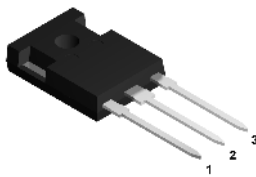
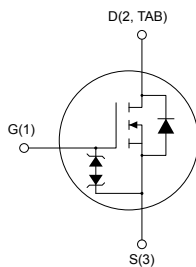


## N-channel 600 V, 61 mΩ typ., 39 A, MDmesh™ M6 Power MOSFET in a TO-247 long leads package



TO-247 long leads



AM01475V1


**Product status link**
[STWA48N60M6](#)
**Product summary**

<b>Order code</b>	STWA48N60M6
<b>Marking</b>	48N60M6
<b>Package</b>	TO-247 long leads
<b>Packing</b>	Tube

### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STWA48N60M6	600 V	69 mΩ	39 A

- Reduced switching losses
- Lower R<sub>DS(on)</sub> per area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications
- LLC converters
- Boost PFC converters

### Description

The new MDmesh™ M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent R<sub>DS(on)</sub> per area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

# 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 $T_C = 25\text{ °C}$	39	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	25	A
$I_{DM}^{(1)}$	Drain current (pulsed)	140	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	100	
$T_{stg}$	Storage temperature range	-55 to 150	°C
$T_j$	Operating junction temperature range		

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 39\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
3.  $V_{DS} \leq 480\text{ V}$

**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 $T_{jmax}$ )	5.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	950	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	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero-gate voltage drain current	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}^{(1)}$			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	$V_{GS} = 10\text{ V}, I_D = 19.5\text{ A}$		61	69	$\text{m}\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	-	2578	-	pF
$C_{oss}$	Output capacitance		-	202	-	pF
$C_{riss}$	Reverse transfer capacitance		-	3.1	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }480\text{ V}$	-	415	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.8	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 39\text{ A},$	-	57	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	16	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	23	-	nC

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	$V_{DD} = 300\text{ V}, I_D = 19.5\text{ A},$	-	28	-	ns
$t_r$	Rise time	$R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	34	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	60	-	ns
$t_f$	Fall time		-	9.5	-	ns

**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		39	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		140	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 39\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 39\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	317		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	4.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	28		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 39\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	475		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$	-	8.67		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	36.5		A

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

## 2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

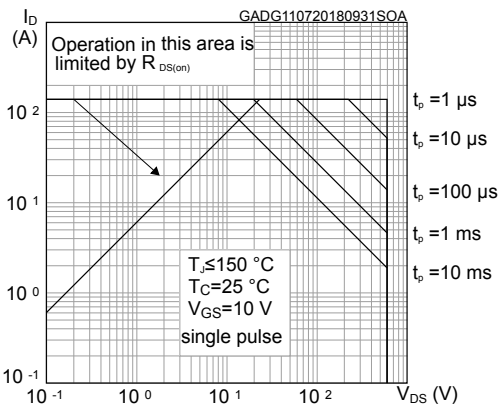


Figure 2. Thermal impedance

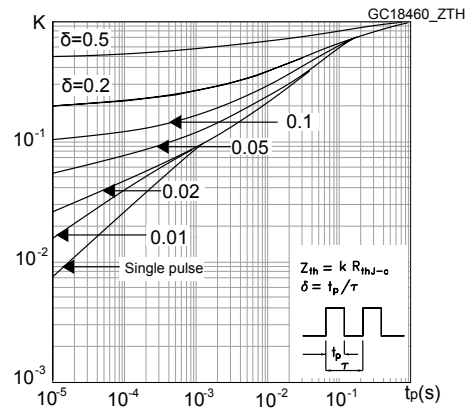


Figure 3. Output characteristics

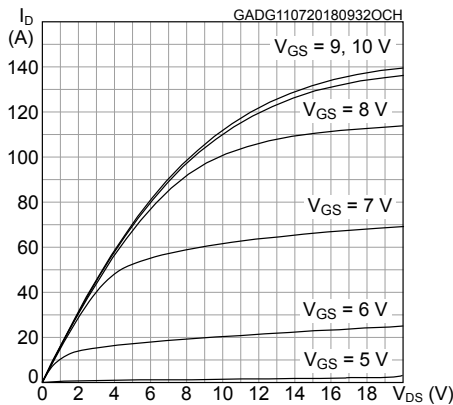


Figure 4. Transfer characteristics

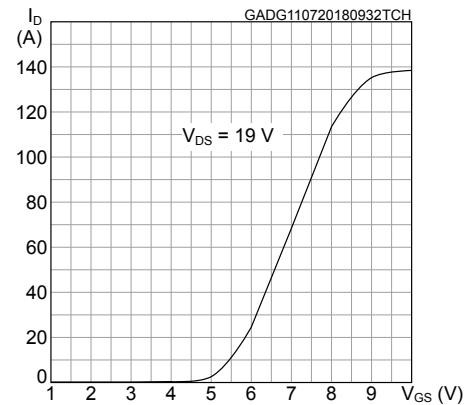


Figure 5. Gate charge vs gate-source voltage

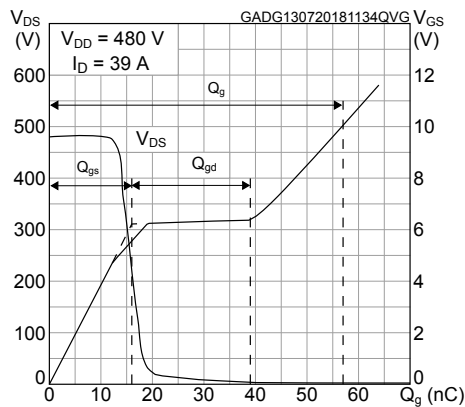
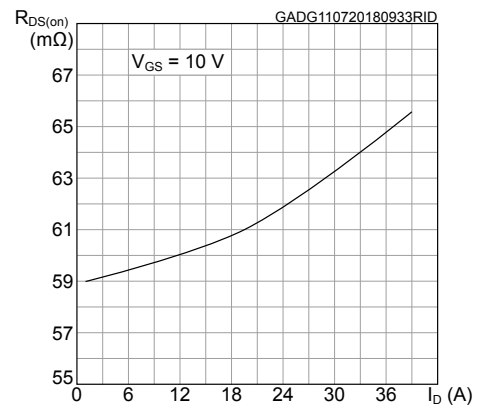
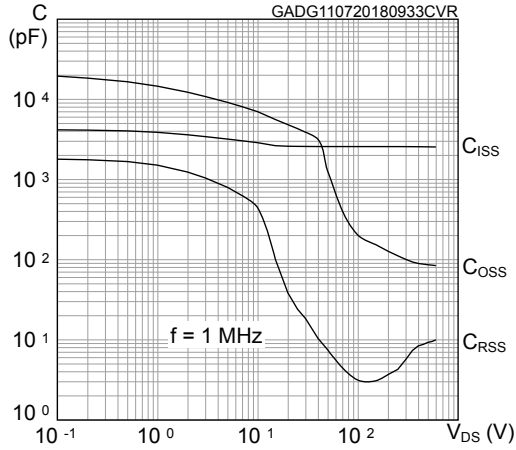


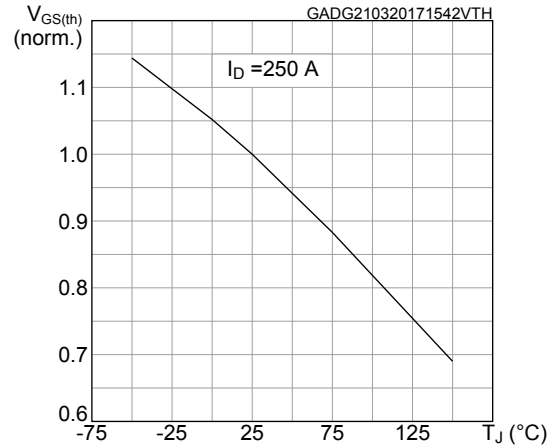
Figure 6. Static drain-source on-resistance



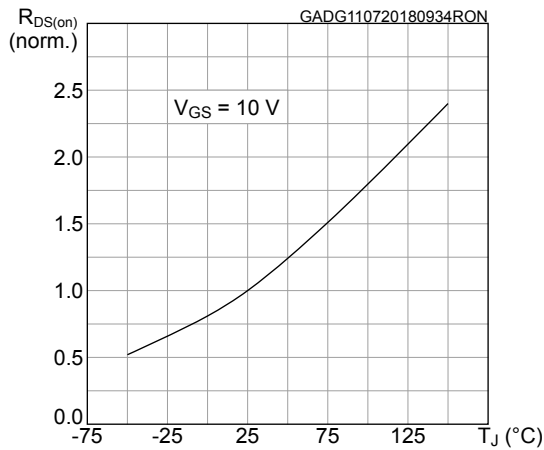
**Figure 7. Capacitance variations**



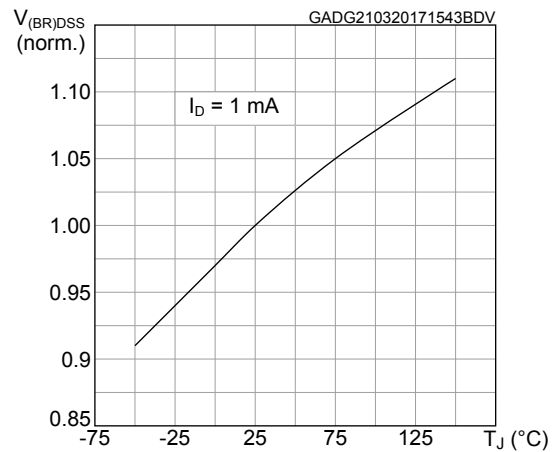
**Figure 8. Normalized gate threshold voltage vs temperature**



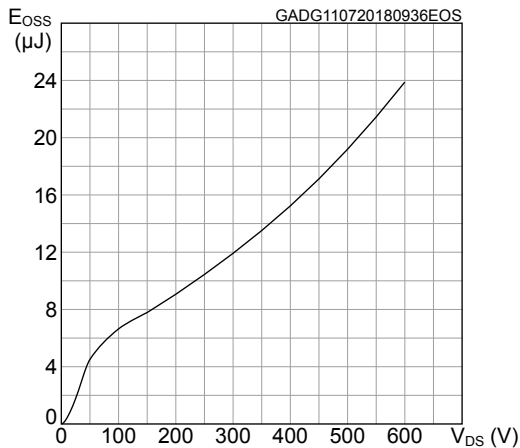
**Figure 9. Normalized on-resistance vs temperature**



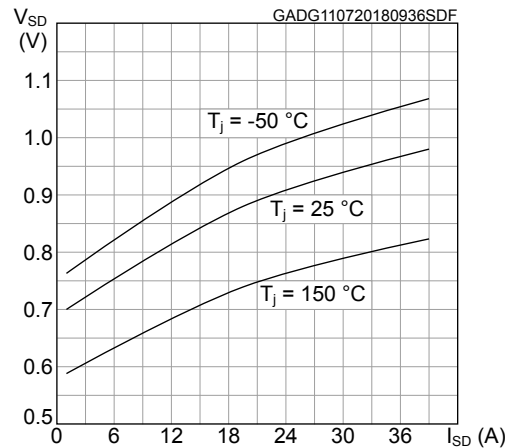
**Figure 10. Normalized  $V_{(BR)DSS}$  vs temperature**



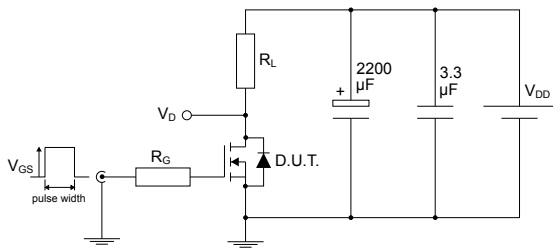
**Figure 11. Output capacitance stored energy**



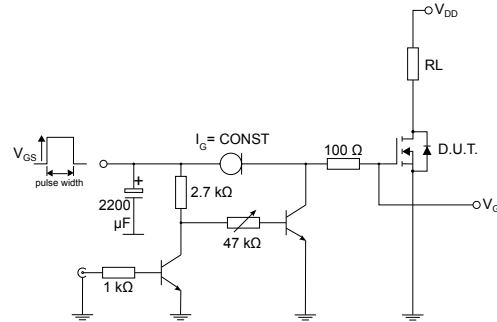
**Figure 12. Source-drain diode forward characteristics**



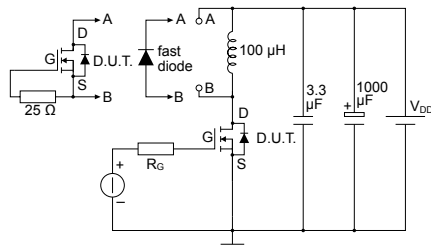
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


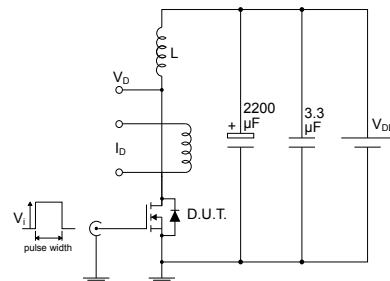
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**Figure 14. Test circuit for gate charge behavior**


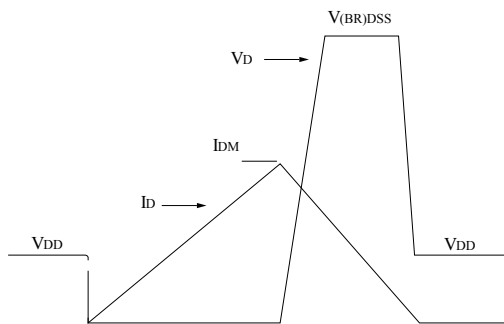
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


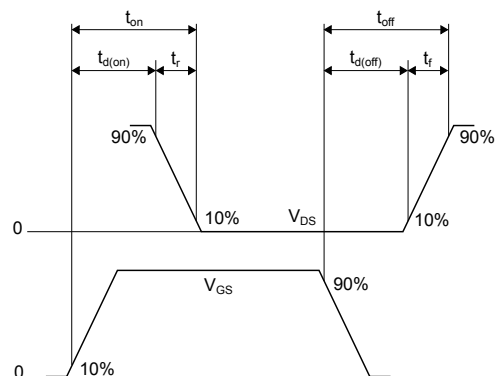
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


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## 4 Package information

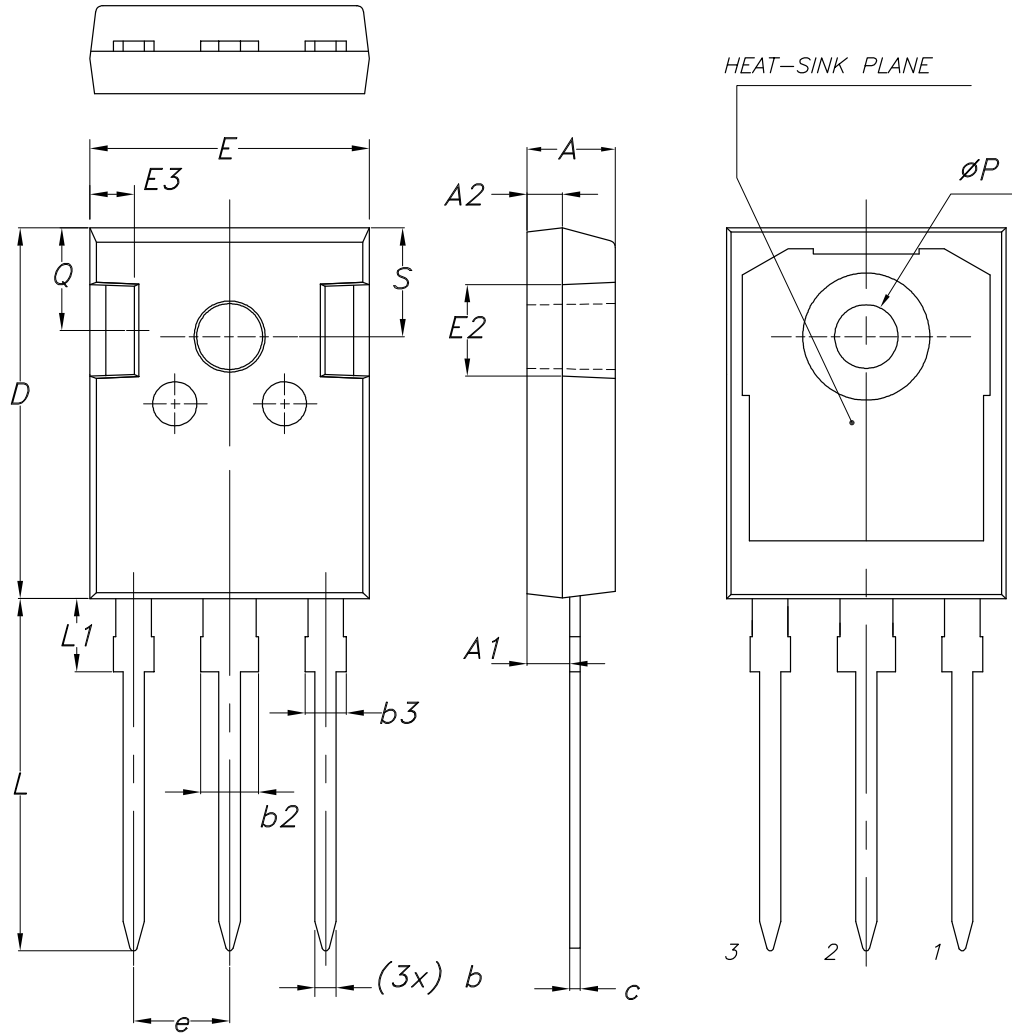
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In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK<sup>®</sup>** packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> 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
11-Jul-2018	1	Initial release.
30-Oct-2018	2	<p>Modified Table 1. Absolute maximum ratings, Table 4. On/off states and Table 5. Dynamic.</p> <p>Modified Figure 1. Safe operating area, Figure 5. Gate charge vs gate-source voltage, Figure 6. Static drain-source on-resistance, Figure 9. Normalized on-resistance vs temperature, Figure 10. Normalized <math>V_{(BR)DSS}</math> vs temperature and Figure 12. Source-drain diode forward characteristics.</p> <p>Minor text changes.</p>

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