



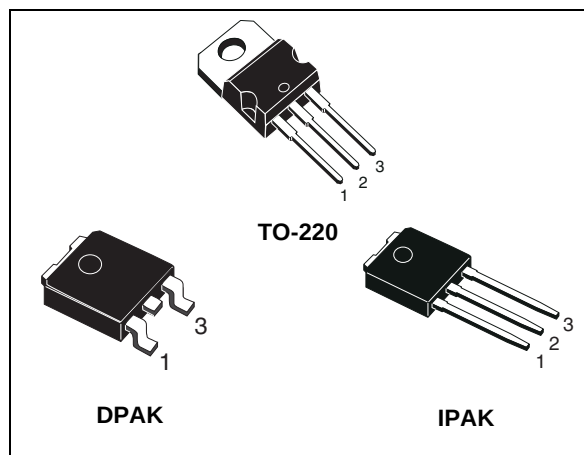
STD60N3LH5 STP60N3LH5, STU60N3LH5

N-channel 30 V, 0.0072 Ω , 48 A DPAK, IPAK, TO-220
STripFET™ V Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D
STD60N3LH5	30 V	0.008 Ω	48 A
STP60N3LH5	30 V	0.0084 Ω	48 A
STU60N3LH5	30 V	0.0084 Ω	48 A

- R_{DS(on)} * Q_g industry benchmark
- Extremely low on-resistance R_{DS(on)}
- Very low switching gate charge
- High avalanche ruggedness
- Low gate drive power losses



Application

- Switching applications

Description

This STripFET™V Power MOSFET technology is among the latest improvements, which have been especially tailored to achieve very low on-state resistance providing also one of the best-in-class FOM.

Figure 1. Internal schematic diagram

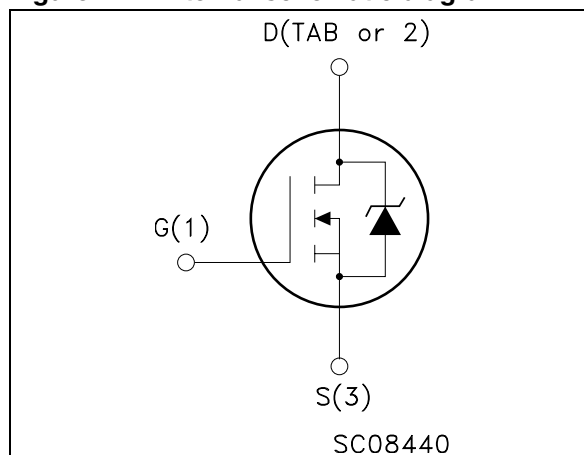


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD60N3LH5	60N3LH5	DPAK	Tape and reel
STP60N3LH5	60N3LH5	TO-220	Tube
STU60N3LH5	60N3LH5	IPAK	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS}=0$)	30	V
V_{DS}	Drain-source voltage ($V_{GS} = 0$) @ T_{JMAX}	35	V
V_{GS}	Gate-Source voltage	± 22	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	48	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	42.8	A
$I_{DM}^{(2)}$	Drain current (pulsed)	192	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	60	W
	Derating factor	0.4	W/ $^{\circ}\text{C}$
$E_{AS}^{(3)}$	Single pulse avalanche energy	160	mJ
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 175	$^{\circ}\text{C}$

1. Limited by wire bonding
2. Pulse width limited by safe operating area
3. Starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_d = 24\text{ A}$, $V_{dd} = 12\text{ V}$

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.5	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-case max	100	$^{\circ}\text{C/W}$
T_j	Maximum lead temperature for soldering purpose	275	$^{\circ}\text{C}$

2 Electrical characteristics

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	30			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 30\text{ V}$ $V_{DS} = 30\text{ V}$, $T_c = 125\text{ }^{\circ}\text{C}$			1 10	μA μA
I_{GSS}	Gate body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 22\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	1	1.8	3	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 24\text{ A}$ SMD version		0.0072	0.008	Ω
		$V_{GS} = 10\text{ V}$, $I_D = 24\text{ A}$		0.0076	0.0084	Ω
		$V_{GS} = 5\text{ V}$, $I_D = 24\text{ A}$ SMD version		0.0088	0.011	Ω
		$V_{GS} = 5\text{ V}$, $I_D = 24\text{ A}$		0.0092	0.0114	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	1350	-	pF
C_{oss}	Output capacitance			265		pF
C_{rss}	Reverse transfer capacitance			32		pF
Q_g	Total gate charge	$V_{DD} = 15\text{ V}$, $I_D = 48\text{ A}$	-	8.8	-	nC
Q_{gs}	Gate-source charge	$V_{GS} = 5\text{ V}$		4.7		nC
Q_{gd}	Gate-drain charge	(Figure 14)		2.2		nC
Q_{gs1}	Pre V_{th} gate-to-source charge	$V_{DD} = 15\text{ V}$, $I_D = 48\text{ A}$	-	2.2	-	nC
Q_{gs2}	Post V_{th} gate-to-source charge	$V_{GS} = 5\text{ V}$ (Figure 19)		2.5		nC
R_G	Gate input resistance	$f = 1\text{ MHz}$ gate bias Bias = 0 test signal level = 20 mV open drain	-	1.1	-	Ω

Table 6. Switching on/off (resistive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on delay time Rise time	$V_{DD}=10\text{ V}$, $I_D=24\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ (Figure 13 and Figure 18)	-	6 33	-	ns ns
$t_{d(off)}$ t_f	Turn-off delay time Fall time	$V_{DD}=10\text{ V}$, $I_D=24\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ (Figure 13 and Figure 18)	-	19 4.2	-	ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}	Source-drain current Source-drain current (pulsed) ⁽¹⁾		-		48 192	A A
V_{SD}	Forward on voltage	$I_{SD}=24\text{ A}$, $V_{GS}=0$	-		1.1	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD}=48\text{ A}$, $di/dt=100\text{ A}/\mu\text{s}$, $V_{DD}=20\text{ V}$, (Figure 15)	-	25 18.5 1.5		ns nC A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

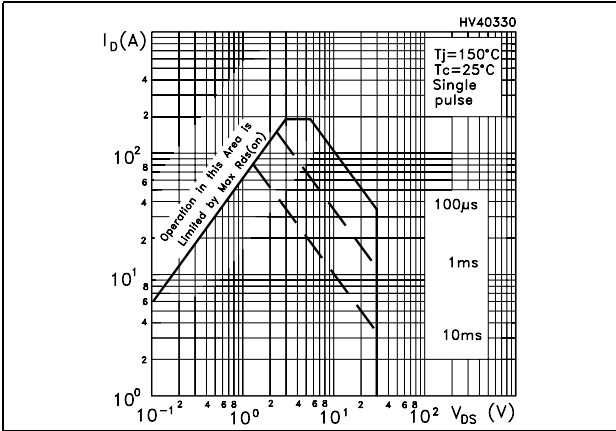


Figure 3. Thermal impedance

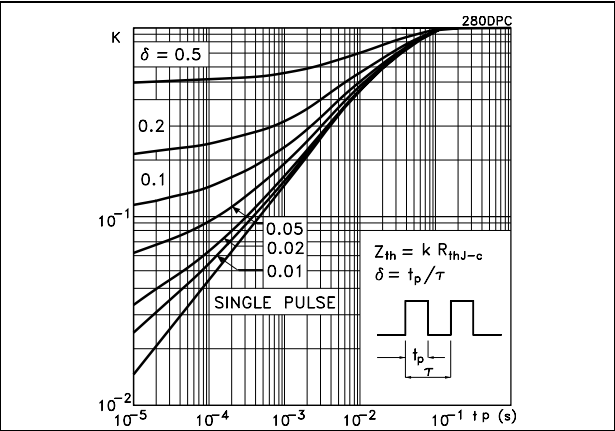


Figure 4. Output characteristics

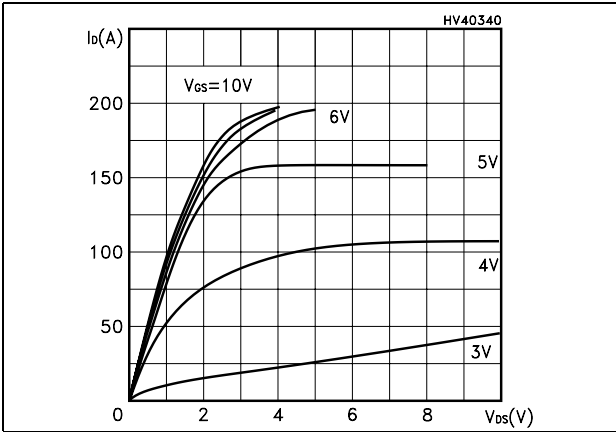


Figure 5. Transfer characteristics

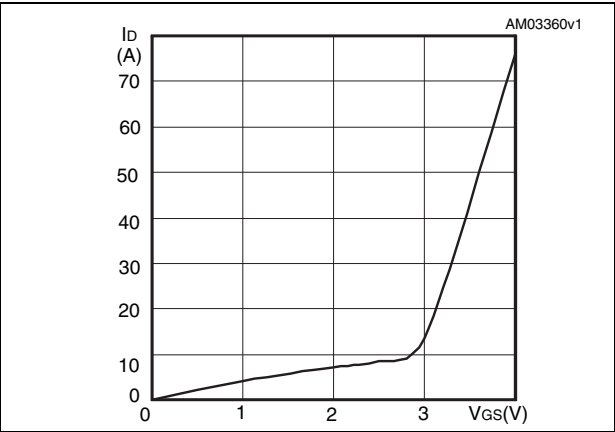


Figure 6. Normalized BvDSS vs temperature

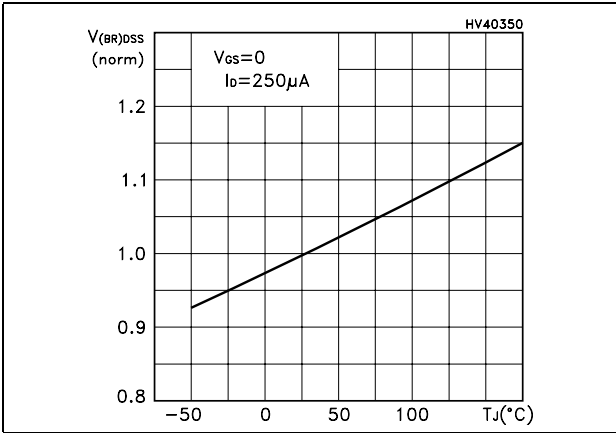


Figure 7. Static drain-source on resistance

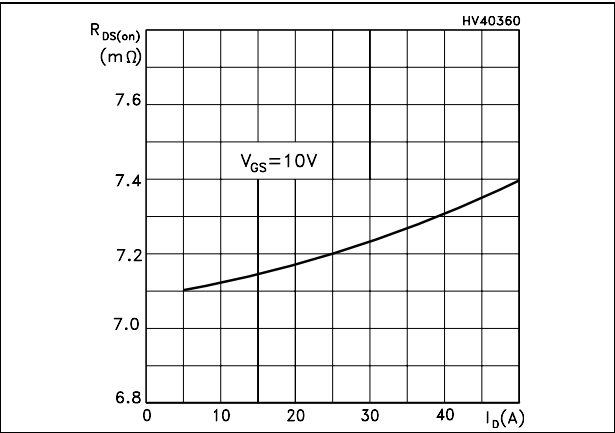


Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

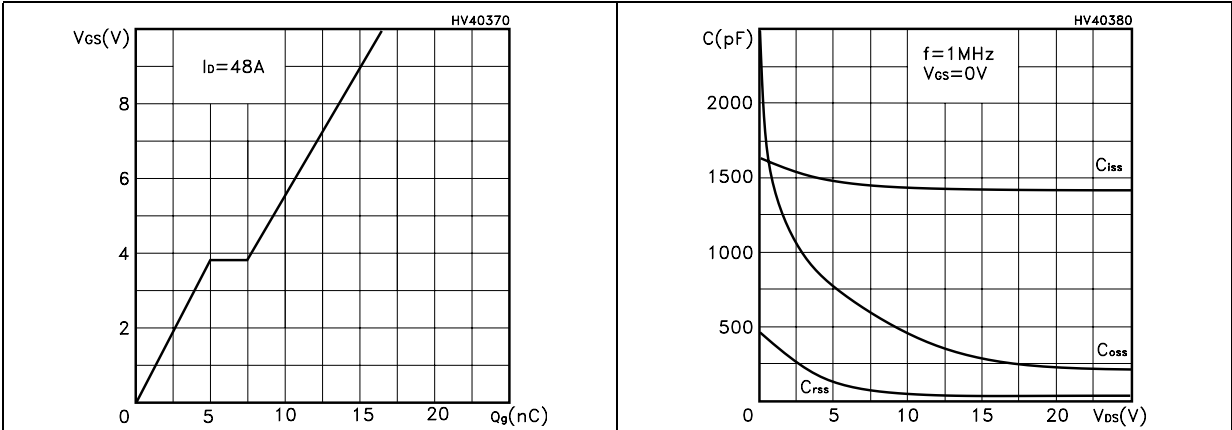


Figure 10. Normalized gate threshold voltage vs temperature Figure 11. Normalized on resistance vs temperature

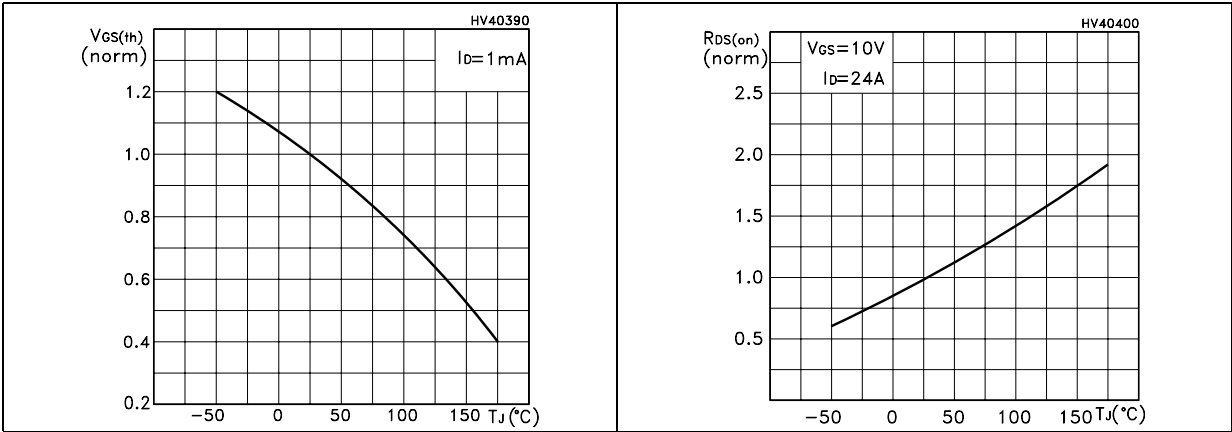
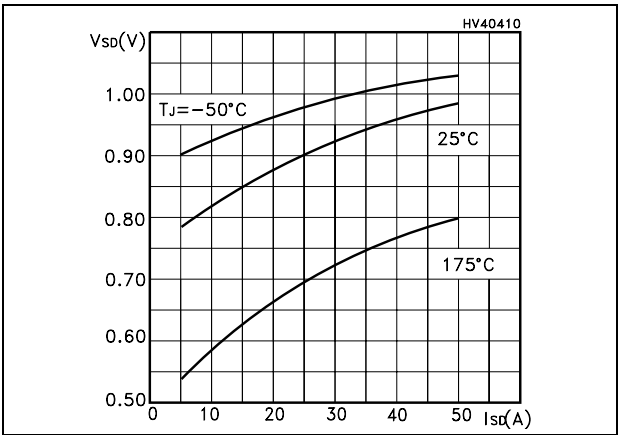


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

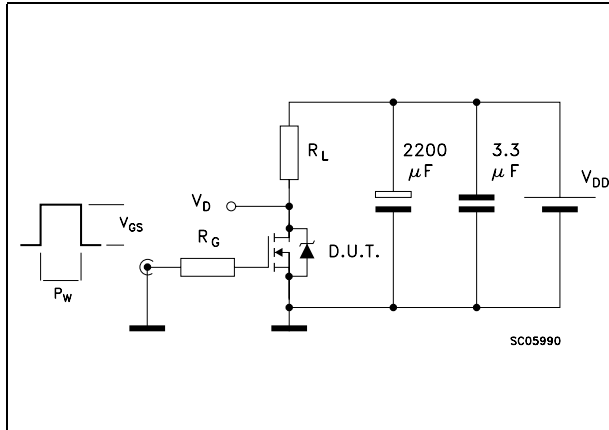


Figure 14. Gate charge test circuit

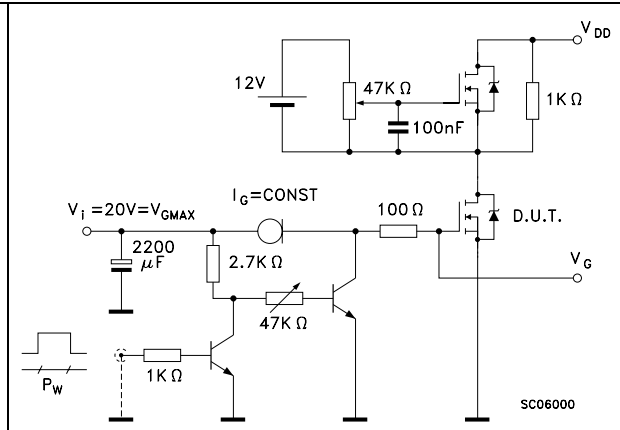


Figure 15. Test circuit for inductive load switching and diode recovery times

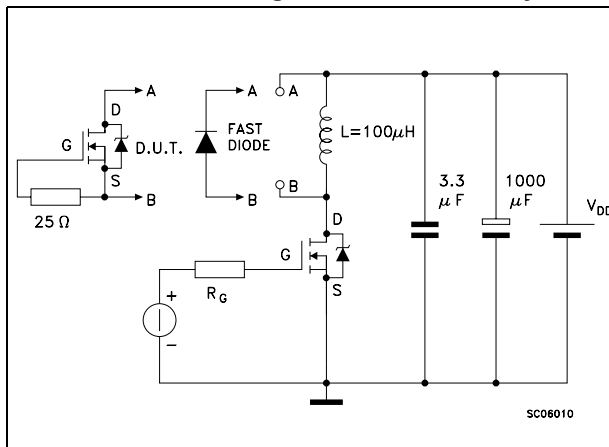


Figure 16. Unclamped inductive load test circuit

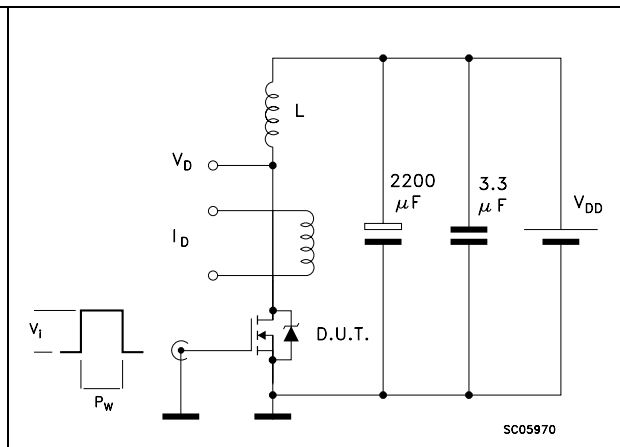


Figure 17. Unclamped inductive waveform

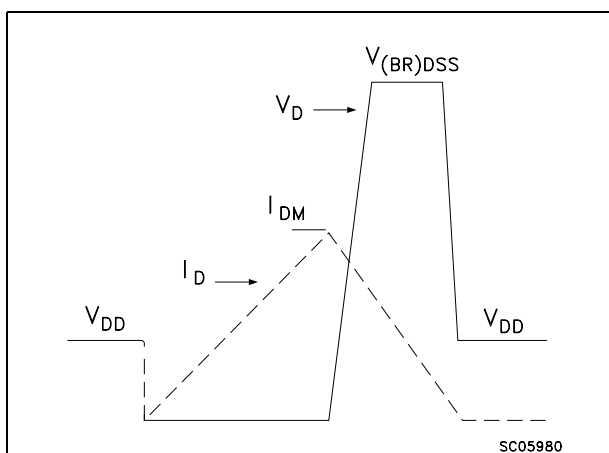


Figure 18. Switching time waveform

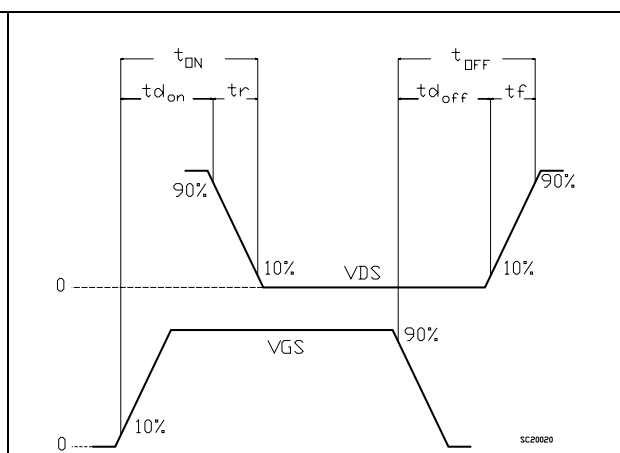
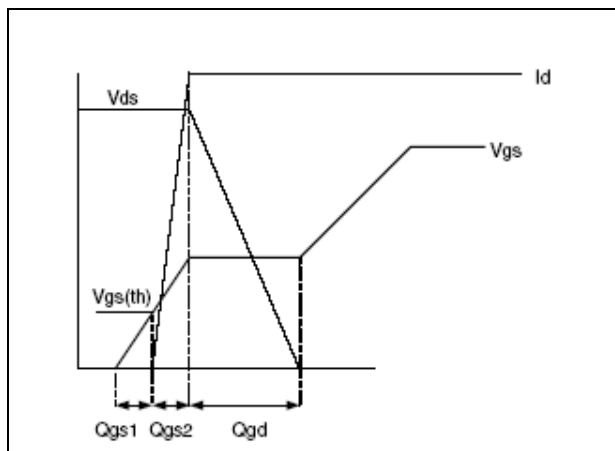


Figure 19. Gate charge waveform

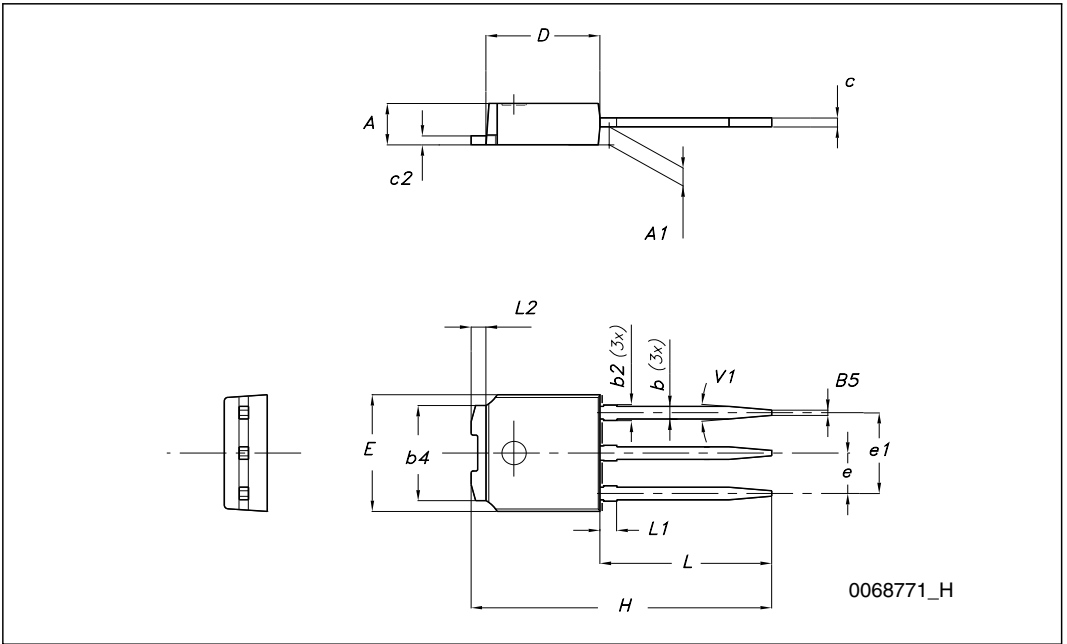


4 Package mechanical data

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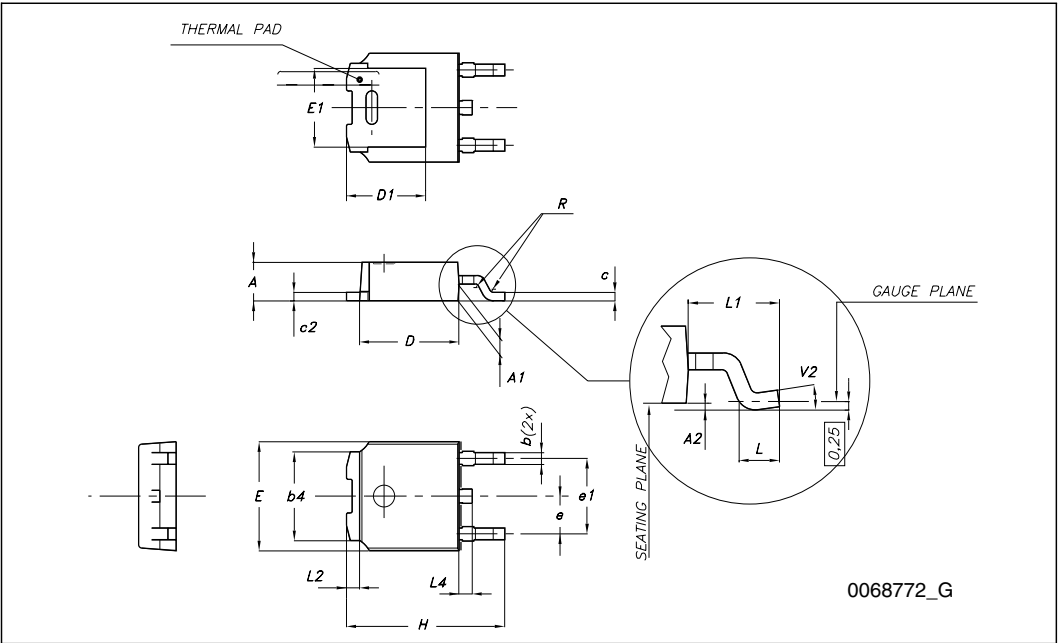
TO-251 (IPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
(L1)	0.80		1.20
L2		0.80	
V1		10°	



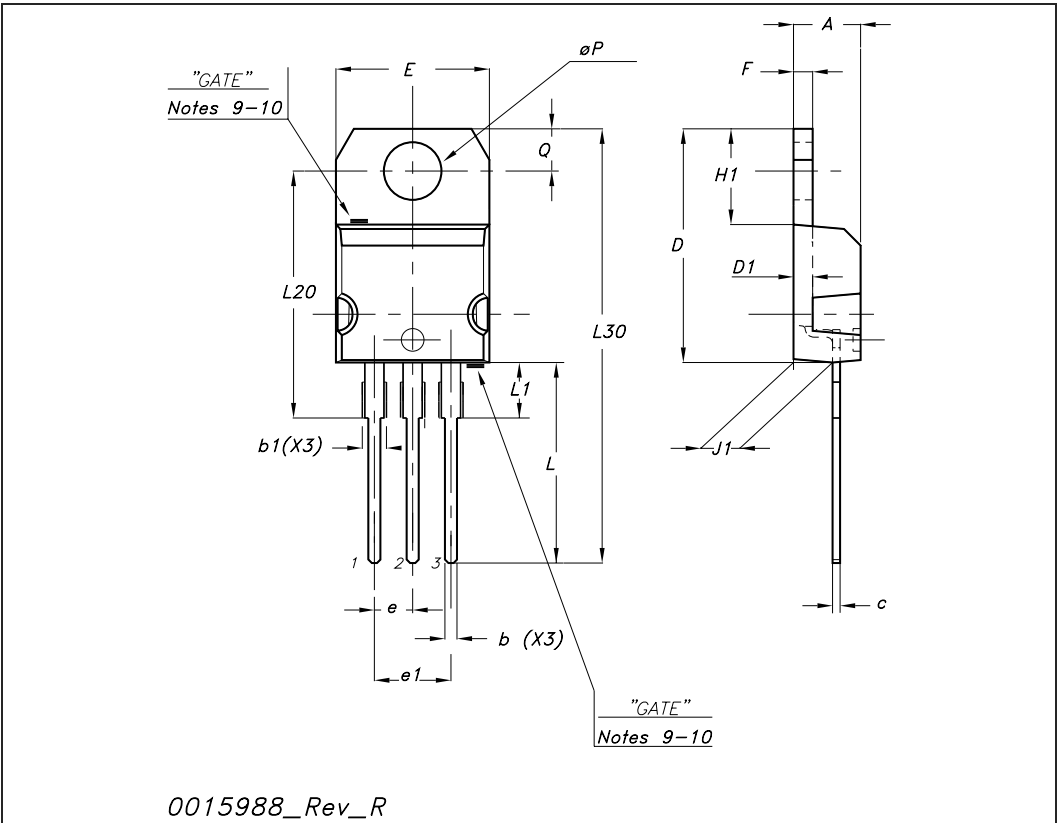
TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°



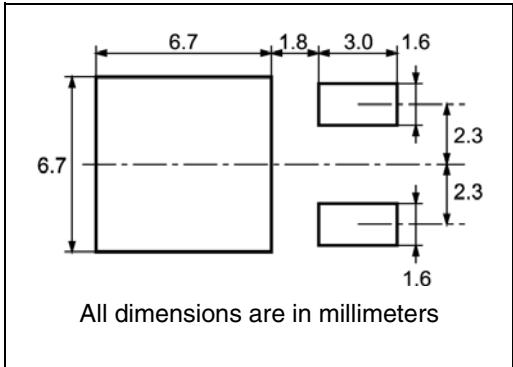
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.48		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116

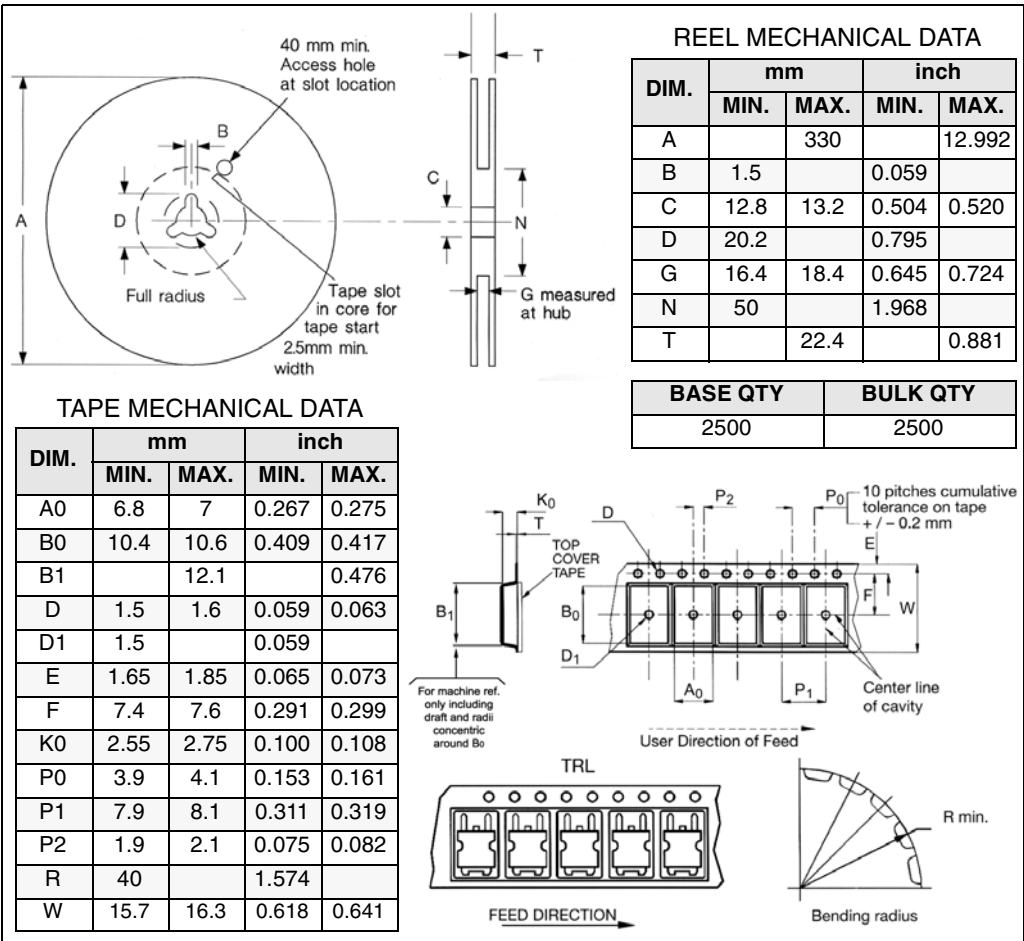


5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT



6 Revision history

Table 8. Document revision history

Date	Revision	Changes
19-Oct-2007	1	First release
23-Sep-2008	2	V_{GS} value has been changed on Table 2 and Table 5
20-Apr-2009	3	– Inserted typical and maximum value in $V_{GS(th)}$ parameter – Figure 5: Transfer characteristics has been updated – Added device in TO-220

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