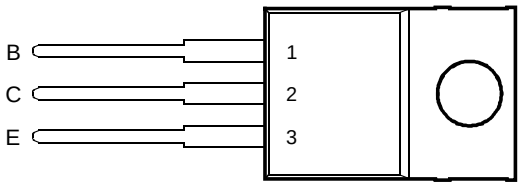
BULD50KC, BULD50SL
NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

FEBRUARY 1994 - REVISED SEPTEMBER 1997

- **Designed Specifically for High Frequency Electronic Ballasts**
- **Integrated Fast t_{rr} Anti-Parallel Diode, Enhancing Reliability**
- **Diode t_{rr} Typically 1 µs**
- **New Low-Height SL Power Package, TO220 Pin-Compatible**
- **Tightly Controlled Transistor Storage Times**
- **Voltage Matched Integrated Transistor and Diode**
- **Characteristics Optimised for Cool Running**
- **Diode-Transistor Charge Coupling Minimised to Enhance Frequency Stability**

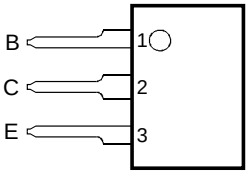
TO-220 PACKAGE
(TOP VIEW)



Pin 2 is in electrical contact with the mounting base.

MDTRACA

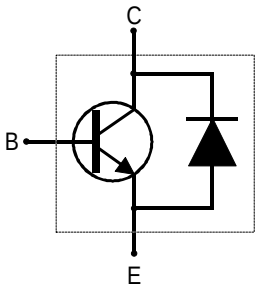
SL PACKAGE
(TOP VIEW)



description

The new BULDxx range of transistors have been designed specifically for use in High Frequency Electronic Ballasts (HFEB's). This range of switching transistors has tightly controlled storage times and an integrated fast t_{rr} anti-parallel diode. The revolutionary design ensures that the diode has both fast forward and reverse recovery times, achieving the same performance as a discrete anti-parallel diode plus transistor. The integrated diode has minimal charge coupling with the transistor, increasing frequency stability, especially in lower power circuits where the circulating currents are low. By design, this new device offers a voltage matched integrated transistor and anti-parallel diode.

device symbol



absolute maximum ratings at 25°C † (unless otherwise noted)

RATING		SYMBOL	VALUE	UNIT
Collector-emitter voltage (V_{BE} = 0)		V_{CES}	600	V
Collector-base voltage (I_E = 0)		V_{CBO}	600	V
Collector-emitter voltage (I_B = 0)		V_{CEO}	400	V
Emitter-base voltage		V_{EBO}	9	V
Continuous collector current	BULD50KC BULD50SL (see Note 1)	I_C	3.5	A
Peak collector current (see Note 2)		I_{CM}	6	A
Continuous base current	BULD50KC BULD50SL (see Note 1)	I_B	1.5	A
Peak base current (see Note 2)		I_{BM}	2.5	A

NOTES: 1. This value applies for t_p = 1 s.
2. This value applies for t_p = 10 ms, duty cycle ≤ 2%.

† ≤ 25°C case temperature for BULD50KC, and ≤ 25°C ambient temperature for BULD50SL

PRODUCT INFORMATION

absolute maximum ratings at 25°C † (unless otherwise noted) (continued)

RATING		SYMBOL	VALUE	UNIT
Continuous device dissipation	BULD50KC BULD50SL	P_{tot}	50 see Figure 11	W
Maximum average continuous diode forward current		$I_{E(av)}$	0.5	A
Operating junction temperature range		T_j	-65 to +150	°C
Storage temperature range		T_{stg}	-65 to +150	°C

electrical characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
$V_{CEO(sus)}$	Collector-emitter sustaining voltage	I_C = 100 mA	L = 25 mH		400			V
I_{CES}	Collector-emitter cut-off current	V_{CE} = 600 V	V_{BE} = 0				10	µA
I_{EBO}	Emitter cut-off current	V_{EB} = 9 V	I_C = 0				1	mA
$V_{BE(sat)}$	Base-emitter saturation voltage	I_B = 150 mA	I_C = 750 mA	(see Notes 3 and 4)		0.9	1.1	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_B = 150 mA I_B = 300 mA	I_C = 750 mA I_C = 1.5 A	(see Notes 3 and 4)		0.2 0.4	0.5 1	V
h_{FE}	Forward current transfer ratio	V_{CE} = 10 V V_{CE} = 1 V V_{CE} = 5 V	I_C = 10 mA I_C = 750 mA I_C = 1.5 A	(see Notes 3 and 4)	10 10 10	17 15 15	 20 20	
V_{EC}	Anti-parallel diode forward voltage	I_E = 1 A		(see Notes 3 and 4)		1.25	1.5	V
t_{rr}	Anti-parallel diode reverse recovery time			(see Note 5)		1		µs

NOTES: 3. These parameters must be measured using pulse techniques, t_p = 300 µs, duty cycle ≤ 2%.
4. These parameters must be measured using voltage-sensing contacts, separate from the current carrying contacts, and located within 3.2 mm from the device body.
5. Tested in a typical High Frequency Electronic Ballast.

thermal characteristics

PARAMETER			MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction to free air thermal resistance	BULD50KC BULD50SL			62.5 115	°C/W
$R_{\theta JC}$	Junction to case thermal resistance	BULD50KC			2.5	°C/W

inductive-load switching characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
t_{sv}	Storage time	I_C = 750 mA L = 1 mH	$I_{B(on)}$ = 150 mA $I_{B(off)}$ = 150 mA	V_{CC} = 40 V V_{CLAMP} = 300 V		3.35	4.5	µs

resistive-load switching characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{fi}	Current fall time	I_C = 750 mA V_{CC} = 300 V	$I_{B(on)}$ = 150 mA $I_{B(off)}$ = 150 mA		150	250	ns

PRODUCT INFORMATION

TYPICAL CHARACTERISTICS

FORWARD CURRENT TRANSFER RATIO vs COLLECTOR CURRENT

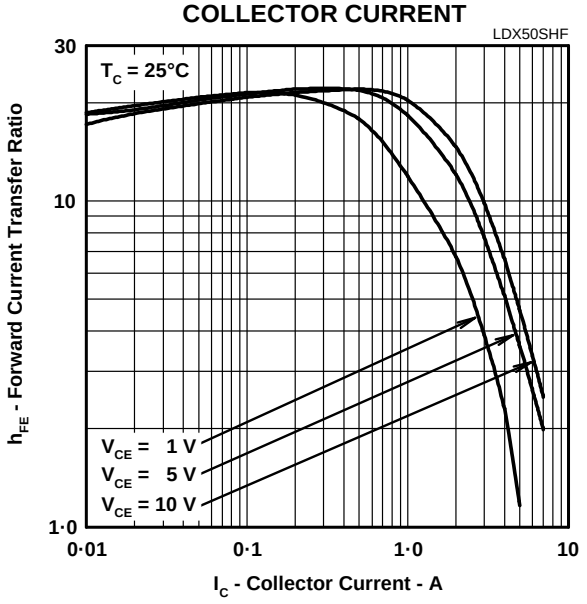


Figure 1.

ANTI-PARALLEL DIODE INSTANTANEOUS FORWARD CURRENT vs INSTANTANEOUS FORWARD VOLTAGE

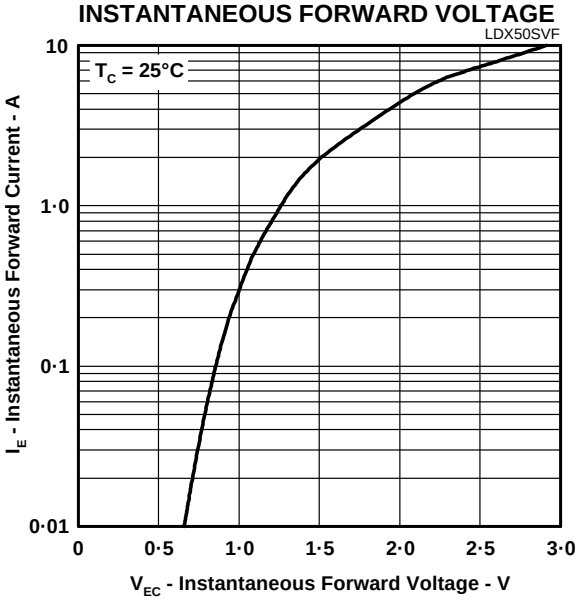


Figure 2.

BASE-EMITTER SATURATION VOLTAGE vs CASE TEMPERATURE

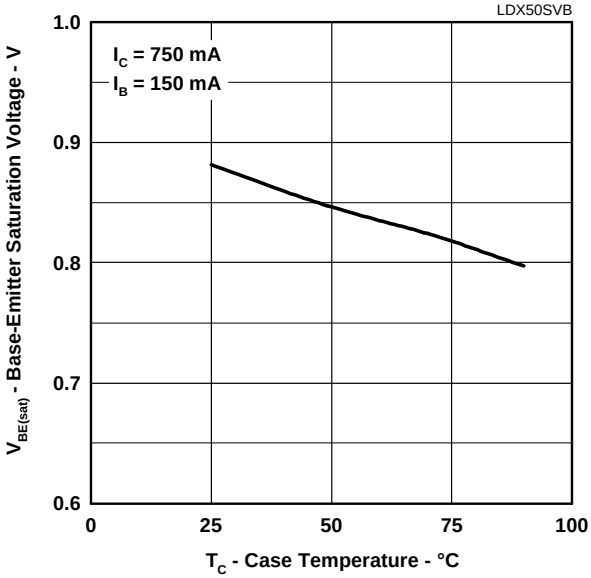


Figure 3.

MAXIMUM SAFE OPERATING REGIONS

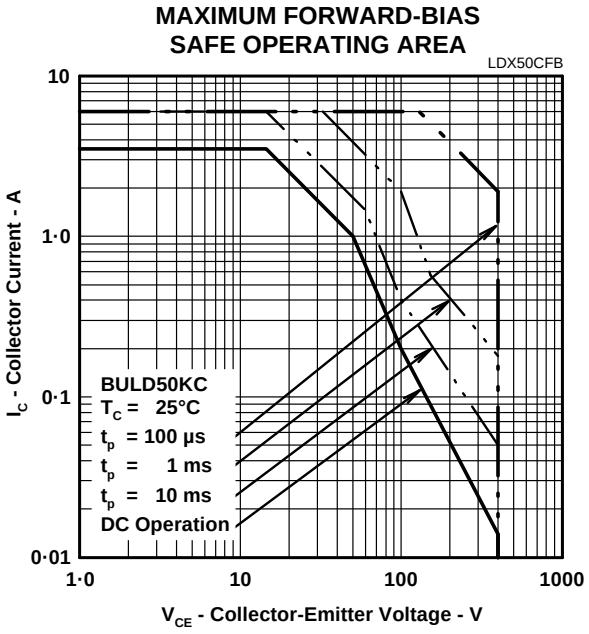


Figure 4.

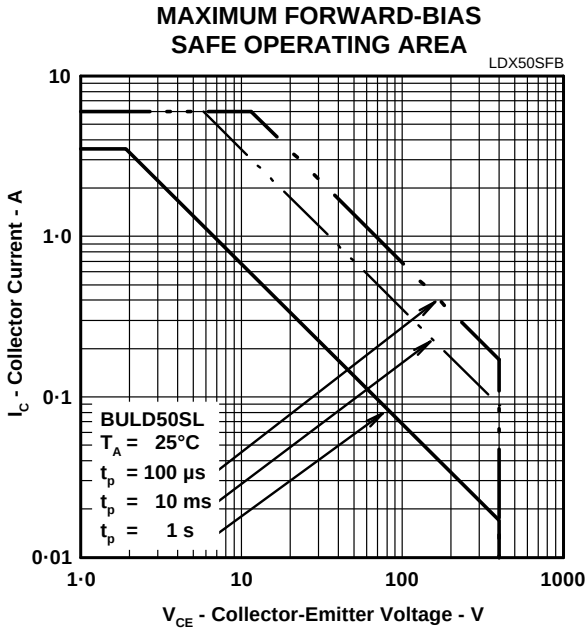


Figure 5.

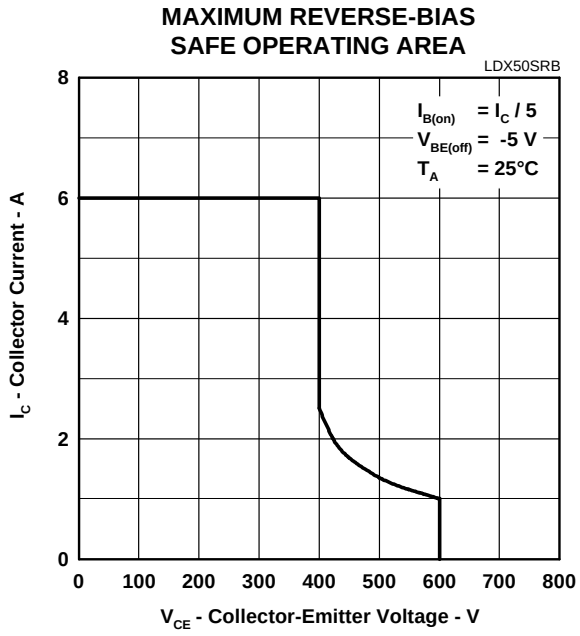


Figure 6.

THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO AMBIENT
vs
POWER PULSE DURATION

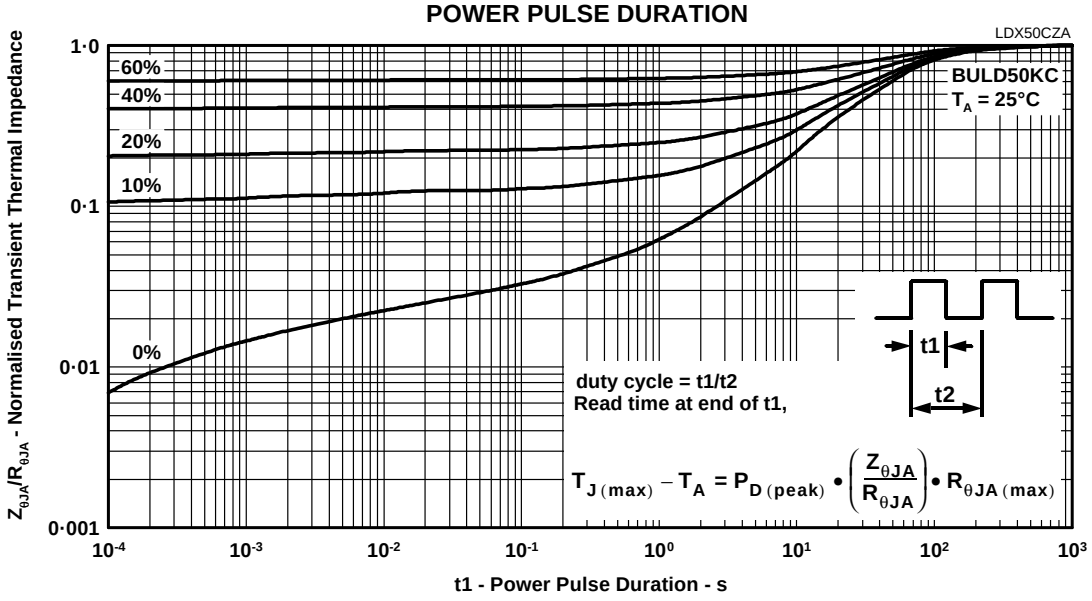


Figure 7.

THERMAL RESPONSE JUNCTION TO AMBIENT
vs
POWER PULSE DURATION

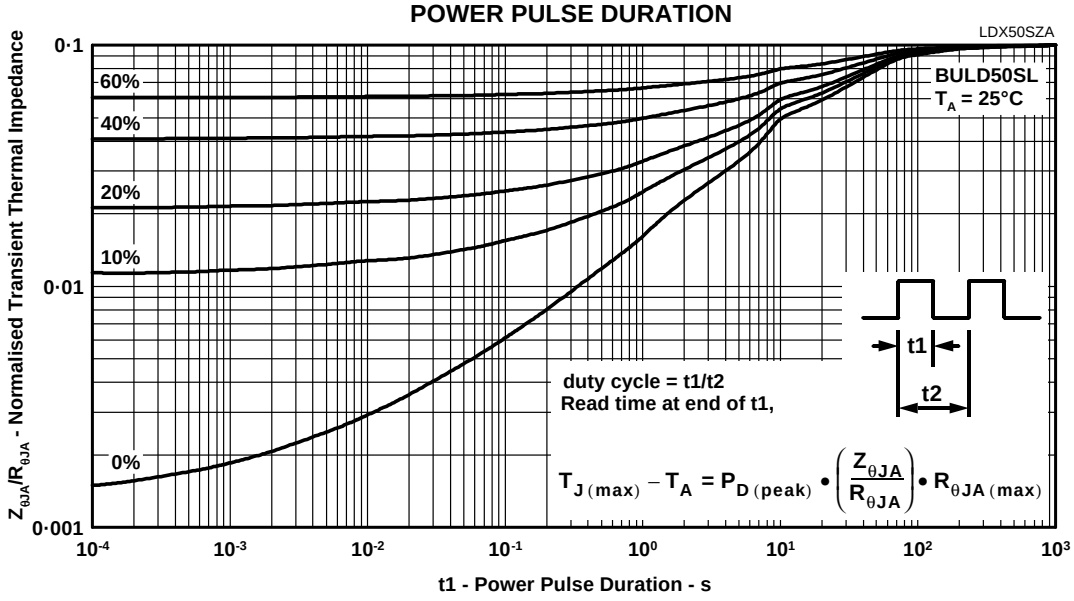


Figure 8.

THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO CASE
vs
POWER PULSE DURATION

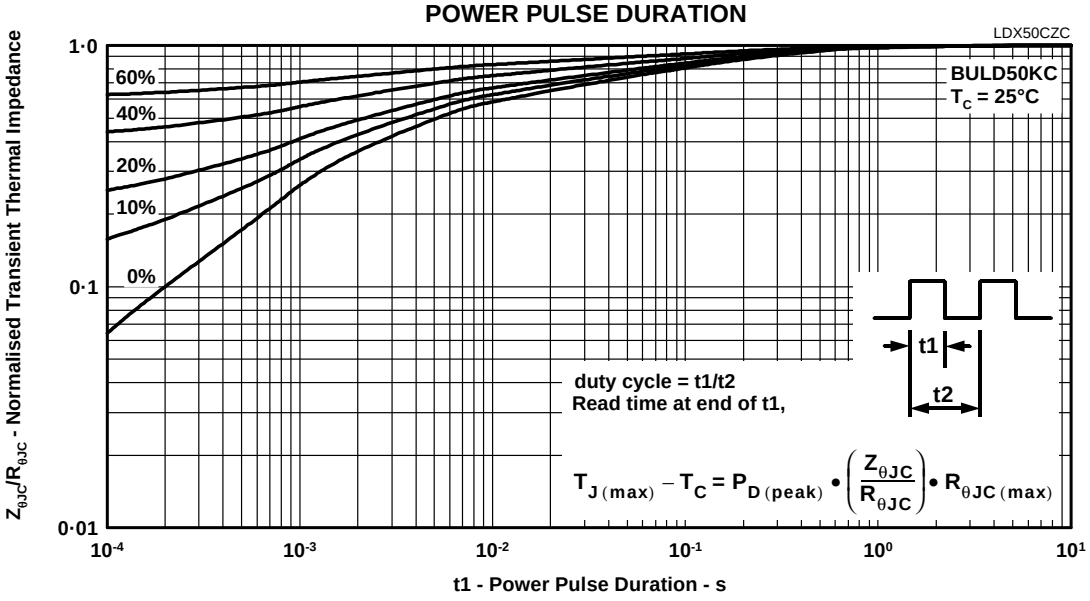


Figure 9.

MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT
vs
POWER PULSE DURATION

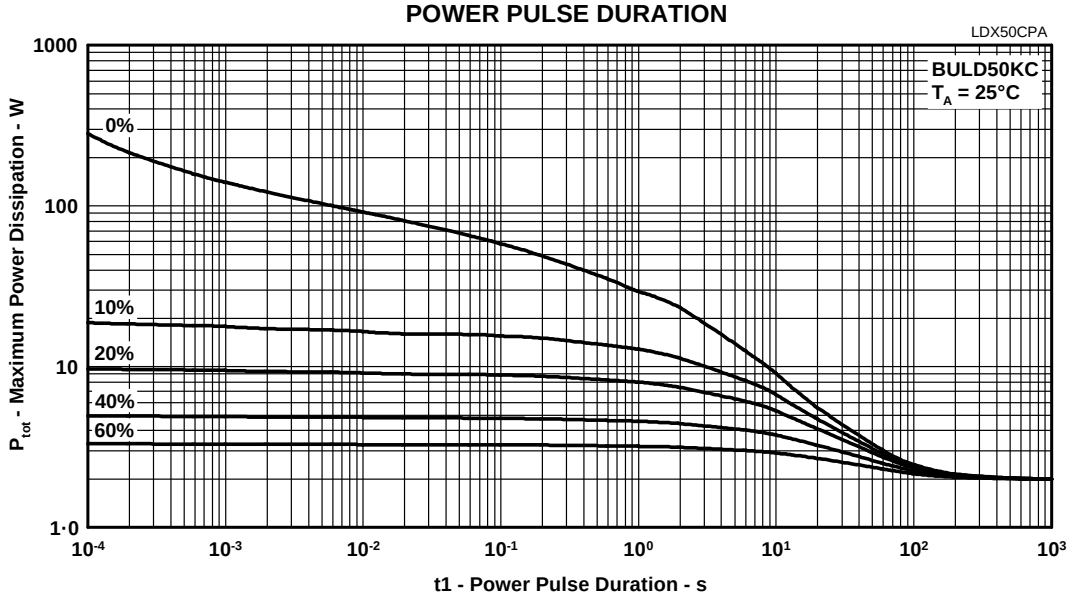


Figure 10.

THERMAL INFORMATION

**MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT
vs
POWER PULSE DURATION**

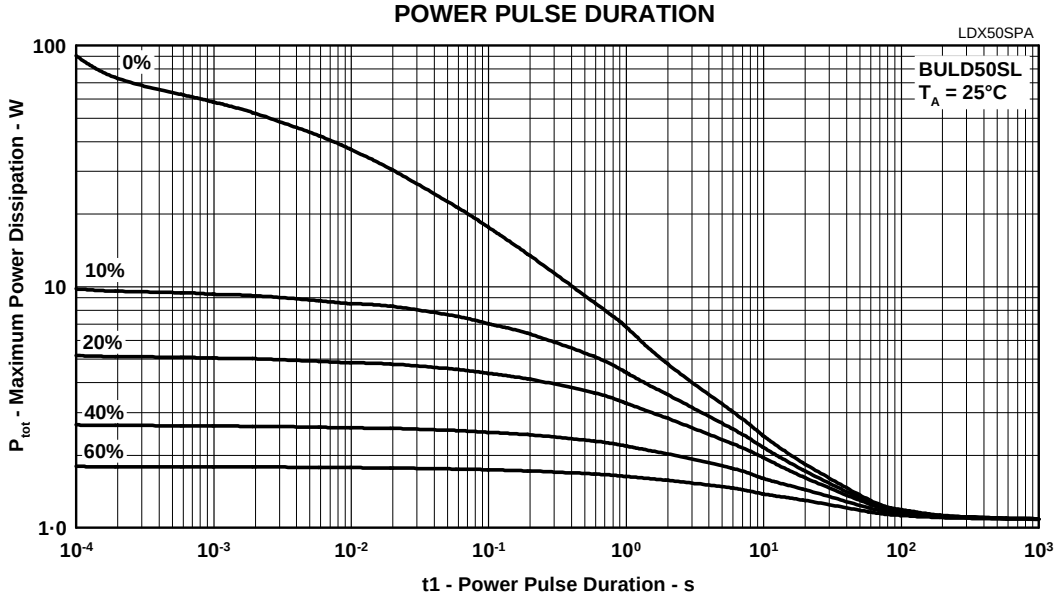


Figure 11.

**MAXIMUM POWER DISSIPATION JUNCTION TO CASE
vs
POWER PULSE DURATION**

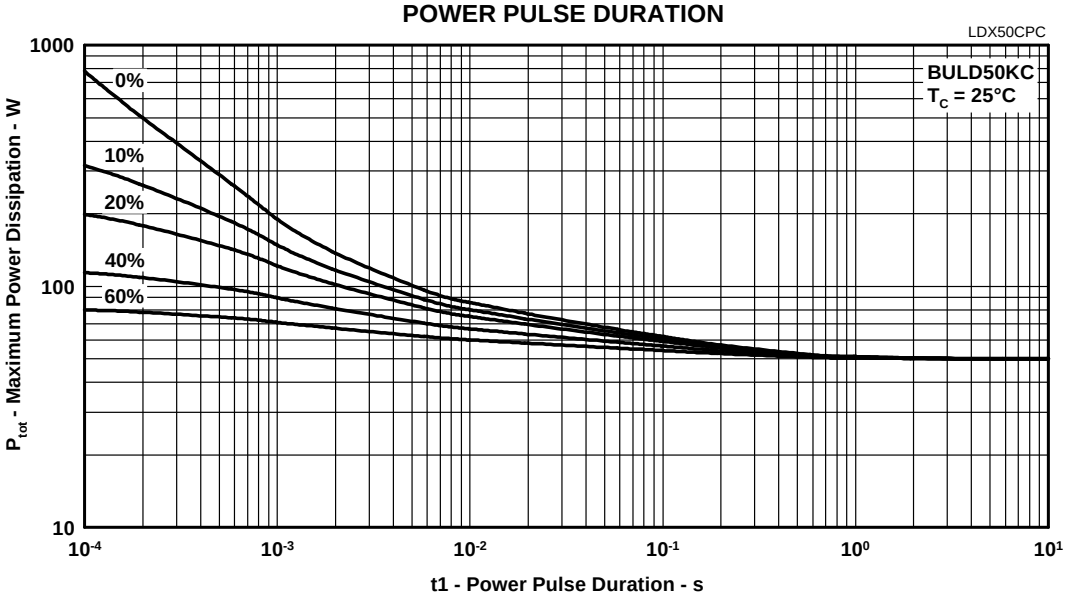


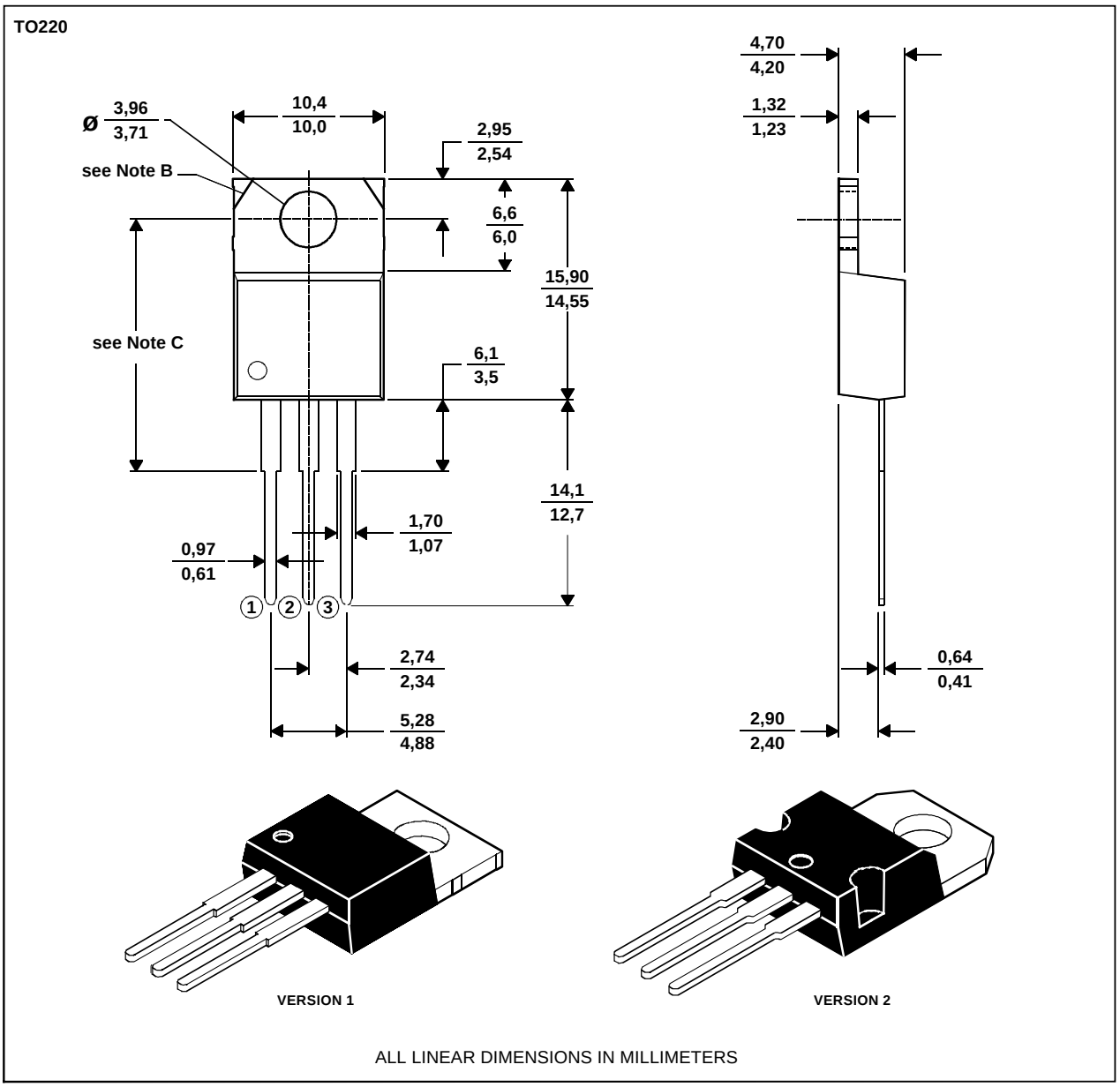
Figure 12.

MECHANICAL DATA

TO-220

3-pin plastic flange-mount package

This single-in-line package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



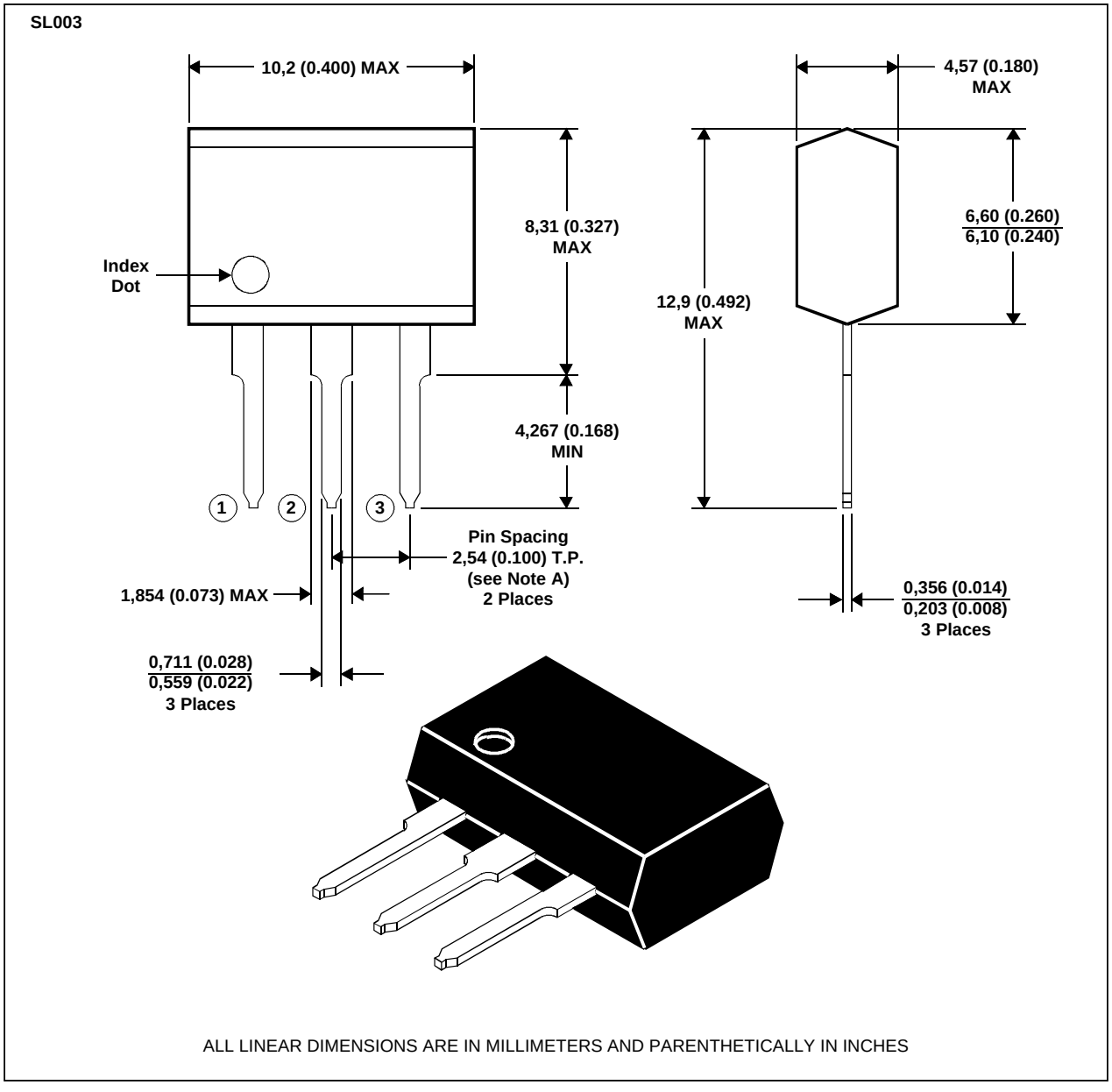
NOTES: A. The centre pin is in electrical contact with the mounting tab. MDXXBE
B. Mounting tab corner profile according to package version.
C. Typical fixing hole centre stand off height according to package version.
Version 1, 18.0 mm. Version 2, 17.6 mm.

MECHANICAL DATA

SL003

3-pin plastic single-in-line package

This single-in-line package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



NOTES: A. Each pin centerline is located within 0,25 (0.010) of its true longitudinal position.
B. Body molding flash of up to 0,15 (0.006) may occur in the package lead plane.

MDXXAD

IMPORTANT NOTICE

Power Innovations Limited (PI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to verify, before placing orders, that the information being relied on is current.

PI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with PI's standard warranty. Testing and other quality control techniques are utilized to the extent PI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except as mandated by government requirements.

PI accepts no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor is any license, either express or implied, granted under any patent right, copyright, design right, or other intellectual property right of PI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

PI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS.