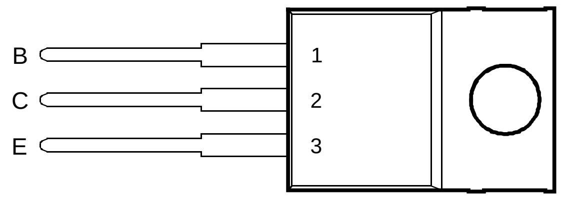
MAY 1994 - REVISED SEPTEMBER 1997

- **Designed Specifically for High Frequency Electronic Ballasts**
- **Integrated Fast t_{rr} Anti-Parallel Diode, Enhancing Reliability**
- **Diode t_{rr} Typically 1 µs**
- **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**

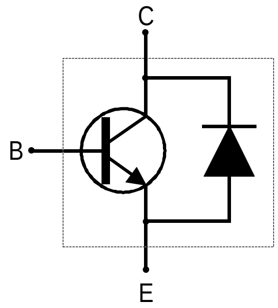
TO-220 PACKAGE (TOP VIEW)



Pin 2 is in electrical contact with the mounting base.

MDTRACA

device symbol



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.

absolute maximum ratings at 25°C case temperature (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	I_C	6	A
Peak collector current (see Note 1)	I_{CM}	8	A
Continuous base current	I_B	2	A
Peak base current (see Note 1)	I_{BM}	4	A
Continuous device dissipation at (or below) 25°C case temperature	P_{tot}	70	W
Maximum average continuous diode forward current at (or below) 25°C case temperature	$I_{E(av)}$	0.5	A
Operating junction temperature range	T_j	-65 to +150	°C
Storage temperature range	T_{stg}	-65 to +150	°C

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

electrical characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
$V_{CEO(sus)}$	Collector-emitter sustaining voltage	I_C = 0.1 A	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 = 0.2 A	I_C = 1 A	(see Notes 2 and 3)		0.85	1.1	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_B = 0.2 A I_B = 0.4 A	I_C = 1 A I_C = 2 A	(see Notes 2 and 3)		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 = 0.01 A I_C = 1 A I_C = 2 A	(see Notes 2 and 3)	10 10 10	17.5 15 15.5	 20 20	
V_{EC}	Anti-parallel diode forward voltage	I_E = 1 A		(see Notes 2 and 3)		1.2	1.5	V

NOTES: 2. These parameters must be measured using pulse techniques, t_p = 300 µs, duty cycle ≤ 2%.
3. 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.

thermal characteristics

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction to free air thermal resistance			62.5	°C/W
$R_{\theta JC}$	Junction to case thermal resistance			1.78	°C/W

switching characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{rr}	Anti-parallel diode reverse recovery time	Measured by holding transistor in an off condition, V_{EB} = -3 V.	(see Note 4)		1		µs

NOTE 4: Tested in a typical High Frequency Electronic Ballast.

inductive-load switching characteristics at 25°C case temperature

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
t_{sv}	Storage time	I_C = 1 A L = 1 mH	$I_{B(on)}$ = 0.2 A $I_{B(off)}$ = 0.2 A	V_{CC} = 40 V V_{CLAMP} = 300 V		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 = 1 A V_{CC} = 300 V	$I_{B(on)}$ = 0.2 A $I_{B(off)}$ = 0.2 A		150	200	ns

TYPICAL CHARACTERISTICS

FORWARD CURRENT TRANSFER RATIO vs COLLECTOR CURRENT

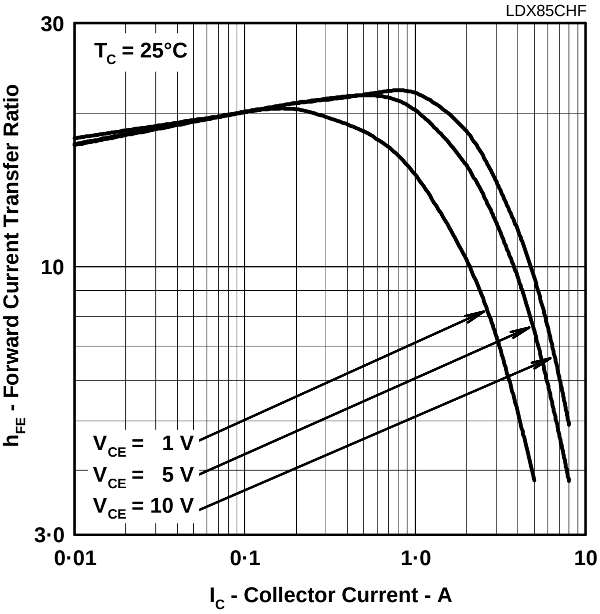


Figure 1.

ANTI-PARALLEL DIODE INSTANTANEOUS FORWARD CURRENT vs INSTANTANEOUS FORWARD VOLTAGE

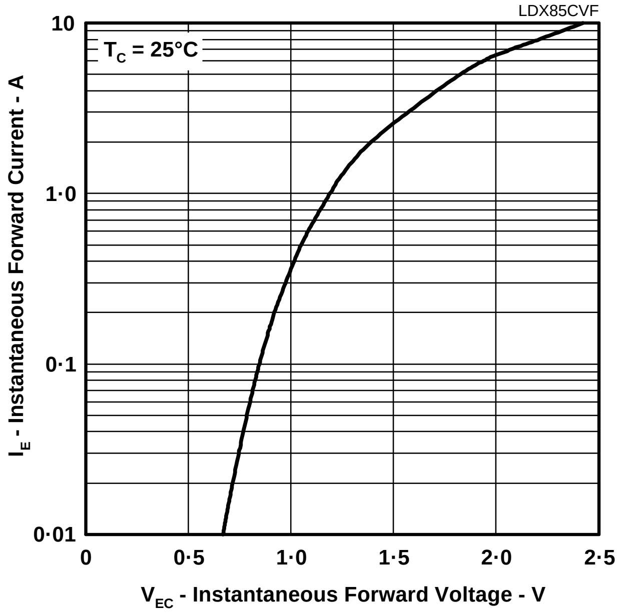


Figure 2.

BASE-EMITTER SATURATION VOLTAGE vs CASE TEMPERATURE

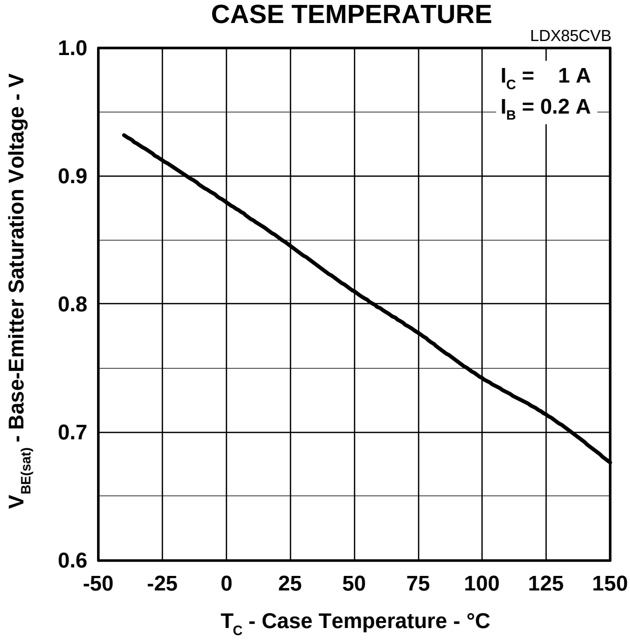


Figure 3.

MAXIMUM SAFE OPERATING REGIONS

MAXIMUM FORWARD-BIAS SAFE OPERATING AREA

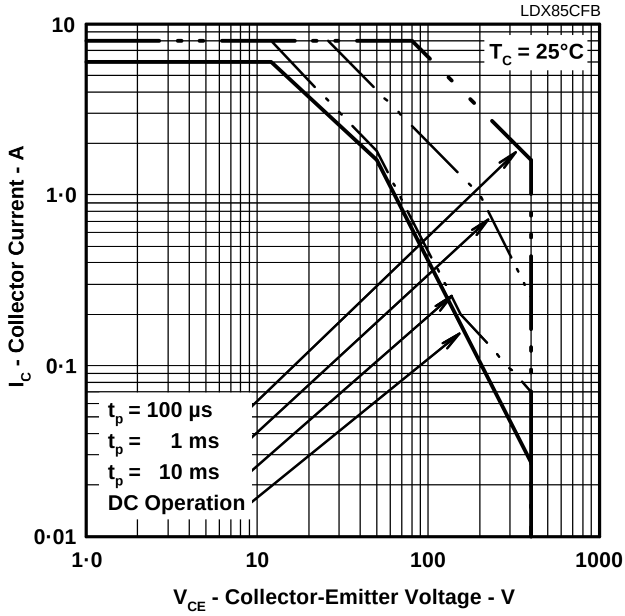


Figure 4.

MAXIMUM REVERSE-BIAS SAFE OPERATING AREA

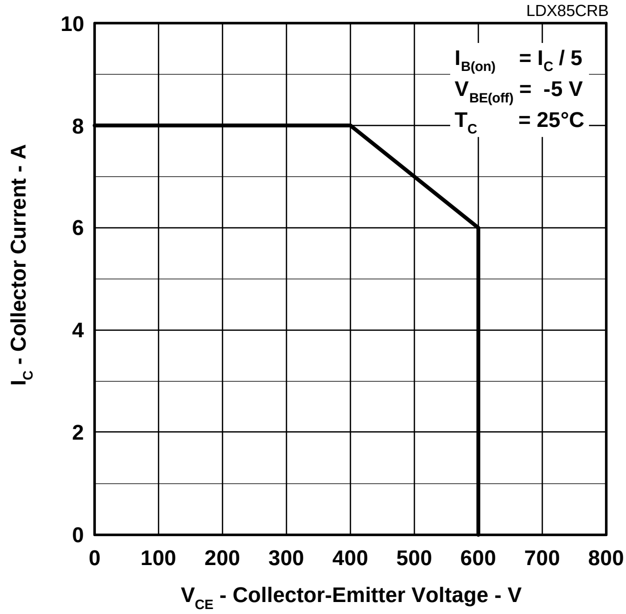


Figure 5.

THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO AMBIENT vs POWER PULSE DURATION

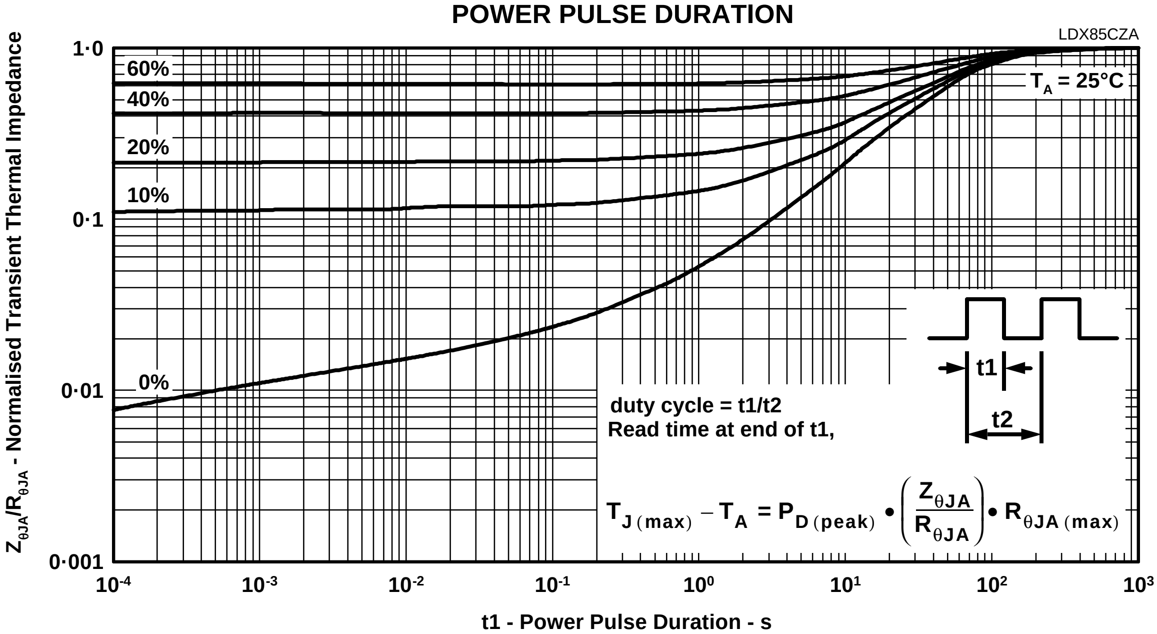


Figure 6.

THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO CASE vs POWER PULSE DURATION

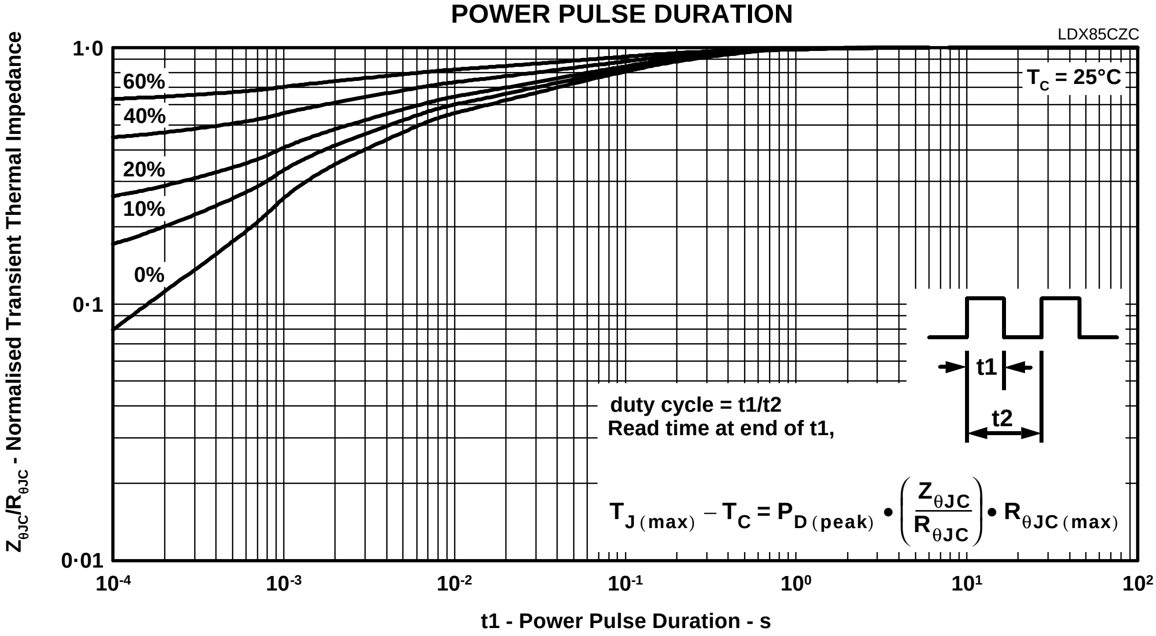


Figure 7.

MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT vs POWER PULSE DURATION

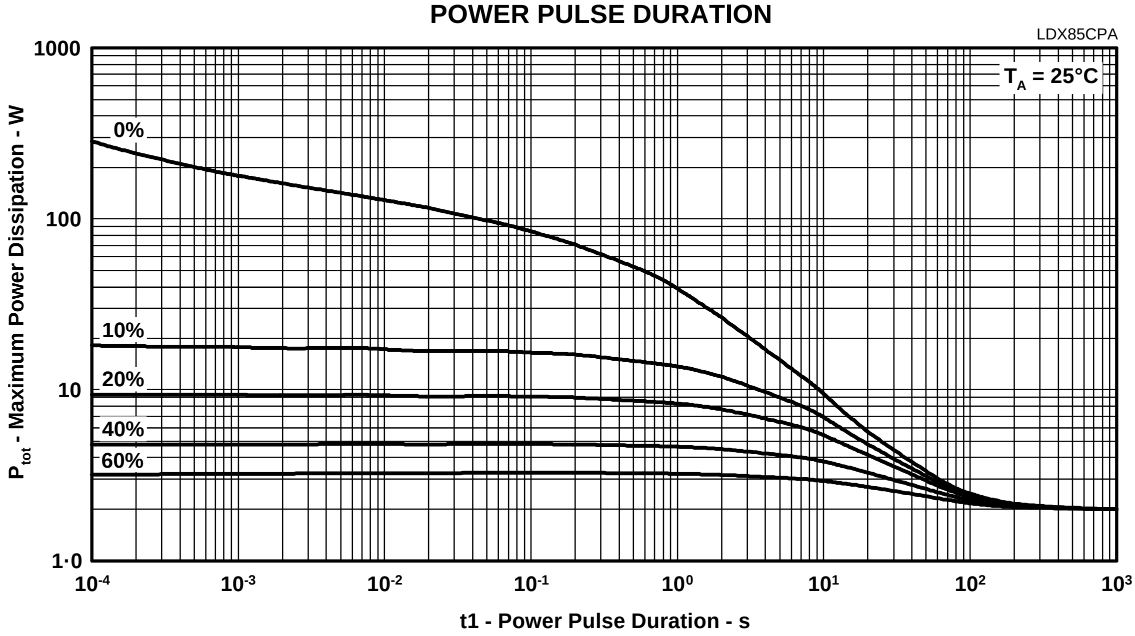


Figure 8.

THERMAL INFORMATION

MAXIMUM POWER DISSIPATION JUNCTION TO CASE vs POWER PULSE DURATION

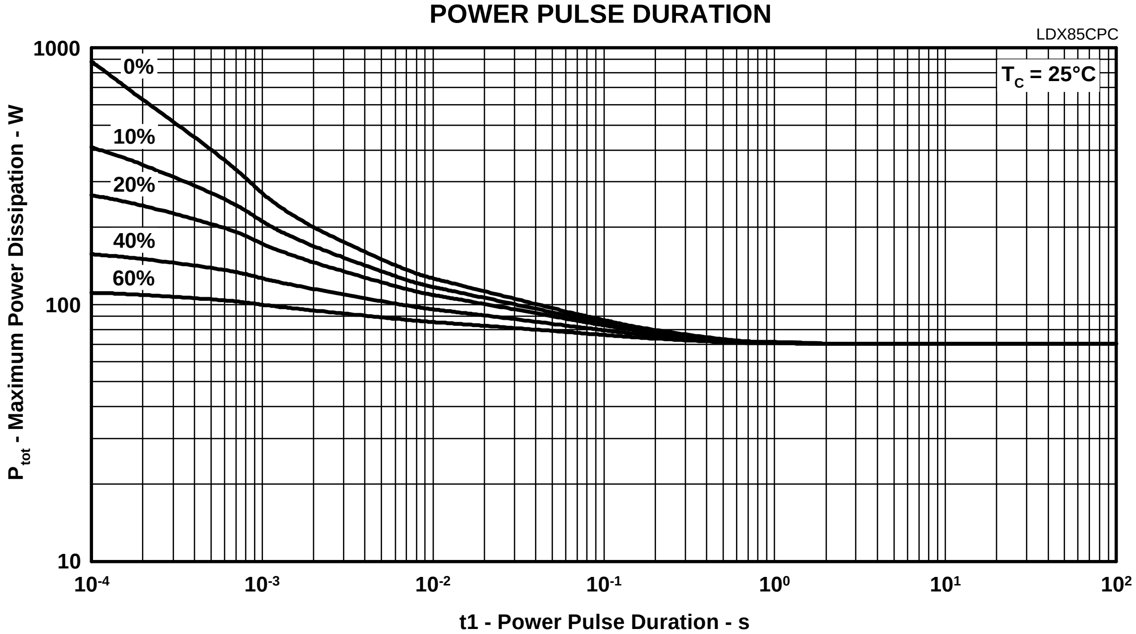


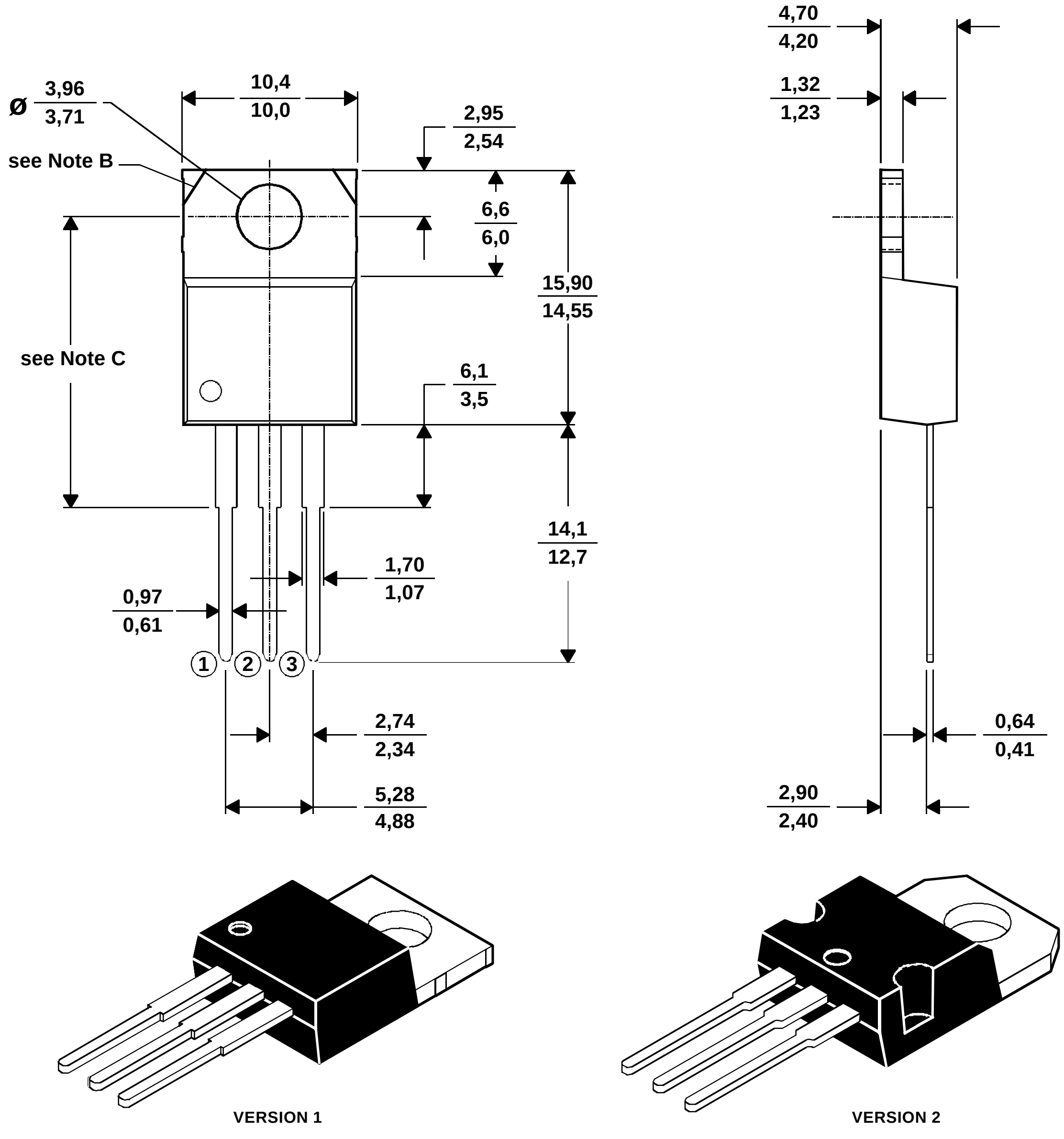
Figure 9.

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.

TO220



ALL LINEAR DIMENSIONS IN MILLIMETERS

NOTES: A. The centre pin is in electrical contact with the mounting tab.
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.

MDXXBE

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.