STF1N105K3, STFW1N105K3, STP1N105K3

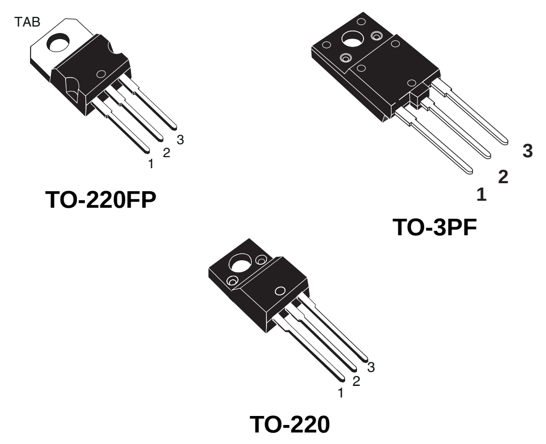
N-channel 1050 V, 8 Ω typ., 1.4 A SuperMESH3™ Power MOSFET in TO-220FP, TO-3PF and TO-220 packages

Datasheet — production data

Features

Order codes	V_{DS}	$R_{DS(on)}$ max	I_D	P_{TOT}
STF1N105K3	1050 V	11 Ω	1.4 A	20 W
STFW1N105K3				
STP1N105K3				60 W

- Gate charge minimized
- Extremely large avalanche performance
- 100% avalanche tested
- Very low intrinsic capacitance



Applications

- Switching applications

Description

These SuperMESH3™ Power MOSFETs are the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

Figure 1. Internal schematic diagram

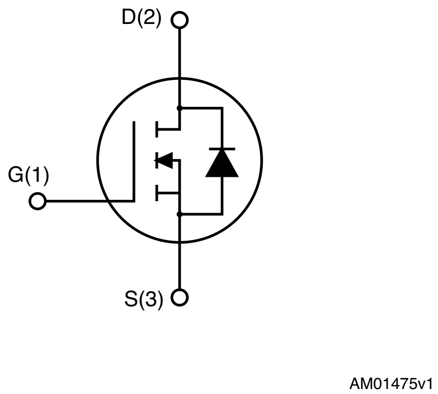


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF1N105K3	1N105K3	TO-220FP	Tube
STFW1N105K3		TO-3PF	
STP1N105K3		TO-220	

Contents

1 Electrical ratings

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Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220FP	TO-3PF	TO-220	
V_{DS}	Drain source voltage	1050			V
V_{GS}	Gate- source voltage	± 30			V
I_D	Drain current (continuous) at T_C = 25 °C	1.4(1)		1.4	A
I_D	Drain current (continuous) at T_C = 100 °C	0.9(1)		0.9	A
I_{DM} (2)	Drain current (pulsed)	5.6(1)		5.6	A
P_{TOT}	Total dissipation at T_C = 25 °C	20		60	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	1.2			A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D=I_{AR}, V_{DD}= 50 V)	130			mJ
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; TC = 25 °C)	2500	3500		V
dv/dt (3)	Peak diode recovery voltage slope	6			V/ns
T_j T_{stg}	Operating junction temperature Storage temperature	- 55 to 150			°C

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. I_{SD} ≤ 1.4 A, di/dt ≤ 100 A/μs, V_{DD} = 80% $V_{(BR)DSS}$, V_{DS} peak ≤ $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220FP	TO-3PF	TO-220	
Rthj-case	Thermal resistance junction-case max	6.25		2.08	°C/W
Rthj-amb	Thermal resistance junction-amb max	62.50	50	62.50	°C/W

2 Electrical characteristics

(T_{CASE} = 25 °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 = 1 mA, V_{GS}= 0	1050			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 1050 V, V_{DS} = 1050 V, Tc=125 °C			1 50	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			±50	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	2	3	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D= 0.6 A		8	11	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} =100 V, f=1 MHz, V_{GS}=0	-	180 15 1	-	pF pF pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0, V_{DS} = 0 to 840 V	-	11	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	7	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	18	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 840 V, I_D = 1.2 A V_{GS} =10 V *(see Figure 18)*	-	13 1.6 8	-	nC nC nC

1. Time related 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}
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 525 V, I_D = 0.6 A, R_G=4.7 Ω, V_{GS}=10 V *(see Figure 20)*	-	6 7 27 50	-	ns ns 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)		-		1.4 5.6	mA A
V_{SD} (1)	Forward on voltage	I_{SD}= 1.2 A, V_{GS}=0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 1.2 A, V_{DD}= 60 V di/dt = 100 A/µs, *(see Figure 19)*	-		244 1 9	ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 1.2 A,V_{DD}= 60 V di/dt=100 A/µs, Tj=25 °C*(see Figure 19)*	-		330 1.3 8	ns µC A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220FP and TO-3PF

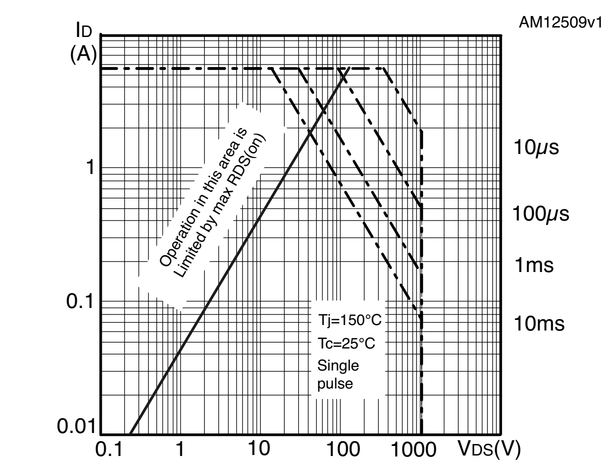


Figure 3. Thermal impedance for TO-220FP and TO-3PF

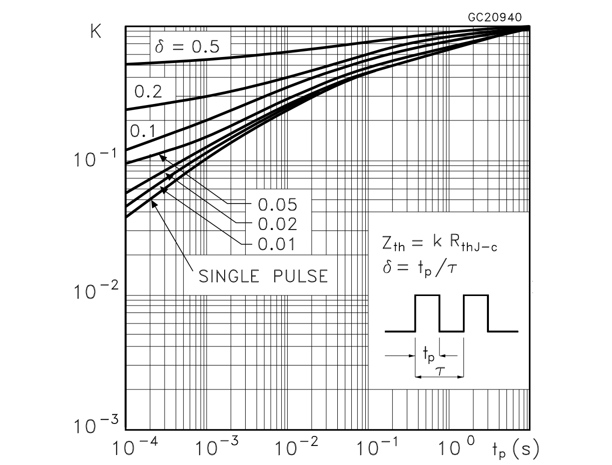


Figure 4. Safe operating area for TO-220

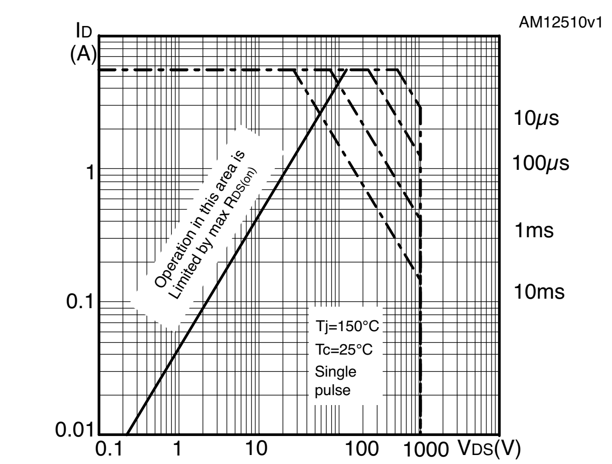


Figure 5. Thermal impedance for TO-220

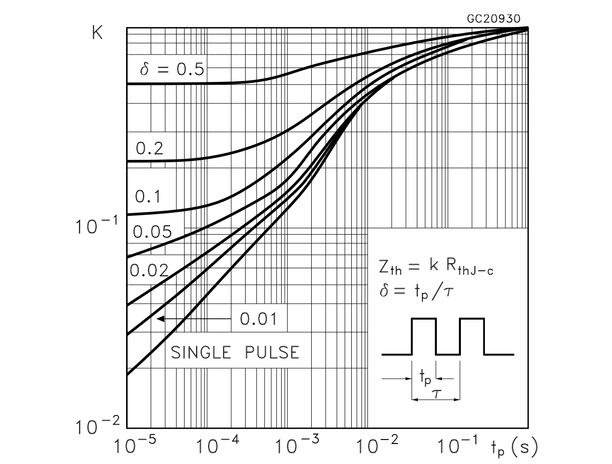


Figure 6. Output characteristics

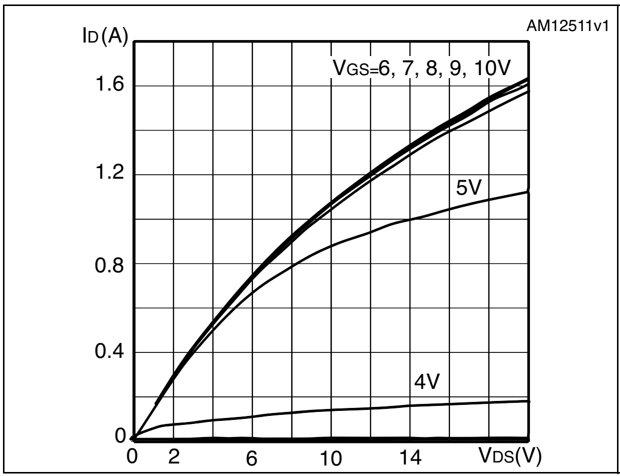


Figure 7. Transfer characteristics

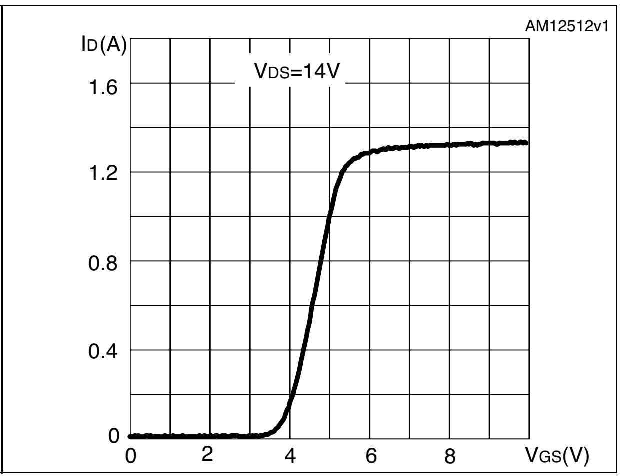


Figure 8. Gate charge vs gate-source voltage

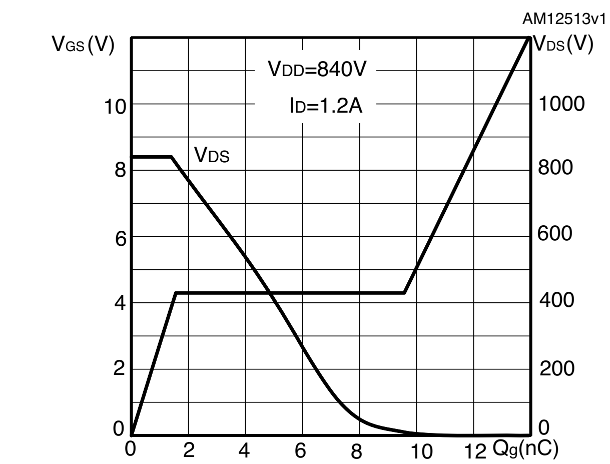


Figure 9. Static drain-source on-resistance

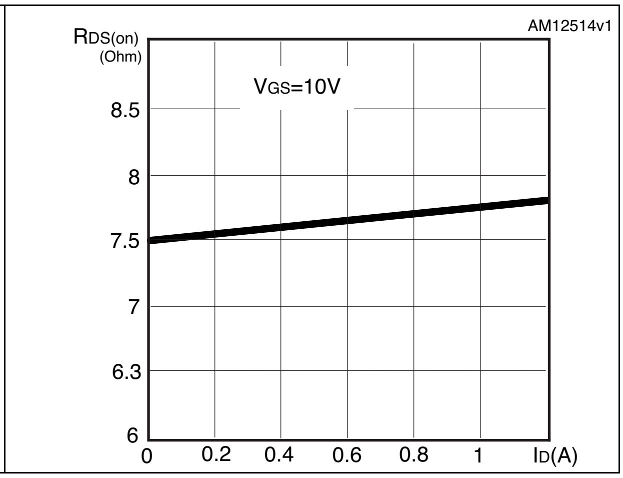


Figure 10. Capacitance variations

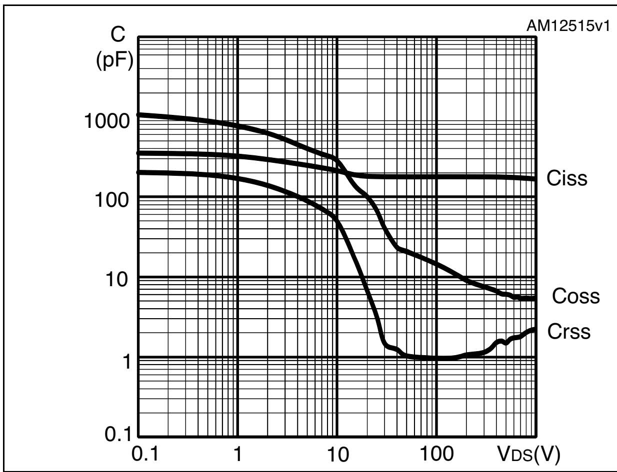


Figure 11. Output capacitance stored energy

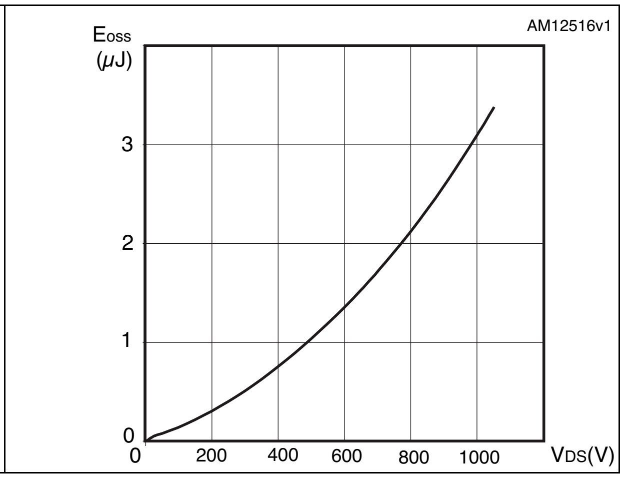


Figure 12. Normalized gate threshold voltage vs temperature

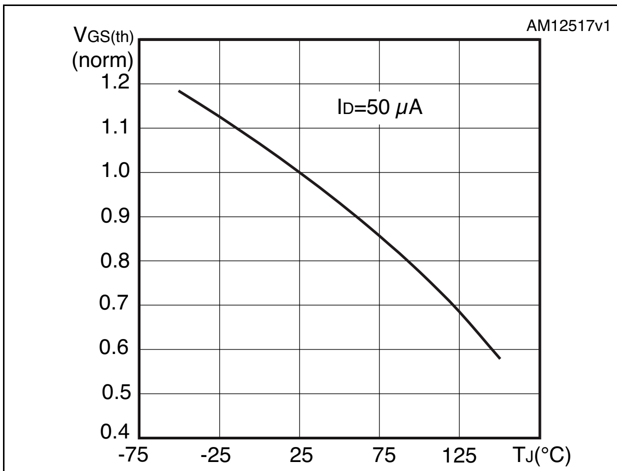


Figure 13. Normalized on-resistance vs temperature

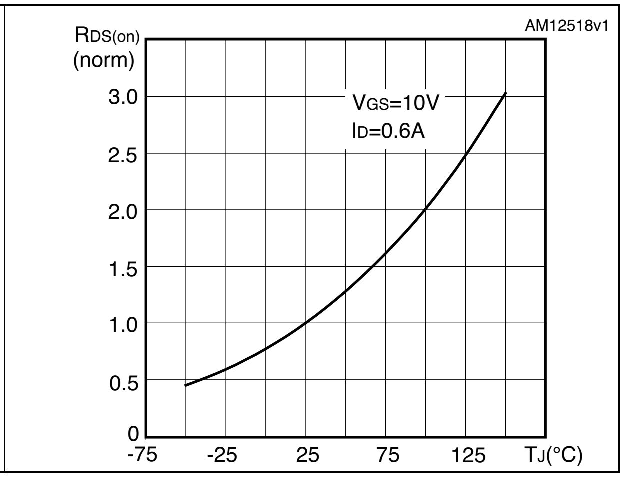


Figure 14. Source-drain diode forward characteristics

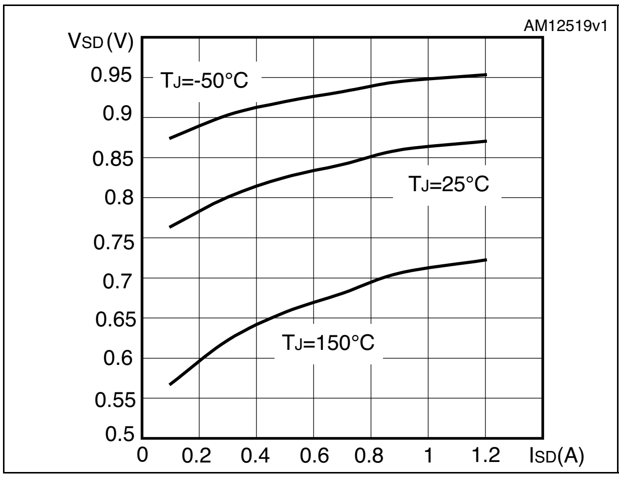


Figure 15. Normalized B_{VDSS} vs temperature

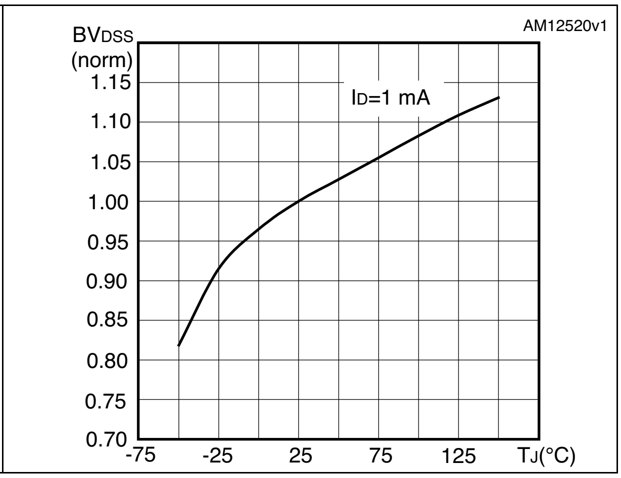
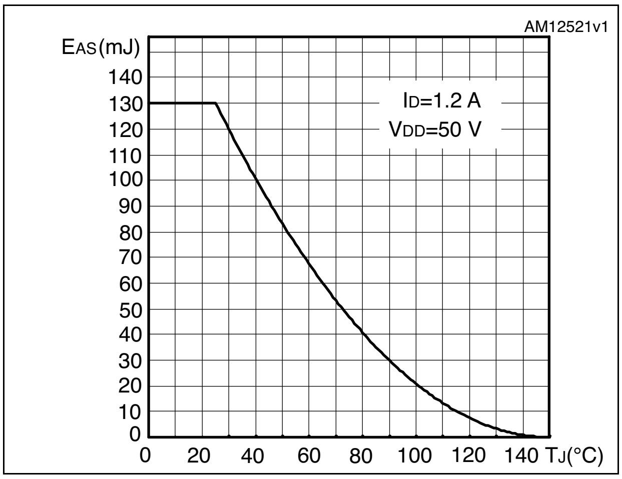


Figure 16. Maximum avalanche energy vs starting Tj



3 Test circuits

Figure 17. Switching times test circuit for resistive load

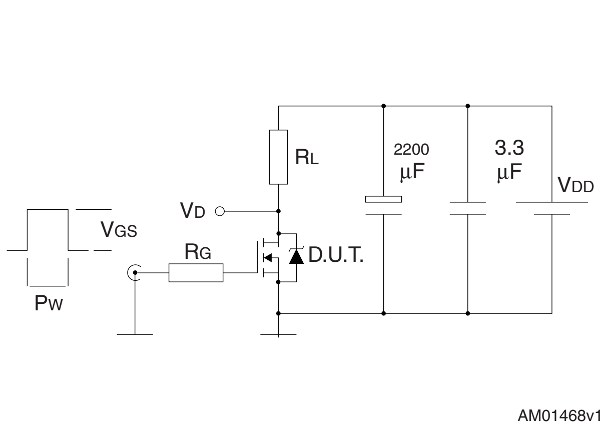


Figure 18. Gate charge test circuit

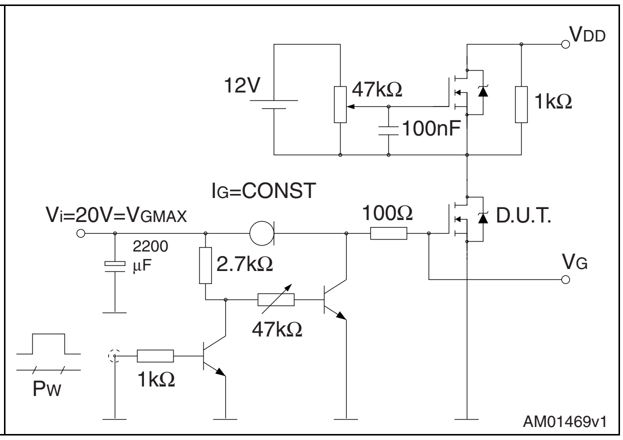


Figure 19. Test circuit for inductive load switching and diode recovery times

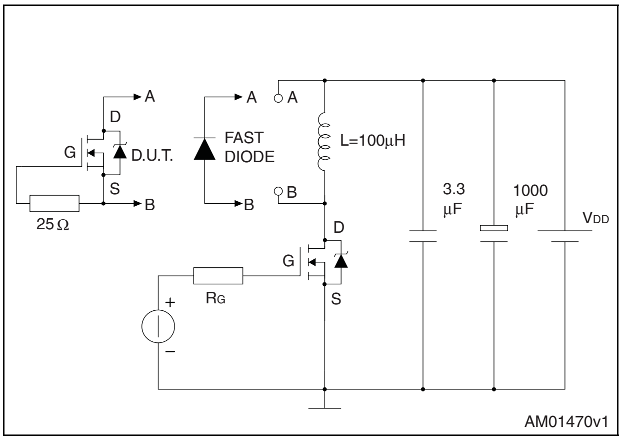


Figure 20. Unclamped inductive load test circuit

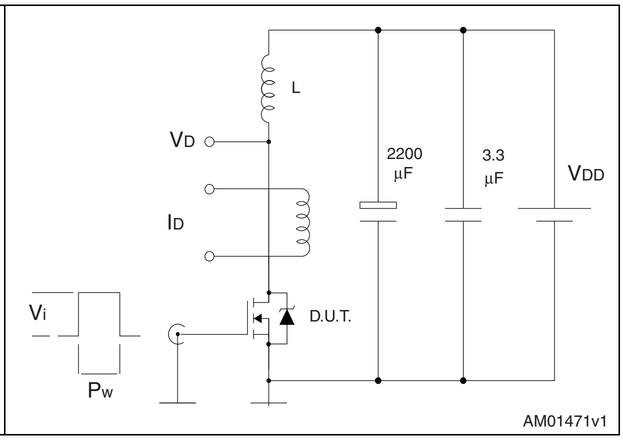


Figure 21. Unclamped inductive waveform

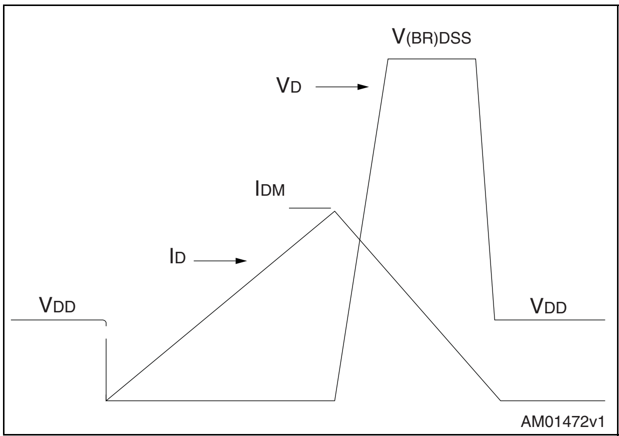
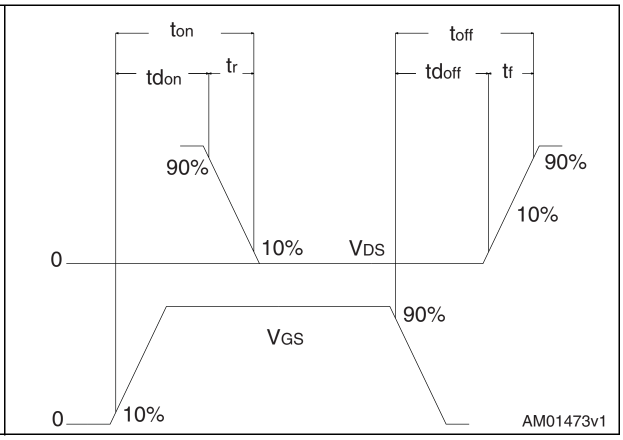


Figure 22. Switching time waveform



4 Package mechanical data

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

Table 8. 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

Figure 23. TO-220FP drawing

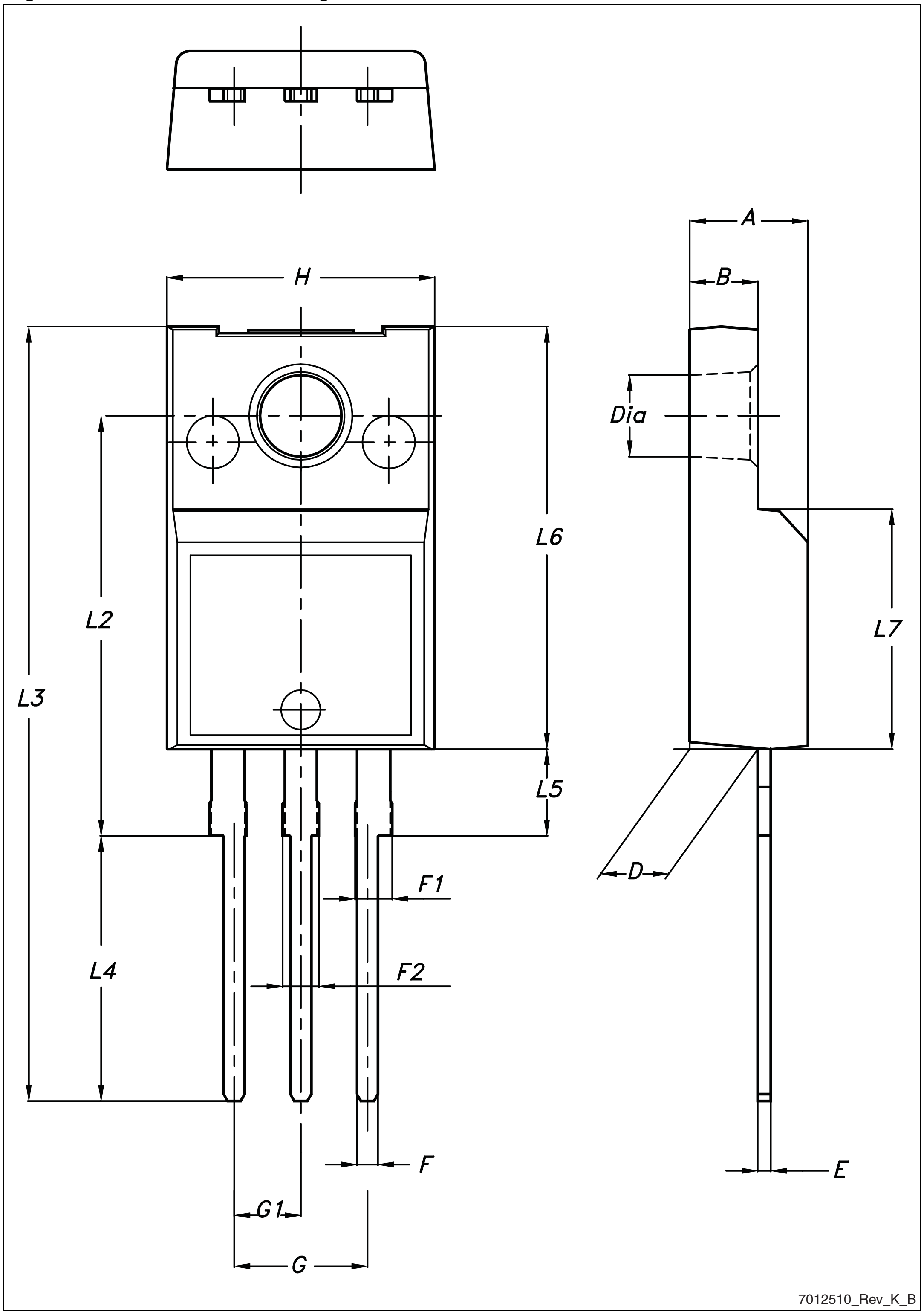


Table 9. TO-3PF mechanical data

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

Figure 24. TO-3PF drawing

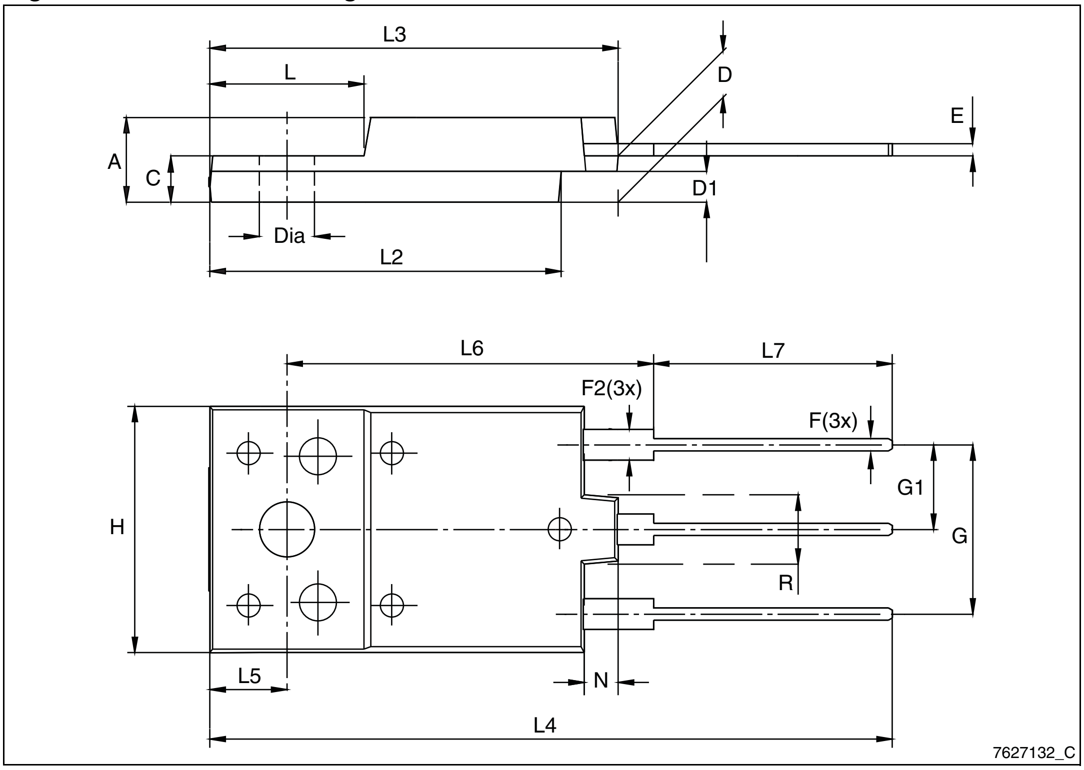
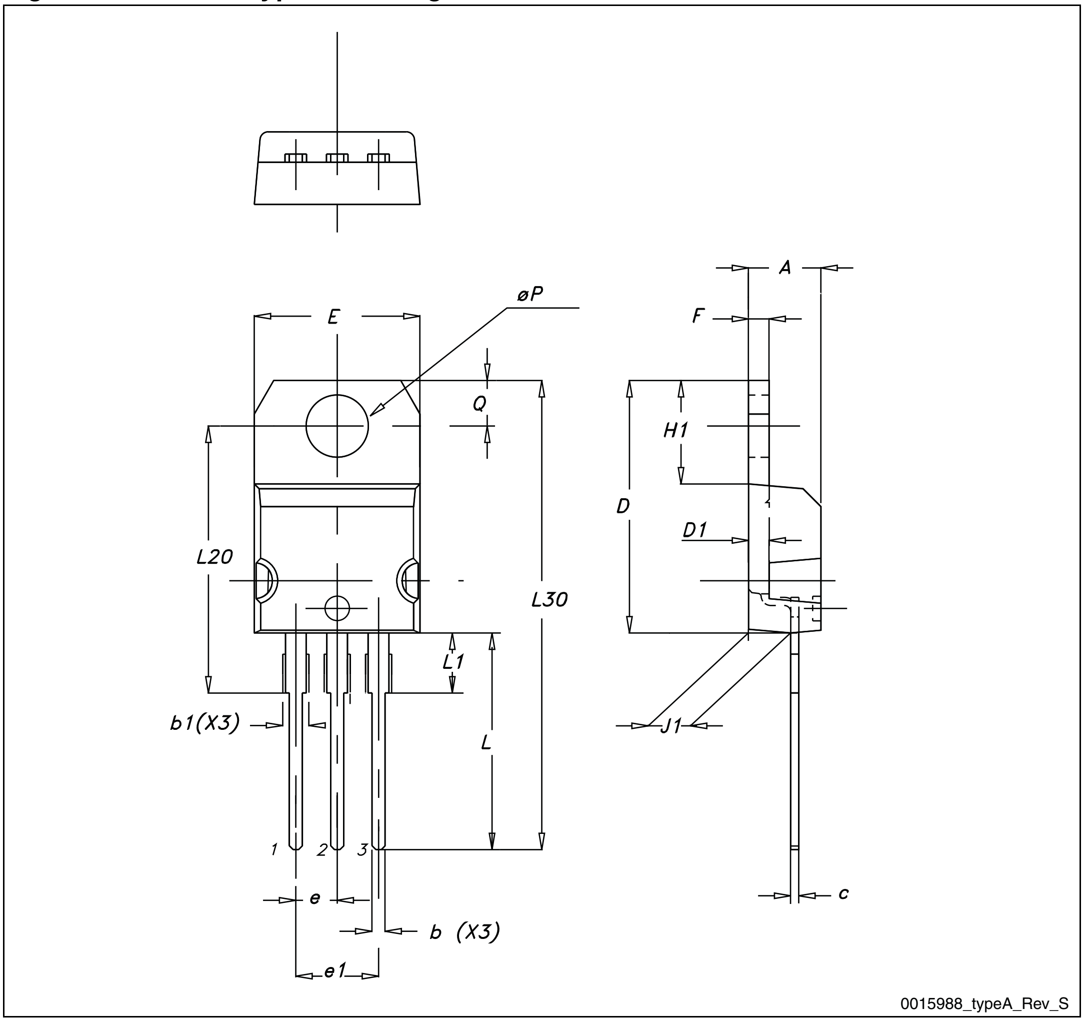


Table 10. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

Figure 25. TO-220 type A drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
13-Aug-2012	1	First release.
23-Jan-2013	2	Added device in TO-3PF.