

# BULD85KC

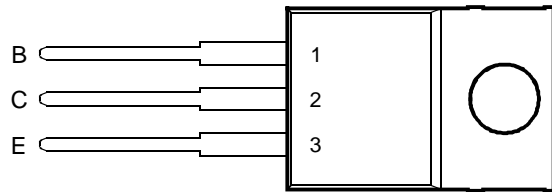
## NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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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  $\mu$ s**
- **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**

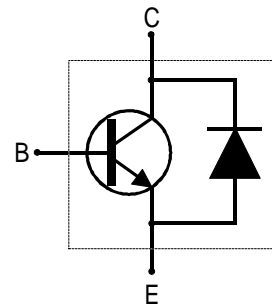
TO-220 PACKAGE  
(TOP VIEW)



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  $\leq 2\%$ .

## PRODUCT INFORMATION

Information is current as of publication date. Products conform to specifications in accordance with the terms of Power Innovations standard warranty. Production processing does not necessarily include testing of all parameters.



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### electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{CEO(sus)}$ Collector-emitter sustaining voltage	$I_C = 0.1\text{ A}$ $L = 25\text{ mH}$	400			V
$I_{CES}$ Collector-emitter cut-off current	$V_{CE} = 600\text{ V}$ $V_{BE} = 0$			10	$\mu\text{A}$
$I_{EBO}$ Emitter cut-off current	$V_{EB} = 9\text{ V}$ $I_C = 0$			1	mA
$V_{BE(sat)}$ Base-emitter saturation voltage	$I_B = 0.2\text{ A}$ $I_C = 1\text{ A}$ (see Notes 2 and 3)		0.85	1.1	V
$V_{CE(sat)}$ Collector-emitter saturation voltage	$I_B = 0.2\text{ A}$ $I_C = 1\text{ A}$ (see Notes 2 and 3) $I_B = 0.4\text{ A}$ $I_C = 2\text{ A}$		0.2 0.4	0.5 1	V
$h_{FE}$ Forward current transfer ratio	$V_{CE} = 10\text{ V}$ $I_C = 0.01\text{ A}$ (see Notes 2 and 3) $V_{CE} = 1\text{ V}$ $I_C = 1\text{ A}$ $V_{CE} = 5\text{ V}$ $I_C = 2\text{ A}$	10 10 10	17.5 15 15.5	20 20	
$V_{EC}$ Anti-parallel diode forward voltage	$I_E = 1\text{ A}$ (see Notes 2 and 3)		1.2	1.5	V

NOTES: 2. These parameters must be measured using pulse techniques,  $t_p = 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

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	$^{\circ}\text{C/W}$
$R_{\theta JC}$ Junction to case thermal resistance			1.78	$^{\circ}\text{C/W}$

### 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, $V_{EB} = -3\text{ V}$ .      (see Note 4)		1		$\mu\text{s}$

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	$I_C = 1\text{ A}$ $I_{B(on)} = 0.2\text{ A}$ $V_{CC} = 40\text{ V}$ $L = 1\text{ mH}$ $I_{B(off)} = 0.2\text{ A}$ $V_{CLAMP} = 300\text{ V}$		4	5	$\mu\text{s}$

### resistive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{fi}$ Current fall time	$I_C = 1\text{ A}$ $I_{B(on)} = 0.2\text{ A}$ $V_{CC} = 300\text{ V}$ $I_{B(off)} = 0.2\text{ A}$		150	200	ns

PRODUCT INFORMATION

TYPICAL CHARACTERISTICS

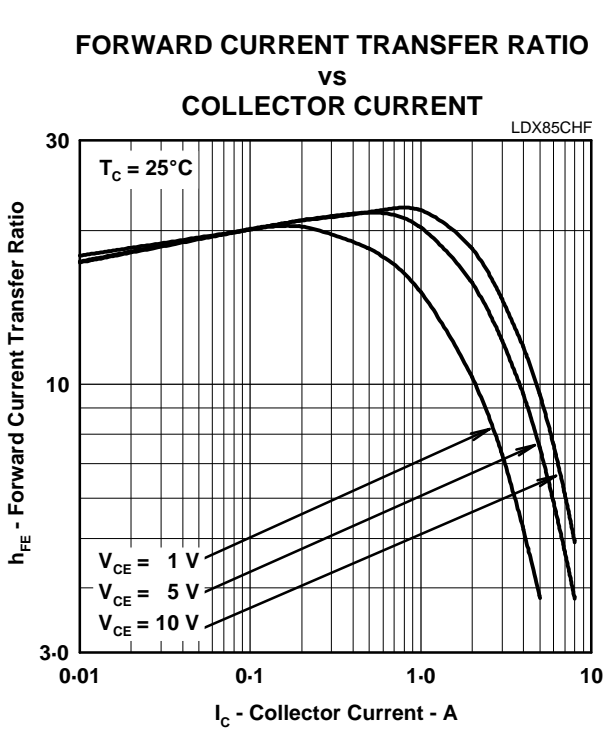


Figure 1.

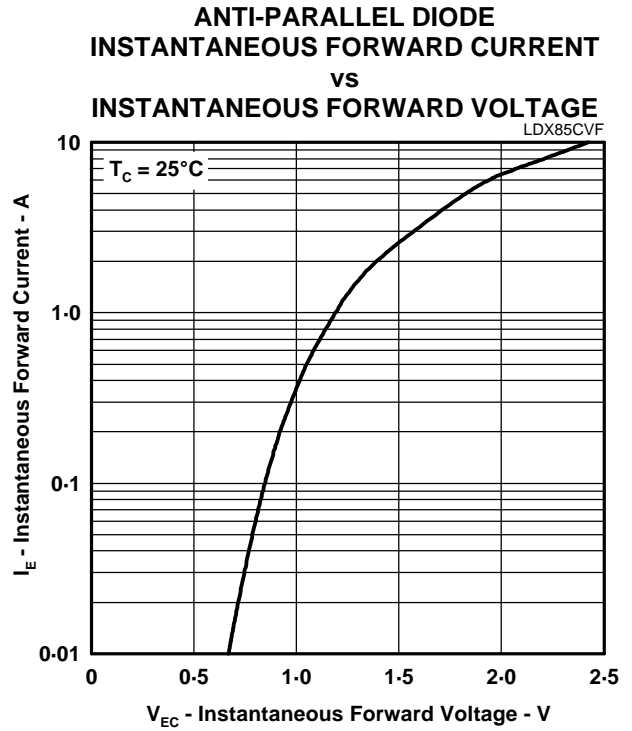


Figure 2.

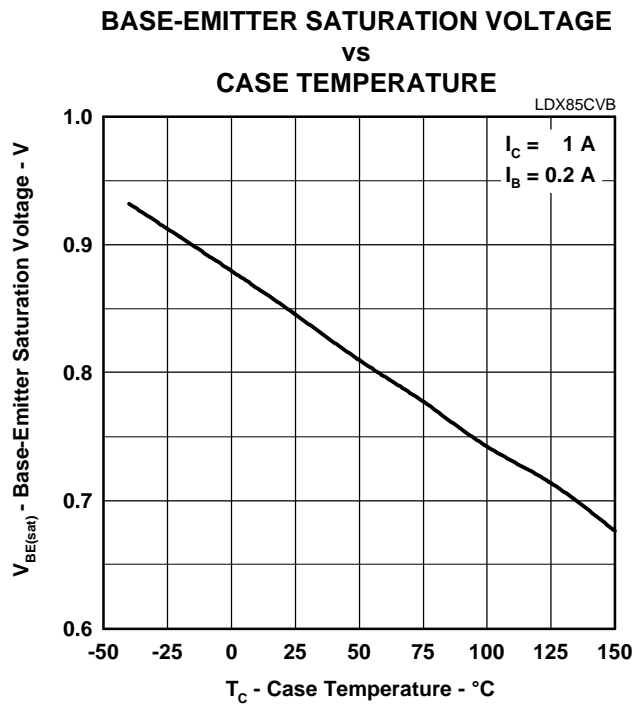


Figure 3.

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## MAXIMUM SAFE OPERATING REGIONS

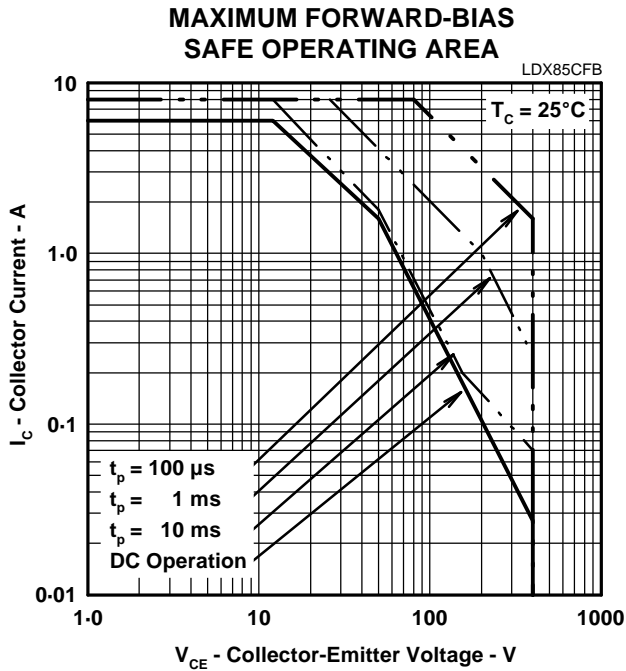


Figure 4.

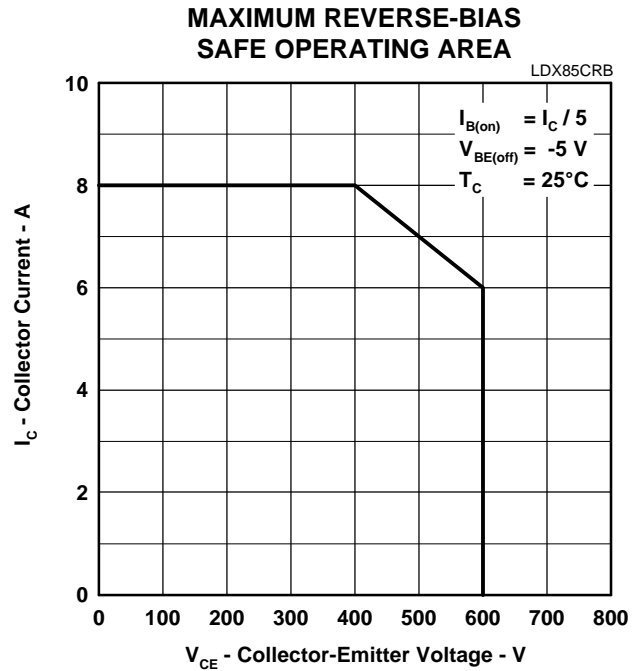


Figure 5.

## THERMAL INFORMATION

### THERMAL RESPONSE JUNCTION TO AMBIENT VS POWER PULSE DURATION

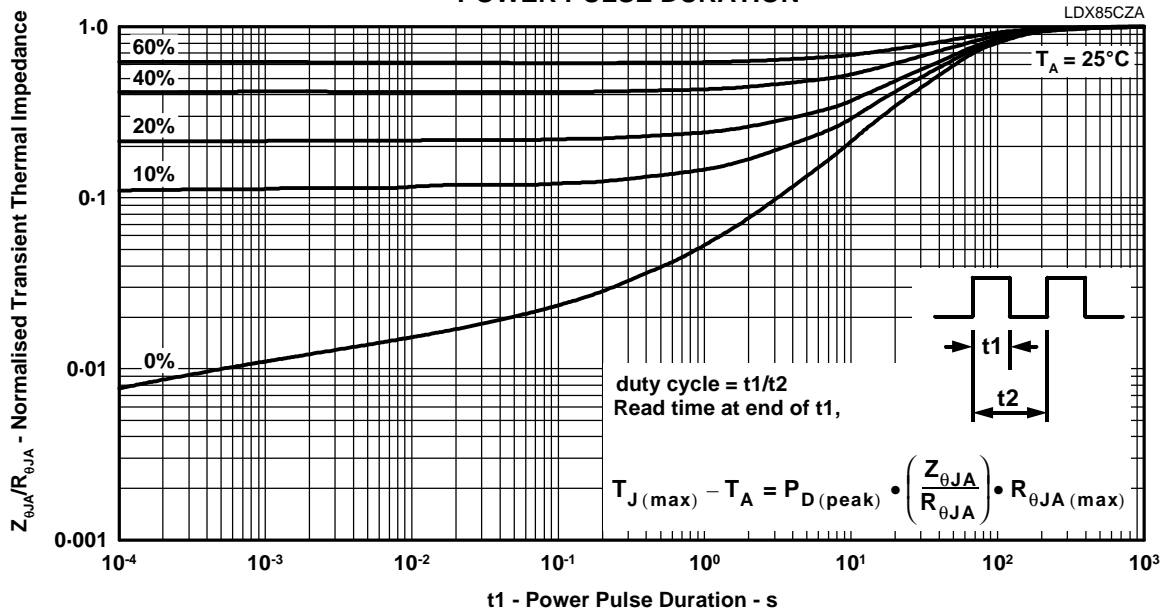


Figure 6.

THERMAL INFORMATION

THERMAL RESPONSE JUNCTION TO CASE  
VS  
POWER PULSE DURATION

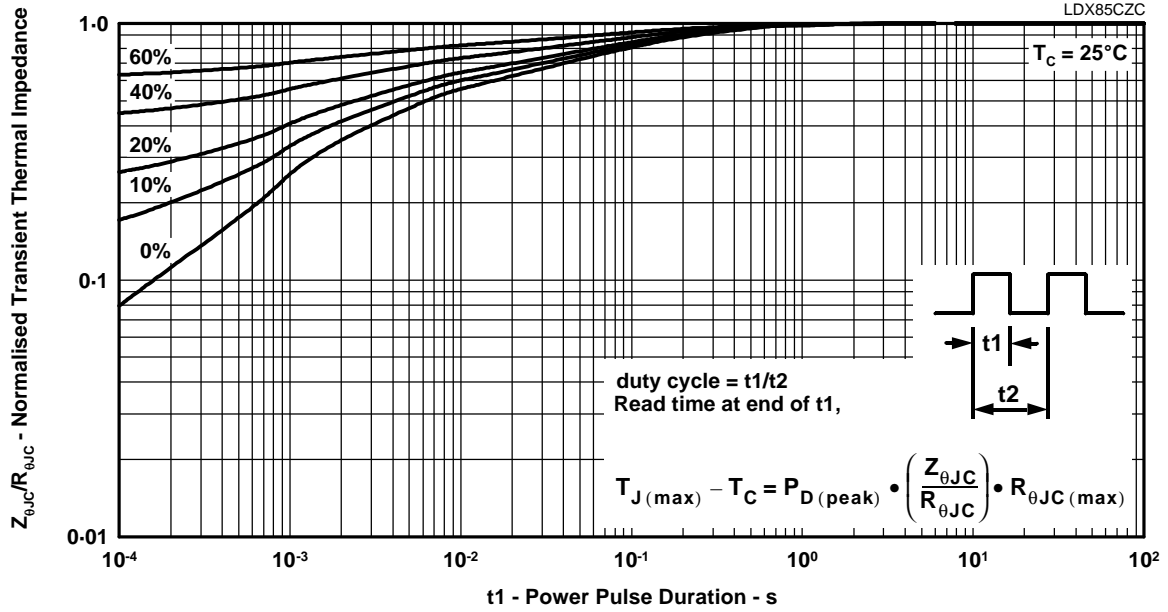


Figure 7.

MAXIMUM POWER DISSIPATION JUNCTION TO AMBIENT  
VS  
POWER PULSE DURATION

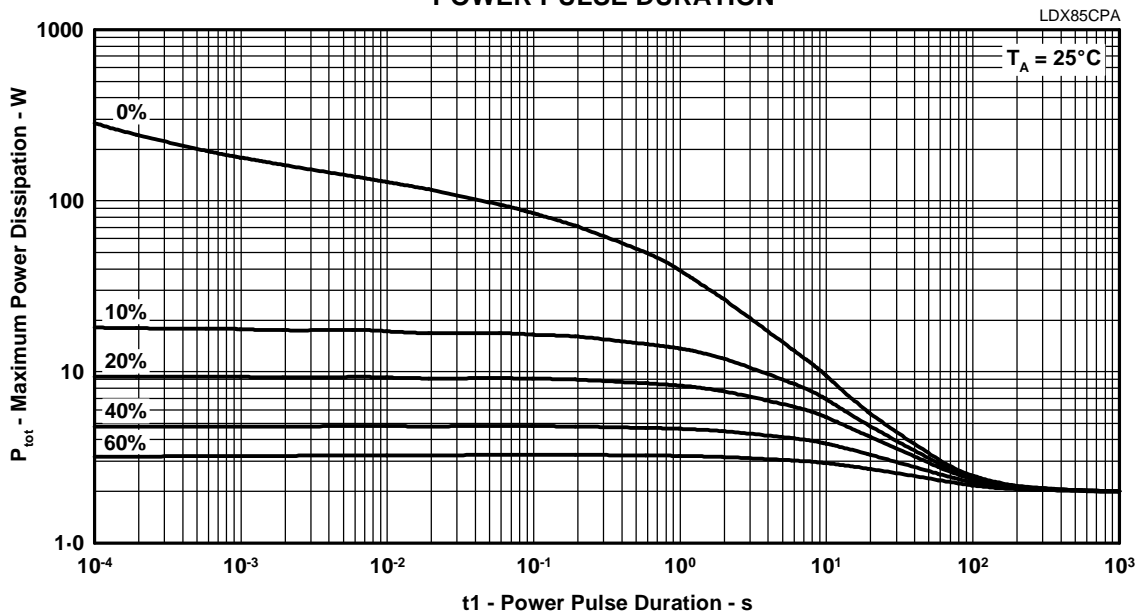


Figure 8.

# BULD85KC NPN SILICON TRANSISTOR WITH INTEGRATED DIODE

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## THERMAL INFORMATION

### MAXIMUM POWER DISSIPATION JUNCTION TO CASE VS POWER PULSE DURATION

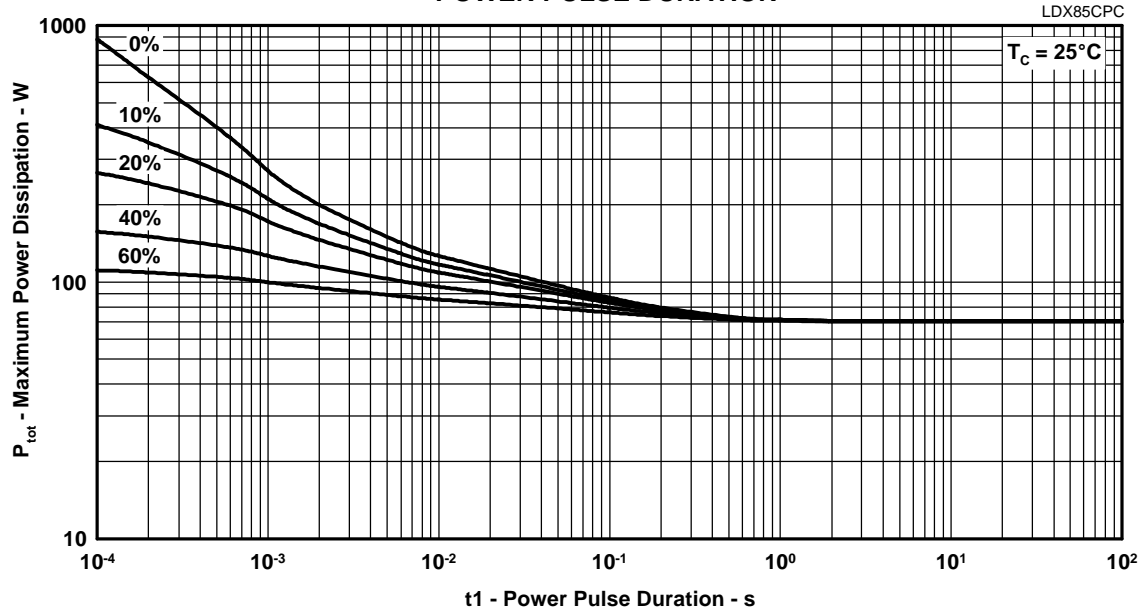


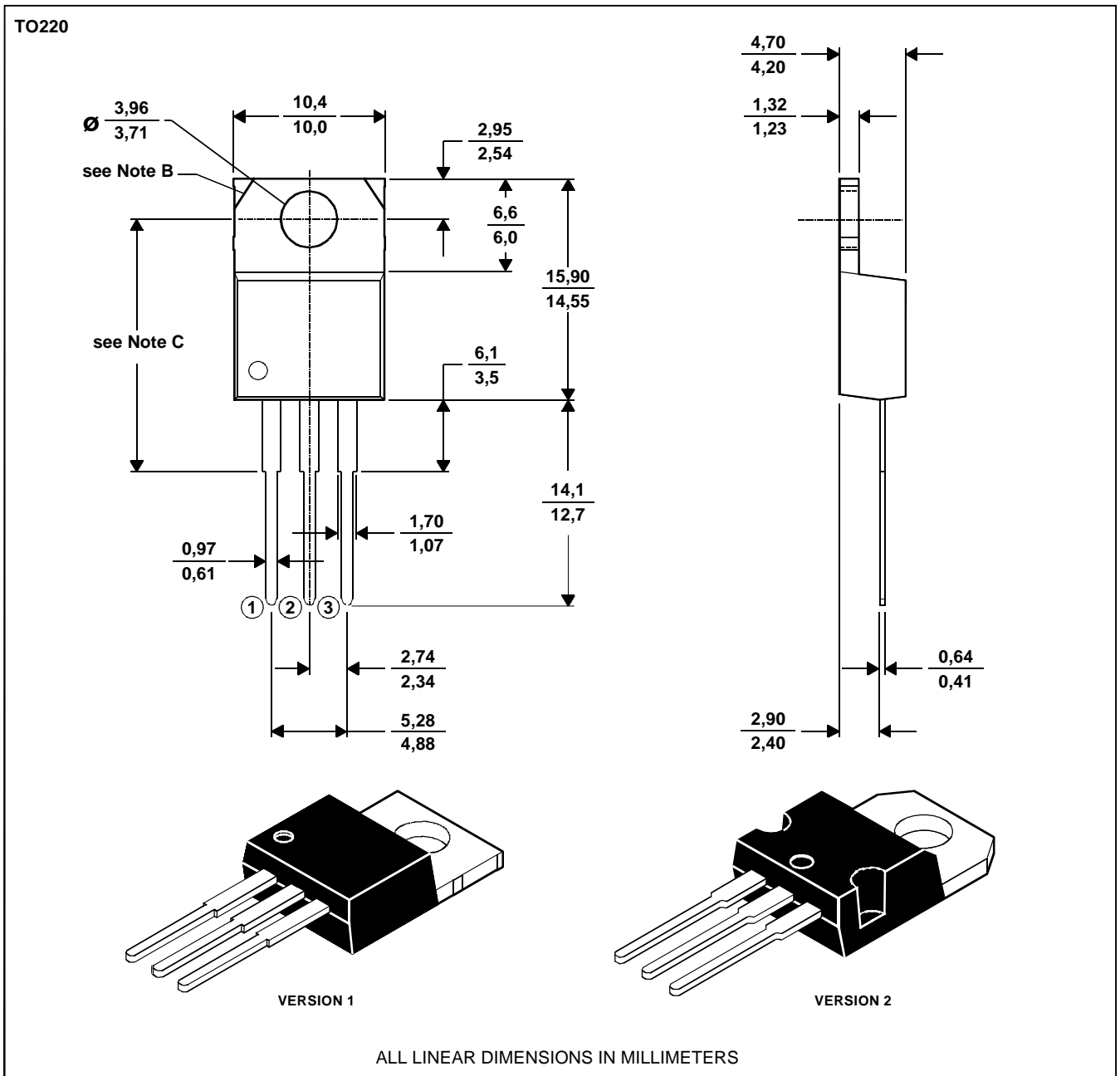
Figure 9.

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.



- 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

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