

N-channel 600 V, 0.076  $\Omega$  typ., 34 A MDmesh™ M2 EP  
Power MOSFETs in TO-220FP and TO-3PF packages

Datasheet – production data

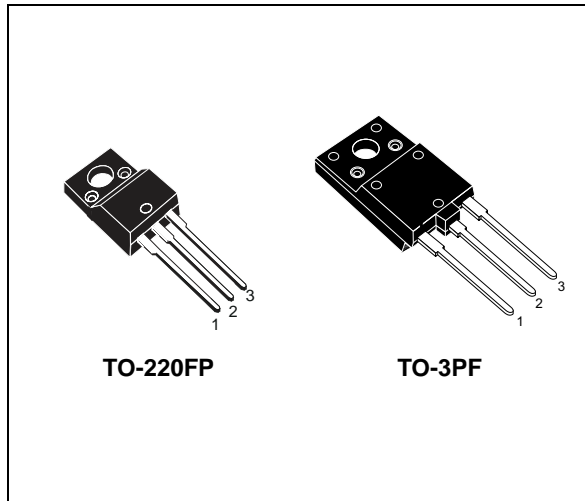
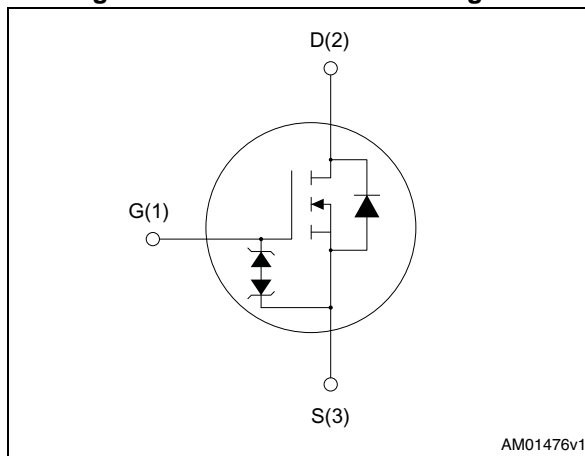


Figure 1. Internal schematic diagram



## Features

Order codes	$V_{DS}$ @ $T_{Jmax}$	$R_{DS(on)}$ max	$I_D$
STF42N60M2-EP	650 V	0.087 $\Omega$	34 A
STFW42N60M2-EP			

- Extremely low gate charge
- Excellent output capacitance ( $C_{OSS}$ ) profile
- Very low turn-off switching losses
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications
- Tailored for very high frequency converters ( $f > 150$  kHz)

## Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 EP enhanced performance technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics with very low turn-off switching losses, rendering them suitable for the most demanding very high frequency converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STF42N60M2-EP	42N60M2EP	TO-220FP	Tube
STFW42N60M2-EP		TO-3PF	

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220FP	TO-3PF	
$V_{GS}$	Gate-source voltage	± 25		V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ °C}$	34		A
$I_D^{(1)}$	Drain current (continuous) at $T_C = 100\text{ °C}$	22		A
$I_{DM}^{(1),(2)}$	Drain current (pulsed)	136		A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	40	63	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15		V/ns
$dv/dt^{(4)}$	MOSFET $dv/dt$ ruggedness	50		V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}$ ; $T_C=25\text{ °C}$ )	2500	3500	V
$T_{stg}$	Storage temperature	- 55 to 150		°C
$T_j$	Max. operating junction temperature	150		°C

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area.
3.  $I_{SD} \leq 34\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD}=400\text{ V}$ .
4.  $V_{DS} \leq 480\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		TO-220FP	TO-3PF	
$R_{thj-case}$	Thermal resistance junction-case max	3.13	2.00	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	50	°C/W

**Table 4. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	800	mJ

## 2 Electrical characteristics

( $T_C = 25\text{ °C}$  unless otherwise specified)

**Table 5. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 17\text{ A}$		0.076	0.087	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	-	2370	-	pF
$C_{oss}$	Output capacitance		-	112	-	pF
$C_{riss}$	Reverse transfer capacitance		-	2.5	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0, V_{DS} = 0\text{ to }480\text{ V}$	-	454	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0$	-	4.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 34\text{ A}, V_{GS} = 10\text{ V}$ (see <a href="#">Figure 18</a> )	-	55	-	nC
$Q_{gs}$	Gate-source charge		-	8.5	-	nC
$Q_{gd}$	Gate-drain charge		-	25	-	nC

1.  $C_{oss\text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 7. Switching Energy**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$R_{(off)}$	Turn-off energy (from 90% $V_{GS}$ to 0% $I_D$ )	$V_{DD} = 400\text{ V}, I_D = 2.5\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	13	-	$\mu\text{J}$
		$V_{DD} = 400\text{ V}, I_D = 5\text{ A}, R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	14.5	-	$\mu\text{J}$

Table 8. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 17\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 17</a> and <a href="#">Figure 22</a> )	-	16.5	-	ns
$t_r$	Rise time		-	9.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	96.5	-	ns
$t_f$	Fall time		-	8	-	ns

Table 9. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		34	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		136	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 34\text{ A}$ , $V_{GS} = 0$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 34\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 22</a> )	-	438		ns
$Q_{rr}$	Reverse recovery charge		-	9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	41.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 34\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 22</a> )	-	538		ns
$Q_{rr}$	Reverse recovery charge		-	12		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	44.5		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-220FP

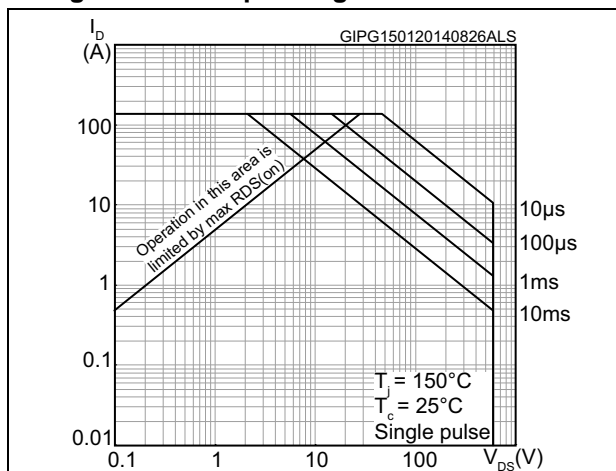


Figure 3. Thermal impedance for TO-220FP

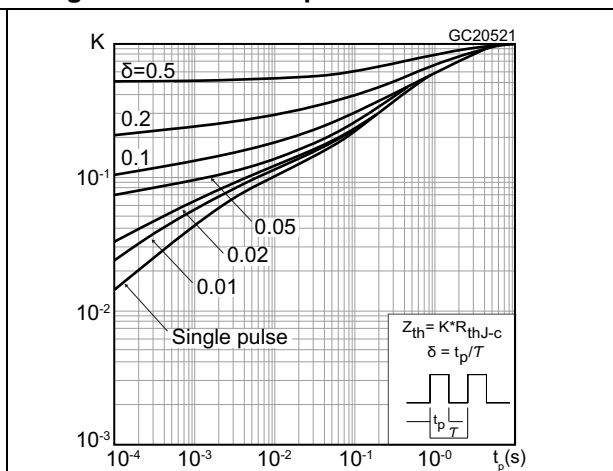


Figure 4. Safe operating area for TO-3PF

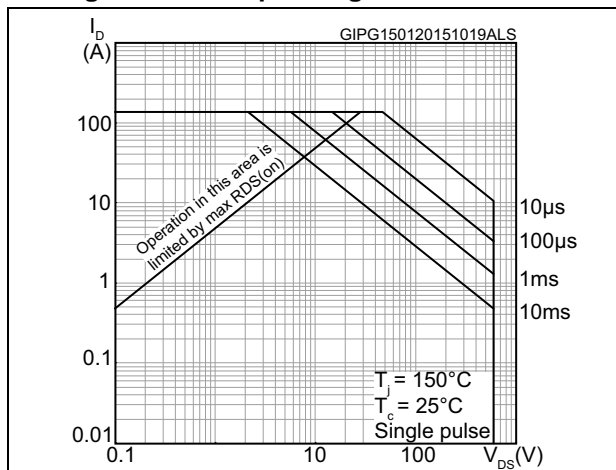


Figure 5. Thermal impedance for TO-3PF

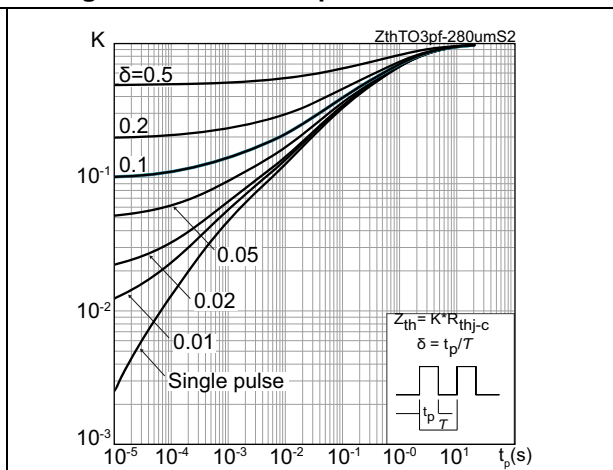


Figure 6. Output characteristics

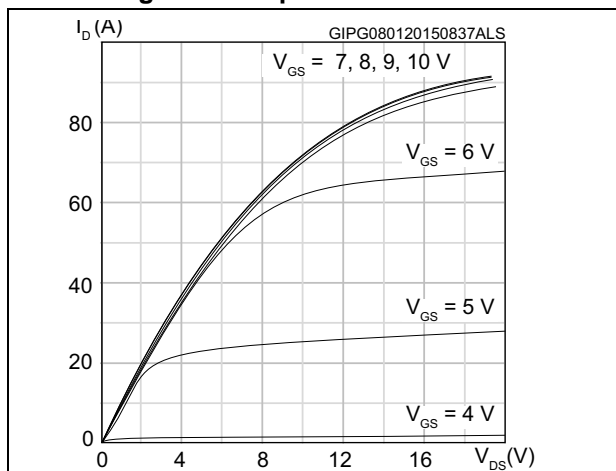


Figure 7. Transfer characteristics

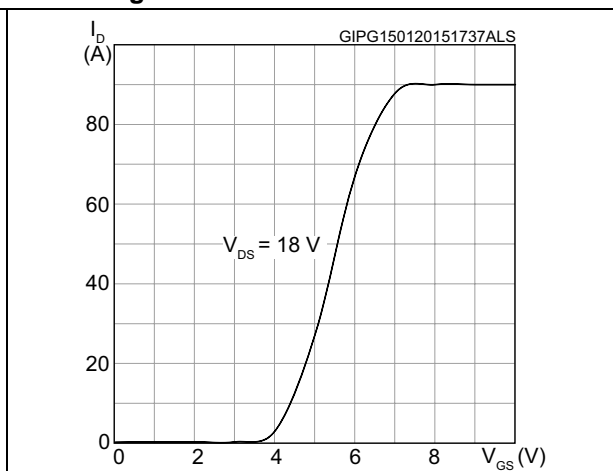


Figure 8. Gate charge vs gate-source voltage

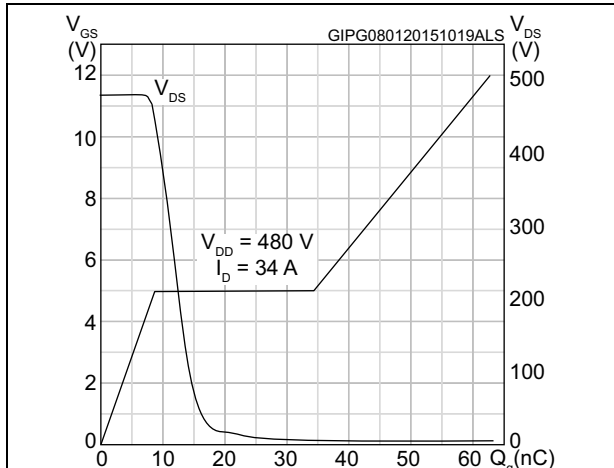


Figure 9. Static drain-source on-resistance

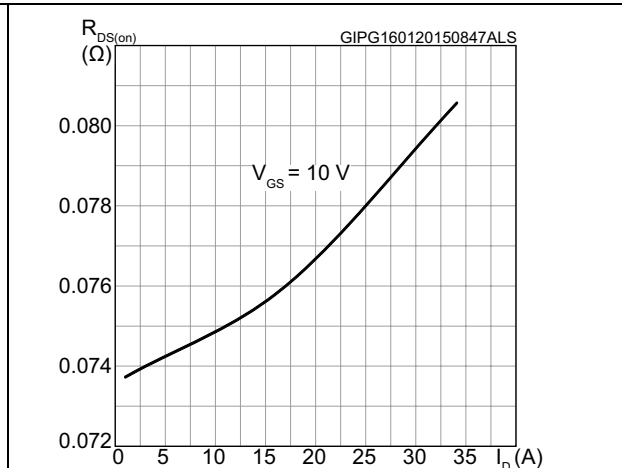


Figure 10. Turn-off switching loss vs drain current

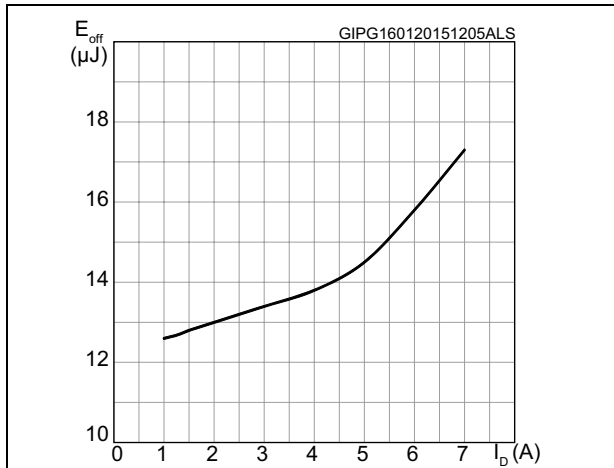


Figure 11. Capacitance variations

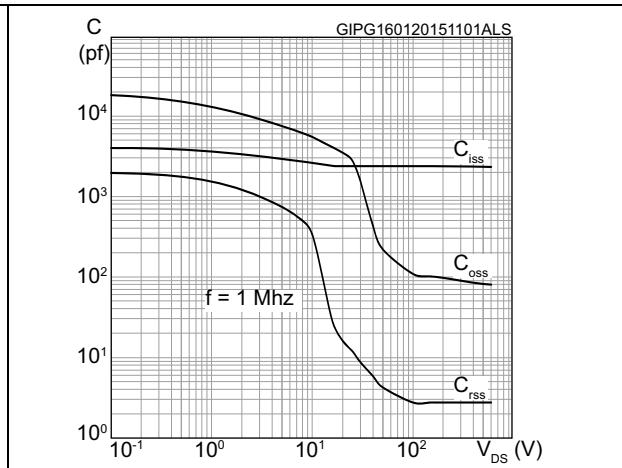


Figure 12. Output capacitance stored energy

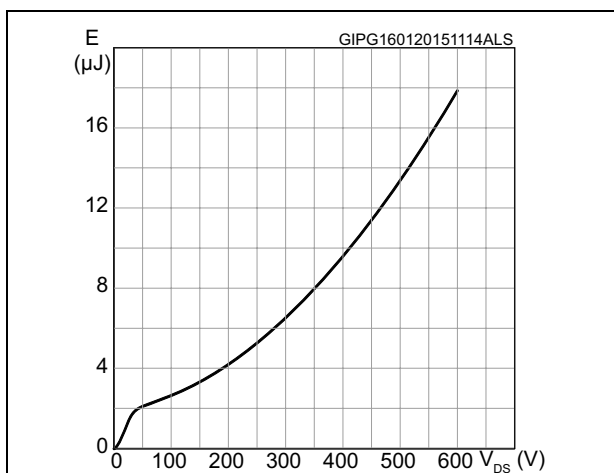


Figure 13. Normalized gate threshold voltage vs temperature

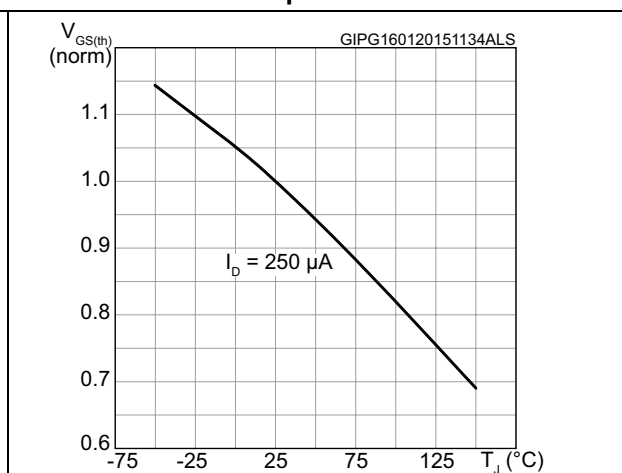


Figure 14. Normalized on-resistance vs temperature

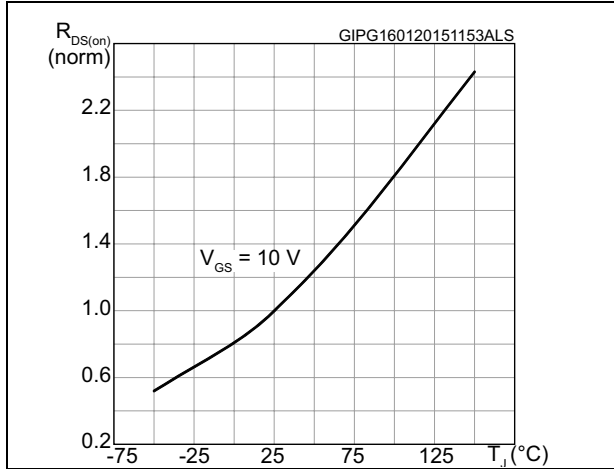


Figure 15. Normalized  $V_{(BR)DSS}$  vs temperature

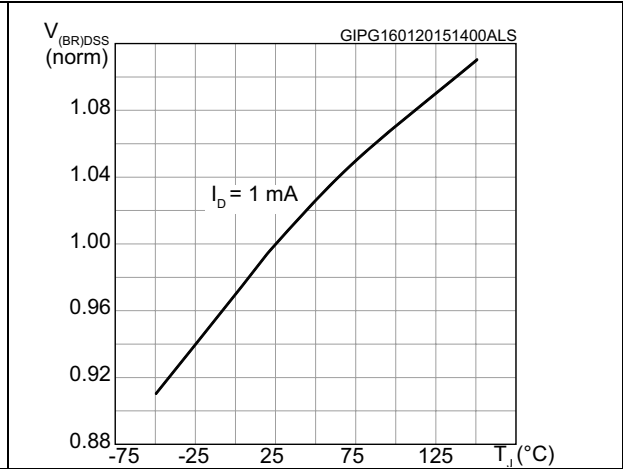
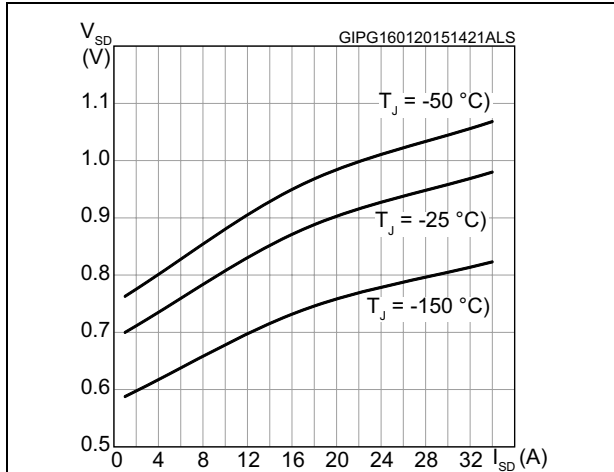


Figure 16. Source-drain diode forward vs temperature





### 3 Test circuits

Figure 17. Switching times test circuit for resistive load

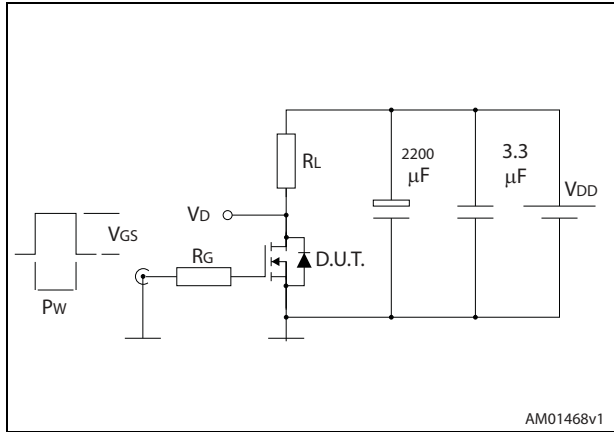


Figure 18. Gate charge test circuit

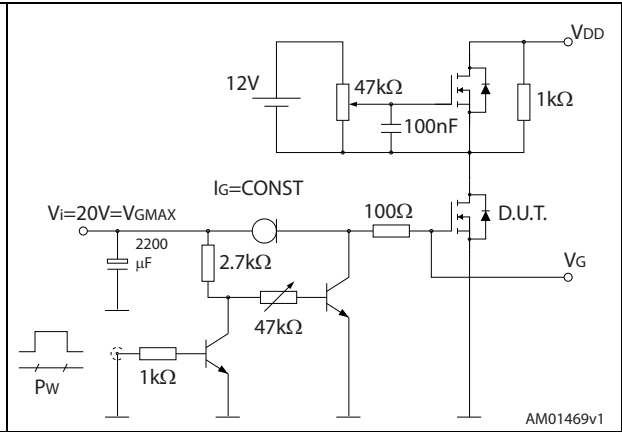


Figure 19. Test circuit for inductive load switching and diode recovery times

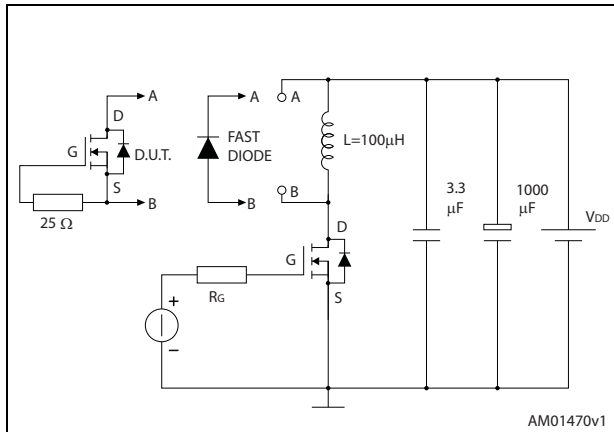


Figure 20. Unclamped inductive load test circuit

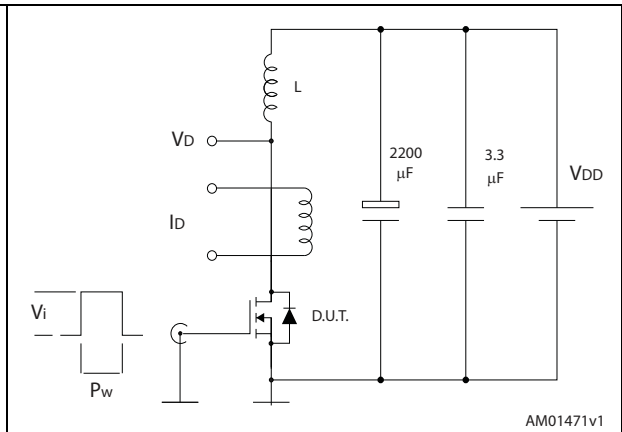


Figure 21. Unclamped inductive waveform

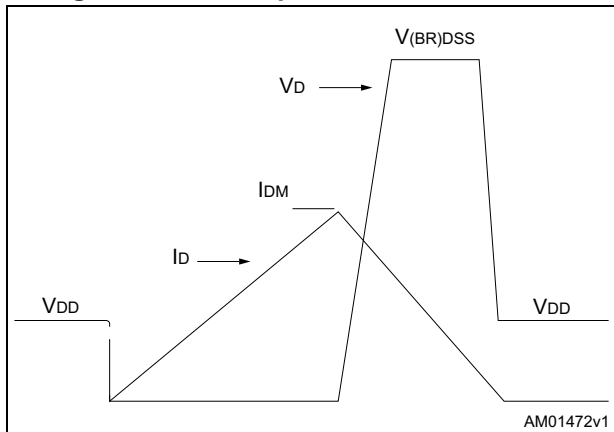
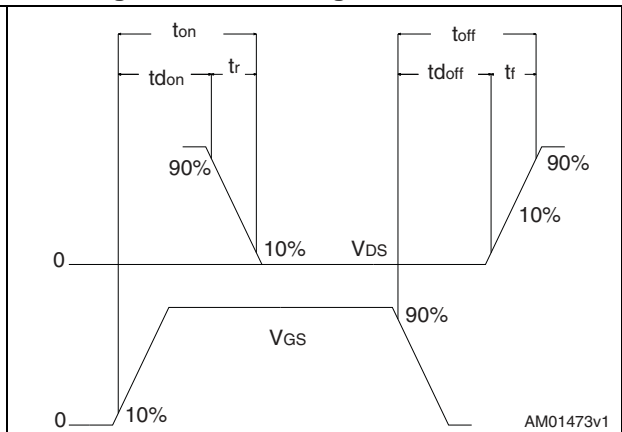


Figure 22. Switching time waveform

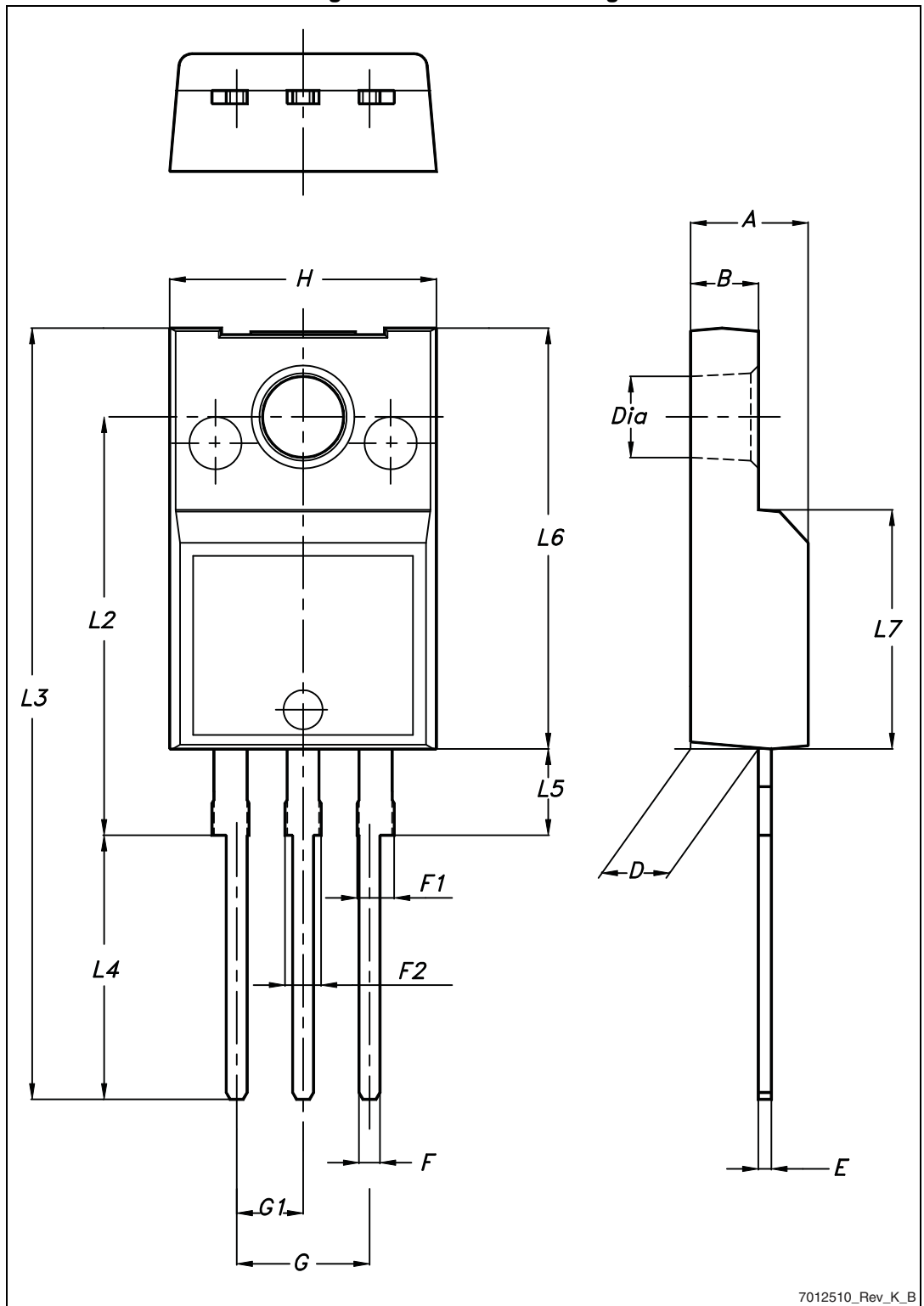


## 4 Package mechanical data

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<sup>®</sup> is an ST trademark.

### 4.1 TO-220FP, STF42N60M2-EP

Figure 23. TO-220FP drawing



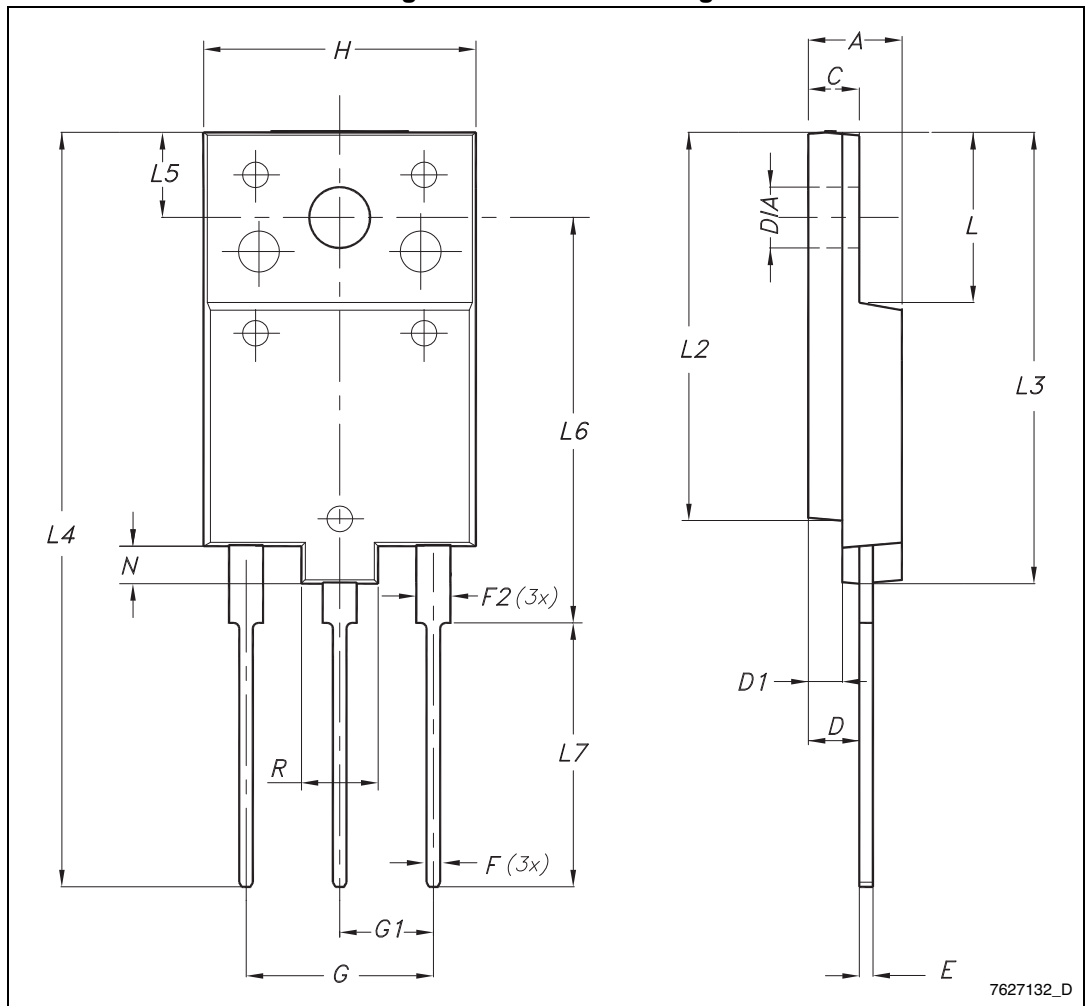
7012510\_Rev\_K\_B

Table 10. 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		1.70
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

### 4.2 TO-3PF, STFW42N60M2-EP

Figure 24. TO-3PF drawing



7627132\_D

Table 11. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

## 5 Revision history

Table 12. Document revision history

Date	Revision	Changes
21-Jan-2015	1	First release.

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