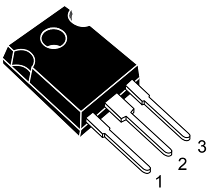
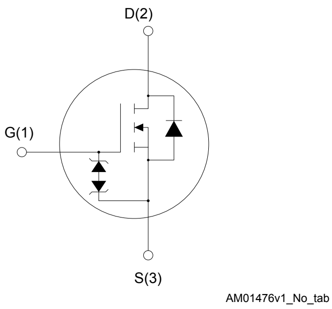
STW20N60M2-EP

N-channel 600 V, 0.230 Ω typ., 13 A MDmesh™ M2 EP Power MOSFET in a TO-247 package



TO-247



Product status link
STW20N60M2-EP

Product summary	
Order code	STW20N60M2-EP
Marking	20N60M2EP
Package	TO-247
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW20N60M2-EP	600 V	0.278 Ω	13 A

- 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

This device is an N-channel Power MOSFET developed using MDmesh™ M2 enhanced performance (EP) technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance, optimized switching characteristics with very low turn-off switching losses, rendering it suitable for the most demanding very high frequency converters.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	13	A
I_D	Drain current (continuous) at T_C = 100 °C	8	A
I_{DM} (1)	Drain current (pulsed)	52	A
P_{TOT}	Total dissipation at T_C = 25 °C	110	W
dv/dt(2)	Peak diode recovery voltage slope	15	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	V/ns
T_J	Operating junction temperature range	- 55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area.*
2. *$I_{SD} \leq 13$ A, di/dt ≤ 400 A/μs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *$V_{DS} \leq 480$ V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.14	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	2.7	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, $I_D = I_{AR}$; V_{DD} = 50 V)	138	mJ

2 Electrical characteristics

T_C = 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	V_{GS} = 0 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage Drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C[1]			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 6.5 A		0.230	0.278	Ω

1. *Defined by design, not subject to production test.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 100 V, f = 1 MHz, V_{GS} = 0 V	-	787	-	pF
C_{oss}	Output capacitance		-	50	-	
C_{rss}	Reverse transfer capacitance		-	1.2	-	
$C_{oss\ eq.}$ [1]	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	89	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	5.9	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 13 A, V_{GS} = 0 to 10 V (see Figure 15. Test circuit for gate charge behavior)	-	22	-	nC
Q_{gs}	Gate-source charge		-	3.5	-	
Q_{gd}	Gate-drain charge		-	10.5	-	

1. *$C_{oss\ eq.}$ 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 6. Switching energy

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{off}	Turn-off energy (from 90% V_{GS} to 0% I_D)	V_{DD}= 400 V, I_D = 2 A, R_G= 4.7 Ω, V_{GS}= 10 V	-	7.2	-	µJ
		V_{DD}= 400 V, I_D = 5 A, R_G= 4.7 Ω, V_{GS}= 10 V	-	20.4	-	µJ

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 6.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	10.5	-	ns
t_r	Rise time		-	5.2	-	ns
$t_{d(off)}$	Turn-off delay time		-	41	-	ns
t_f	Fall time		-	8	-	ns

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		13	A
I_{SDM} (1)	Source-drain current (pulsed)		-		52	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 13 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	230		ns
Q_{rr}	Reverse recovery charge		-	2.3		µC
I_{RRM}	Reverse recovery current		-	20		A
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	287		ns
Q_{rr}	Reverse recovery charge		-	2.9		µC
I_{RRM}	Reverse recovery current		-	20.2		A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

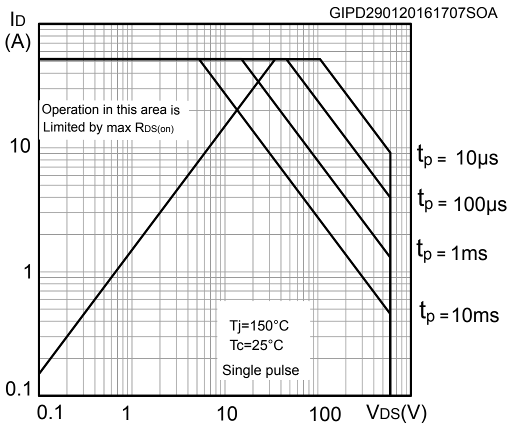


Figure 2. Thermal impedance

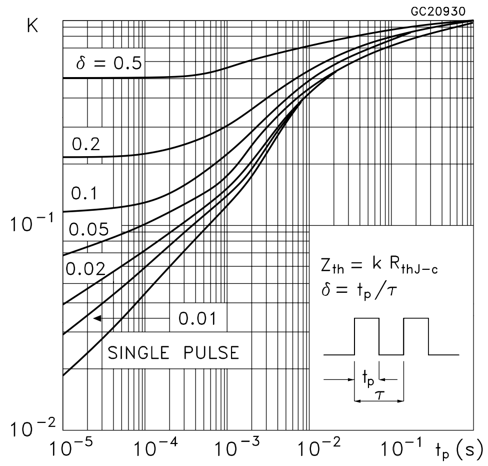


Figure 3. Output characteristics

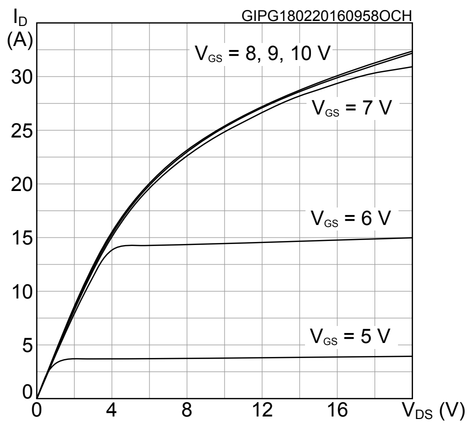


Figure 4. Transfer characteristics

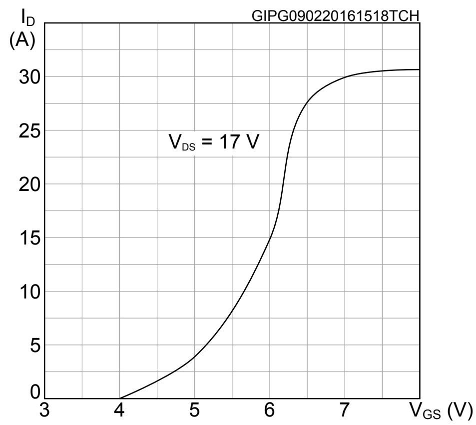


Figure 5. Gate charge vs gate-source voltage

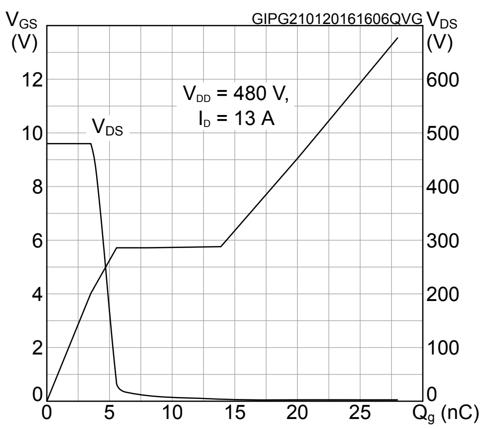


Figure 6. Static drain-source on-resistance

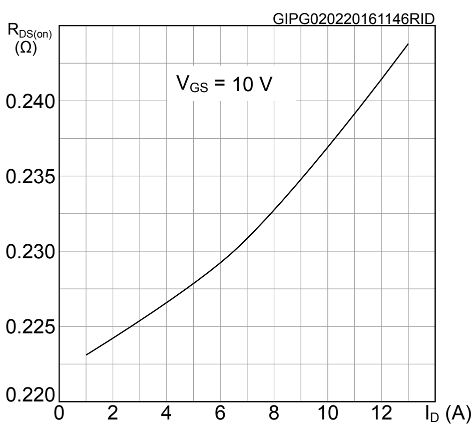


Figure 7. Capacitance variations

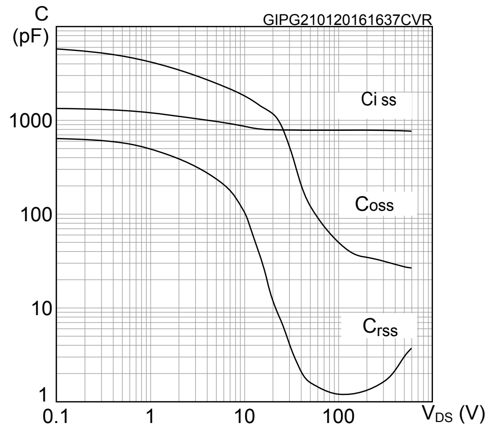


Figure 8. Output capacitance stored energy

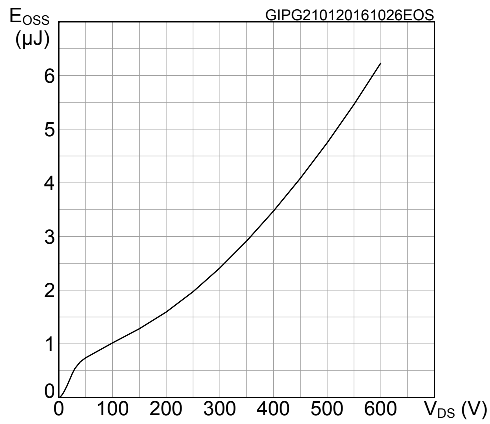


Figure 9. Normalized on-resistance vs temperature

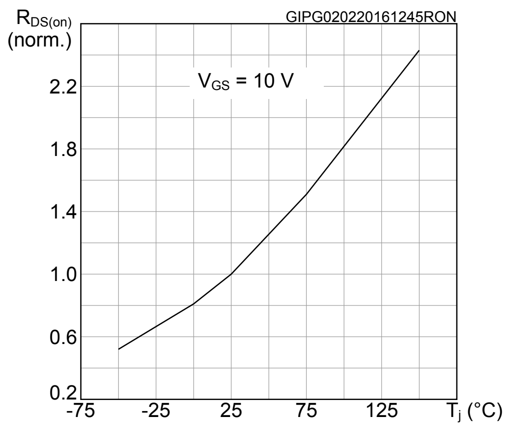


Figure 10. Normalized gate threshold voltage vs temperature

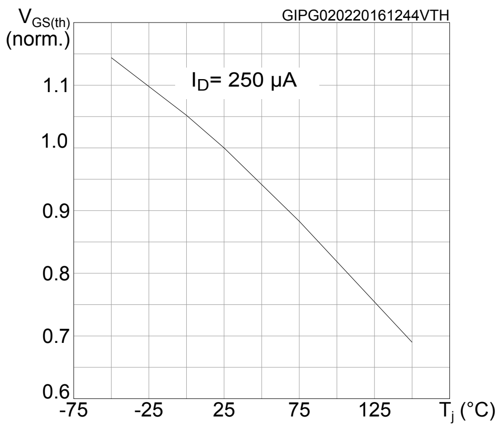


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

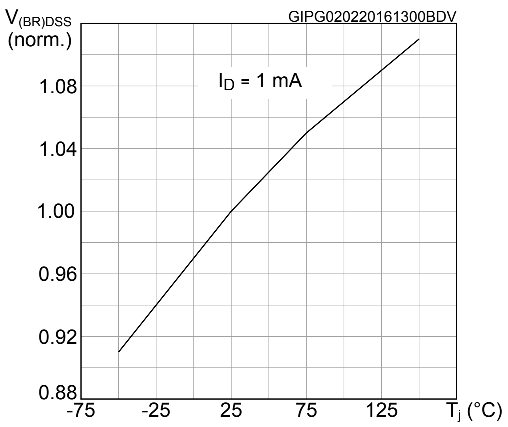


Figure 12. Source-drain diode forward characteristics

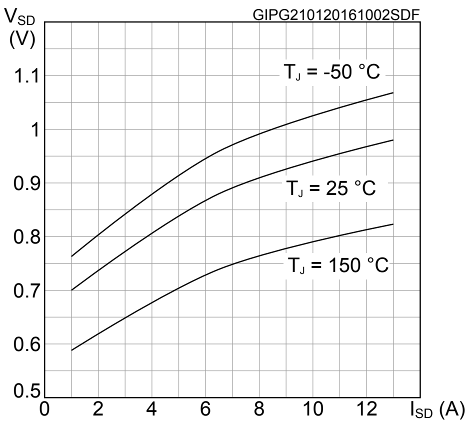
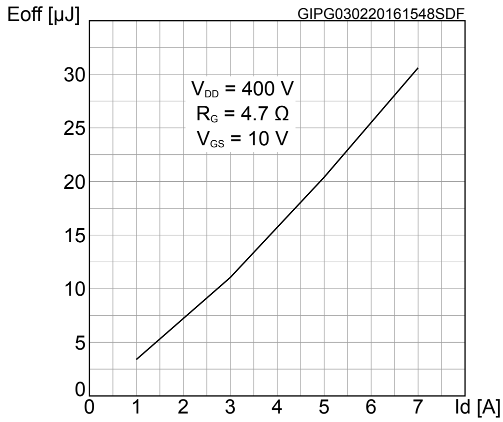


Figure 13. Turn-off switching energy vs drain current



3 Test circuits

Figure 14. Test circuit for resistive load switching times

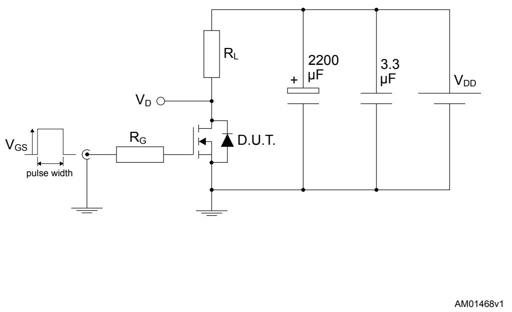


Figure 15. Test circuit for gate charge behavior

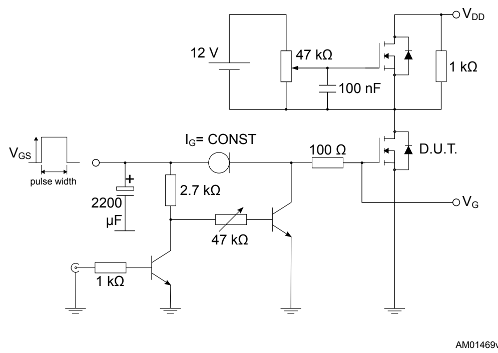


Figure 16. Test circuit for inductive load switching and diode recovery times

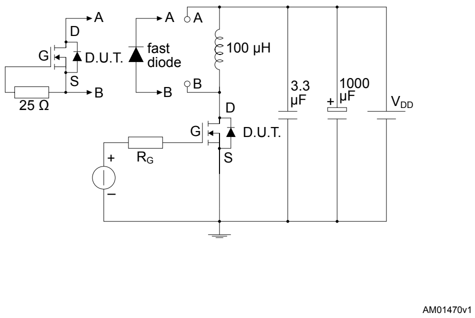


Figure 17. Unclamped inductive load test circuit

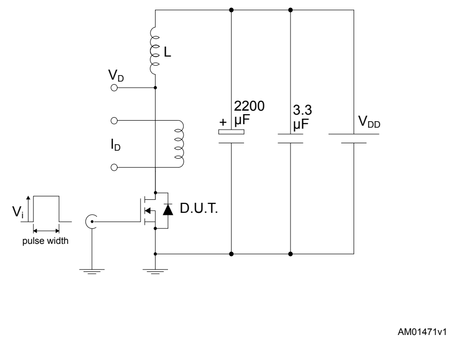


Figure 18. Unclamped inductive waveform

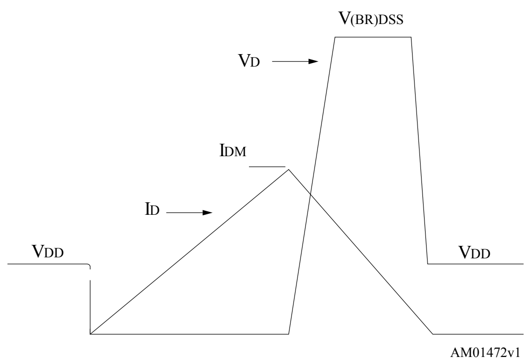
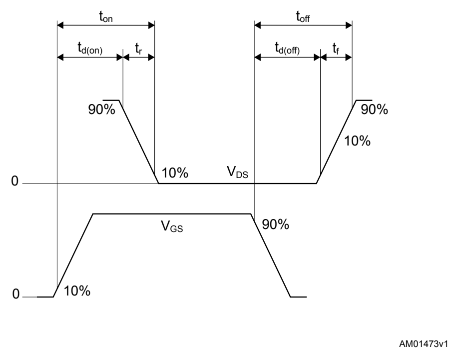


Figure 19. Switching time waveform



4 Package information

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.

4.1 TO-220 package information

Figure 20. TO-247 package outline

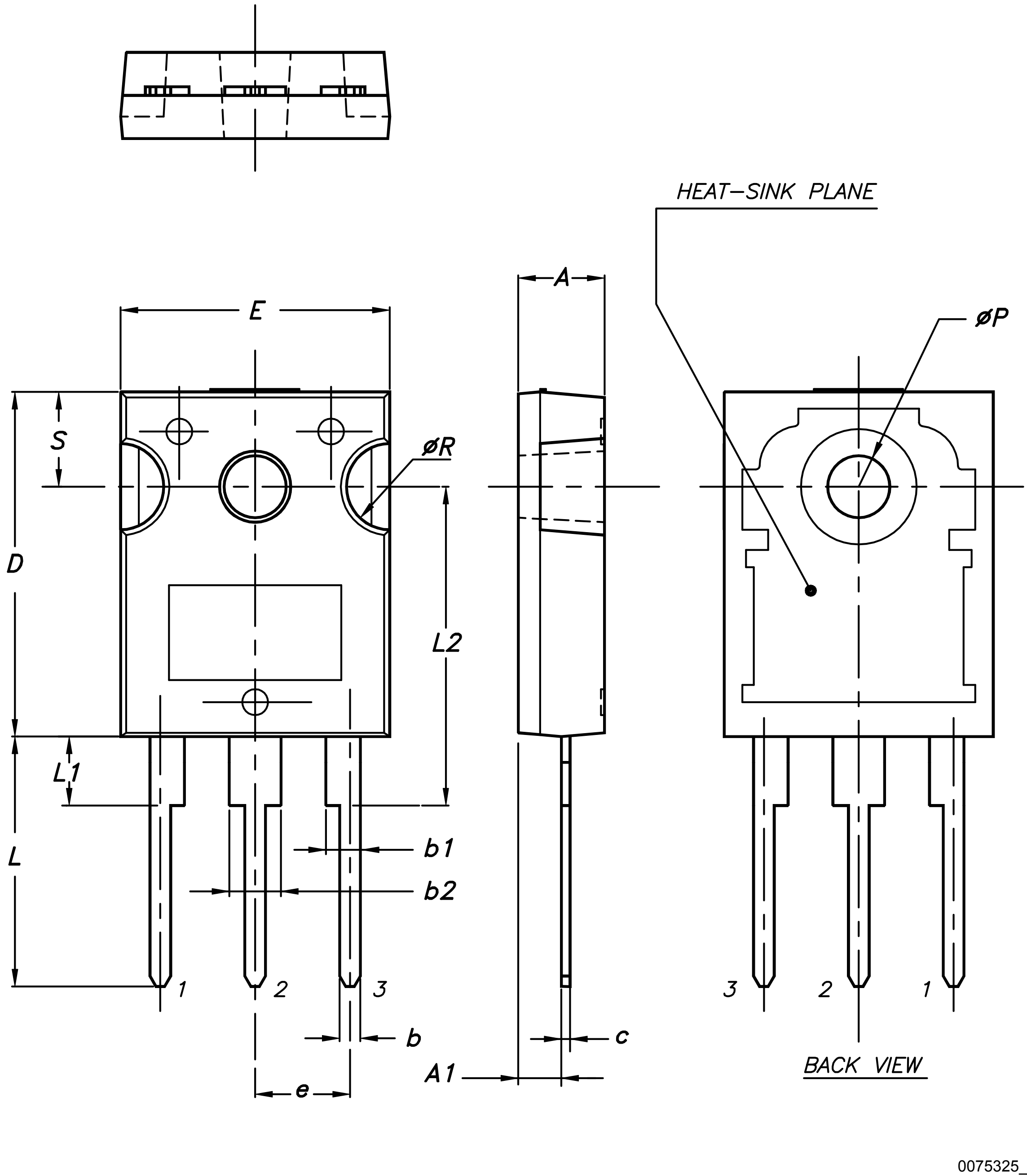


Table 9. TO-247 package mechanical data

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	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Revision history

Table 10. Document revision history

Date	Revision	Changes
20-Mar-2018	1	First release, the part number previously included in DS11505. The document status is production data.
04-Jun-2018	2	Modified Table 1. Absolute maximum ratings. Modified Table 8. Source-drain diode and Figure 1. Safe operating area. Minor text changes.

Contents