Silicon Diffused Power Transistor BUT211X

GENERAL DESCRIPTION

Enhanced performance, new generation, high speed switching npn transistor in a plastic full-pack envelope specially suited for high frequency electronic lighting ballast applications.

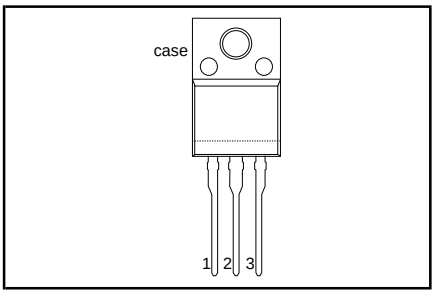
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	10	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	32	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 0.4 A	-	2.0	V
t_f	Inductive fall time	I_{Con} = 3.0 A; I_{Bon} = 0.3 A	-	0.1	µs

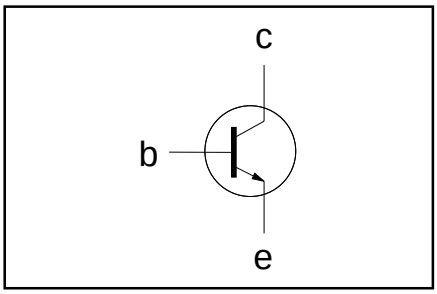
PINNING - SOT186A

PIN	DESCRIPTION
1	base
2	collector
3	emitter
case	isolated

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

Limiting values in accordance with the Absolute Maximum Rating System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	10	A
I_B	Base current (DC)		-	2	A
I_{BM}	Base current peak value		-	4	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	32	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heat sink		-	3.95	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	-	55	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{isol}	R.M.S. isolation voltage from all three terminals to external heatsink	f = 50-60 Hz; sinusoidal waveform; R.H. ≤ 65% ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	10	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER		CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [1]		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	1.0	mA
I_{CES}			V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; T_j = 125 ˚C	-	-	2.0	mA
I_{EBO}	Emitter cut-off current		V_{EB} = 9.0 V; I_C = 0 A	-	-	10.0	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage		I_B = 0 A; I_C = 100 mA; L = 25 mH	400	-	-	V
V_{CEsat}	Collector-emitter saturation voltage		I_C = 3.0 A; I_B = 0.4 A	-	0.8	2.0	V
V_{BEsat}	Base-emitter saturation voltage		I_C = 3.0 A; I_B = 0.4 A	-	-	1.3	V
h_{FE}	DC current gain		I_C = 1.0 A; V_{CE} = 2 V	13	21	30	
h_{FE}			I_C = 3.0 A; V_{CE} = 2 V	7.5	11	-	
h_{FE}	Gain bands[2]	1	I_C = 1.0 A; V_{CE} = 2 V	13	-	20	
	(Acceptance limits)	2		18	-	25	
		3		23	-	30	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times resistive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; -I_{Boff} = 0.6 A			
t_s	Turn-off storage time		1.5	2.0	µs
t_f	Turn-off fall time		0.5	0.8	µs
	Switching times inductive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; -V_{BB} = 5 V			
t_s	Turn-off storage time		1.0	1.2	µs
t_f	Turn-off fall time		60	100	ns
		I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; -V_{BB} = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.1	1.4	µs
t_f	Turn-off fall time		120	250	ns

1 Measured with half sine-wave voltage (curve tracer).

2 Gain Banding.

Product is divided into 3 gain bands for matching purposes.
The gain band is printed on the device.
All devices within a device rail will be from the same gain band.
However, a box may contain rails from more than one band.
Band quantities are shown on the box label.
It is not possible to order specific gain bands.

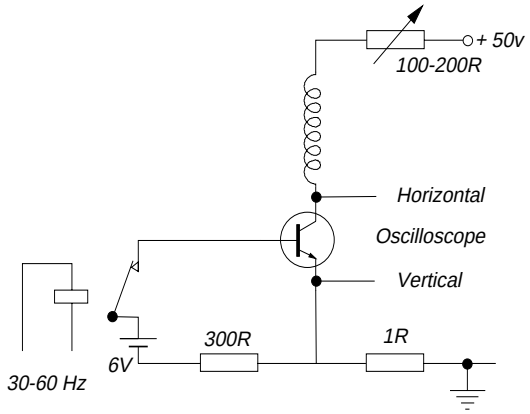


Fig.1. Test circuit for $V_{CEOsust}$.

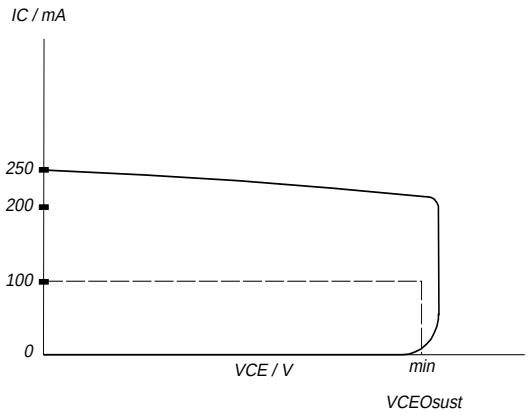


Fig.2. Oscilloscope display for $V_{CEOsust}$.

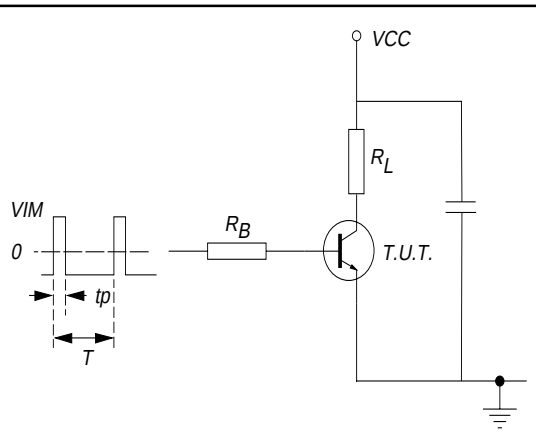


Fig.3. Test circuit resistive load. VIM = -6 to +8 V
V_{CC} = 250 V; tp = 20 μs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

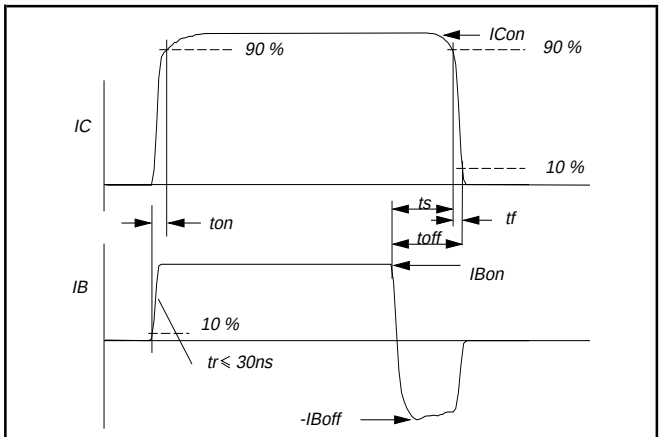


Fig.4. Switching times waveforms with resistive load.

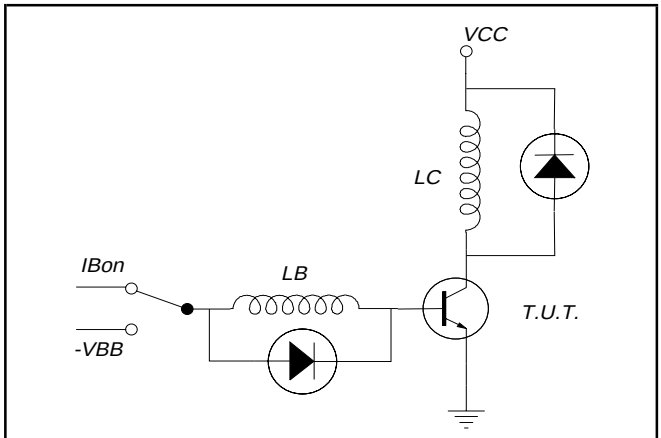


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V;L_B = 1 uH

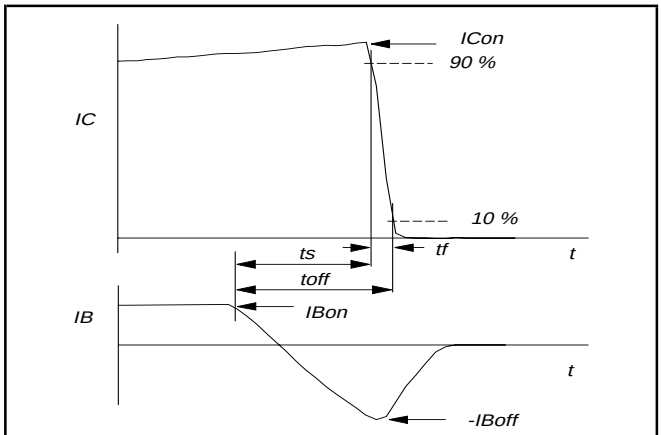


Fig.6. Switching times waveforms with inductive load.

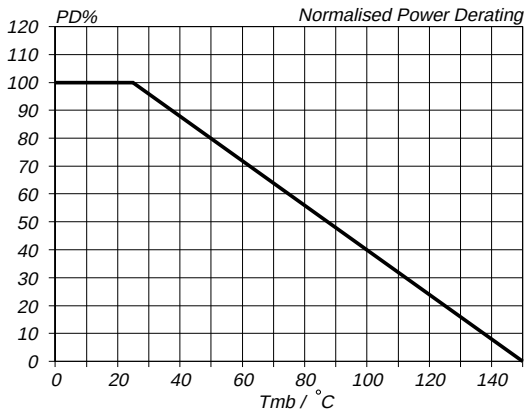


Fig.7. Normalised power dissipation.
PD% = 100·PD/PD $_{25°C}$ = f (T_{mb})

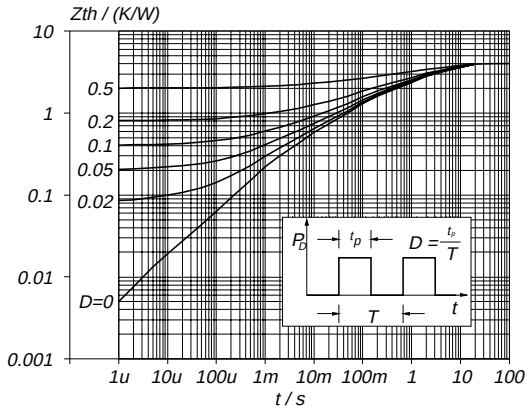


Fig.8. Transient thermal impedance.
$Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

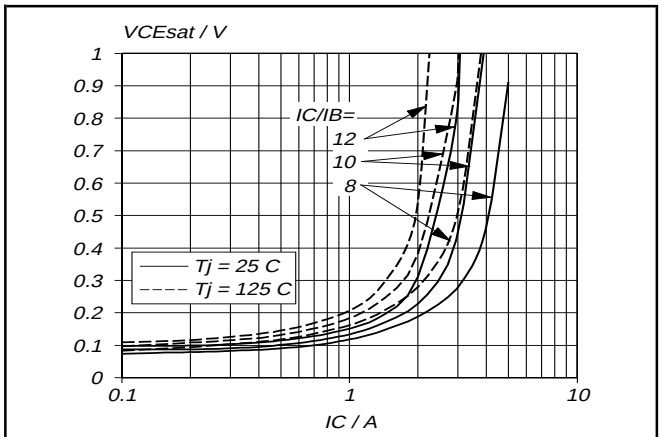


Fig.10. Typical collector-emitter saturation voltage.
V_{CEsat} = f(I_C); parameter I_C/I_B

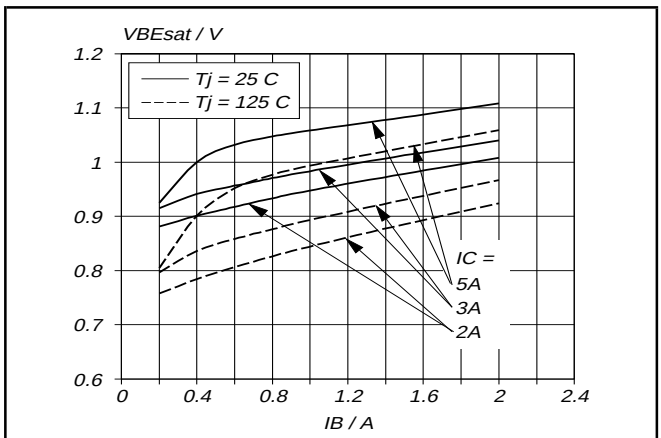


Fig.11. Typical base-emitter saturation voltage.
V_{BEsat} = f(I_B); parameter I_C

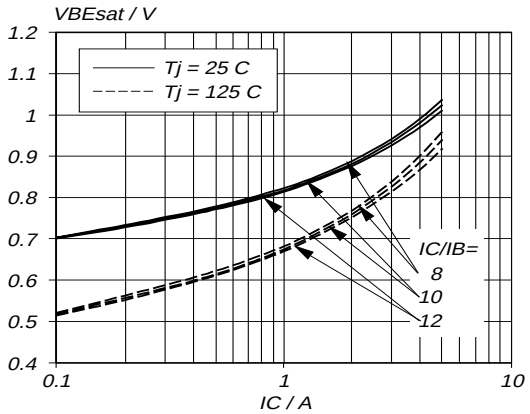


Fig.9. Typical base-emitter saturation voltage.
V_{BEsat} = f(I_C); parameter I_C/I_B

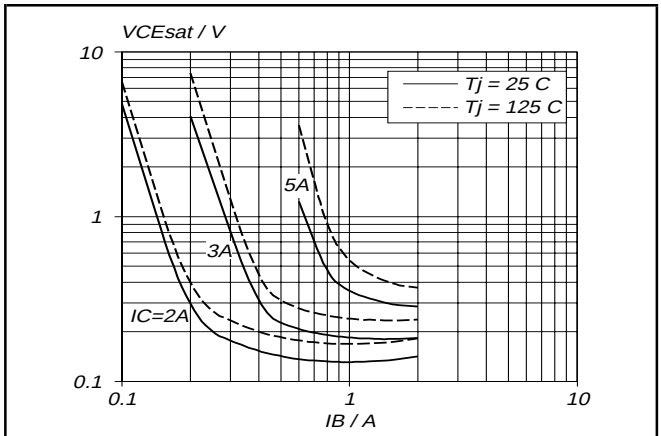


Fig.12. Typical collector-emitter saturation voltage.
V_{CEsat} = f(I_B); parameter I_C

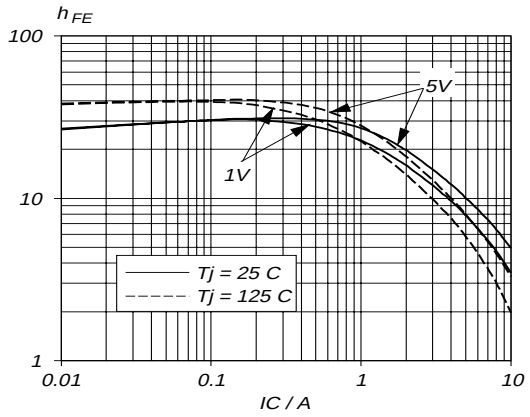


Fig.13. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

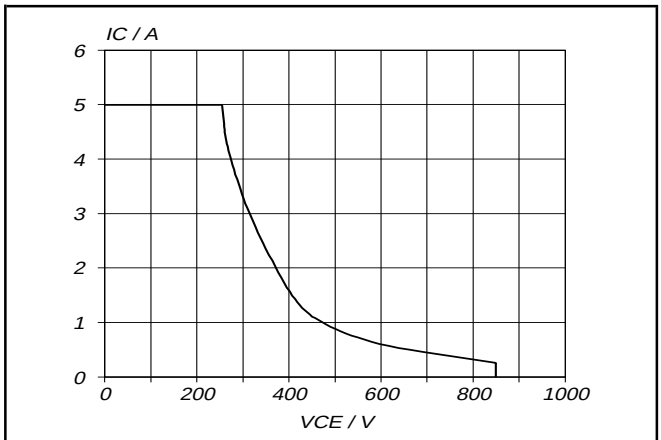


Fig.15. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

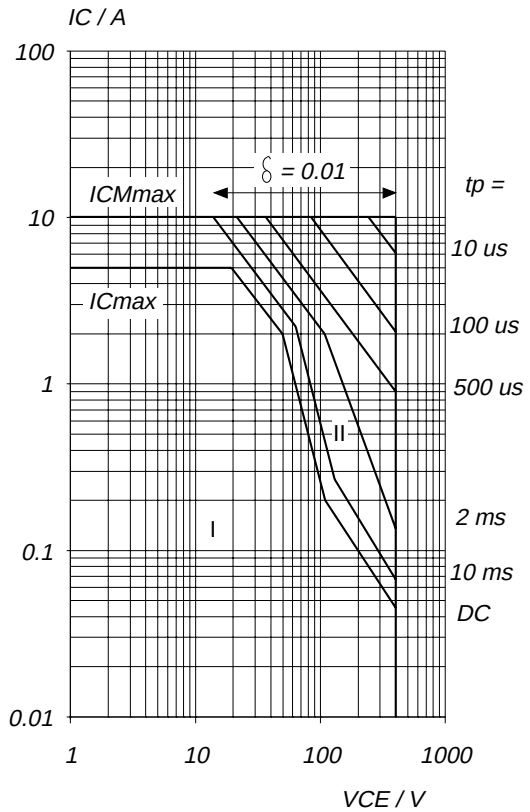


Fig.14. Forward bias safe operating area. $T_{mb} = 25^{\circ}C$

I Region of permissible DC operation.
II Extension for repetitive pulse operation.
NB: Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

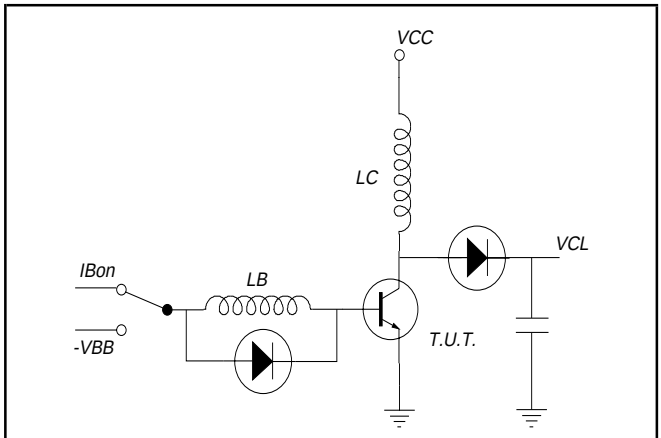


Fig.16. Test circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 5 V L_C = 200 µH; $V_{CL} \leq$ 850 V; L_B = 1 µH

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

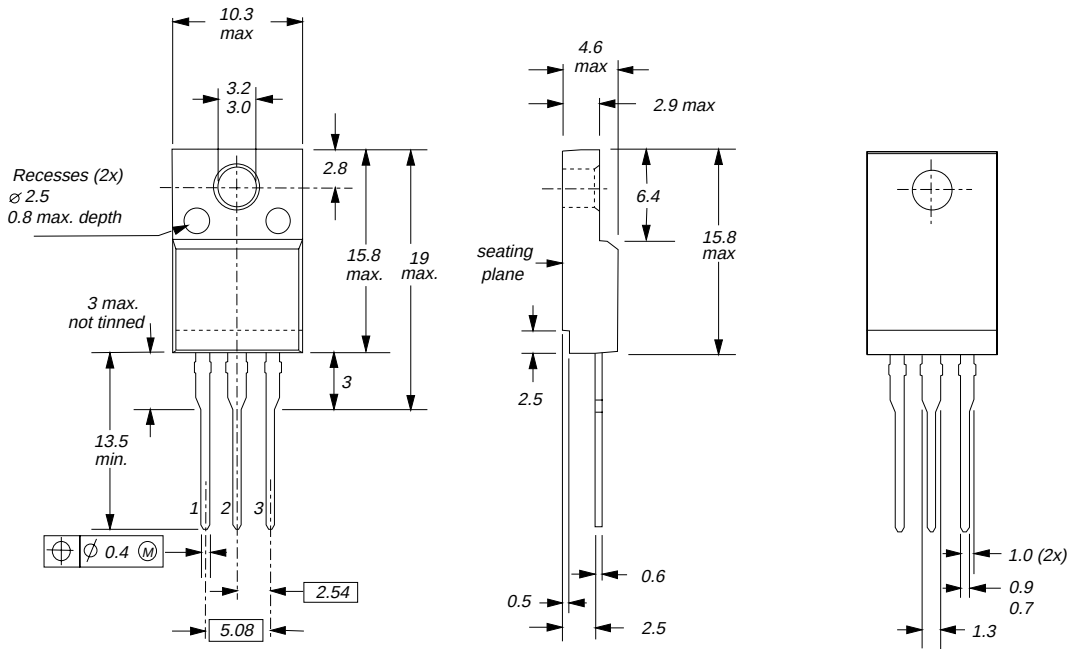


Fig.17. SOT186A; The seating plane is electrically isolated from all terminals.

Notes
1. Refer to mounting instructions for F-pack envelopes.
2. Epoxy meets UL94 V0 at 1/8".

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.