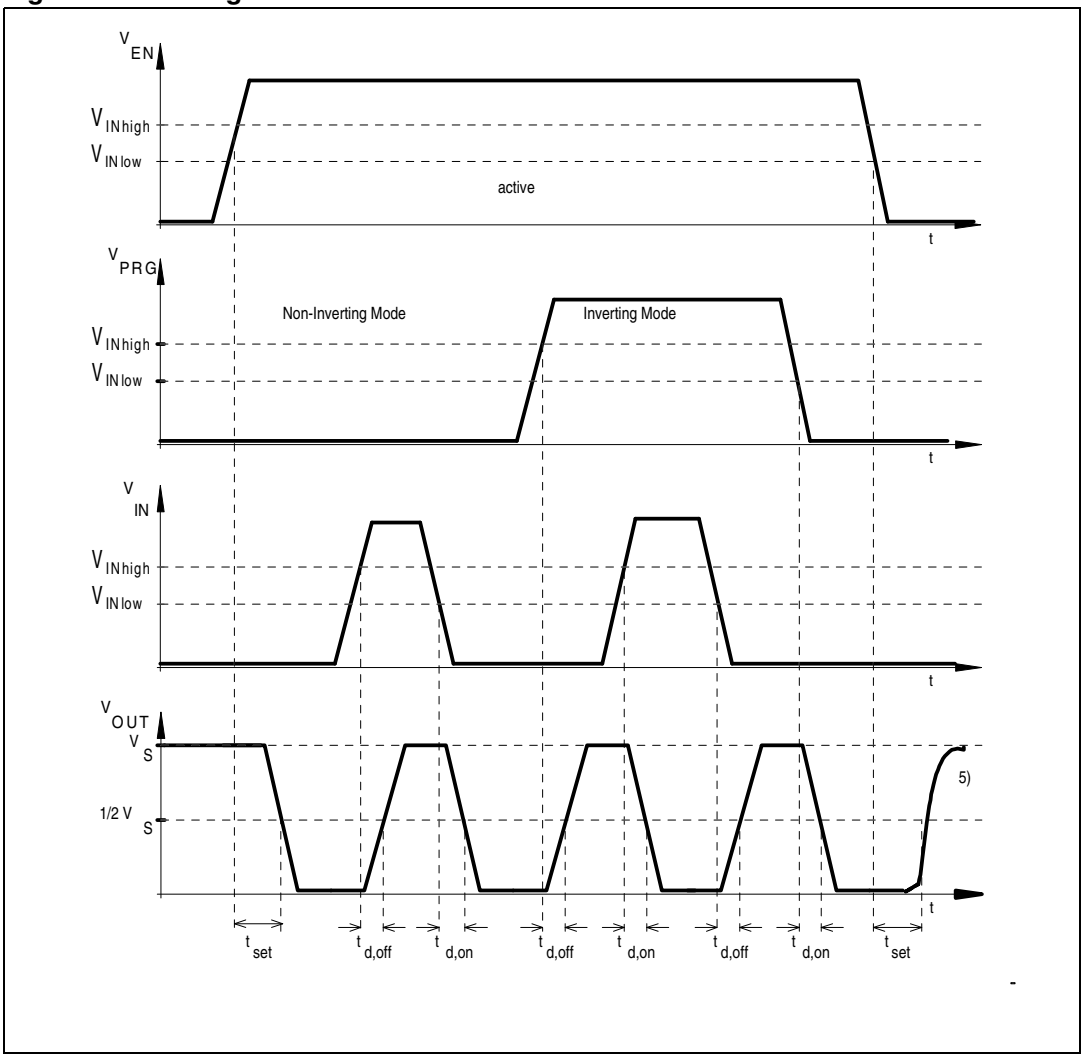
Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{DLeak}	Leakage current	$V_D = V_S = 14$ V; $T_a \leq 125$ °C		≤ 0.1	1	µA
		$V_D = V_S = 14$ V; $T_a \leq 150$ °C			5	µA
Timing characteristics (1)						
$t_{d,on}$	On delay time	$V_S = 14$ V, $C_{ext} = 0$ pF 10 mA ≤ I_O ≤ 200 mA		2	3.5	µs
$t_{d,off}$	Off delay time			3	4.5	µs
t_{set}	Enable settling time				10	µs
$t_{d,DIAG}$	ON or OFF diagnostic delay time				10	µs
S_{out}	Output voltage slopes (2)		2.5	9	16	V/µs

1. See also *Figure 3* timing characteristics.
2. Output voltage slope not controlled for enable low.

All parameters are measured at T_{amb} = 125 °C.

Figure 3. Timing characteristics



4 Functional description

The L9339 is a quad low side driver for lines, lamps or inductive loads in automotive and industrial applications.

The logic input levels are TTL and CMOS compatible. This allows the device to be driven directly by a microcontroller. For the noise immunity, all input thresholds has a hysteresis of typ. 100 mV. At each input (IN and PRG) voltages from -0.3 V to 32 V can be applied, EN can withstand voltages from -25 V to 3 2 V. The device is activated with a 'high' signal on ENable. ENable 'low' switches the device into the sleep mode. In this mode the quiescent current is less than 10 µA. A high signal on PRoGramming input changes the signal transfer polarity from non inverting into the inverting mode. This pin can be connected to V_S or GND. The forced status of the PRG and EN pin is low, if these pins are not connected. This forced condition leads to a mode change if the PRG pin was high before the interruption. Independent of the PRoGramming input, the OUTput switches off, if the signal INput pin is not connected.

Each output driver has a current limitation of min 0.4 A and a independent thermal shut-down. The thermal shut-down deactivates that output, which exceeds temperature switch off level. When the junction temperature decreases 20 K below this temperature threshold the output will be activated again (hysteresis of the thermal shutdown function). The slew rate of the output voltage is limited to max. 14 V/µs, to reduce the electromagnetic radiation of the loads and its wiring. For inductive loads a output voltage clamp of typically 52 V is implemented.

The DIAGnostic is an open drain output with an additional series diode. The logic status depends on the PRoGramming pin. If the PRG pin is 'low' the DIAG output becomes low, if the device works correctly. At thermal shut-down of one channel the DIAGnostic output becomes high. If the PRG pin is 'high' this output is switched off at normal function and switched on at over temperature.

Table 6. Diagnostic

Pins	EN	PRG	IN	OUT	DIAG
Correct function	H	L	L	L (on)	L (on)
	H	L	H	H (off)	L (on)
	H	H	L	H (off)	H (off)
	H	H	H	L (on)	H (off)
	L	X	X	H (off)	H (off)
Over temperature or supply voltage	H	L	X	H (off)(1)	H (off)
Over temperature	H	H	X	H (off)(1)	L (on)

1. Selective for each channel at over temperature

X = not relevant

H = high

L = low

Figure 4. Application for inverting transfer polarity

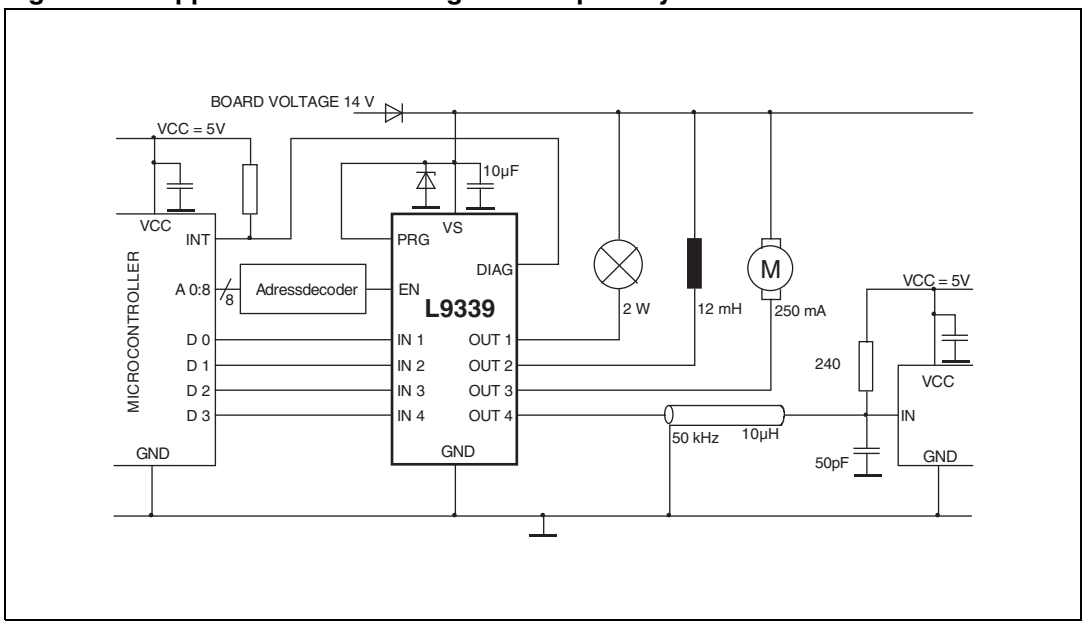
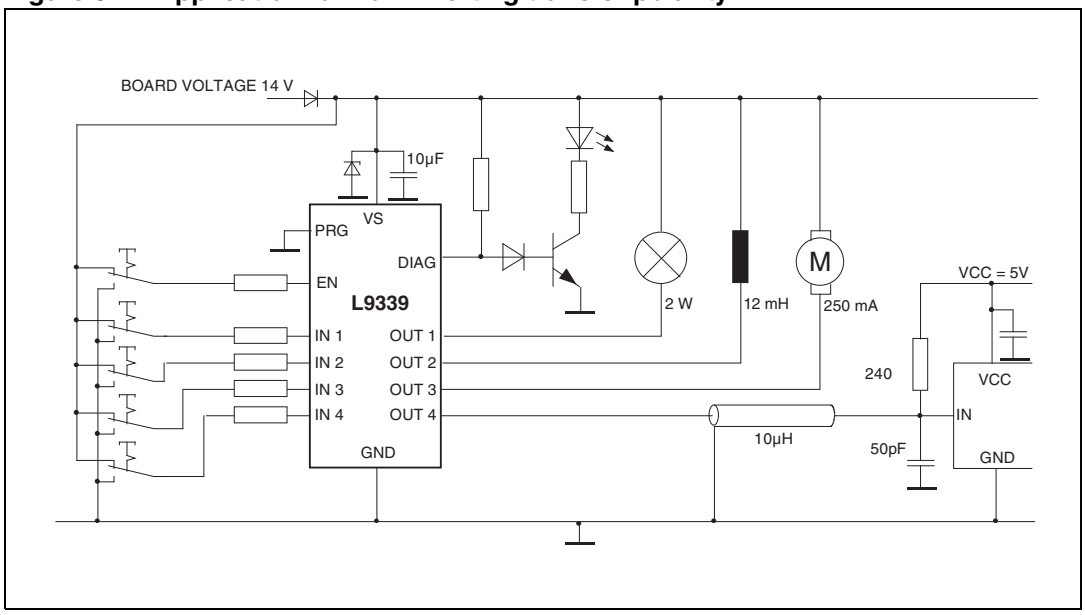


Figure 5. Application for non inverting transfer polarity



1. We recommend to use the device for driving inductive loads with flyback energy $E_{FB} \leq 2mJ$.

5 Package information

In order to meet environmental requirements, ST (also) offers these devices in ECOPACK® packages. ECOPACK® packages are lead-free. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label.

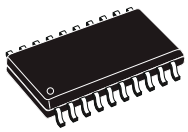
ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Figure 6. SO20 mechanical data and package dimensions

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
B	0.33		0.51	0.013		0.200
C	0.23		0.32	0.009		0.013
D (1)	12.60		13.00	0.496		0.512
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
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

(1) "D" dimension does not include mold flash, protusions or gate burrs. Mold flash, protusions or gate burrs shall not exceed 0.15mm per side.

OUTLINE AND MECHANICAL DATA



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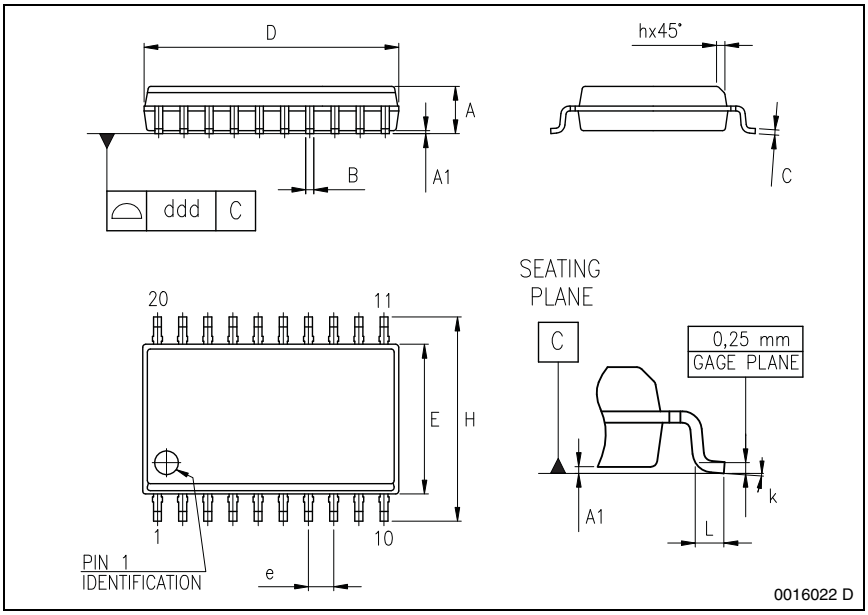

6 Revision history

Table 7. Document revision history

Date	Revision	Changes
20-Dec-1999	1	Initial release.
24-Jun-2008	2	Document reformatted. Updated the *Table 1: Device summary*. Updated the *Figure 5*.
20-Sep-2013	3	Updated disclaimer.

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