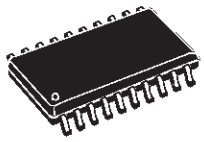
L9997ND

DUAL HALF BRIDGE DRIVER

- FULL BRIDGE OUTPUT CONFIGURATION WITH LOW SATURATION VOLTAGE, LESS THAN 3.6V AT OUTPUT CURRENT OF ±1.2A
- OPERATING SUPPLY VOLTAGE RANGE 7V TO 16.5V
- VERY LOW QUIESCENT CURRENT IN STANDBY MODE Typ. 2µA
- SUPPLY OVERVOLTAGE PROTECTION FUNCTION FOR V_S MORE THAN 16.5V, UP TO 40V
- TWO LOGIC CONTROL INPUTS WITH THRESHOLD HYSTERESIS
- OUTPUT SHORT-CIRCUIT PROTECTION DUE TO OUTPUT CURRENT LIMITING
- THERMAL OVERLOAD PROTECTION
- THERMAL OVERLOAD AND OVERVOLTAGE DIAGNOSTIC



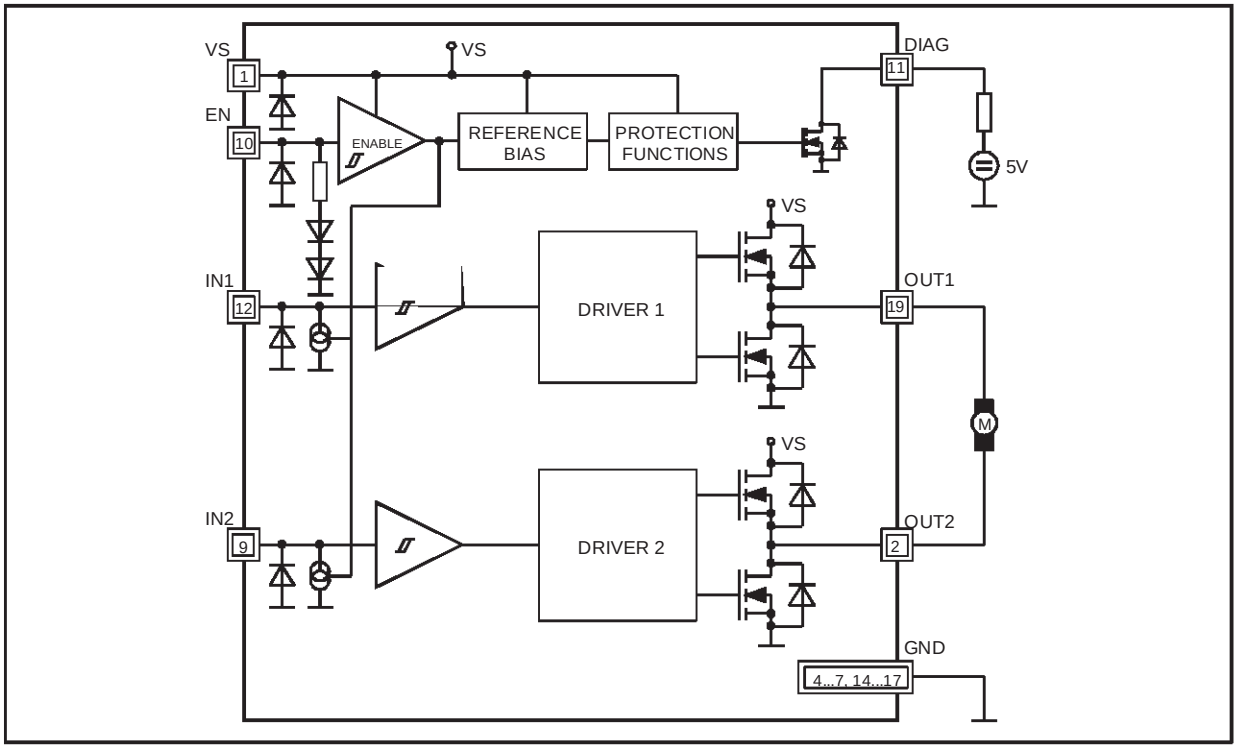
SO20 (12+4+4)

ORDERING NUMBERS: L9997ND
L9997ND013TR

DESCRIPTION

The L9997ND is a monolithic integrated bridge driver, intended for driving DC motors, optimized for automotive electronics enviromental conditions.

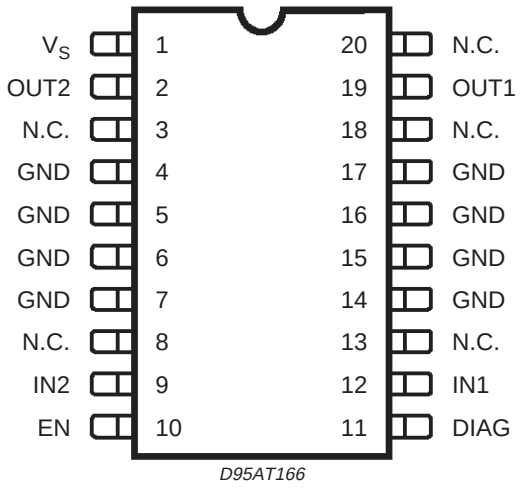
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{SCD}	DC Supply Voltage	26	V
V_{SP}	Supply voltage pulse (T ≤ 400ms)	40	V
I_{OUT}	DC output Current	±1.2	A
$V_{IN1,2}$	DC Input Voltage	-0.3 to 7	V
V_{EN}	Enable Input Voltage	-0.3 to 7	V
V_{DIAG}	DCInput Voltage	-0.3 to 7	V
I_{DIAG}	DC Sink Current	internally limited	

PIN CONNECTION (Top view)



THERMAL DATA

Symbol	Parameter	Value	Unit
T_{jTS}	Thermal Shut-down Junction Temperature	165	°C
T_{jTSH}	Thermal Shut-down Threshold Hysteresis	25K	
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-Ambient (1)	50K	°C/W
$R_{th\ j\text{-}pins}$	Thermal Resistance Junction-Pins	15K	°C/W

(1) With 6cm^2 on board heatsink area.

ELECTRICAL CHARACTERISTICS (7V ≤ V_S ≤ 16.5V; -40°C < T_J < 150°C; unless otherwise specified.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_{VS_SB}	Quiescent Current in Standby Mode	V_{EN} ≤ 0.3V; V_{VS} ≤ 16.5V; T_j ≤ 85° V_{EN} = 0; V_{VS} = 14.5V; T_j = 25°C		 2	90 10	µA µA
I_S	Supply Current	EN = HIGH, $I_{OUT1,2}$ = 0		3	6	mA
V_{ENL}	Low Enable Voltage				1.5	V
V_{ENH}	High Enable Voltage		3.5		6	V
V_{ENthh}	Enable Threshold Hysteresis			1		V
I_{EN}	Enable Input Current	V_{EN} = 5V	2	110	250	µA
$V_{IN1,2L}$	Low Input Voltage				1.5	V
$V_{IN1,2H}$	High Input Voltage		3.5			V
$V_{IN1,2thh}$	Input Threshold Hysteresis			1		mV
$I_{IN1,2}$	Input Bias Current	V_{IN} = 0 V_{IN} = 5V, EN = HIGH	-1 2	0 10	1 50	µA µA
$R_{ON\ OUT1,2}$	ON-Resistance to Supply or GND	I_{OUT} = ±0.8A; V_{VS} = 7V; T_j = 125°C I_{OUT} = ±0.8A; V_{VS} = 12V; T_j = 125°C I_{OUT} = ±0.8A; V_{VS} = 12V; T_j = 25°C		 0.83	2.8 2.25	Ω Ω Ω
V_{DIAG}	Diagnostic Output Drop	I_{DIAG} = 0.5mA, EN = HIGH Overvoltage or Thermal Shut-down			0.6	V
V_{VSOVth}	Supply Overvoltage Threshold	Measured with 93Ω load to ground	17		21	V
t_{ON}	Turn on Delay Time	V_S = 13.5V		50	150	µs
t_{OFF}	Turn off Delay Time			50	100	µs
t_{dLH}	Rising Delay Time			60	250	µs
t_{dHL}	Falling Delay Time			60	250	µs
t_r	Rise Time			60	100	µs
t_f	Fall Time			60	100	µs

FUNCTIONAL DESCRIPTION

The L9997ND is a motor driver with full-bridge push-pull outputs, intended for driving dc motors in automotive systems. The basic function of the device is shown in the following table.

Status	EN	IN1	IN2	OUT1	OUT2	DIAG	NOTE
1	L	X	X	Tristate	Tristate	OFF	Standby Mode
2	H	H	H	SRC	SRC	OFF	Recommended for braking
3	H	H	L	SRC	SNK	OFF	Left Mode
4	H	L	H	SNK	SRC	OFF	Right Mode
5	H	L	L	SNK	SNK	OFF	Not to be used for braking
6	H	X	X	Tristate	Tristate	ON	Overvoltage or Overtemperature

Function table of the L9997N The device is activated with enable input voltage HIGH.
For enable input LOW the device is in Standby Mode. Very low quiescent current is defined for V_{EN} ≤ 0.3V.
When activating or disactivating the device by the enable input a delay time of 100µs is recommended.

For the braking of the motor the status 2 is recommended, when the motor has stopped also the status 5 with lower Iq can be used. The reason for this recommendation is a higher current threshold of parasitic initialisation when using the internal flyback diodes connected to V_S than of the diodes connected to GND.

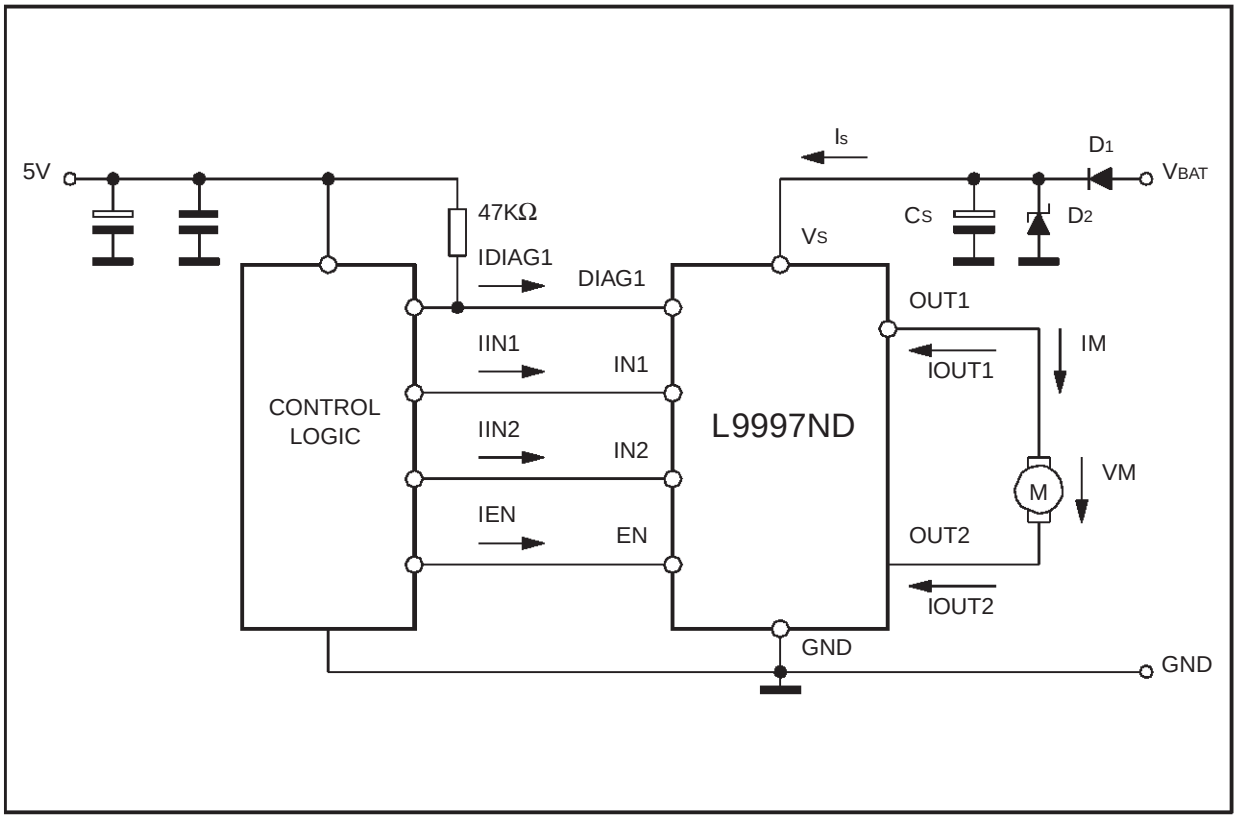
The circuit features an overvoltage disable function referred to the supply voltage V_S. This function assures disabling the output for V_S higher than 16.5V, both outputs are forced to tristate in this condition and the diagnostic output is LOW.
The thermal overload function disables the outputs (tristate) and activates the diagnostic when the junction temperature increases above the

thermal shut-down threshold temperature of min. 150°C. For the start of a heavy loaded motor, if the motor current reaches the max. value it is necessary to respect the dynamical thermal resistance junction to ambient. The internal output current limitation threshold is rated to be higher than 1A. The maximum junction temperature in this phase should not exceed the thermal shut-down threshold. In the case of output disable due to thermal overload the output remains disabled till the junction temperature decreases under the thermal enable threshold. This behaviour is assured with the thermal shut-down threshold hysteresis, its minimum value is 20K.

The open collector diagnostic output needs an external pull-up resistor to a 5V supply. By systems with several L9997N the diagnostic outputs could be connected together to a common pull-up resistor. The DIAG output current is internally limited (typ 1.2mA). Fig. 1 shows a typical application diagram for the DC motor driving. To assure the safety of the circuit in the reverse battery condition a reverse protection diode D_1 is necessary. The transient protection diode D_2 must assure that the maximal supply voltage V_S during the transients at the V_{BAT} line will be limited to a value lower than the absolute maximum rating for V_S.

The inputs IN1, IN2 and OUT1, OUT2 can be connected in parallel to drive a load with a lower impedance.

Figure 1: Application Circuit Diagram.



APPLICATION INFORMATION

Please respect for the reading of the diagnostic status in output short circuit condition the following behaviour:

With the inductive load in short circuit condition the device can deliver at the power output and at the diagnostic output a pulse signal with period of approximately 28µs.

Figure 2. Timing Diagram.

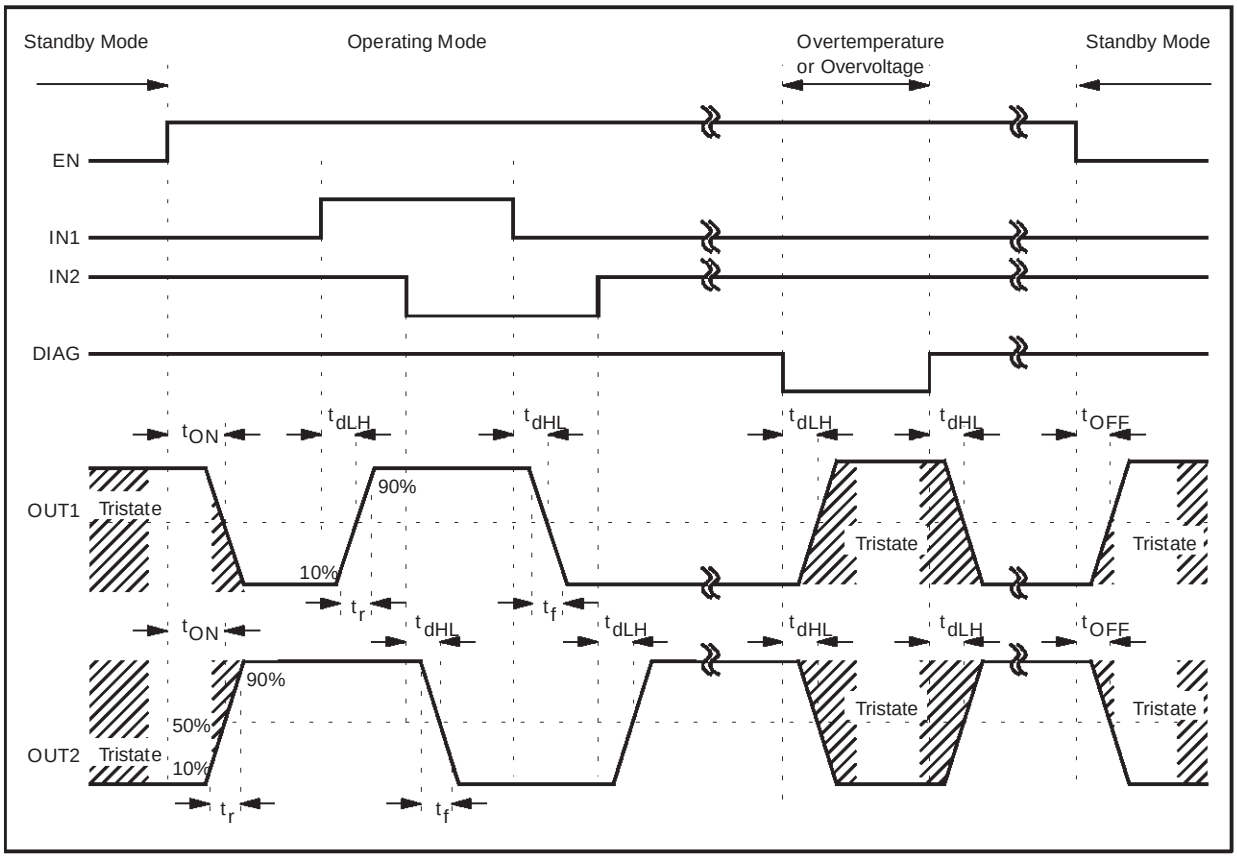


Figure 3. Typical R_{ON} - Characteristics of Source and Sink Stage

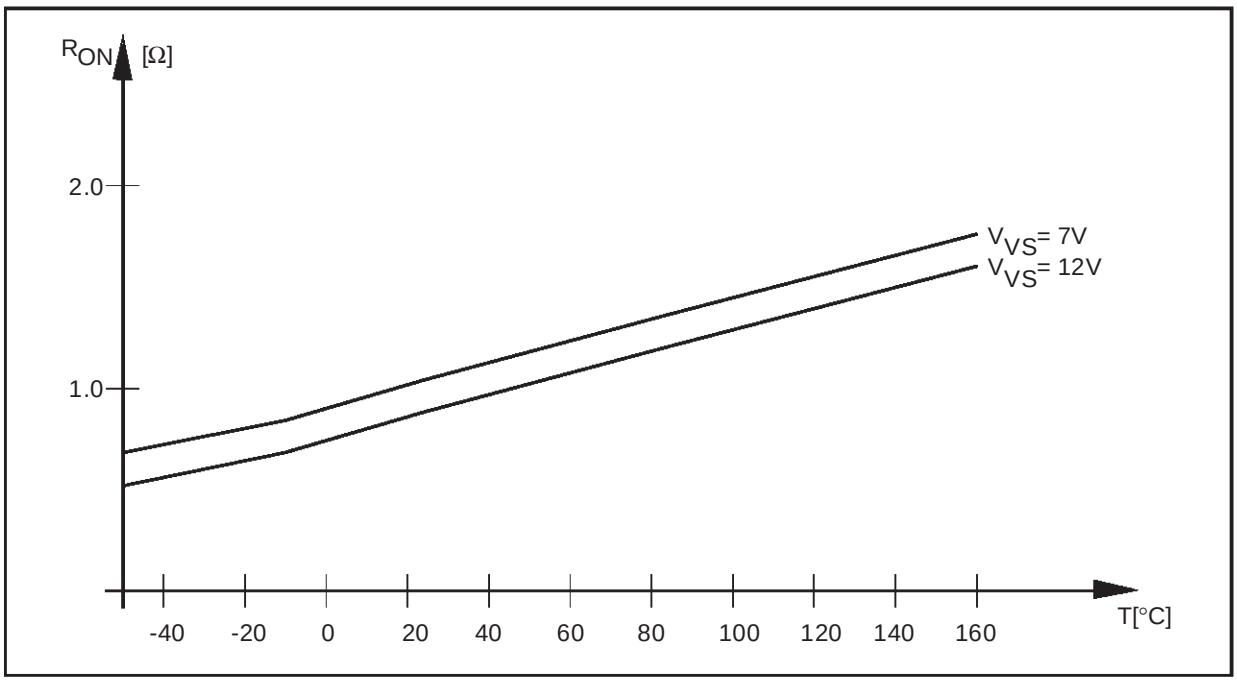


Figure 4. Quiesent current in standby mode versus supply voltage.

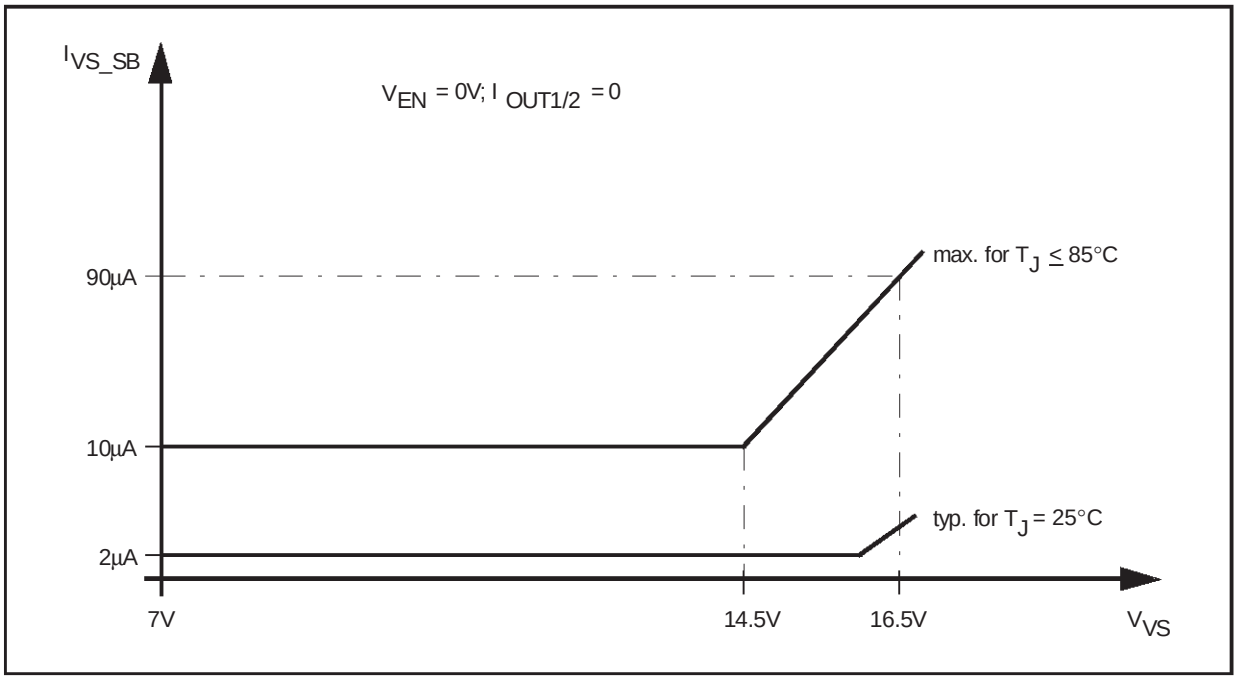


Figure 5. ON-Resistance versus supply voltage.

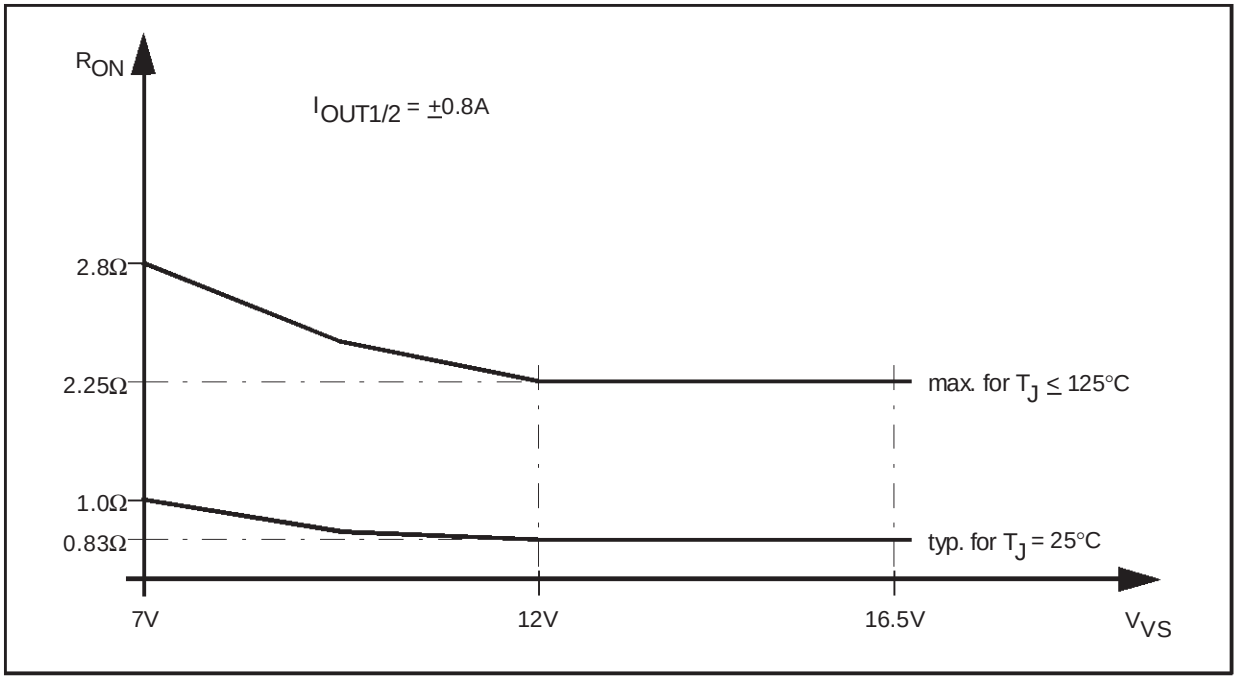


Figure 6. I_{OUT} versus V_{OUT} for outputs switched ON (expected typical curve).

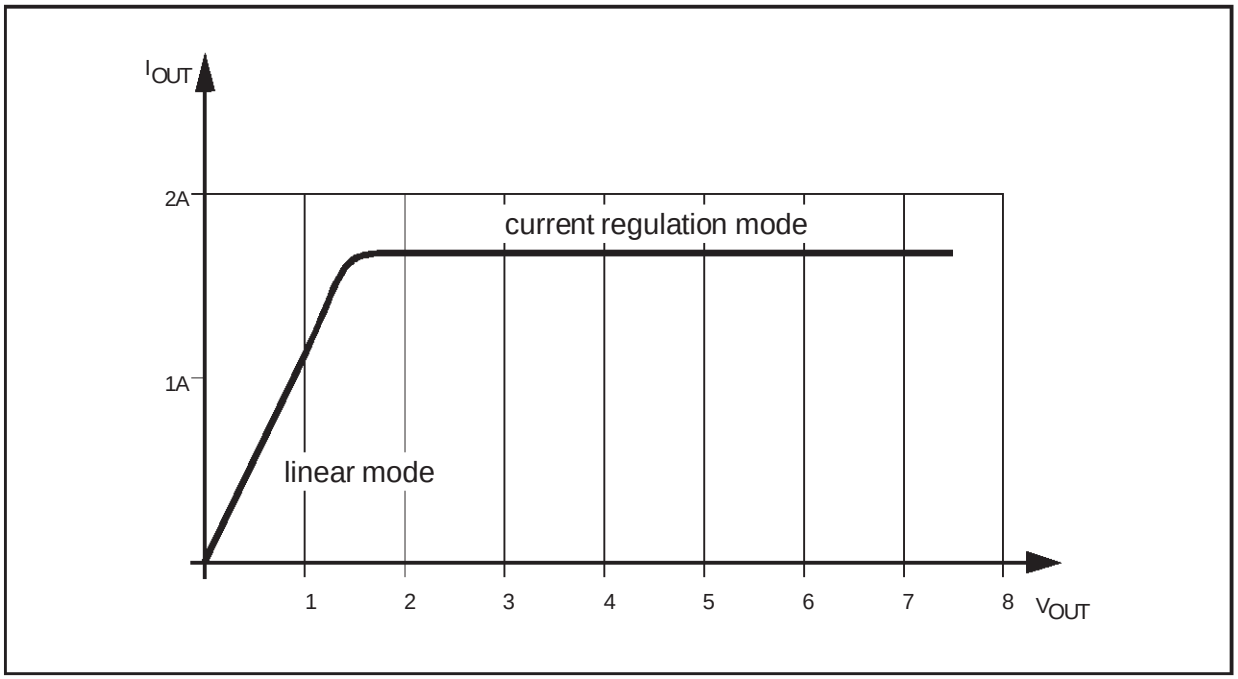
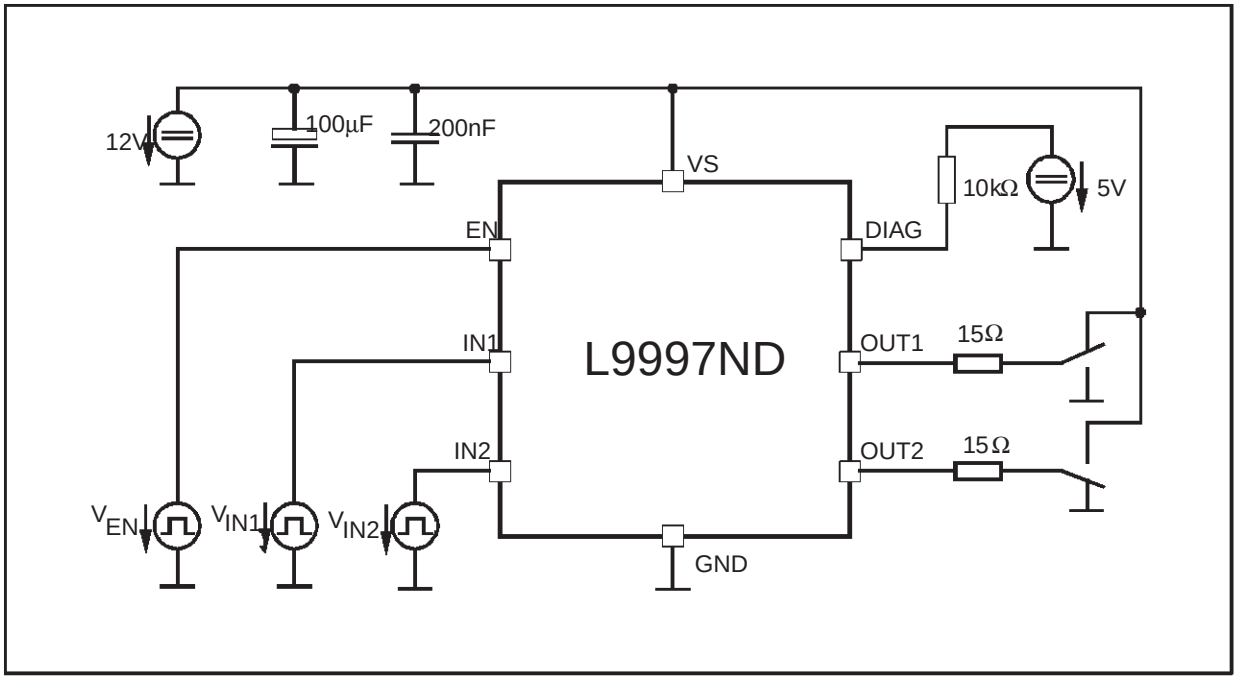
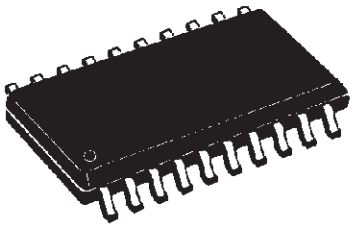


Figure 7. Test circuit.



DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13	0.496		0.512
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0° (min.)8° (max.)					

OUTLINE AND MECHANICAL DATA



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