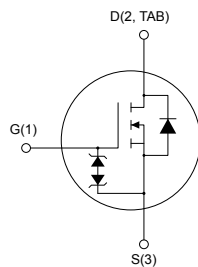


# N-channel 650 V, 51 mΩ typ., 48 A MDmesh DM6 Power MOSFET in a TO-247 long leads package



TO-247 long leads



AM01475V1



## Features

Order code	$V_{DS}$	$R_{DS(on) \text{ max}}$	$I_D$
STWA68N65DM6	650 V	59 mΩ	48 A

- 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

This high-voltage N-channel Power MOSFET is 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.

### Product status links

[STWA68N65DM6](#)

### Product summary

<b>Order code</b>	STWA68N65DM6
<b>Marking</b>	68N65DM6
<b>Package</b>	TO-247 long leads
<b>Packing</b>	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	48	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	30	A
$I_D^{(1)}$	Drain current (pulsed)	172	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	330	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	100	V/ns
$di/dt^{(2)}$	Peak diode recovery current slope	1000	A/ $\mu\text{s}$
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	100	V/ns
$T_{STG}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 48\text{ A}$ ,  $V_{DS}(\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .
3.  $V_{DS} \leq 520\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.38	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^\circ\text{C/W}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive ( $t_p$ limited by $T_J$ max)	9	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	930	mJ

## 2 Electrical characteristics

$T_C = 25\text{ °C}$  unless otherwise specified

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$			10	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}, T_C = 125\text{ °C}^{(1)}$			100	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}, I_D = 24\text{ A}$		51	59	m $\Omega$

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	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	3528	-	$\text{pF}$
$C_{oss}$	Output capacitance		-	258	-	
$C_{rss}$	Reverse transfer capacitance		-	1.5	-	
$C_{oss\text{ eq}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }520\text{ V}, V_{GS} = 0\text{ V}$	-	609	-	
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1.25	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 48\text{ A}, V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	80	-	nC
$Q_{gs}$	Gate-source charge		-	21.5	-	
$Q_{gd}$	Gate-drain charge		-	35	-	

1.  $C_{oss\text{ eq}}$  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 times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}, I_D = 34\text{ A},$ $R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	25	-	ns
$t_r$	Rise time		-	32	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	76	-	ns
$t_f$	Fall time		-	9	-	ns

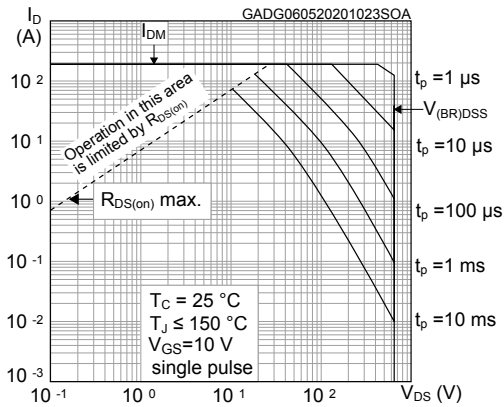
**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		48	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		172	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 48\text{ A}$	-		0.98	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 48\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	135		ns
$Q_{rr}$	Reverse recovery charge		-	0.641		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	9.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 48\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	245		ns
$Q_{rr}$	Reverse recovery charge		-	2.45		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	20		A

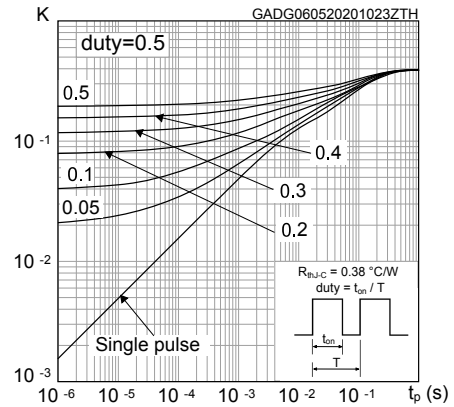
1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

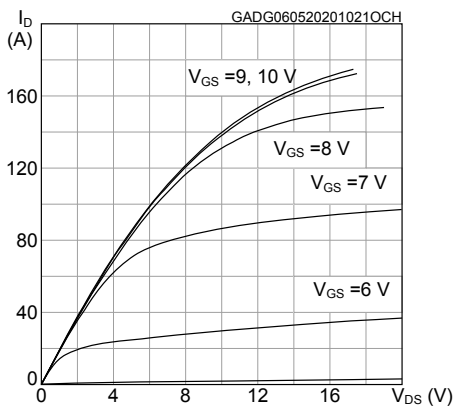
**Figure 1. Safe operating area**



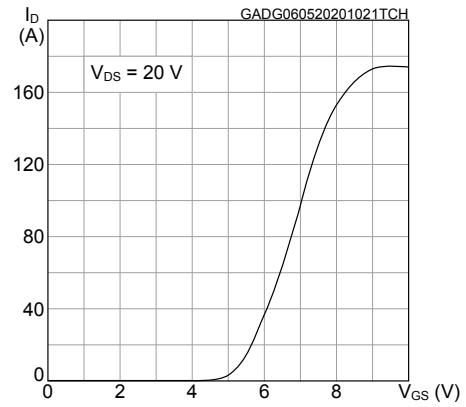
**Figure 2. Maximum transient thermal impedance**



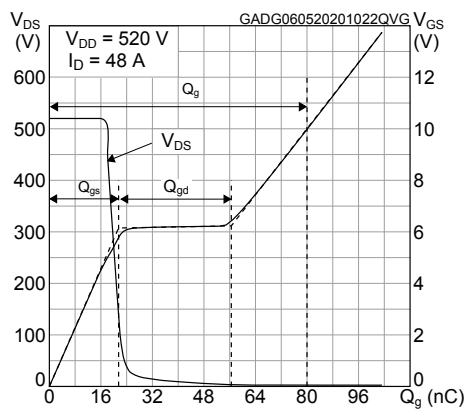
**Figure 3. Typical output characteristics**



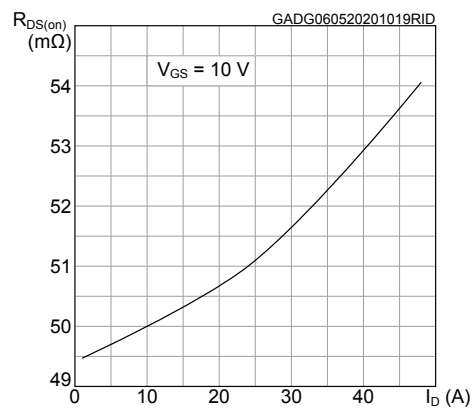
**Figure 4. Typical transfer characteristics**



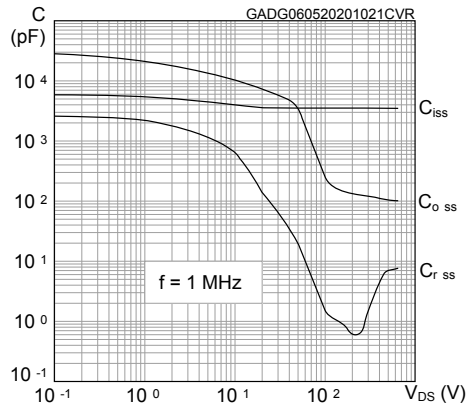
**Figure 5. Typical gate charge characteristics**



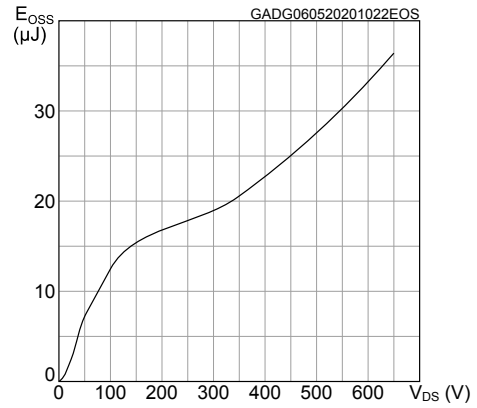
**Figure 6. Typical drain-source on-resistance**



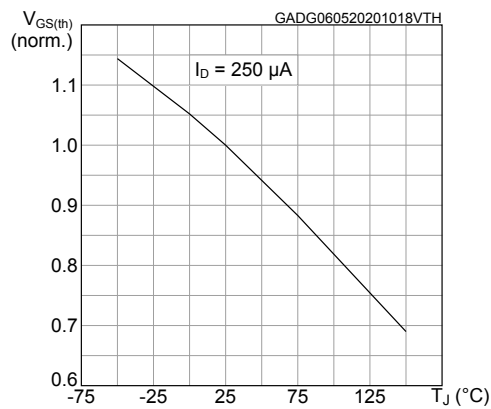
**Figure 7. Typical capacitance characteristics**



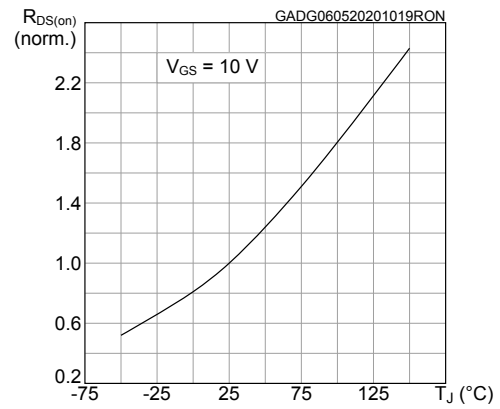
**Figure 8. Typical output capacitance stored energy**



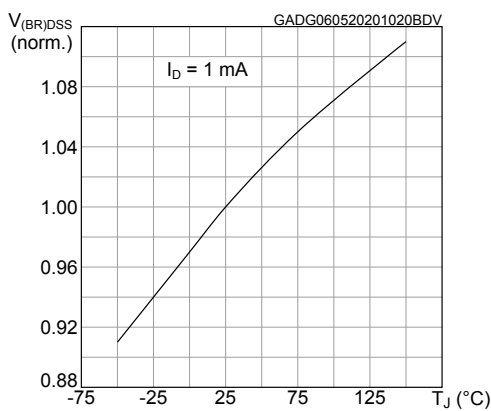
**Figure 9. Normalized gate threshold vs temperature**



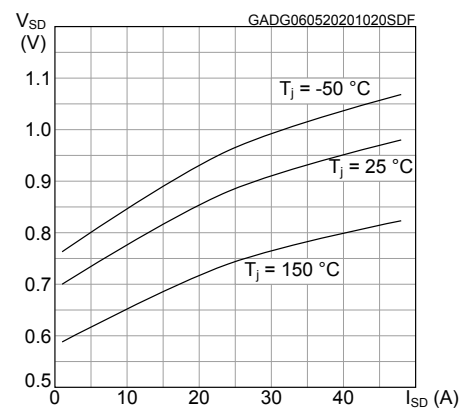
**Figure 10. Normalized on-resistance vs. temperature**



**Figure 11. Normalized breakdown voltage vs temperature**

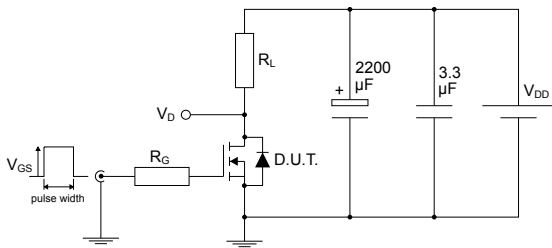


**Figure 12. Typical reverse diode forward characteristics**



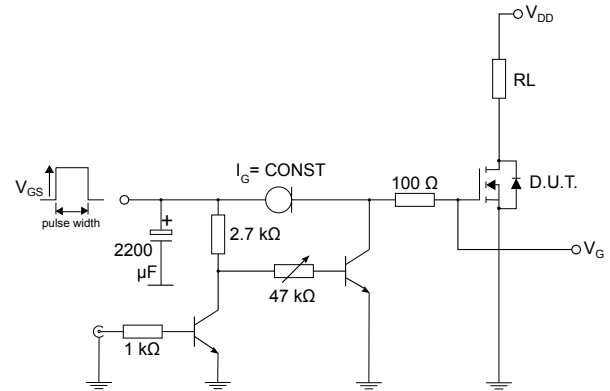
### 3 Test circuits

Figure 13. Test circuit for resistive load switching times



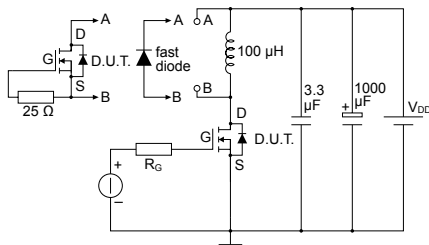
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Figure 14. Test circuit for gate charge behavior



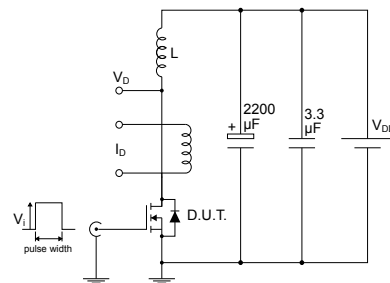
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Figure 15. Test circuit for inductive load switching and diode recovery times



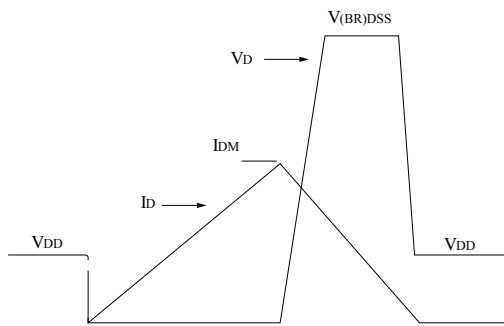
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Figure 16. Unclamped inductive load test circuit



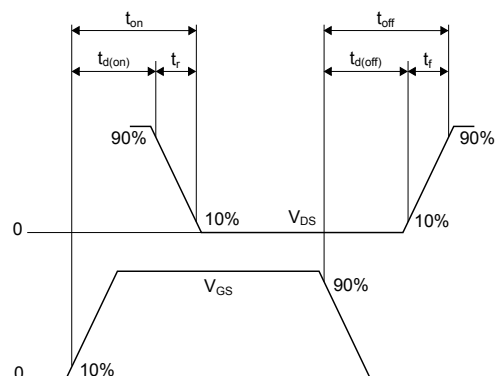
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Figure 17. Unclamped inductive waveform



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Figure 18. Switching time waveform



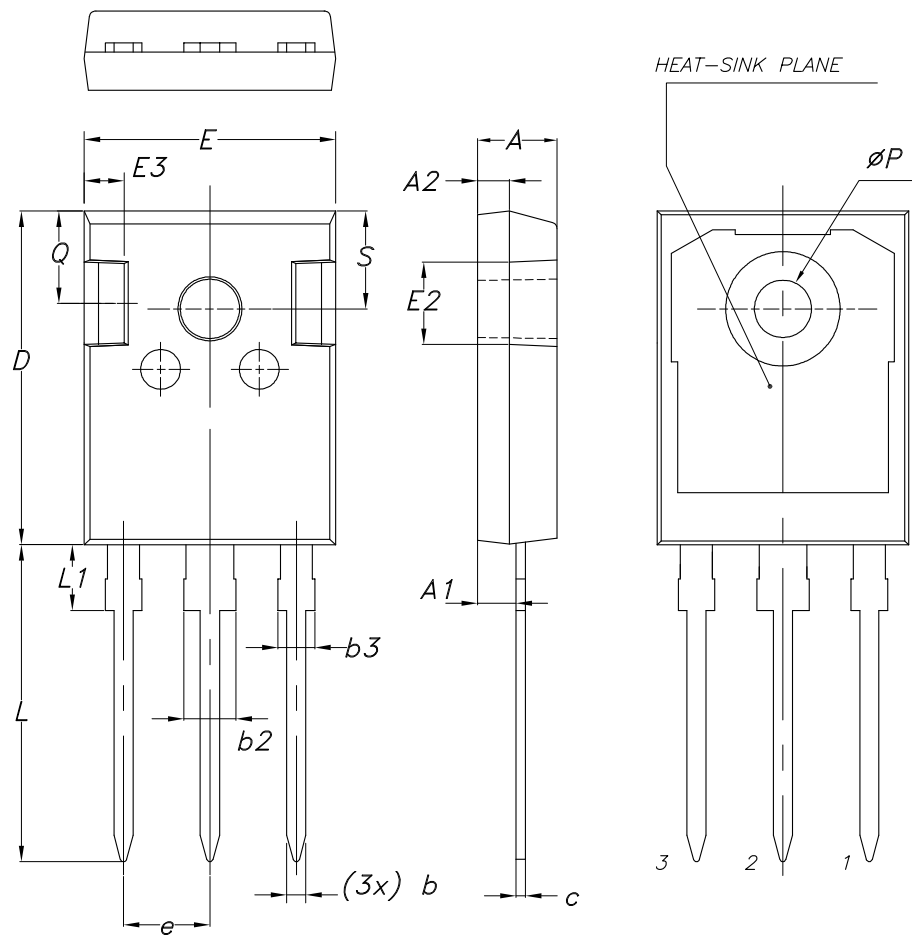
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## 4 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-247 long leads package information

Figure 19. TO-247 long leads package outline



8463846\_2\_F



**Table 8. 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 9. Document revision history**

Date	Version	Changes
24-Nov-2017	1	First release.
06-May-2020	2	<p>The part number STW68N65DM6 have been moved to a separate datasheet and the document has been updated accordingly.</p> <p>Added <a href="#">Section 2.1 Electrical characteristics (curves)</a>.</p> <p>Modified <a href="#">Table 1. Absolute maximum ratings</a>, <a href="#">Table 3. Avalanche characteristics</a>.</p> <p>Modified <a href="#">Section 2 Electrical characteristics</a>.</p> <p>Minor text changes.</p>

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## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	<b>Electrical characteristics (curves)</b> .....	<b>5</b>
<b>3</b>	<b>Test circuits</b> .....	<b>7</b>
<b>4</b>	<b>Package information</b> .....	<b>8</b>
<b>4.1</b>	<b>TO-247 long leads package information</b> .....	<b>8</b>
	<b>Revision history</b> .....	<b>10</b>

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