STD6N95K5, STF6N95K5
STP6N95K5, STW6N95K5

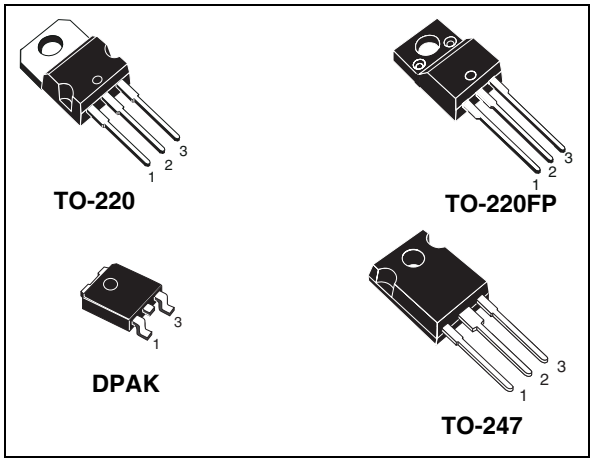
N-channel 950 V, 1 Ω, 5 A TO-220, TO-220FP, TO-247, DPAK Zener-protected SuperMESH 5™ Power MOSFET

Preliminary data

Features

Type	V_{DSS}	$R_{DS(on)}$max	I_D	P_W
STD6N95K5	950 V	< 1.25 Ω	5 A	90 W
STF6N95K5				25 W
STP6N95K5				90 W
STW6N95K5				

- DPAK worldwide best $R_{DS(on)}$
- Worldwide best FOM (figure of merit)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected



Application

- Switching applications

Description

SuperMESH 5™ is a revolutionary avalanche-rugged very high voltage Power MOSFET technology based on an innovative proprietary vertical structure. The result is a drastic reduction in on-resistance and ultra low gate charge for applications which require superior power density and high efficiency.

Figure 1. Internal schematic diagram

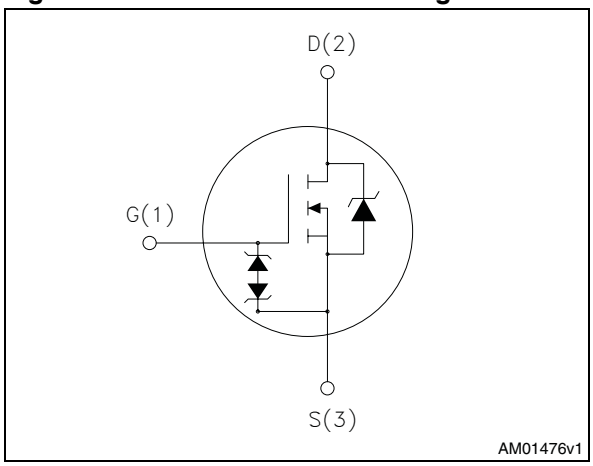


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD6N95K5	6N95K5	DPAK	Tape and reel
STF6N95K5		TO-220FP	Tube
STP6N95K5		TO-220	
STW6N95K5		TO-247	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220, DPAK TO-247	TO-220FP	
V_{GS}	Gate- source voltage	± 30		V
I_D	Drain current (continuous) at T_C = 25 °C	5		A
I_D	Drain current (continuous) at T_C = 100 °C	3.1		A
I_{DM} (1)	Drain current (pulsed)	20		A
P_{TOT}	Total dissipation at T_C = 25 °C	90	25	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{jmax})	TBD		A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D=I_{AS}, V_{DD}= 50 V)	TBD		mJ
$V_{ESD(G-S)}$	Gate source ESD (HBM-C = 100 pF, R = 1.5 kΩ)	TBD		V
V_{iso}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s;T_C=25 °C)		2500	V
dv/dt (2)	Peak diode recovery voltage slope	TBD		V/ns
T_j T_{stg}	Operating junction temperature Storage temperature	-55 to 150		°C

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 5$ A, di/dt $\leq$ 100 A/µs, $V_{Peak} \leq V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	DPAK	TO-247	TO-220FP	
Rthj-case	Thermal resistance junction-case max	1.38			5	°C/W
Rthj-amb	Thermal resistance junction-amb max	62.5		50	62.5	°C/W
Rthj-pcb (1)	Thermal resistance junction-pcb max		50			°C/W
T_l	Maximum lead temperature for soldering purpose	300		300		°C

1. When mounted on 1inch² FR-4 board, 2 oz Cu

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. 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	950			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = max rating, V_{DS} = Max rating,Tc=125 °C			1 50	µA µA
I_{GSS}	Gate body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D= 2.5 A		1	1.25	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} =100 V, f=1 MHz, V_{GS}=0	-	450	-	pF
C_{oss}	Output capacitance			30		pF
C_{rss}	Reverse transfer capacitance			1		pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0, V_{DS} = 0 to 720 V	-	TBD	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	TBD	-	pF
R_G	Intrinsic gate resistance	f = 1MHz open drain	-	10.5	-	Ω
Q_g	Total gate charge	V_{DD} = 760 V, I_D = 5 A	-	11	-	nC
Q_{gs}	Gate-source charge	V_{GS} =10 V		TBD		nC
Q_{gd}	Gate-drain charge	*(see Figure 3)*		TBD		nC

1. Time related 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}
2. energy related is defined as a constant equivalent capacitance giving the same stored energy 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
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 475 V, I_D = 2.5 A, R_G=4.7 Ω, V_{GS}=10 V *(see Figure 5)*	-	TBD TBD TBD TBD	-	ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM}	Source-drain current Source-drain current (pulsed)		-		5 20	mA A
V_{SD} (1)	Forward on voltage	I_{SD}= 5 A, V_{GS}=0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 5 A, V_{DD}= 60 V di/dt = 100 A/µs, *(see Figure 4)*	-	TBD TBD TBD		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD}= 5 A,V_{DD}= 60 V di/dt=100 A/µs, Tj=150 °C*(see Figure 4)*	-	TBD TBD TBD		ns µC A

1. Pulsed: pulse duration = 300µs, duty cycle 1.5%

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
BV_{GSO}	Gate-source breakdown voltage	Igs ± 1mA, (open drain)	30	-		V

The built-in-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

3 Test circuits

Figure 2. Switching times test circuit for resistive load

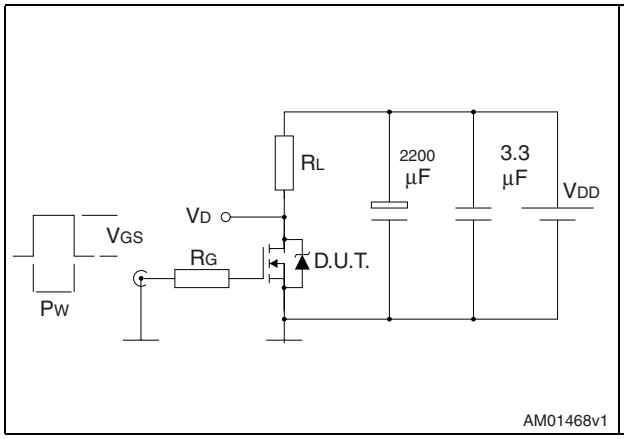


Figure 3. Gate charge test circuit

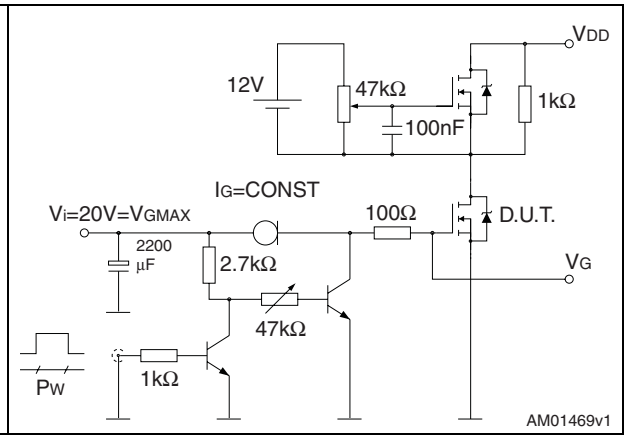


Figure 4. Test circuit for inductive load switching and diode recovery times

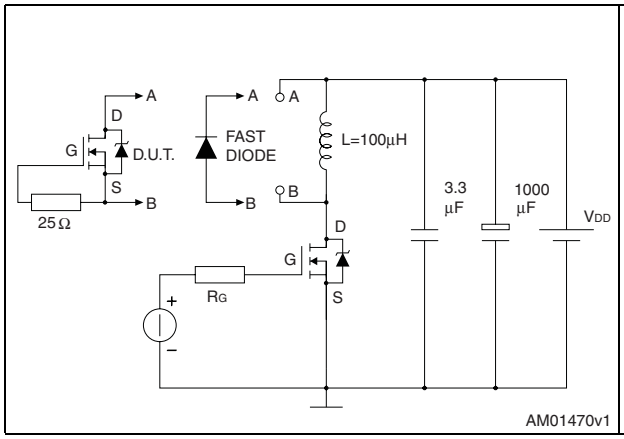


Figure 5. Unclamped inductive load test circuit

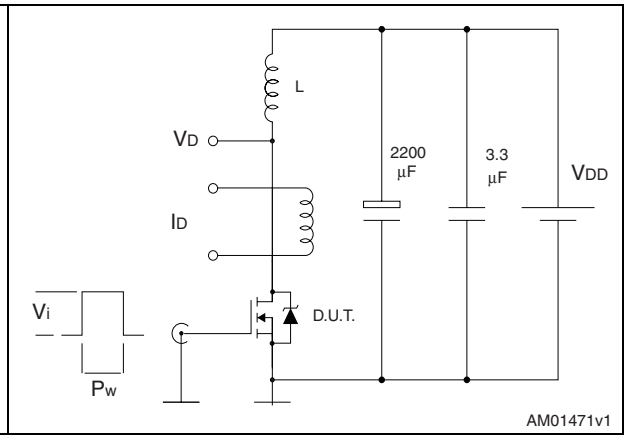


Figure 6. Unclamped inductive waveform

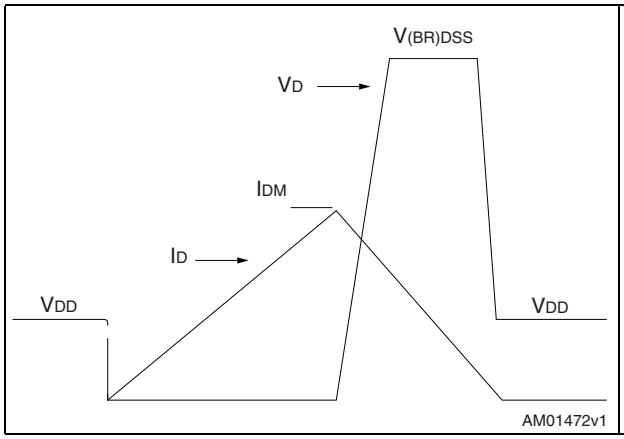
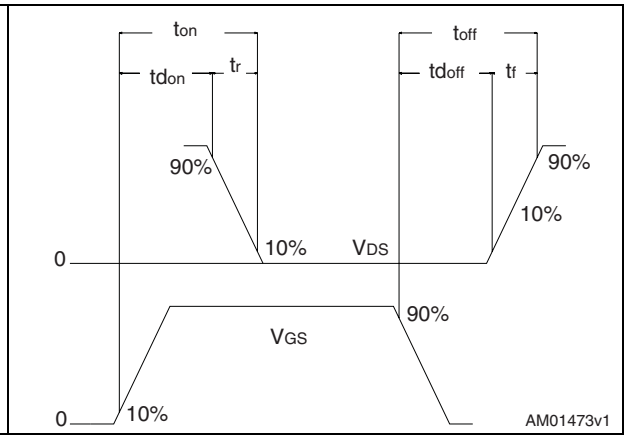


Figure 7. Switching time waveform



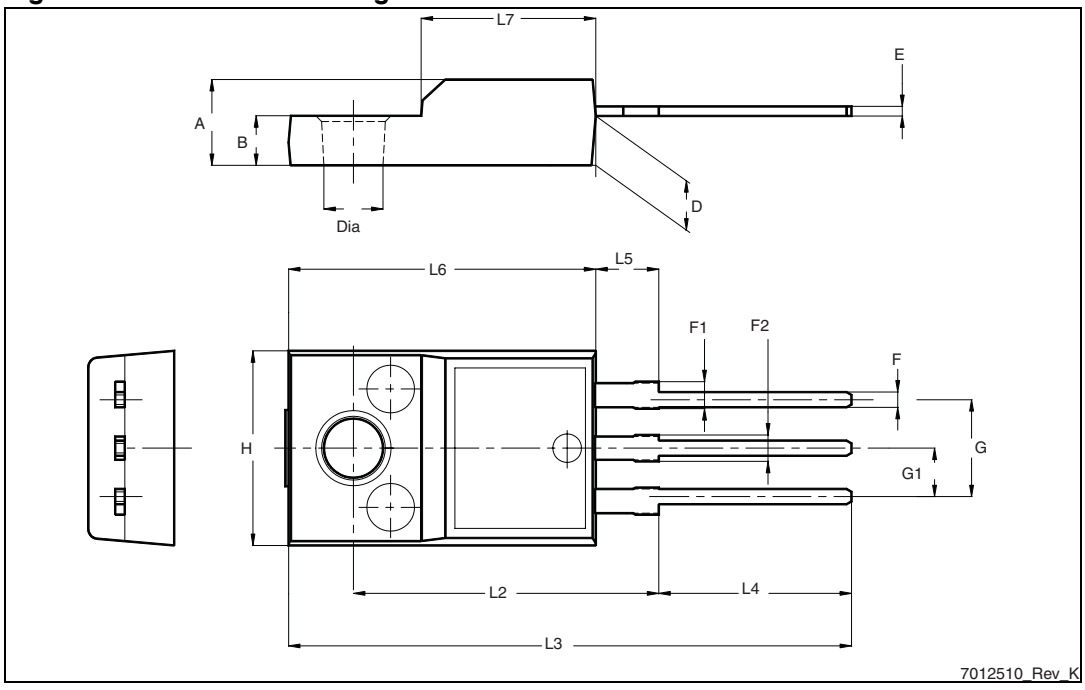
4 Package mechanical data

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.

Table 9. TO-220FP mechanical data

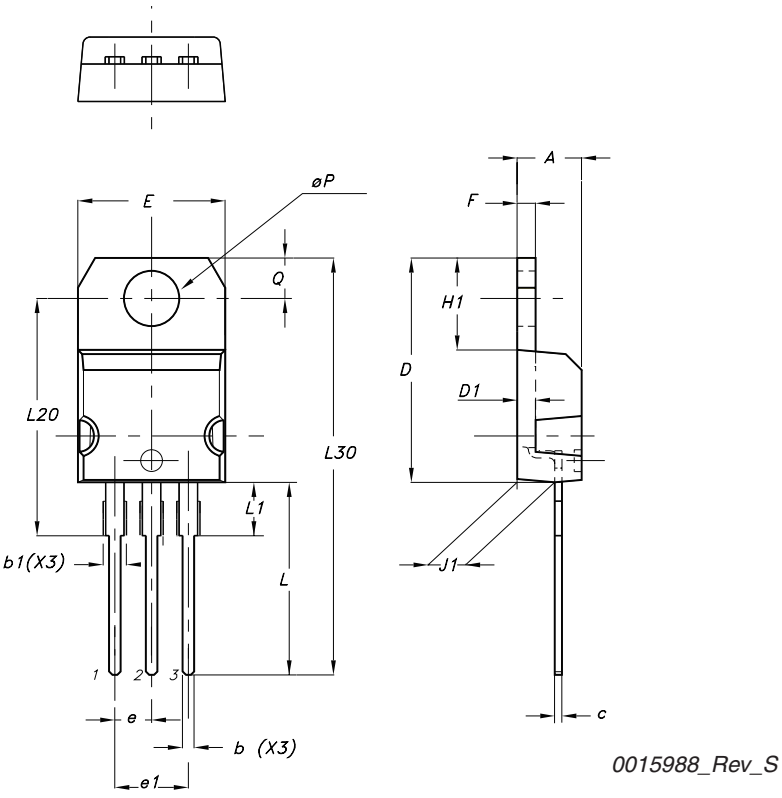
Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 8. TO-220FP drawing



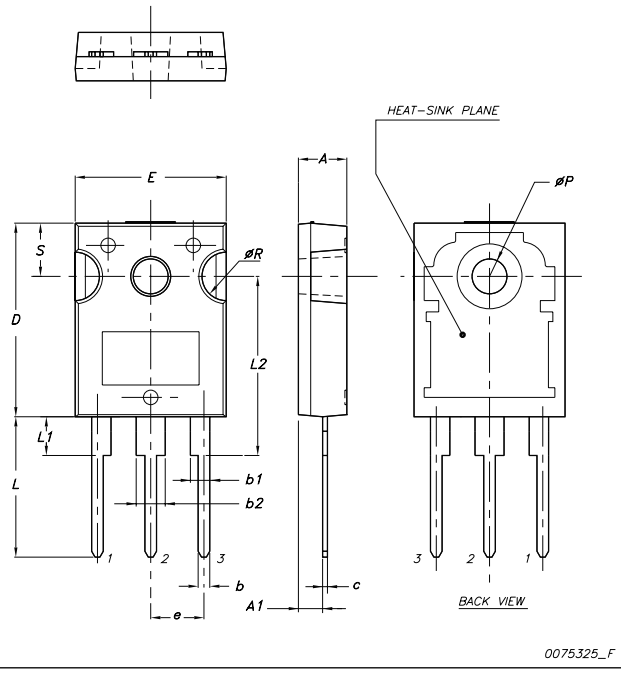
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



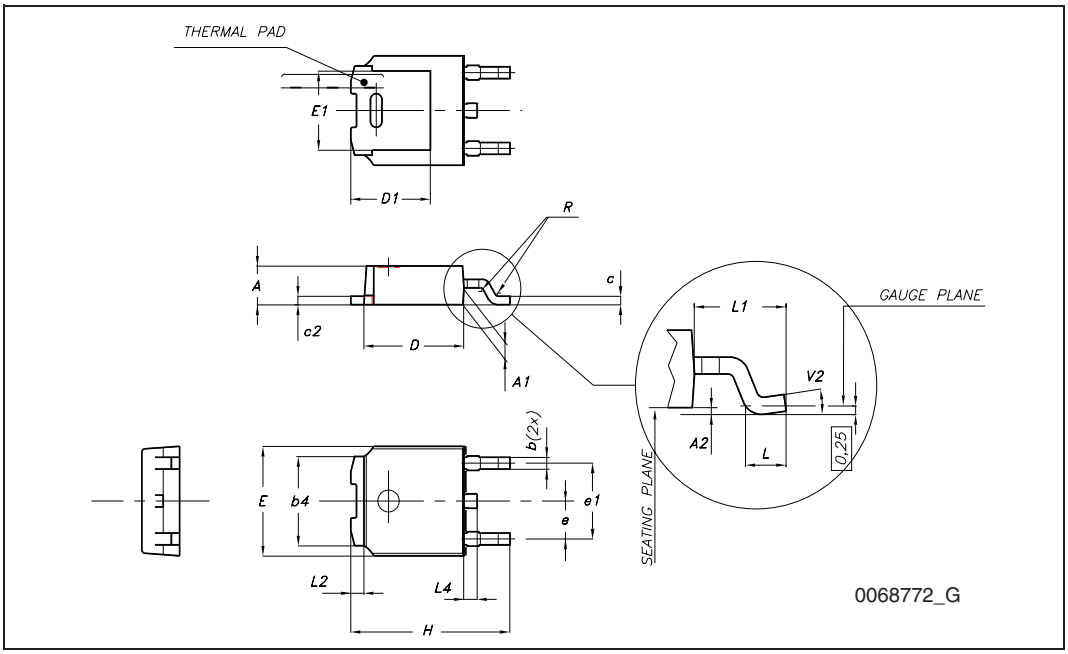
TO-247 mechanical data

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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0 °		8 °



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
12-Jan-2010	1	First release.

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