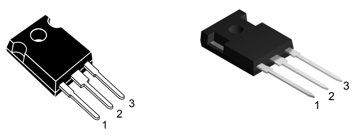
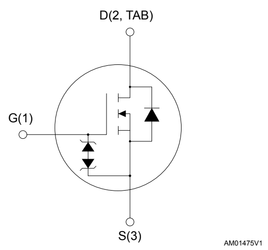
STW65N60DM6, STWA65N60DM6

Datasheet

N-channel 600 V, 60 mΩ typ., 38 A MDmesh™ DM6 Power MOSFETs in TO-247 and TO-247 long leads packages



TO-247 TO-247 long leads



Product status link
STW65N60DM6
STWA65N60DM6

Product summary	
Order code	**STW65N60DM6**
Marking	65N60DM6
Package	TO-247
Packing	Tube
Order code	**STWA65N60DM6**
Marking	65N60DM6
Package	TO-247 long leads
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW65N60DM6	600 V	71 mΩ	38 A
STWA65N60DM6			

- Fast-recovery body diode
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

These high-voltage N-channel Power MOSFETs are part of the MDmesh™ DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge (Q_{rr}), recovery time (t_{rr}) and excellent improvement in $R_{DS(on)}$ per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift 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	38	A
I_D	Drain current (continuous) at T_C = 100 °C	24	A
I_D (1)	Drain current (pulsed)	140	A
P_{TOT}	Total dissipation at T_C = 25 °C	250	W
dv/dt(2)	Peak diode recovery voltage slope	50	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	100	V/ns
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 38 A, di/dt ≤ 900 A/μs; V_{DS}(peak) < $V_{(BR)DSS}$, V_{DD} = 400 V.*
3. *V_{DS} ≤ 480 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.5	°C/W
$R_{thj-amb}$	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})	6	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}; V_{DD} = 50 V)	900	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			5	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C(1)			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	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= 19 A		60	71	mΩ

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

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	2500	-	pF
C_{oss}	Output capacitance		-	125	-	
C_{rss}	Reverse transfer capacitance		-	4	-	
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	204	-	
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	1.7	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 38 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior).	-	54	-	nC
Q_{gs}	Gate-source charge		-	16	-	
Q_{gd}	Gate-drain charge		-	22	-	

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

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 19 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 15. Test circuit for inductive load switching and diode recovery times and Figure 18. Switching time waveform)	-	21	-	ns
t_r	Rise time		-	22	-	ns
$t_{d(off)}$	Turn-off delay time		-	56	-	ns
t_f	Fall time		-	9	-	ns

Table 7. **Source drain diode**

<table>
<tr><th>Symbol</th><th>Parameter</th><th>Test conditions</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>I_{SD}</td><td>Source-drain current</td><td></td><td>-</td><td></td><td>38</td><td>A</td></tr>
<tr><td>I_{SDM} (1)</td><td>Source-drain current (pulsed)</td><td></td><td>-</td><td></td><td>140</td><td>A</td></tr>
<tr><td>V_{SD} (2)</td><td>Forward on voltage</td><td>V_{GS} = 0 V, I_{SD} = 38 A</td><td>-</td><td></td><td>1.6</td><td>V</td></tr>
<tr><td>t_{rr}</td><td>Reverse recovery time</td><td rowspan="3">I_{SD} = 38 A, di/dt = 100 A/µs,
V_{DD} = 60 V
(see Figure 15. Test circuit for inductive load switching and diode recovery times)</td><td>-</td><td>116</td><td>-</td><td>ns</td></tr>
<tr><td>Q_{rr}</td><td>Reverse recovery charge</td><td>-</td><td>0.58</td><td>-</td><td>µC</td></tr>
<tr><td>I_{RRM}</td><td>Reverse recovery current</td><td>-</td><td>10</td><td>-</td><td>A</td></tr>
<tr><td>t_{rr}</td><td>Reverse recovery time</td><td rowspan="3">I_{SD} = 38 A, di/dt = 100 A/µs,
V_{DD} = 60 V, T_J = 150 °C
(see Figure 15. Test circuit for inductive load switching and diode recovery times)</td><td>-</td><td>208</td><td>-</td><td>ns</td></tr>
<tr><td>Q_{rr}</td><td>Reverse recovery charge</td><td>-</td><td>1.98</td><td>-</td><td>µC</td></tr>
<tr><td>I_{RRM}</td><td>Reverse recovery current</td><td>-</td><td>19</td><td>-</td><td>A</td></tr>
</table>

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

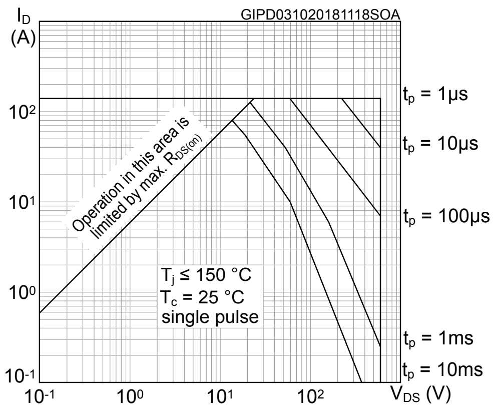


Figure 2. Thermal impedance

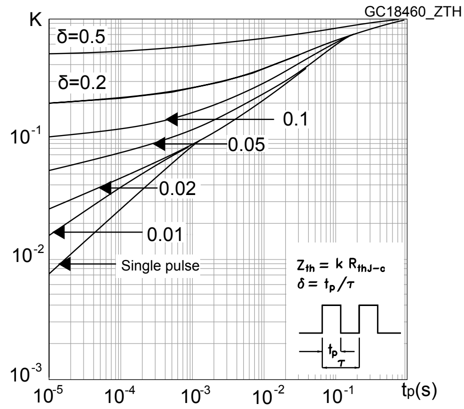


Figure 3. Output characterisics

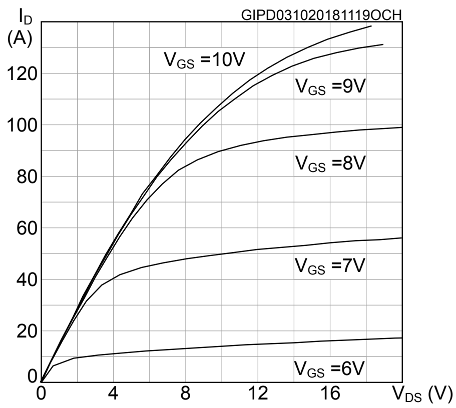


Figure 4. Transfer characteristics

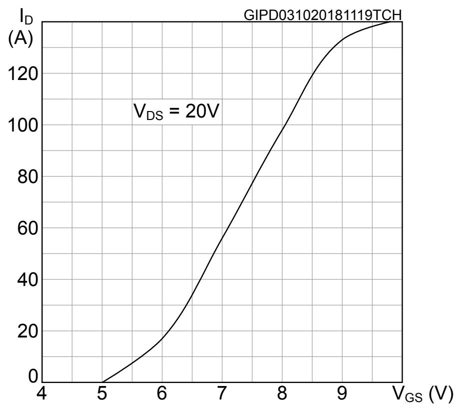


Figure 5. Static drain-source on resistance

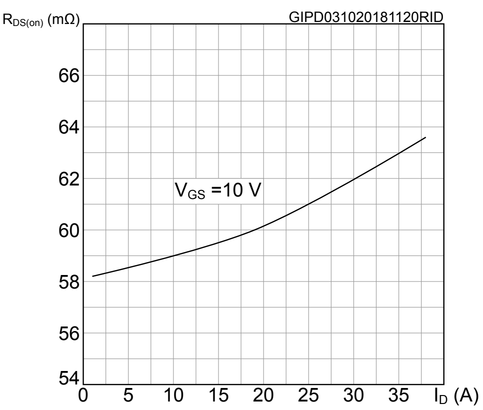


Figure 6. Gate charge vs gate-source voltage

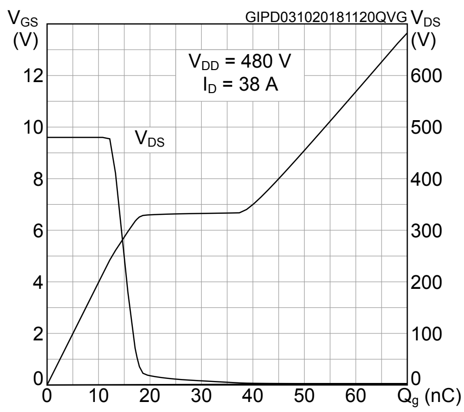


Figure 7. Capacitance variations

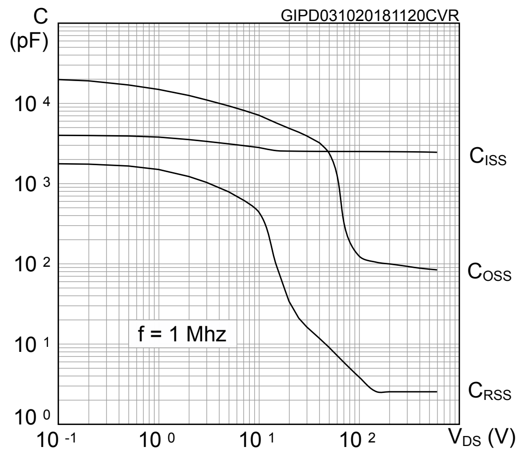


Figure 8. Normalized gate threshold voltage vs temperature

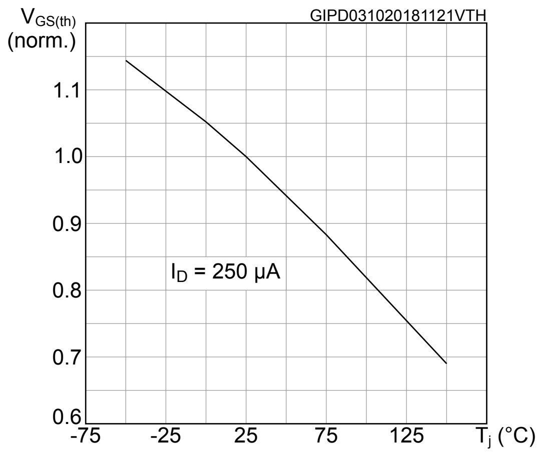


Figure 9. Normalized on resistance vs temperature

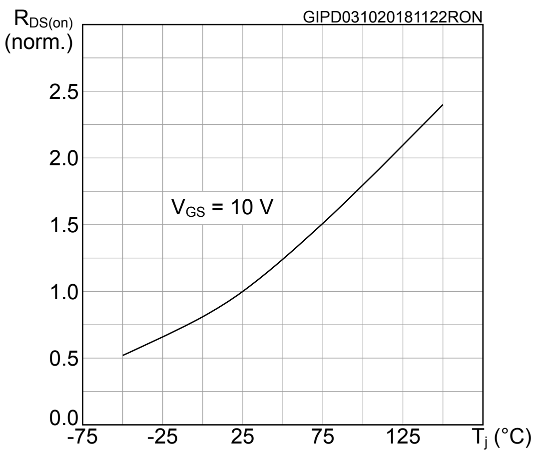


Figure 10. Coss stored energy vs V_{DS}

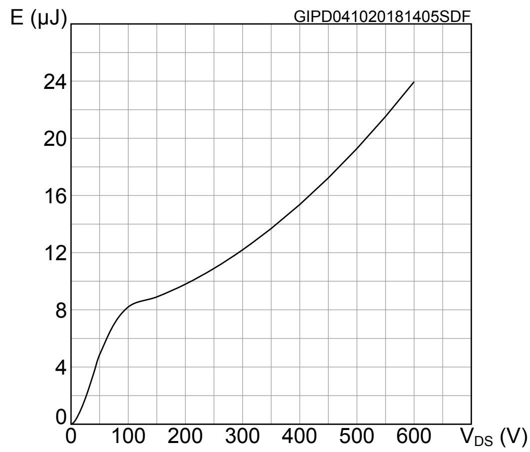


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

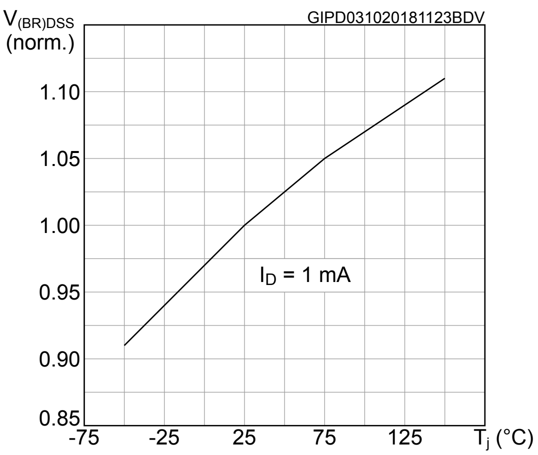
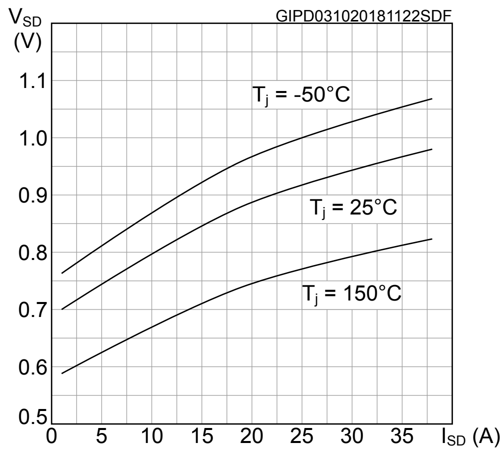


Figure 12. Source-drain diode forward characteristic



3 Test circuits

Figure 13. Test circuit for resistive load switching times

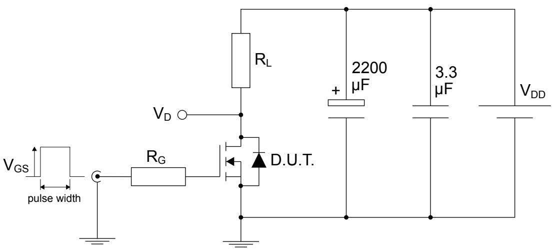


Figure 14. Test circuit for gate charge behavior

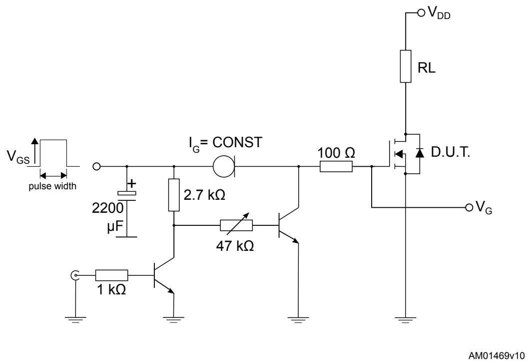


Figure 15. Test circuit for inductive load switching and diode recovery times

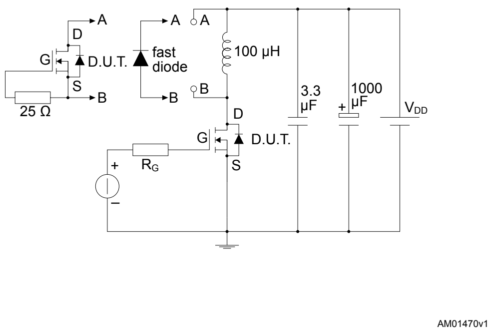


Figure 16. Unclamped inductive load test circuit

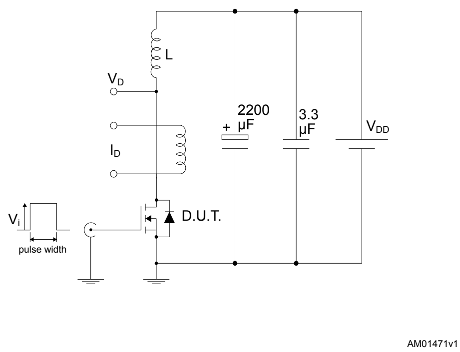


Figure 17. Unclamped inductive waveform

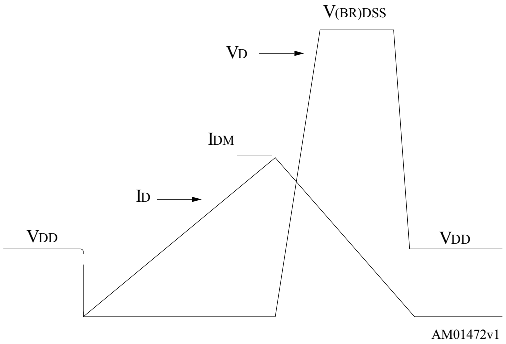
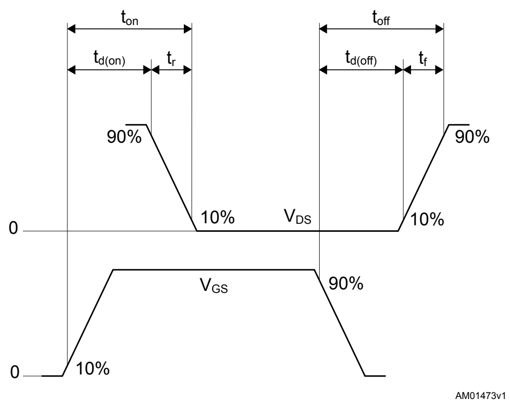


Figure 18. Switching time waveform

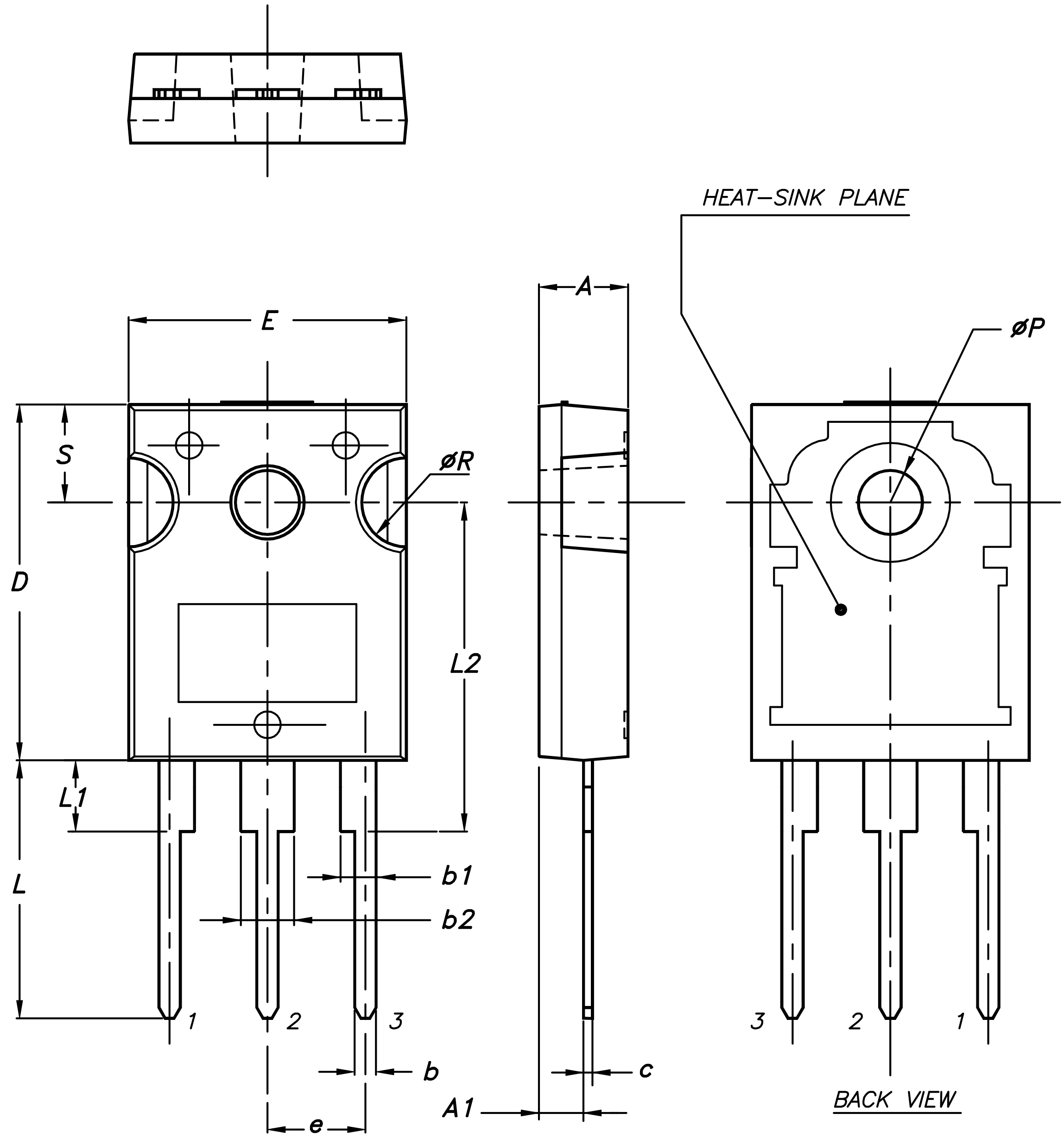


4 Package information

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-247 package information

Figure 19. **TO-247 package outline**



0075325_9

Table 8. 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

4.2 TO-247 long leads package information

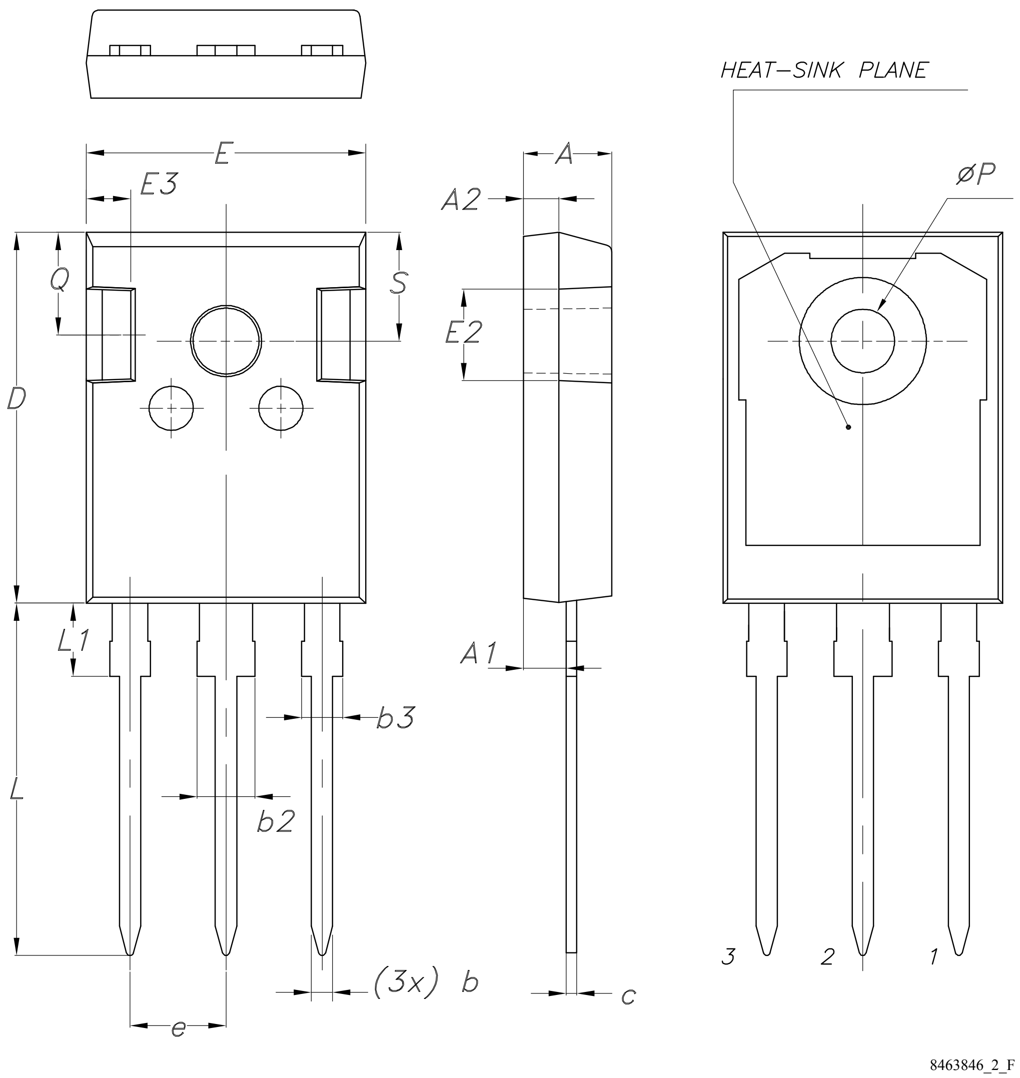


Figure 20. TO-247 long leads package outline

Table 9. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

Revision history

Table 10. Document revision history

Date	Version	Changes
02-Nov-2017	1	Initial release.
03-Oct-2018	2	Removed maturity status indication from cover page. The document status is production data. Updated title and features in cover page. Updated Section 1 Electrical ratings, Section 2 Electrical characteristics. Added Section 2.1 Electrical characteristics curves. Minor text changes.

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