

VN5010AK-E

High side driver with analog current sense for automotive applications

Features

Max supply voltage	V_{CC}	41 V
Operating voltage range	V_{CC}	4.5 to 36 V
Max on-state resistance	R _{ON}	10 m Ω
Current limitation (typ)	I _{LIMH}	65 A
Off-state supply current (typ)	IS	2 μΑ

Main features

- Inrush current active management by power limitation
- Very low standby current
- 3.0v CMOS compatible input
- Optimized electromagnetic emission
- Very low electromagnetic susceptibility
- In compliance with the 2002/95/EC European directive

Diagnostic functions

- Proportional load current sense
- High current sense precision for wide range currents
- Current sense disable
- Thermal shutdown indication
- Very low current sense leakage

■ Protections

- Undervoltage shutdown
- Overvoltage clamp
- Load current limitation
- Self limiting of fast thermal transients
- Protection against loss of ground and loss of V_{CC}
- Thermal shutdown



- Reverse battery protection (see Figure 26)
- Electrostatic discharge protection

Application

All types of resistive, inductive and capacitive loads

Description

The VN5010AK-E is a monolithic device made using STMicroelectronics VIPower M0-5 technology. It is intended for driving resistive or inductive loads with one side connected to ground. Active V_{CC} pin voltage clamp protects the device against low energy spikes (see ISO7637 transient compatibility table). This device integrates an analog current sense which delivers a current proportional to the load current (according to a known ratio) when CS_DIS is driven low or left open. When CS_DIS is driven high, the CURRENT SENSE pin is in a high impedance condition. Output current limitation protects the device in overload condition. In case of long overload duration, the device limits the dissipated power to safe level up to thermal shutdown intervention. Thermal shutdown with automatic restart allows the device to recover normal operation as soon as fault condition disappears.

Table 1. Device summary

Package	Order codes		
	Tube	Tape and reel	
PowerSSO-24 TM	VN5010AK-E	VN5010AKTR-E	

Contents VN5010AK-E

Contents

1	Block diagram and pin description				
2	Elec	trical specifications	7		
	2.1	Absolute maximum ratings	7		
	2.2	Electrical characteristics	8		
	2.3	Electrical characteristics curves	18		
3	Арр	lication information 2	21		
	3.1	GND protection network against reverse battery	21		
		3.1.1 Solution 1: resistor in the ground line (RGND only)	21		
		3.1.2 Solution 2: diode (DGND) in the ground line	22		
	3.2	Load dump protection	22		
	3.3	Microcontroller I/Os protection	22		
	3.4	Maximum demagnetization energy (V _{CC} =13.5V)	23		
4	Pacl	kage and PCB thermal data	<u>2</u> 4		
	4.1	PowerSSO-24 TM thermal data	24		
5	Pacl	kage and packing information	27		
	5.1	ECOPACK [®] packages 2	27		
	5.2	Packing information	<u>2</u> 9		
6	Revi	ision history 3	30		

VN5010AK-E List of tables

List of tables

Table 1.	Device summary	. 1
Table 2.	Pin function	. 5
Table 3.	Suggested connections for unused and not connected pins	. 6
Table 4.	Absolute maximum ratings	. 7
Table 5.	Thermal data	. 8
Table 6.	Power section	. 8
Table 7.	Switching (VCC=13V)	. 9
Table 8.	Logic input	. 9
Table 9.	Protections and diagnostics	10
Table 10.	Current sense (8V <vcc<16v)< td=""><td>10</td></vcc<16v)<>	10
Table 11.	Truth table	14
Table 12.	Electrical transient requirements (part 1/3)	15
Table 13.	Electrical transient requirements (part 2/3)	15
Table 14.	Electrical transient requirements (part 3/3)	16
Table 15.	Thermal parameters	26
Table 16.	PowerSSO-24™ mechanical data	28
Table 17.	Document revision history	30

List of figures VN5010AK-E

List of figures

Figure 1.	Block diagram	
Figure 2.	Connection diagram (top view)	6
Figure 3.	Current and voltage conventions	7
Figure 4.	Current sense delay characteristics	12
Figure 5.	Delay response time between rising edge of output current and rising edge of Current Sens	е
(CS enabled	d)12	
Figure 6.	IOUT/ISENSE vs IOUT (see <i>Table 10</i> for details)	13
Figure 7.	Maximum current sense ratio drift vs load current	13
Figure 8.	Switching characteristics	
Figure 9.	Output voltage drop limitation	15
Figure 10.	Waveforms	17
Figure 11.	Off-state output current	18
Figure 12.	High level input current	
Figure 13.	Input clamp voltage	18
Figure 14.	Input low level	18
Figure 15.	Input high level	18
Figure 16.	Input hysteresis voltage	18
Figure 17.	On-state resistance vs T _{case}	19
Figure 18.	On-state resistance vs V _{CC}	19
Figure 19.	Undervoltage shutdown	19
Figure 20.	Turn-on voltage slope	19
Figure 21.	I _{LIMH} vs T _{case}	19
Figure 22.	Turn-off voltage slope	19
Figure 23.	CS_DIS high level voltage	20
Figure 24.	CS_DIS clamp voltage	
Figure 25.	CS_DIS low level voltage	
Figure 26.	Application schematic	
Figure 27.	Maximum turn-off current versus load inductance	23
Figure 28.	PowerSSO-24 TM PC board	
Figure 29.	Rthj-amb vs PCB copper area in open box free air condition	
Figure 30.	PowerSSO-24 TM thermal impedance junction ambient single pulse	25
Figure 31.	Thermal fitting model of a double channel HSD in PowerSSO-24 TM	25
Figure 32.	PowerSSO-24 TM package dimensions	27
Figure 33.	PowerSSO-24 TM tube shipment (no suffix)	29
Figure 34.	PowerSSO-24 TM tape and reel shipment (suffix "TR")	29

1 Block diagram and pin description

Figure 1. Block diagram

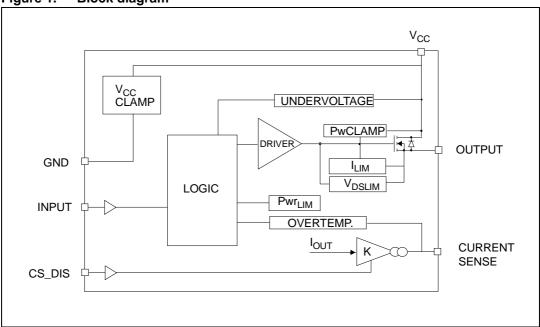


Table 2. Pin function

Name	Function
V _{CC}	Battery connection.
OUTPUT	Power output.
GND	Ground connection. Must be reverse battery protected by an external diode/resistor network.
INPUT	Voltage controlled input pin with hysteresis, CMOS compatible. Controls output switch state.
CURRENT SENSE	Analog current sense pin, delivers a current proportional to the load current.
CS_DIS	Active high CMOS compatible pin, to disable the current sense pin.

V_{CC} □ 24 □ NC 2 23 GND □ □ NC NC □ 3 22 \neg NC NC □ 21 4 □ OUTPUT INPUT □ 5 20 □ OUTPUT 19 6 NC □ □ OUTPUT CURRENT SENSE □ 7 18 □ OUTPUT 8 17 □ OUTPUT NC □ CS_DIS □ 16 9 □ OUTPUT NC □ 10 15 □ NC NC □ 11 14 \neg NC V_{CC} □ 12 13 □ NC TAB = Vcc

Figure 2. Connection diagram (top view)

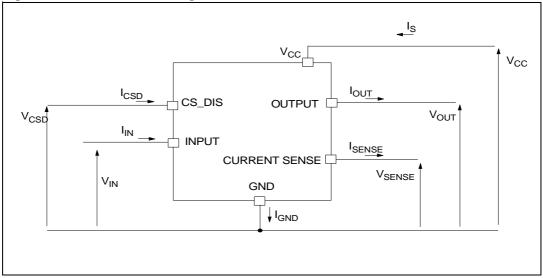
Table 3. Suggested connections for unused and not connected pins

Connection/pin	Current sense	N.C.	Output	Input	CS_DIS	
Floating	N.R. ⁽¹⁾	Х	Х	Х	Х	
To ground	Through 1 kΩ resistor	Х	N.R.	Through 10 kΩ resistor	Through 10 kΩ resistor	

^{1.} Not recommended.

2 Electrical specifications

Figure 3. Current and voltage conventions



Note: $V_{Fn} = V_{OUT} - V_{CC}$ during reverse battery condition.

2.1 Absolute maximum ratings

Stressing the device above the ratings listed in the "Absolute maximum ratings" tables may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the Operating sections of this specification is not implied. Exposure to the conditions in this section for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V _{CC}	DC supply voltage	41	V
-V _{CC}	Reverse DC supply voltage	0.3	٧
- I _{GND}	DC reverse ground pin current	200	mA
I _{OUT}	DC output current	Internally limited	Α
- I _{OUT}	Reverse DC output current	30	Α
I _{IN}	DC input current	-1 to 10	mA
I _{CSD}	DC current sense disable input current	-1 to 10	mA
-I _{CSENSE}	DC reverse CS pin current	200	mA

Table 4. Absolute maximum ratings (continued)

Symbol	Parameter	Value	Unit
V _{CSENSE}	Current sense maximum voltage	V _{CC} -41 +V _{CC}	V V
E _{MAX}	Maximum switching energy (single pulse) (L=1.25mH; R_L =0 Ω ; V_{bat} =13.5V; T_{jstart} =150°C; I_{OUT} = I_{limL} (typ.))	609	mJ
V _{ESD}	Electrostatic discharge (Human Body Model: R=1.5KΩ; C=100pF) – Input – Current Sense – CS_DIS – Output – V _{CC}	4000 2000 4000 5000 5000	٧
V _{ESD}	Charge device model (CDM-AEC-Q100-011)	750	V
T _j	Junction operating temperature	-40 to 150	°C
T _{stg}	Storage temperature	-55 to 150	°C

Table 5. Thermal data

Symbol	Parameter	Max value	Unit
R _{thj-case}	Thermal resistance junction case (max)	0.3	°C/W
R _{thj-amb}	Thermal resistance junction ambient (max)	See Figure 29	°C/W

2.2 Electrical characteristics

Values specified in this section are for 8 V< $V_{CC}\!<\!36$ V; -40 °C< $T_{j}\!<\!150$ °C, unless otherwise stated (for each channel).

Table 6. Power section

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{CC}	Operating supply voltage		4.5	13	36	V
V _{USD}	Undervoltage shutdown			3.5	4.5	V
V _{USDhyst}	Undervoltage shutdown hysteresis			0.5		٧
R _{ON}	On-state resistance	I _{OUT} = 6A; T _j = 25°C I _{OUT} = 6A; T _j = 150°C I _{OUT} =6A; V _{CC} =5V;T _j =25°C			10 20 13	$m\Omega$ $m\Omega$ $m\Omega$
V _{clamp}	Clamp voltage	I _{CC} = 20 mA	41	46	52	V
I _S	Supply current	Off-state; V_{CC} = 13V; T_j = 25°C; V_{IN} = V_{OUT} = V_{SENSE} = V_{CSD} =0V On-state; V_{CC} =13V; V_{IN} =5V; I_{OUT} =0A		2 ⁽¹⁾ 1.5	5 ⁽¹⁾	μA mA

Table 6. Power section (continued)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{L(off)}	Off-state output current	$V_{IN} = V_{OUT} = 0V; V_{CC} = 13V; T_j = 25^{\circ}C$ $V_{IN} = V_{OUT} = 0V; V_{CC} = 13V; T_j = 125^{\circ}C$	0 0	0.01	3 5	μA
V _F	Output - V _{CC} diode voltage	-I _{OUT} = 10A; T _j = 150°C			0.7	V

^{1.} PowerMOS leakage included.

Table 7. Switching (V_{CC}=13V)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time	R_L = 2.6 Ω (see <i>Figure 8</i>)	-	35	-	μs
t _{d(off)}	Turn-off delay time	R _L = 2.6Ω (see <i>Figure 8</i>)	-	65	-	μs
(dV _{OUT} /dt) _{on}	Turn-on voltage slope	$R_L = 2.6\Omega$	-	See Figure 20	-	V/µs
(dV _{OUT} /dt) _{off}	Turn-off voltage slope	$R_L = 2.6\Omega$	-	See Figure 22	-	V/µs
W _{ON}	Switching energy losses during t _{won}	R _L = 2.6Ω (see <i>Figure 8</i>)	-	1.5	-	mJ
W _{OFF}	Switching energy losses during t _{woff}	R _L = 2.6Ω (see <i>Figure 8</i>)	-	0.8	-	mJ

Table 8. Logic input

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{IL}	Input low level voltage				0.9	V
I _{IL}	Low level input current	V _{IN} = 0.9V	1			μΑ
V _{IH}	Input high level voltage		2.1			V
I _{IH}	High level input current	V _{IN} = 2.1V			10	μΑ
V _{I(hyst)}	Input hysteresis voltage		0.25			V
V _{ICL}	Input clamp voltage	I _{IN} = 1mA I _{IN} = -1mA	5.5	-0.7	7	V V
V _{CSDL}	CS_DIS low level voltage				0.9	V
I _{CSDL}	Low level CS_DIS current	V _{CSD} = 0.9V	1			μA
V _{CSDH}	CS_DIS high level voltage		2.1			V
I _{CSDH}	High level CS_DIS current	V _{CSD} = 2.1V			10	μA
V _{CSD(hyst)}	CS_DIS hysteresis voltage		0.25			V
V _{CSCL}	CS_DIS clamp voltage	I _{CSD} = 1mA I _{CSD} = -1mA	5.5	-0.7	7	V V

47/

Table 9. Protections and diagnostics⁽¹⁾

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{limH}	Short circuit current	V _{CC} = 13V 5V <v<sub>CC<36V</v<sub>	46	65	91 91	A A
I _{limL}	Short circuit current during thermal cycling	V_{CC} = 13V; $T_R < T_j < T_{TSD}$		24		Α
T _{TSD}	Shutdown temperature		150	175	200	°C
T_{R}	Reset temperature		T _{RS} +1	T _{RS} +5		°C
T _{RS}	Thermal reset of STATUS		135			°C
T _{HYST}	Thermal hysteresis (T _{TSD} -T _R)			7		°C
V_{DEMAG}	Turn-off output voltage clamp	I _{OUT} =2A; V _{IN} =0; L=6mH	V _{CC} -41	V _{CC} -46	V _{CC} -52	V
V _{ON}	Output voltage drop limitation	I_{OUT} =0.5A (see <i>Figure 9</i>); T_{j} = -40°C+150°C		25		mV

To ensure long term reliability under heavy overload or short circuit conditions, protection and related diagnostic signals must be used together with a proper software strategy. If the device is subjected to abnormal conditions, this software must limit the duration and number of activation cycles.

Table 10. Current sense (8V<V_{CC}<16V)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
К ₀	I _{OUT} /I _{SENSE}	I _{OUT} = 0.25A; V _{SENSE} =0.5V;V _{CSD} =0V; T _j = -40°C150°C	2770	5490	8220	
K ₁	I _{OUT} /I _{SENSE}	I _{OUT} = 6A; V _{SENSE} =0.5V; V _{CSD} =0V; T _j = -40°C150°C I _{OUT} = 6A; V _{SENSE} =0.5V; V _{CSD} =0V; T _j = 25°C150°C	3610 3930	4580 4580	5630 5230	
dK ₁ /K ₁ ⁽¹⁾	Current sense ratio drift	I _{OUT} = 6A; V _{SENSE} = 0.5V; V _{CSD} = 0V; T _J = -40 °C to 150 °C	-8		+8	%
К ₂	I _{OUT} /I _{SENSE}	I _{OUT} = 10A; V _{SENSE} =4V; V _{CSD} =0V; T _j =-40°C150°C I _{OUT} = 10A; V _{SENSE} =4V; V _{CSD} =0V; T _j =25°C150°C		4570 4570	5220 4960	
$dK_2/K_2^{(1)}$	Current sense ratio drift	I _{OUT} = 10A; V _{SENSE} = 4V; V _{CSD} =0V; T _J = -40 °C to 150 °C	-5		+5	%
К ₃	I _{OUT} /I _{SENSE}	I _{OUT} = 25A; V _{SENSE} =4V; V _{CSD} =0V; T _j = -40°C150°C I _{OUT} = 25A; V _{SENSE} =4V; V _{CSD} =0V; T _j = 25°C150°C		4660 4660		

10/31 Doc ID 13218 Rev 7

Table 10. Current sense (8V<V_{CC}<16V) (continued)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
$dK_3/K_3^{(1)}$	Current sense ratio drift	I _{OUT} = 25A; V _{SENSE} = 4V; V _{CSD} =0V; T _J = -40 °C to 150 °C	-3		+3	%
I _{SENSE0}	Analog sense leakage current	I _{OUT} = 0A; V _{SENSE} =0V; V _{CSD} = 5V; V _{IN} =0V; T _j = -40°C150°C V _{CSD} = 0V; V _{IN} =5V; T _j = -40°C150°C	0		1 2	μA μA
		I _{OUT} = 2A; V _{SENSE} =0V; V _{CSD} =5V; V _{IN} =5V; T _j = -40°C150°C	0		1	μA
I _{OL}	Openload on-state current detection threshold	V _{IN} = 5V, I _{SENSE} = 5 μA	10		45	mA
V _{SENSE}	Max analog sense output voltage	I _{OUT} =15A; V _{CSD} =0V;	5			V
V _{SENSEH}	Analog sense output voltage in over temperature condition	V_{CC} = 13V; R_{SENSE} = 3.9K Ω		9		V
I _{SENSEH}	Analog sense output current in over temperature condition	V _{CC} = 13V; V _{SENSE} = 5V		8		mA
t _{DSENSE1H}	Delay response time from falling edge of CS_DIS pin	V _{SENSE} <4V, 1.5A <lout<25a I_{SENSE} = 90% of I_{SENSE max} (see <i>Figure 4</i>)</lout<25a 		50	100	μs
t _{DSENSE1L}	Delay response time from rising edge of CS_DIS pin	V _{SENSE} <4V, 1.5A <lout<25a I_{SENSE} = 10% of I_{SENSE max} (see <i>Figure 4</i>)</lout<25a 		5	20	μs
t _{DSENSE2H}	Delay response time from rising edge of INPUT pin	V _{SENSE} <4V, 1.5A <lout<25a I_{SENSE}=90% of I_{SENSE max} (see <i>Figure 4</i>)</lout<25a 		270	500	μs
$\Delta t_{\sf DSENSE2H}$	Delay response time between rising edge of output current and rising edge of current sense	V _{SENSE} < 4V, I _{SENSE} = 90% of I _{SENSEMAX} , I _{OUT} = 90% of I _{OUTMAX} I _{OUTMAX} =15A (see <i>Figure 5</i>)			310	□□µ s
t _{DSENSE2L}	Delay response time from falling edge of INPUT pin	V _{SENSE} <4V, 1.5A <lout<25a I_{SENSE}=10% of I_{SENSE max} (see <i>Figure 4</i>)</lout<25a 		100	250	μs

^{1.} Parameter guaranteed by design; it is not tested.

Figure 4. Current sense delay characteristics

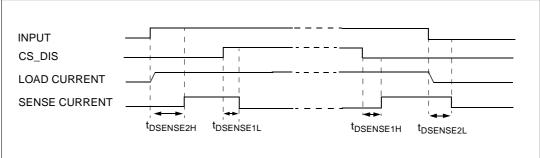
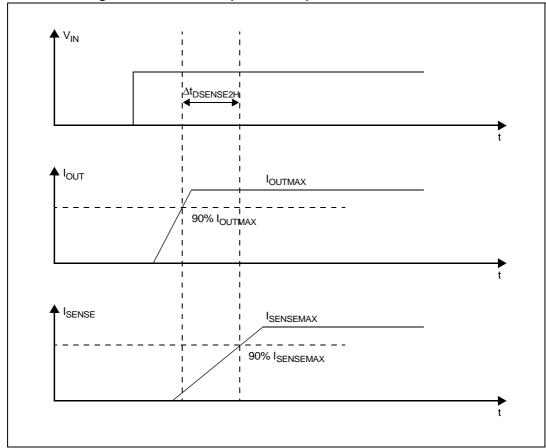


Figure 5. Delay response time between rising edge of output current and rising edge of Current Sense (CS enabled)



12/31 Doc ID 13218 Rev 7

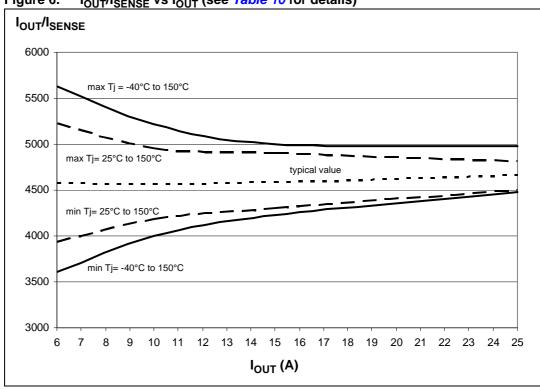
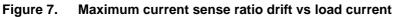
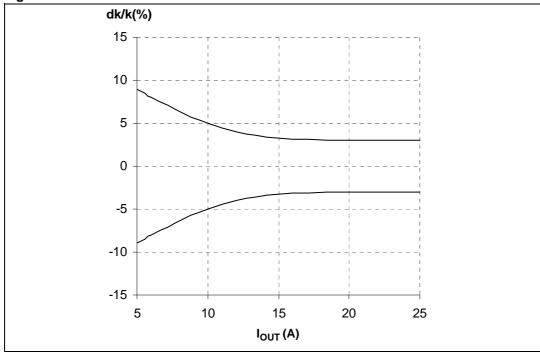


Figure 6. I_{OUT}/I_{SENSE} vs I_{OUT} (see *Table 10* for details)





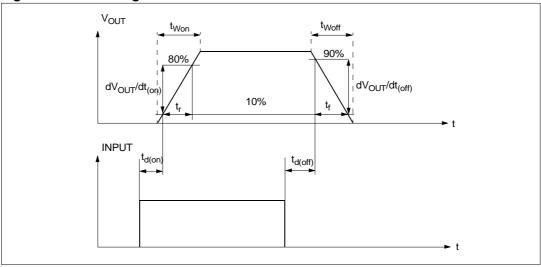
Note: Parameter guaranteed by design; it is not tested.

Table 11. Truth table

Conditions	Input	Output	Sense (V _{CSD} =0V) ⁽¹⁾
Normal operation	L	L	0
Normal operation	Н	Н	Nominal
Overtemperature	L	L	0
Overtemperature	Н	L	V _{SENSEH}
Lindonyoltaga	L	L	0
Undervoltage	Н	L	0
Short circuit to GND	L	L	0
$(R_{sc} \le 10 \text{ m}\Omega)$	Н	L	0 if $T_j < T_{TSD}$
(NSC 2 10 11122)	Н	L	V_{SENSEH} if $T_j > T_{TSD}$
Short circuit to \/	L	Н	0
Short circuit to V _{CC}	Н	Н	< Nominal
Negative output voltage clamp	L	L	0

^{1.} If the V_{CSD} is high, the SENSE output is at a high impedance, its potential depends on leakage currents and external circuit.

Figure 8. Switching characteristics



Vcc-Vout

Tj=150°C Tj=25°C

Tj=-40°C

Von/Ron(T)

Figure 9. Output voltage drop limitation

Table 12. Electrical transient requirements (part 1/3)

ISO 7637-2:	Test le	vels ⁽¹⁾	Number of	Burst cycle/pulse		Delays and
2004(E) Test pulse	III	IV	pulses or test times repetition time			
1	-75V	-100V	5000 pulses	0.5 s	5 s	2 ms, 10 Ω
2a	+37V	+50V	5000 pulses	0.2 s	5 s	50 μs, 2 Ω
3a	-100V	-150V	1h	90 ms	100 ms	0.1 μs, 50 Ω
3b	+75V	+100V	1h	90 ms	100 ms	0.1 μs, 50 Ω
4	-6V	-7V	1 pulse			100 ms, 0.01Ω
5b ⁽²⁾	+65V	+87V	1 pulse			400 ms, 2 Ω

Table 13. Electrical transient requirements (part 2/3)

ISO 7637-2: 2004(E)	Test level results ⁽¹⁾				
Test pulse	III	IV			
1	С	С			
2a	С	С			
3a	С	С			
3b	С	С			
4	С	С			
5b ⁽²⁾	С	С			

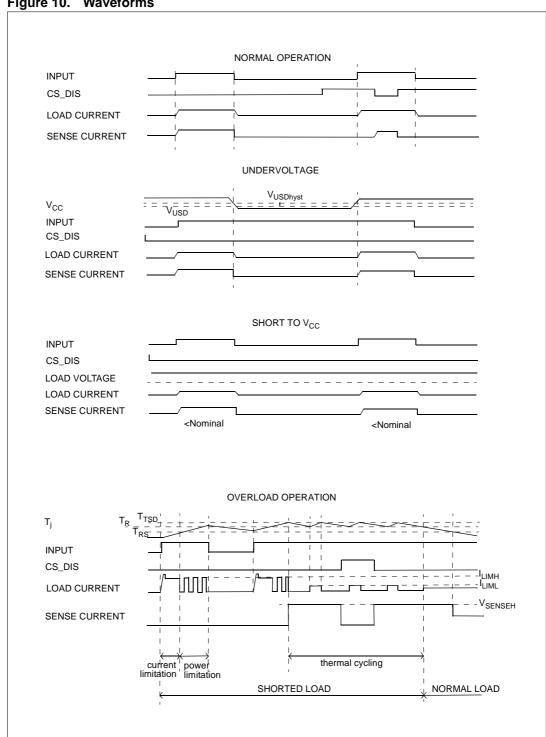
^{1.} The above test levels must be considered referred to Vcc = 13.5V except for pulse 5b.

^{2.} Valid in case of external load dump clamp: 40V maximum referred to ground.

Table 14. Electrical transient requirements (part 3/3)

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

Figure 10. Waveforms



2.3 Electrical characteristics curves

Figure 11. Off-state output current

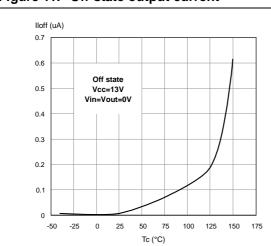


Figure 12. High level input current

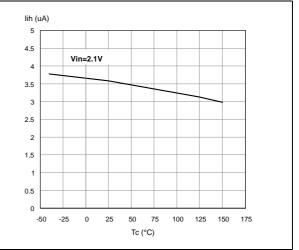


Figure 13. Input clamp voltage

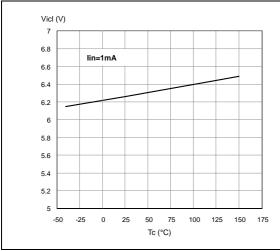


Figure 14. Input low level

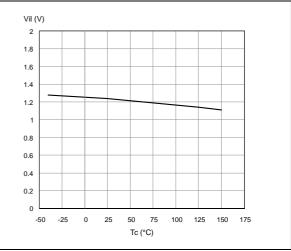


Figure 15. Input high level

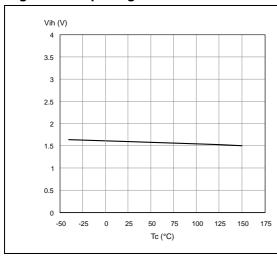
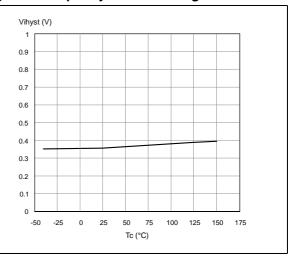


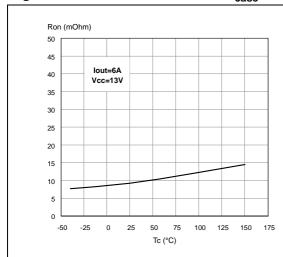
Figure 16. Input hysteresis voltage



18/31 Doc ID 13218 Rev 7

Figure 17. On-state resistance vs T_{case}

Figure 18. On-state resistance vs V_{CC}



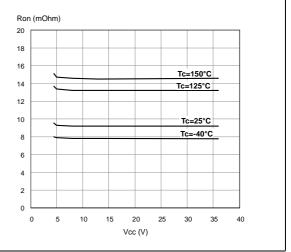
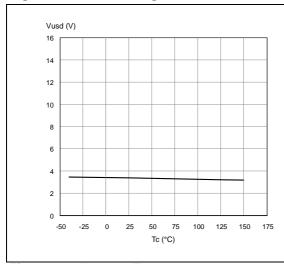


Figure 19. Undervoltage shutdown

Figure 20. Turn-on voltage slope



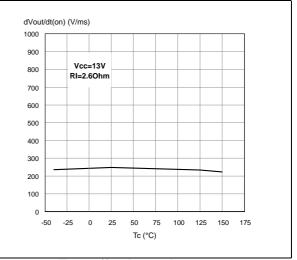
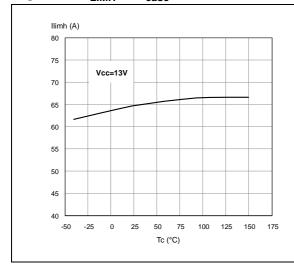


Figure 21. I_{LIMH} vs T_{case}

Figure 22. Turn-off voltage slope



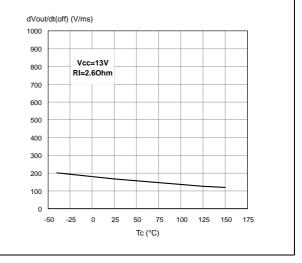
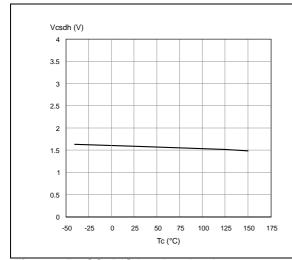


Figure 23. CS_DIS high level voltage

Figure 24. CS_DIS clamp voltage



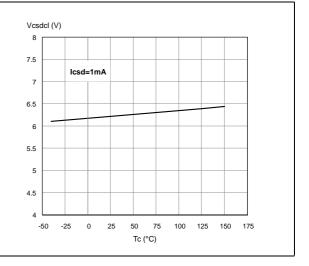
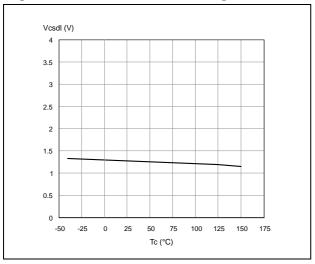


Figure 25. CS_DIS low level voltage



Application information 3

+5V V_{CC} CS_DIS mC IINPUT OUTPUT CURRENT SENSE GND R_{SENSE} D_GND

 V_{GND}

Figure 26. **Application schematic**

3.1 **GND** protection network against reverse battery

3.1.1 Solution 1: resistor in the ground line (R_{GND} only)

This can be used with any type of load.

 $\mathsf{C}_{\mathsf{ext}}$

The following is an indication on how to dimension the R_{GND} resistor.

- $R_{GND} \le 600 \text{ mV} / (I_{S(on)max}).$
- $R_{GND} \ge (-V_{CC}) / (-I_{GND})$

where -I_{GND} is the DC reverse ground pin current and can be found in the absolute maximum rating section of the device datasheet.

Power Dissipation in R_{GND} (when V_{CC}<0: during reverse battery situations) is:

$$P_D = (-V_{CC})^2 / R_{GND}$$

This resistor can be shared amongst several different HSDs. Please note that the value of this resistor should be calculated with formula (1) where $I_{S(on)max}$ becomes the sum of the maximum on-state currents of the different devices.

Please note that if the microprocessor ground is not shared by the device ground then the R_{GND} will produce a shift ($I_{S(on)max} * R_{GND}$) in the input thresholds and the status output values. This shift will vary depending on how many devices are ON in the case of several high side drivers sharing the same R_{GND}.

If the calculated power dissipation leads to a large resistor or several devices have to share the same resistor then ST suggests to utilize Solution 2 (see below).

3.1.2 Solution 2: diode (D_{GND}) in the ground line

A resistor (R_{GND}=1 k Ω) should be inserted in parallel to D_{GND} if the device drives an inductive load.

This small signal diode can be safely shared amongst several different HSDs. Also in this case, the presence of the ground network will produce a shift (≈600 mV) in the input threshold and in the status output values if the microprocessor ground is not common to the device ground. This shift will not vary if more than one HSD shares the same diode/resistor network.

3.2 Load dump protection

 D_{ld} is necessary (voltage transient suppressor) if the load dump peak voltage exceeds the V_{CC} max DC rating. The same applies if the device is subject to transients on the V_{CC} line that are greater than the ones shown in the ISO 7637-2: 2004(E) table.

3.3 Microcontroller I/Os protection

If a ground protection network is used and negative transient are present on the V_{CC} line, the control pins will be pulled negative. ST suggests to insert a resistor (R_{prot}) in line to prevent the microcontroller I/Os pins to latch-up.

The value of these resistors is a compromise between the leakage current of microcontroller and the current required by the HSD I/Os (Input levels compatibility) with the latch-up limit of microcontroller I/Os.

 $-V_{CCpeak}/I_{latchup} \le R_{prot} \le (V_{OH\mu C}-V_{IH}-V_{GND}) / I_{IHmax}$

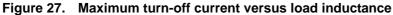
Calculation example:

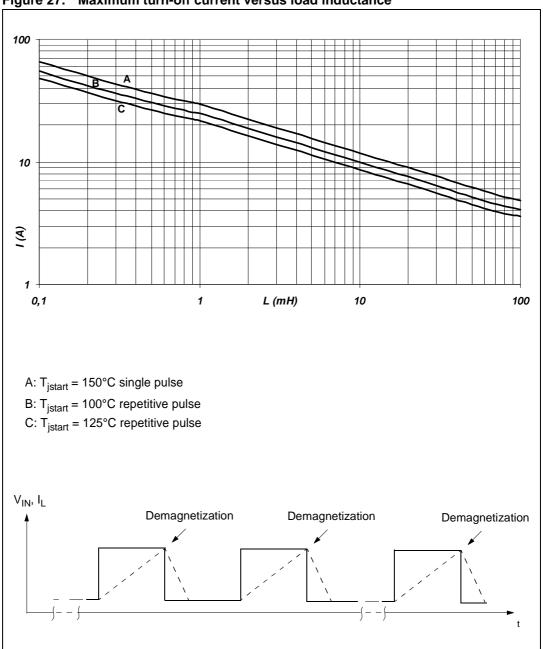
For V_{CCpeak} = - 100 V and $I_{latchup} \ge 20$ mA; $V_{OH\mu C} \ge 4.5$ V

 $5 \text{ k}\Omega \le R_{\text{prot}} \le 180 \text{ k}\Omega$

Recommended values: $R_{prot} = 10 \text{ k}\Omega$, $C_{EXT} = 10 \text{ nF}$.

3.4 Maximum demagnetization energy (V_{cc}=13.5V)





Note:

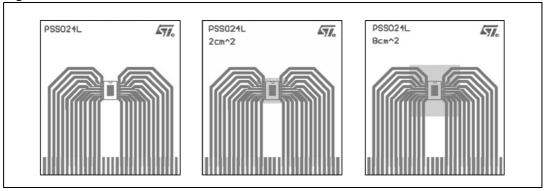
Values are generated with $R_L=0 \Omega$.

In case of repetitive pulses, T_{jstart} (at beginning of each demagnetization) of every pulse must not exceed the temperature specified above for curves B and C.

4 Package and PCB thermal data

4.1 PowerSSO-24[™] thermal data

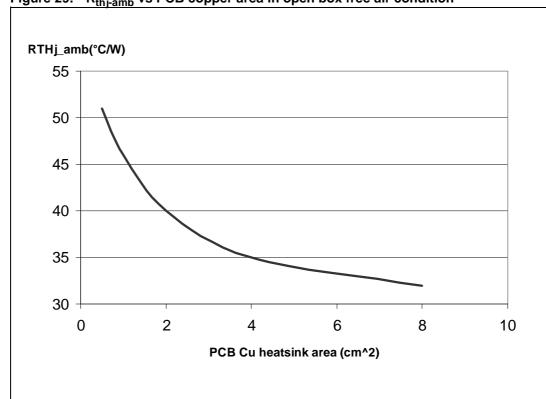
Figure 28. PowerSSO-24[™] PC board



Note:

Layout condition of R_{th} and Z_{th} measurements (PCB: Double layer, Thermal Vias, FR4 area= 77 mm x 86 mm, PCB thickness=1.6mm, Cu thickness=70 μ m (front and back side), Copper areas: from minimum pad lay-out to 8 cm²).

Figure 29. R_{thj-amb} vs PCB copper area in open box free air condition



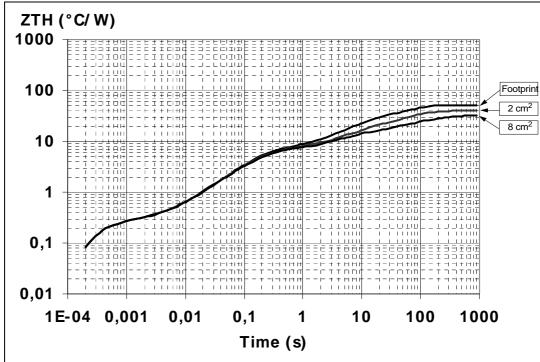
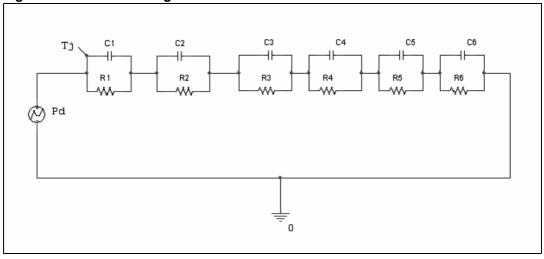


Figure 30. PowerSSO-24™ thermal impedance junction ambient single pulse

Equation 1: pulse calculation formula

$$\begin{split} Z_{TH\delta} &= R_{TH} \cdot \delta + Z_{THtp} (1 - \delta) \\ \text{where } \delta &= t_P / T \end{split}$$

Figure 31. Thermal fitting model of a double channel HSD in PowerSSO-24^{™(a)}



a. The fitting model is a simplified thermal tool and is valid for transient evolutions where the embedded protections (power limitation or thermal cycling during thermal shutdown) are not triggered.

4

Table 15. Thermal parameters

Area/island (cm ²)	Footprint	2	8
R1 (°C/W)	0.08		
R2 (°C/W)	0.16		
R3 (°C/W)	6		
R4 (°C/W)	7.7		
R5 (°C/W)	9	9	8
R6 (°C/W)	28	17	10
C1 (W.s/°C)	0.002		
C2 (W.s/°C)	0.002		
C3 (W.s/°C)	0.025		
C4 (W.s/°C)	0.75		
C5 (W.s/°C)	1	4	9
C6 (W.s/°C)	2.2	5	17

5 Package and packing information

5.1 ECOPACK[®] packages

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.

Figure 32. PowerSSO-24™ package dimensions

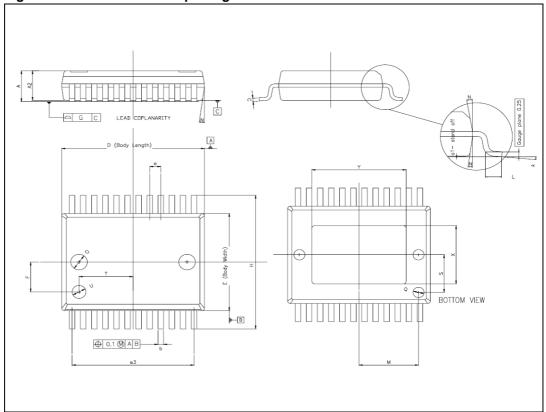


Table 16. PowerSSO-24™ mechanical data

O-mak al		Millimeters	
Symbol	Min.	Тур.	Max.
A			2.45
A2	2.15		2.35
a1	0		0.1
b	0.33		0.51
С	0.23		0.32
D	10.10		10.50
E	7.4		7.6
е		0.8	
e3		8.8	
F		2.3	
G			0.1
Н	10.1		10.5
h			0.4
k	0°		8°
L	0.55		0.85
0		1.2	
Q		0.8	
S		2.9	
Т		3.65	
U		1.0	
N			10deg
X	4.1		4.7
Υ	6.5		7.1

5.2 Packing information

Figure 33. PowerSSO-24™ tube shipment (no suffix)

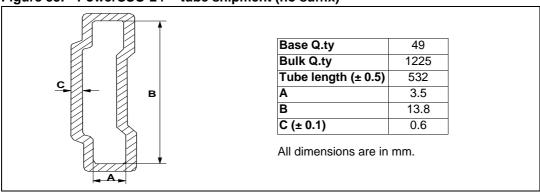
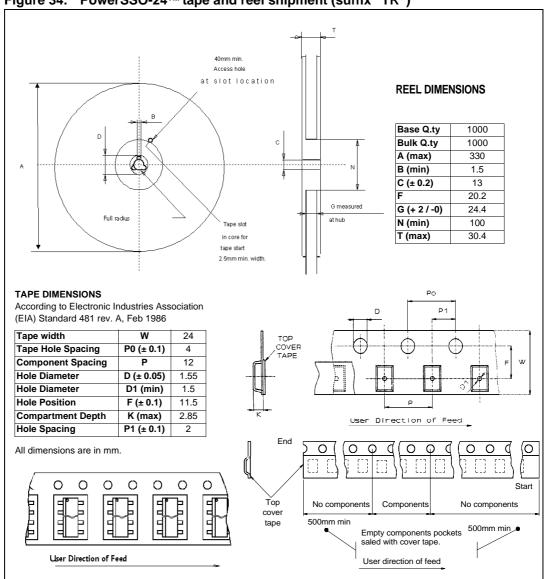


Figure 34. PowerSSO-24[™] tape and reel shipment (suffix "TR")



Revision history VN5010AK-E

6 Revision history

Table 17. Document revision history

Date	Revision	Changes
24-Jan-2006	1	Initial release.
09-Feb-2007	2	Reformatted and restructured. Added Contents, List of tables and List of figures. Added Section 3.4: Maximum demagnetization energy (VCC=13.5V).
13-Dec-2007	3	Document reformatted and restructured. Table 4: Absolute maximum ratings: corrected E _{MAX} value from 506 to 609 mJ. Updated Table 10: Current sense (8V <vcc<16v): -="" changed="" t<sub="">DSENSE2H max value from 600 to 500 µs. - Added dk1/k1, dk2/k2, dk3/k3, \(\Delta\text{DSENSE2H}\), I_{OL} parameters. Added Figure 5: Delay response time between rising edge of output current and rising edge of Current Sense (CS enabled). Updated Figure 6: IOUT/ISENSE vs IOUT (see Table 10 for details). Added Figure 7: Maximum current sense ratio drift vs load current. Table 12: Electrical transient requirements (part 1/3): updated test level values III and IV for test pulse 5b and notes. Figure 31: Thermal fitting model of a double channel HSD in PowerSSO-24TM: added note.</vcc<16v):>
12-Feb-2008	4	Corrected typing error in <i>Table 10: Current sense (8V<vcc<16v)< i="">: changed I_{OL} test condition from $V_{IN} = 0V$ to $V_{IN} = 5V$.</vcc<16v)<></i>
16-Jun-2009	5	Table 16: PowerSSO-24™ mechanical data: - Deleted A (min) value - Changed A (max) value from 2.47 to 2.45 - Changed A2 (max) value from 2.40 to 2.35 - Changed a1 (max) value from 0.075 to 0.1 - Added F and k rows
16-Jul-2009	6	Updated Figure 32: PowerSSO-24™ package dimensions. Table 16: PowerSSO-24™ mechanical data: - Deleted G1 row - Added O, Q, S, T and U rows
23-Sep-2013	7	Updated Disclaimer.

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