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STF18N65M5, STI18N65M5, STP18N65M5, STW18N65M5

N-channel 650 V, 0.198 Ω typ., 15 A MDmesh™ V Power MOSFET in TO-220FP, I²PAK, TO-220 and TO-247 packages

Datasheet — production data

Features

Order code	V_{DSS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D
STF18N65M5	710 V	< 0.22 Ω	15 A
STI18N65M5			
STP18N65M5			
STW18N65M5			

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating and high dv/dt capability
- Excellent switching performance
- 100% avalanche tested

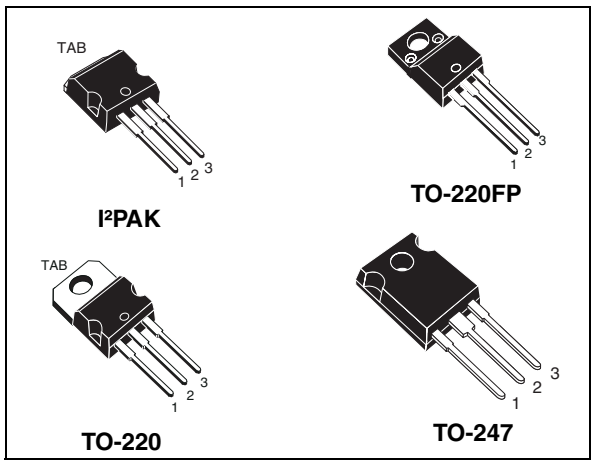
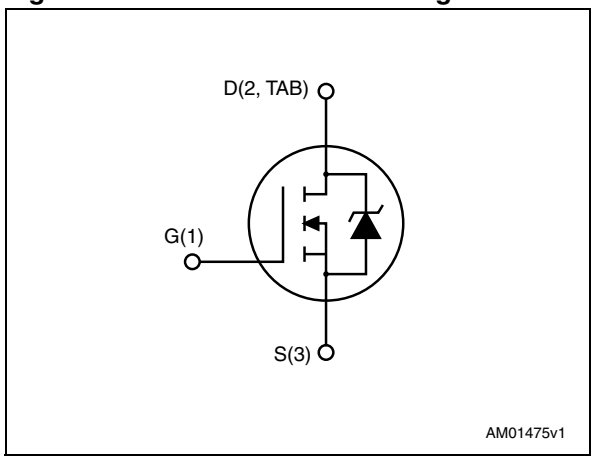


Figure 1. Internal schematic diagram



Applications

- Switching applications

Description

These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Table 1. Device summary

Order code	Marking	Package	Packaging
STF18N65M5	18N65M5	TO-220FP	Tube
STI18N65M5		I²PAK	
STP18N65M5		TO-220	
STW18N65M5		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		I²PAK	TO-220	TO-247	TO-220FP	
V_{GS}	Gate-source voltage	± 25				V
I_D	Drain current (continuous) at T_C = 25 °C	15			15 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	9.4			9.4 (1)	A
I_{DM} (1)	Drain current (pulsed)	60			60 (1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	110			25	W
dv/dt (2)	Peak diode recovery voltage slope	15				V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; Tc = 25 °C)				2500	V
T_{stg}	Storage temperature	- 55 to 150				°C
T_j	Max. operating junction temperature	150				°C

1. Limited by maximum junction temperature.
2. $I_{SD} \leq 15$ A, di/dt ≤400 A/µs; $V_{DSPeak} < V_{(BR)DSS}$, V_{DD} = 400 V

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		I²PAK	TO-220	TO-247	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.14			5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5		50	62.5	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetetive or not repetetive (pulse width limited by T_{jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D= I_{AR}; V_{DD} = 50 V)	210	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 5. 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	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 650 V V_{DS} = 650 V, T_C=125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 7.5 A		0.198	0.22	Ω

Table 6. 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	-	1240 32 3.2	-	pF pF pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{DS} = 0 to 520 V, V_{GS} = 0	-	99	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	30	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	3	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 520 V, I_D = 7.5 A, V_{GS} = 10 V (see *Figure 20*)	-	31 8 14	-	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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(V)}$	Voltage delay time	V_{DD} = 400 V, I_D = 9.5 A,	-	36	-	ns
$t_{r(V)}$	Voltage rise time	R_G = 4.7 Ω, V_{GS} = 10 V		7		ns
$t_{f(i)}$	Current fall time	(see *Figure 21* and		9		ns
$t_{c(off)}$	Crossing time	*Figure 24*)		11		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		15	A
I_{SDM} (1)	Source-drain current (pulsed)				60	A
V_{SD} (2)	Forward on voltage	I_{SD} = 15 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 15 A, di/dt = 100 A/µs	-	290		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V (see *Figure 24*)		3.4		µC
I_{RRM}	Reverse recovery current			23.5		A
t_{rr}	Reverse recovery time	I_{SD} = 15 A, di/dt = 100 A/µs	-	352		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_j = 150 °C		4		µC
I_{RRM}	Reverse recovery current	(see *Figure 24*)		24		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for I²PAK and TO-220

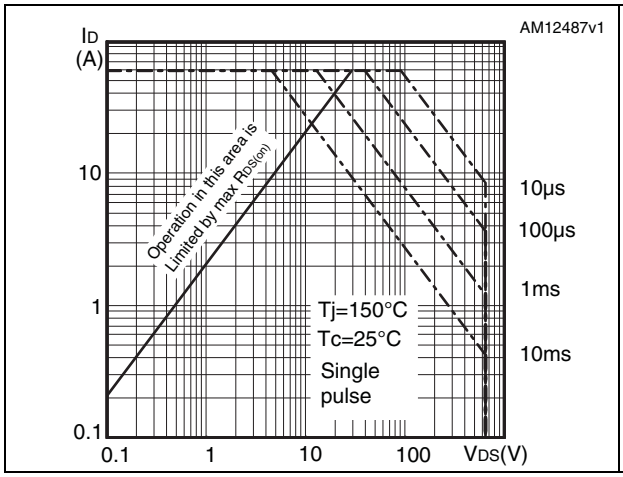


Figure 3. Thermal impedance for I²PAK and TO-220

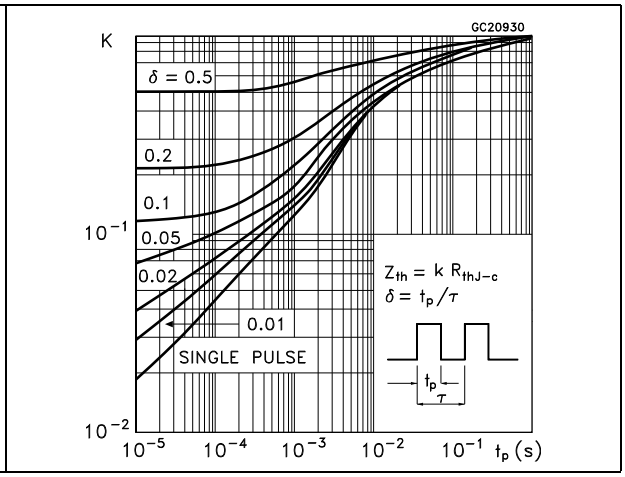


Figure 4. Safe operating area TO220FP

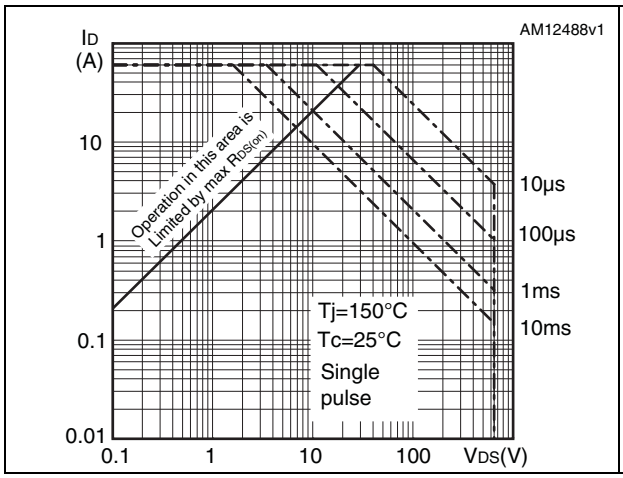


Figure 5. Thermal impedance for TO-220FP

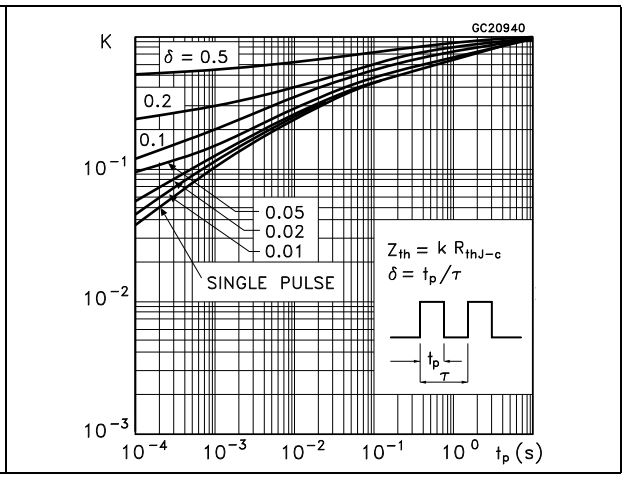


Figure 6. Safe operating area TO-247

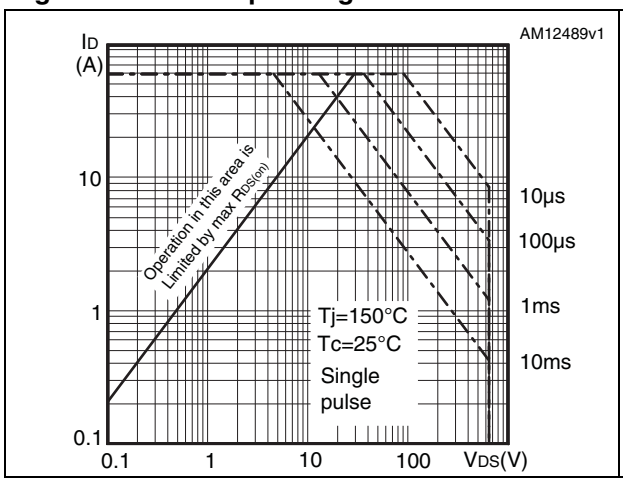


Figure 7. Thermal impedance TO-247

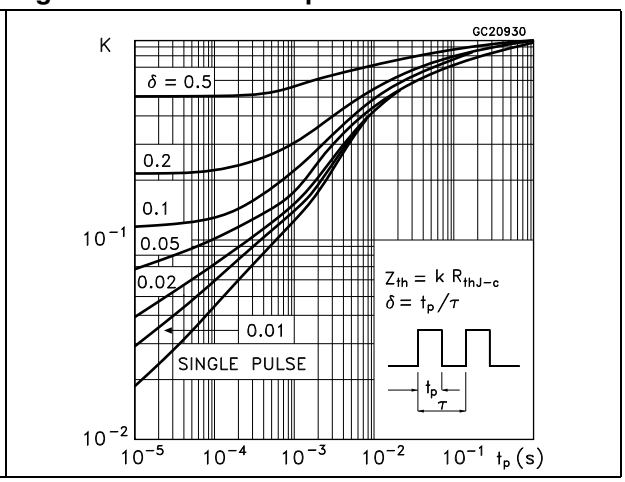


Figure 8. Output characteristics

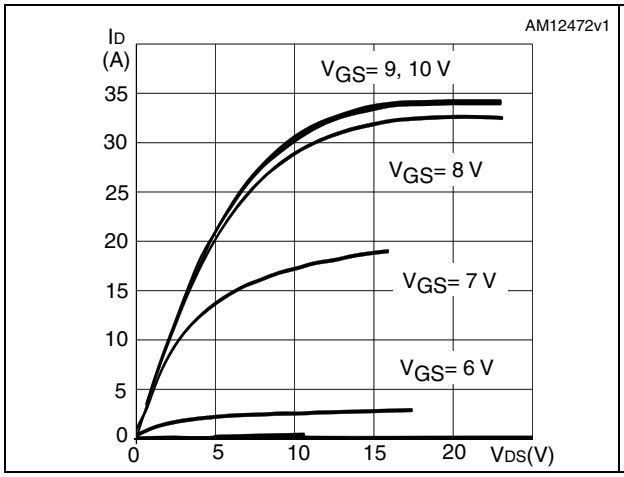


Figure 9. Transfer characteristics

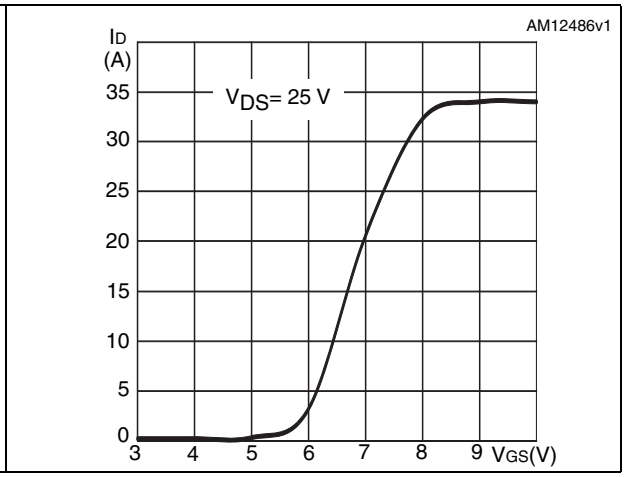


Figure 10. Gate charge vs gate-source voltage

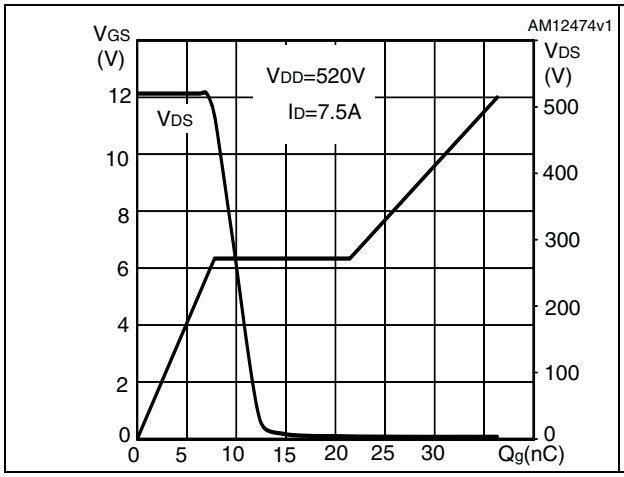


Figure 11. Static drain-source on-resistance

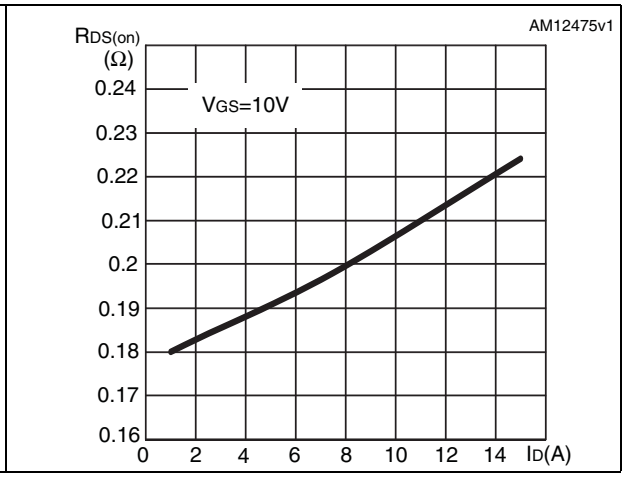


Figure 12. Capacitance variations

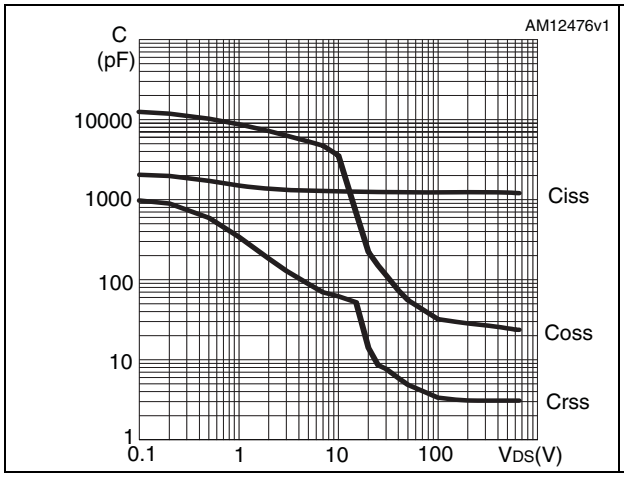


Figure 13. Output capacitance stored energy

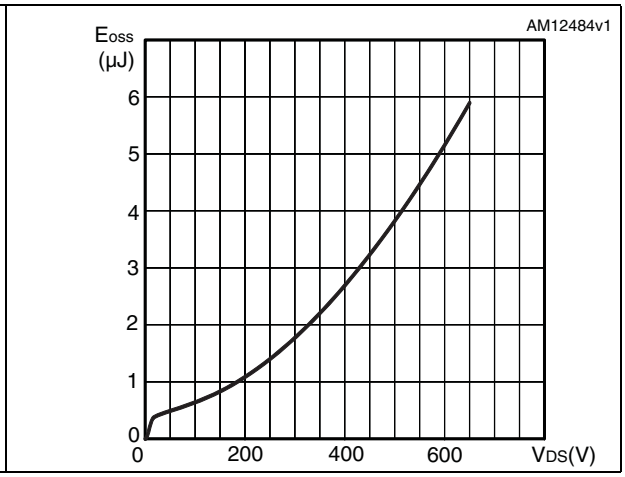


Figure 14. Normalized gate threshold voltage vs temperature

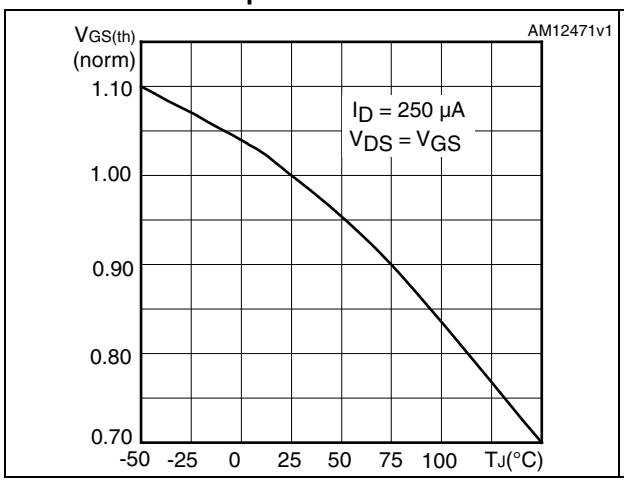


Figure 15. Normalized on-resistance vs temperature

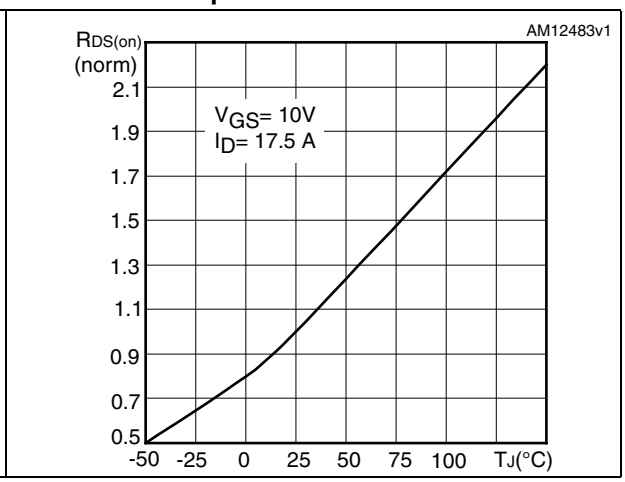


Figure 16. Drain-source diode forward characteristics

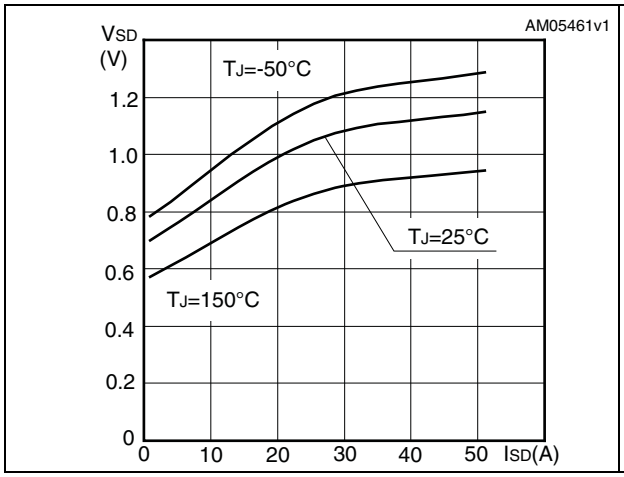


Figure 17. Normalized B_{VDSS} vs temperature

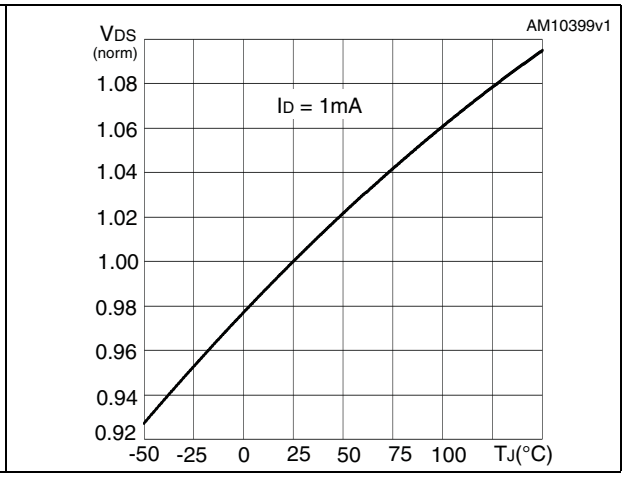
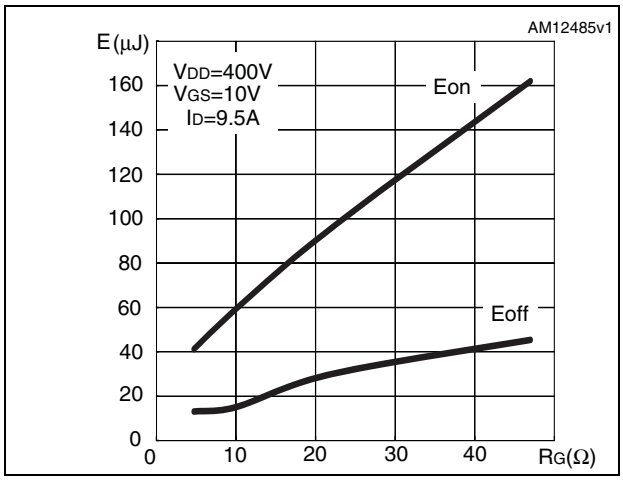


Figure 18. Switching losses vs gate resistance (1)



1. Eon including reverse recovery of a SiC diode

3 Test circuits

Figure 19. Switching times test circuit for resistive load

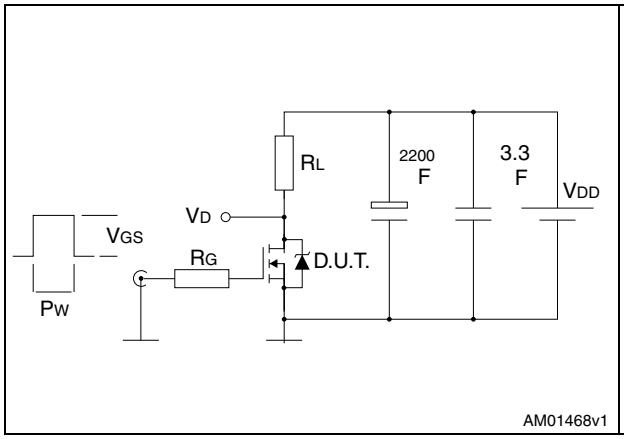


Figure 20. Gate charge test circuit

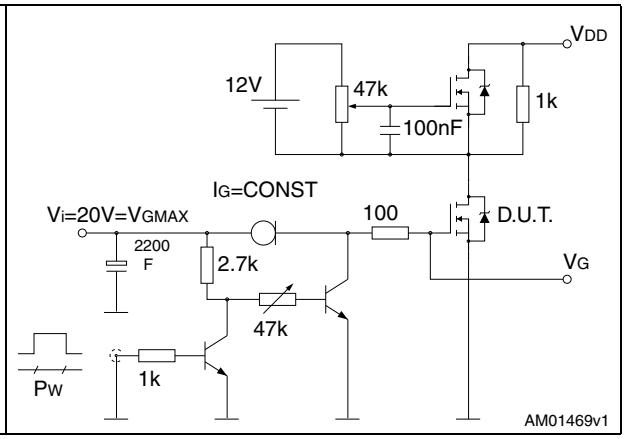


Figure 21. Test circuit for inductive load switching and diode recovery times

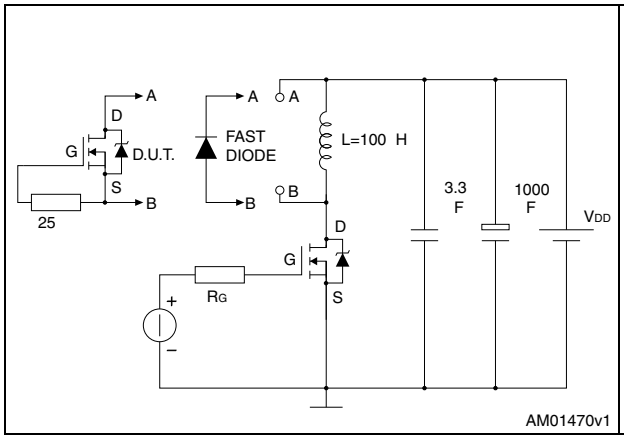


Figure 22. Unclamped inductive load test circuit

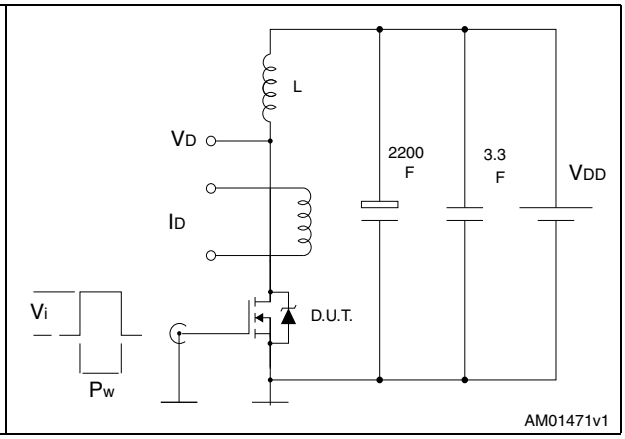


Figure 23. Unclamped inductive waveform

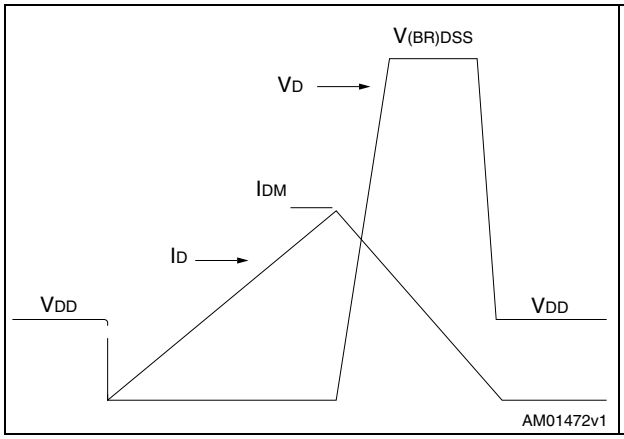
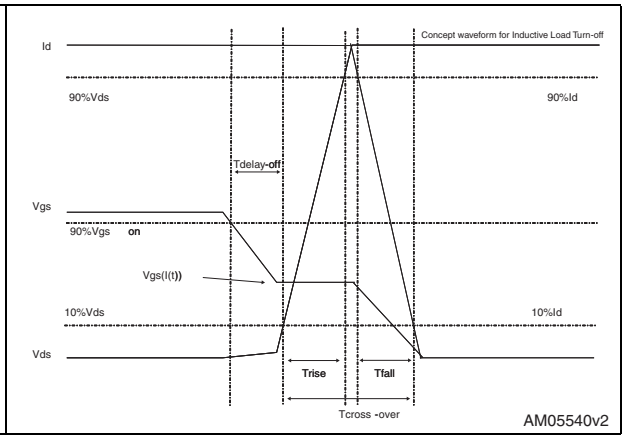


Figure 24. Switching time waveform



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 9. 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 25. TO-220FP drawing

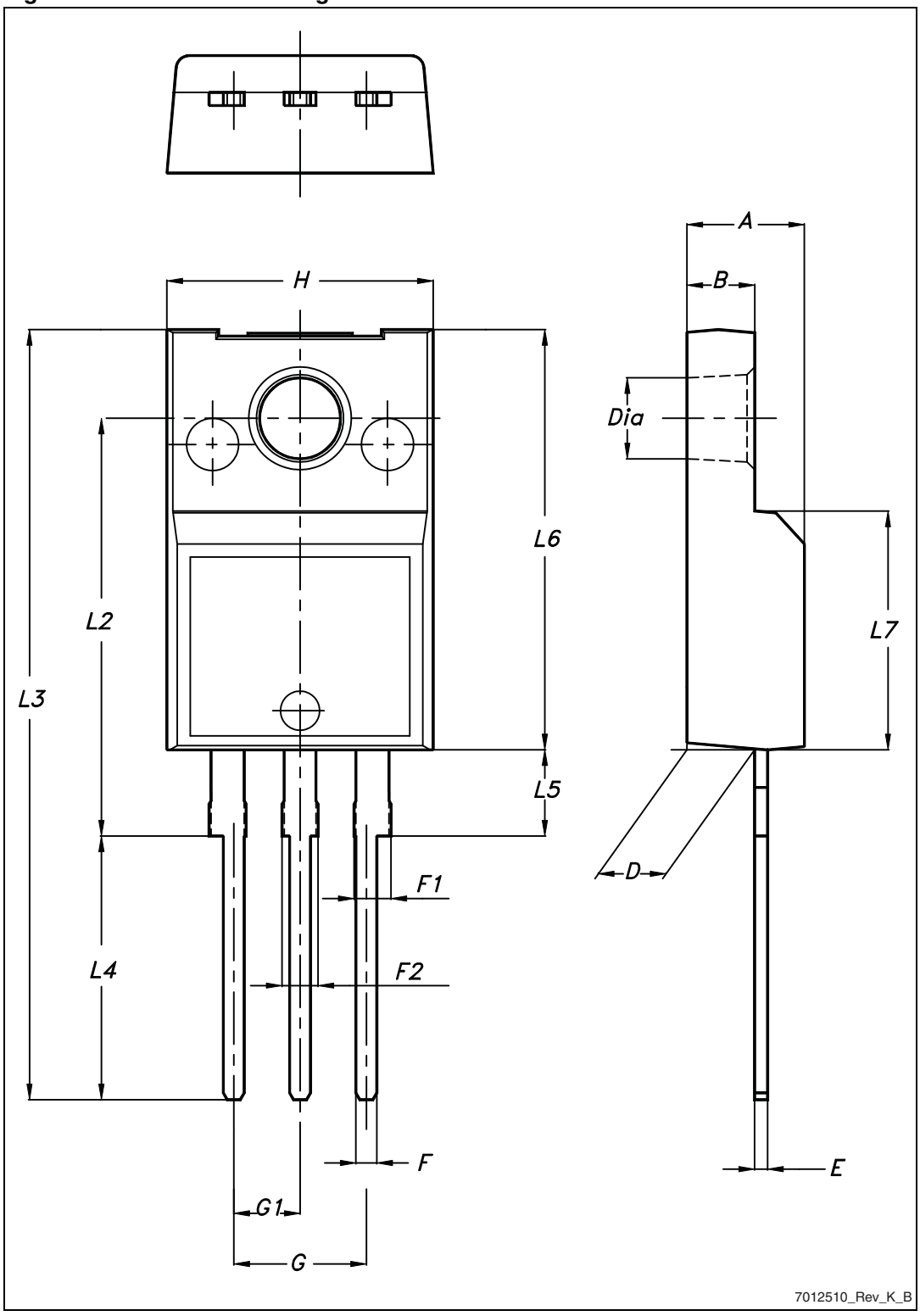


Table 10. I²PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 26. I²PAK (TO-262) drawing

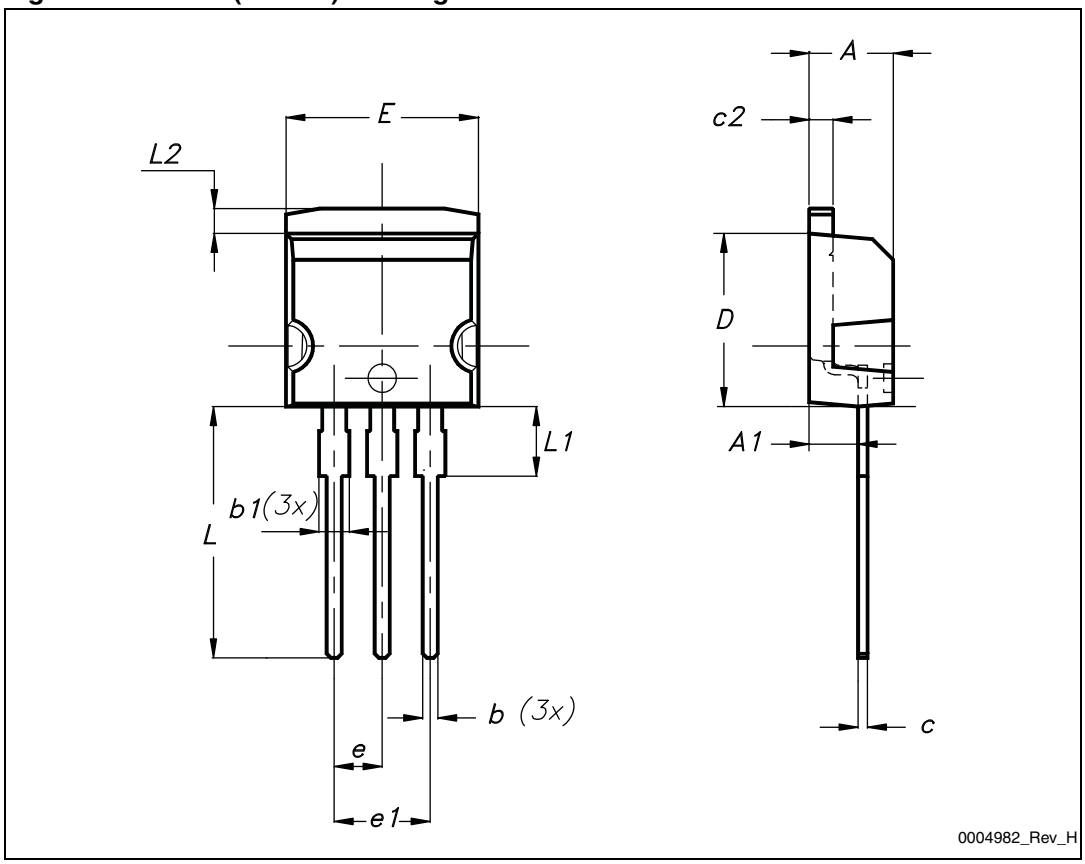


Table 11. TO-220 type A mechanical data

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 27. TO-220 type A drawing

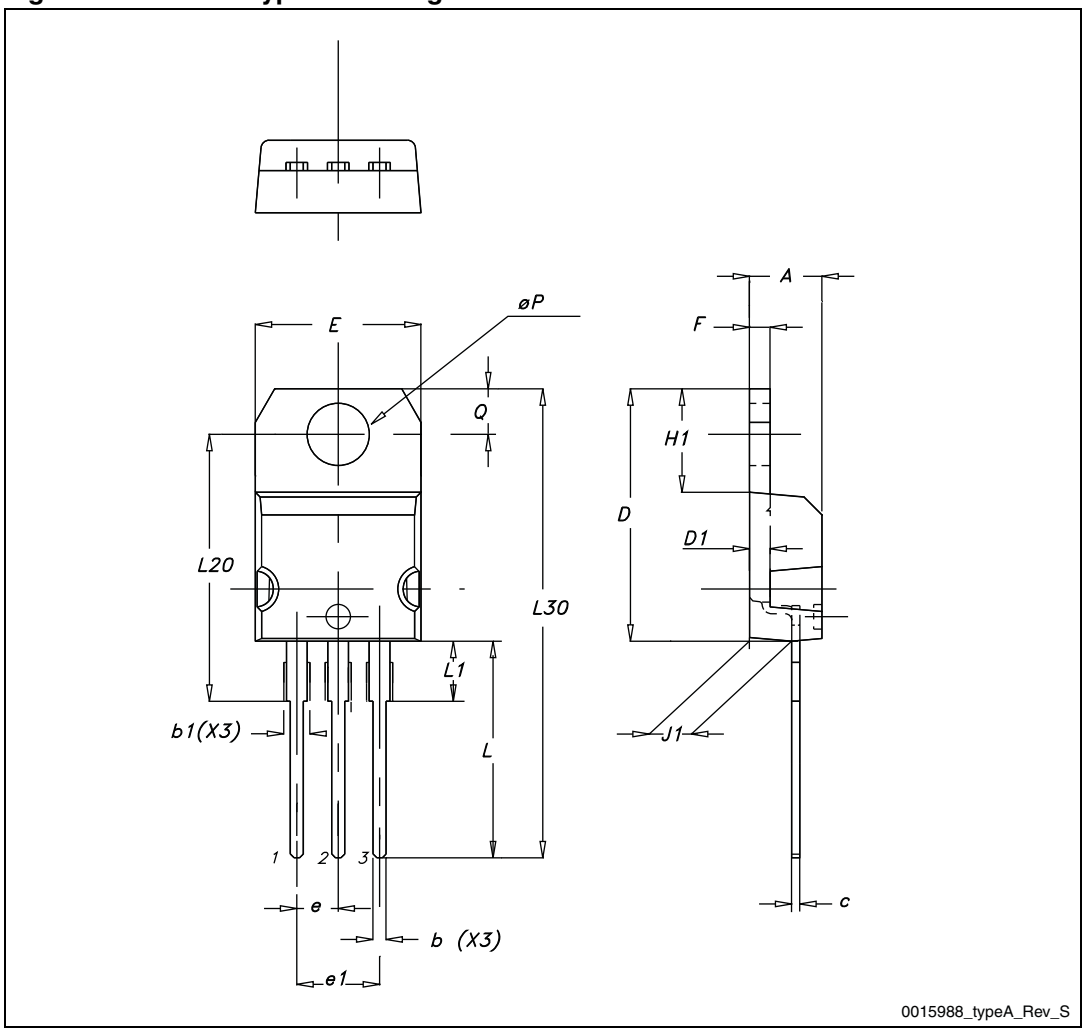
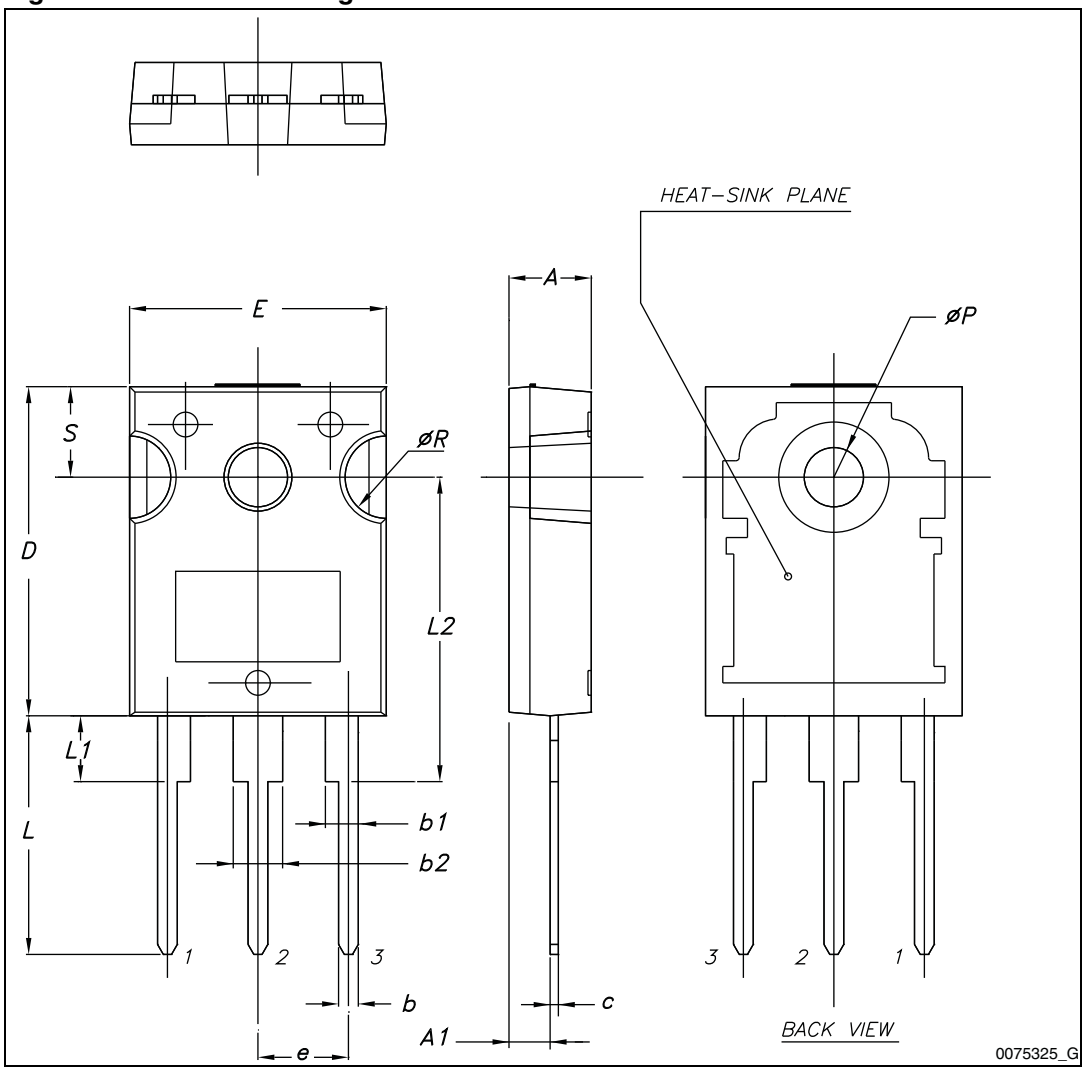


Table 12. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 28. TO-247 drawing



5 Revision history

Table 13. Document revision history

Date	Revision	Changes
01-Mar-2012	1	First release.
11-Jul-2012	2	The part numbers STB18N65M5 and STD18N65M5 have been moved to a separate datasheet. The part numbers STI18N65M5 and STW18N65M5 in I²PAK and TO-247 packages have been added. Document status promoted from preliminary data to production data. Added *Section 2.1: Electrical characteristics (curves)*.
19-Jul-2012	3	Updated *Figure 8: Output characteristics*, *Figure 11: Static drain-source on-resistance* and *Figure 14: Normalized gate threshold voltage vs temperature*.