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STD90N4F3, STI90N4F3 STP90N4F3, STU90N4F3

N-channel 40 V, 5.0 mΩ, 80 A, DPAK, TO-220, I²PAK, i²PAK
STripFET™ III Power MOSFET

Features

Type	V _{DSS}	R _{DS(on)} max	I _D	P _w
STD90N4F3	40 V	< 5.8mΩ	80 A	110 W
STI90N4F3	40 V	< 6.2 mΩ	80 A	110 W
STP90N4F3	40 V	< 6.2 mΩ	80 A	110 W
STU90N4F3	40 V	< 6.2 mΩ	80 A	110 W

- Standard threshold drive
- 100% avalanche tested

Application

- Switching applications

Description

This STripFET™ III Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance providing superior switching performances.

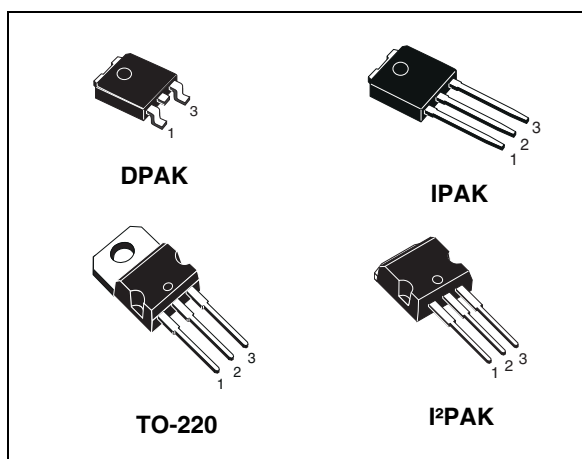


Figure 1. Internal schematic diagram

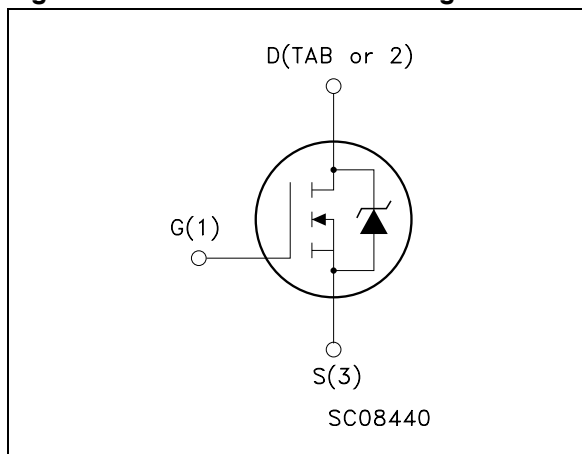


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD90N4F3	90N4F3	DPAK	Tape & reel
STI90N4F3	90N4F3	I ² PAK	Tube
STP90N4F3	90N4F3	TO-220	Tube
STU90N4F3	90N4F3	IPAK	Tube

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STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

Electrical ratings

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage ($V_{GS}=0$)	40	V
V_{GS}	Gate-source voltage	± 20	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	80	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	65	A
$I_{DM}^{(2)}$	Drain current (pulsed)	320	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	110	W
	Derating factor	0.73	W/ $^\circ\text{C}$
$dv/dt^{(3)}$	Peak diode recovery voltage slope	8	V/ns
$E_{AS}^{(4)}$	Single pulse avalanche energy	400	mJ
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 175	$^\circ\text{C}$

1. Current limited by package
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 80\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS} \leq V_{(BR)DSS}$, $T_j \leq T_{jmax}$
4. Starting $T_j = 25\text{ }^\circ\text{C}$, $I_D = 40\text{ A}$, $V_{DD} = 30\text{ V}$

Table 3. Thermal resistance

Symbol	Parameter	Value			Unit
		TO-220 I ² PAK	IPAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case max	1.36			$^\circ\text{C}/\text{W}$
R_{thj-a}	Thermal resistance junction-ambient max	62.5	100		$^\circ\text{C}/\text{W}$
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-ambient max	50			$^\circ\text{C}/\text{W}$
T_l	Maximum lead temperature for soldering purpose	300	275		$^\circ\text{C}$

1. When mounted on 1inch² FR-4 2Oz Cu board

Electrical characteristics

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2 Electrical characteristics

(T_{CASE} = 25 °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 μA, V _{GS} = 0	40			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = Max rating, V _{DS} = Max rating, T _c = 125°C			10 100	μA μA
I _{GSS}	Gate body leakage current (V _{DS} = 0)	V _{GS} = ±20 V			±200	nA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 250 μA	2		4	V
R _{DS(on)}	Static drain-source on resistance	V _{GS} = 10 V, I _D = 40 A for DPAK		5.0	5.8	mΩ
		V _{GS} = 10 V, I _D = 40 A for IPAK, I ² PAK, TO-220		5.4	6.2	mΩ

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
g _{fs} ⁽¹⁾	Forward transconductance	V _{DS} = 25 V, I _D = 40 A	-	100		S
C _{iss}	Input capacitance	V _{DS} = 25 V, f = 1 MHz, V _{GS} = 0	-	2200		pF
C _{oss}	Output capacitance			580		pF
C _{rss}	Reverse transfer capacitance			40		pF
Q _g	Total gate charge	V _{DD} = 20 V, I _D = 80 A	-	40	54	nC
Q _{gs}	Gate-source charge	V _{GS} = 10 V		11		nC
Q _{gd}	Gate-drain charge	(see Figure 14)		8		nC

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

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Electrical characteristics

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD}=20\text{ V}$, $I_D=40\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ (see Figure 16)	-	15	-	ns
t_r	Rise time			50		ns
$t_{d(off)}$	Turn-off delay time	$V_{DD}=20\text{ V}$, $I_D=40\text{ A}$, $R_G=4.7\ \Omega$, $V_{GS}=10\text{ V}$ (see Figure 16)	-	40	-	ns
t_f	Fall time			15		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		80	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				320	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD}=80\text{ A}$, $V_{GS}=0$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD}=80\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=30\text{ V}$, $T_j=150^\circ\text{C}$ (see Figure 15)	-	45		ns
Q_{rr}	Reverse recovery charge			60		nC
I_{RRM}	Reverse recovery current			2.8		A

1. Pulse width limited by safe operating area

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

Electrical characteristics

STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

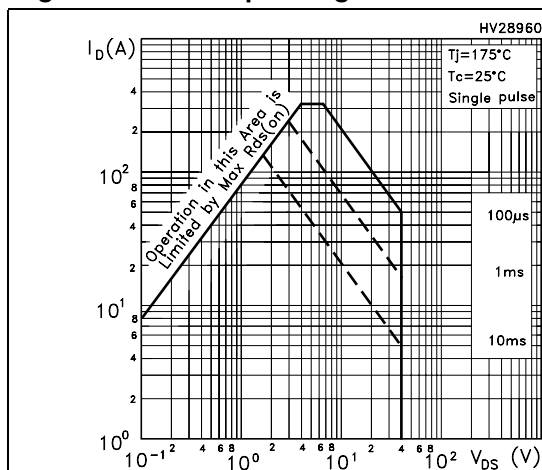


Figure 3. Thermal impedance

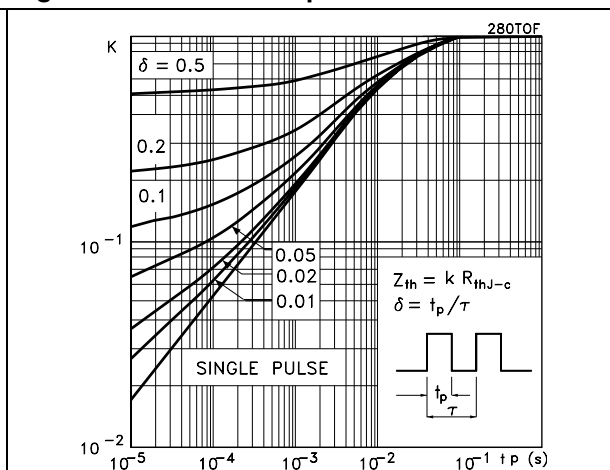


Figure 4. Output characteristics

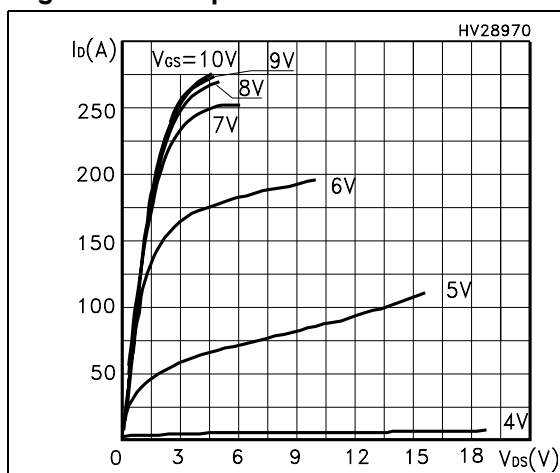


Figure 5. Transfer characteristics

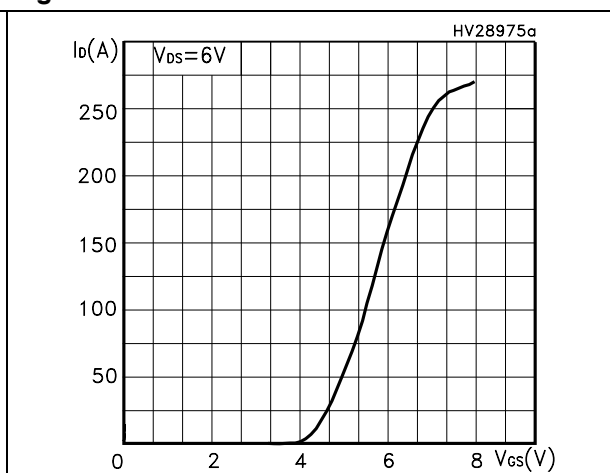


Figure 6. Static drain-source on resistance

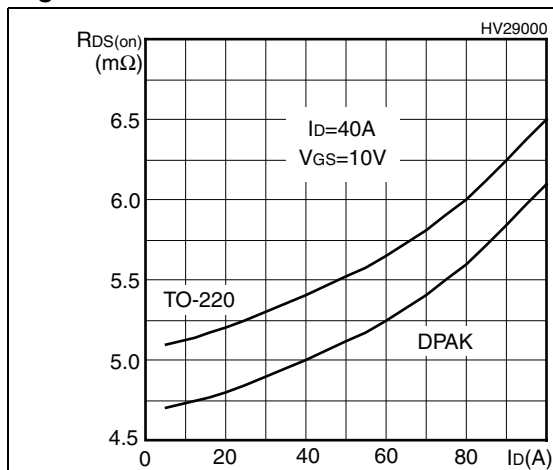
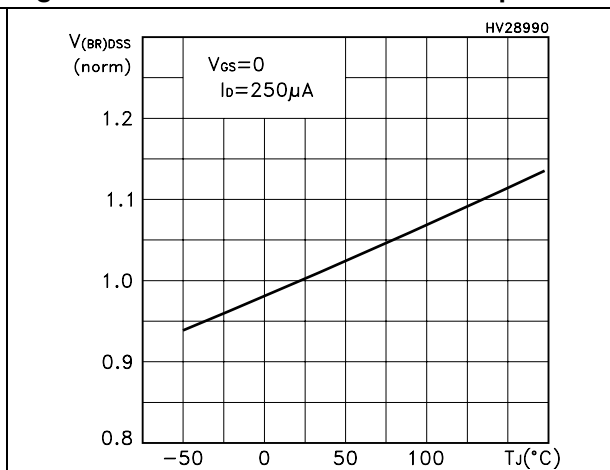


Figure 7. Normalized BVDSS vs temperature



STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

Electrical characteristics

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

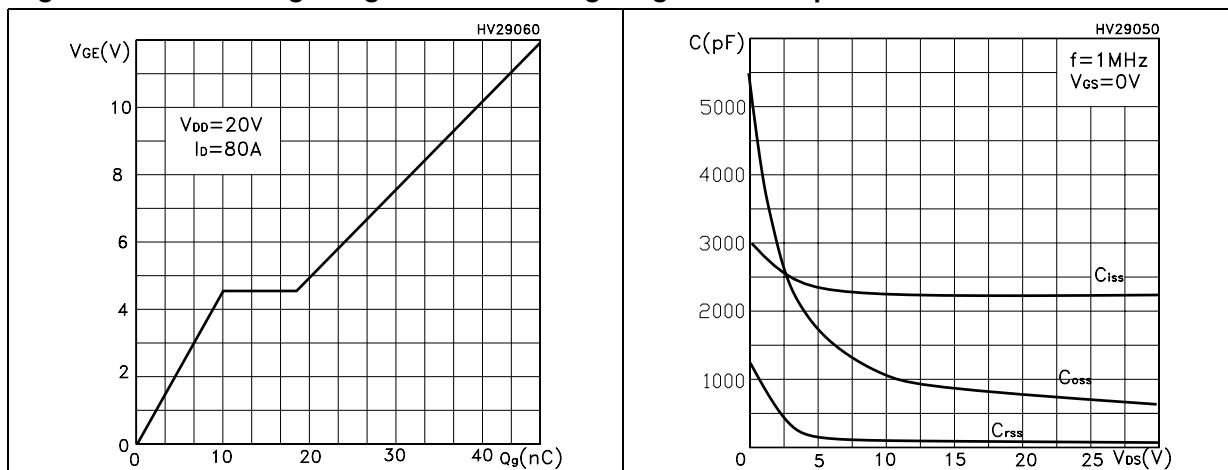


Figure 10. Normalized gate threshold voltage vs temperature **Figure 11. Normalized on resistance vs temperature**

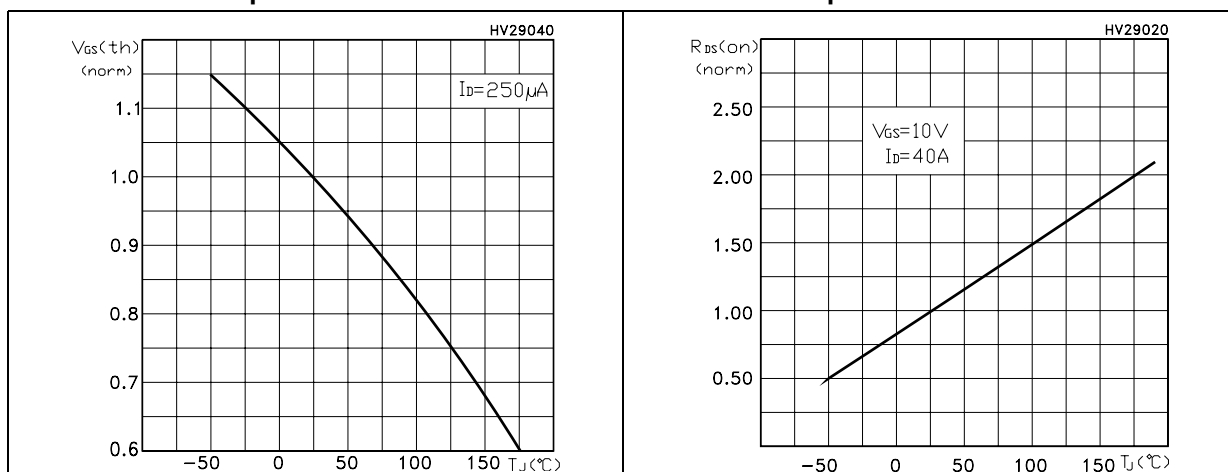
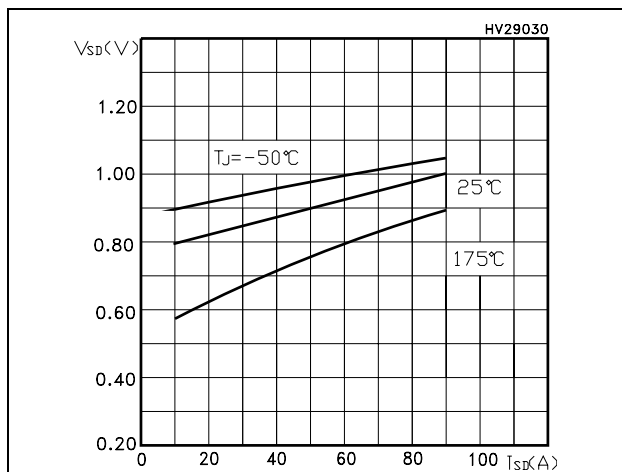


Figure 12. Source-drain diode forward characteristics



Test circuits

STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

3 Test circuits

Figure 13. Switching times test circuit for resistive load

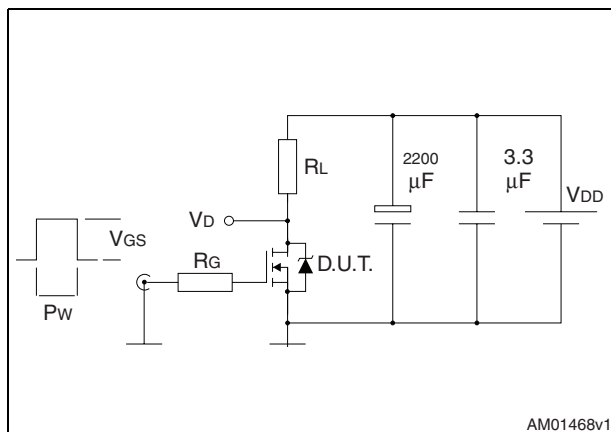


Figure 14. Gate charge test circuit

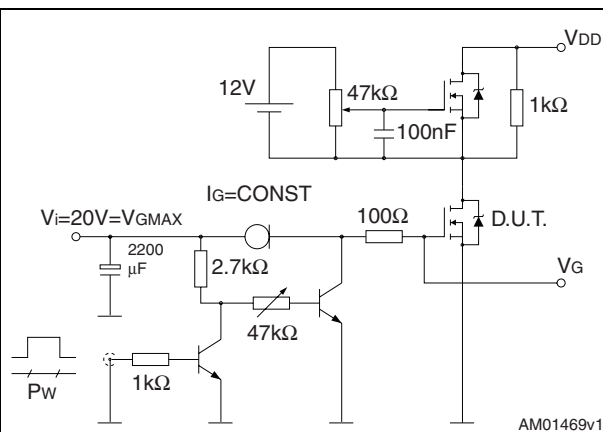


Figure 15. Test circuit for inductive load switching and diode recovery times

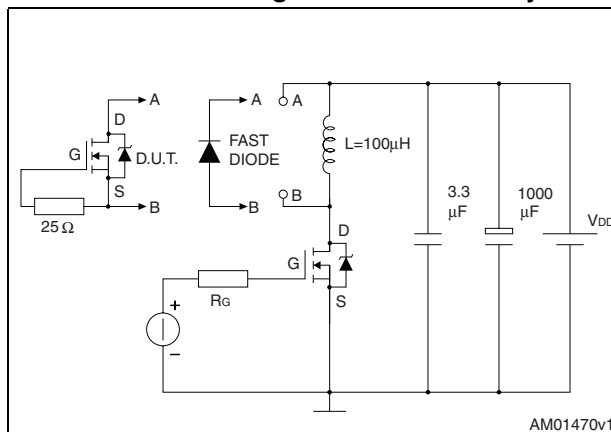


Figure 16. Unclamped inductive load test circuit

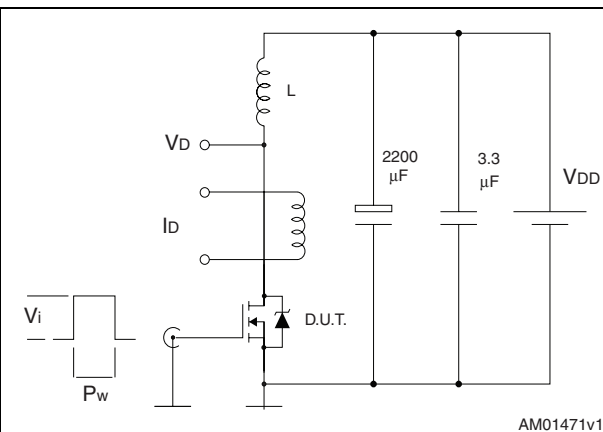


Figure 17. Unclamped inductive waveform

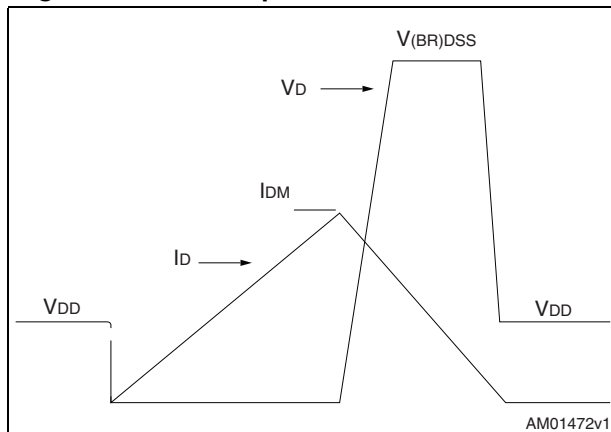
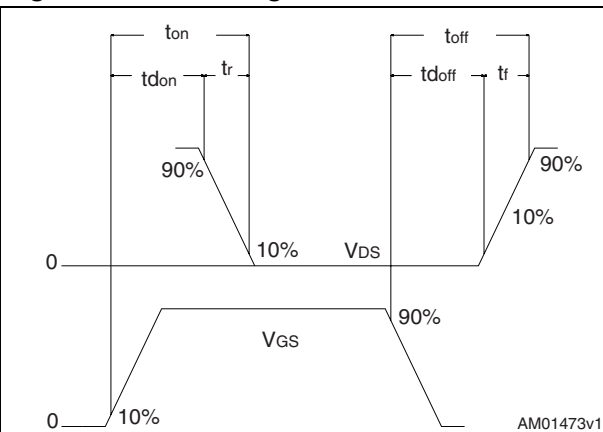


Figure 18. Switching time waveform



4 Package mechanical data

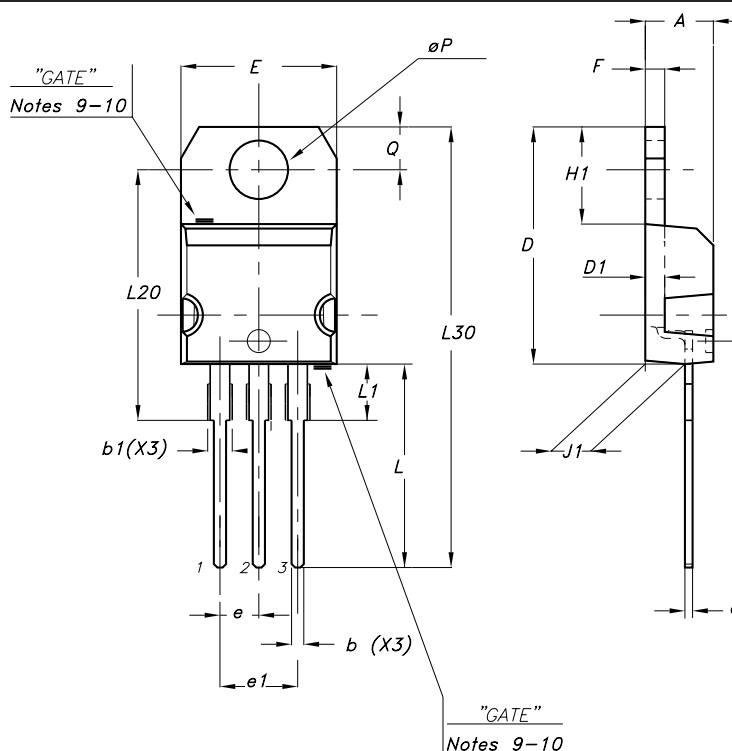
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Package mechanical data

STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

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



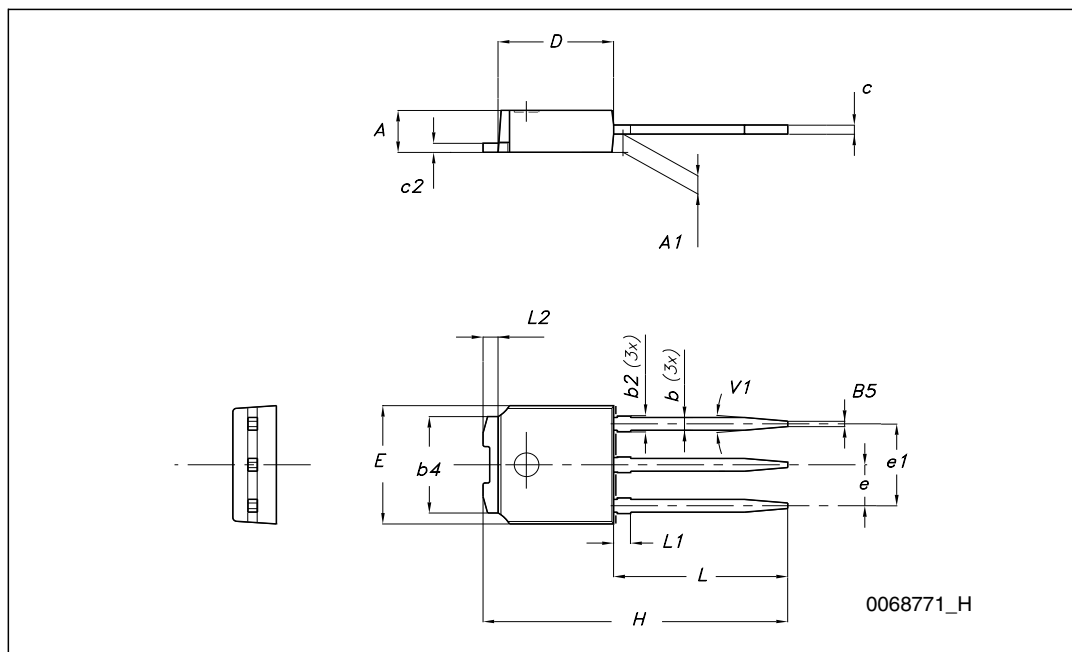
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STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

Package mechanical data

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 °	

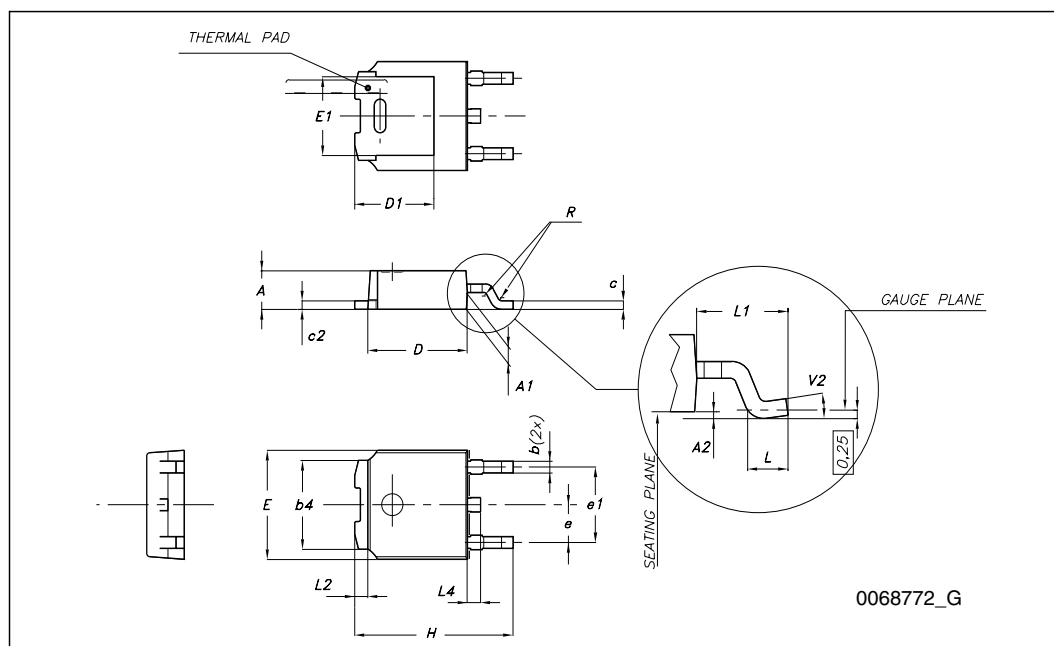


Package mechanical data

STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

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°

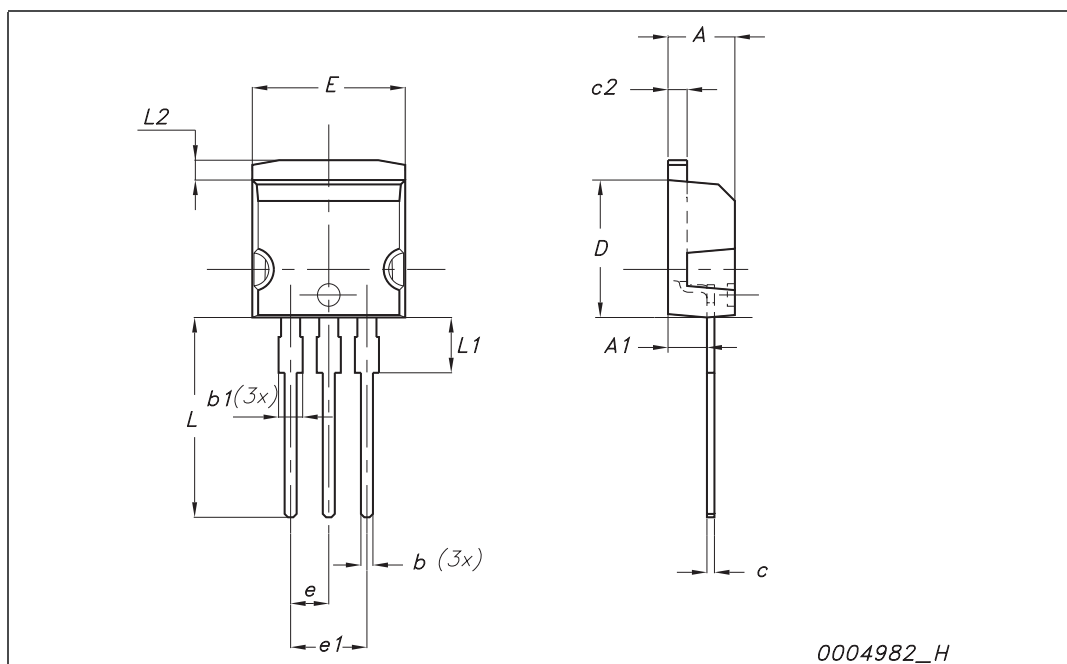


STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

Package mechanical data

I²PAK (TO-262) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055

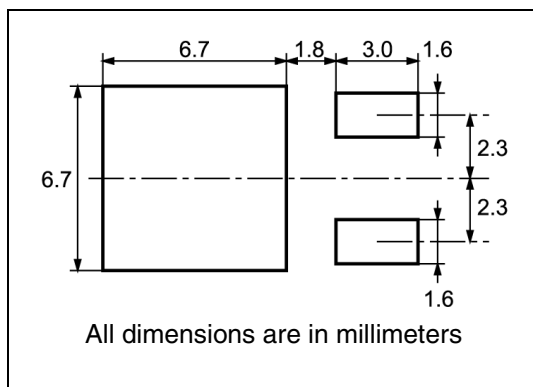


Packaging mechanical data

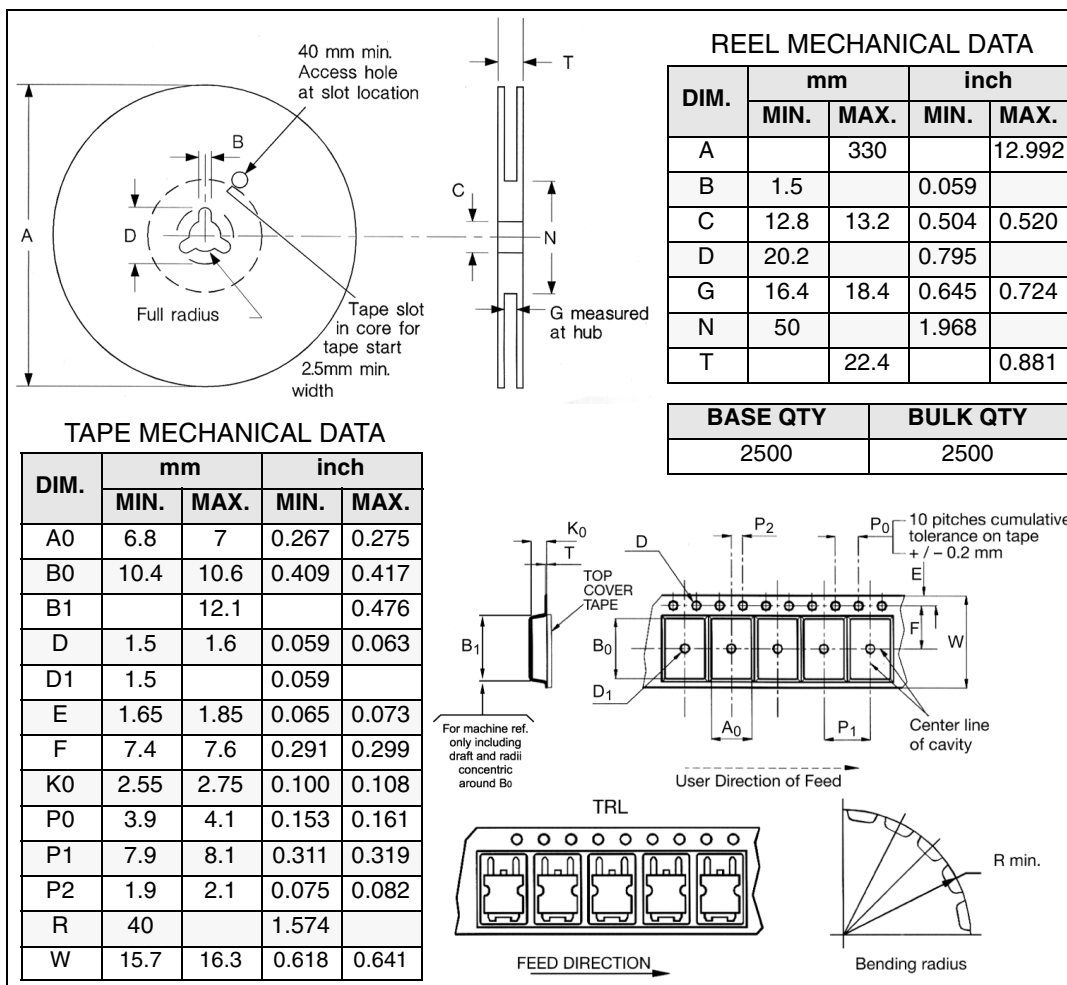
STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT



6 Revision history

Table 8. Document revision history

Date	Revision	Changes
29-Nov-2007	1	First release
15-Jul-2008	2	Added new package, mechanical data: I ² PAK
23-Jul-2009	3	R _{DS(on)} values have been revised

STD90N4F3, STI90N4F3, STP90N4F3, STU90N4F3

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