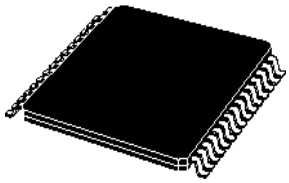
VNH3ASP30-E

Automotive fully integrated H-bridge motor driver

Datasheet - production data



MultiPowerSO-30™

Features

Type	$R_{DS(on)}$	I_{out}	V_{ccmax}
VNH3ASP30-E	42 mΩ max (per leg)	30 A	41 V

- AEC-100 qualified
- 5 V logic level compatible inputs
- Undervoltage and overvoltage shutdown
- Overvoltage clamp
- Thermal shut down
- Cross-conduction protection
- Linear current limiter
- Very low standby power consumption
- PWM operation up to 20 kHz
- Protection against loss of ground and loss of V_{CC}
- Current-sense output proportional to motor current
- Package: ECOPACK®

Description

The VNH3ASP30-E is a full-bridge motor driver intended for a wide range of automotive applications. The device incorporates a dual monolithic high-side driver (HSD) and two low-side switches. The HSD switch is designed using STMicroelectronics proprietary VIPower™ M0 technology that efficiently integrates a true Power MOSFET with an intelligent signal/protection circuit on the same die.

The low-side switches are vertical MOSFETs manufactured using STMicroelectronics proprietary EHD ("STripFET™") process.The three circuits are assembled in a MultiPowerSO-30 package on electrically isolated lead frames. This package, specifically designed for the harsh automotive environment, offers improved thermal performance thanks to exposed die pads. Moreover, its fully symmetrical mechanical design provides superior manufacturability at board level. The input signals IN_A and IN_B can directly interface with the microcontroller to select the motor direction and the brake condition. Pins $DIAG_A/EN_A$ or $DIAG_B/EN_B$, when connected to an external pull-up resistor, enable one leg of the bridge. They also provide a feedback digital diagnostic signal. The normal condition operation is explained in the truth table. The CS pin monitors the motor current by delivering a current proportional to its value. The speed of the motor can be controlled in all possible conditions by the PWM up to 20 kHz. In all cases, a low level state on the PWM pin will turn off both the LS_A and LS_B switches. When PWM rises to a high level, LS_A or LS_B turn on again depending on the input pin state.

Table 1. Device summary

Package	Order code
	Tape & reel
MultiPowerSO-30	VNH3ASP30TR-E

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1 Block diagram and pin description

Figure 1. Block diagram

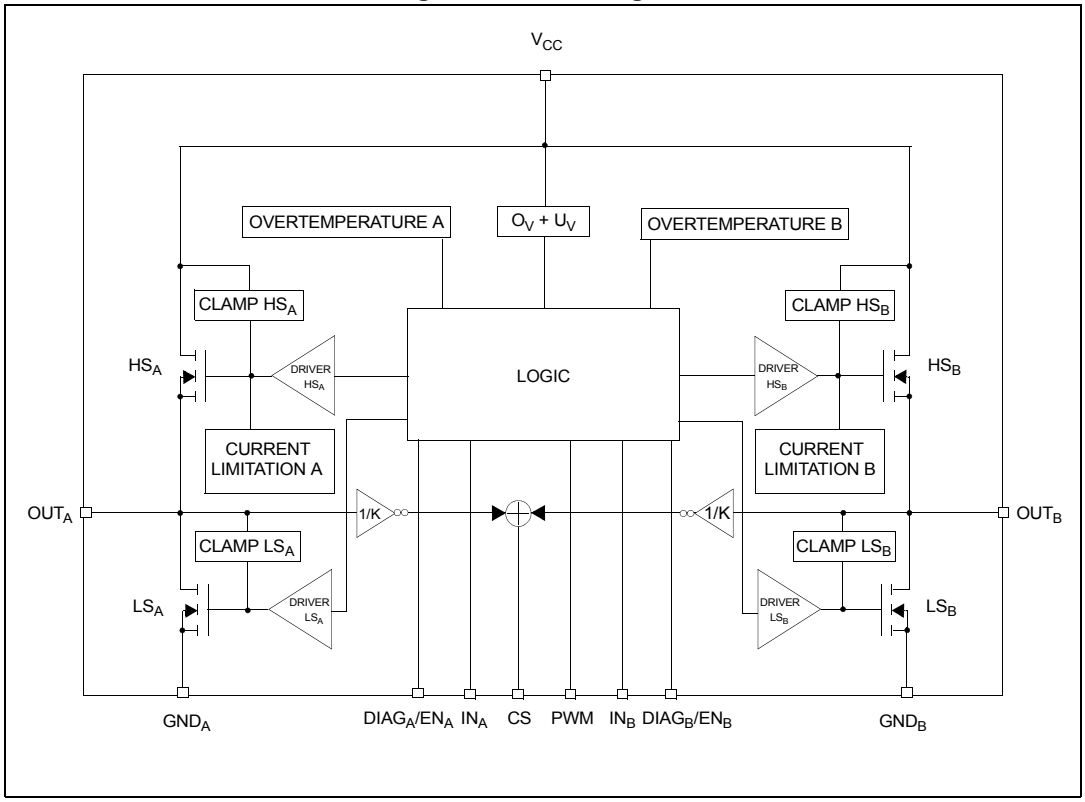


Table 2. Block description

Name	Description
Logic control	Allows the turn-on and the turn-off of the high-side and the low-side switches according to the truth table
Overvoltage + undervoltage	Shuts down the device outside the range [5.5V..16V] for the battery voltage
High-side and low-side clamp voltage	Protect the high-side and the low-side switches from the high voltage on the battery line in all configurations for the motor
High-side and low-side driver	Drives the gate of the concerned switch to allow a good $R_{DS(on)}$ for the leg of the bridge
Linear current limiter	Limits the motor current by reducing the high-side switch gate source voltage when short-circuit to ground occurs
Overtemperature protection	In case of short-circuit with the increase of the junction's temperature, shuts down the concerned high side to prevent its degradation and to protect the die
Fault detection	Signals an abnormal behavior of the switches in the half-bridge A or B by pulling low the concerned $EN_x/DIAG_x$ pin

Figure 2. Configuration diagram (top view)

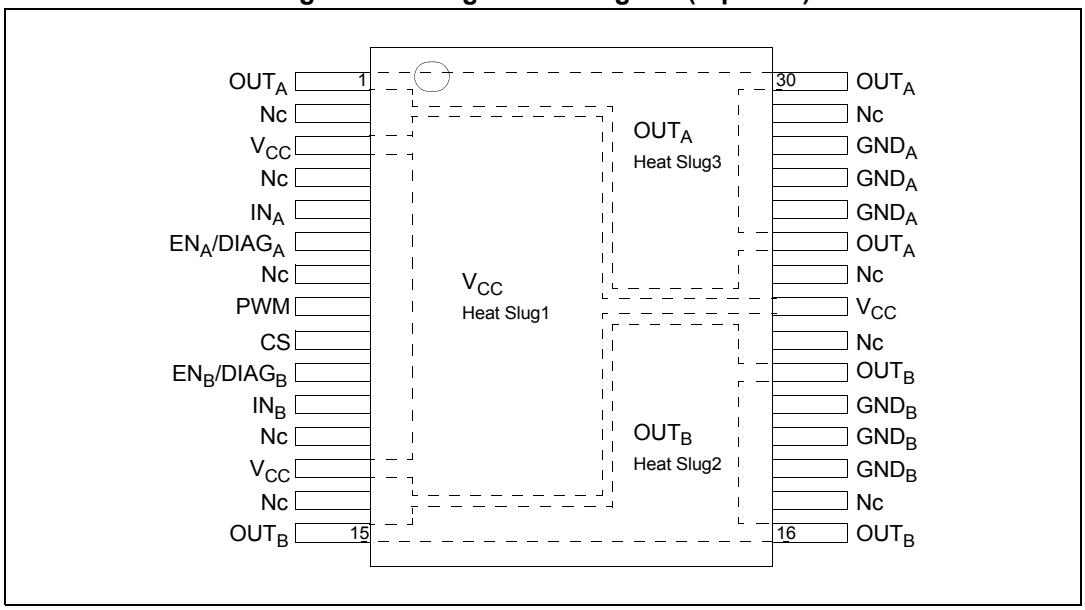


Table 3. Pin definitions and functions

Pin No.	Symbol	Function
1, 25, 30	OUT_A, Heat Slug3	Source of high-side switch A / Drain of low-side switch A
2, 4, 7, 12, 14, 17, 22, 24, 29	NC	Not connected
3, 13, 23	V_{CC}, Heat Slug1	Drain of high-side switches and power supply voltage
5	IN_A	Clockwise input
6	$EN_A/DIAG_A$	Status of high-side and low-side switches A; open drain output
8	PWM	PWM input
9	CS	Output of current sense
10	$EN_B/DIAG_B$	Status of high-side and low-side switches B; open drain output
11	IN_B	Counter clockwise input
15, 16, 21	OUT_B, Heat Slug2	Source of high-side switch B / Drain of low-side switch B
26, 27, 28	GND_A	Source of low-side switch A(1)
18, 19, 20	GND_B	Source of low-side switch B(1)

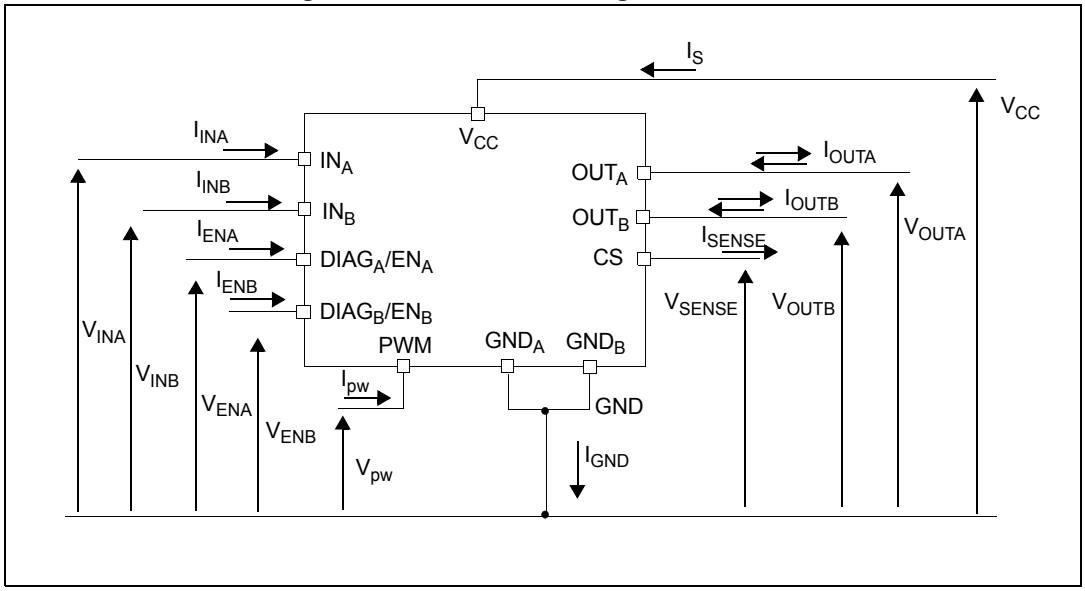
1. GND_A and GND_B must be externally connected together.

Table 4. Pin functions description

Name	Description
V_{CC}	Battery connection
GND_A, GND_B	Power grounds; must always be externally connected together
OUT_A, OUT_B	Power connections to the motor
IN_A, IN_B	Voltage controlled input pins with hysteresis, CMOS compatible: These two pins control the state of the bridge in normal operation according to the truth table (brake to V_{CC}, brake to GND, clockwise and counterclockwise).
PWM	Voltage controlled input pin with hysteresis, CMOS compatible: Gates of low-side FETs are modulated by the PWM signal during their ON phase allowing speed control of the motor.
$EN_A/DIAG_A$, $EN_B/DIAG_B$	Open drain bidirectional logic pins. These pins must be connected to an external pull up resistor. When externally pulled low, they disable half-bridge A or B. In case of fault detection (thermal shutdown of a high-side FET or excessive ON state voltage drop across a low-side FET), these pins are pulled low by the device (see truth table in fault condition).
CS	Analog current-sense output. This output sources a current proportional to the motor current. The information can be read back as an analog voltage across an external resistor.

2 Electrical specifications

Figure 3. Current and voltage conventions



2.1 Absolute maximum ratings

Table 5. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	+41	V
I_{max}	Maximum output current (continuous)	30	A
I_R	Reverse output current (continuous)	-30	
I_{IN}	Input current (IN_A and IN_B pins)	±10	mA
I_{EN}	Enable input current ($DIAG_A/EN_A$ and $DIAG_B/EN_B$ pins)	±10	
I_{PW}	PWM input current	±10	
V_{CS}	Current-sense maximum voltage	-3/+15	V
V_{ESD}	Electrostatic discharge (R = 1.5kΩ, C = 100pF) – CS pin – logic pins – output pins: OUT_A, OUT_B, V_{CC}	 2 4 5	 kV kV kV
T_J	Junction operating temperature	Internally limited	°C
T_C	Case operating temperature	-40 to 150	
T_{stg}	Storage temperature	-55 to 150	

2.2 Electrical characteristics

V_{CC} = 9V up to 16 V; -40°C < T_J < 150°C, unless otherwise specified.

Table 6. Power section

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{CC}	Operating supply voltage		5.5		16	V
I_S	Supply current	Off state: IN_A = IN_B = PWM = 0; T_J = 25°C; V_{CC} = 13V IN_A = IN_B = PWM = 0;		12	30 60	µA µA
		On state: IN_A or IN_B = 5V, no PWM			10	mA
R_{ONHS}	Static high-side resistance	I_{OUT} = 12A; T_J = 25°C I_{OUT} = 12A; T_J = -40 to 150°C			30 60	mΩ
R_{ONLS}	Static low-side resistance	I_{OUT} = 12A T_J = 25°C I_{OUT} = 12A; T_J = -40 to 150°C			12 24	mΩ
V_f	High-side freewheeling diode forward voltage	I_f = 12A		0.8	1.1	V
$I_{L(off)}$	High-side off-state output current (per channel)	T_J = 25°C; V_{OUTX} = EN_X = 0V; V_{CC} = 13V			3	µA
		T_J = 125°C; V_{OUTX} = EN_X = 0V; V_{CC} = 13V			5	
I_{RM}	Dynamic cross-conduction current	I_{OUT} = 12A (see *Figure 7*)		1.7		A

Table 7. Logic inputs (IN_A, IN_B, EN_A, EN_B)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{IL}	Input low-level voltage	Normal operation ($DIAG_X$/EN_X pin acts as an input pin)			1.25	V
V_{IH}	Input high-level voltage		3.25			
V_{Ihys}	Input hysteresis voltage		0.5			
V_{ICL}	Input clamp voltage	I_{IN} = 1mA	5.5	6.3	7.5	
		I_{IN} = -1mA	-1.0	-0.7	-0.3	
I_{INL}	Input low current	V_{IN} = 1.25 V	1			µA
I_{INH}	Input high current	V_{IN} = 3.25V			10	
V_{DIAG}	Enable output low-level voltage	Fault operation ($DIAG_X$/EN_X pin acts as an output pin); I_{EN} = 1mA			0.4	V

Table 8. PWM

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{PWL}	PWM low-level voltage				1.25	V
I_{PWL}	PWM low-level pin current	V_{pw} = 1.25 V	1			µA
V_{PWH}	PWM high-level voltage		3.25			V
I_{PWH}	PWM high-level pin current	V_{pw} = 3.25V			10	µA
V_{PWhys}	PWM hysteresis voltage		0.5			V
V_{PWCL}	PWM clamp voltage	I_{pw} = 1mA	V_{CC} + 0.3	V_{CC} + 0.7	V_{CC} + 1.0	
		I_{pw} = -1mA	-6.0	-4.5	-3.0	
C_{INPW}	PWM pin input capacitance	V_{IN} = 2.5V			25	pF

Table 9. Switching (V_{CC} = 13V, R_{LOAD} = 1 Ω)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
f_{PW}	PWM frequency		0		20	kHz
$t_{d(on)}$	Turn-on delay time	Input rise time < 1µs (see *Figure 6*)			250	µs
$t_{d(off)}$	Turn-off delay time	Input rise time < 1µs (see *Figure 6*)			250	
t_r	Rise time	(see *Figure 5*)		1	1.6	
t_f	Fall time	(see *Figure 5*)		1	2.4	
t_{DEL}	Delay time during change of operating mode	(see *Figure 4*)	300	600	1800	
t_{rr}	High-side freewheeling diode reverse recovery time	(see *Figure 7*)		110		ns

Table 10. Protection and diagnostic

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{UV(sd)}$	Undervoltage shutdown				5.5	V
$V_{UV(reset)}$	Undervoltage reset			4.7		
$V_{OV(sd)}$	Overvoltage shutdown		16	19	22	
I_{LIM}	High-side current limitation		30	50	70	A
V_{CLP}	Total clamp voltage (V_{CC} to GND)	I_{OUT} = 12A	43	48	54	V
$T_{th(sd)}$	Thermal shutdown temperature	V_{IN} = 3.25V	150	175	200	°C
$T_{h(reset)}$	Thermal reset temperature		135			
$T_{th(hys)}$	Thermal hysteresis		7	15		

Table 11. Current sense (9V < V_{CC} < 16V)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
K_1	I_{OUT}/I_{SENSE}	I_{OUT} = 30A; R_{SENSE} = 700Ω; T_J = -40 to 150°C	4000	4700	5400	
K_2	I_{OUT}/I_{SENSE}	I_{OUT} = 8A; R_{SENSE} = 700Ω; T_J = -40 to 150°C	3750	4700	5650	
dK_1/K_1 (1)	Analog sense current drift	I_{OUT} = 30A; R_{SENSE} = 700Ω; T_J = -40 to 150°C	-8		+8	%
dK_2/K_2 (1)	Analog sense current drift	I_{OUT} = 8A; R_{SENSE} = 700Ω; T_J = -40 to 150°C	-10		+10	
I_{SENSEO}	Analog sense leakage current	I_{OUT} = 0A; V_{SENSE} = 0V; T_J = -40 to 150°C	0		70	µA

1. Analog sense current drift is deviation of factor K for a given device over (-40°C to 150°C and 9V < V_{CC} < 16V) with respect to its value measured at T_J = 25°C, V_{CC} = 13V

Figure 4. Definition of the delay times measurement

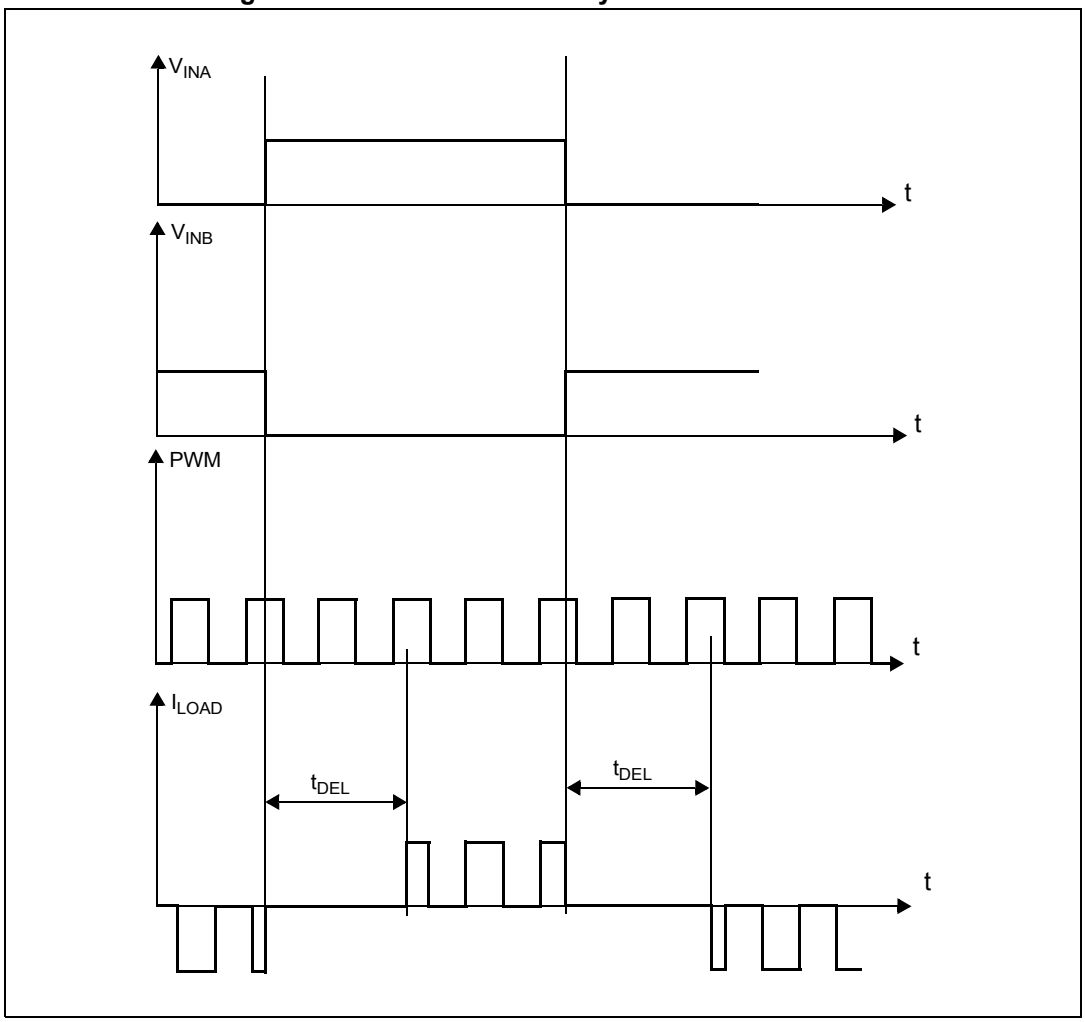


Figure 5. Definition of the low-side switching times

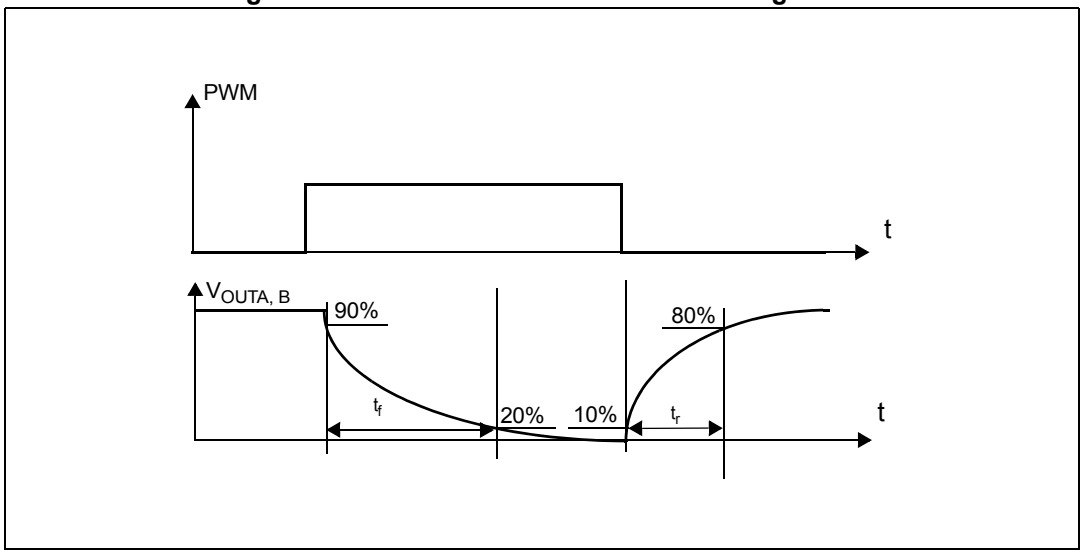


Figure 6. Definition of the high-side switching times

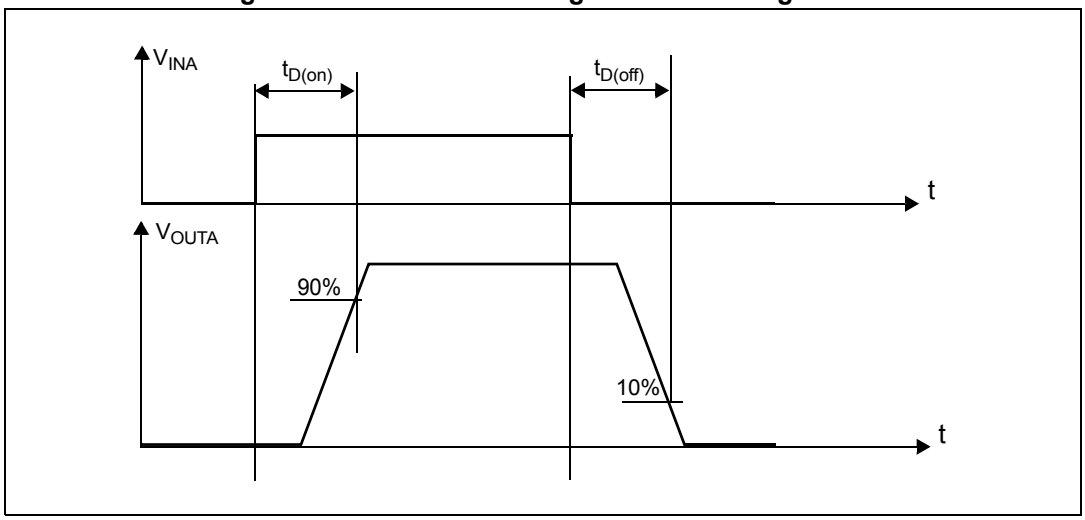


Figure 7. Definition of dynamic cross conduction current during a PWM operation

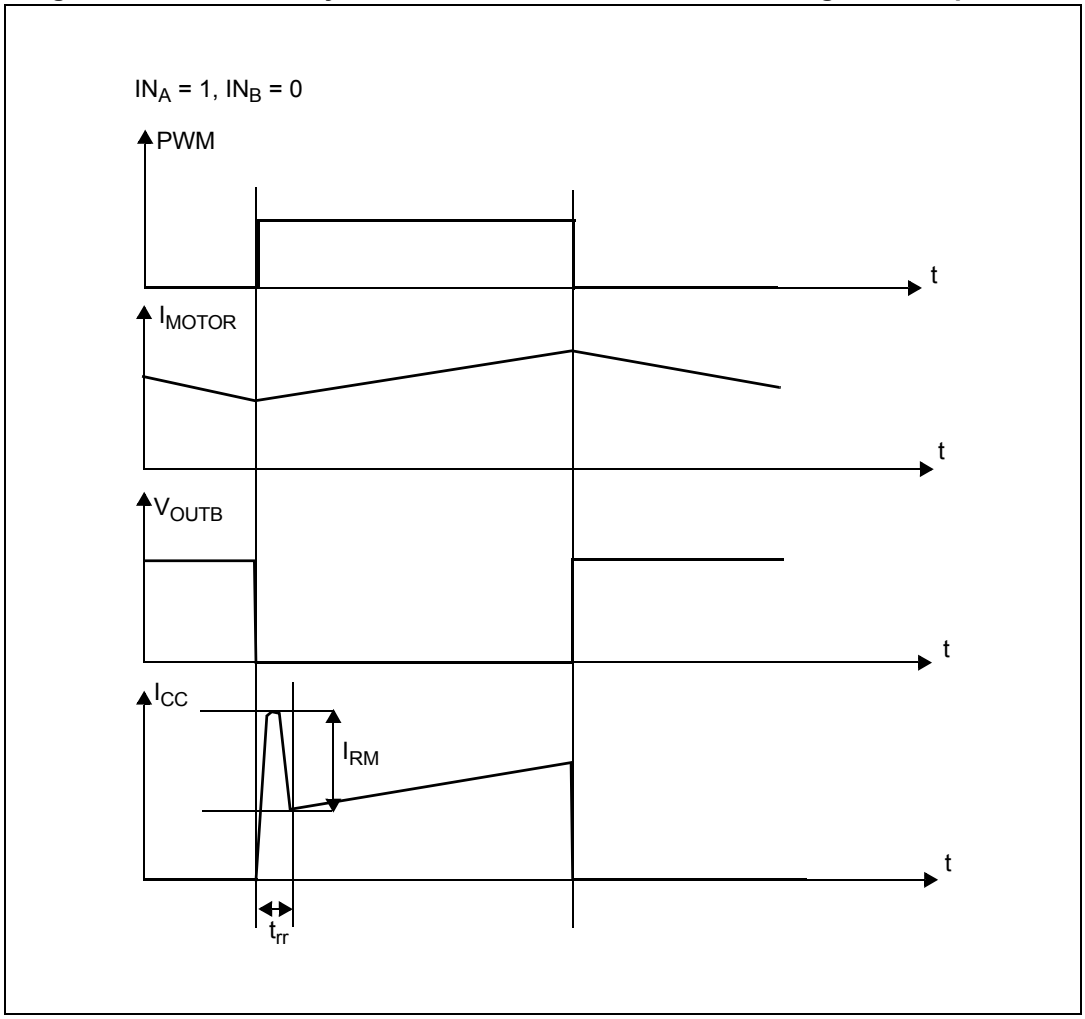


Table 12. Truth table in normal operating conditions

IN_A	IN_B	$DIAG_A/EN_A$	$DIAG_B/EN_B$	OUT_A	OUT_B	CS	Operating mode
1	1	1	1	H	H	High Imp.	Brake to V_{CC}
	0				L	$I_{SENSE} = I_{OUT}/K$	Clockwise (CW)
0	1			L	H		Counterclockwise (CCW)
	0				L	High Imp.	Brake to GND

Table 13. Truth table in fault conditions (detected on OUT_A)

IN_A	IN_B	$DIAG_A/EN_A$	$DIAG_B/EN_B$	OUT_A	OUT_B	CS
1	1	0	1	OPEN	H	High Imp.
	0				L	
0	1				H	I_{OUTB}/K
	0				L	High Imp.
X	X		0		OPEN	
	1		1		H	I_{OUTB}/K
	0				L	High Imp.
			Fault Information		Protection Action	

Note: Notice that saturation detection on the low side power MOSFET is possible only if the impedance of the short-circuit from the output to the battery is less than 100mΩ when the device is supplied with a battery voltage of 13.5V.

Table 14. Electrical transient requirements

ISO T/R - 7637/1 test pulse	Test level I	Test level II	Test level III	Test level IV	Test level delays and impedance
1	-25V	-50V	-75V	-100V	2ms, 10Ω
2	+25V	+50V	+75V	+100V	0.2ms, 10Ω
3a	-25V	-50V	-100V	-150V	0.1µs, 50Ω
3b	+25V	+50V	+75V	+100V	
4	-4V	-5V	-6V	-7V	100ms, 0.01Ω
5	+26.5V	+46.5V	+66.5V	+86.5V	400ms, 2Ω

ISO T/R - 7637/1 test pulse	Test levels result I	Test levels result II	Test levels result III	Test levels result IV
1	C	C	C	C
2				
3a				
3b				
4				
5(1)		E	E	E

1. For load dump exceeding the above value a centralized suppressor must be adopted.

Class	Contents
C	All functions of the device performed as designed after exposure to disturbance.
E	One or more functions of the device did not perform as designed after exposure to disturbance and cannot be returned to proper operation without replacing the device.

2.3 Electrical characteristics curves

Figure 8. On state supply current

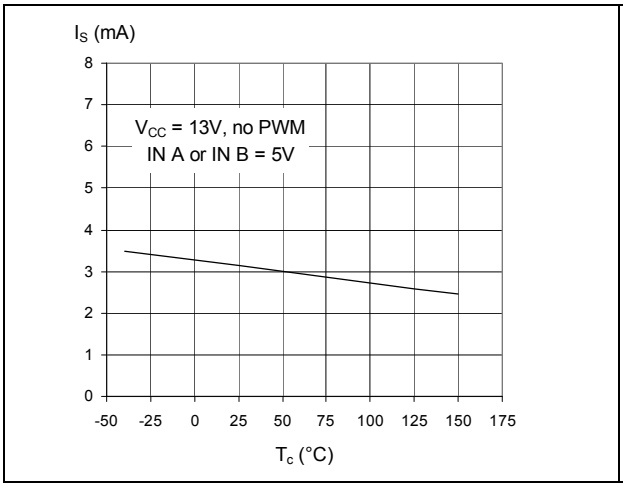


Figure 9. Off state supply current

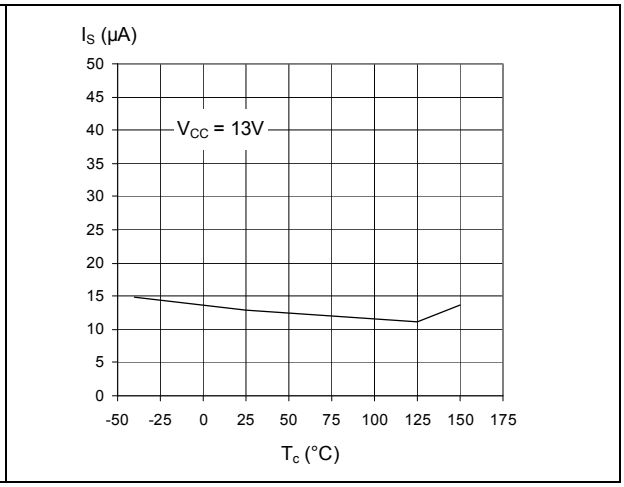


Figure 10. High-level input current

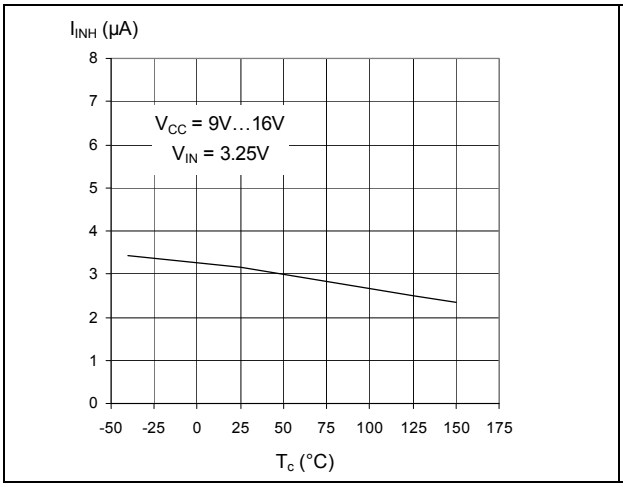


Figure 11. Input clamp voltage

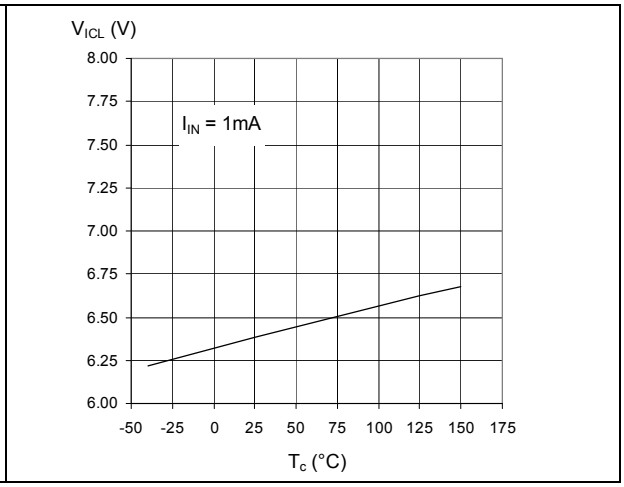


Figure 12. Input high-level voltage

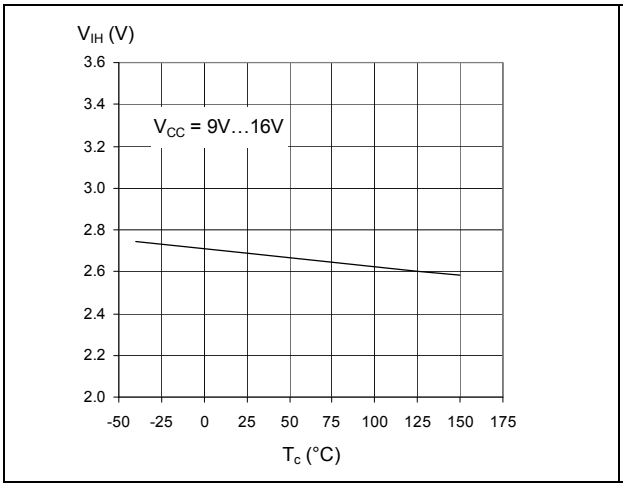


Figure 13. Input low-level voltage

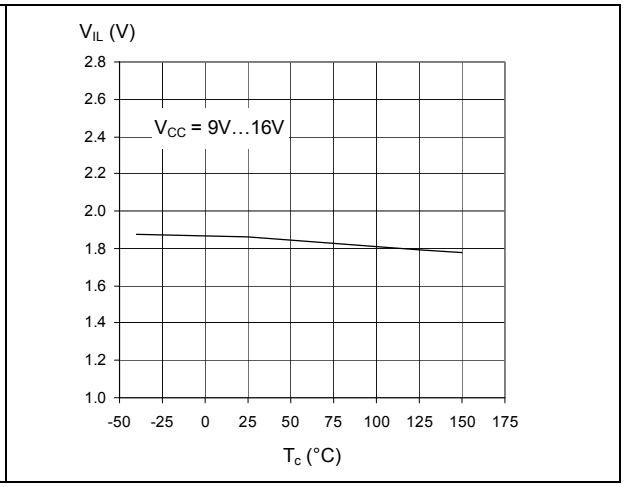


Figure 14. Input hysteresis voltage

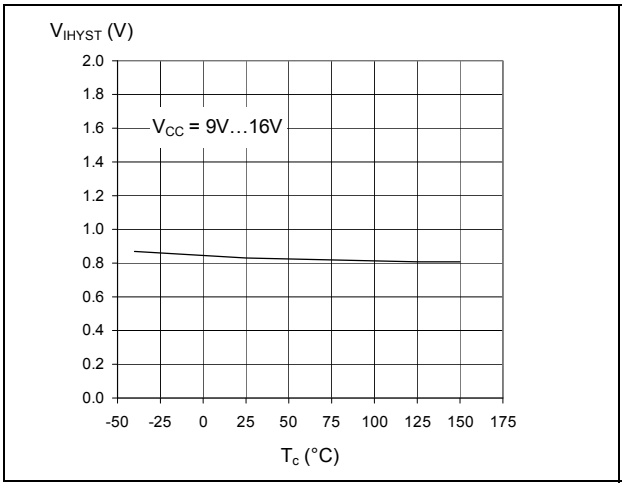


Figure 15. High-level enable pin current

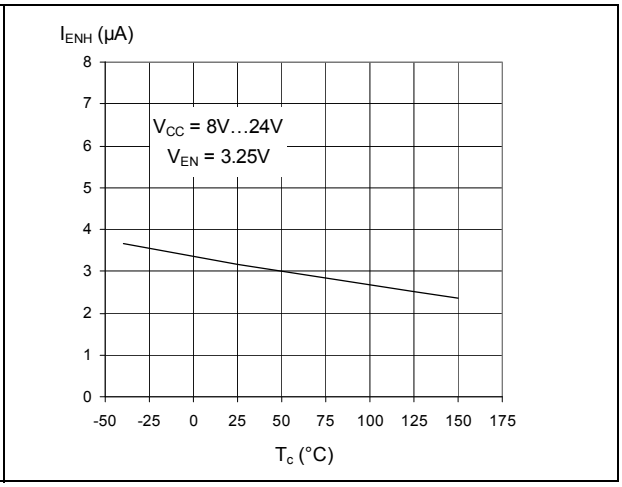


Figure 16. Delay time during change of operation mode

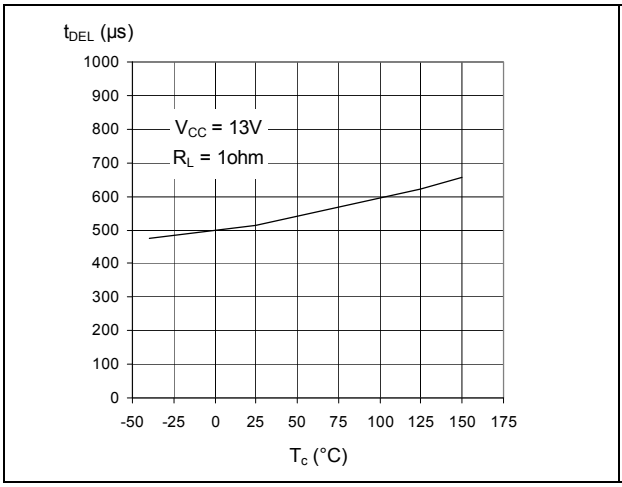


Figure 17. Enable clamp voltage

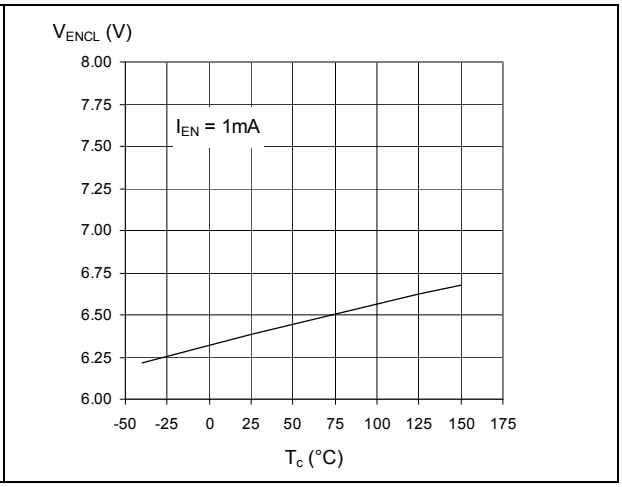


Figure 18. High-level enable voltage

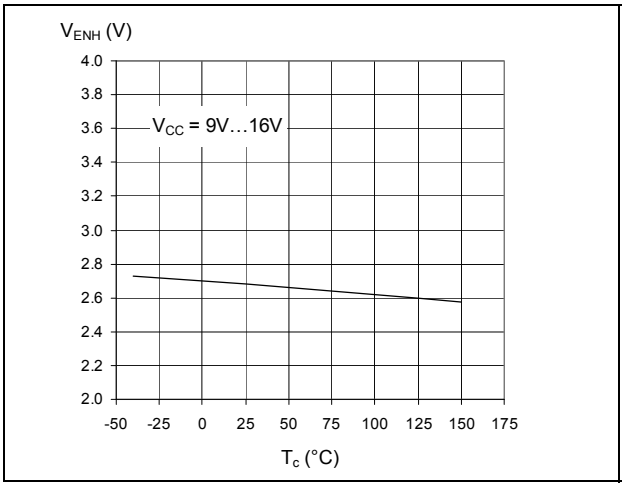


Figure 19. Low-level enable voltage

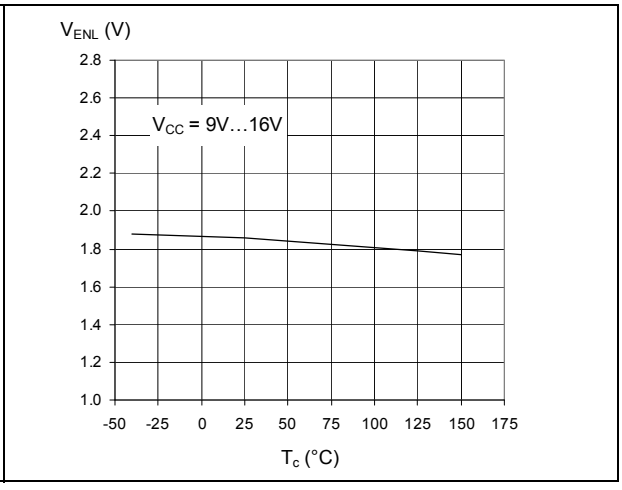


Figure 20. PWM high-level voltage

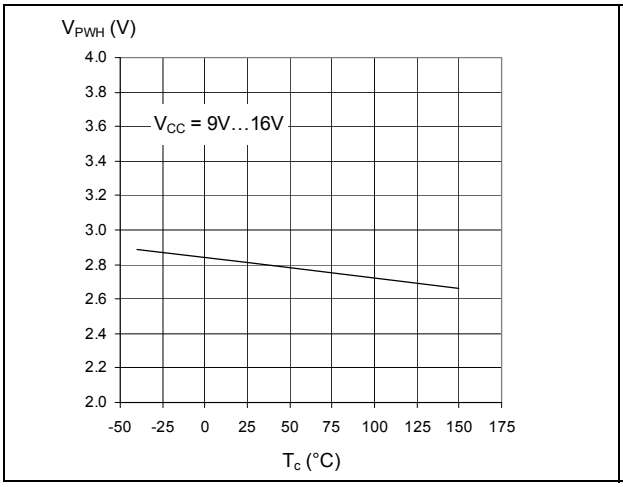


Figure 21. PWM low-level voltage

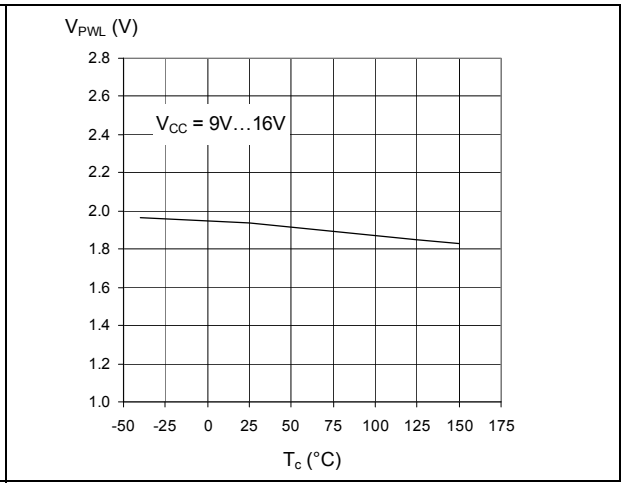


Figure 22. PWM high-level current

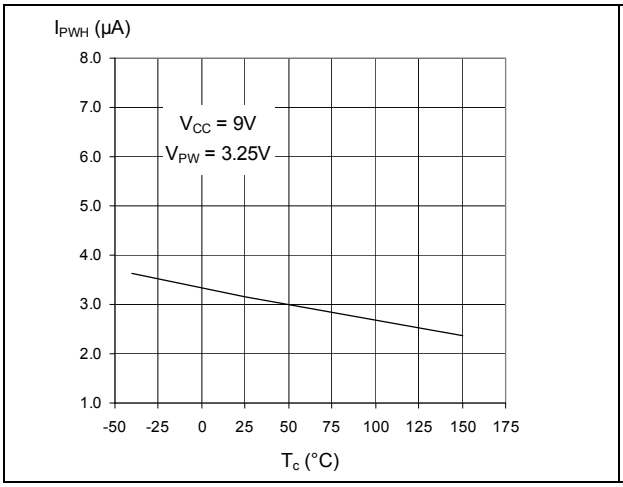


Figure 23. Overvoltage shutdown

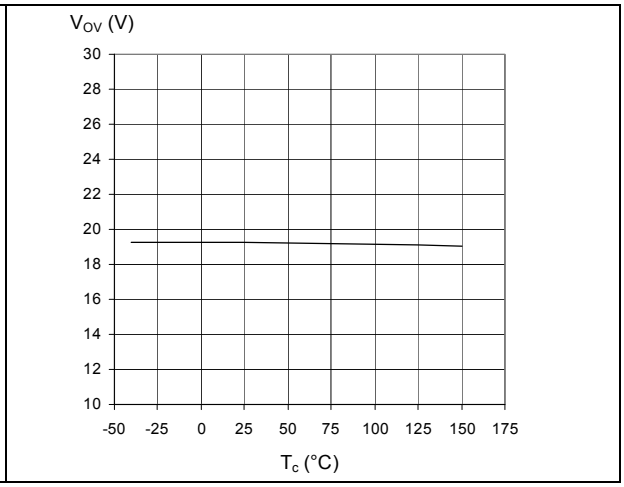


Figure 24. Undervoltage shutdown

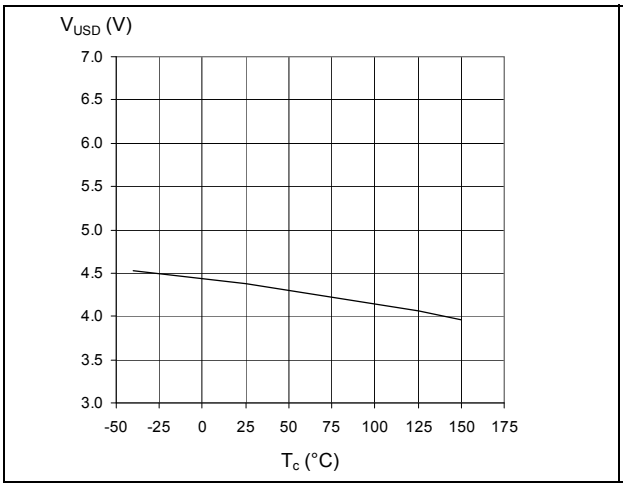


Figure 25. Current limitation

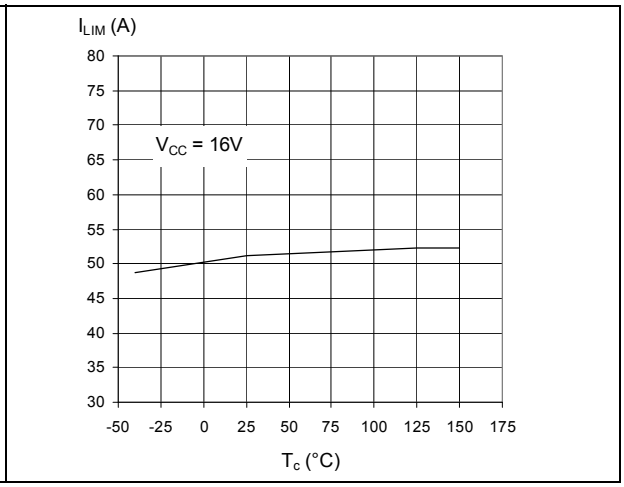


Figure 26. On state high-side resistance vs T_{case}

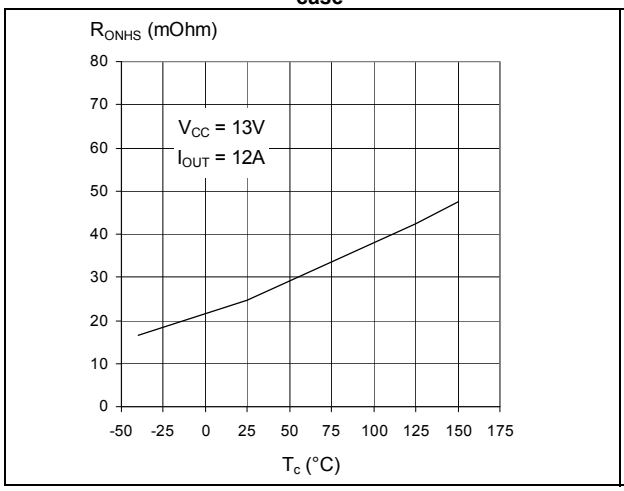


Figure 27. On state low-side resistance vs T_{case}

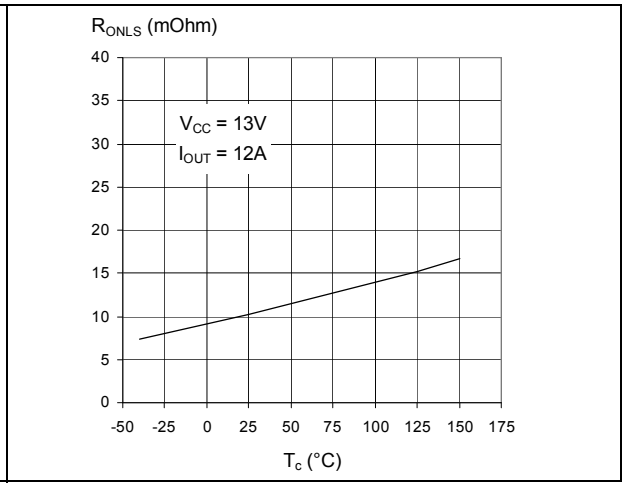


Figure 28. On state high-side resistance vs V_{CC}

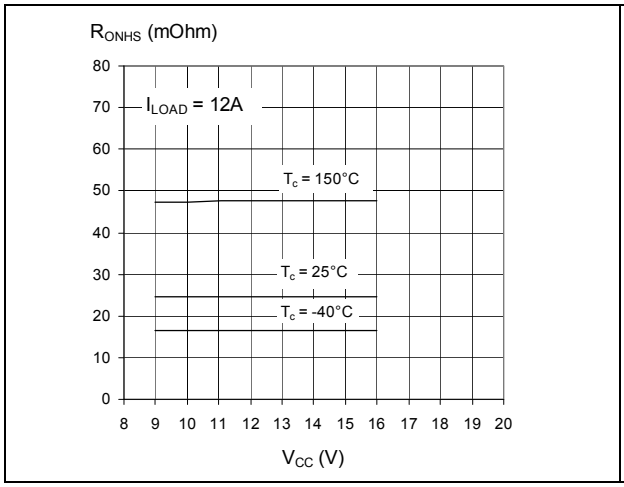


Figure 29. On state low-side resistance vs V_{CC}

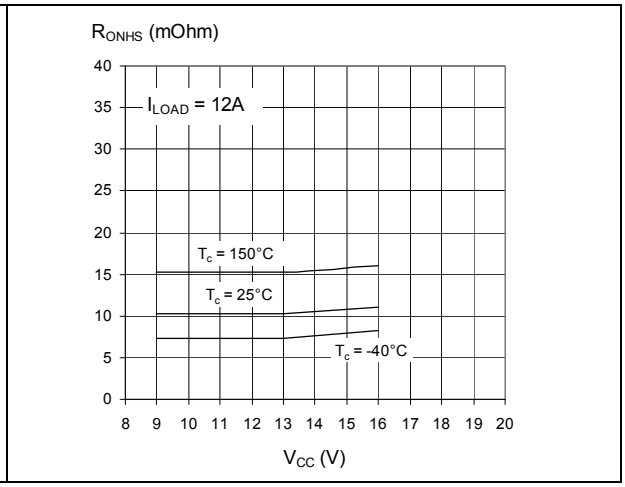


Figure 30. Output voltage rise time

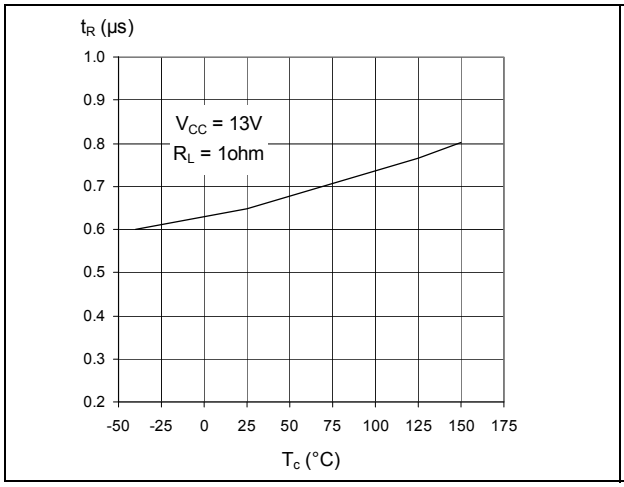
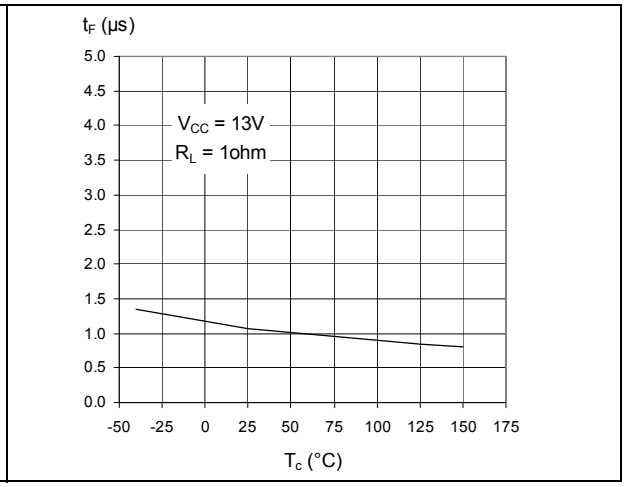


Figure 31. Output voltage fall time

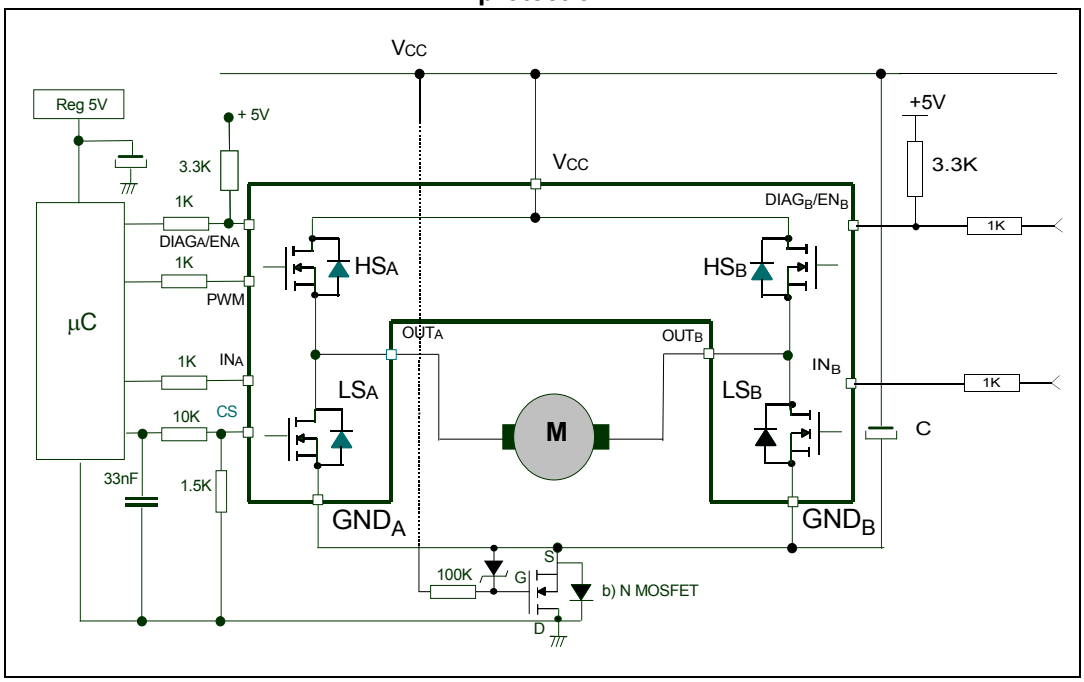


3 Application information

In normal operating conditions the $DIAG_X/EN_X$ pin is considered as an input pin by the device. This pin must be externally pulled high.

PWM pin usage: In all cases, a “0” on the PWM pin will turn off both LS_A and LS_B switches. When PWM rises back to “1”, LS_A or LS_B turn on again depending on the input pin state.

Figure 32. Typical application circuit for DC to 20 kHz PWM operation short circuit protection



Note: The value of the blocking capacitor (C) depends on the application conditions and defines voltage and current ripple onto supply line at PWM operation. Stored energy of the motor inductance may fly back into the blocking capacitor, if the bridge driver goes into tri-state. This causes a hazardous overvoltage if the capacitor is not big enough. As basic orientation, 500µF per 10A load current is recommended.

In case of a fault condition the $DIAG_X/EN_X$ pin is considered as an output pin by the device.

The fault conditions are:

overtemperature on one or both high sides

short to battery condition on the output (saturation detection on the low-side power MOSFET)

Possible origins of fault conditions may be:

OUT_A is shorted to ground → overtemperature detection on high side A

OUT_A is shorted to V_{CC} → low-side power MOSFET saturation detection

When a fault condition is detected, the user can know which power element is in fault by monitoring the IN_A, IN_B, $DIAG_A/EN_A$ and $DIAG_B/EN_B$ pins.

In any case, when a fault is detected, the faulty leg of the bridge is latched off. To turn on the respective output (OUT_X) again, the input signal must rise from low to high level.

3.1 Reverse battery protection

Three possible solutions can be considered:

a Schottky diode D connected to V_{CC} pin

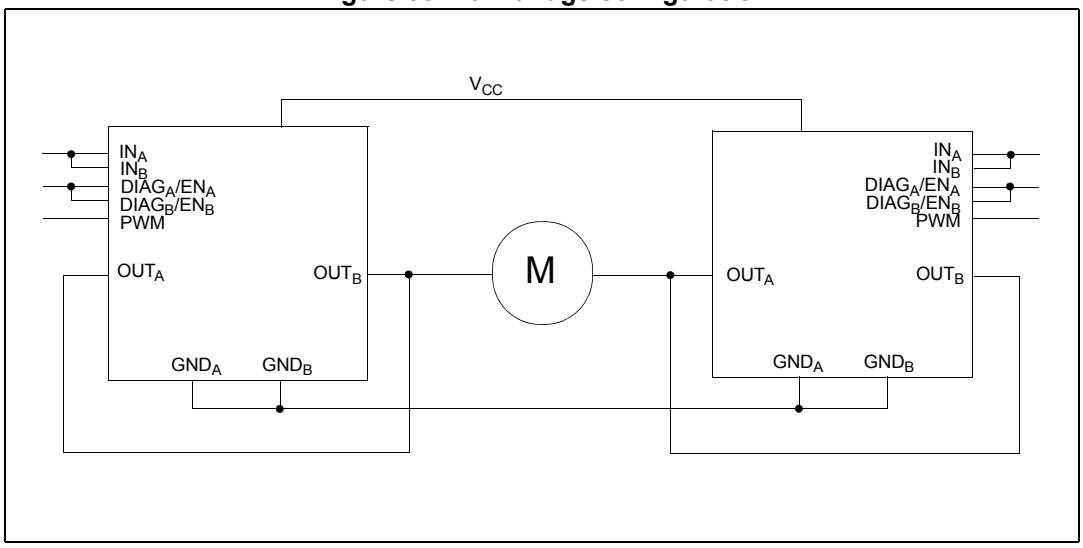
an N-channel MOSFET connected to the GND pin (see *Figure 32: Typical application circuit for DC to 20 kHz PWM operation short circuit protection on page 20*)

a P-channel MOSFET connected to the V_{CC} pin

The device sustains no more than -30 A in reverse battery conditions because of the two body diodes of the power MOSFETs. Additionally, in reverse battery condition the I/Os of Root part number 1 are pulled down to the V_{CC} line (approximately -1.5 V). A series resistor must be inserted to limit the current sunk from the microcontroller I/Os. If I_{Rmax} is the maximum target reverse current through µC I/Os, the series resistor is:

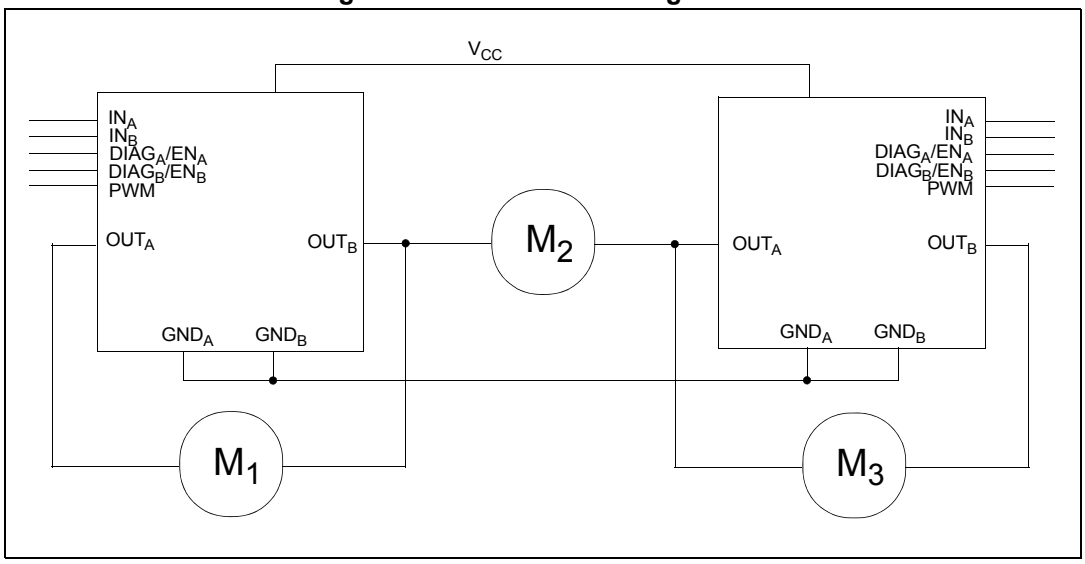
$$R = \frac{V_{IOs} - V_{CC}}{I_{Rmax}}$$

Figure 33. Half-bridge configuration



Note: The VNH3ASP30-E can be used as a high power half-bridge driver achieving an On resistance per leg of 21 mΩ.

Figure 34. Multi-motor configuration



Note: The VNH3ASP30-E can easily be designed in multi-motor driving applications such as seat positioning systems, where only one motor must be driven at a time. The $DIAG_X/EN_X$ pins allow the unused half-bridges to be put into high impedance.

Figure 35. Waveforms in full-bridge operation

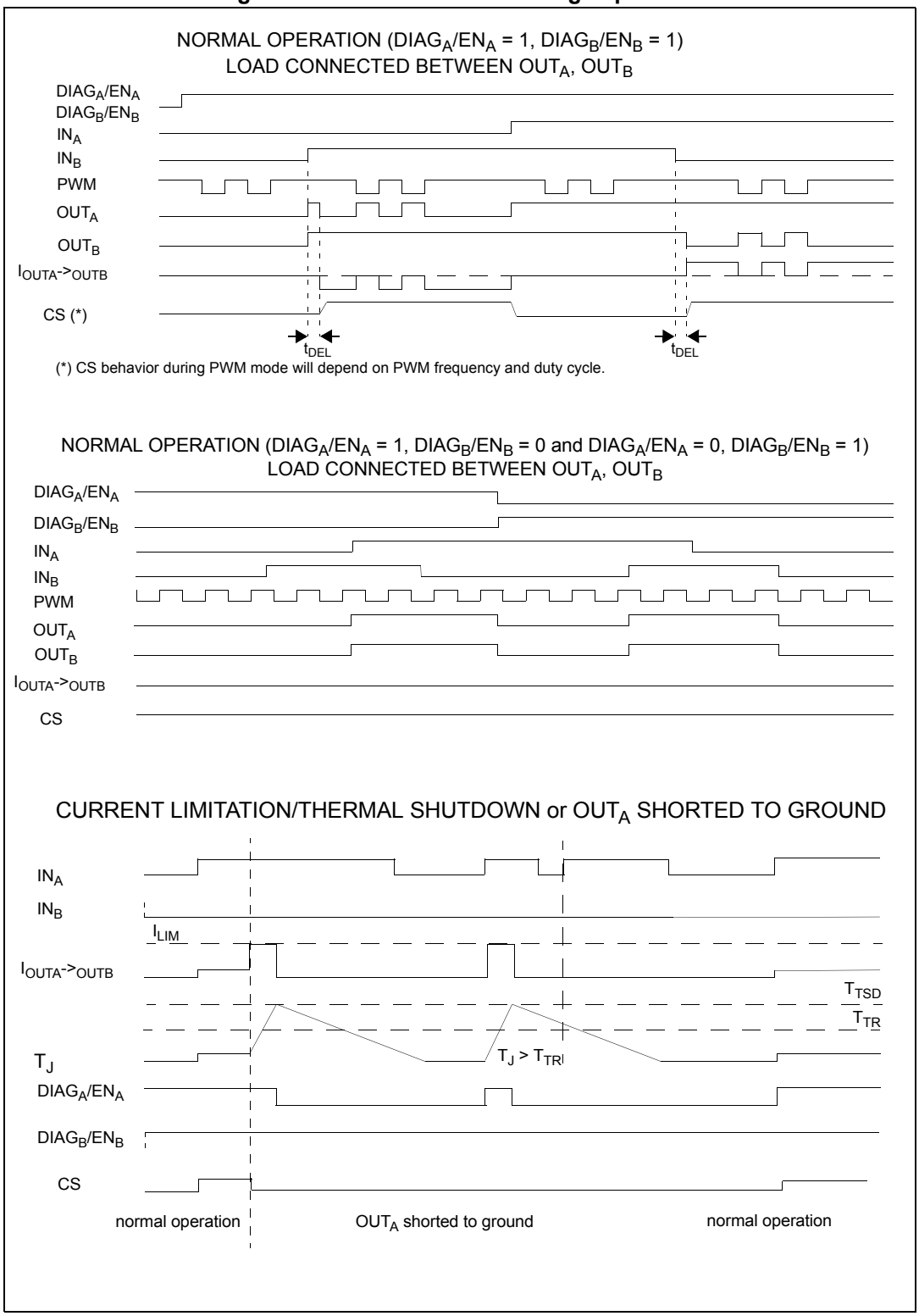
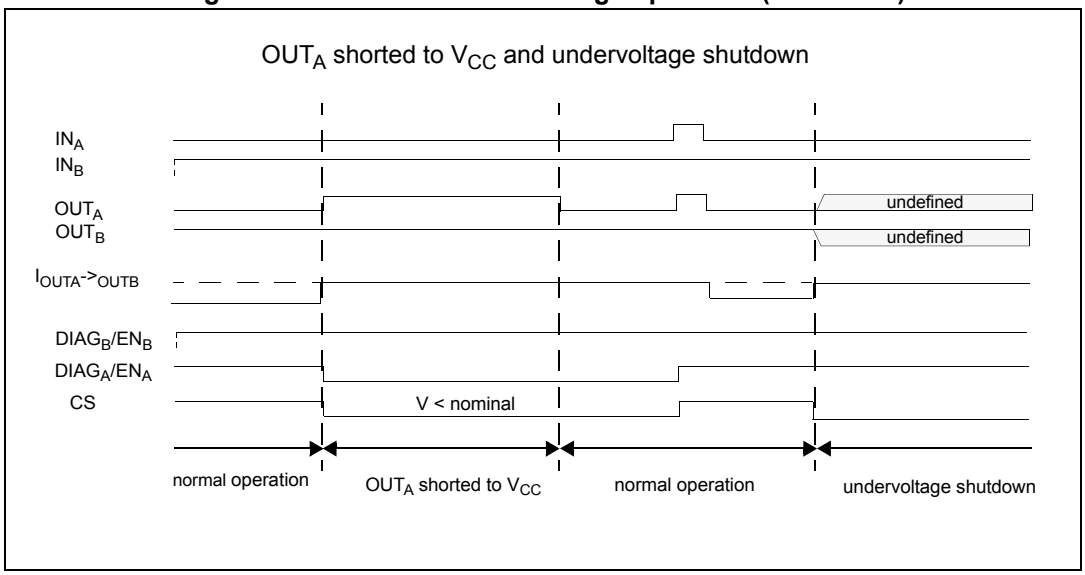


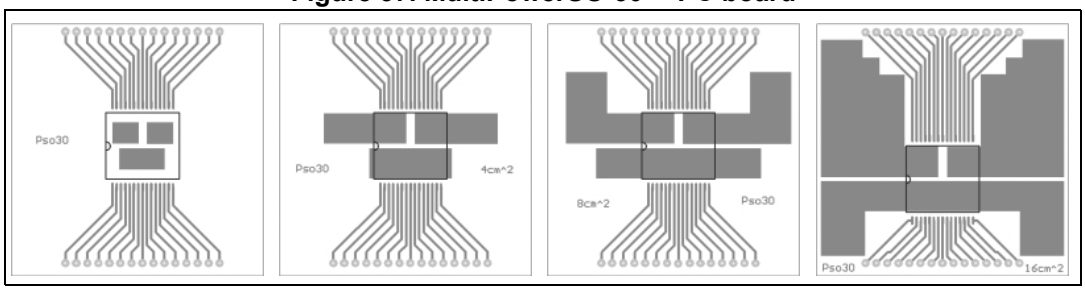
Figure 36. Waveforms in full-bridge operation (continued)



4 Package and PCB thermal data

4.1 MultiPowerSO-30 thermal data

Figure 37. MultiPowerSO-30™ PC board



Note: Layout condition of Rth and Zth measurements (PCB FR4 area= 58 mm x 58 mm, PCB thickness=2 mm, Cu thickness=35 µm, Copper areas: from minimum pad lay-out to 16 cm2).

Figure 38. Chipset configuration

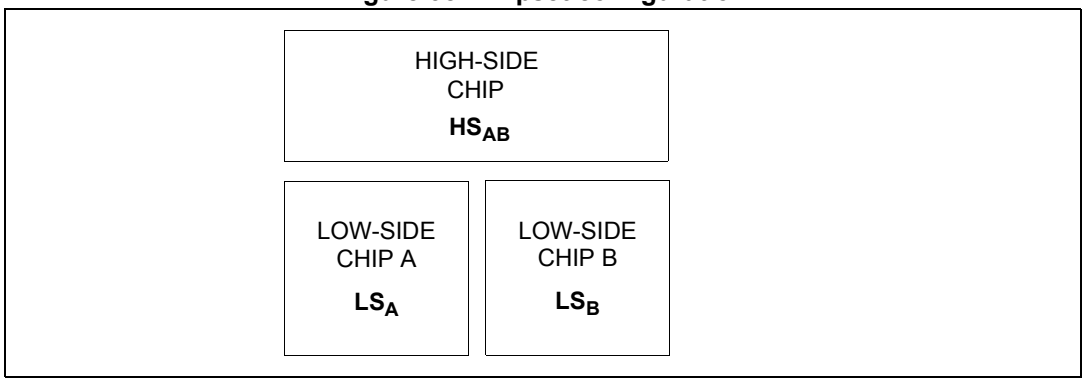
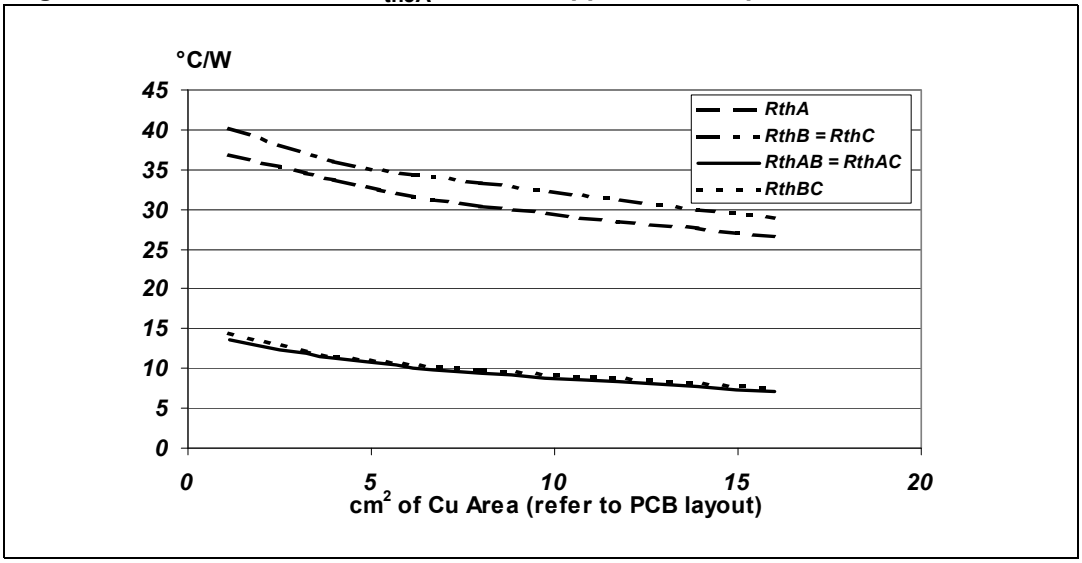


Figure 39. Auto and mutual R_{thJA} vs PCB copper area in open box free air condition



4.1.1 Thermal calculation in clockwise and anti-clockwise operation in Steady-state mode

Table 15. Thermal calculation in clockwise and anti-clockwise operation in steady-state mode

HS_A	HS_B	LS_A	LS_B	T_{JHSAB}	T_{JLSA}	T_{JLSB}
ON	OFF		ON	$P_{dHSA} \times R_{thHS} + P_{dLSB} \times R_{thHSLS} + T_A$	$P_{dHSA} \times R_{thHSLS} + P_{dLSB} \times R_{thLS} + T_A$	$P_{dHSA} \times R_{thHSLS} + P_{dLSB} \times R_{thLS} + T_A$
OFF	ON		OFF	$P_{dHSB} \times R_{thHS} + P_{dLSA} \times R_{thHSLS} + T_A$	$P_{dHSB} \times R_{thHSLS} + P_{dLSA} \times R_{thLS} + T_A$	$P_{dHSB} \times R_{thHSLS} + P_{dLSA} \times R_{thLSLS} + T_A$

4.1.2 Thermal resistances definition (values according to the PCB heatsink area)

R_{thHS} = R_{thHSA} = R_{thHSB} = High-Side Chip Thermal Resistance Junction to Ambient (HS_A or HS_B in ON state)

R_{thLS} = R_{thLSA} = R_{thLSB} = Low-Side Chip Thermal Resistance Junction to Ambient

R_{thHSLS} = $R_{thHSALSB}$ = $R_{thHSBLSA}$ = Mutual Thermal Resistance Junction to Ambient between High-Side and Low-Side Chips

R_{thLSLS} = $R_{thLSALSB}$ = Mutual Thermal Resistance Junction to Ambient between Low-Side Chips

4.1.3 Thermal calculation in Transient mode[(a)]

T_{JHSAB} = $Z_{thHS} \times P_{dHSAB} + Z_{thHSLS} \times (P_{dLSA} + P_{dLSB}) + T_A$

a. Calculation is valid in any dynamic operating condition. P_d values set by user.

$T_{JLSA} = Z_{thHSLS} \times P_{dHSAB} + Z_{thLS} \times P_{dLSA} + Z_{thLSLS} \times P_{dLSB} + T_A$

$T_{JLSB} = Z_{thHSLS} \times P_{dHSAB} + Z_{thLSLS} \times P_{dLSA} + Z_{thLS} \times P_{dLSB} + T_A$

4.1.4 Single pulse thermal impedance definition (values according to the PCB heatsink area)

Z_{thHS} = High-Side Chip Thermal Impedance Junction to Ambient

$Z_{thLS} = Z_{thLSA} = Z_{thLSB}$ = Low-Side Chip Thermal Impedance Junction to Ambient

$Z_{thHSLS} = Z_{thHSABLSA} = Z_{thHSABLSB}$ = Mutual Thermal Impedance Junction to Ambient between High-Side and Low-Side Chips

$Z_{thLSLS} = Z_{thLSALSB}$ = Mutual Thermal Impedance Junction to Ambient between Low-Side Chips

Equation 1: pulse calculation formula

$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_p / T$

Figure 40. MultiPowerSO-30 HSD thermal impedance junction ambient single pulse

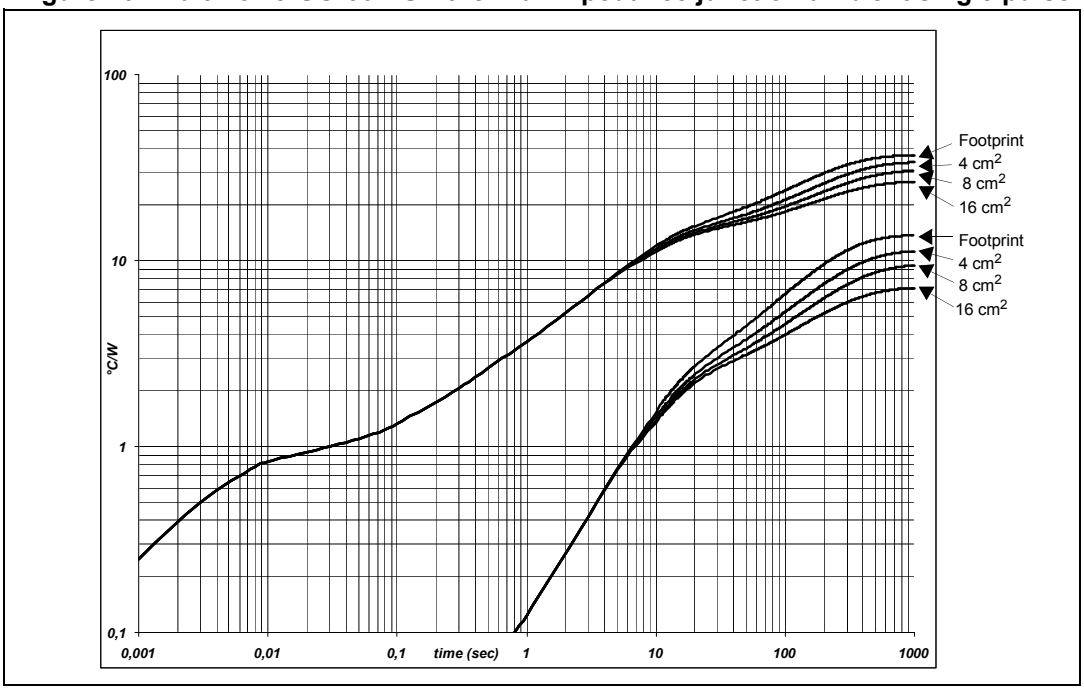


Figure 41. MultiPowerSO-30 LSD thermal impedance junction ambient single pulse

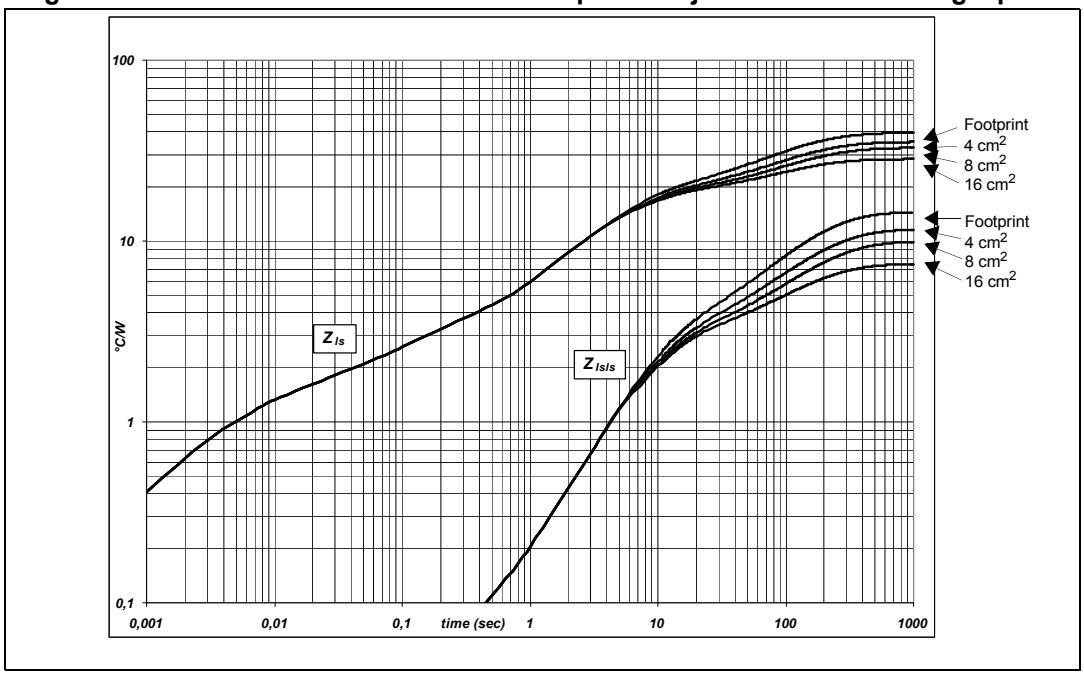


Figure 42. Thermal fitting model of an H-bridge in MultiPowerSO-30

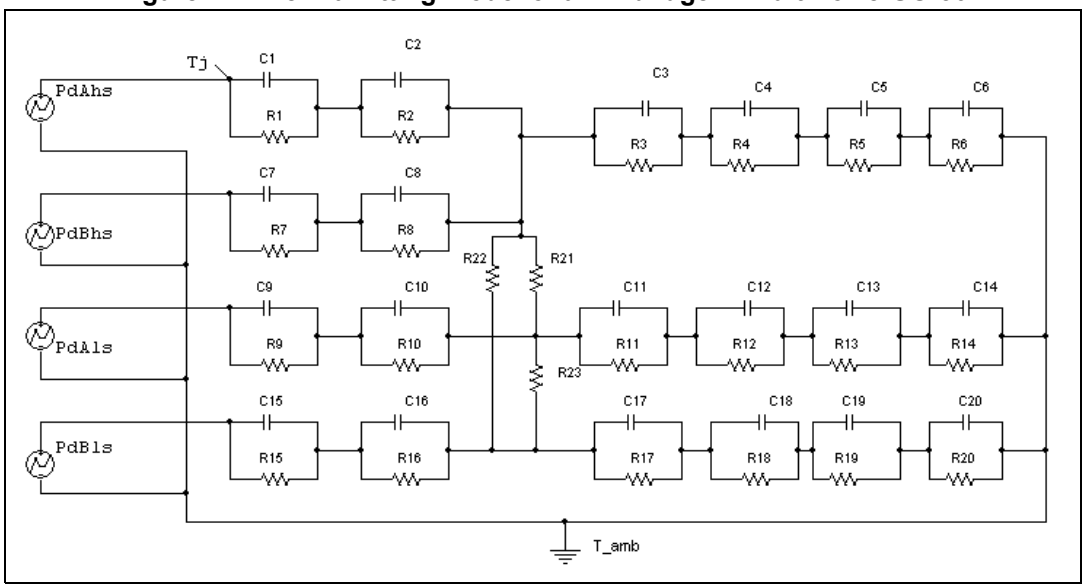


Table 16. Thermal parameters(1)

Area/island (cm^2)	Footprint	4	8	16
R1 = R7 (°C/W)	0.05			
R2 = R8 (°C/W)	0.3			
R3 (°C/W)	0.5			
R4 (°C/W)	1.3			
R5 (°C/W)	14			
R6 (°C/W)	44.7	39.1	31.6	23.7

Table 16. Thermal parameters[1] (continued)

R9 = R15 (°C/W)	0.11			
R10 = R16 (°C/W)	0.21			
R11 = R17 (°C/W)	0.42			
R12 = R18 (°C/W)	1.5			
R13 = R19 (°C/W)	20			
R14 = R20 (°C/W)	46.9	36.1	30.4	20.8
R21 = R22 = R23 (°C/W)	115			
C1 = C7 (W.s/°C)	0.005			
C2 = C8 (W.s/°C)	0.008			
C3	0.01			
C4 = C13 = C19 (W.s/°C)	0.3			
C5 (W.s/°C)	0.6			
C6 (W.s/°C)	5	7	9	11
C9 = C15 (W.s/°C)	0.0016			
C10 = C16 (W.s/°C)	0.0032			
C11 = C17 (W.s/°C)	0.0053			
C12 = C18 (W.s/°C)	0.075			
C14 = C20 (W.s/°C)	2.5	3.5	4.5	5.5

1. The blank space means that the value is the same as the previous one.

5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

5.1 MultiPowerSO-30 package information

Figure 43. MultiPowerSO-30 package outline

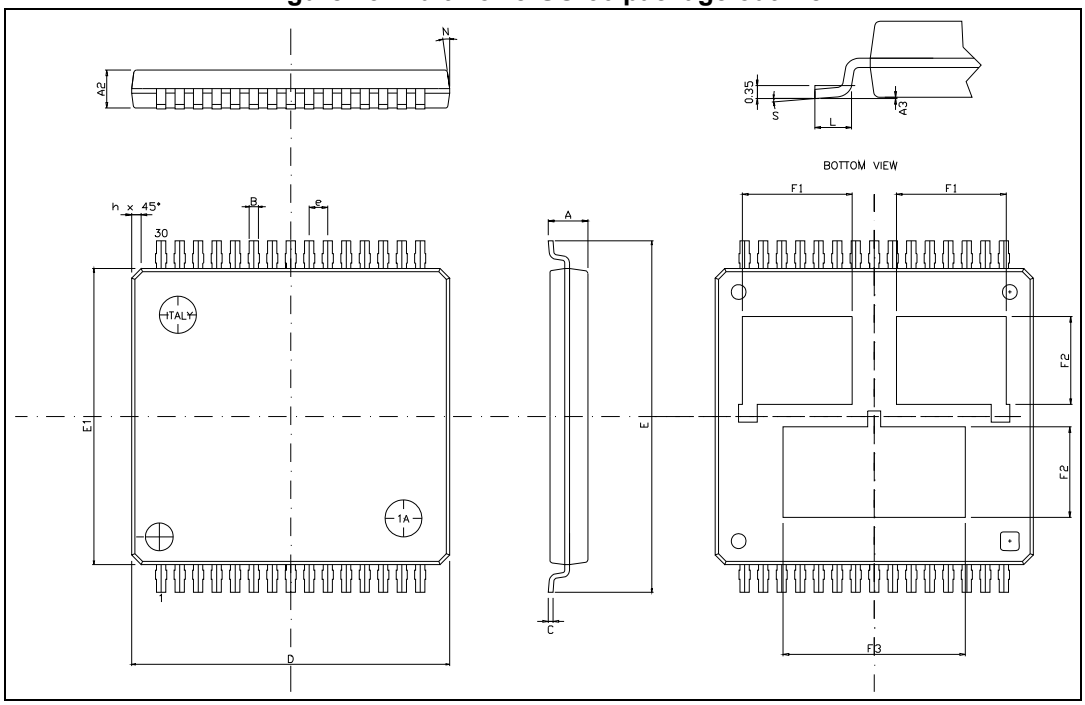


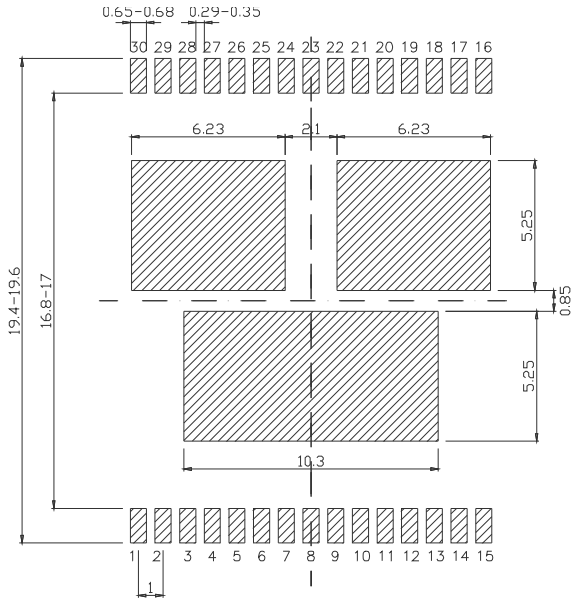
Table 17. MultiPowerSO-30 mechanical data

Symbol	Millimeters		
	Min	Typ	Max
A			2.35
A2	1.85		2.25
A3	0		0.1
B	0.42		0.58
C	0.23		0.32
D	17.1	17.2	17.3
E	18.85		19.15
E1	15.9	16	16.1
e		1	
F1	5.55		6.05
F2	4.6		5.1

Table 17. MultiPowerSO-30 mechanical data (continued)

Symbol	Millimeters		
	Min	Typ	Max
F3	9.6		10.1
L	0.8		1.15
N			10 deg
S	0 deg		7 deg

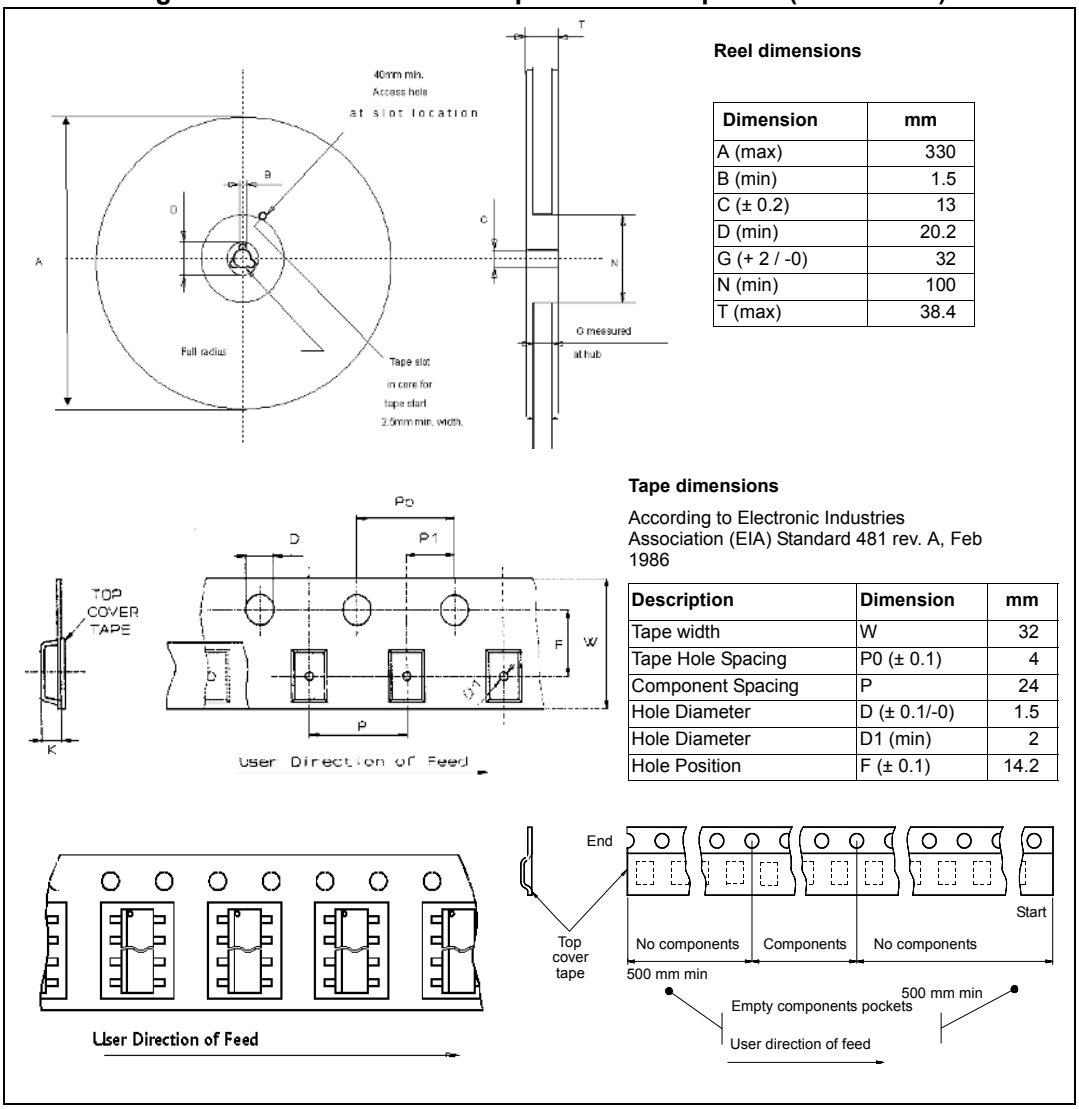
Figure 44. MultiPowerSO-30 suggested pad layout



5.2 Packing information

Note: The devices are packed in tape and reel shipments (see the Device summary on page 1).

Figure 45. MultiPowerSO-30 tape and reel shipment (suffix “TR”)



Reel dimensions

Dimension	mm
A (max)	330
B (min)	1.5
C (± 0.2)	13
D (min)	20.2
G (+ 2 / -0)	32
N (min)	100
T (max)	38.4

Tape dimensions

According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Description	Dimension	mm
Tape width	W	32
Tape Hole Spacing	P0 (± 0.1)	4
Component Spacing	P	24
Hole Diameter	D (± 0.1/-0)	1.5
Hole Diameter	D1 (min)	2
Hole Position	F (± 0.1)	14.2

6 Revision history

Table 18. Document revision history

Date	Revision	Changes
Sep-2004	1	First issue
Dec-2005	2	Resistance per leg modification *Figure 33: Half-bridge configuration on page 21*
11-Feb-2007	3	Document converted into new ST template. Changed *Datasheet - production data on page 1* to add ECOPACK® package Removed Table 7. Thermal Data from page 4 *Table 6: Power section on page 9*: Changed test conditions and max values for supply current in Off state and On state *Table 7: Logic inputs (INA, INB, ENA, ENB) on page 9*: Modified parameter descriptions for I_{INL} and I_{INH} *Table 8: PWM on page 10*: Modified parameter descriptions for I_{PWL} and I_{PWH} *Table 10: Protection and diagnostic on page 10*: Modified all symbols except I_{LIM} and V_{CLP} *Table 11 on page 11*: Changed test conditions for K_2 analog sense current drift *Section Table 13.: Truth table in fault conditions (detected on OUTA) on page 14*: Changed first of two fault conditions *Figure 6: Definition of the high-side switching times on page 13*: Added vertical limitation line to left side of $t_{D(off)}$ arrow *Figure 36: Waveforms in full-bridge operation (continued) on page 24*: Added dotted vertical limitation lines Added *Section 2.3: Electrical characteristics curves on page 16* Added *Section 4: Package and PCB thermal data on page 25* Added *Section 5: Package information on page 30* Updated disclaimer on last page
01-Jun-2007	4	Document reformatted. *Table 6: Power section on page 9*: changed test conditions and max values for supply current in Off state
06-Feb-2008	5	Corrected Heat Slug numbers in *Table 3: Pin definitions and functions*.
23-Sep-2013	6	Updated Disclaimer.
11-Jan-2017	7	– Removed all information relative to tube packing of the product – Modified *Section 5: Package information* – Added AEC-Q100 qualified in the Features section – Minor text edits throughout the document