



STD70N03L STD70N03L-1

N-channel 30V - 0.0059Ω - 70A - DPAK / IPAK
STripFET™ III Power MOSFET

General features

Type	V _{DSS}	R _{DS(on)}	I _D
STD70N03L	30V	<0.0073Ω	70A
STD70N03L-1	30V	<0.0073Ω	70A

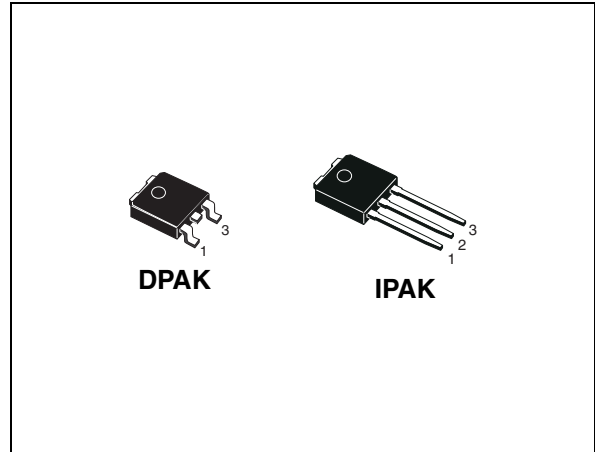
- R_{DS(ON)} * Qg industry's benchmark
- Conduction losses reduced
- Switching losses reduced
- Low threshold device

Description

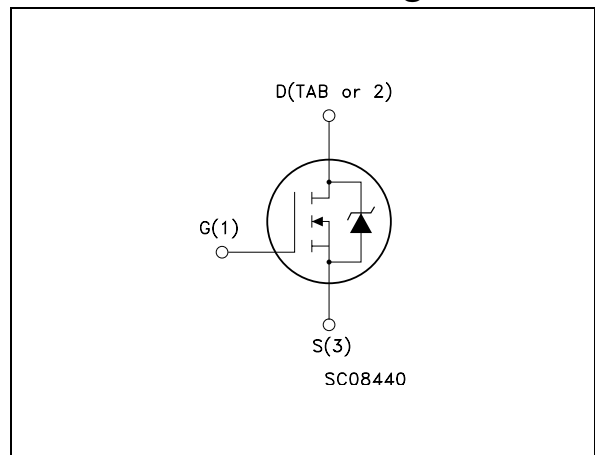
This product utilizes the latest advanced design rules of ST's proprietary STripFET™ technology. This is suitable for the most demanding DC-DC converter application where high efficiency is to be achieved.

Applications

- Switching application



Internal schematic diagram



Order codes

Part number	Marking	Package	Packaging
STD70N03L	D70N03L	DPAK	Tape & reel
STD70N03L-1	D70N03L-1	IPAK	Tube

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1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	30	V
V_{GS}	Gate-source voltage	± 20	V
I_D	Drain current (continuous) at $T_C = 25^\circ\text{C}$	70	A
I_D	Drain current (continuous) at $T_C = 100^\circ\text{C}$	50	A
$I_{DM}^{(1)}$	Drain current (pulsed)	280	A
P_{TOT}	Total dissipation at $T_C = 25^\circ\text{C}$	70	W
	Derating factor	0.47	W/ $^\circ\text{C}$
$E_{AS}^{(2)}$	Single pulse avalanche energy	300	mJ
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 175	$^\circ\text{C}$

1. Pulse width limited by safe operating area

2. Starting $T_j = 25^\circ\text{C}$, $I_D = 30\text{A}$, $V_{DD} = 15\text{V}$

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case Max	2.14	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-amb Max	100	$^\circ\text{C/W}$
T_l	Maximum lead temperature for soldering purpose	275	$^\circ\text{C}$

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	I _D = 250μA, V _{GS} = 0	30			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = 20V, V _{DS} = 20V, T _c = 125°C			1 10	μA μA
I _{GSS}	Gate body leakage current (V _{DS} = 0)	V _{GS} = ±20V			±100	nA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 250μA	1			V
R _{DS(on)}	Static drain-source on resistance	V _{GS} = 10V, I _D = 35A V _{GS} = 5V, I _D = 35A V _{GS} = 10V, I _D = 35A @ T _j = 125°C V _{GS} = 5V, I _D = 35A @ T _j = 125°C		0.0059 0.007 0.0091 0.0108	0.0073 0.013 0.0113 0.0201	Ω Ω Ω Ω

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g _{fs} ⁽¹⁾	Forward transconductance	V _{DS} = 10V, I _D = 15A		40		S
C _{iss} C _{oss} C _{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V _{DS} = 25V, f = 1MHz, V _{GS} = 0		2200 380 49		pF pF pF
Q _g Q _{gs} Q _{gd}	Total gate charge Gate-source charge Gate-drain charge	V _{DD} = 15V, I _D = 70A V _{GS} = 5V (see Figure 7)		15.7 8.3 3.4	21	nC nC nC
Q _{gls} ⁽²⁾	Third-quadrant gate charge	V _{DS} < 0V, V _{GS} = 10V		15		nC
R _G	Gate input resistance	f = 1MHz Gate DC Bias = 0 Test signal level = 20mV open drain		1.5		Ω

1. Pulsed: pulse duration = 300μs, duty cycle 1.5%

2. Gate charge for synchronous operation: see [Appendix A: Power losses estimation](#)

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=15V$, $I_D=35A$, $R_G=4.7\Omega$, $V_{GS}=5V$ (see Figure 13)		21		ns
t_r	Rise time			95		ns
$t_{d(off)}$	Turn-off delay time			19		ns
t_f	Fall time			15		ns

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current				70	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				280	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=35A$, $V_{GS}=0$			1.3	V
t_{rr}	Reverse recovery time	$I_{SD} = 70A$, $di/dt=100A/\mu s$, $V_{DD}=20V$, $T_j=150^\circ C$ (see Figure 18)		32		ns
Q_{rr}	Reverse recovery charge			51		nC
I_{RRM}	Reverse recovery current			3.2		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

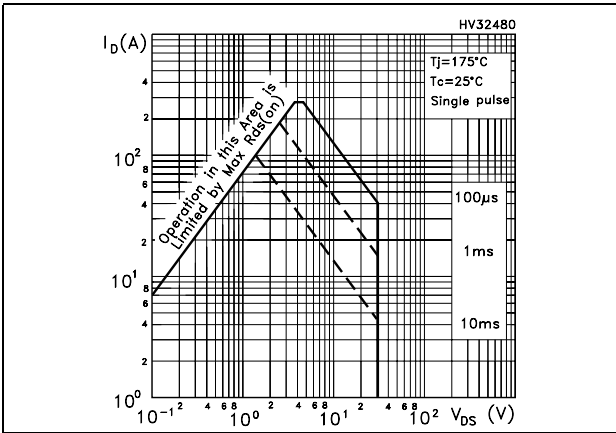


Figure 2. Thermal impedance

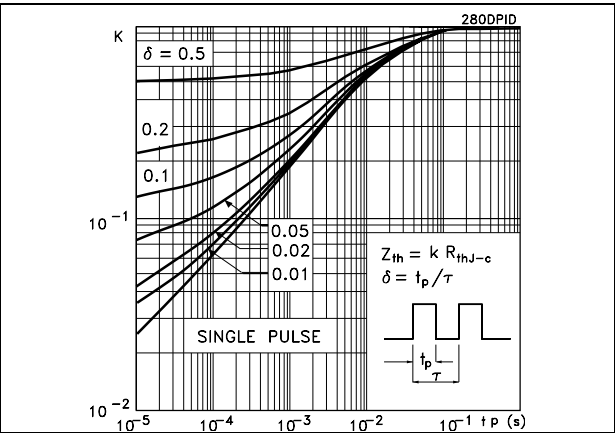


Figure 3. Output characteristics

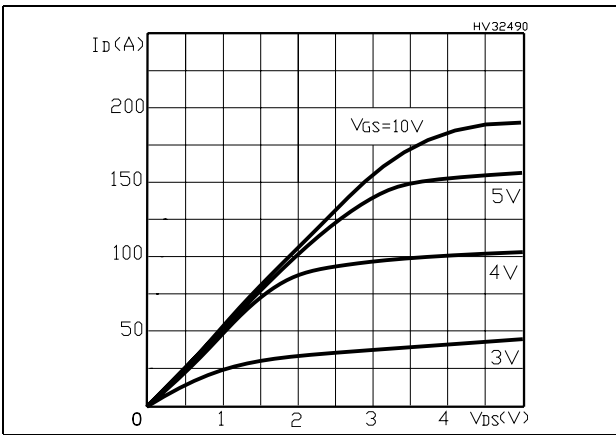


Figure 4. Transfer characteristics

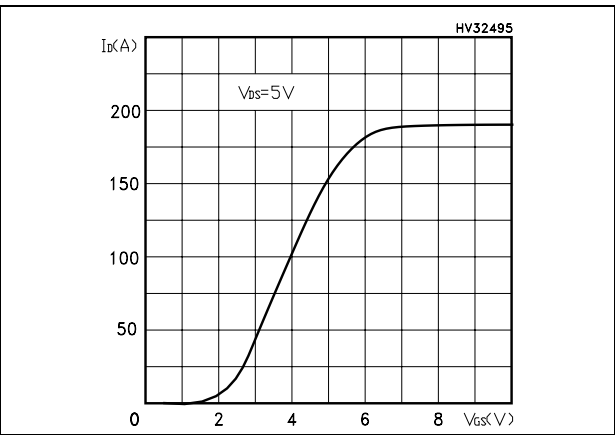


Figure 5. Transconductance

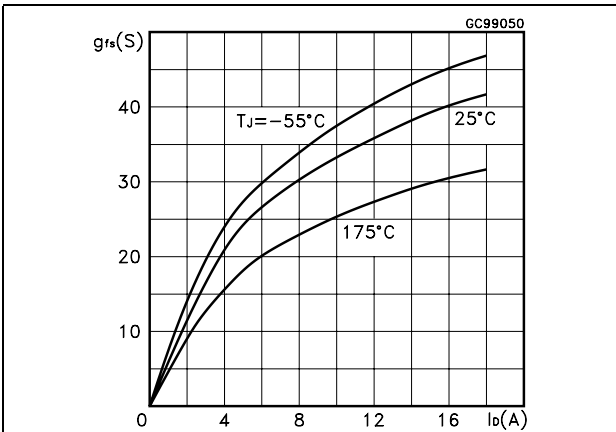


Figure 6. Static drain-source on resistance

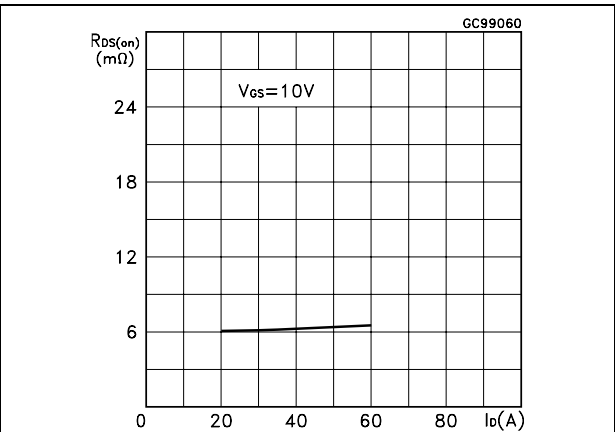


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

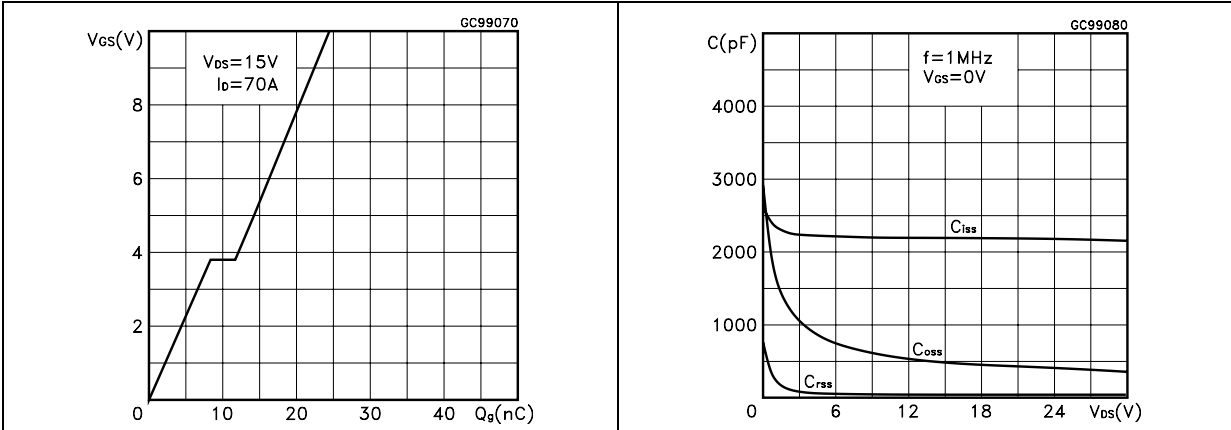


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature

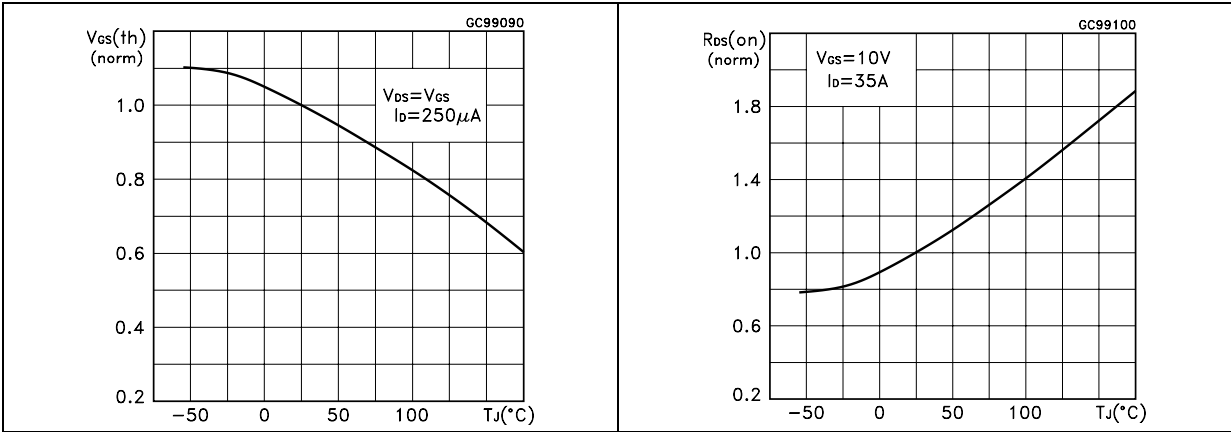
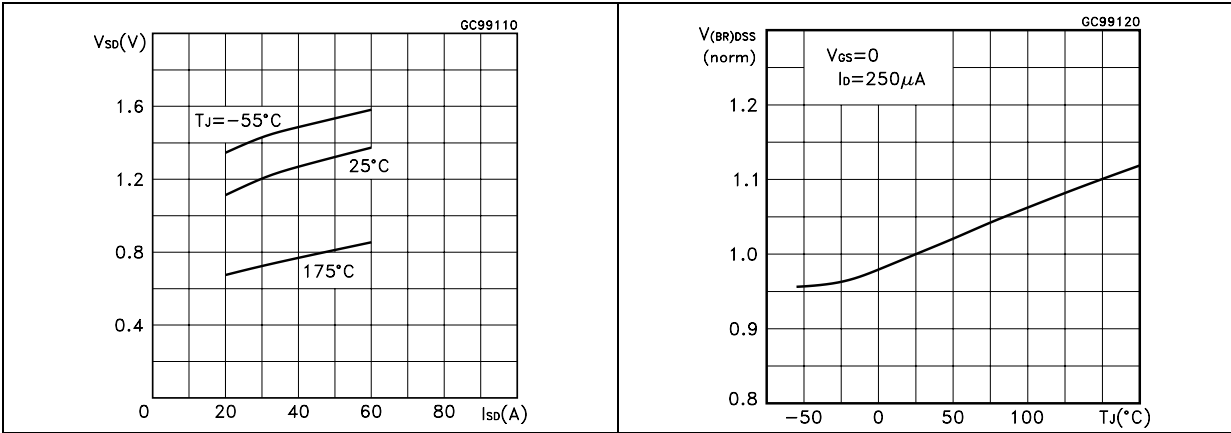


Figure 11. Source-drain diode forward characteristics Figure 12. Normalized $B_{V_{DS}}$ vs temperature



3 Test circuit

Figure 13. Switching times test circuit for resistive load

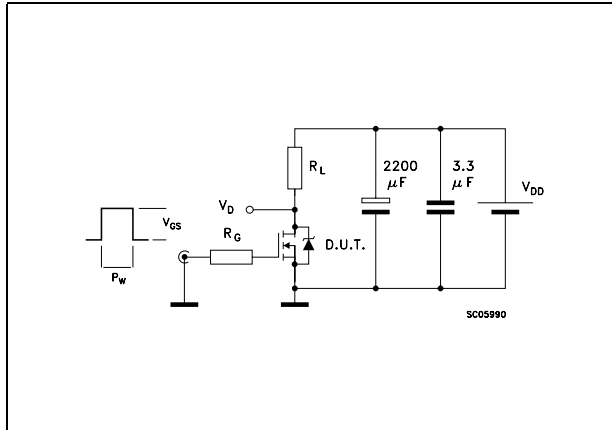


Figure 14. Gate charge test circuit

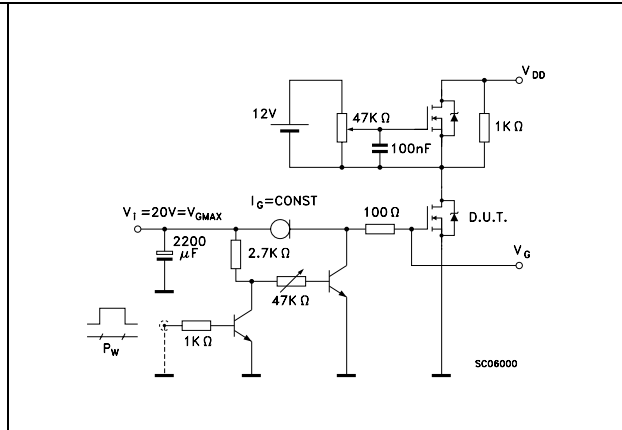


Figure 15. Test circuit for inductive load switching and diode recovery times

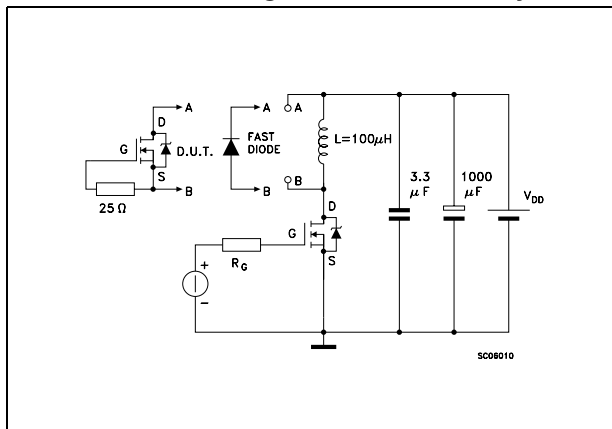


Figure 16. Unclamped inductive load test circuit

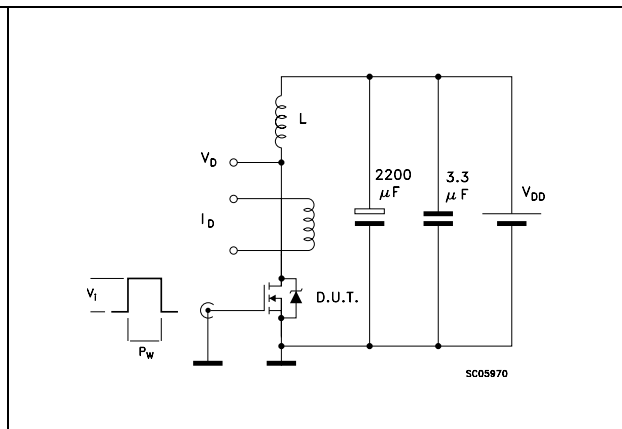


Figure 17. Unclamped inductive waveform

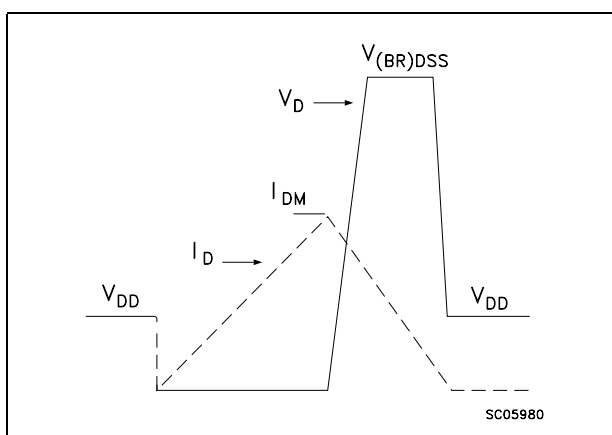
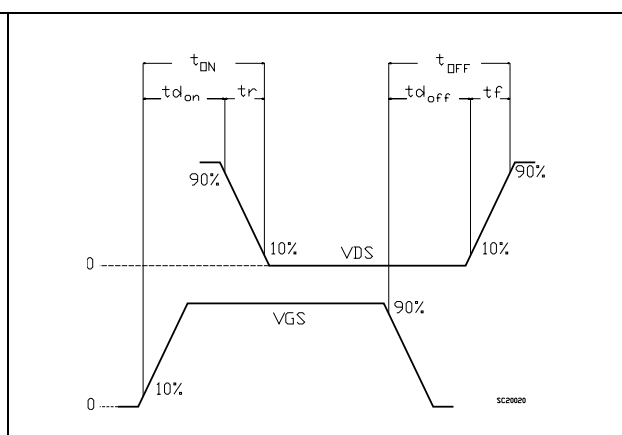
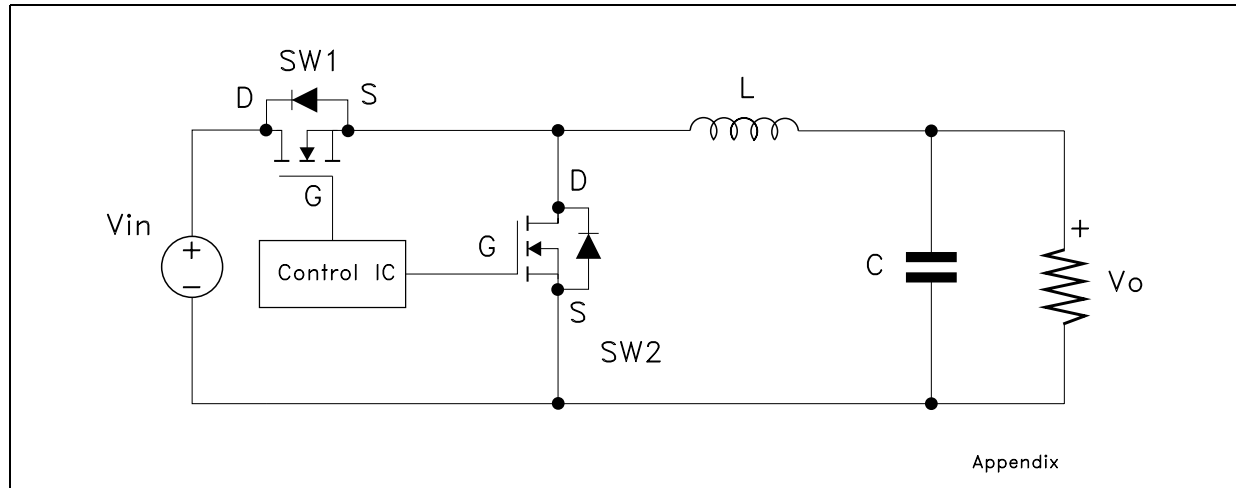


Figure 18. Switching time waveform



Appendix A Power losses estimation

Figure 19. Buck converter



The power losses associated with the FETs in a synchronous buck converter can be estimated using the equations shown in the table below. The formulas give a good approximation, for the sake of performance comparison, of how different pairs of devices affect the converter efficiency. However a very important parameter, the working temperature, is not considered. The real device behavior is really dependent on how the heat generated inside the devices is removed to allow for a safer working junction temperature.

The low side (SW2) device requires:

- Very low $R_{DS(on)}$ to reduce conduction losses
- Small Q_{gls} to reduce the gate charge losses
- Small C_{oss} to reduce losses due to output capacitance
- Small Q_{rr} to reduce losses on SW₁ during its turn-on
- The C_{gd}/C_{gs} ratio lower than V_{th}/V_{gg} ratio especially with low drain to source voltage to avoid the cross conduction phenomenon.

The high side (SW1) device requires:

- Small R_g and L_g to allow higher gate current peak and to limit the voltage feedback on the gate
- Small Q_g to have a faster commutation and to reduce gate charge losses
- Low $R_{DS(on)}$ to reduce the conduction losses

		High side switch (SW1)	Low side switch (SW2)
$P_{\text{conduction}}$		$R_{\text{DS(on)}} \cdot I_L^2 \cdot \delta$	$R_{\text{DS(on)}} \cdot I_L^2 \cdot (1 - \delta)$
$P_{\text{switching}}$		$V_{\text{in}} \cdot (Q_{\text{gsth(SW1)}} + Q_{\text{gd(SW1)}}) \cdot f \cdot \frac{I_L}{I_g}$	Zero voltage switching
P_{diode}	Recovery	Not applicable	$V_{\text{in}} \cdot Q_{\text{rr(SW2)}} \cdot f$
	Conduction	Not applicable	$V_{\text{f(SW2)}} \cdot I_L \cdot t_{\text{deadtime}} \cdot f$
$P_{\text{gate(Qg)}}$		$Q_{\text{g(SW1)}} \cdot V_{\text{gg}} \cdot f$	$Q_{\text{gls(SW2)}} \cdot V_{\text{gg}} \cdot f$
P_{Qoss}		$\frac{V_{\text{in}} \cdot Q_{\text{oss(SW1)}} \cdot f}{2}$	$\frac{V_{\text{in}} \cdot Q_{\text{oss(SW2)}} \cdot f}{2}$

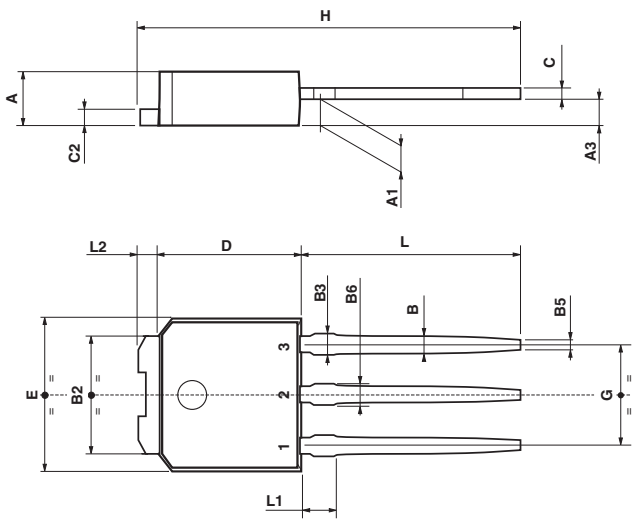
Parameter	Meaning
d	Duty-cycle
Q_{gsth}	Post threshold gate charge
Q_{gls}	Third quadrant gate charge
$P_{\text{conduction}}$	On state losses
$P_{\text{switching}}$	On-off transition losses
P_{diode}	Conduction and reverse recovery diode losses
P_{gate}	Gate driver losses
P_{Qoss}	Output capacitance losses

4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . 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

TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



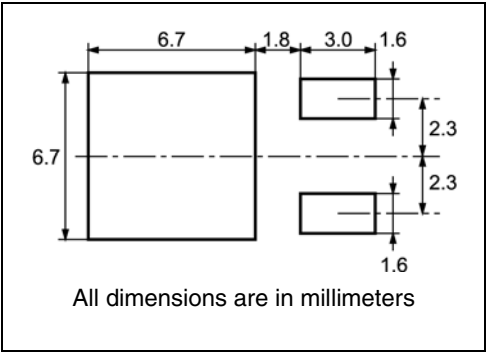
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DPAK MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°

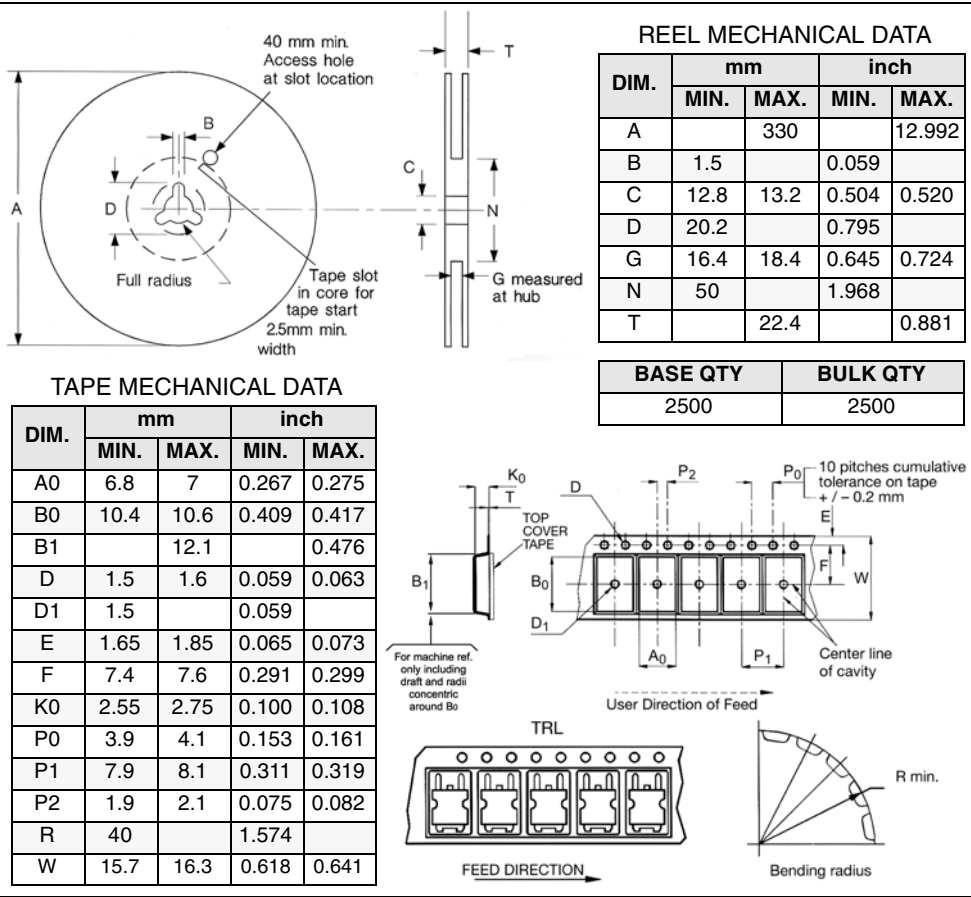
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5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT



6 Revision history

Table 7. Revision history

Date	Revision	Changes
29-Jun-2006	1	First Release

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