



# STF40NF03L STP40NF03L

N-channel 30 V, 0.018  $\Omega$ , 40 A TO-220, TO-220FP  
STripFET™ Power MOSFET

## Features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STF40NF03L	30 V	0.022 $\Omega$	23 A
STP40NF03L	30 V	0.022 $\Omega$	40 A

- Low threshold device

## Application

- Switching applications

## Description

This Power MOSFET is the latest development of STMicroelectronics unique "single feature size" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

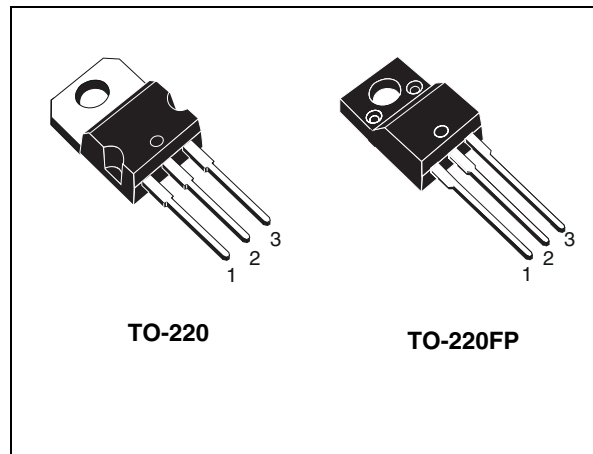


Figure 1. Internal schematic diagram

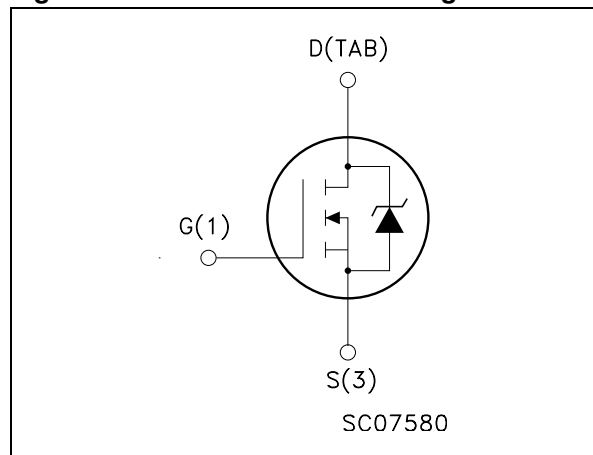


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF40NF03L	F40NF03L	TO-220FP	Tube
STP40NF03L	P40NF03L	TO-220	Tube

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# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220	TO-220FP	
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	30		V
$V_{GS}$	Gate- source voltage	$\pm 16$		V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	40	23	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	28	16	A
$I_{DM}^{(1)}$	Drain current (pulsed)	160	92	A
$P_{tot}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	25	W
	Derating factor	0.46		W/ $^\circ\text{C}$
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}; T_C=25\text{ }^\circ\text{C}$ )		2500	V
$E_{AS}^{(2)}$	Single pulse avalanche energy	250		mJ
$T_{stg}$	Storage temperature	-55 to 175		$^\circ\text{C}$
$T_j$	Max. operating junction temperature			

1. Pulse width limited by safe operating area.

2. Starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = 20\text{ A}$ ,  $V_{DD} = 15\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Package	Value		Unit
			Typ.	Max.	
$R_{thj-c}$	Thermal resistance junction-case	TO-220	1.8	2.1	$^\circ\text{C}/\text{W}$
		TO-220FP		6	
$R_{thj-amb}$	Thermal resistance junction-ambient max			62.5	$^\circ\text{C}/\text{W}$
$T_J$	Maximum lead temperature for soldering purpose			300	$^\circ\text{C}$

## 2 Electrical characteristics

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

**Table 4. On/off states**

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 ( $V_{GS} = 0$ )	$V_{DS} = \text{max ratings}$ $V_{DS} = \text{max ratings}$ , $T_C = 125\text{ }^{\circ}\text{C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 16\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	1	1.7	2.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$ $V_{GS} = 4.5\text{ V}$ , $I_D = 20\text{ A}$		0.018 0.028	0.022 0.035	$\Omega$ $\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 20\text{ A}$	-	20	-	S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	770 255 60	-	pF pF pF
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on delay time Rise time Turn-off delay time Fall time	$V_{DD} = 15\text{ V}$ , $I_D = 20\text{ A}$ $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 4.5\text{ V}$ (see <a href="#">Figure 16</a> )	-	14 80 25 16	-	ns ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 15\text{ V}$ , $I_D = 40\text{ A}$ , $V_{GS} = 4.5\text{ V}$ (see <a href="#">Figure 17</a> )	-	10.5 4 4.5	15	nC nC nC

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

**Table 6. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)		-		40 160	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 40\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 40\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 15\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 18</a> )	-	34.5 30 2		ns nC A

1. Pulse width limited by safe operating area.
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220

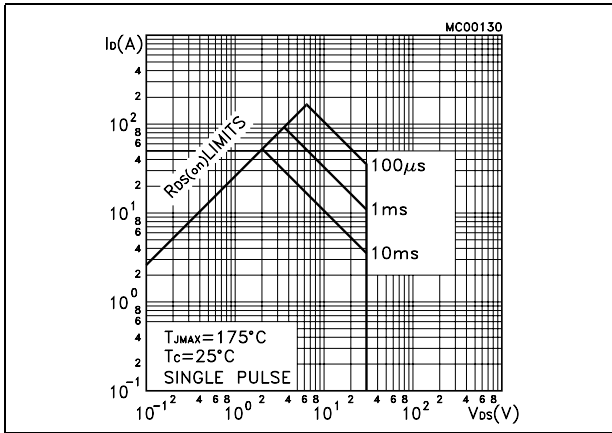


Figure 3. Thermal impedance for TO-220

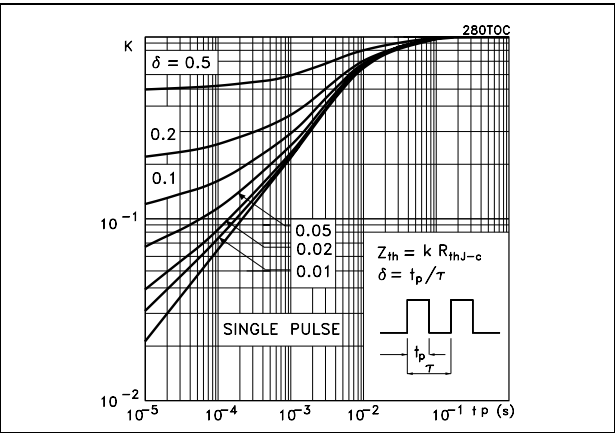


Figure 4. Safe operating area for TO-220FP

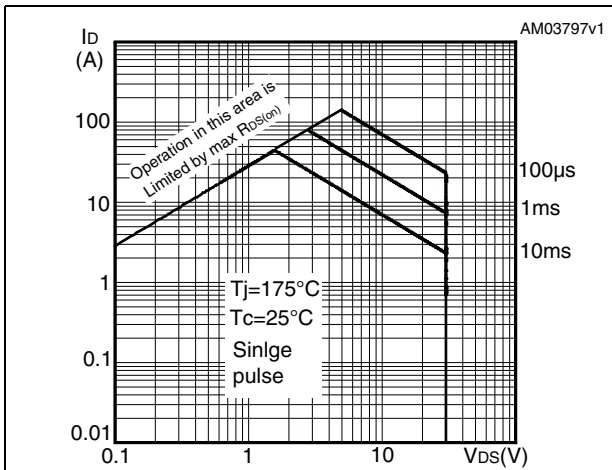


Figure 5. Thermal impedance for TO-220FP

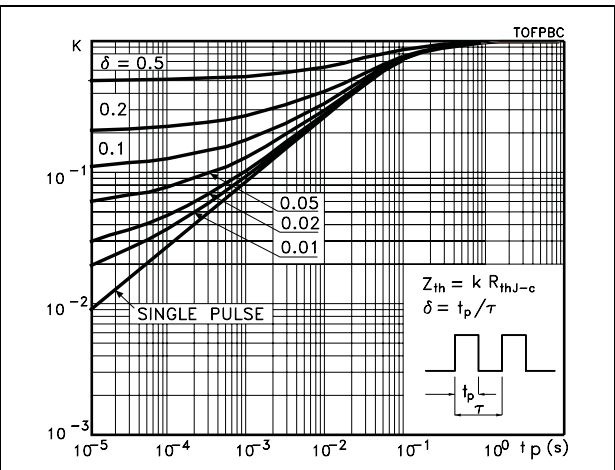


Figure 6. Output characteristics

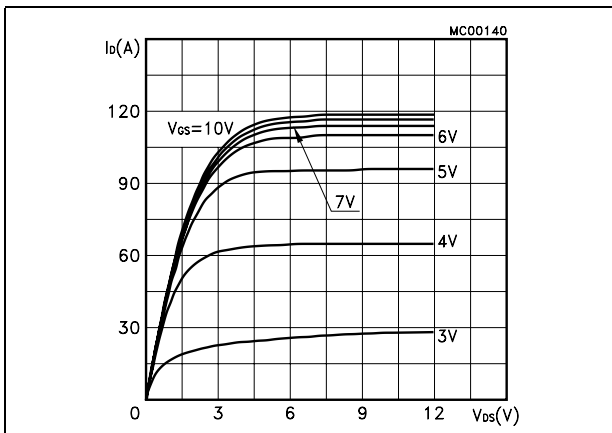


Figure 7. Transfer characteristics

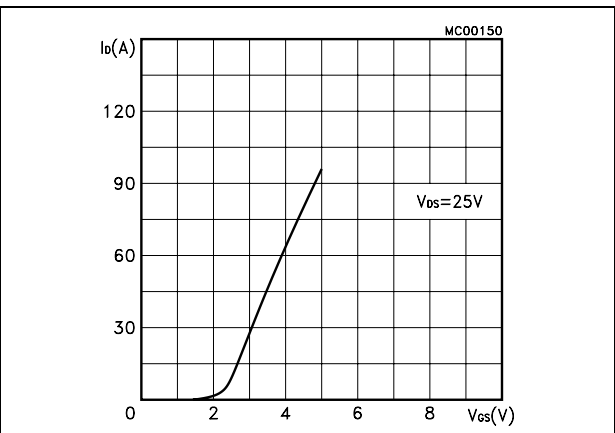


Figure 8. Transconductance

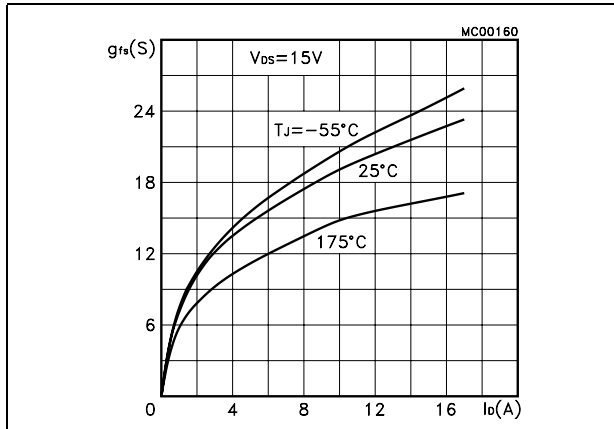


Figure 9. Static drain-source on resistance

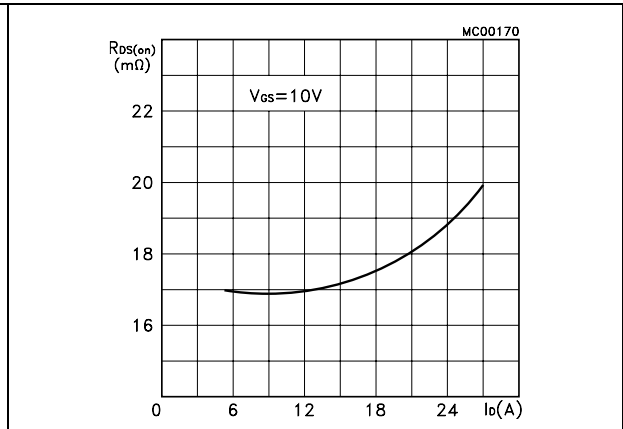


Figure 10. Gate charge vs. gate-source voltage Figure 11. Capacitance variations

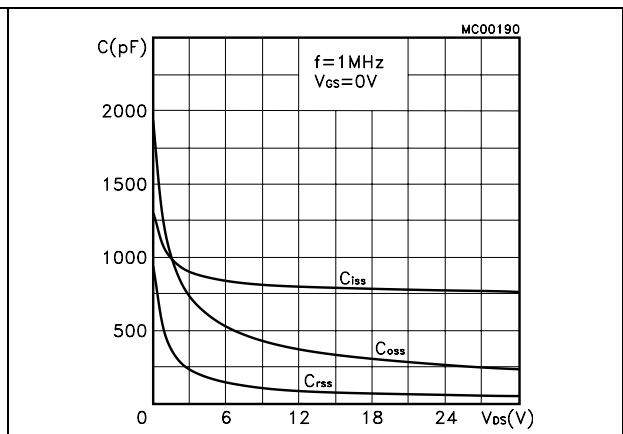
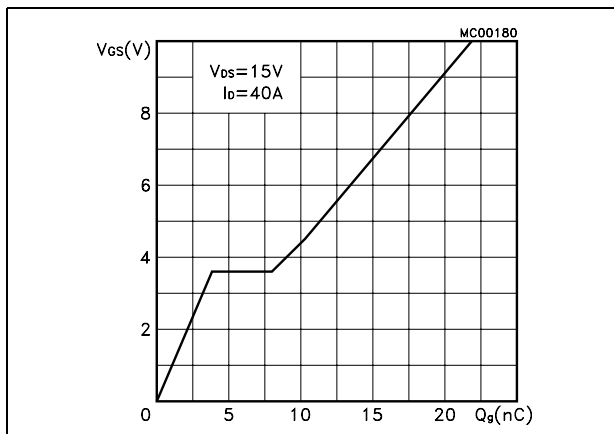


Figure 12. Normalized gate threshold voltage vs. temperature

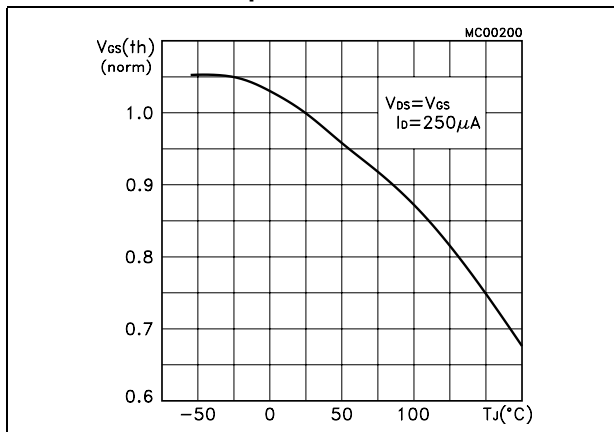


Figure 13. Normalized on resistance vs. temperature

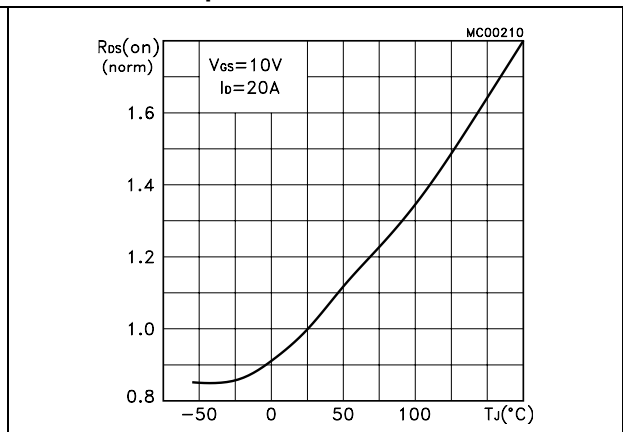


Figure 14. Source-drain diode forward characteristics

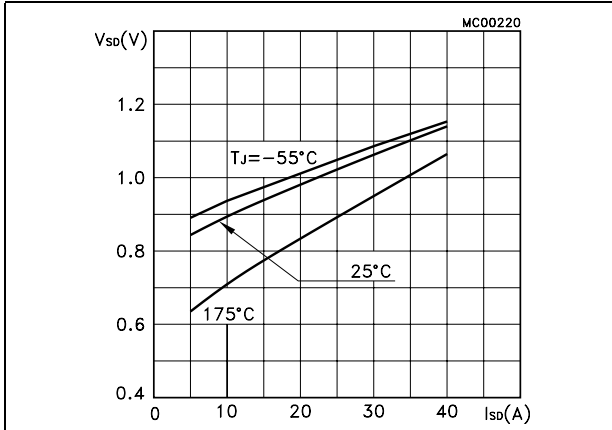
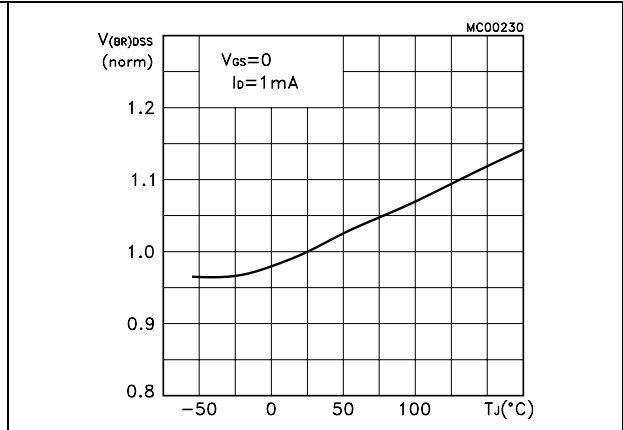


Figure 15. Normalized  $B_{VDSS}$  vs. temperature





### 3 Test circuits

Figure 16. Switching times test circuit for resistive load



Figure 17. Gate charge test circuit

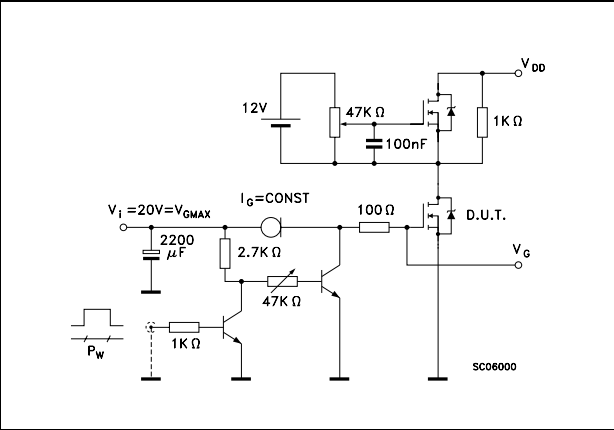


Figure 18. Test circuit for inductive load switching and diode recovery times



Figure 19. Unclamped inductive load test circuit

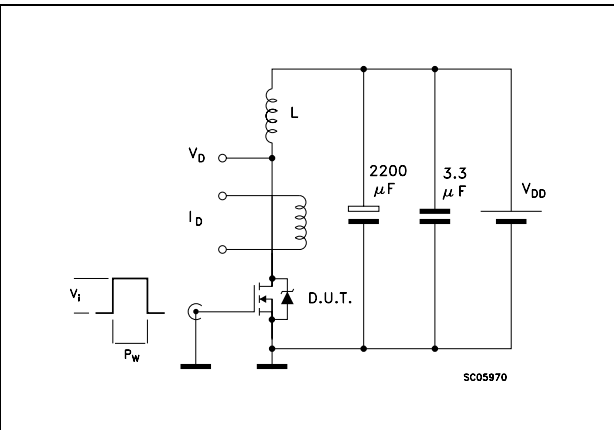


Figure 20. Unclamped inductive waveform

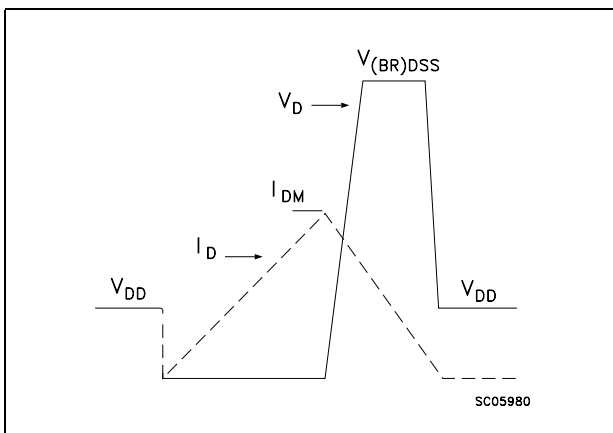
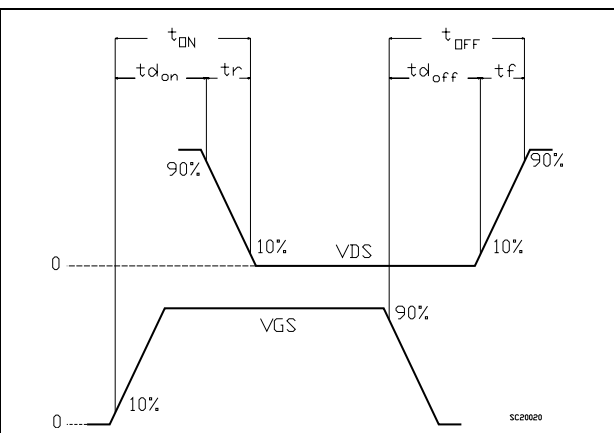


Figure 21. Switching time waveform

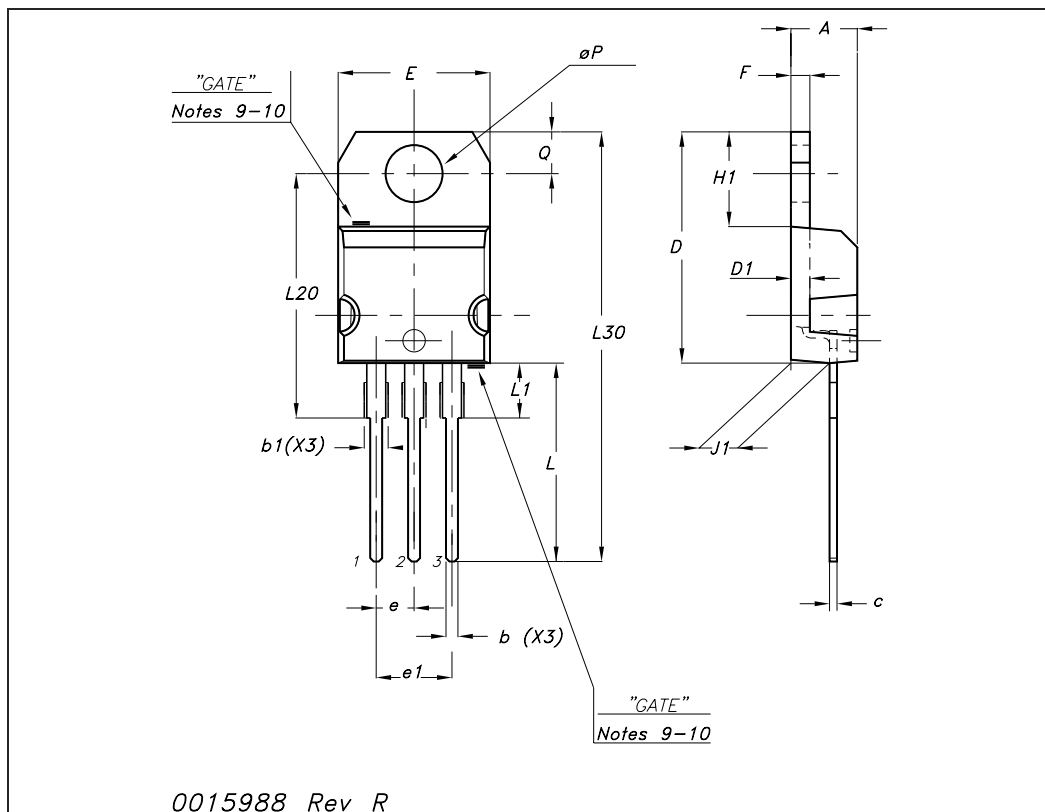


## 4 Package mechanical data

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

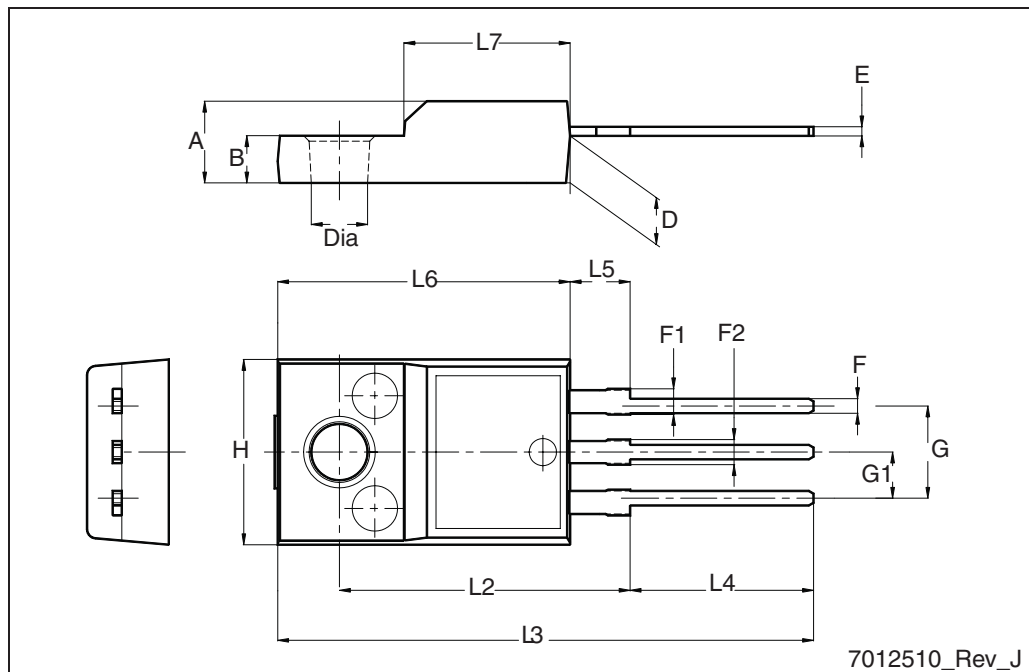
## TO-220 mechanical data

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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



## 5 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
09-Sep-2004	1	Preliminary version
21-Jun-2005	2	Complete version with curves
16-Aug-2006	3	New template, no content change
21-Feb-2007	4	Typo mistake on page 1
20-Nov-2008	5	<a href="#">Figure 9: Static drain-source on resistance</a> has been corrected.
14-Apr-2009	6	The device in TO-220FP has been added
03-Feb-2010	7	Updated <a href="#">Table 3: Thermal data</a> .
22-Feb-2010	8	Updated <a href="#">Table 3: Thermal data</a> .

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