

N-channel 600 V, 0.045 Ω typ., 52 A MDmesh™ M2 Power MOSFET in a TO247-4 package

Datasheet - production data

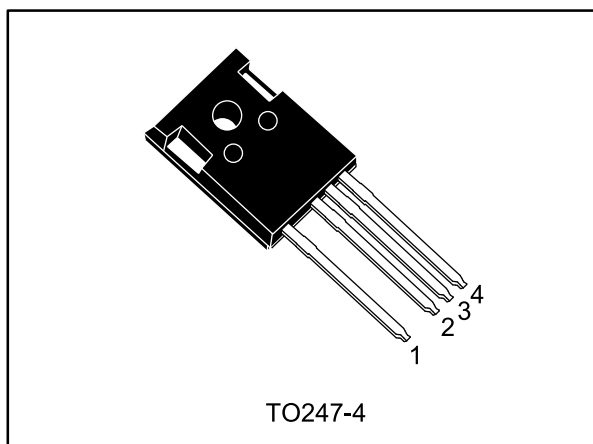
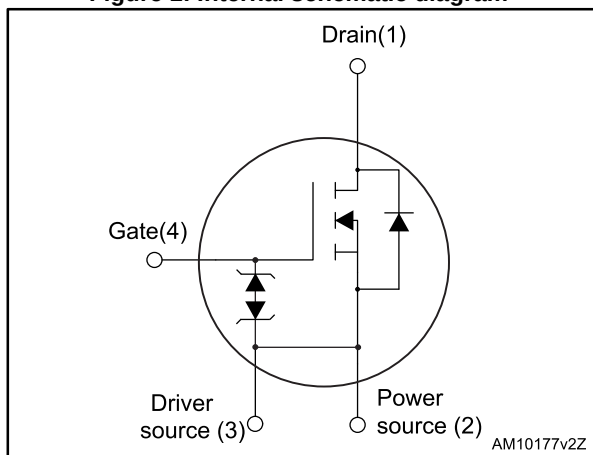


Figure 1: Internal schematic diagram



Features

Order code	V _{DS} @ T _{Jmax}	R _{DS(on)} max	I _D
STW56N60M2-4	650 V	0.055 Ω	52 A

- Excellent switching performance thanks to the extra driving source pin
- Extremely low gate charge
- Excellent output capacitance (C_{oss}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STW56N60M2-4	56N60M2	TO247-4	Tube

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1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	52	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	33	A
$I_{DM}^{(1)}$	Drain current (pulsed)	208	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	350	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature	- 55 to 150	$^{\circ}\text{C}$
T_j	Max. operating junction temperature	150	$^{\circ}\text{C}$

Notes:

(1) Pulse width limited by safe operating area

(2) $I_{SD} \leq 52\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, $V_{DS(peak)} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$ (3) $V_{DS} \leq 480\text{ V}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^{\circ}\text{C}/\text{W}$
$R_{thj-case}$	Thermal resistance junction-case max	0.36	$^{\circ}\text{C}/\text{W}$

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{JMAX})	7.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	1100	mJ

2 Electrical characteristics

(T_C = 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	600			V
I _{DSS}	Zero gate voltage drain current (V _{GS} = 0)	V _{DS} = 600 V V _{DS} = 600 V, T _C = 125 °C			1 100	μA μA
I _{GSS}	Gate-body leakage current (V _{DS} = 0)	V _{GS} = ± 25 V			± 10	nA
V _{GS(th)}	Gate threshold voltage	V _{DS} = V _{GS} , I _D = 250 μA	2	3	4	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 26 A		0.045	0.055	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{iss}	Input capacitance	V _{DS} = 100 V, f = 1 MHz, V _{GS} = 0	-	3750	-	pF
C _{oss}	Output capacitance		-	175	-	pF
C _{rss}	Reverse transfer capacitance		-	6.6	-	pF
C _{o(er)} ⁽¹⁾	Equivalent output capacitance	V _{GS} = 0, V _{DS} = 0 to 480V	-	740	-	pF
R _G	Intrinsic gate resistance	f = 1 MHz open drain	-	4.7	-	Ω
Q _g	Total gate charge	V _{DD} = 480 V, I _D = 52 A, V _{GS} = 10 V	-	91	-	nC
Q _{gs}	Gate-source charge		-	13.5	-	nC
Q _{gd}	Gate-drain charge		-	41	-	nC

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_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t _{d(on)}	Turn-on delay time	V _{DD} = 300 V, I _D = 26 A, R _G = 4.7 Ω, V _{GS} = 10 V	-	18	-	ns
t _r	Rise time		-	26.5	-	ns
t _{d(off)}	Turn-off delay time		-	119	-	ns
t _f	Fall time		-	14	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		52	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		208	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 52\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 52\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$	-	496		ns
Q_{rr}	Reverse recovery charge		-	10		μC
I_{RRM}	Reverse recovery current		-	41		A
t_{rr}	Reverse recovery time	$I_{SD} = 52\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$	-	632		ns
Q_{rr}	Reverse recovery charge		-	14		μC
I_{RRM}	Reverse recovery current		-	45		A

Notes:

⁽¹⁾Pulse width limited by safe operating area

⁽²⁾Pulsed: pulse duration = 300 μs , duty cycle 1.5%

2.2 Electrical characteristics (curves)

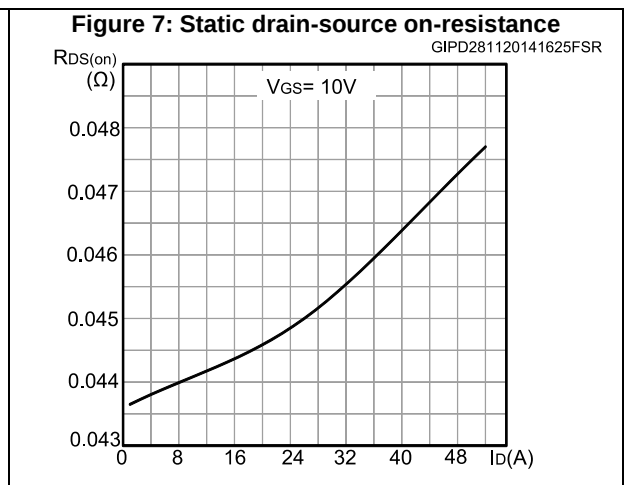
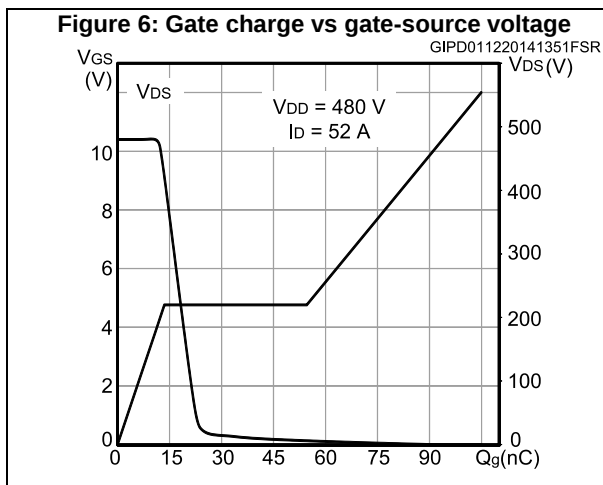
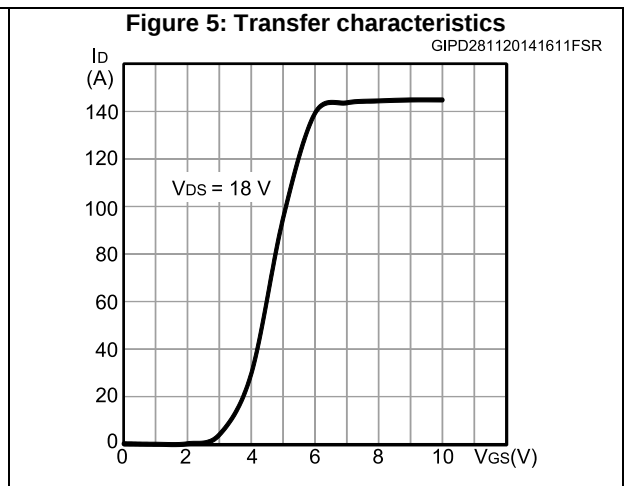
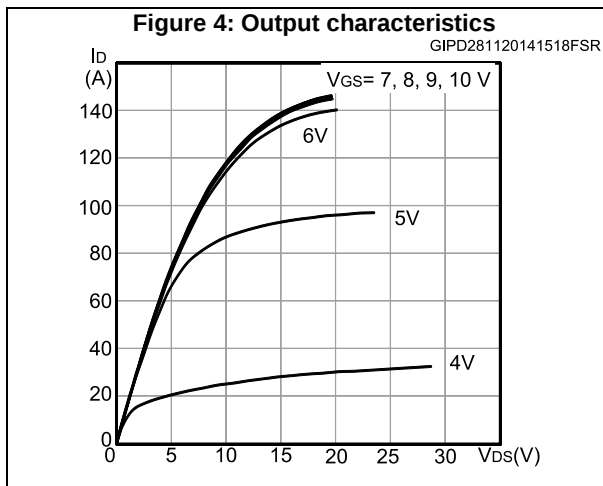
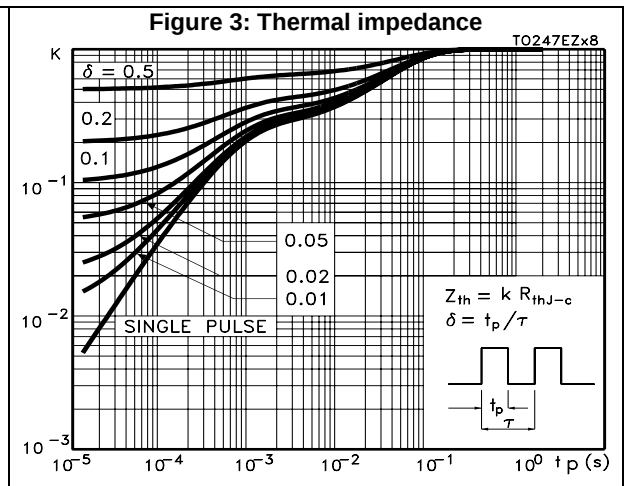
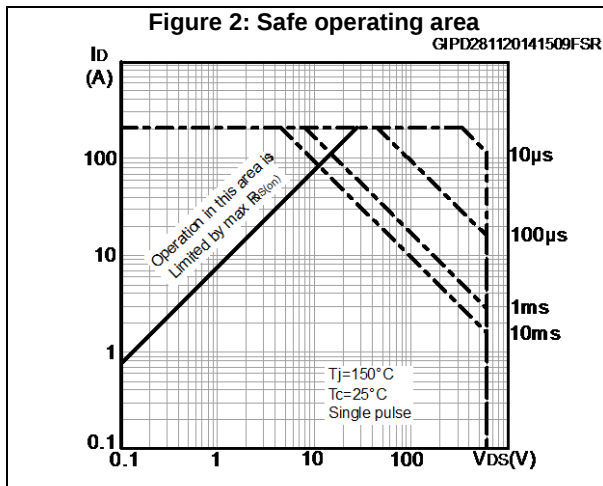


Figure 8: Capacitance variations

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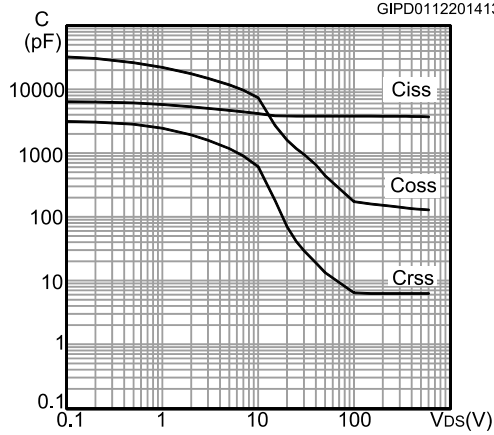


Figure 9: Normalized gate threshold voltage vs temperature

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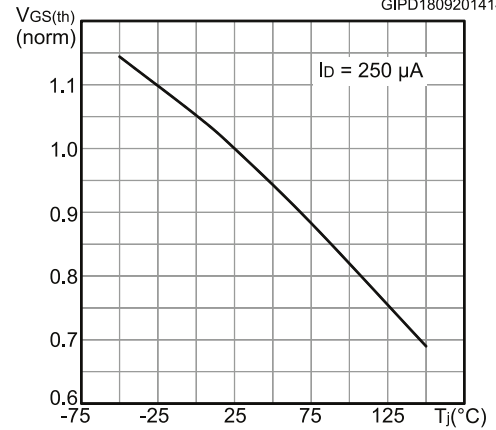


Figure 10: Normalized on-resistance

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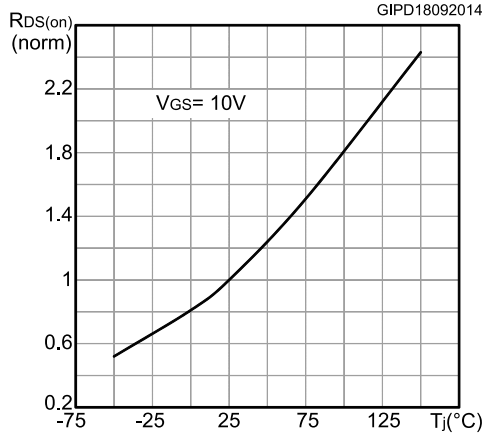


Figure 11: Normalized V(BR)DSS vs temperature

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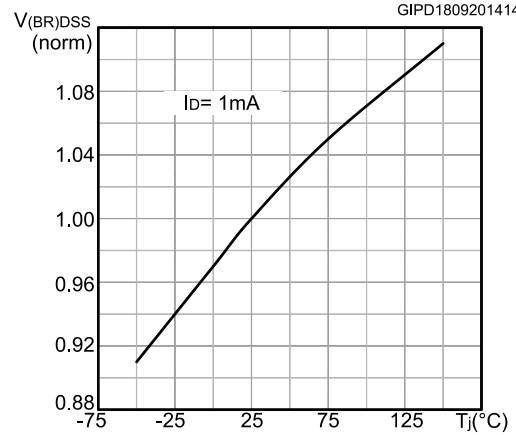


Figure 12: Source-drain diode forward characteristics

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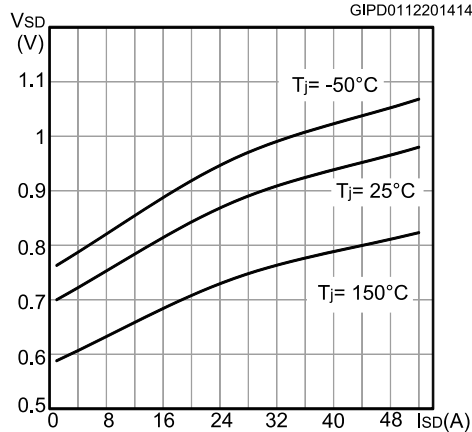
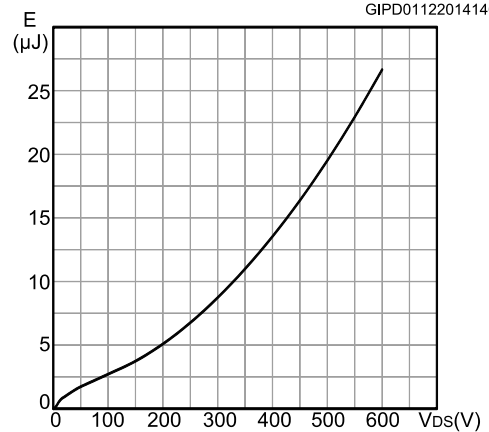


Figure 13: Output capacitance stored energy

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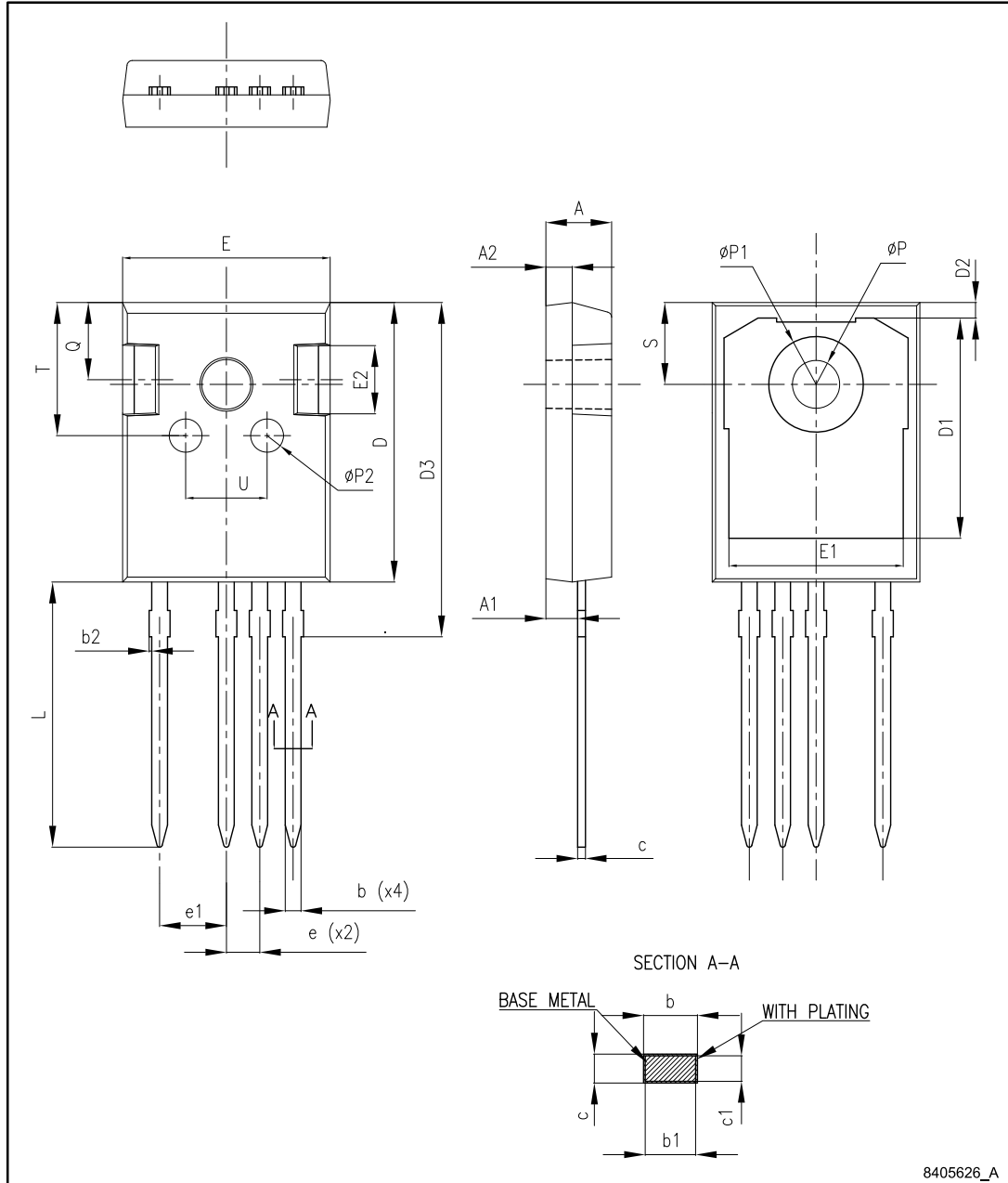
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4 Package mechanical data

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 TO247-4 package information

Figure 20: TO247-4 package outline



8405626_A

Table 9: TO247-4 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		1.29
b1	1.15	1.20	1.25
b2	0		0.20
c	0.59		0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
D3	24.97	25.12	25.27
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
L	19.80	19.92	20.10
P	3.50	3.60	3.70
P1			7.40
P2	2.40	2.50	2.60
Q	5.60		6.00
S		6.15	
T	9.80		10.20
U	6.00		6.40

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
25-Jul-2014	1	Initial release.
01-Dec-2014	2	Document status promoted from preliminary to production data. Added Section 2.1: "Electrical characteristics (curves)" .
29-Jan-2015	3	Updated Figure 1: "Internal schematic diagram" .

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