



## STP60NS04ZB

N-channel clamped - 10mΩ - 60A - TO-220  
Fully protected Mesh Overlay™ Power MOSFET

### General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP60NS04ZB	Clamped	< 0.015Ω	60A

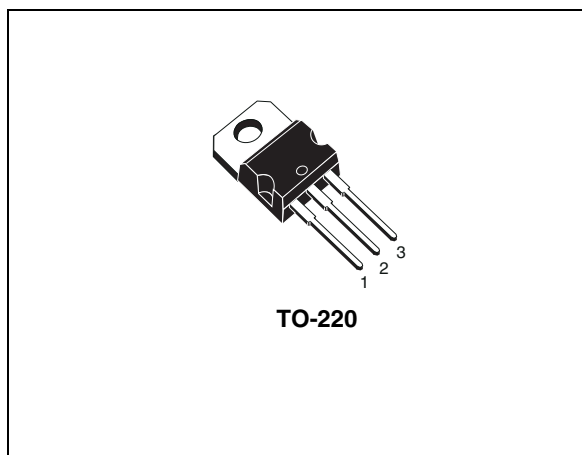
- 100% avalanche tested
- Low capacitance and gate charge
- 175 °C maximum junction temperature

### Description

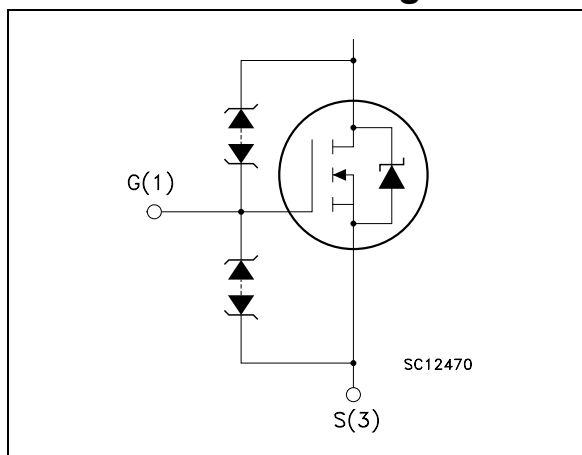
This fully clamped Power MOSFET is produced by using the latest advanced Company's Mesh Overlay process which is based on a novel strip layout. The inherent benefits of the new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encountered in the automotive environment. Any other application requiring extra ruggedness is also recommended.

### Applications

- Switching application



### Internal schematic diagram



### Order codes

Part number	Marking	Package	Packaging
STP60NS04ZB	P60NS04ZB	TO-220	Tube

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	Clamped	V
$V_{GS}$	Gate- source voltage	Clamped	V
$I_D$	Drain current (continuous) at $T_C = 25^\circ\text{C}$	60	A
$I_D$	Drain current (continuous) at $T_C = 100^\circ\text{C}$	42	A
$I_{DG}$	Drain gate current (continuous)	$\pm 50$	mA
$I_{GS}$	Gate source current (continuous)	$\pm 50$	mA
$I_{DM}^{(1)}$	Drain current (pulsed)	240	A
$P_{tot}$	Total dissipation at $T_C = 25^\circ\text{C}$	150	W
	Derating factor	1	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate-source ESD (HBM - C = 100pF, R=1.5 k $\Omega$ )	6	KV
$V_{ESD(G-D)}$	Gate-drain ESD (HBM - C = 100pF, R=1.5 k $\Omega$ )	4	KV
$V_{ESD(D-S)}$	Drain-source ESD (HBM - C = 100pF, R=1.5 k $\Omega$ )	4	KV
$T_{stg}$	Storage temperature	-65 to 175	$^\circ\text{C}$
$T_j$	Max. operating junction temperature		

1. Pulse width limited by safe operating area.

**Table 2. Thermal data**

$R_{thj-case}$	Thermal resistance junction-case max	1	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C/W}$
$T_J$	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

Symbol	Parameter	Max Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	60	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 30\text{ V}$ )	400	mJ

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}\text{C}$  unless otherwise specified)

**Table 3. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{mA}$ , $V_{GS} = 0$ $-40 < T_J < 175^{\circ}\text{C}$	33			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 16\text{V}$ ; $T_J = 150^{\circ}\text{C}$ $V_{DS} = 16\text{V}$ ; $T_J = 175^{\circ}\text{C}$			50 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 10\text{V}$ ; $T_J = 175^{\circ}\text{C}$ $V_{GS} = \pm 16\text{V}$ ; $T_J = 175^{\circ}\text{C}$			50 150	$\mu\text{A}$ $\mu\text{A}$
$V_{GSS}$	Gate-source breakdown voltage	$I_{GS} = 100\mu\text{A}$	18			V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 1\text{mA}$ $-40 < T_J < 150^{\circ}\text{C}$	1.7	3	4.2	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{V}$ , $I_D = 30\text{A}$ $V_{GS} = 16\text{V}$ , $I_D = 30\text{A}$		11 10	15 14	$\text{m}\Omega$ $\text{m}\Omega$

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15\text{V}$ , $I_D = 30\text{A}$	20	40		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GS} = 0$		1700 800 190	2100 1000 240	pF pF pF
$t_{r(Voff)}$ $t_f$ $t_c$	Turn-on delay time Fall time Cross-over time	$V_{clamp} = 30\text{V}$ , $I_D = 60\text{A}$ $R_G = 4.7\Omega$ , $V_{GS} = 10\text{V}$ (see <a href="#">Figure 14</a> )		60 45 100	75 60 130	ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total gate charge Gate-source charge Gate-drain charge	$V_{DD} = 18\text{V}$ , $I_D = 60\text{A}$ , $V_{GS} = 10\text{V}$ , $R_G = 4.7\Omega$ (see <a href="#">Figure 15</a> )		48 13 16	42	nC nC nC

1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

**Table 5. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain current Source-drain current (pulsed)				60 240	A A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60A$ , $V_{GS} = 0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 60A$ , $di/dt = 100A/\mu s$ , $V_{DD} = 15V$ , $T_j = 150^\circ C$ (see <a href="#">Figure 16</a> )		50 62 2.6		ns nC A

1. Pulse width limited by safe operating area.

2. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

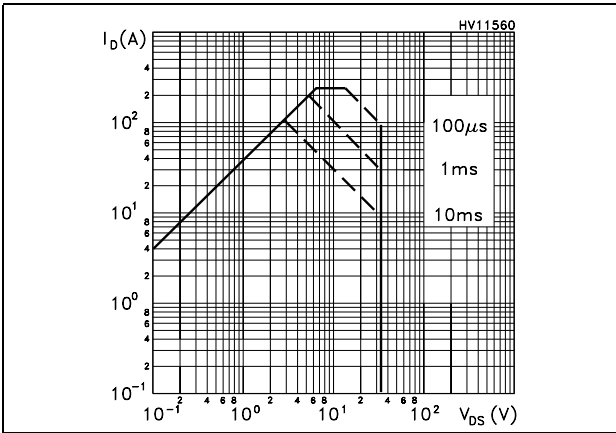


Figure 2. Thermal impedance

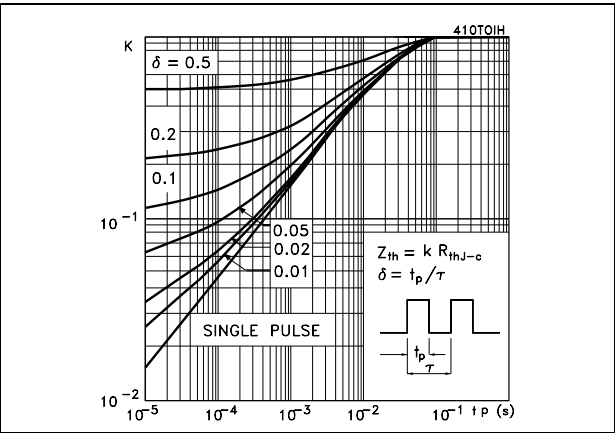


Figure 3. Output characteristics

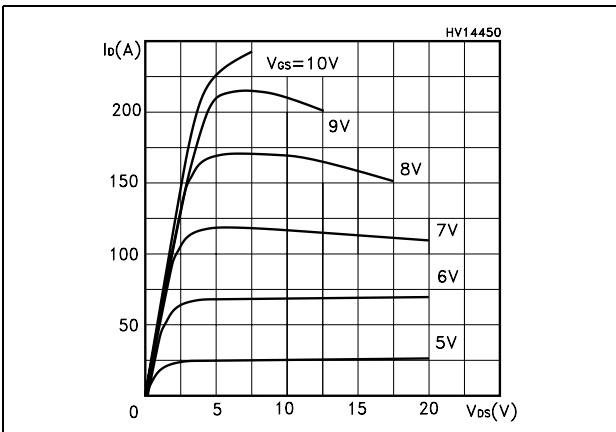


Figure 4. Transfer characteristics

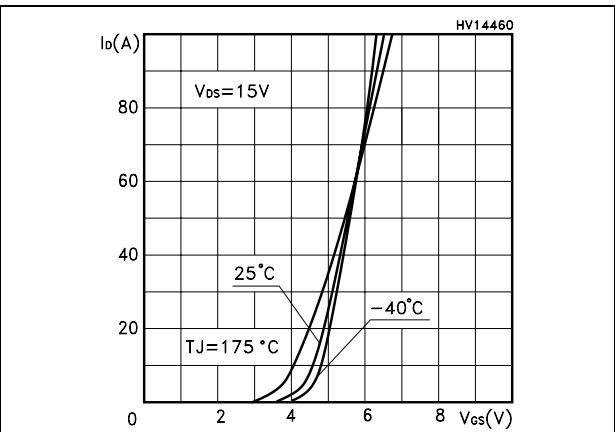


Figure 5. Transconductance

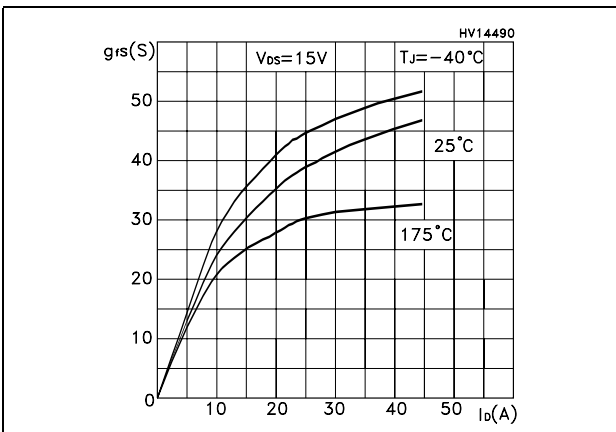


Figure 6. Static drain-source on resistance

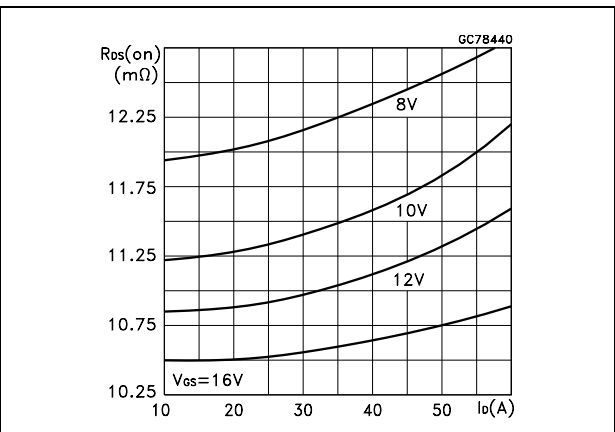


Figure 7. Gate charge vs gate-source voltage    Figure 8. Capacitance variations

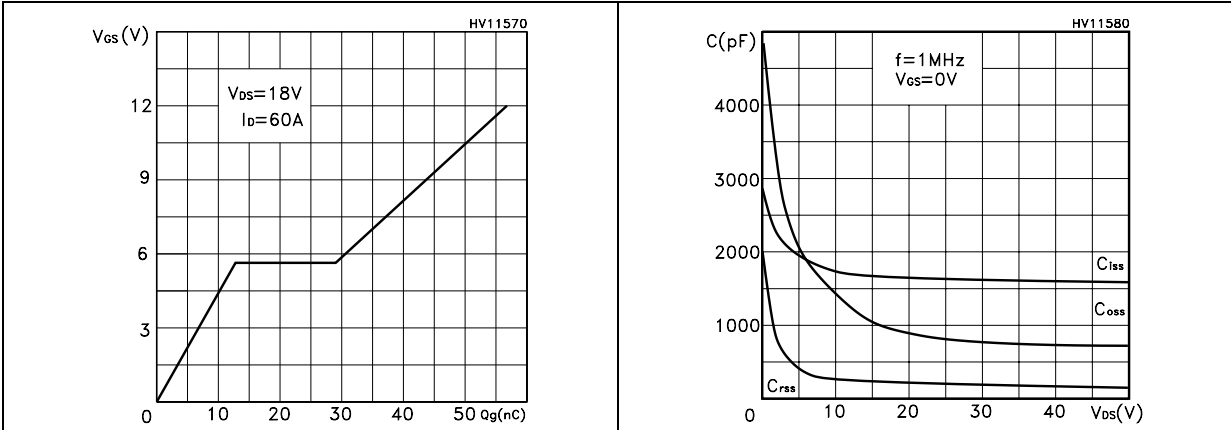


Figure 9. Normalized gate threshold voltage vs temperature    Figure 10. Normalized on resistance vs temperature

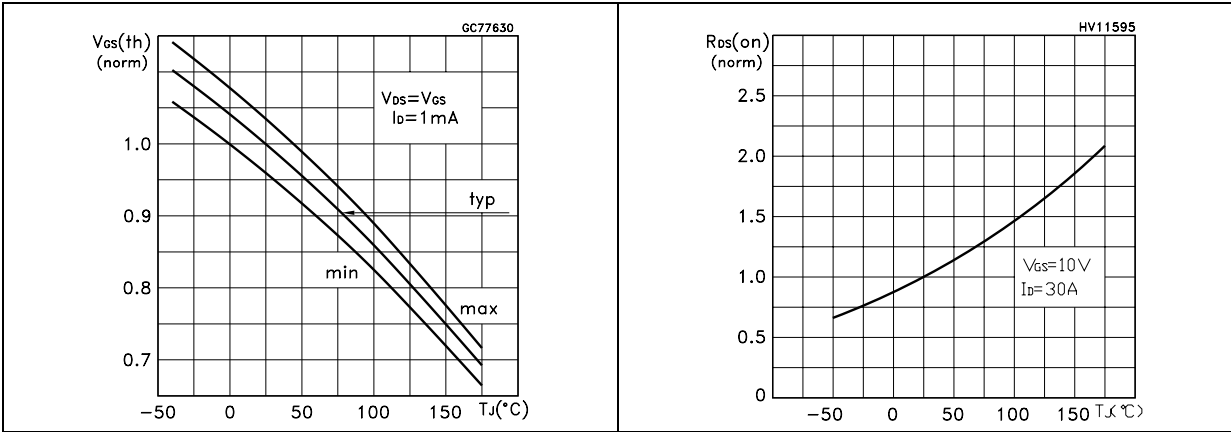


Figure 11. Source-drain diode forward characteristics    Figure 12. Zero gate voltage drain current vs temperature

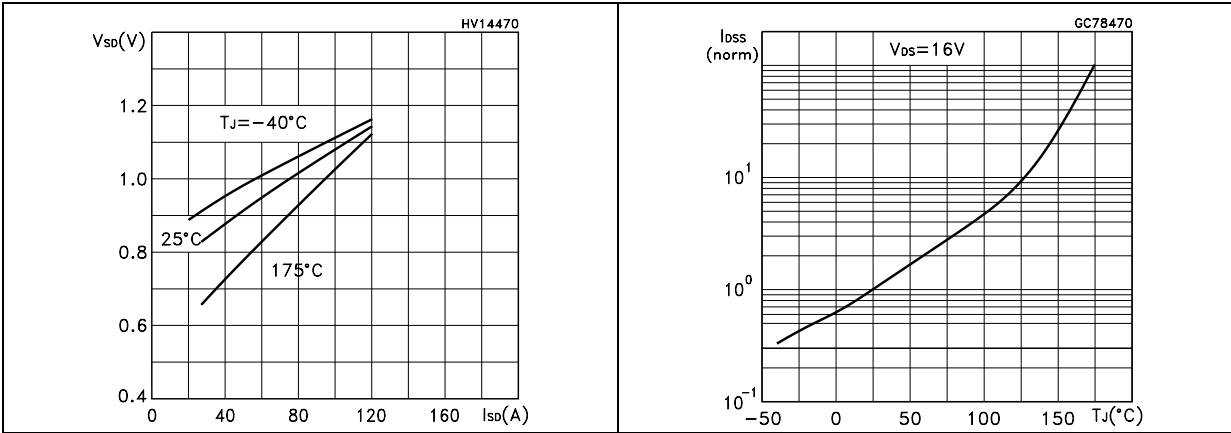
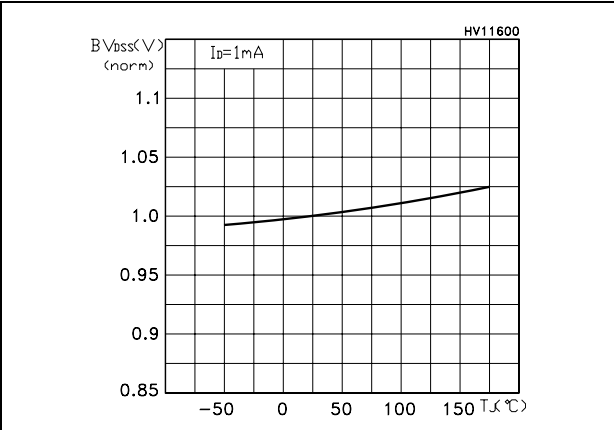
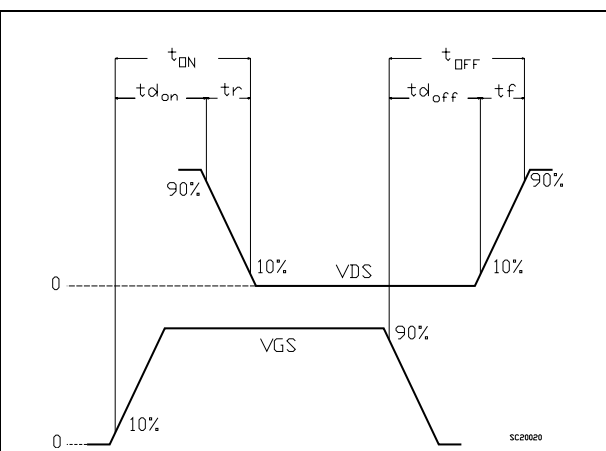


Figure 13. Normalized  $BV_{DSS}$  vs temperature



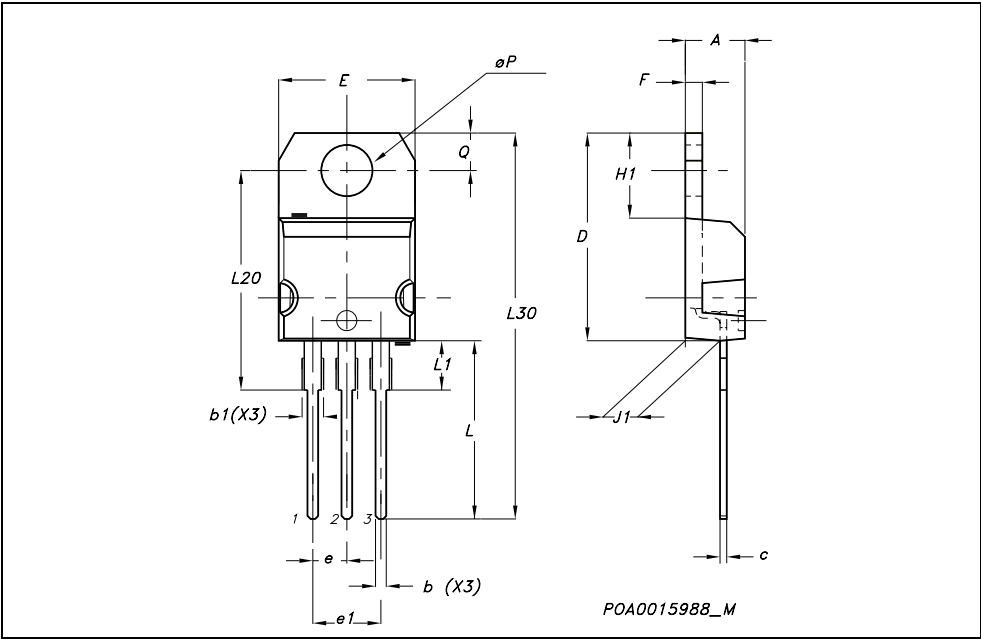




## 4      **Package mechanical data**

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

TO-220 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 5 Revision history

**Table 6. Revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
21-Jun-2004	1	Complete document
04-Oct-2006	2	New template, no content change

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