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# 1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	3.5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.2	
$I_{DM}^{(2)}$	Drain current (pulsed)	14	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	20	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ )	2500	V
$dv/dt^{(3)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(4)}$	MOSFET $dv/dt$ ruggedness	50	
$T_{stg}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature range		

**Notes:**

(1) Limited by package.

(2) Pulse width limited by safe operating area.

(3)  $I_{SD} \leq 3.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .(4)  $V_{DS} \leq 480\text{ V}$ .

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	6.25	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.5	$^\circ\text{C}/\text{W}$

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax}$ )	0.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	80	mJ

## 2 Electrical characteristics

(T<sub>case</sub> = 25 °C unless otherwise specified)

**Table 5: On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA	600			V
I <sub>DSS</sub>	Zero gate voltage drain current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V			1	μA
		V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 600 V, T <sub>C</sub> = 125 °C <sup>(1)</sup>			100	
I <sub>GSS</sub>	Gate-body leakage current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±25 V			±10	μA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2	3	4	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.7 A		1.3	1.4	Ω

**Notes:**

<sup>(1)</sup> Defined by design, not subject to production test.

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0 V	-	211	-	pF
C <sub>oss</sub>	Output capacitance		-	13	-	
C <sub>rss</sub>	Reverse transfer capacitance		-	0.75	-	
C <sub>oss eq.</sub> <sup>(1)</sup>	Equivalent output capacitance	V <sub>DS</sub> = 0 to 480 V, V <sub>GS</sub> = 0 V	-	19.5	-	pF
R <sub>G</sub>	Intrinsic gate resistance	f = 1 MHz open drain	-	6.2	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 480 V, I <sub>D</sub> = 3.5 A, V <sub>GS</sub> = 10 V (see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> )	-	8	-	nC
Q <sub>gs</sub>	Gate-source charge		-	1.6	-	
Q <sub>gd</sub>	Gate-drain charge		-	4.4	-	

**Notes:**

<sup>(1)</sup> C<sub>oss eq.</sub> is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

**Table 7: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 1.7 A R <sub>G</sub> = 4.7 Ω, V <sub>GS</sub> = 10 V (see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a> )	-	12	-	ns
t <sub>r</sub>	Rise time		-	3	-	
t <sub>d(off)</sub>	Turn-off delay time		-	70	-	
t <sub>f</sub>	Fall time		-	15	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		3.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		14	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 3.5\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 3.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	220		ns
$Q_{rr}$	Reverse recovery charge		-	1.05		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	9.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 3.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	314		ns
$Q_{rr}$	Reverse recovery charge		-	1.5		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	9.5		A

**Notes:**

(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)

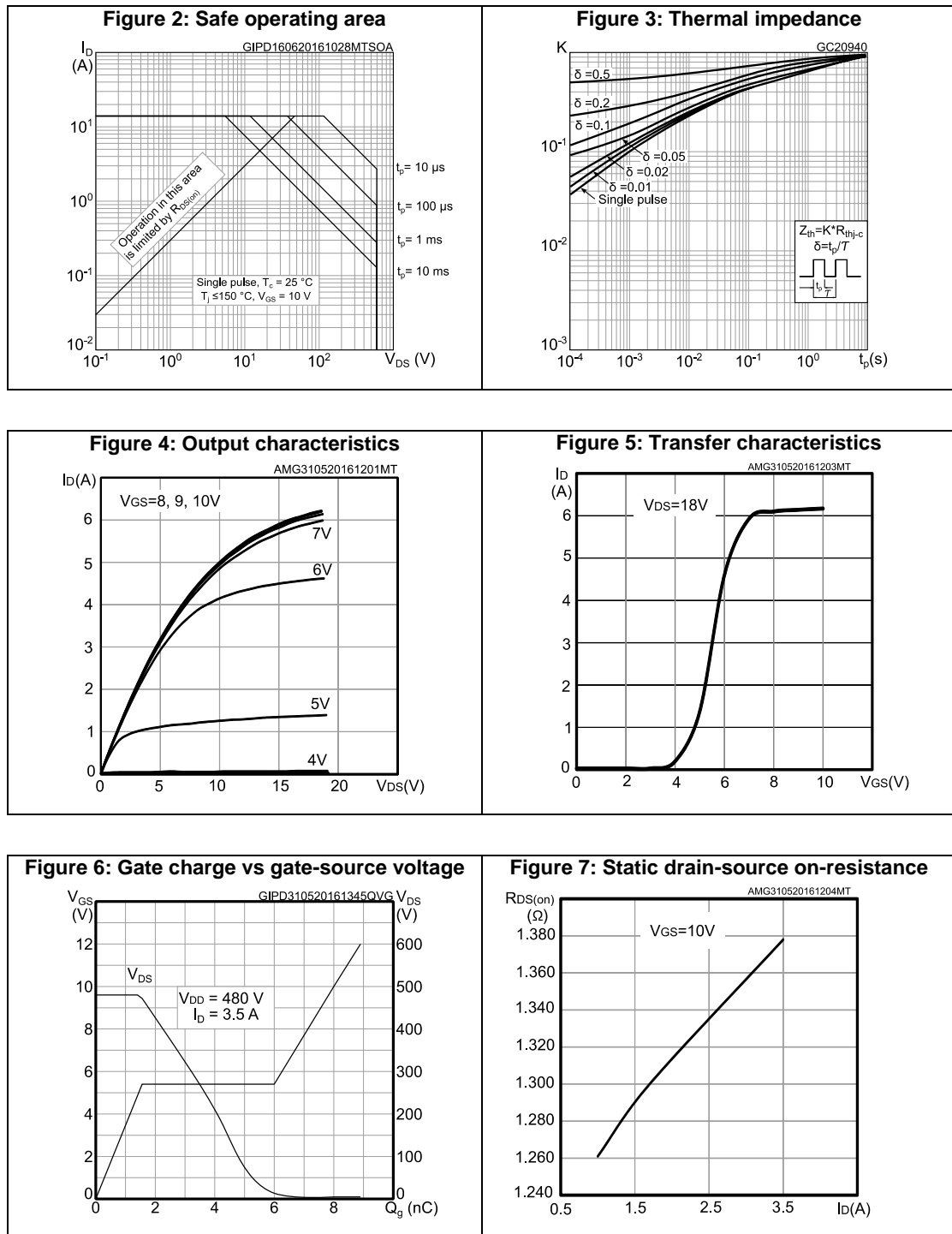


Figure 8: Capacitance variations

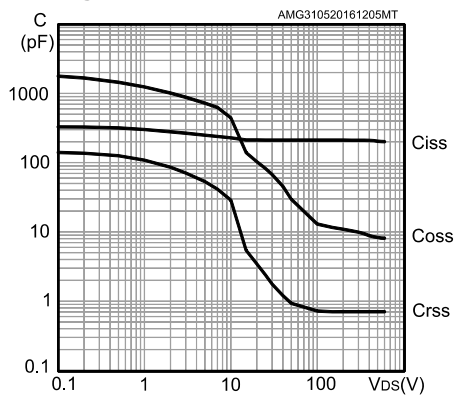


Figure 9: Output capacitance stored energy

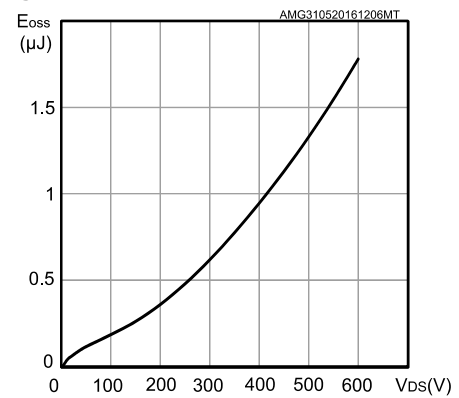


Figure 10: Normalized gate threshold voltage vs temperature

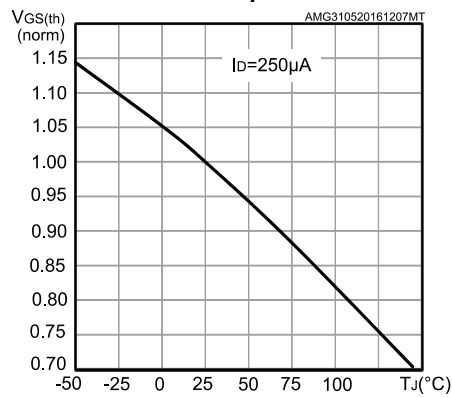


Figure 11: Normalized on-resistance vs temperature

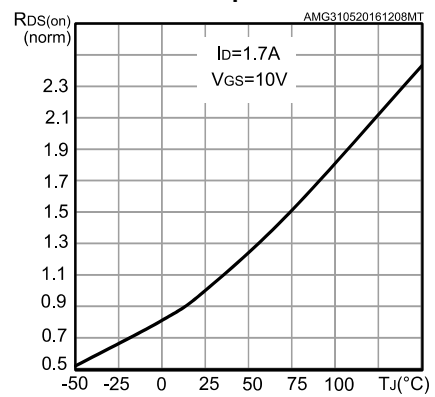


Figure 12: Normalized V(BR)DSS vs temperature

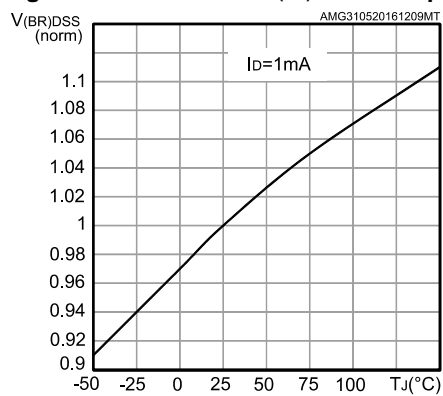
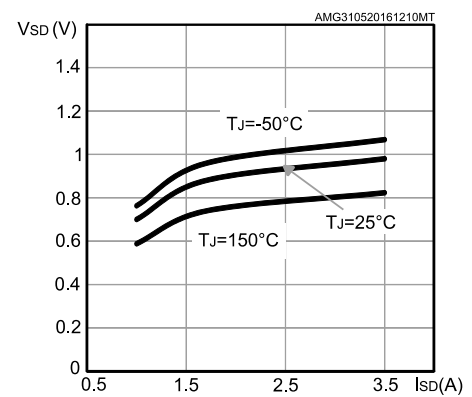
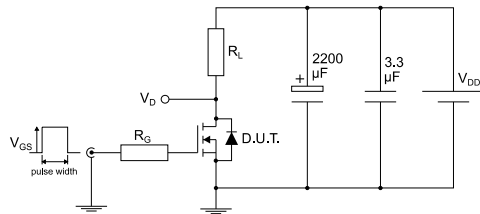


Figure 13: Source-drain diode forward characteristics



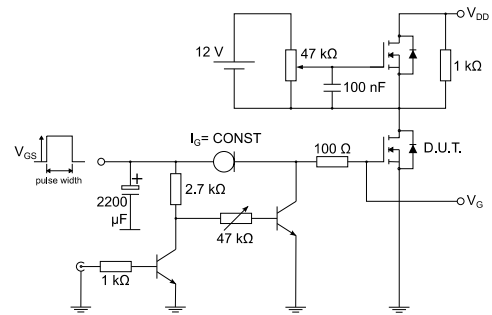
### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



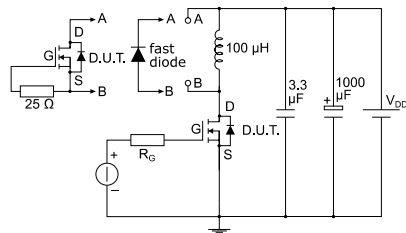
AM01468v1

**Figure 15: Test circuit for gate charge behavior**



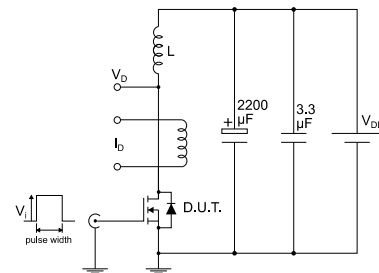
AM01469v1

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



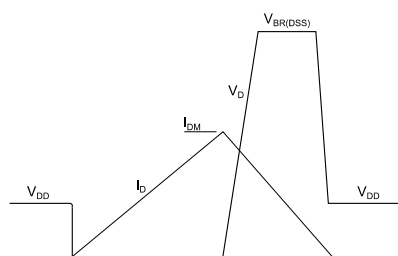
AM01470v1

**Figure 17: Unclamped inductive load test circuit**



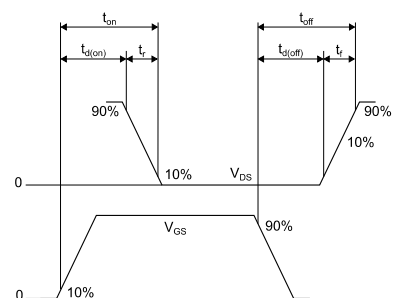
AM01471v1

**Figure 18: Unclamped inductive waveform**



AM01472v1

**Figure 19: 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](http://www.st.com)**. ECOPACK® is an ST trademark.



#### 4.1 TO-220FP package information

**Figure 20: TO-220FP package outline**

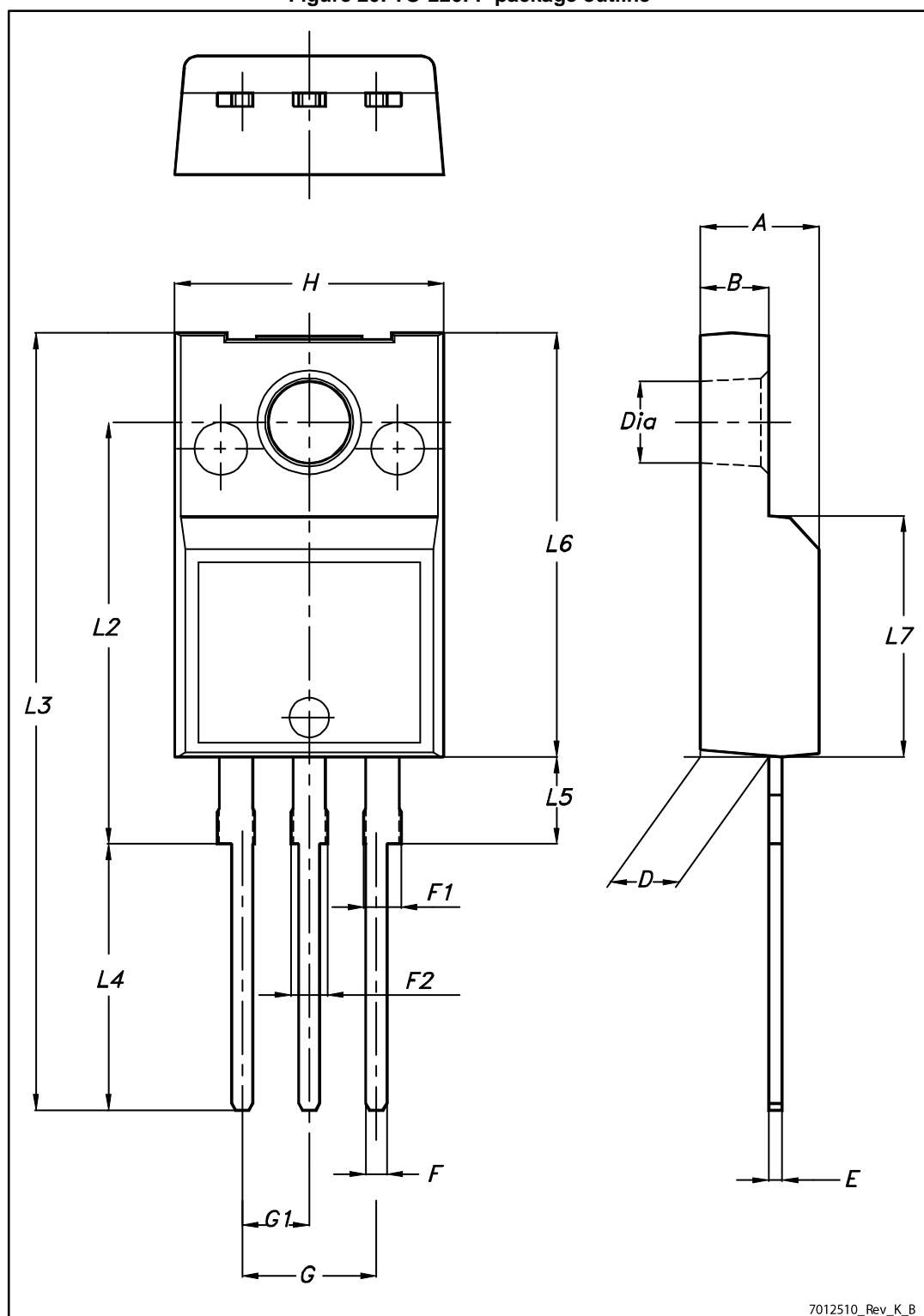


Table 9: TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

## 5 Revision history

Table 10: Document revision history

Date	Revision	Changes
30-Sep-2013	1	First release.
15-Jun-2016	2	Updated title, features and description in cover page. Updated <a href="#">Section 1: "Electrical ratings"</a> and <a href="#">Section 2: "Electrical characteristics"</a> . Added <a href="#">Section 2.1: "Electrical characteristics (curves)"</a> . Minor text changes.

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