

N-channel 500 V, 0.08 Ω typ., 45 A MDmesh™ Power MOSFET in a TO-247 package

Datasheet - production data

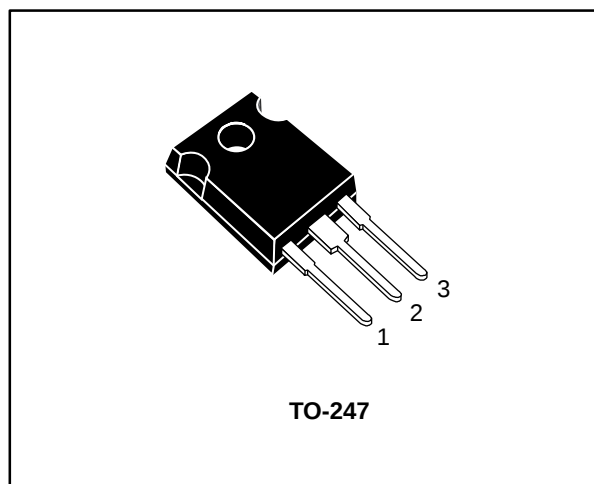
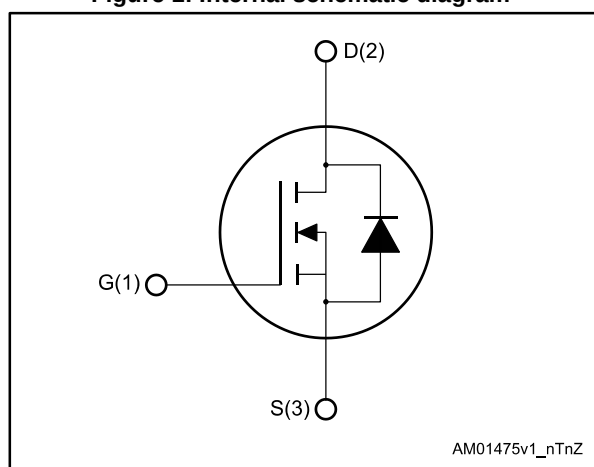


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D
STW45NM50	500 V	0.1 Ω	45 A

- 100% avalanche tested
- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This N-channel Power MOSFET is developed using STMicroelectronics' revolutionary MDmesh™ technology, which associates the multiple drain process with the company's PowerMESH™ horizontal layout. This device offer extremely low on-resistance, high dv/dt and excellent avalanche characteristics. Utilizing ST's proprietary strip technique, this Power MOSFET boasts an overall dynamic performance which is superior to similar products on the market.

Table 1: Device summary

Order code	Marking	Package	Packaging
STW45NM50	W45NM50	TO-247	Tube

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	45	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	28.4	A
$I_{DM}^{(1)}$	Drain current (pulsed)	180	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	390	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature range		

Notes:

⁽¹⁾Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 45\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS(\text{peak})} \leq V_{(BR)DSS}$, $V_{DD} \leq 80\% V_{(BR)DSS}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-case}}$	Thermal resistance junction-case	0.32	$^{\circ}\text{C}/\text{W}$
$R_{thj\text{-amb}}$	Thermal resistance junction-ambient	30	$^{\circ}\text{C}/\text{W}$

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_{j\text{ max}}$)	15	A
E_{AS}	Single pulse avalanche energy (starting $T_j=25\text{ }^{\circ}\text{C}$, $I_D=I_{AR}$, $V_{DD}=50\text{ V}$)	700	mJ

2 Electrical characteristics

(T_{CASE} = 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 V	500			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 500 V			10	μA
		V _{GS} = 0 V, V _{DS} = 500 V, T _C = 125 °C ⁽¹⁾			100	
I _{GSS}	Gate-body leakage current	V _{DS} = 0 V, V _{GS} = ±30 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 = 22.5 A		0.08	0.1	Ω

Notes:

⁽¹⁾Defined by design, not subject to production test.

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{DS} = 25 V, f = 1 MHz, V _{GS} = 0 V	-	3290	-	pF
C _{oss}	Output capacitance		-	865	-	pF
C _{rss}	Reverse transfer capacitance		-	140	-	pF
C _{oss eq.} ⁽¹⁾	Equivalent output capacitance	V _{GS} = 0 V, V _{DS} = 0 to 400 V	-	270	-	pF
Q _g	Total gate charge	V _{DD} = 400 V, I _D = 45 A, V _{GS} = 10 V (see Figure 14: "Test circuit for gate charge behavior")	-	113	-	nC
Q _{gs}	Gate-source charge		-	17	-	nC
Q _{gd}	Gate-drain charge		-	82	-	nC
R _G	Gate input resistance	f = 1 MHz, I _D = 0 A	-	1.7	-	Ω

Notes:

⁽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_{DS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 250\text{ V}$, $I_D = 22.5\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	29.1	-	ns
t_r	Rise time		-	73.6	-	ns
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 400\text{ V}$, $I_D = 45\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	20.8	-	ns
t_f	Fall time		-	58.3	-	ns
t_c	Cross-over time		-	67.6	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		45	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		180	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 45\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	454		ns
Q_{rr}	Reverse recovery charge		-	9380		nC
I_{RRM}	Reverse recovery current		-	41.3		A
t_{rr}	Reverse recovery time	$I_{SD} = 45\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15: "Test circuit for inductive load switching and diode recovery times")	-	567		ns
Q_{rr}	Reverse recovery charge		-	12700		nC
I_{RRM}	Reverse recovery current		-	44.8		A

Notes:

⁽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

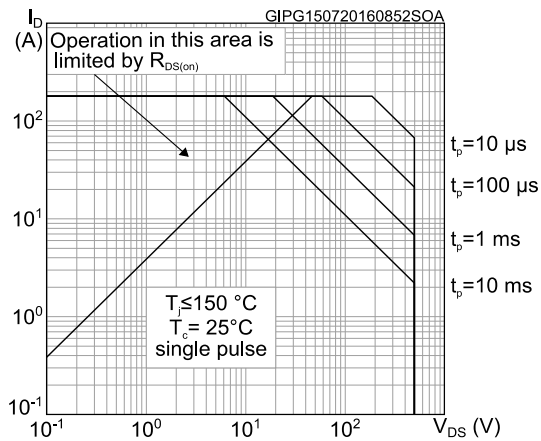


Figure 3: Thermal impedance

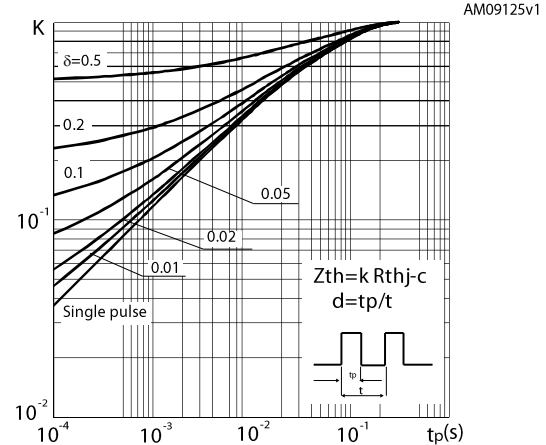


Figure 4: Output characteristics

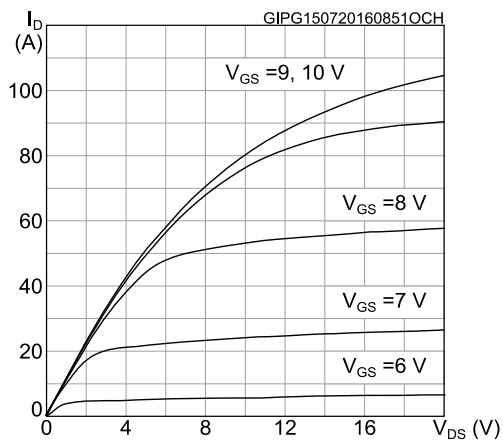


Figure 5: Transfer characteristics

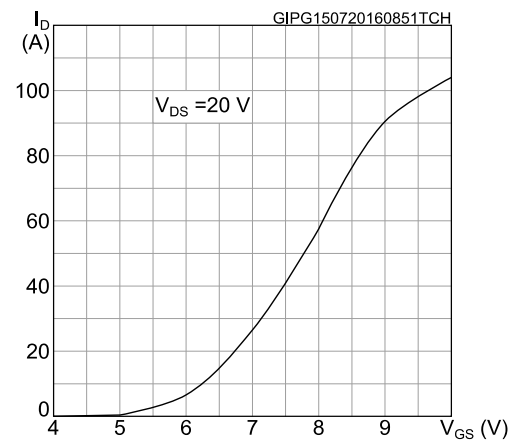


Figure 6: Gate charge vs gate-source voltage

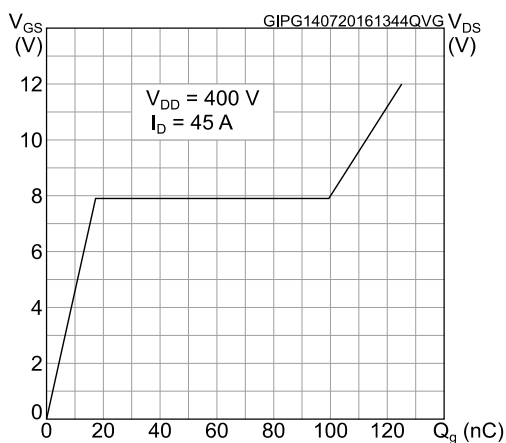


Figure 7: Static drain-source on resistance

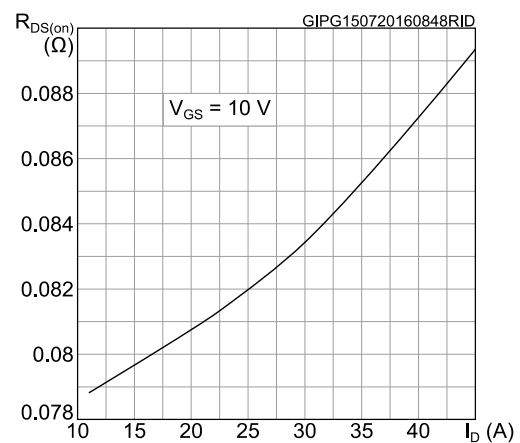


Figure 8: Capacitance variations

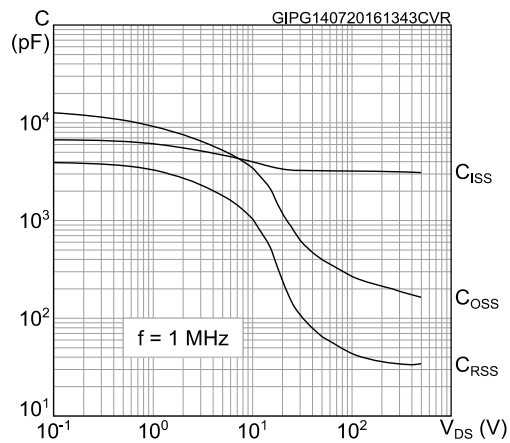


Figure 9: Normalized gate threshold voltage vs temperature

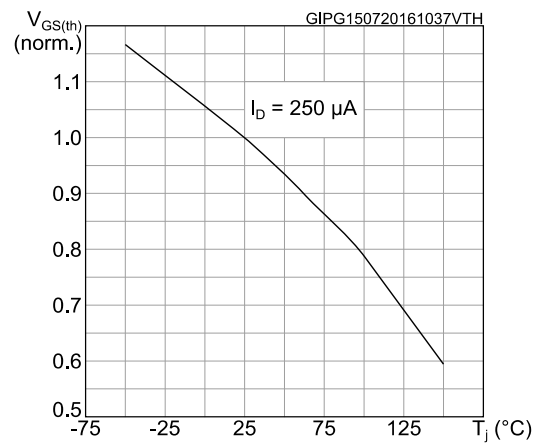


Figure 10: Normalized on-resistance vs temperature

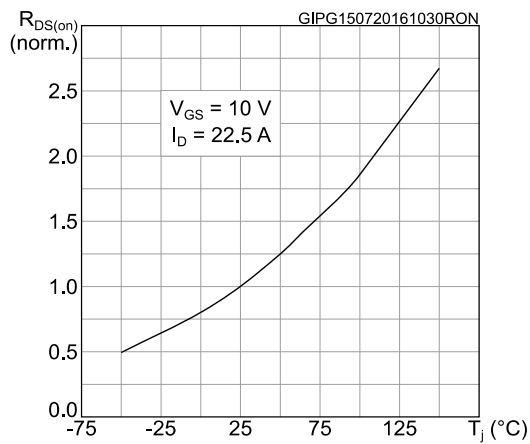


Figure 11: Normalized V(BR)DSS vs temperature

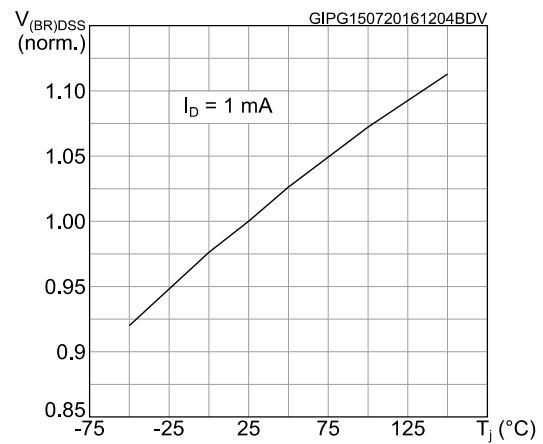
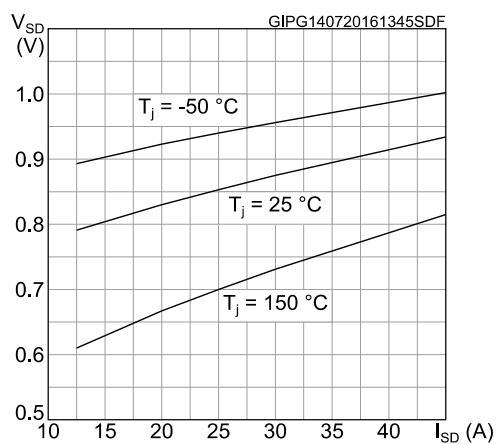
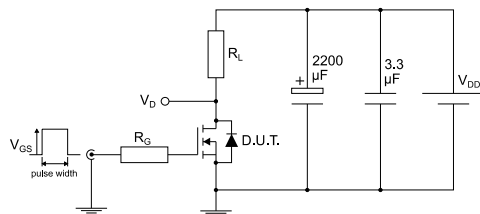


Figure 12: Source-drain diode forward characteristics



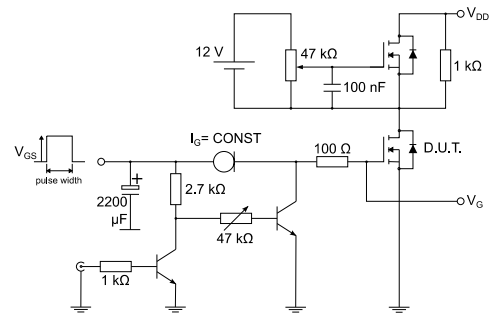
3 Test circuits

Figure 13: Test circuit for resistive load switching times



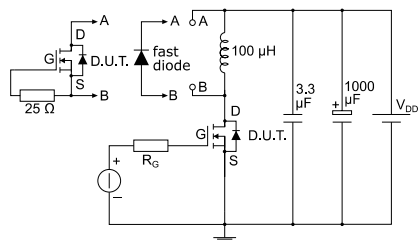
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Figure 14: Test circuit for gate charge behavior



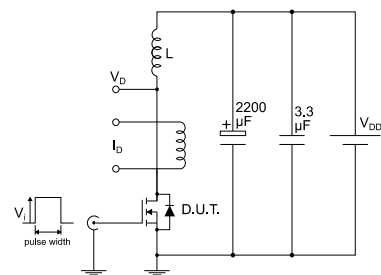
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Figure 15: Test circuit for inductive load switching and diode recovery times



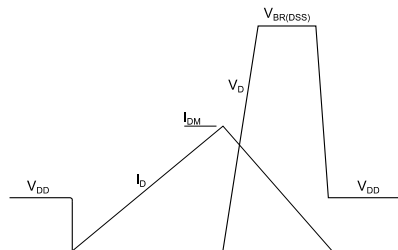
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Figure 16: Unclamped inductive load test circuit



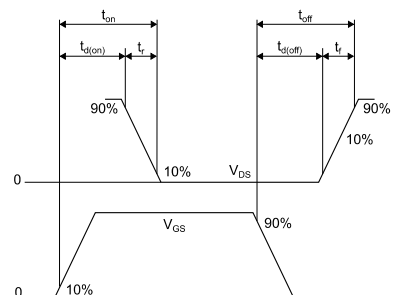
AM01471v1

Figure 17: Unclamped inductive waveform



AM01472v1

Figure 18: Switching time waveform



AM01473v1

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

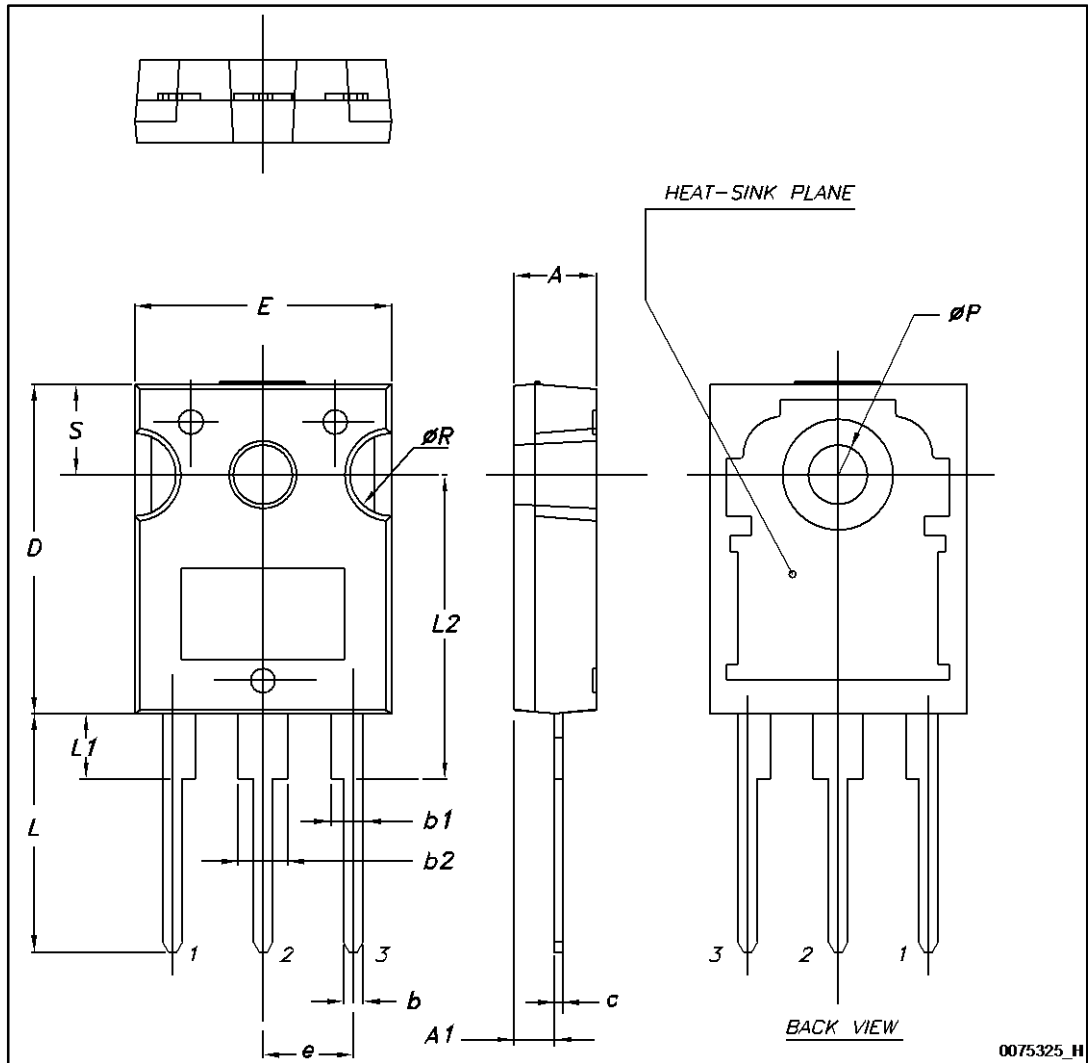


Table 9: TO-247 package mechanical data

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

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
30-Mar-2005	4	Modified value on <i>Source drain diode</i>
23-Jul-2009	5	Modified values on <i>Switching times</i>
18-Jul-2016	6	Modified: Table 2: "Absolute maximum ratings" , Table 3: "Thermal data" , Table 4: "Avalanche characteristics" , Table 5: "On/off states" , Table 6: "Dynamic" , Table 7: "Switching times" and Table 8: "Source-drain diode" Modified: Section 5.1: "Electrical characteristics (curves)" Updated: Section 7.1: "TO-247 package information"

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