



## STP60NF06

N-channel 60V - 0.014Ω - 60A TO-220  
STripFET II™ Power MOSFET

### General features

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP60NF06	60V	<0.016Ω	60A

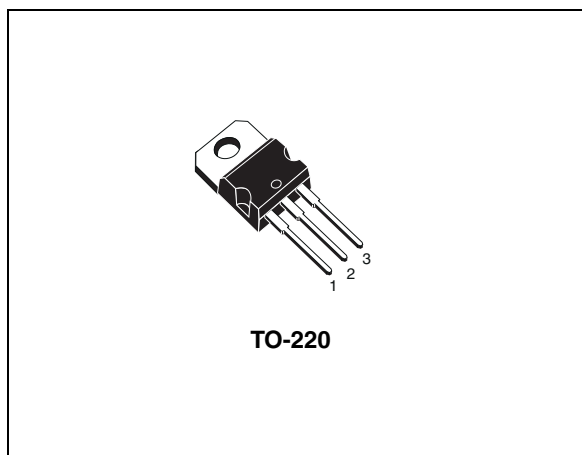
- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

### Description

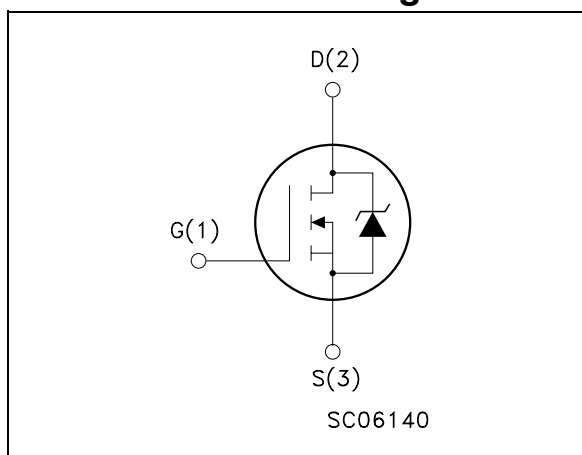
This Power MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

### Applications

- Switching application



### Internal schematic diagram



### Order code

Part number	Marking	Package	Packaging
STP60NF06	P60NF06	TO-220	Tube

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# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )	60	V
$V_{GS}$	Gate- source voltage	$\pm 20$	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
$I_{DM}^{(1)}$	Drain current (pulsed)	240	A
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	110	W
	Derating factor	0.74	W/ $^\circ\text{C}$
$dv/dt^{(2)}$	Peak diode recovery voltage slope	7.5	V/ns
$T_{stg}$	Storage temperature	- 55 to 175	$^\circ\text{C}$
$T_j$	Max. operating junction temperature		

1. Pulse width limited by safe operating area

2.  $I_{SD} \leq 60\text{A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 48\text{V}$ ,  $T_j \leq T_{jmax}$

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.36	$^\circ\text{C}/\text{W}$
$R_{thj-a}$	Thermal resistance junction-ambient max	62.5	$^\circ\text{C}/\text{W}$
$T_l$	Maximum lead temperature for soldering purpose	300	$^\circ\text{C}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ Max)	30	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j=25^\circ\text{C}$ , $I_d=I_{AR}$ , $V_{dd}=30\text{V}$ )	370	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 250 \mu A, V_{GS} = 0$	60			V
$I_{DSS}$	Zero gate voltage Drain current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}, T_C = 125^{\circ}C$			1 10	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20V$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	2		4	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10V, I_D = 30A$		0.014	0.016	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} = 15V, I_D = 30A$		50		S
$C_{iss}$	Input capacitance			1660		pF
$C_{oss}$	Output capacitance	$V_{DS} = 25V, f = 1 \text{ MHz},$ $V_{GS} = 0$		400		pF
$C_{rss}$	Reverse transfer capacitance			140		pF
$Q_g$	Total gate charge	$V_{DD} = 30V, I_D = 60A,$ $V_{GS} = 10V$		54	73	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 10V$		9		nC
$Q_{gd}$	Gate-drain charge	(see Figure 12)		23		nC

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

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 30V, I_D = 30A$ $R_G = 4.7\Omega, V_{GS} = 10V$		15		ns
$t_r$	Rise time	(see Figure 11)		65		ns
$t_{d(off)}$	Turn-off-delay time	$V_{DD} = 30V, I_D = 30A,$ $R_G = 4.7\Omega, V_{GS} = 10V$		45		ns
$t_f$	Fall time	(see Figure 11)		20		ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$I_{SD}$	Source-drain current				60	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				240	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 60A, V_{GS} = 0$			1.3	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 60A, V_{DD} = 30V$ $di/dt = 100A/\mu s, T_j = 150^\circ C$ <i>(see Figure 13)</i>		70		ns
$Q_{rr}$	Reverse recovery charge			185		nC
$I_{RRM}$	Reverse recovery current			5		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

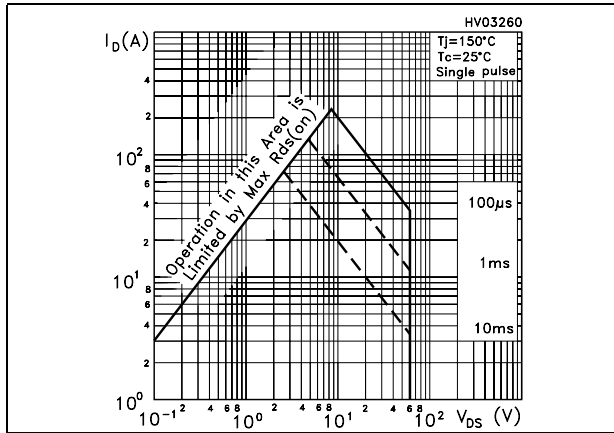


Figure 2. Thermal impedance

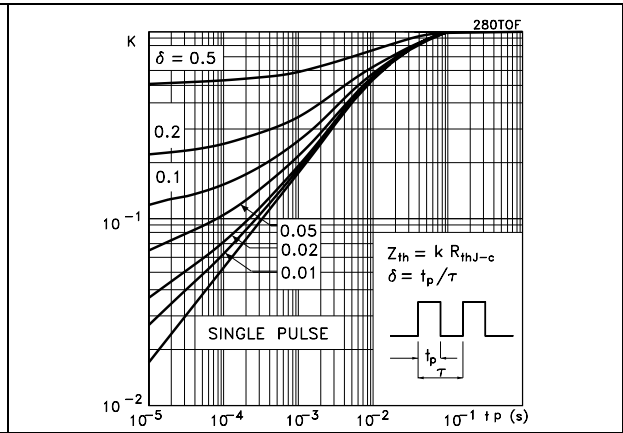


Figure 3. Output characteristics

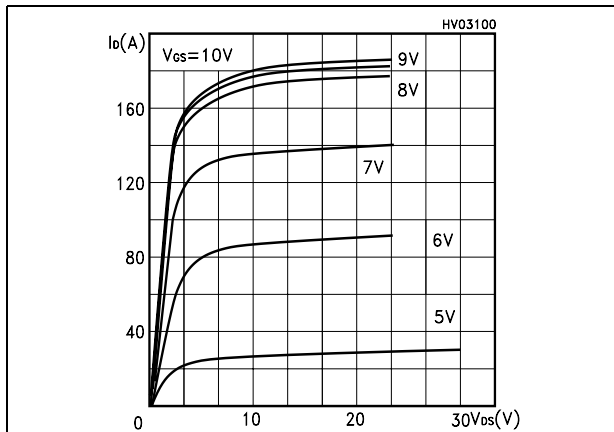


Figure 4. Transfer characteristics

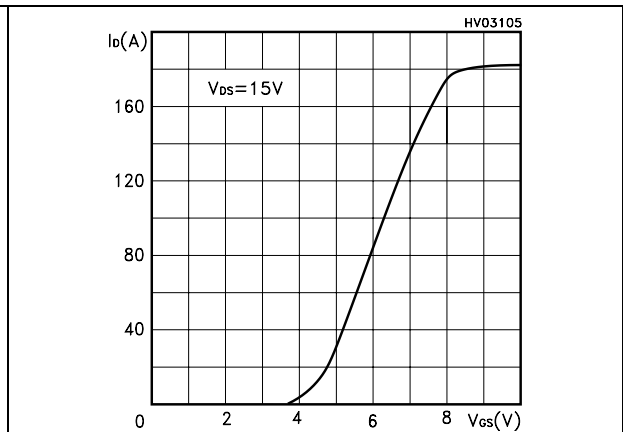


Figure 5. Source-drain diode forward characteristics

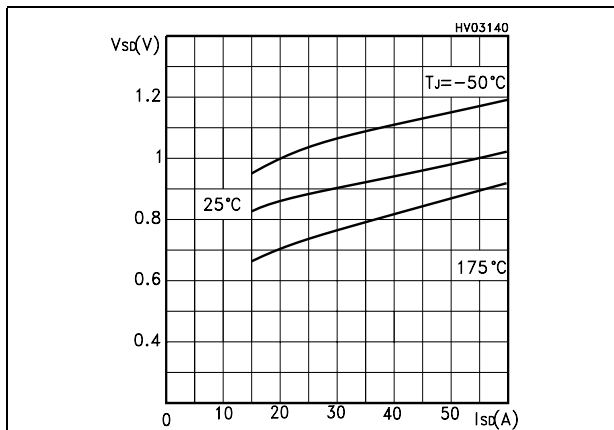


Figure 6. Static drain-source on resistance

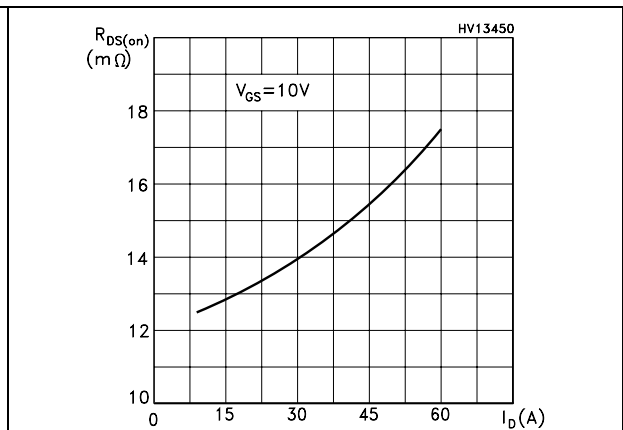


Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

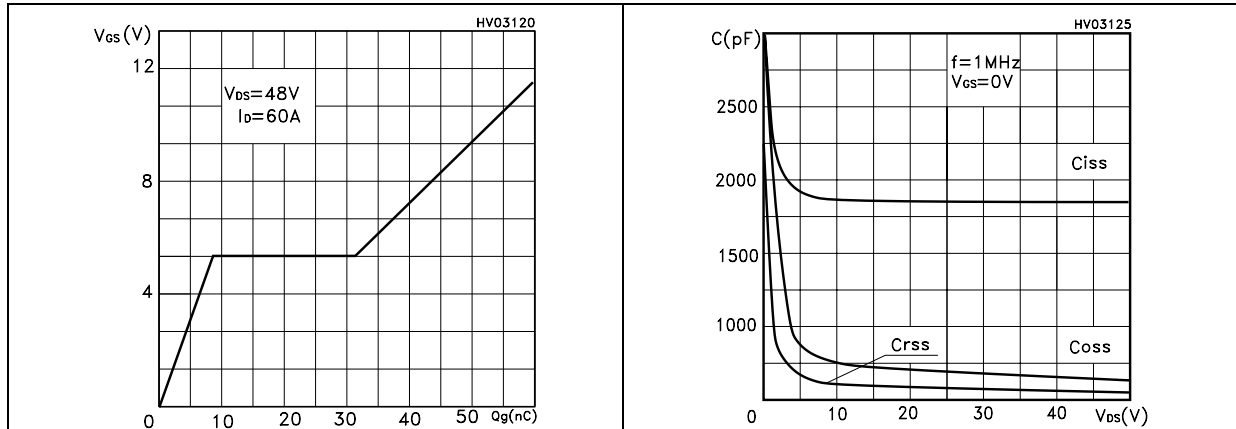
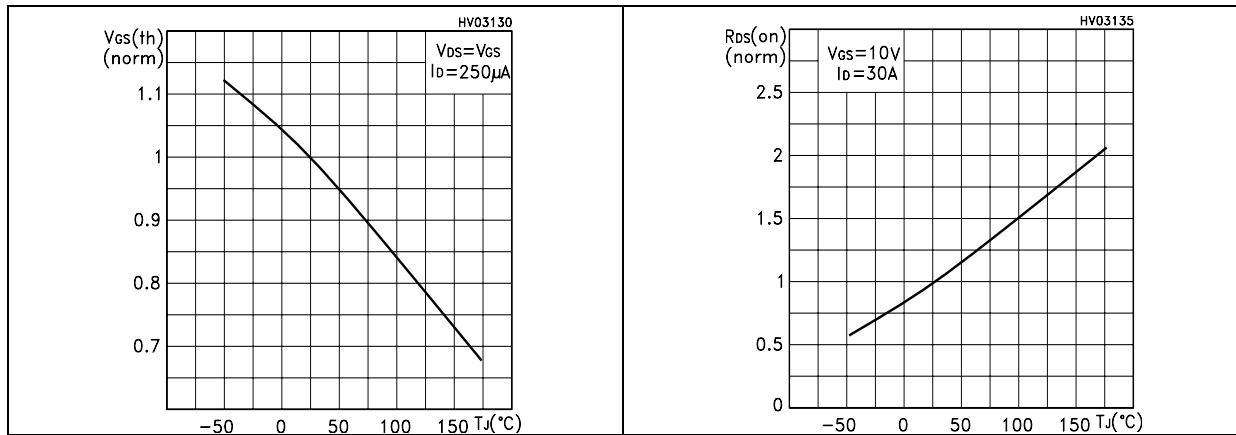


Figure 9. Normalized gate threshold voltage vs temperature Figure 10. Normalized on resistance vs temperature



### 3 Test circuit

Figure 11. Switching times test circuit for resistive load



Figure 12. Gate charge test circuit

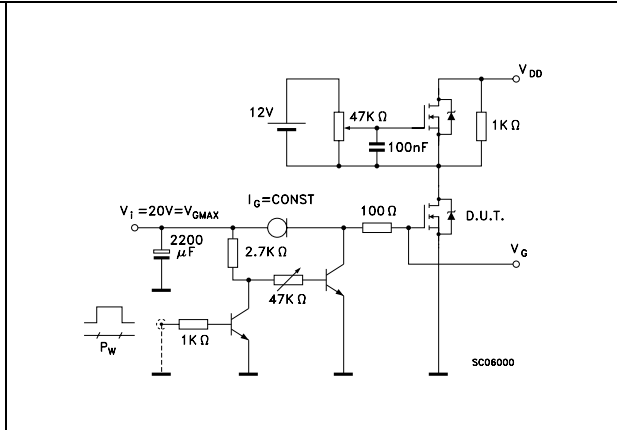


Figure 13. Test circuit for inductive load switching and diode recovery times

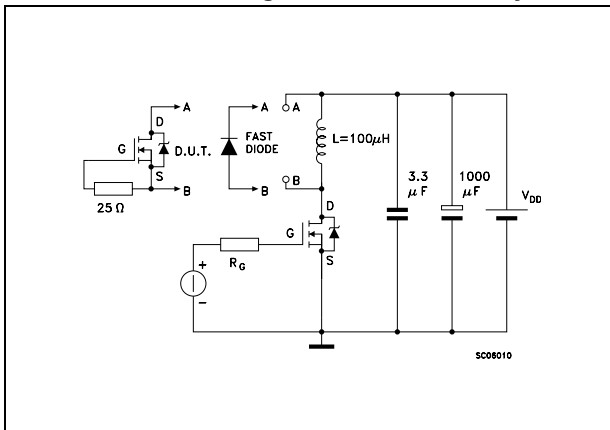


Figure 14. Unclamped Inductive load test circuit

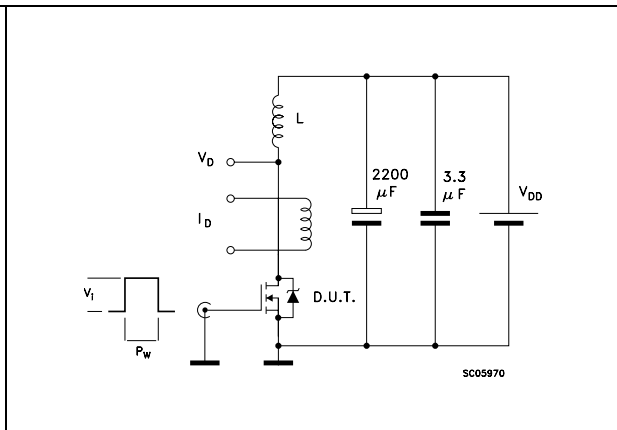


Figure 15. Unclamped inductive waveform

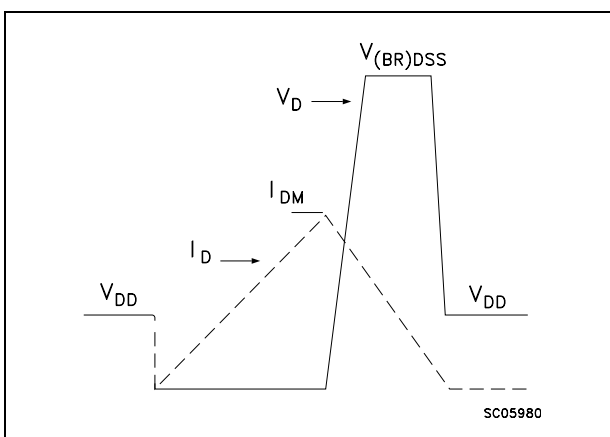
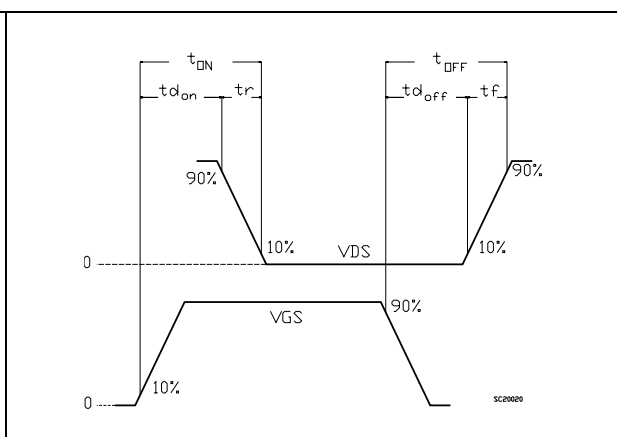


Figure 16. Switching time waveform



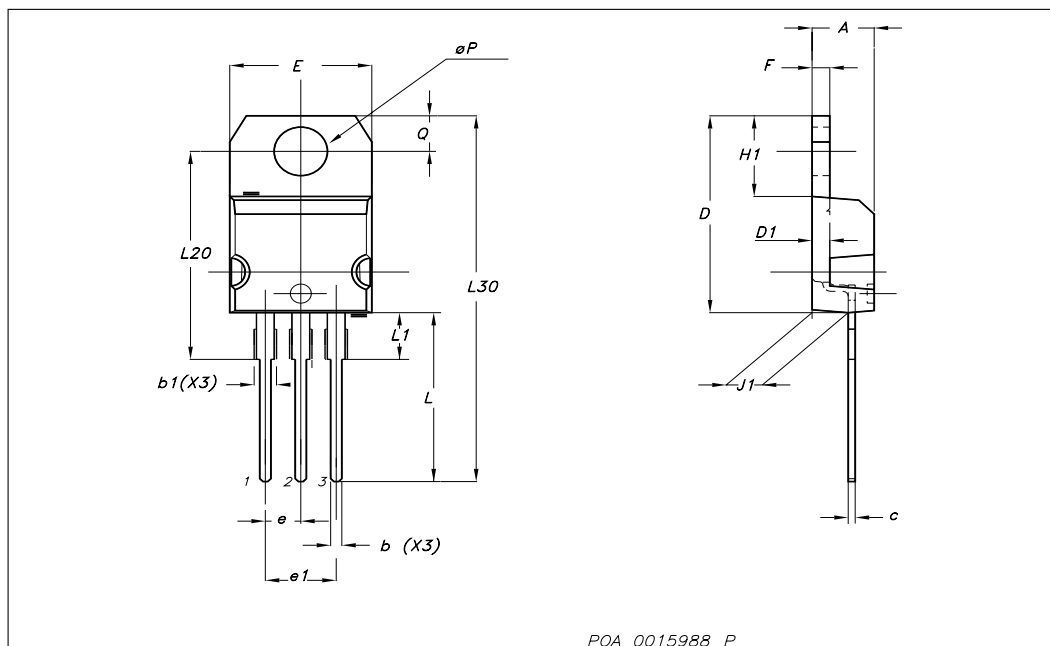


## 4 Package mechanical data

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	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
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		0.051
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	
θP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## 5 Revision history

Table 8. Revision history

Date	Revision	Changes
09-Sep-2004	3	Complete version
17-Aug-2006	4	The document has been reformatted
04-Oct-2006	5	Changes in <i>Dynamic</i>
02-Mar-2007	6	<i>Safe operating area</i> has been updated

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