SUPER E-LINE TRANSISTORS

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50p

GENERAL INFORMATION

This Product Guide contains full data on the Ferranti ranges of Super E-line, Medium Power E-line and High Voltage E-line Plastic Encapsulated Transistors, as well as abbreviated data for quick reference. Application notes covering typical circuits are also included. The catalogue has been specifically designed to enable the engineer and buyer to rapidly select a Ferranti preferred product. It contains five principle sections:

(a) Descriptions of super E-line chip and package

(b) Product Index – *listings of Commercial & Quality Assured products*

(c) Selector Tables – *details of device types within application groups arranged to highlight the important characteristics in an easy to use format*

(d) Technical Data – *full technical data for the individual types listed*

(e) Application Notes – *covering typical examples of circuits using Super E-line transistors*

NEW PRODUCTS

The continual evolution of new products means that the Ferranti range is being constantly updated. If your particular requirement is not covered herein, please do not hesitate to contact us for new product information.

APPLICATIONS LABORATORY

An experienced team of applications engineers is available to give advice and active assistance with circuit design and system problems.

CUSTOMER SPECIFICATIONS

Devices may be supplied against 'in-house' Ferranti specifications to suit individual customer requirements for:

(a) Non-standard Electrical, Mechanical or environmental specifications.

(b) Customer Procurement Specifications.

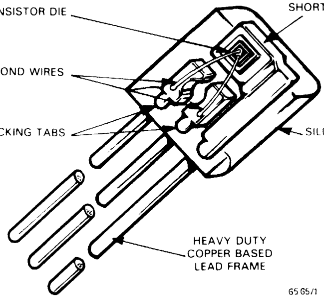
Device pricing will be dependant on the basic type, additional work involved, test yield and the quantity required.

SUPER E-LINE PRODUCT DESCRIPTION

DESIGN FEATURES

The Ferranti Super E-line range of complementary NPN and PNP transistors brings together advanced chip technology and assembly techniques to give superior performance in a TO-92 style package. Parallel studies into chip design and assembly techniques have combined to produce the outstanding features of the Super E-line.

E-line Package — Constructed for Reliability



The Ferranti E-line package has built a reputation for its reliabilty and advanced design. The Super E-line demanded even better performance, and a major study of eutectic die attach techniques produced void free die attach to give improved thermal and electrical characteristics.

HIGH DISSIPATION

The improved chip construction together with void free die attach and SILICONE encapsulant has given a device with a true 1 watt dissipation at room temperature (25°C). This allows a practical power dissipation of up to 1.5 watts when the collector lead is soldered to an equivalent of 1 square inch of copper. An in-depth study of heat sink techniques in conjunction with Super E-line packages has shown that up to 2.5 watts can be handled.

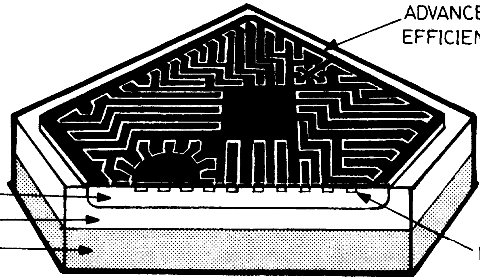
ENVIRONMENTAL PROTECTION

The SILICONE plastic used for the Ferranti E-line encapsulation protects the active semiconductor chip from exposure to corrosive agents, moisture and extreme environmental conditions.

The absence of ionic contamination in the Silicone allows chip operation up to 200°C without risk of failure. In regular tests conducted by the Ferranti Reliability Group, E-line devices are operated at $T_{amb} = 230°C$ under reverse bias conditions. All devices must survive without degradation. This permits the wide operating and storage temperature range normally associated only with metal-can devices.

The E-line manufacturing process includes a Resin Backfill Stage — a unique step that involves vacuum impregnation of the moulded package with Silicone resin. This seals any voids which might exist between the lead frame and the encapsulant giving the package hermeticity properties approaching those of metal-can devices.

SUPER E-LINE CHIP



HIGH CURRENT GAIN

A major objective of the chip design was to produce a transistor with improved gain properties at high current levels. By utilising advanced power efficient geometries and diffusion techniques, minimum gains of 40 have been achieved at collector currents of 2 Amps.

LOW SATURATION VOLTAGE

Improvements in high current gain performance together with improved die attach techniques have combined to give an extremely low $V_{CE(sat)}$ specification.

COMPLEMENTARY PAIRS

Selective chip design has produced the ZTX650 (NPN) and ZTX750 (PNP) series with excellent gain linearity, ideal for consumer applications including audio amplifiers and complementary drivers.

WIDE VOLTAGE AND GAIN RANGES

Both NPN and PNP series are specified up to a V_{CEO} maximum of 100 volts with d.c. gain specified up to 2 amps.

HIGH CURRENT HANDLING CAPABILITY

Improvements in equalising current distribution across the chip (avoiding 'hot spots') has produced a continuous current (I_C) rating of 2 amps and peak pulse currents (I_{CM}) of 6 amps. This makes the ZTX650 and ZTX750 series ideal for applications such as solenoids, actuators, relays, lamp drivers, motor drivers and photo flash units.

FAST SWITCHING — HIGH f_T

The planar epitaxial construction gives inherently fast switching speeds – 25ns turn on time at $I_C = 500mA$, and high f_T – typically 175MHz for the ZTX650 and 140MHz for the ZTX750 at 100MHz.

THE RESULT — MORE POWER FROM E-LINE

The FERRANTI SUPER E-LINE gives performance and reliability beyond standard TO-92 products and metal-can transistors. The package is approved over and beyond the full military temperature range. Ferranti E-line transistors are currently in use in many military applications and have been approved for 20 years application use in telecommunication equipment.

PERFORMANCE

As a direct result of the design features described, FERRANTI SUPER E-LINE transistors out perform similar types of plastic transistors. In addition to the wide range of industry standard types, Ferranti has produced 3 ranges that fully exploit the unique features of E-line.

SUPER E-LINE

Designated the ZTX650 and ZTX750 series.

The ultimate performance in E-line, featuring:

- Complementary NPN and PNP ranges
- 1 watt dissipation at $T_{amb} = 25°C$
- 1.5 watt practical power dissipation
- Voltages up to 100 volts (V_{CEO})
- Gain specified up to 6 amps
- Continuous current (I_C) = 2 amps
- Peak current = 6 amps
- Fast switching
- Excellent gain linearity

The SUPER E-LINE is designed to replace TO-39, TO-126, TO-202, TO-220 and TO-237 in free standing applications.

If your application demands continuous current up to 2 amps or peak currents up to 6 amps the SUPER E-LINE gives that performance at lower cost.

HIGH PERFORMANCE E-LINE

Designated the ZTX450 and ZTX550 series, the range consists of NPN and PNP complementary types featuring:

- P_{tot} = 1 watt at $T_{amb} = 25°C$.
- Continuous current (I_C) = 1 amp
- Peak current = 2 amps
- Gain specified up to 1 amp

The ZTX450/550 series are intended as full replacements for TO-39/TO-18 metal can transistors, and for medium current applications where a guaranteed gain up to 1 amp is required.

HIGH VOLTAGE E-LINE

Designed for applications which require high voltages, low saturation voltages and low capacitance.

- V_{CEO} up to 300V
- $I_C = 500mA$
- $P_{tot} = 680mW$ at $T_{amb} = 25°C$

PACKAGE PERFORMANCE

The E-LINE PACKAGE is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation, resistant to severe environments and allow the high junction temperature operation normally associated with metal-can devices. E-LINE encapsulated devices are approved for use in MILITARY, INDUSTRIAL and PROFESSIONAL equipments.

The standard lead formation is collector-base-emitter (c-b-e) 'in-line'. Alternative lead configurations are available as plug-in replacements for TO-5/39 and TO-18 metal-can types, as well as for flat mounting and wider spacing.

The BASIC PERFORMANCE of E-LINE is dependent, to a certain degree, on the type of chip used in the package. The following summary may be used as a basic guide:

MAXIMUM COLLECTOR CURRENT (continuous)	up to 2 Amps*
POWER DISSIPATION (at $T_{amb} = 25°C$)	500 up to 1000 mW*
OPERATING AND STORAGE TEMPERATURE RANGE	-55 to $+200°C$

*Dependent on chip size.

LEAD CONFIGURATIONS

The alternative lead configurations are denoted by a suffix such as K, L, M or S at the end of the part number.

e.g. ZTX650K where the K denotes that the leads are preformed to the TO-5/39 pin circle.

The available lead formations may be listed as:

IN-LINE	no suffix
TO-5/39 pin circle	suffix K
TO-18 pin circle	suffix L
Flat mounting	suffix M
In-line wide-spacing	suffix S

TAPED PRODUCT

E-line transistors can be supplied on tape for automatic insertion. Two types of packaging are available:

(a) Devices mounted on tape and then put on a reel which is then packed in a cardboard box.

(b) Devices mounted on tape and then folded in a concertina (or Z) form directly into a cardboard box (Ammo Pack).

See page SE111 for further details of taped product.

ORDERING INFORMATION

To order E-line transistors with alternative lead configurations, the following format should be used.

e.g. ZTX650L where L refers to TO-18 lead formation.

To order E-line transistors on tape, the following format should be used.

(a) Suffix 'STO' for product taped and supplied on reels.

(b) Suffix 'STZ' for product taped and folded (Ammo Pack).

(c) Orientation (option A or B).

e.g. ZTX650STOA.

Orders in multiples of 2000 pieces only will be accepted for taped product.

For Pricing, Ordering or Technical Information, Contact:

Discrete Component Marketing (061-624 0515) or your nearest Ferranti Sales Office.

QUALITY ASSURANCE

The Ferranti E-LINE transistor range has been designed to reproduce the Electrical and environmental qualities of metal-can devices with added benefits of the product consistency normally associated with automated production techniques and the consequent cost savings.

Ferranti has been successful in perfecting the E-LINE device to achieve the standards of quality and reliability necessary for their release to the appropriate BRITISH STANDARDS specification for electronic components of assessed quality.

In order to qualify for BS approval the E-LINE device must be subjected to, and have survived without degradation, the following environmental tests:

1. *Rapid change of temperature, thermal shock in air*
   Device cycled from −55 to +175°C for 400 excursions.
2. *Damp heat climatic test with reverse bias*
   Device subjected for 2000 hours to a relative humidity of 98% at a temperature of 55°C, with the collector-base reverse biased.
3. *Thermally accelerated test*
   Device subjected to a temperature of 230°C with collector-base and emitter-base reverse biased for a duration of 160 hours minimum.

It is important to note that **ALL** the E-LINE devices detailed in this product guide are manufactured with the same degree of care and process quality as those subject to BS9300 qualification procedures.

The FERRANTI QUALITY ASSURANCE PROGRAMME is, in general, linked to the BRITISH STANDARDS scheme and the range of available standards may be listed as:

1 **Commercial** – with factory acceptance quality levels (AQL).

2 **BS Approval** – to BS9300 series – categories P and Q.

3 **CECC harmonised European Standard** – 50000 series approval (categories F and L).

4 **CECC** – 50000 series approval +20 year life requirement to meet British Telecom D3007 approval.

5 **Release to Defence Standard** (DEF STAN 05-21) conditions i.e. 6/49 release.

6 **Release to Civil Aviation Authority** (CAA) conditions.

7 **CV/DEF STAN** specifications where the appropriate device is approved – until such time as they are incorporated into the BS scheme.

8 **Non-Approved Types** – where Ferranti is not listed as an approved supplier or where approval is pending, we may supply devices which have been subjected to the full quality assurance procedures as 'tested to............', subject to the basic type being available from Ferranti. Similarly, we may supply on a partial release basis such as 'released to Group A tests only' etc.

If any additional information on the FERRANTI QUALITY ASSURANCE PROGRAMME is required, contact: **Discrete Component Marketing (061-624 0515).**

PRODUCT INDEX

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	BS9365	F139(Q)		
	BS9365	F205(F)§		
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	BS9365	F205(F)§		
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ZTX649			1	SE63
ZTX650	50002	138(F)*	1	SE69
ZTX651	50002	138(F)*	1	SE69
ZTX652	50002	138(F)*	1	SE69
ZTX653	50002	138(F)*	1	SE69
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ZTX657			4	SE79
ZTX749			1	SE85
ZTX750	50002	137(F)*	1	SE91
ZTX751	50002	137(F)*	1	SE91
ZTX752	50002	137(F)*	1	SE91
ZTX753	50002	137(F)*	1	SE91
ZTX756			4	SE101
ZTX757			4	SE101

NOTE. (F), (P) or (Q) are BS Categories.
CAT F – * indicates full plus additional assessment.
CAT F – § indicates full plus additional assessment with long life requirements.

TABLE 1 : NPN/PNP SUPER E-LINE

These devices offer the ultimate performance for a TO-92 style package. They have been designed to operate and provide useful gain at current levels up to 2 amps with power dissipation capabilities in excess of 1 watt at 25°C ambient temperature.

Type	V_{CBO} V	V_{CEO} V	Max cont I_C A	Max I_{CM} A	Max $V_{CE(sat)}$ at V	I_C A	I_B A	h_{FE} at Min	I_C A	Min f_T at MHz	I_C mA	P_{tot} at T_{amb} = 25°C mW	Complement
NPN													
ZTX653	120	100	2	6	0.5	2	0.2	40	2	140	100	1000	ZTX753
ZTX652	100	80	2	6	0.5	2	0.2	40	2	140	100	1000	ZTX752
ZTX651	80	60	2	6	0.5	2	0.2	25	2	140	100	1000	ZTX751
ZTX650	60	45	2	6	0.5	2	0.2	25	2	140	100	1000	ZTX750
ZTX649	35	25	2	6	0.5	2	0.2	75	2	150	100	1000	ZTX749
PNP													
ZTX753	120	100	2	6	0.5	2	0.2	40	2	100	100	1000	ZTX653
ZTX752	100	80	2	6	0.5	2	0.2	40	2	100	100	1000	ZTX652
ZTX751	80	60	2	6	0.5	2	0.2	25	2	100	100	1000	ZTX651
ZTX750	60	45	2	6	0.5	2	0.2	25	2	100	100	1000	ZTX650
ZTX749	35	25	2	6	0.5	2	0.2	75	2	100	100	1000	ZTX649

TABLE 2 : NPN/PNP HIGH PERFORMANCE E-LINE

The devices shown in this table have been designed to operate and provide useful gain at current levels up to 1 amp with power dissipation capabilities up to 1 watt at 25°C ambient temperature.

Type	V_{CBO} V	V_{CEO} V	Max cont I_C A	Max I_{CM} A	Max $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} at Min	I_C mA	Min f_T at MHz	I_C mA	P_{tot} at T_{amb} = 25°C mW	Complement
NPN													
ZTX455	160	140	1	2	0.7	150	15	100	150	100	50	1000	—
ZTX454	140	120	1	2	0.7	150	15	100	150	100	50	1000	—
ZTX453	120	100	1	2	0.7	150	15	40	150	150	50	1000	—
ZTX452	100	80	1	2	0.7	150	15	40	150	150	50	1000	ZTX552
ZTX451	80	60	1	2	0.35	150	15	50	150	150	50	1000	ZTX551
ZTX450	60	45	1	2	0.25	150	15	100	150	150	50	1000	ZTX550
ZTX449	50	30	1	2	0.5	1000	100	100	500	150	50	1000	ZTX549
PNP													
ZTX552	100	80	1	2	0.7	150	15	40	150	150	50	1000	ZTX452
ZTX551	80	60	1	2	0.35	150	15	50	150	150	50	1000	ZTX451
ZTX550	60	45	1	2	0.25	150	15	100	150	150	50	1000	ZTX450
ZTX549	35	25	1	2	0.5	1000	100	100	500	100	100	1000	ZTX449

TABLE 3 : NPN HIGH PERFORMANCE DARLINGTONS

The devices shown in this table are designed for applications requiring very high current gain at current levels up to 1 amp and power dissipation up to 1 watt.

Type	V_{CBO} V	V_{CEO} V	Max I_C cont A	Max I_{CM} A	Max $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min	Max	at I_C mA	Max. I_{CBO} nA	at V_{CB} V	P_{tot} at T_{amb} = 25°C mW
ZTX600	160	140	1	4	1.2	1000	10	2K	100K	500	100	140	1000
ZTX601	180	160	1	4	1.2	1000	10	2K	100K	500	100	160	1000

TABLE 4 : NPN/PNP HIGH VOLTAGE TRANSISTORS

The transistors shown in this table are designed for driving Numerical Indicator Tubes, Neon Lamps and other applications requiring high voltage capability.

Type	V_{CBO} V	V_{CEO} V	Max I_C cont mA	Max $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min	Max	at I_C mA	Max I_{CBO} μA	at V_{CB} V	P_{tot} at T_{amb} = 25°C mW	Complement
NPN													
ZTX657	300	300	500	0.5	100	10	50	—	100	0.1	200	1000	ZTX757
MPSA42	300	300	500	0.5	20	2.0	40	—	10	0.1	200	680	MPSA92
BF393	300	300	500	2.0	20	2.0	40	—	10	0.1	200	625	BF493
BF392	250	250	500	2.0	20	2.0	40	—	10	0.1	200	625	BF492
ZTX656	200	200	500	0.5	100	10	50	—	100	0.1	160	1000	ZTX756
MPSA43	200	200	500	0.4	20	2.0	40	—	10	0.1	160	680	MPSA93
BF391	200	200	500	2.0	20	2.0	40	—	10	0.1	160	625	BF491
PNP													
ZTX757	300	300	500	0.5	100	10	50	—	100	0.1	200	1000	ZTX657
MPSA92	300	300	500	0.5	20	2.0	40	—	10	0.1	200	680	MPSA42
BF493	300	300	500	2.0	20	2.0	40	—	10	0.1	200	625	BF393
BF492	250	250	500	2.0	20	2.0	40	—	10	0.1	200	625	BF392
ZTX756	200	200	500	0.5	100	10	50	—	100	0.1	160	1000	ZTX656
MPSA93	200	200	500	0.4	20	2.0	40	—	10	0.1	160	680	MPSA43
BF491	200	200	500	2.0	20	2.0	40	—	10	0.1	160	625	BF391

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FERRANTI semiconductors ®

BF391
BF392
BF393

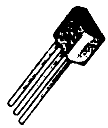
NPN Silicon Planar High Voltage Transistors

DESCRIPTION

These plastic encapsulated general purpose transistors are designed for applications requiring high breakdown voltage and low capacitance.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.



PLASTIC E-LINE (TO-92)

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BF391	BF392	BF393	Unit
Collector-Base Voltage	V_{CBO}	200	250	300	V
Collector-Emitter Voltage	V_{CEO}	200	250	300	V
Emitter-Base Voltage	V_{EBO}	6	6	6	V
Continuous Collector Current	I_C	500			mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	625 1.5			mW W
Operating and Storage Temperature Range	$T_j:T_{stg}$	−55 to +175			°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance Junction to Ambient Junction to Case	$R_{th(j-amb)}$ $R_{th(j-case)}$	220 80	°C/W °C/W

BF391 Series

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	BF391	$V_{(BR)CBO}$	200	—	V	$I_C = 100\mu A$, $I_E = 0$
	BF392		250	—	V	
	BF393		300	—	V	
Collector-emitter breakdown voltage	BF391	$V_{(BR)CEO}$	200	—	V	$I_C = 10mA$, $I_B = 0$*
	BF392		250	—	V	
	BF393		300	—	V	
Emitter-base breakdown voltage	BF391	$V_{(BR)EBO}$	6.0	—	V	$I_E = 100\mu A$, $I_C = 0$
	BF392		6.0	—	V	
	BF393		6.0	—	V	
Collector cut-off current	BF391	I_{CBO}	—	0.1	μA	$V_{CB} = 160V$, $I_E = 0$
	BF392		—	0.1	μA	$V_{CB} = 200V$, $I_E = 0$
	BF393		—	0.1	μA	$V_{CB} = 200V$, $I_E = 0$
Emitter cut-off current	BF391	I_{EBO}	—	0.1	μA	$V_{BE} = 4V$, $I_C = 0$
	BF392		—	0.1	μA	$V_{BE} = 6V$, $I_C = 0$
	BF393		—	0.1	μA	$V_{BE} = 6V$, $I_C = 0$
Static forward current transfer ratio	All types	h_{FE}	25	—		$I_C = 1mA$, $V_{CE} = 10V$*
	All types		40	—		$I_C = 10mA$, $V_{CE} = 10V$*
Collector-emitter saturation voltage		$V_{CE(sat)}$	—	2.0	V	$I_C = 20mA$, $I_B = 2mA$
Collector-base saturation voltage		$V_{BE(sat)}$	—	2.0	V	$I_C = 20mA$, $I_B = 2mA$
Transition frequency		f_T	50	—	MHz	$I_C = 10mA$, $V_{CE} = 20V$ $f = 20MHz$
Collector-base capacitance		C_{re}	—	1.6	pF	$V_{CE} = 60V$, $I_E = 0$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width $= 300\mu s$. Duty cycle $\leq 2\%$.

BF491
BF492
BF493

FERRANTI semiconductors®

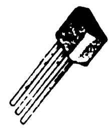
PNP Silicon Planar High Voltage Transistors

DESCRIPTION

These plastic encapsulated general purpose transistors are designed for applications requiring high breakdown voltage and low capacitance.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.



PLASTIC E-LINE (TO-92)

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BF491	BF492	BF493	Unit
Collector-Base Voltage	V_{CBO}	−200	−250	−300	V
Collector-Emitter Voltage	V_{CEO}	−200	−250	−300	V
Emitter-Base Voltage	V_{EBO}	−6	−8	−8	V
Continuous Collector Current	I_C	−500			mA
Power Dissipation at $T_{amb}=25°C$ at $T_{case}=25°C$	P_{tot}	625 1.5			mW W
Operating and Storage Temperature Range	T_j:T_{stg}	−55 to +175			°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance Junction to Ambient Junction to Case	$R_{th(j\text{-}amb)}$ $R_{th(j\text{-}case)}$	220 80	°C/W °C/W

BF491 Series

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	BF491	$V_{(BR)CBO}$	−200	—	V	$I_C = -100\mu A$, $I_E = 0$
	BF492		−250	—	V	
	BF493		−300	—	V	
Collector-emitter breakdown voltage	BF491	$V_{(BR)CEO}$	−200	—	V	$I_C = -10mA$, $I_B = 0$*
	BF492		−250	—	V	
	BF493		−300	—	V	
Emitter-base breakdown voltage	BF491	$V_{(BR)EBO}$	−6.0	—	V	$I_E = -100\mu A$, $I_C = 0$
	BF492		−8.0	—	V	
	BF493		−8.0	—	V	
Collector cut-off current	BF491	I_{CBO}	—	0.1	μA	$V_{CB} = -160V$, $I_E = 0$
	BF492		—	0.1	μA	$V_{CB} = -200V$, $I_E = 0$
	BF493		—	0.1	μA	$V_{CP} = -200V$, $I_E = 0$
Emitter cut-off current	BF491	I_{EBO}	—	0.1	μA	$V_{BE} = -4V$, $I_C = 0$
	BF492		—	0.1	μA	$V_{BE} = -6V$, $I_C = 0$
	BF493		—	0.1	μA	$V_{BE} = -6V$, $I_C = 0$
Static forward current transfer ratio	All types	h_{FE}	25	—		$I_C = -1mA$, $V_{CE} = -10V$*
	All types		40	—		$I_C = -10mA$, $V_{CE} = -10V$*
Collector-emitter saturation voltage		$V_{CE(sat)}$	—	2.0	V	$I_C = -20mA$, $I_B = -2mA$
Collector-base saturation voltage		$V_{BE(sat)}$	—	2.0	V	$I_C = -20mA$, $I_B = -2mA$
Transition frequency		f_T	50	—	MHz	$I_C = -10mA$, $V_{CE} = -20V$ $f = 20MHz$
Collector-base capacitance		C_{re}	—	1.6	pF	$V_{CE} = -100V$, $I_E = 0$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width $= 300\mu s$. Duty cycle $\leqslant 2\%$.

FERRANTI semiconductors®

MPSA42
MPSA43

NPN Silicon Planar High Voltage Transistors

DESCRIPTION

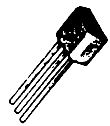
These plastic encapsulated, general purpose transistors are designed for applications requiring high breakdown voltages, low saturation voltages and low capacitance.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

Complementary to MPSA92 and MPSA93.



PLASTIC E-LINE (TO-92)

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	MPSA42	MPSA43	Unit
Collector-Base Voltage	V_{CBO}	300	200	V
Collector-Emitter Voltage	V_{CEO}	300	200	V
Emitter-Base Voltage	V_{EBO}	6	6	V
Continuous Collector Current	I_C	500	500	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	680 1.8	680 1.8	mW W
Operating and Storage Temp. Range	$T_j;T_{stg}$	−55 to +175		°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance Junction to Ambient Junction to Case	$R_{th(j-amb)}$ $R_{th(j-case)}$	220 80	°C/W °C/W

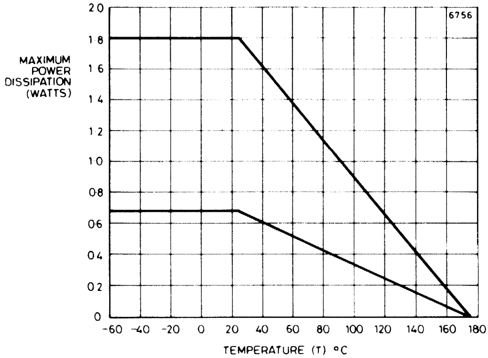
MPSA42 Series

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

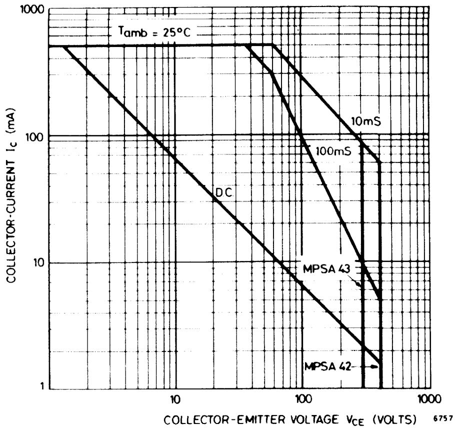
Parameter	Symbol	MPSA42		MPSA43		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	300	—	200	—	V	$I_C = 100\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	300	—	200	—	V	$I_C = 1mA$, $I_B = 0$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	6	—	V	$I_E = 100\mu A$, $I_C = 0$
Collector cut-off current	I_{CBO}	— —	0.1 —	— —	— 0.1	μA μA	$V_{CB} = 200V$, $I_E = 0$ $V_{CB} = 160V$, $I_E = 0$
Emitter cut-off current	I_{EBO}	— —	0.1 —	— —	— 0.1	μA μA	$V_{EB} = 6V$, $I_C = 0$ $V_{EB} = 4V$, $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.5	—	0.4	V	$I_C = 20mA$ $I_B = 2mA$
Collector-base saturation voltage	$V_{BE(sat)}$	—	0.9	—	0.9	V	$I_C = 20mA$ $I_B = 2mA$
Static forward current transfer ratio	h_{FE}	25	—	25	—		$I_C = 1mA$ $V_{CE} = 10V$*
		40	—	40	—		$I_C = 10mA$ $V_{CE} = 10V$*
		40	—	50	200		$I_C = 30mA$ $V_{CE} = 10V$*
Transition frequency	f_T	50	—	50	—	MHz	$I_C = 10mA$ $V_{CE} = 20V$ $f = 20MHz$
Output capacitance	C_{obo}	—	6	—	6	pF	$V_{CB} = 20V$, $I_E = 0$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 200μs. Duty cycle = 2%.

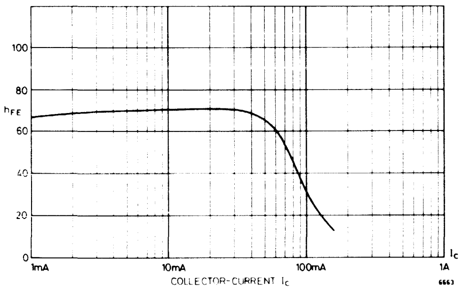
DISSIPATION DERATING CURVE

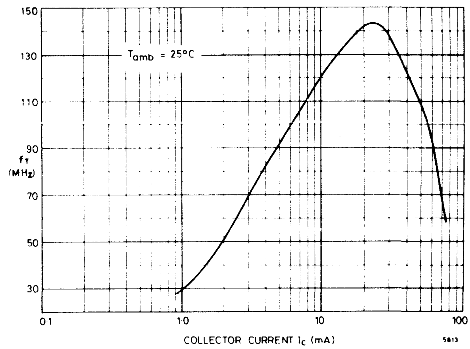


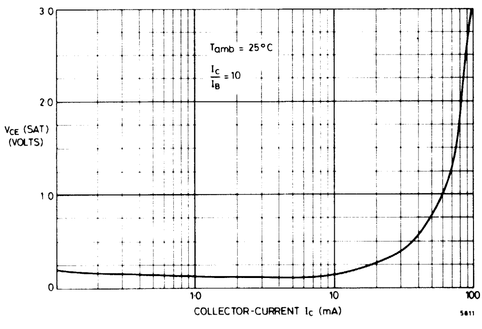
SAFE OPERATING AREA



TYPICAL CHARACTERISTICS







FERRANTI semiconductors®

MPSA92
MPSA93

PNP Silicon Planar High Voltage Transistors

DESCRIPTION

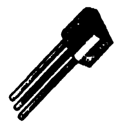
These plastic encapsulated, general purpose transistors are designed for applications requiring high breakdown voltages, low saturation voltages and low capacitance.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

Complementary to MPSA42 and MPSA43.



PLASTIC E-LINE (TO-92)

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	MPSA92	MPSA93	Unit
Collector-Base Voltage	V_{CBO}	−300	−200	V
Collector-Emitter Voltage	V_{CEO}	−300	−200	V
Emitter-Base Voltage	V_{EBO}	−5	−5	V
Continuous Collector Current	I_C	−500	−500	mA
Power Dissipation at $T_{amb}=25°C$ at $T_{case}=25°C$	P_{tot}	680 1.8	680 1.8	mW W
Operating and Storage Temp. Range	$T_j;T_{stg}$	−55 to +175		°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance Junction to Ambient Junction to Case	$R_{th(j-amb)}$ $R_{th(j-case)}$	220 80	°C/W °C/W

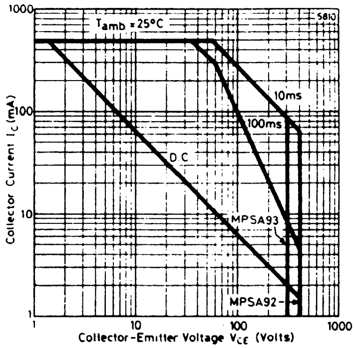
MPSA92/93

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

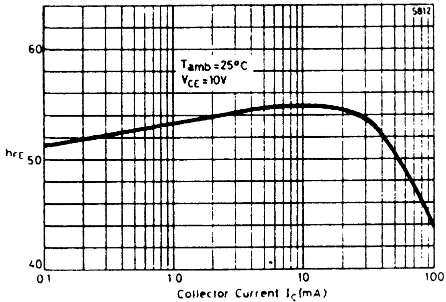
Parameter	Symbol	MPSA92		MPSA93		Unit	Test Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	–300	—	–200	—	V	$I_C = -100\ \mu A$ $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	–300	—	–200	—	V	$I_C = -1$ mA* $I_B = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	–5	—	–5	—	V	$I_E = -10\ \mu A$ $I_C = 0$
Collector cut-off current	I_{CBO}	—	–0.25	—	—	μA	$V_{CB} = -200V$ $I_E = 0$
		—	—	—	–0.25	μA	$V_{CB} = -160V$ $I_E = 0$
Emitter cut-off current	I_{EBO}	—	–0.1	—	–0.1	μA	$V_{EB} = -3V$ $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	–0.5	—	–0.4	V	$I_C = -20$ mA $I_B = -2$ mA
Collector-base saturation voltage	$V_{BE(sat)}$	—	–0.9	—	–0.9	V	$I_C = -20$ mA $I_B = -2$ mA
Static forward current transfer ratio	h_{FE}	25	—	25	—		$I_C = -1$ mA $V_{CE} = -10V$*
		40	—	40	—		$I_C = -10$ mA $V_{CE} = -10V$*
		25	—	30	150		$I_C = -30$ mA $V_{CE} = -10V$*
Transition frequency	f_T	50	—	50	—	MHz	$I_C = -10$ mA $V_{CE} = -20V$ f = 20 MHz
Output capacitance	C_{obo}	—	6	—	8	pF	$V_{CB} = -20V$ f = 1 MHz

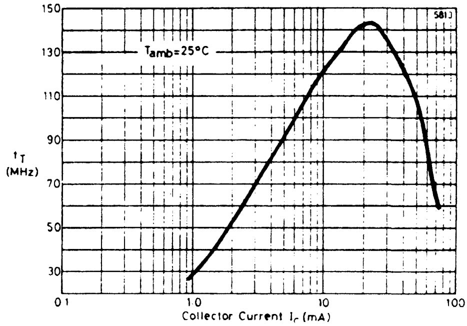
*Measured under pulsed conditions. Pulse width = 300 μs, Duty Cycle = 2%.

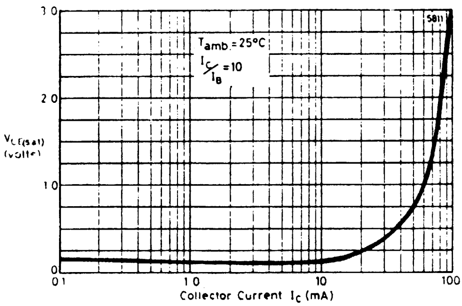
SAFE OPERATING AREA



TYPICAL CHARACTERISTICS







FERRANTI semiconductors®

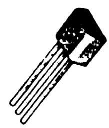
ZTX449

NPN Silicon Planar Medium Power Transistor

DESCRIPTION

The ZTX449 is a high current transistor encapsulated in the popular E-line package. The device is intended for low voltage, high current L.F. applications and features high power dissipation, 1W at 25°C ambient temperature, and excellent gain characteristics up to 2 amps.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.



PLASTIC E-LINE (TO-92)

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

Complementary to the ZTX549

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Max.	Unit
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current (see note below)	I_{CM}	2	amps
Continuous Collector Current	I_C	1	amp
Base Current	I_B	200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	W W
Operating and Storage Temperature Range		−55 to +200	°C

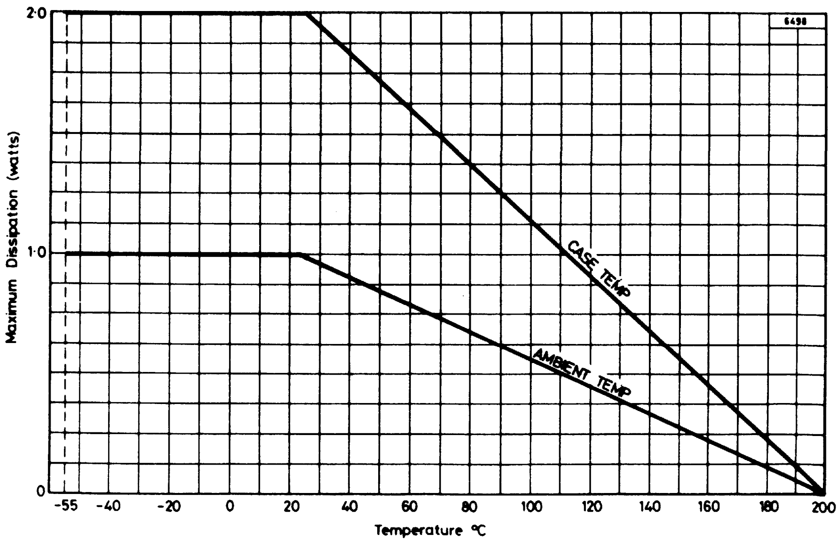
Note: Measured under pulsed conditions. Pulse width $= 300\mu s$. Duty cycle $\leq 2\%$.

ZTX449

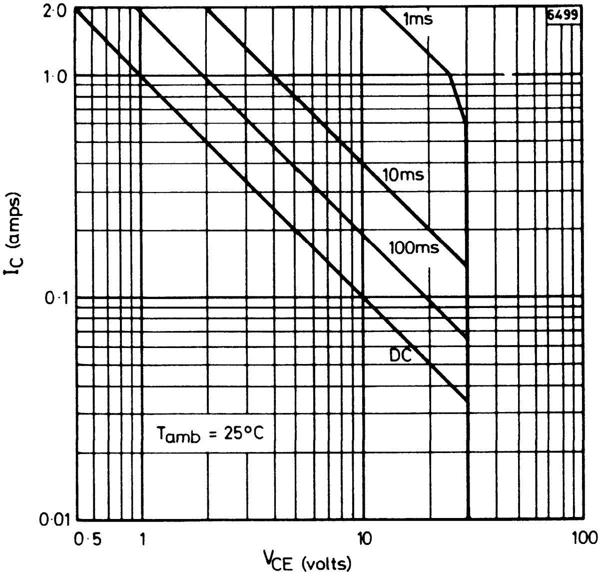
CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base cut-off current	I_{CBO}	– –	0.1 10	μA μA	$V_{CB}=40V$ $V_{CB}=40V$, $T_{amb}=100°C$
Emitter-base cut-off current	I_{EBO}	–	0.1	μA	$V_{EB}=4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	– –	0.5 1.0	V V	$I_C=1A$, $I_B=0.1A$* $I_C=2A$, $I_B=0.2A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	–	1.25	V	$I_C=1A$, $I_B=0.1A$*
Base-emitter turn-on time	$V_{BE(on)}$	–	1.0	V	$I_C=1A$, $V_{CE}=2V$*
Static forward current transfer ratio	h_{FE}	70 100 80 40	– 300 – –		$I_C=50mA$, $V_{CE}=2V$* $I_C=500mA$, $V_{CE}=2V$* $I_C=1A$, $V_{CE}=2V$* $I_C=2A$, $V_{CE}=2V$*
Transition frequency	f_T	150	–	MHz	$I_C=50mA$, $V_{CE}=10V$ $f=100MHz$
Output capacitance	C_{obo}	–	15	pF	$V_{CB}=10V$, $f=1MHz$

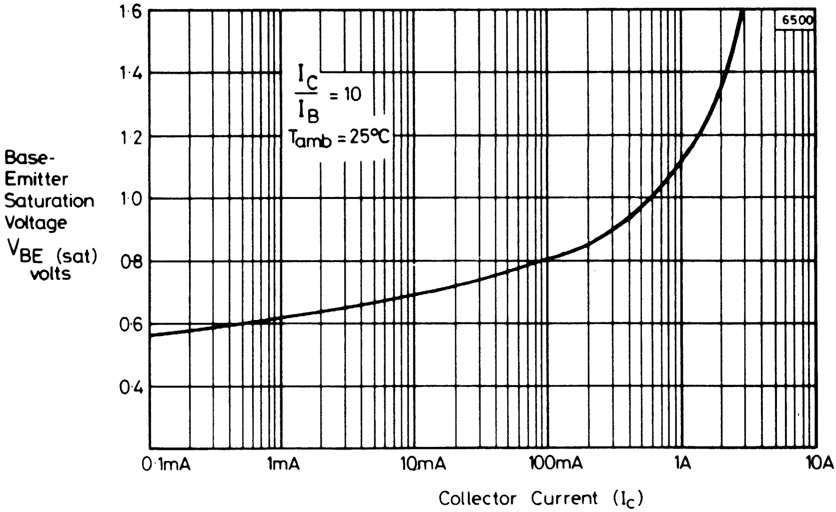
*Measured under pulsed conditions. Pulse width =300μs. Duty cycle ≤2%.



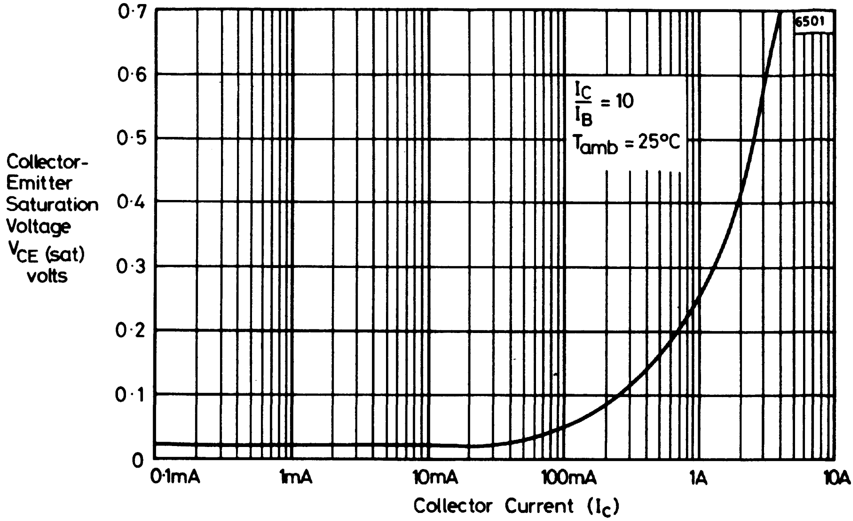
DERATING CURVE



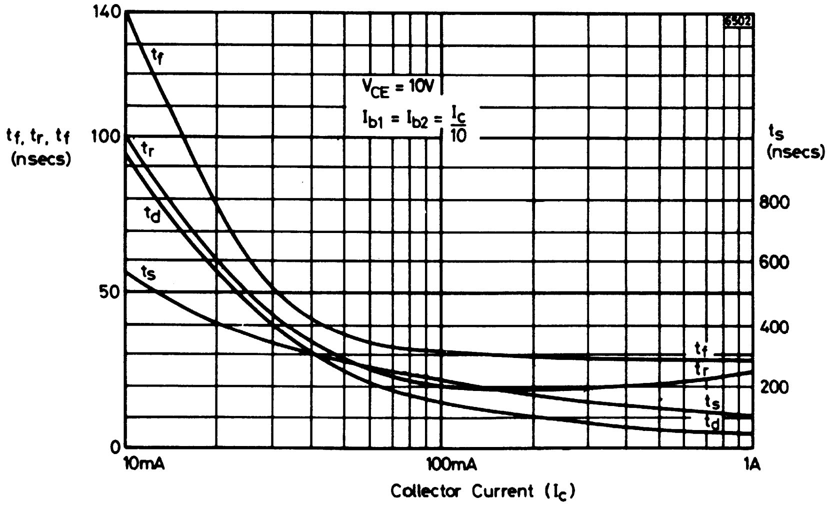
OPERATING AREA AT $T_{amb} = 25°C$



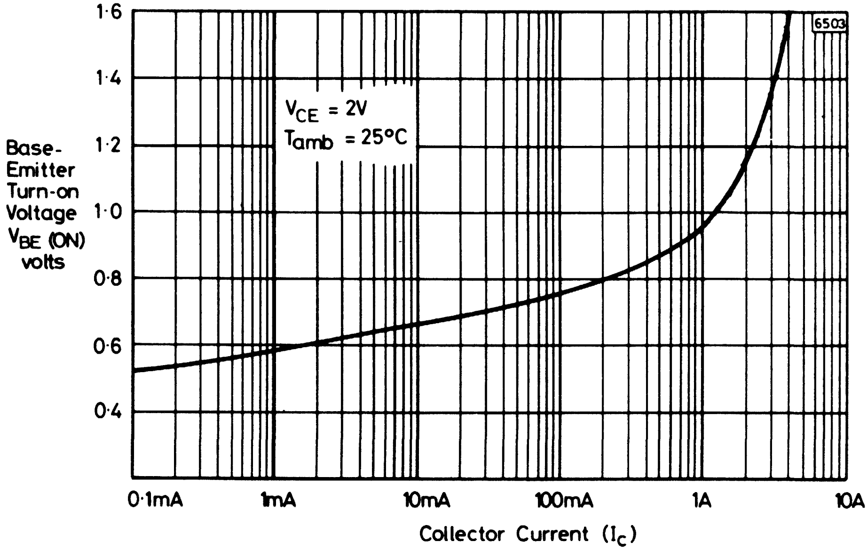
$V_{BE(sat)}/I_C$



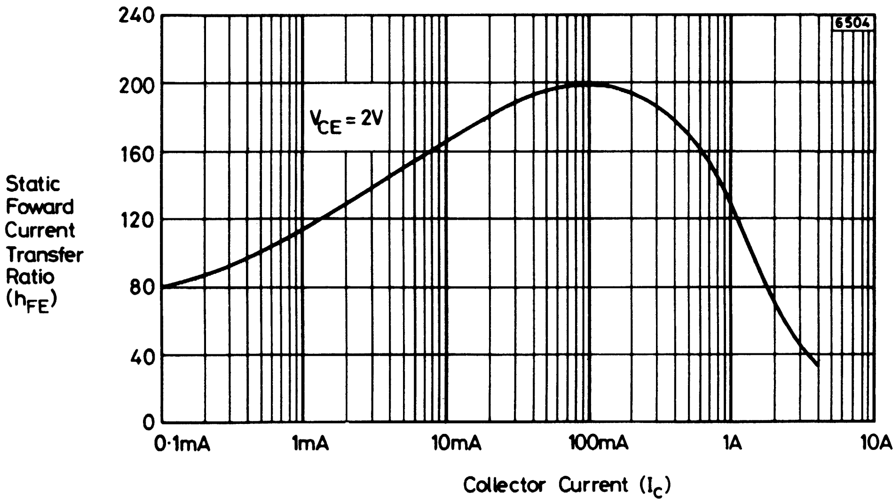
$V_{CE(sat)}/I_C$



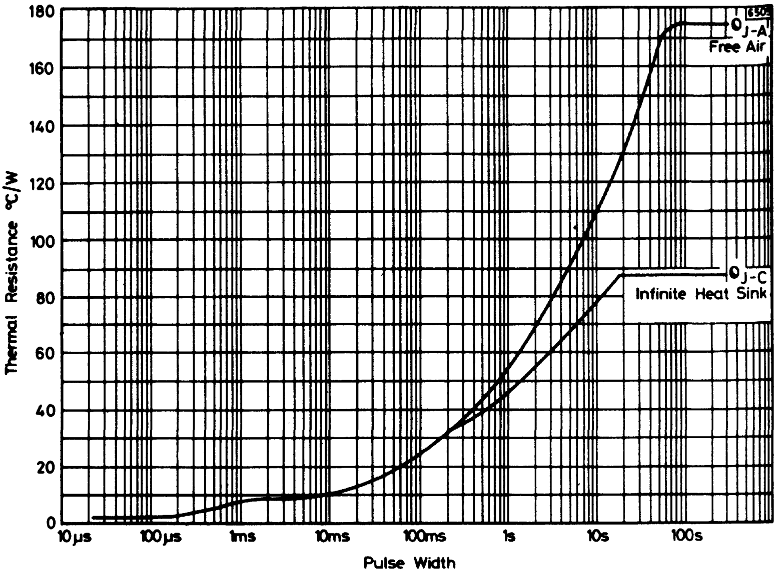
SWITCHING TIMES



$V_{BE(on)}/I_C$



h_{FE}/I_C

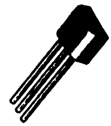


TRANSIENT THERMAL RESISTANCE

FERRANTI semiconductors®

ZTX450
ZTX451

NPN Silicon Planar Medium Power Transistors



PLASTIC E-LINE (TO-92)

FEATURES

- High power dissipation: 1W at $T_{amb} = 25°C$.
- h_{FE} specified up to 1 amp.
- High F_T: 200 MHz typical

DESCRIPTION

These are plastic encapsulated, general purpose transistors designed for small and medium signal amplification from d.c. to radio frequencies.

Application areas include: Audio Frequency Amplifiers, Driver and Output Stages, Oscillators and General Purpose Switching.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

Complementary to the ZTX550 and ZTX 551 PNP transistors.

The ZTX450 and ZTX451 transistors APPROVED FOR USE IN MILITARY EQUIPMENT are identified by the following numbers:

BS 9365 F137 & F138 – Category P.

BS 9365 F139 & F140 – Category Q.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX450	ZTX451	Unit
Collector-Base Voltage	V_{CBO}	60	80	Volts
Collector-Emitter Voltage	V_{CEO}	45	60	Volts
Emitter-Base Voltage	V_{EBO}	5	5	Volts
Peak Pulse Current (see note below)	I_{CM}	2	2	A
Continuous Collector Current	I_C	1	1	A
Base Current	I_B	200	200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	1 2	W W
Operating and Storage Temp. Range		−55 to +200		°C

Note: Pulse width = 300 μs. Duty cycle $\leqslant$ 2%.

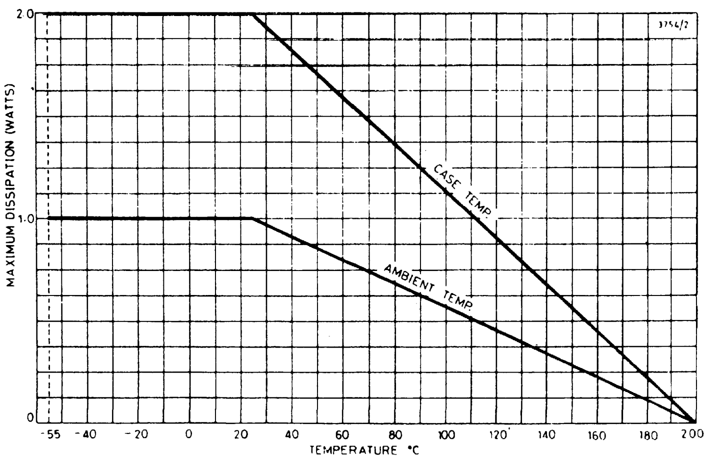
ZTX450/451

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

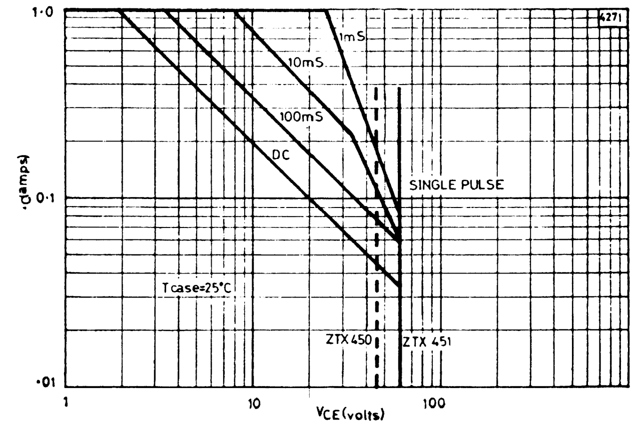
Parameter	Symbol	ZTX450		ZTX451		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base cut-off current	I_{CBO}	— —	0.1 —	— —	— 0.1	μA μA	$V_{CB} = 45V$ $V_{CB} = 60V$
Emitter-base cut-off current	I_{EBO}	—	0.1	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.25	—	0.35	V	$I_C = 150$ mA $I_B = 15$ mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	—	1.1	V	$I_C = 150$ mA $I_B = 15$ mA*
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	45	—	60	—	V	$I_C = 10$ mA*
Static forward current transfer ratio	h_{FE}	100 15	300 —	50 10	150 —		$I_C = 150$ mA $V_{CE} = 10V$* $I_C = 1$ A $V_{CE} = 10V$*
Transition frequency	f_T	150	—	150	—	MHz	$I_C = 50$ mA $V_{CE} = 10V$ f = 100 MHz
Output capacitance	C_{obo}	—	15	—	15	pF	$V_{CB} = 10V$ f = 1 MHz

*Measured under pulsed conditions. Pulse width = 300 μs. Duty cycle ⩽2%.

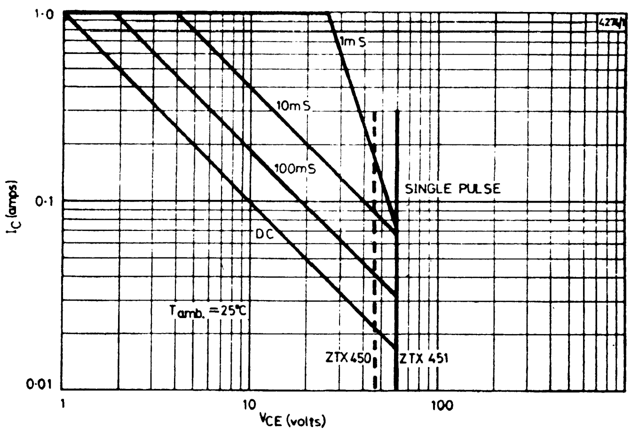
DERATING CURVE



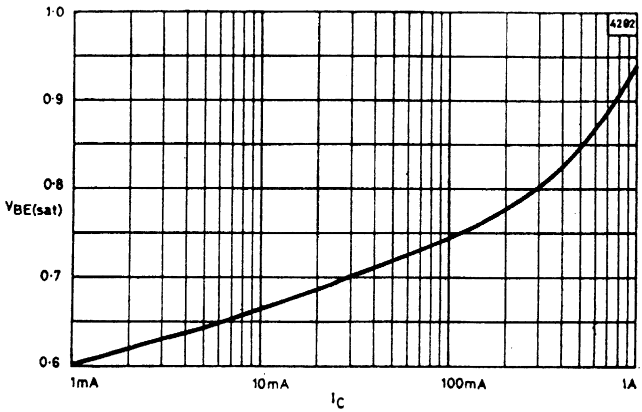
TYPICAL CHARACTERISTICS



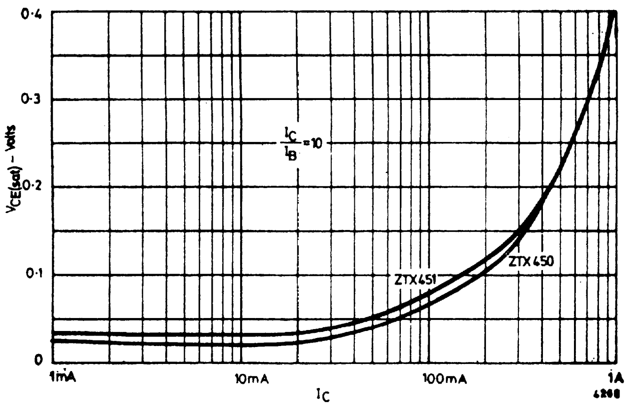
Operating Area at $T_{case} = 25°C$



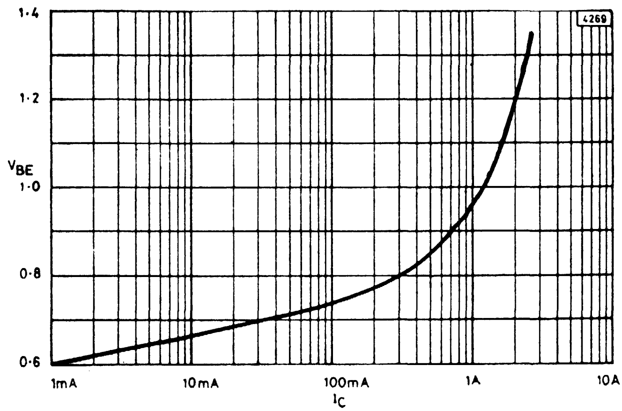
Operating Area at T_{amb} = 25°C



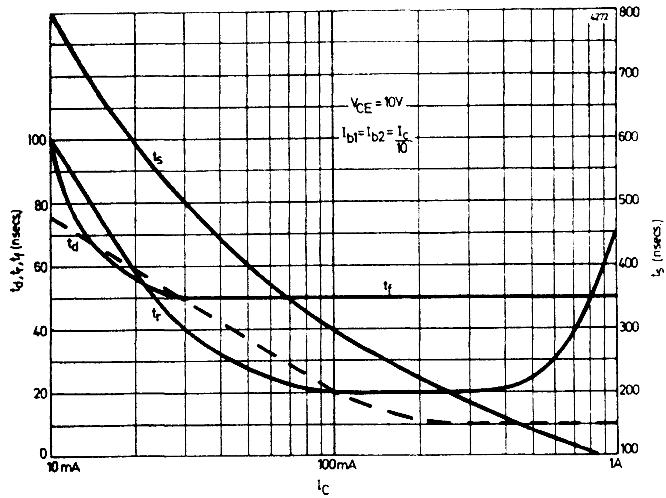
$V_{BE(sat)}/I_C$



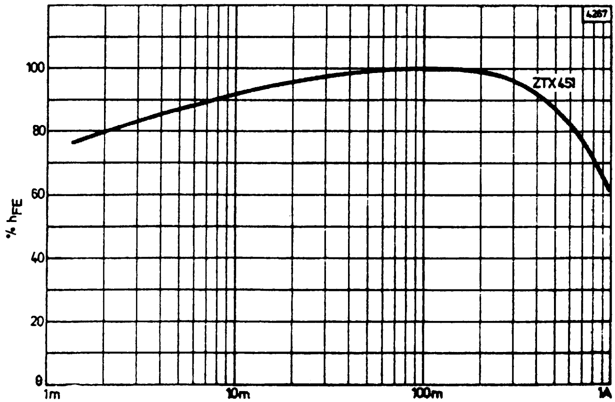
$V_{CE(sat)}/I_C$



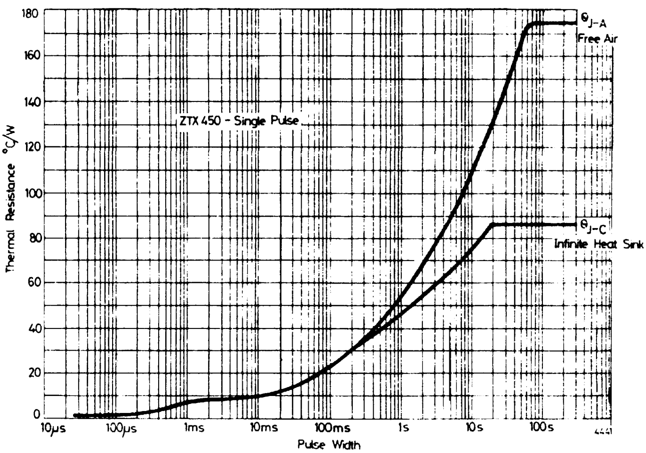
V_{BE}/I_C



SWITCHING TIMES



% h_{FE}/I_C



TRANSIENT THERMAL RESISTANCE

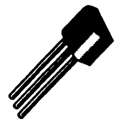
FERRANTI semiconductors®

ZTX452
ZTX453

NPN Silicon Planar Medium Power Transistors

FEATURES

- High power dissipation: 1W at $T_{amb} = 25°C$.
- h_{FE} specified up to 1 amp.
- High V_{CEO} up to 100 volts.
- ZTX452 complementary to ZTX552.



E-LINE (TO-92)

DESCRIPTION

These are plastic encapsulated, general purpose transistors designed for small and medium signal amplification from d.c. to radio frequencies.

Application areas include: Audio Frequency Amplifiers, Drivers and Output Stages, Oscillators and General Purpose Switching.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX452	ZTX453	Units
Collector-Base Voltage	V_{CBO}	100	120	Volts
Collector-Emitter Voltage	V_{CEO}	80	100	Volts
Emitter-Base Voltage	V_{EB}	5	5	Volts
Peak Pulse Current (See note overleaf)	I_{CM}	2	2	Amps
Continuous D.C. Current	I_C	1	1	Amp
Base Current	I_B	200	200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	1 2	Watt Watts
Operating and Storage Temp. Range		–55 to +200		°C

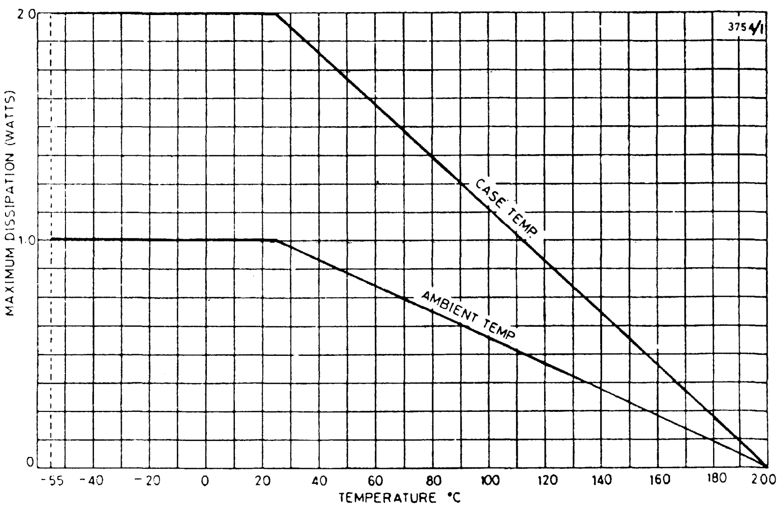
ZTX452/453

CHARACTERISTICS (at 25°C ambient temperature unless otherwise specified)

Parameter	Symbol	ZTX452		ZTX453		Unit	Test Conditions
		Min.	Max.	Min.	Max.		
Collector-base cut-off current	I_{CBO}	— —	0.1 —	— —	— 0.1	μA μA	$V_{CB} = 80V$ $V_{CB} = 100V$
Emitter-base cut-off current	I_{EBO}	—	0.1	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.7	—	0.7	V	$I_C = 150$ mA, $I_B = 15$ mA
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.3	—	1.3	V	$I_C = 150$ mA, $I_B = 15$ mA
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	80	—	100	—	V	$I_C = 10$ mA
Static forward current transfer ratio	h_{FE}	40 10	150 —	40 10	200 —		$I_C = 150$ mA, $V_{CE} = 10V$* $I_C = 1$ Amp, $V_{CE} = 10V$*
Transition frequency	f_T	150	—	150	—	MHz	$I_C = 50$ mA, $V_{CE} = 10V$, f = 100 MHz
Output capacitance	C_{obo}	—	15	—	15	pF	$V_{CB} = 10V$, f = 1 MHz

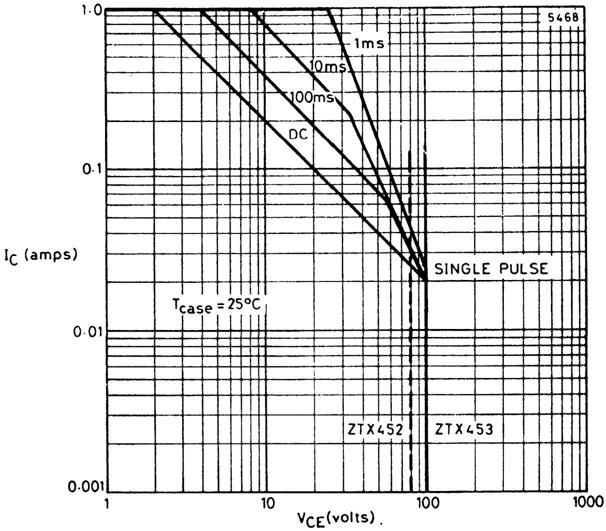
* Pulsed: Pulse width = 300 μs, duty cycle ⩽2%.

DERATING CURVE

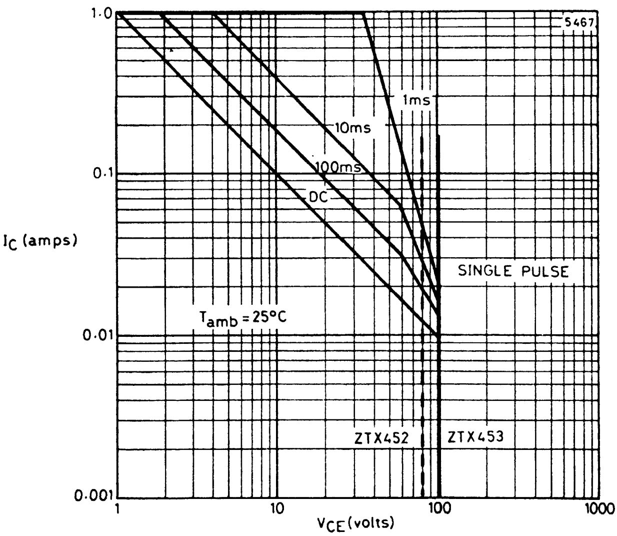


TYPICAL CHARACTERISTICS

Operating Area at $T_{case} = 25°C$



Operating Area at $T_{amb} = 25°C$



FERRANTI semiconductors®

ZTX454
ZTX455

NPN Silicon Planar Medium Power Transistors

DESCRIPTION

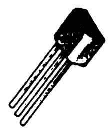
These are plastic encapsulated, general purpose transistors designed for small and medium signal amplification from d.c. to radio frequencies.

Application areas include: Audio Frequency Amplifiers, Drivers and Output Stages, Oscillators and General Purpose Switching.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.



PLASTIC E-LINE (TO-92)

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX454	ZTX455	Unit
Collector-Base Voltage	V_{CBO}	140	160	V
Collector-Emitter Voltage	V_{CEO}	120	140	V
Emitter-Base Voltage	V_{EBO}	5	5	V
Peak Pulse Current*	I_{CM}	2	2	A
Continuous Direct Current	I_C	1	1	A
Base Current	I_B	200	200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	1 2	W W
Operating and Storage Temp. Range	$T_j;T_{stg}$	−55 to +200		°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance Junction to Ambient Junction to Case	$R_{th(j-amb)}$ $R_{th(j-case)}$	175 87.5	°C/W °C/W

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

ZTX454/455

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX454 Min.	ZTX454 Max.	ZTX455 Min.	ZTX455 Max.	Unit	Conditions
Collector-base cut-off current	I_{CBO}	—	0.1	—	—	μA	$V_{CB}=120V$
		—	—	—	0.1	μA	$V_{CB}=140V$
Emitter-base cut-off current	I_{EBO}	—	0.1	—	0.1	μA	$V_{EB}=4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.7	—	0.7	V	$I_C=150mA$ $I_B=15mA$
		—	1.0	—	—	V	$I_C=200mA$ $I_B=20mA$
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	120	—	140	—	V	$I_C=10mA$
Static forward current transfer ratio	h_{FE}	100	300	100	300		$I_C=150mA$ $V_{CE}=10V$*
		30	—	—	—		$I_C=200mA$ $V_{CE}=1V$*
		10 typ.		10 typ.			$I_C=1A$ $V_{CE}=10V$*
Transition frequency	f_T	100	—	100	—	MHz	$I_C=50mA$ $V_{CE}=10V$ $f=100MHz$
Output capacitance	C_{obo}	—	15	—	15	pF	$V_{CB}=10V$ $f=1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

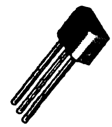
FERRANTI semiconductors®

ZTX549

PNP Silicon Planar Medium Power Transistor

FEATURES

- 1.0W power dissipation at $T_{amb} = 25°C$
- 2A peak pulse current
- Excellent gain characteristics up to 2A (pulsed)
- Low saturation voltages
- Fast switching
- NPN complementary type available



PLASTIC E-LINE (TO-92)

DESCRIPTION

A high performance transistor encapsulated in the popular E-line (TO-92) plastic package.
The 2 amp, 1 watt performance and excellent gain characteristics up to 2 amps permit use in a wide range of industrial and consumer applications.
The specially selected SILICONE encapsulation provides resistance to severe environments comparable with metal can devices. In addition the small size of the E-line package assists where space is at a premium.
Complementary to the ZTX449

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX549	Unit
Collector-Base Voltage	V_{CBO}	−35	volts
Collector-Emitter Voltage	V_{CEO}	−25	volts
Emitter-Base Voltage	V_{EBO}	−5	volts
Peak Pulse Current*	I_{CM}	−2	amps
Continuous Collector Current	I_C	−1	amps
Power Dissipation: at $T_{amb} = 25°C$ derate above 25°C	P_{tot}	1 5.7	watts mW/°C
Operating & Storage Temperature Range		−55 to +200	°C

* Measured under pulsed conditions. Pulse width = 300μS. Duty cycle ≤2%.

ZTX549

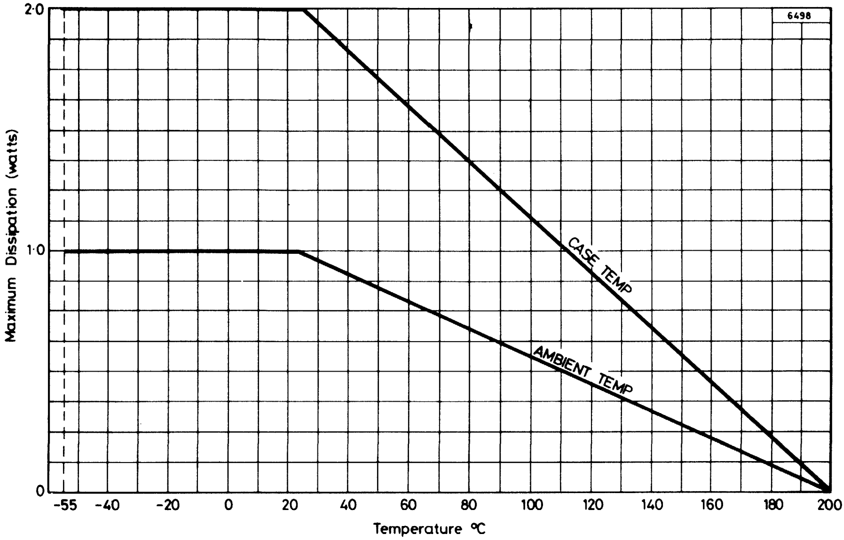
CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−35			V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−25			V	$I_C = -10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5			V	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}			−0.1 −10	μA μA	$V_{CB} = -30V$ $V_{CB} = -30V$, $T_{amb} = 100°C$
Emitter cut-off current	I_{EBO}			−0.1	μA	$V_{EB} = -4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$		−0.25 −0.50	−0.5 −0.75	V V	$I_C = -1A$, $I_B = -100mA$* $I_C = -2A$, $I_B = -200mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$		−0.90	−1.25	V	$I_C = -1A$, $I_B = -100mA$*
Base-emitter turn on voltage	$V_{BE(ON)}$		−0.85	−1.0	V	$I_C = -1A$, $V_{CE} = -2V$*
Static forward current transfer ratio	h_{FE}	70 100 80 40	200 160 130 80	– 300 – –		$I_C = -50mA$, $V_{CE} = -2V$* $I_C = -500mA$, $V_{CE} = -2V$* $I_C = -1A$, $V_{CE} = -2V$* $I_C = -2A$, $V_{CE} = -2V$*
Transition frequency	f_T	100			MHz	$I_C = -100mA$, $V_{CE} = -5V$ $f = 100MHz$
Output capacitance	C_{obo}			25	pF	$V_{CB} = -10V$, $f = 1MHz$
Switching times	T_{on} T_{off}	–	300 50		nS nS	$I_C = -500mA$, $I_{B1} = I_{B2} = -50mA$, $V_{CC} = -10V$

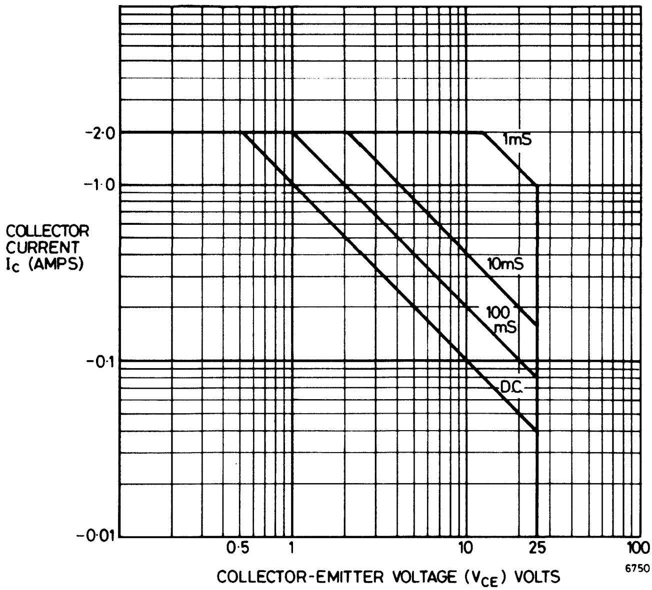
* Measured under pulsed conditions. Pulse width = 300μS. Duty cycle ⩽2%.

THERMAL CHARACTERISTICS

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient Junction to Case	$R_{th(j-amb)}$ $R_{th(j-case)}$	175 87.5	°C/W °C/W

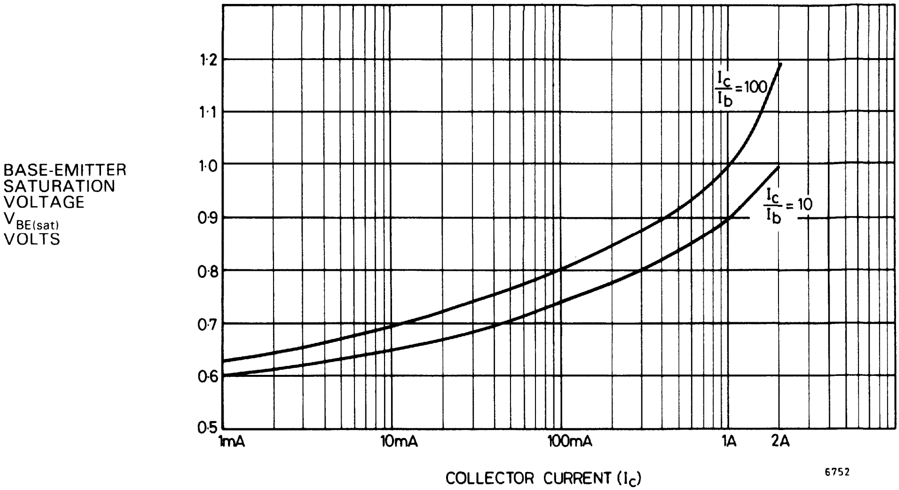


DISSIPATION DERATING CURVE



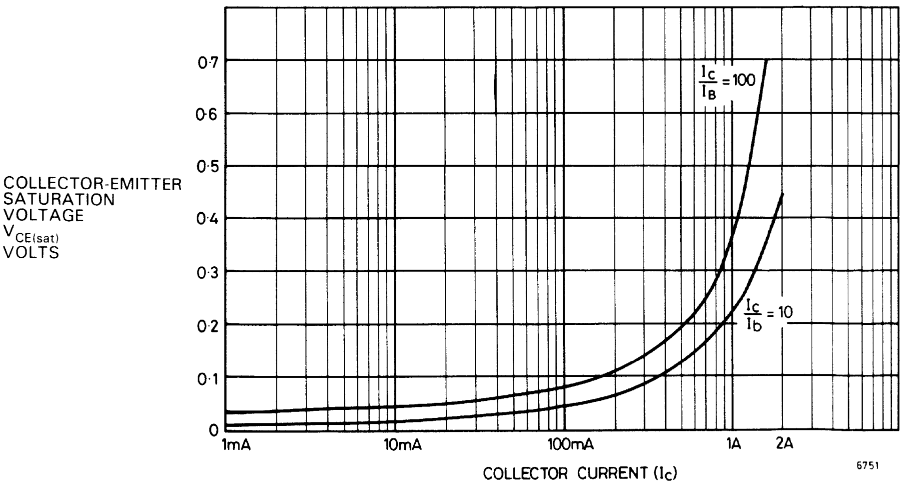
SAFE OPERATING AREA
at T_{amb} = 25°C (SINGLE PULSE)

ZTX549



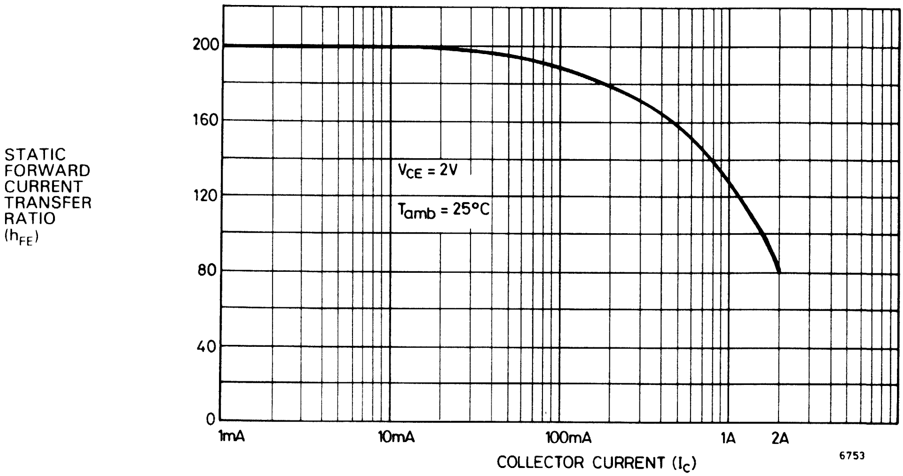
$V_{BE(sat)}/I_C$

TYPICAL BASE-EMITTER SATURATION VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT



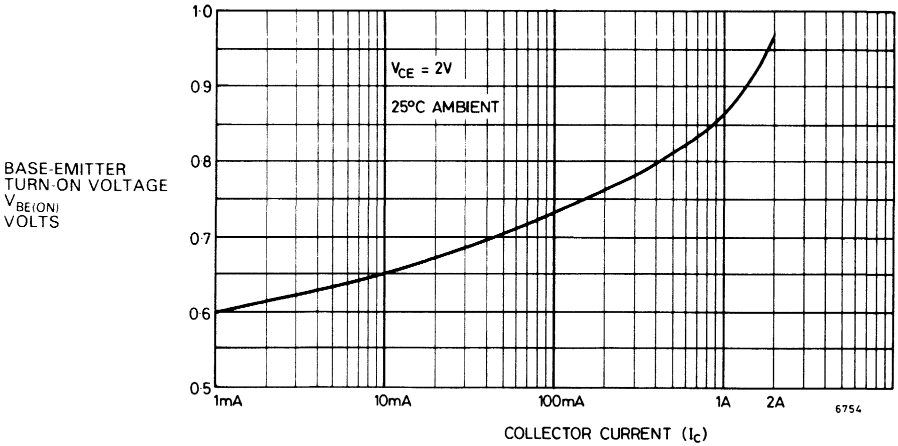
$V_{CE(sat)}/I_C$

TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT



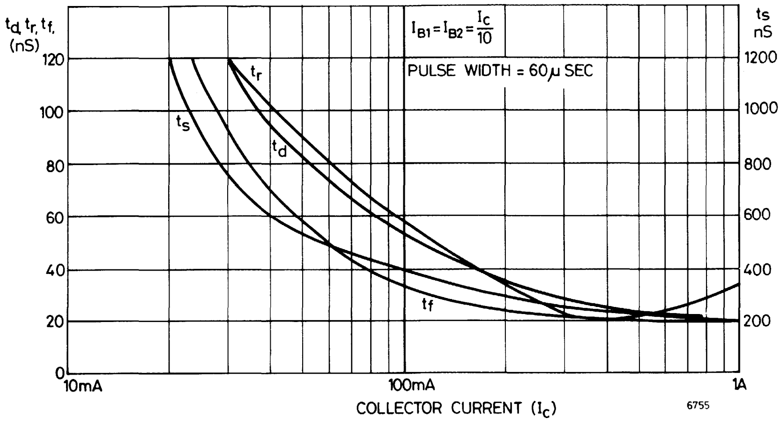
h_{FE}/I_C

TYPICAL STATIC FORWARD CURRENT TRANSFER RATIO PLOTTED AGAINST COLLECTOR CURRENT

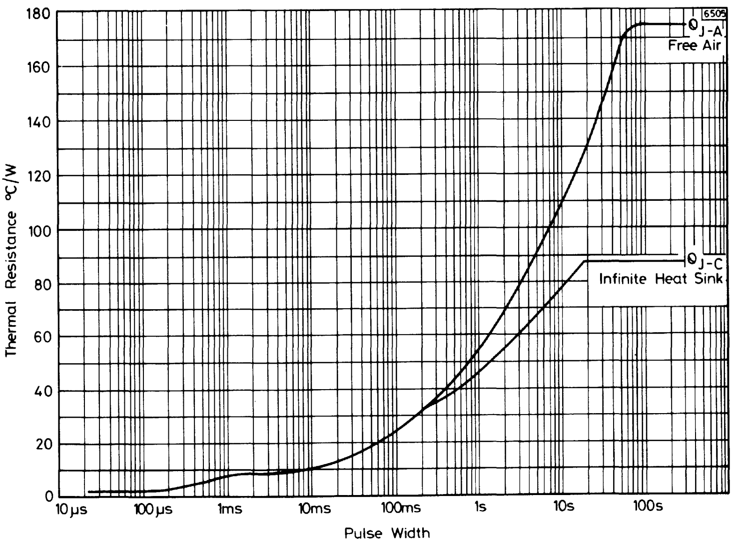


$V_{BE(ON)}/I_C$

TYPICAL BASE-EMITTER TURN-ON VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT



TYPICAL SWITCHING SPEEDS



TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

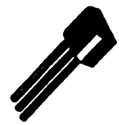
FERRANTI semiconductors®

ZTX550
ZTX551

PNP Silicon Planar Medium Power Transistors

FEATURES

- High power dissipation: 1W at $T_{amb} = 25°C$.
- h_{FE} specified up to 1 amp.
- High F_T: 200 MHz typical



PLASTIC E-LINE (TO-92)

DESCRIPTION

These are plastic encapsulated, general purpose transistors designed for small and medium signal amplification from d.c. to radio frequencies.

Application areas include: Audio Frequency Amplifiers, Driver and Output Stages, Oscillators and General Purpose Switching.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

Complementary to the ZTX450 and ZTX 451 NPN transistors.

The ZTX550 and ZTX551 transistors APPROVAL PENDING FOR USE IN MILITARY EQUIPMENT will be identified by the following numbers:

BS9365 F143 & F144 – Category P.

BS9365 F145 & F146 – Category Q.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX550	ZTX551	Unit
Collector-Base Voltage	V_{CBO}	−60	−80	Volts
Collector-Emitter Voltage	V_{CEO}	−45	−60	Volts
Emitter-Base Voltage	V_{EBO}	−5	−5	Volts
Peak Pulse Current (see note below)	I_{CM}	−2	−2	A
Continuous Collector Current	I_C	−1	−1	A
Base Current	I_B	−200	−200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	1 2	W W
Operating and Storage Temp. Range		−55 to +200		°C

Note: Pulse width = 300 μs. Duty cycle ≤ 2%.

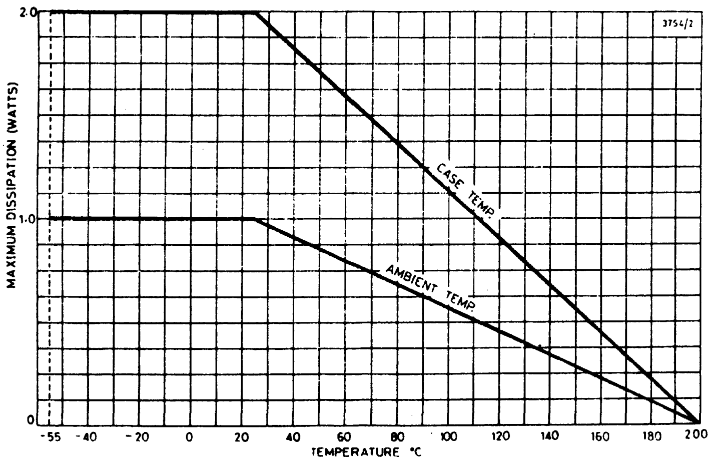
ZTX550/551

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

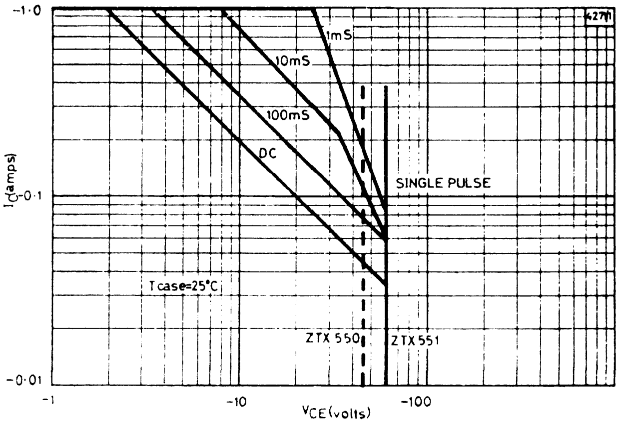
Parameter	Symbol	ZTX550		ZTX551		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base cut-off current	I_{CBO}	— —	−0.1 —	— —	— −0.1	μA μA	V_{CB} = −45V V_{CB} = −60V
Emitter-base cut-off current	I_{EBO}	—	−0.1	—	−0.1	μA	V_{EB} = −4V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.25	—	−0.35	V	I_C = −150 mA I_B = −15 mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.1	—	−1.1	V	I_C = −150 mA I_B = −15 mA*
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	−45	—	−60	—	V	I_C = −10 mA*
Static forward current transfer ratio	h_{FE}	100 15	300 —	50 10	150 —		I_C = −150 mA V_{CE} = −10V* I_C = −1 A V_{CE} = −10V*
Transition frequency	f_T	150	—	150	—	MHz	I_C = −50 mA V_{CE} = −10V f = 100 MHz
Output capacitance	C_{obo}	—	25	—	25	pF	V_{CB} = −10V f = 1 MHz

*Measured under pulsed conditions. Pulse width = 300 μs. Duty cycle ⩽2%.

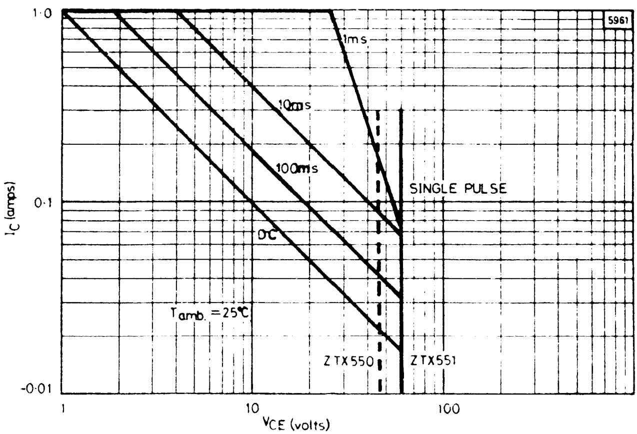
DERATING CURVE



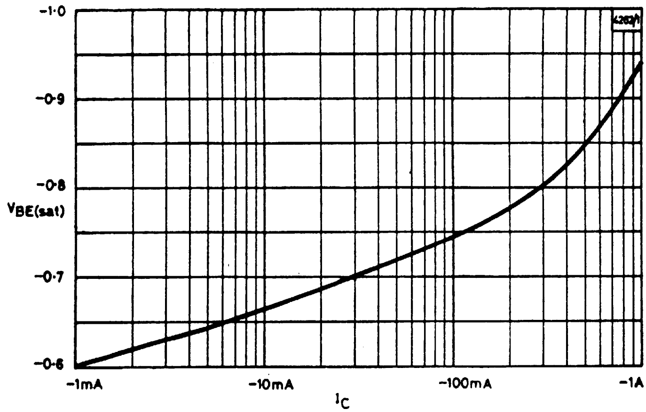
TYPICAL CHARACTERISTICS



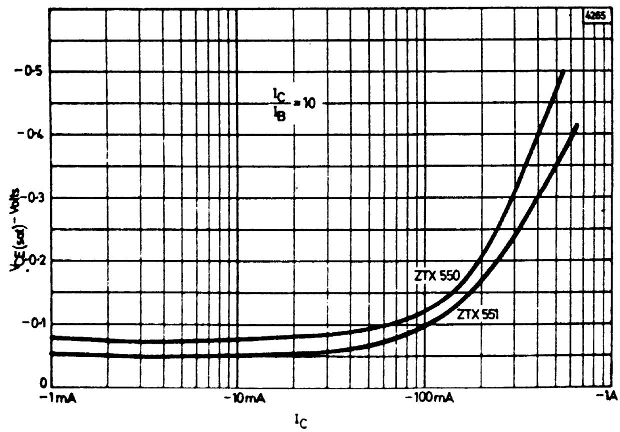
Operating Area at $T_{case} = 25°C$



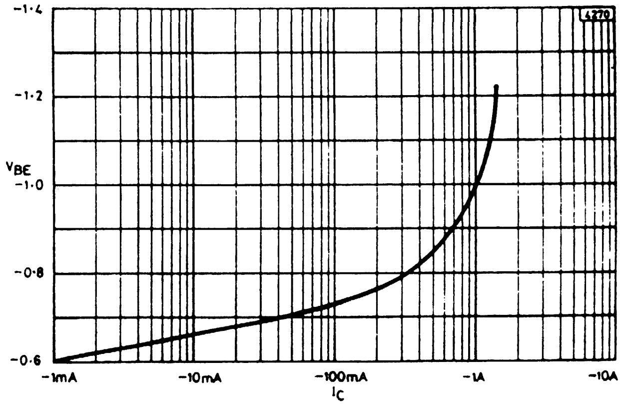
Operating Area at $T_{amb} = 25°C$



$V_{BE(sat)}/I_C$



$V_{CE(sat)}/I_C$


-1·4
-1·2
VBE
-1·0
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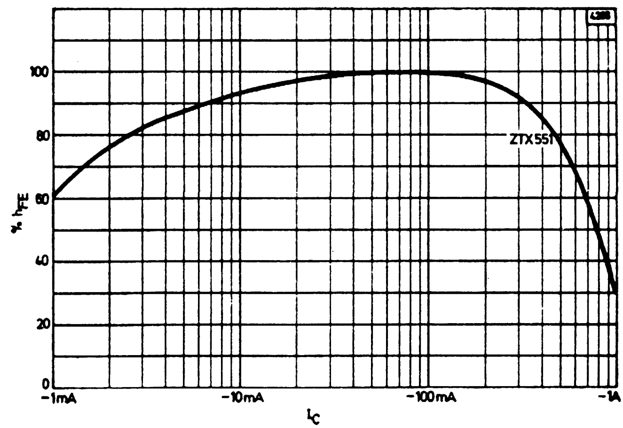
-0·6
4270
-1mA
-10mA
-100mA
-1A
-10A
IC

V_{BE}/I_C


100
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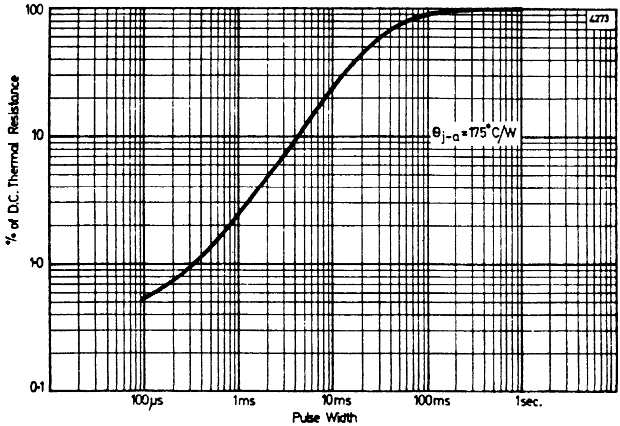
$\%\ h_{FE}/I_C$

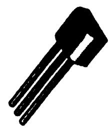


TRANSIENT THERMAL RESISTANCE

FERRANTI semiconductors®

ZTX552

PNP Silicon Planar Medium Power Transistors



PLASTIC E-LINE (TO-92)

FEATURES

- **High power dissipation: 1W at $T_{amb} = 25°C$.**
- **h_{FE} specified up to 1 amp.**
- **High V_{CEO} up to 80 volts.**
- **Complementary to ZTX452.**

DESCRIPTION

This plastic encapsulated, general purpose transistor is designed for small and medium signal amplification from d.c. to radio frequencies.

Application areas include: Audio Frequency Amplifiers, Drivers and Output Stages, Oscillators and General Purpose Switching.

The E-line package is transfer moulded with a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX552	Unit
Collector-Base Voltage	V_{CBO}	−100	Volts
Collector-Emitter Voltage	V_{CEO}	−80	Volts
Emitter-Base Voltage	V_{EB}	−5	Volts
Peak Pulse Current (*See note overleaf)	I_{CM}	−2	Amps
Continuous Direct Current	I_C	−1	Amps
Base Current	I_B	−200	mA
Power Dissipation at $T_{amb} = 25°C$ at $T_{case} = 25°C$	P_{tot}	1 2	Watt Watts
Operating and Storage Temperature Range		−55 to +200	°C

THERMAL CHARACTERISTICS

Parameter	Symbol	Maximum	Unit
Thermal Resistance (junction to ambient) (junction to case)	$R_{th(j\text{-}amb)}$ $R_{th(j\text{-}case)}$	175 87.5	°C/W °C/W

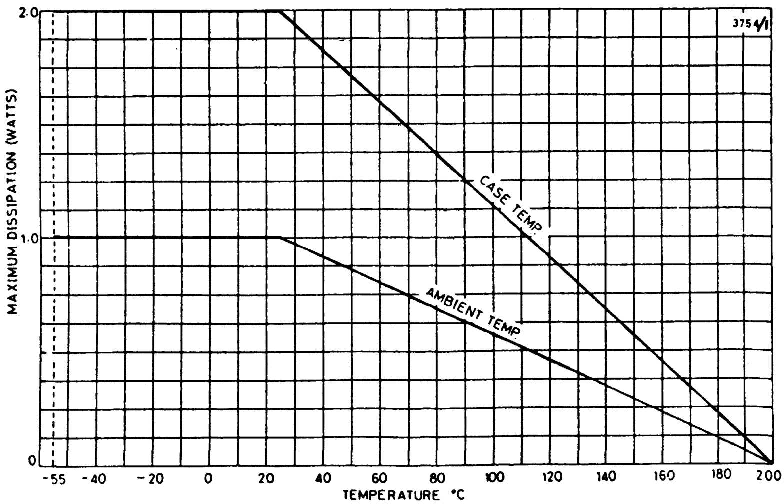
ZTX552

CHARACTERISTICS (at 25°C ambient temperature unless otherwise specified)

Parameter	Symbol	ZTX552		Unit	Test Conditions
		Min.	Max.		
Collector-base cut-off current	I_{CBO}	— —	–0.1 —	μA μA	V_{CB} = –80V V_{CB} = –100V
Emitter-base cut-off current	I_{EBO}	—	–0.1	μA	V_{EB} = –4V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	–0.7	V	I_C = –150 mA, I_B = –15 mA
Base-emitter saturation voltage	$V_{BE(sat)}$	—	–1.3	V	I_C = –150 mA, I_B = –15 mA
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	–80	—	V	I_C = –10 mA
Static forward current transfer ratio	h_{FE}	40 10	150 —		I_C = –150 mA, V_{CE} = –10V* I_C = –1 Amp, V_{CE} = –10V*
Transition frequency	f_T	150	—	MHz	I_C = –50 mA, V_{CE} = –10V, f = 100 MHz
Output capacitance	C_{obo}	—	25	pF	V_{CB} = –10V, f = 1 MHz

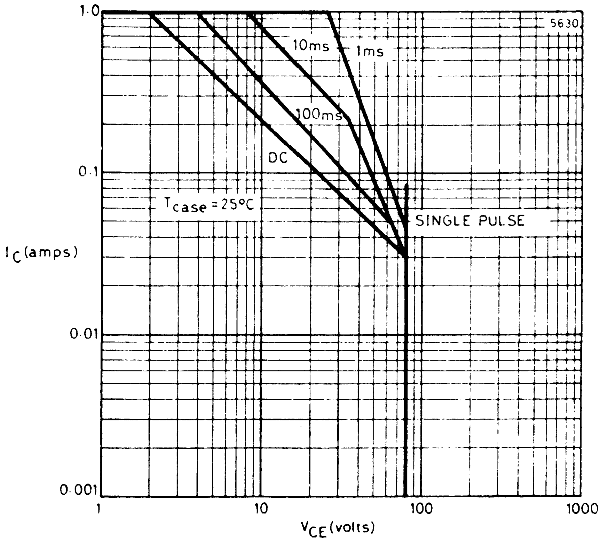
* Pulsed: Pulse width = 300 μs, duty cycle ≤2%.

DERATING CURVE

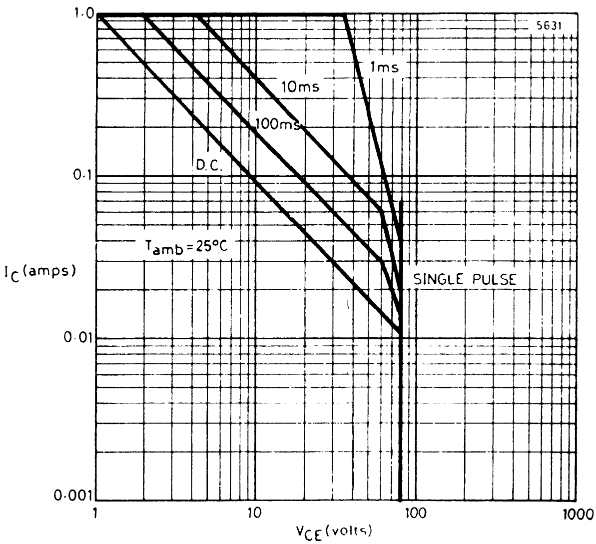


TYPICAL CHARACTERISTICS

Operating Area at $T_{case} = 25°C$



Operating Area at $T_{amb} = 25°C$



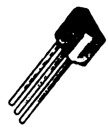
FERRANTI semiconductors®

ZTX600
ZTX601

NPN Silicon Medium Power Darlington Transistors

FEATURES

- 1.5W power dissipation at $T_{amb} = 25°C$
- 1A continuous collector current
- High V_{CEO} up to 160V
- Guaranteed h_{FE} specified up to 1A
- Fast switching



PLASTIC E-LINE (TO-92)

DESCRIPTION

The ZTX600 and ZTX601 are high performance medium power darlington amplifier transistors encapsulated in the popular E-line (TO-92) plastic package.

The 1A performance permits use in a wide variety of industrial consumer applications.

The E-line package is formed by transfer moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX600	ZTX601	Unit
Collector-Base Voltage	V_{CBO}	160	180	Volts
Collector-Emitter Voltage	V_{CEO}	140	160	Volts
Emitter-Base Voltage	V_{EBO}	10	10	Volts
Peak Pulse Current*	I_{CM}	4	4	Amps
Continuous Collector Current	I_C	1	1	Amps
Practical Power Dissipation†	P_{totp}	1.5	1.5	Watts
Power Dissipation at $T_{amb} = 25°C$ derate above 25°C at $T_{case} = 25°C$	P_{tot}	1 5.7 2.5	1 5.7 2.5	Watts mW/°C Watts
Operating and Storage Temp. Range		−55 to +200		°C

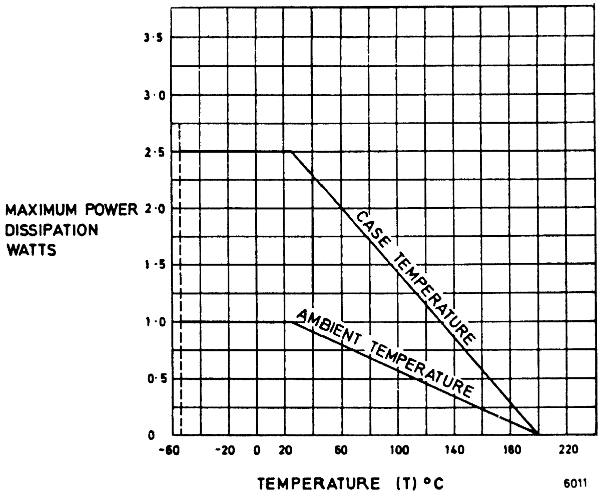
*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.
†The power which can be dissipated assuming that the device is mounted in a typical manner on a PCB.

ZTX600/601

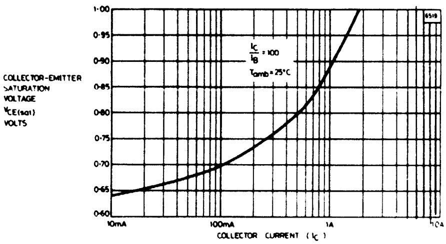
CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX600			ZTX601			Unit	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	160	—	—	180	—	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	140	—	—	160	—	—	V	$I_C = 10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	10	—	—	10	—	—	V	$I_C = 100\mu A$
Collector cut-off current	I_{CBO}	—	—	0.1	—	—	—	μA	$V_{CB} = 140V$
		—	—	10	—	—	—	μA	$V_{CB} = 140V$ $T_{amb} = 100°C$
		—	—	—	—	—	0.1	μA	$V_{CB} = 160V$
		—	—	—	—	—	10	μA	$V_{CB} = 160V$ $T_{amb} = 100°C$
Emitter cut-off current	I_{EBO}	—	—	0.1	—	—	0.1	μA	$V_{EB} = 8V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.75	1.1	—	0.75	1.1	V	$I_C = 0.5A$ $I_B = 5mA$*
		—	0.85	1.2	—	0.85	1.2	V	$I_C = 1A$ $I_B = 10mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.7	1.9	—	1.7	1.9	V	$I_C = 1A$ $I_B = 10mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.5	1.7	—	1.5	1.7	V	$I_C = 1A$ $V_{CE} = 5V$*
Static forward current transfer ratio	h_{FE}	1K	—	—	1K	—	—		$I_C = 50mA$ $V_{CE} = 10V$*
		2K	—	100K	2K	—	100K		$I_C = 0.5A$ $V_{CE} = 10V$*
		1K	—	—	1K	—	—		$I_C = 1A$ $V_{CE} = 10V$*
		1K	2K	—	1K	2K	—		$I_C = 50mA$ $V_{CE} = 10V$*
Group A		2K	5K	20K	2K	5K	20K		$I_C = 0.5A$ $V_{CE} = 10V$*
		1K	3K	—	1K	3K	—		$I_C = 1A$ $V_{CE} = 10V$*
		5K	10K	—	5K	10K	—		$I_C = 50mA$ $V_{CE} = 10V$*
Group B		10K	20K	100K	10K	20K	100K		$I_C = 0.5A$ $V_{CE} = 10V$*
		5K	10K	—	5K	10K	—		$I_C = 1A$ $V_{CE} = 10V$*
Transition frequency	f_T	150	250	—	150	250	—	MHz	$I_C = 100mA$ $V_{CE} = 10V$ $f = 20MHz$
Switching times	t_{on}	—	0.75	—	—	0.75	—	μs	$I_C = 0.5A$ $V_{CE} = 10V$
	t_{off}	—	2.2	—	—	2.2	—	μs	$I_{B1} = I_{B2} = 0.5mA$
Input capacitance	C_{ibo}	—	60	90	—	60	90	pF	$V_{EB} = 0.5V$ $f = 1MHz$
Output capacitance	C_{obo}	—	10	15	—	10	15	pF	$V_{CE} = 10V$ $f = 1MHz$

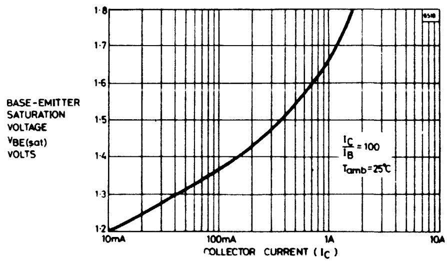
*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.



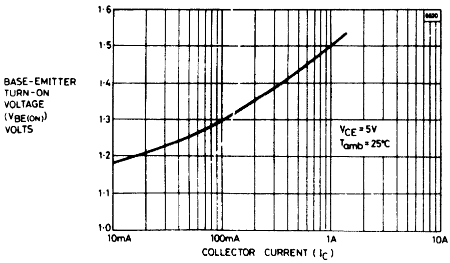
DERATING CURVE



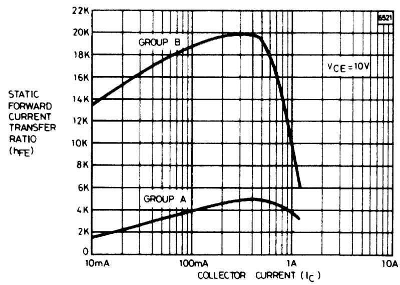
$V_{CE(sat)}/I_C$



$V_{BE(sat)}/I_C$



$V_{BE(on)}/I_C$



h_{FE}/I_C

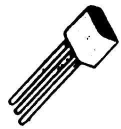
FERRANTI semiconductors ®

ZTX649

NPN Silicon Planar Medium Power Transistor

FEATURES

- **1.5W power dissipation at $T_{amb} = 25°C$§**
- **2A continuous I_C**
- **Excellent gain characteristics up to 6A (pulsed)**
- **Low saturation voltages**
- **Fast swithing**
- **PNP complementary type available**



PLASTIC E-LINE (TO-92)

DESCRIPTION

A high perfomance transistor encapsulated in the popular E-line (TO-92) plastic package.

The 1.5W performance and outstanding electrical characteristics permit use in a wide range of industrial and consumer applications including lamp and solenoid drivers.

In addition the excellent gain characteristics at high collector current levels make the device ideal in pulsed applications.

The specially selected SILICONE encapsulation provides resistance to severe environments comparable with metal can devices.

Complementary to the ZTX749

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX649	Unit
Collector-Base Voltage	V_{CBO}	35	V
Collector-Emitter Voltage	V_{CEO}	25	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current*	I_{CM}	6	amps
Continuous Collector Current	I_C	2	amps
Practical Power Dissipation§	P_{totP}	1.5	watts
Power Dissipation at $T_{amb} = 25°C$ derate above 25°C	P_{tot}	1 5.7	watt mW/°C
Operating and Storage Temperature Range		−55 to +200	°C

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

§The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1sq. inch minimum.

ZTX649

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	35	–	–	V	$I_C=100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	25	–	–	V	$I_C=10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	–	–	V	$I_E=100\mu A$
Collector cut-off current	I_{CBO}	– –	– –	0.1 10	μA μA	$V_{CB}=30V$ $V_{CB}=30V$, $T_{amb}=100°C$
Emitter cut-off current	I_{EBO}	–	–	0.1	μA	$V_{EB}=4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	– –	0.12 0.23	0.3 0.5	V V	$I_C=1A$, $I_B=100mA$* $I_C=2A$, $I_B=200mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	–	0.9	1.25	V	$I_C=1A$, $I_B=100mA$*
Base-emitter turn-on voltage	$B_{BE(on)}$	–	0.8	1.0	V	$I_C=1A$, $V_{CE}=2V$*
Static forward current transfer ratio	h_{FE}	70 100 75 15	200 200 150 50	– 300 – –		$I_C=50mA$, $V_{CE}=2V$* $I_C=1A$, $V_{CE}=2V$* $I_C=2A$, $V_{CE}=2V$* $I_C=6A$, $V_{CE}=2V$*
Transition frequency	f_T	150	240	–	MHz	$I_C=100mA$, $V_{CE}=5V$ $f=100MHz$
Output capacitance	C_{obo}	–	25	50	pF	$V_{CB}=10V$, $f=1MHz$
Switching times	t_{on} t_{off}	– –	55 300	– –	ns ns	$I_C=500mA$ $V_{CC}=10V$ $I_{B1}=I_{B2}=50mA$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

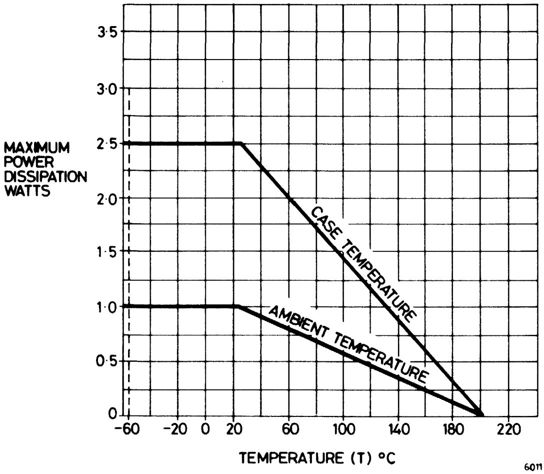
THERMAL CHARACTERISTICS

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient$_1$	$R_{th(j-amb)1}$	175	°C/W
	Junction to Ambient$_2$	$R_{th(j-amb)2}$§	116	°C/W
	Junction to Case	$R_{th(j-case)}$	70	°C/W

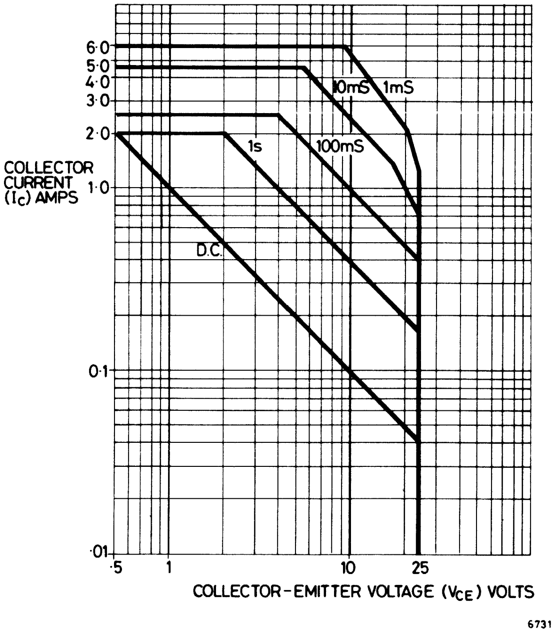
§Device mounted on P.C.B. with copper equal to 1 sq. inch minimum.

Note: Practical Power Dissipation. Where space does not permit 1 sq. inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

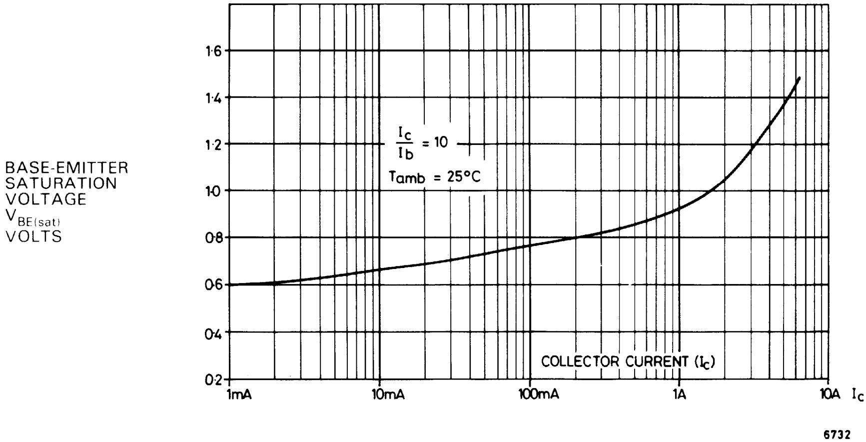
Power Dissipation at $T_{amb}=25°C$ (P_{tot})	1.4 Watts
Derate above 25°C	8.0 mW/°C
Thermal resistance, Junction to Ambient	125°C/W



DISSIPATION DERATING CURVE

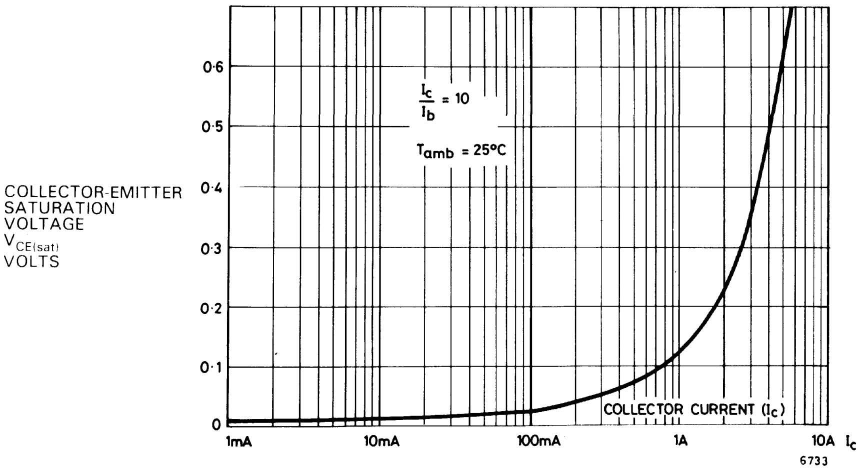


SAFE OPERATING AREA
at T_{amb} = 25°C (SINGLE PULSE)



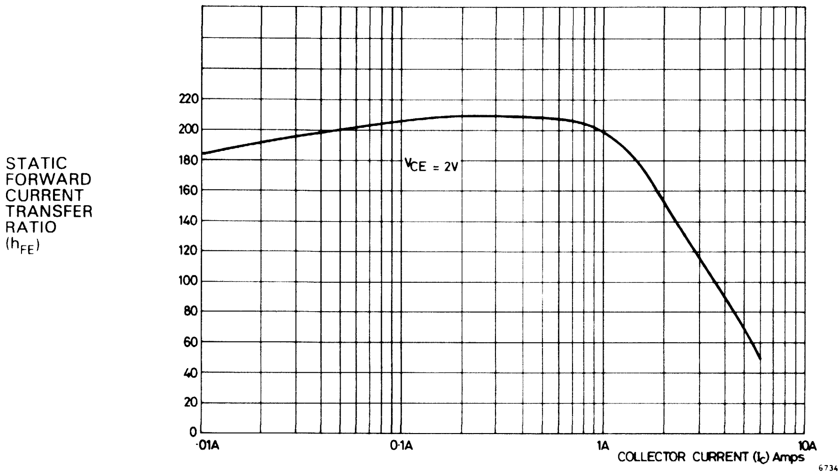
$V_{BE(sat)}/I_C$

TYPICAL BASE-EMITTER SATURATION VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT



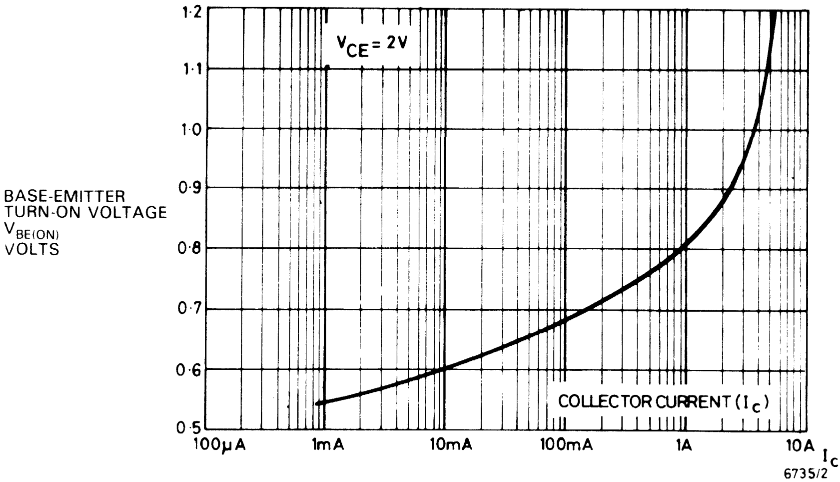
$V_{CE(sat)}/I_C$

TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT



h_{FE}/I_C

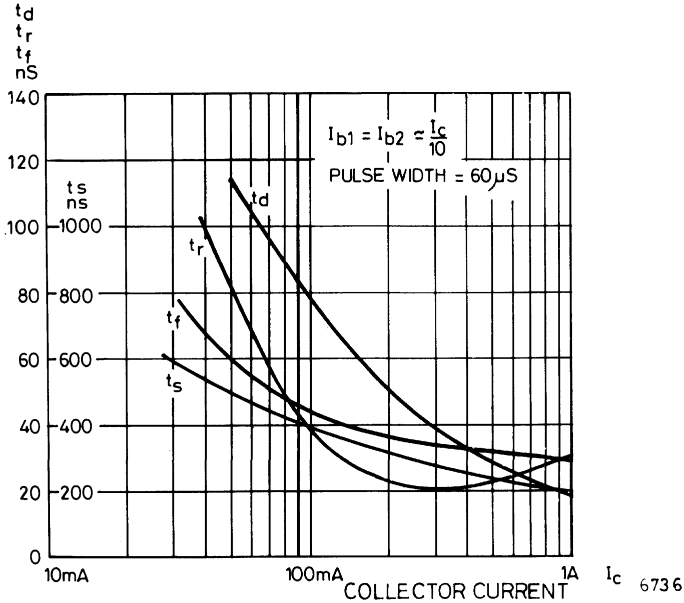
TYPICAL STATIC FORWARD CURRENT TRANSFER RATIO PLOTTED AGAINST COLLECTOR CURRENT



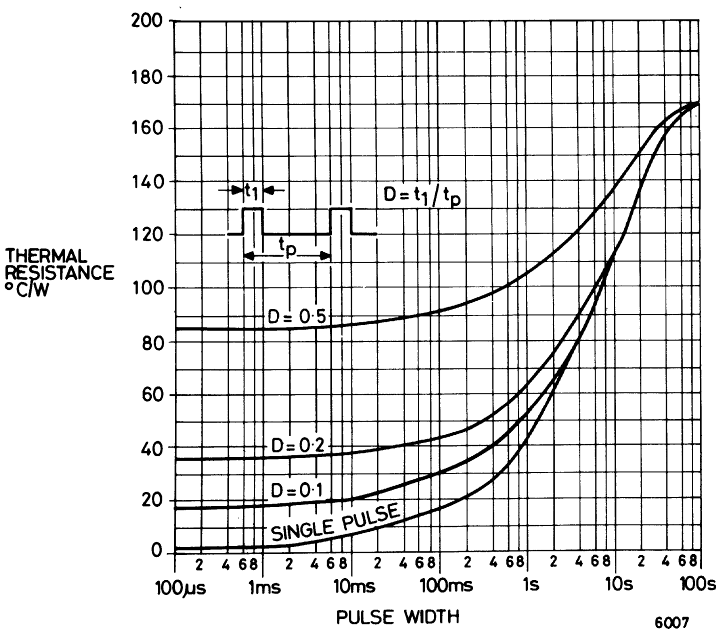
$V_{BE(ON)}/I_C$

TYPICAL BASE-EMITTER TURN-ON VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT

ZTX649



TYPICAL SWITCHING SPEEDS



TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

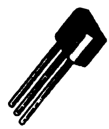
FERRANTI semiconductors®

ZTX650
ZTX651
ZTX652
ZTX653

NPN Silicon Planar Medium Power Transistors

FEATURES

- 1.5W Power dissipation at $T_{amb} = 25°C$§
- 2A continuous I_C
- Excellent gain characteristics to 2A
- High V_{CEO}: up to 100 volts
- Low saturation voltages
- Guaranteed h_{FE} specified up to 2A
- Fast switching
- Exceptional price-to-power ratio
- Complementary types



PLASTIC E-LINE (TO-92)

DESCRIPTION

A range of high performance medium power transistors encapsulated in the popular E-line (TO-92) plastic package.

The 1.5W performance and outstanding electrical characteristics permit use in a wide variety of industrial and consumer applications including lamp and solenoid drivers, audio amplifiers, complementary drivers for hi-fi amplifiers.

In addition to achieving excellent linearity the devices are designed to function as high speed power switching transistors.

The specially selected SILICONE encapsulation provides resistance to severe environments comparable with metal can devices.

Complementary to ZTX750 series.

ABSOUTE MAXIUM RATINGS

Parameter	Symbol	ZTX650	ZTX651	ZTX652	ZTX653	Unit
Collector-Base Voltage	V_{CBO}	60	80	100	120	Volts
Collector-Emitter Voltage	V_{CEO}	45	60	80	100	Volts
Emitter-Base Voltage	V_{EBO}	5	5	5	5	Volts
Peak Pulse Current*	I_{CM}	6	6	6	6	Amps
Continuous Collector Current	I_C	2	2	2	2	Amps
Practical Power Dissipation§	P_{totP}	1.5	1.5	1.5	1.5	Watts
Power Dissipation: at $T_{amb} = 25°C$ derate above 25°C at $T_{case} = 25°C$	P_{tot}	1 5.7 2.5	1 5.7 2.5	1 5.7 2.5	1 5.7 2.5	Watts mW/°C Watts
Operating and Storage Temperature Range		55 to +200				°C

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.
§The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1sq. inch minimum. See also note on Page SE71.

ZTX650/1

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX650			ZTX651			Unit	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	—	—	80	—	—	V	$I_C = 100\,\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	45	—	—	60	—	—	V	$I_C = 10$ mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	—	5	—	—	V	$I_E = 100\,\mu A$
Collector cut off current	I_{CBO}	— — — —	— — — —	0.1 10 — —	— — — —	— — — —	— — 0.1 10	μA μA μA μA	$V_{CB} = 45V$ $V_{CB} = 45V$, $T_{amb} = 100°C$ $V_{CB} = 60V$ $V_{CB} = 60V$, $T_{amb} = 100°C$
Emitter cut off current	I_{EBO}	—	—	0.1	—	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.12 0.23	0.3 0.5	— —	0.12 0.23	0.3 0.5	V V	$I_C = 1A$*, $I_B = 100$ mA* $I_C = 2A$*, $I_B = 200$ mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.90	1.25	—	0.90	1.25	V	$I_C = 1A$*, $I_B = 100$ mA*
Base-emitter turn on voltage	$V_{BE(on)}$	—	0.8	1.0	—	0.8	1.0	V	$I_C = 1A$*, $V_{CE} = 2V$*
Static forward current transfer ratio	h_{FE}	70 100 80 40	200 200 170 80	— 300 — —	70 100 80 40	200 200 170 80	— 300 — —		$I_C = 50$ mA*, $V_{CE} = 2V$* $I_C = 500$ mA*, $V_{CE} = 2V$* $I_C = 1A$*, $V_{CE} = 2V$* $I_C = 2A$*, $V_{CE} = 2V$*
Transition frequency	f_T	140	175	—	140	175	—	MHz	$I_C = 100$ mA, $V_{CE} = 5V$ f = 100 MHz
Switching times	T_{on} T_{off}	— —	45 800	— —	— —	45 800	— —	ns ns	$I_C = 500$ mA, $I_{B_1} = 50$ mA $I_{B_2} = 50$ mA, $V_{CC} = 10V$

*Measured under pulsed conditions. Pulse width = 300 μs. Duty cycle ≤2%.

THERMAL CHARACTERISTICS (ZTX650/1/2/3)

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient₁	$R_{th(j-amb)1}$	175	°C/W
	Junction to Ambient₂	$R_{th(j-amb)2}$†	116	°C/W
	Junction to Case	$R_{th(j-case)}$	70	°C/W

†Device mounted on P.C.B. with copper equal to 1 sq. inch minimum.

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

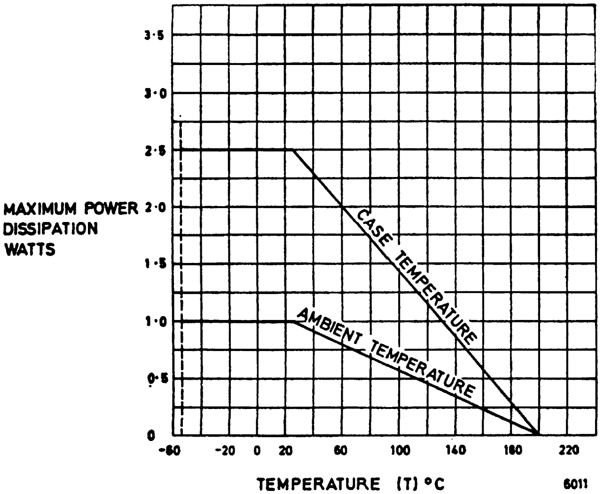
Parameter	Symbol	ZTX652			ZTX653			Unit	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	100	—	—	120	—	—	V	$I_C = 100\ \mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	80	—	—	100	—	—	V	$I_C = 10$ mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	—	5	—	—	V	$I_E = 100\ \mu A$
Collector cut off current	I_{CBO}	— — — —	— — — —	0.1 10 — —	— — — —	— — — —	— — 0.1 10	μA μA μA μA	$V_{CB} = 80V$ $V_{CB} = 80V, T_{amb} = 100°C$ $V_{CB} = 100V$ $V_{CB} = 100V, T_{amb} = 100°C$
Emitter cut off current	I_{EBO}	—	—	0.1	—	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.13 0.23	0.3 0.5	— —	0.13 0.23	0.3 0.5	V V	$I_C = 1A^*, I_B = 100$ mA* $I_C = 2A^*, I_B = 200$ mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.90	1.25	—	0.90	1.25	V	$I_C = 1A^*, I_B = 100$ mA*
Base-emitter turn on voltage	$V_{BE(on)}$	—	0.8	1.0	—	0.8	1.0	V	$I_C = 1A^*, V_{CE} = 2V^*$
Static forward current transfer ratio	h_{FE}	70 100 55 25	200 200 110 55	— 300 — —	70 100 55 25	200 200 110 55	— 300 — —		$I_C = 50$ mA*, $V_{CE} = 2V^*$ $I_C = 500$ mA*, $V_{CE} = 2V^*$ $I_C = 1A^*, V_{CE} = 2V^*$ $I_C = 2A^*, V_{CE} = 2V^*$
Transition frequency	f_T	140	175	—	140	175	—	MHz	$I_C = 100$ mA, $V_{CE} = 5V$ f = 100 MHz
Switching times	T_{on} T_{off}	— —	80 1200	— —	— —	80 1200	— —	ns ns	$I_C = 500$ mA, $I_{B_1} = 50$ mA $I_{B_2} = 50$ mA, $V_{CC} = 10V$

*Measured under pulsed conditions. Pulse width = 300 μs, Duty cycle ≤2%.

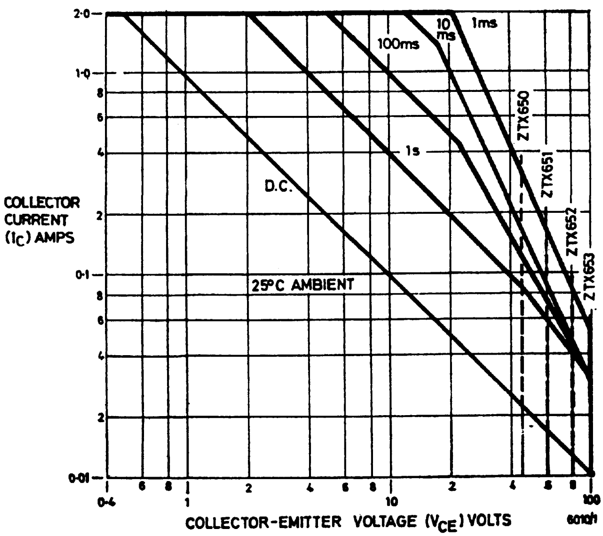
Note: Practical Power Dissipation. Where space does not permit 1 sq. inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

Power Dissipation at $T_{amb} = 25°C$ (P_{tot}) .. 1.4 Watts
Derate above 25°C .. .. 8.0 mW/°C
Thermal resistance, Junction to Ambient .. 125°C/W

ZTX650 Series

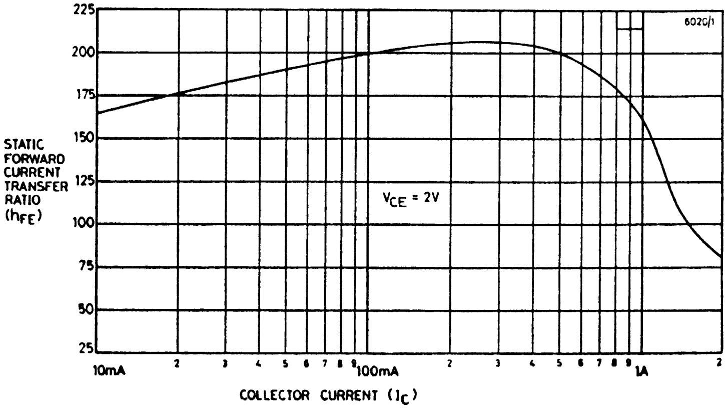


DISSIPATION DERATING CURVE FOR ALL TYPES



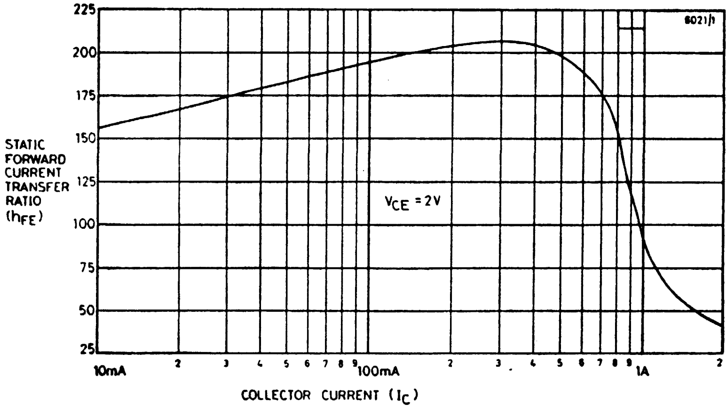
SAFE OPERATING AREA at T_{amb} = 25°C
(SINGLE PULSE)

TYPICAL CHARACTERISTICS



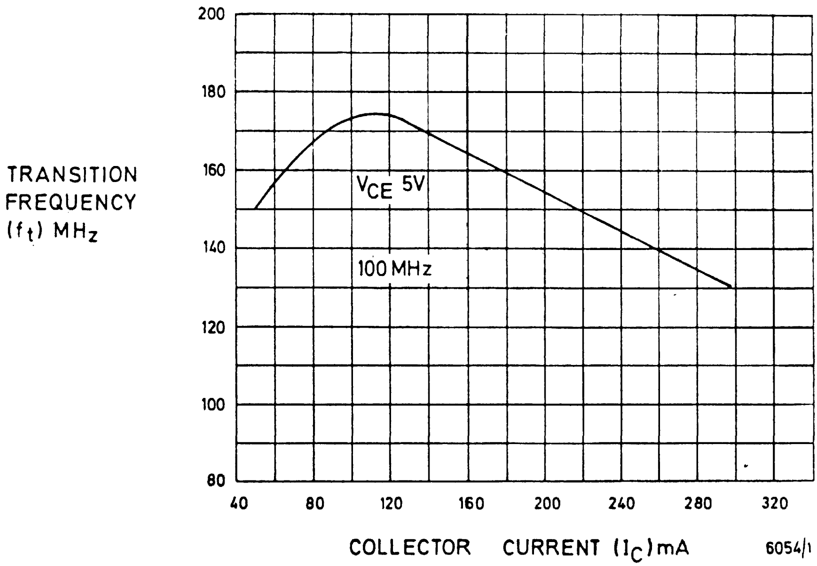
h_{FE}/I_C

STATIC FORWARD CURRENT TRANSFER RATIO PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX650/651



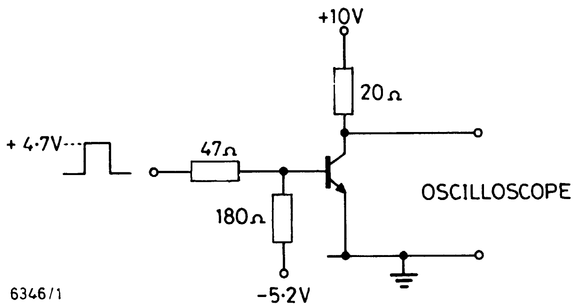
h_{FE}/I_C

STATIC FORWARD CURRENT TRANSFER RATIO PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX652/653

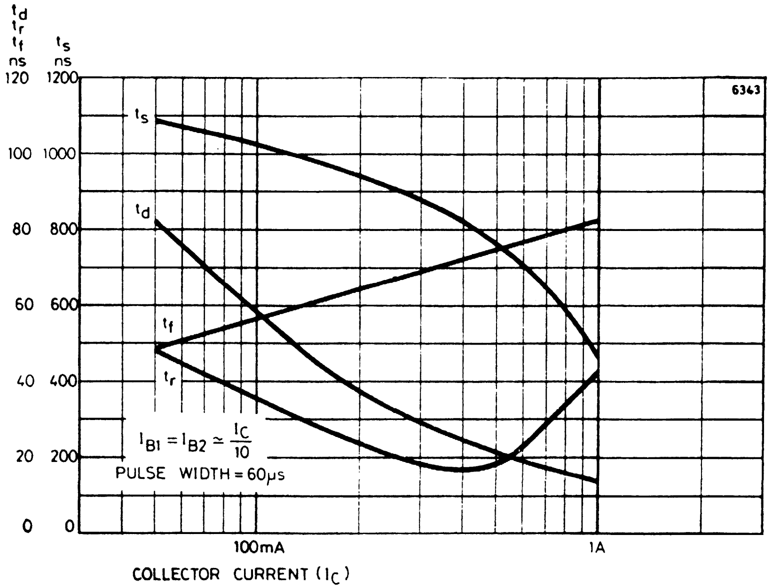


f_T/I_C

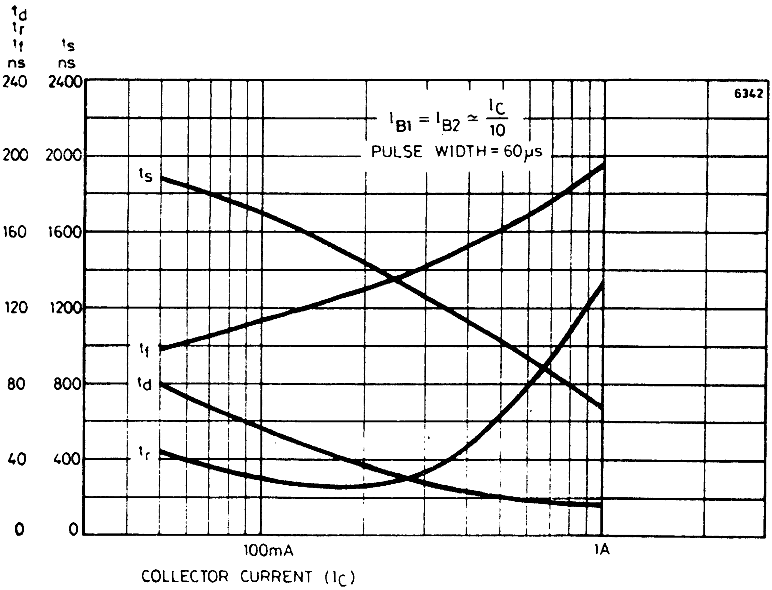
TYPICAL TRANSITION FREQUENCY PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX650



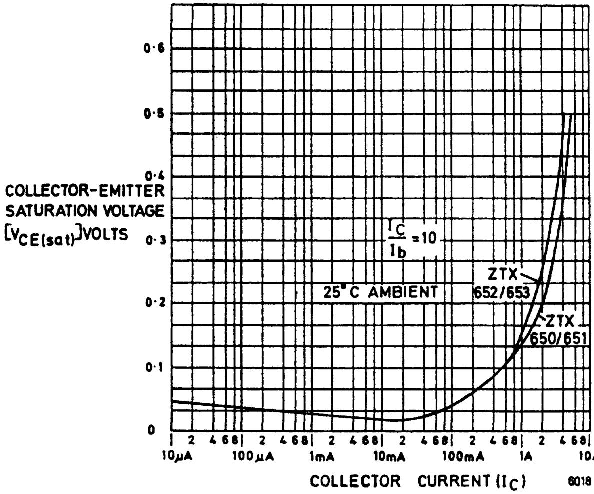
SWITCHING SPEEDS TEST CIRCUIT



TYPICAL SWITCHING SPEEDS (ZTX650/651)

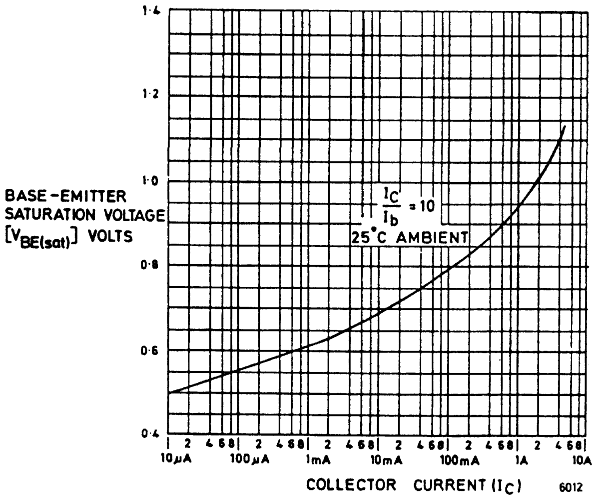


TYPICAL SWITCHING SPEEDS (ZTX652/653)



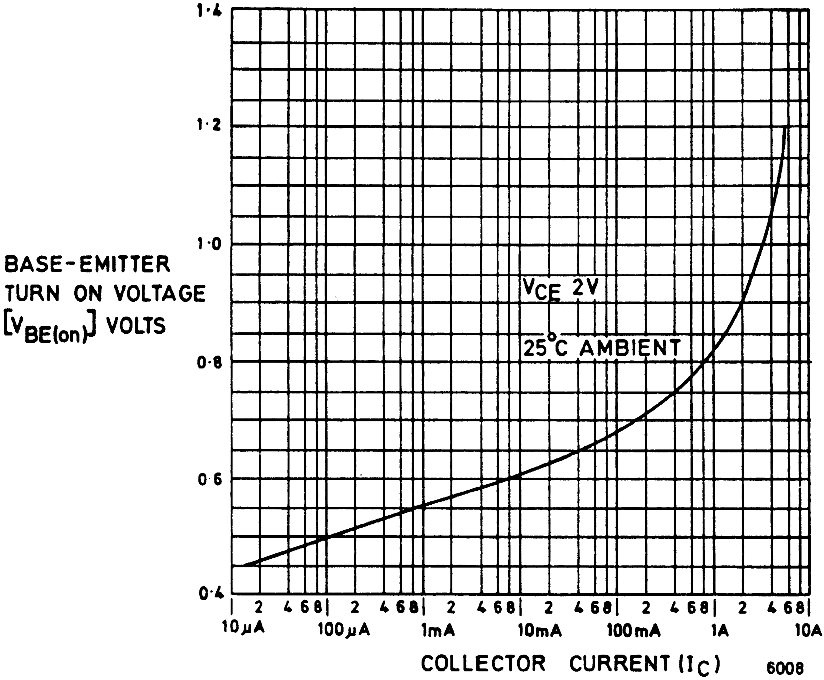
$V_{CE(sat)}/I_C$

TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGES
PLOTTED AGAINST COLLECTOR CURRENT



$V_{BE(sat)}/I_C$

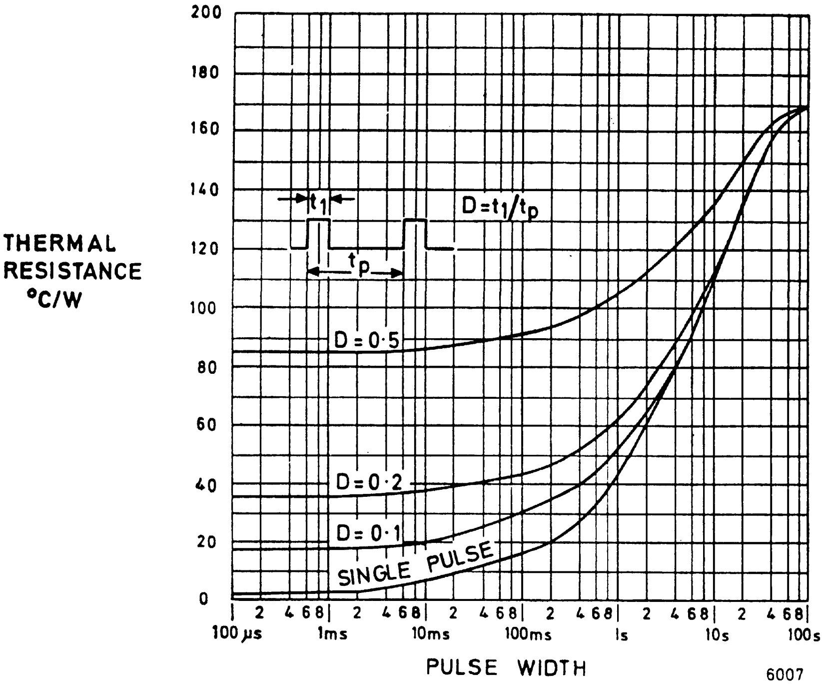
TYPICAL BASE-EMITTER SATURATION VOLTAGES
PLOTTED AGAINST COLLECTOR CURRENT FOR ALL TYPES



$V_{BE(on)}/I_C$

TYPICAL BASE-EMITTER TURN ON VOLTAGES
PLOTTED AGAINST COLLECTOR CURRENT FOR ALL TYPES

ZTX650 Series



TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

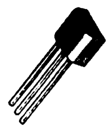
FERRANTI semiconductors®

ZTX 656
ZTX 657

NPN Silicon Planar Medium Power High Voltage Transistors

FEATURES

- 1W power dissipation at $T_{amb} = 25°C$
- Excellent gain characteristics at $I_C = 100mA$
- Voltages up to 300 volts
- Low saturation voltages
- Complementary types



PLASTIC E-LINE (TO-92)

DESCRIPTION

These plastic encapsulated, medium power transistors are designed for applications requiring high breakdown voltages and low saturation voltages.

The E-line package is formed by injection moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting. Also available on tape for automatic handling.

Complementary to
ZTX756
ZTX757

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX656	ZTX657	Unit
Collector-Base Voltage	V_{CBO}	200	300	Volts
Collector-Emitter Voltage	V_{CEO}	200	300	Volts
Emitter-Base Voltage	V_{EBO}	5	5	Volts
Peak Collector Current*	I_{CM}	1	1	Amps
Continuous Collector Current	I_C	0.5	0.5	Amps
Practical Power Dissipation†	P_{totP}	1.5	1.5	Watts
Power Dissipation : at $T_{amb} = 25°C$ derate above 25°C	P_{tot}	1 5.7	1 5.7	Watts mW/°C
Operating and Storage Temperature Range		−55 to +200		°C

*Measured under pulsed conditions. Pulse width $= 300\mu S$. Duty cycle $\leqslant 2\%$.
†The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1 sq.inch minimum. See also note overleaf.

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX656		ZTX657		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	200		300		volts	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	200		300		volts	$I_C = 10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5		5		volts	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}		100		 100	nA nA	$V_{CB} = 160V$ $V_{CB} = 200V$
Emitter cut-off current	I_{EBO}		100		100	nA	$V_{EB} = 3V$
Collector-emitter saturation voltage	$V_{CE(SAT)}$		0.5		0.5	volts	$I_C = 100mA$*, $I_B = 10mA$
Base-emitter saturation voltage	$V_{BE(SAT)}$		1.0		1.0	volts	$I_C = 100mA$*, $I_B = 10mA$
Static forward current transfer ratio	h_{FE}	50 40		50 40			$I_C = 100mA$*, $V_{CE} = 5V$ $I_C = 10mA$, $V_{CE} = 5V$
Base-emitter turn on voltage	$V_{BE(ON)}$		1.0		1.0	volts	$I_C = 100mA$*, $V_{CE} = 5V$
Transition frequency	f_T	30		30		MHz	$I_C = 10mA$, $V_{CE} = 20V$ $f = 20MHz$
Output capacitance	C_{obo}		20		20	pF	$V_{CB} = 20V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μS. Duty cycle ⩽2%.

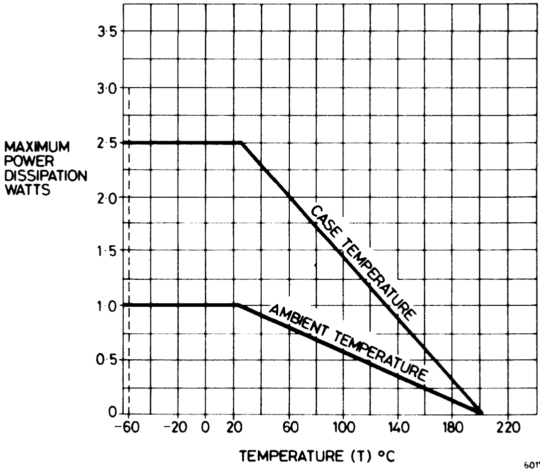
THERMAL CHARACTERISTICS (ZTX656/657)

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient$_1$	$R_{th(j-amb)1}$	175	°C/W
	Junction to Ambient$_2$	$R_{th(j-amb)2}$†	116	°C/W
	Junction to Case	$R_{th(j-case)}$	70	°C/W

†Device mounted on P.C.B. with copper equal to 1 sq.inch minimum.

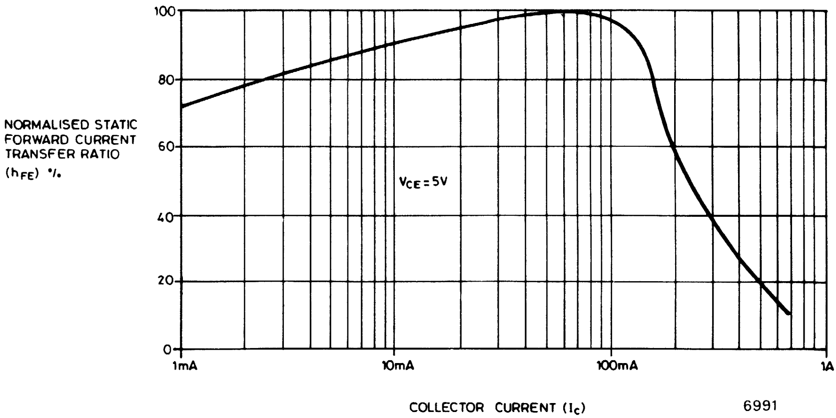
Note: Practical Power Dissipation. Where space does not permit 1 sq.inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

Power Dissipation at $T_{amb} = 25°C$ (P_{tot}) . . . . 1.4 Watts
Derate above 25°C . . . . 8.0mW/°C
Thermal Resistance, Junction to Ambient . . 125°C/W



Dissipation Derating Curve for all types

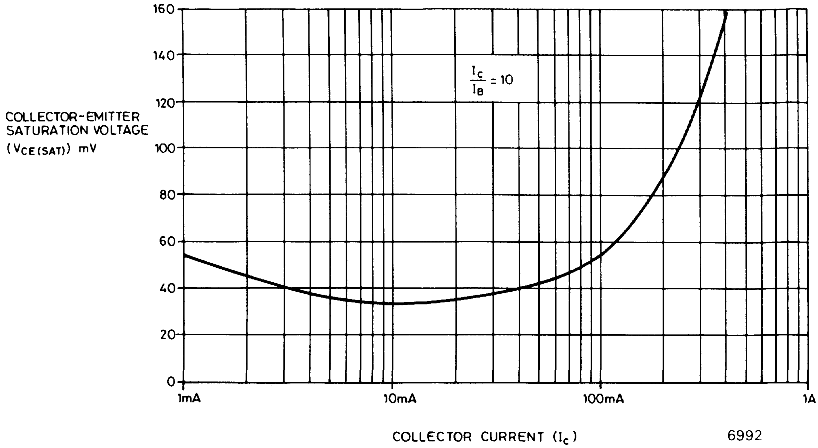
Typical Characteristics



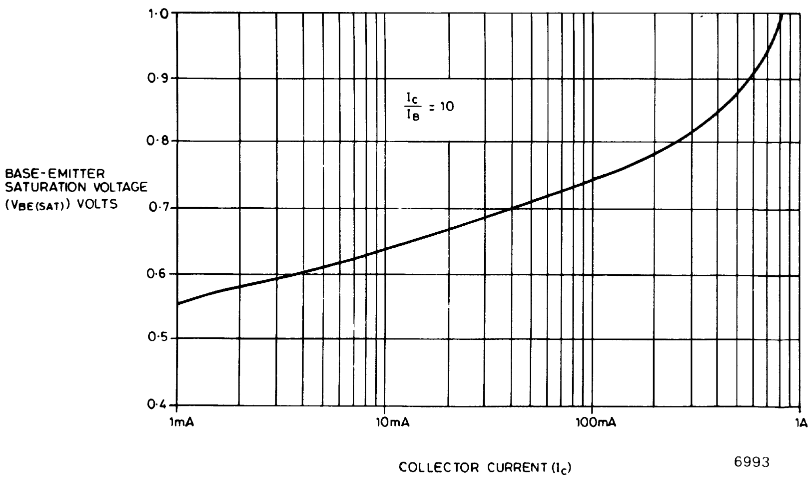
h_{FE}/I_C

Typical Static Forward Current Transfer Ratio Plotted against Collector Current

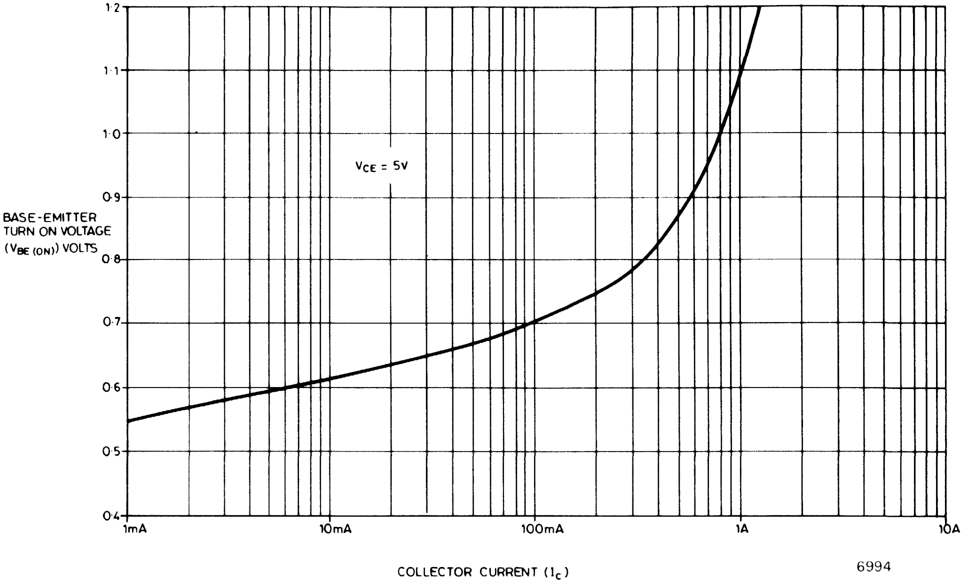
Typical Characteristics



$V_{CE(sat)}/I_C$
Typical Collector-Emitter Saturation Voltages Plotted against Collector Current

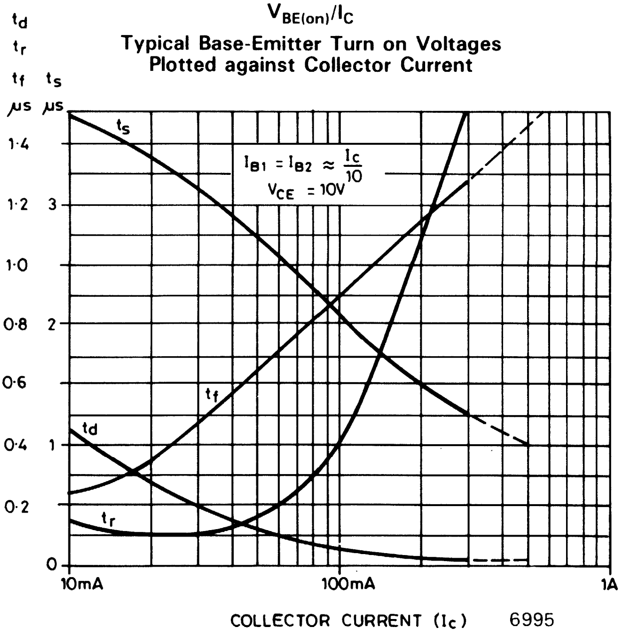


$V_{BE(sat)}/I_C$
Typical Base-Emitter Saturation Voltages Plotted against Collector Current

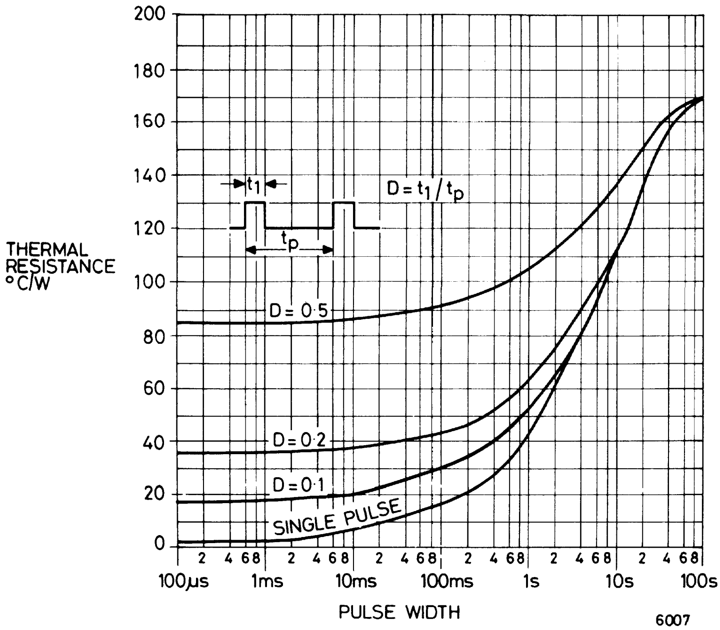


$V_{BE(on)}/I_C$

Typical Base-Emitter Turn on Voltages Plotted against Collector Current



Typical Switching Speeds



TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

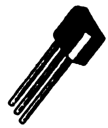
FERRANTI semiconductors®

ZTX749

PNP Silicon Planar Medium Power Transistor

FEATURES

- 1.5W power dissipation at $T_{amb} = 25°C$§
- 2A continuous I_C
- Excellent gain characteristics up to 6A (pulsed)
- Low saturation voltages
- Fast switching
- NPN complementary type available



PLASTIC E-LINE (TO-92)

DESCRIPTION

A high perfomance transistor encapsulated in the popular E-line (TO-92) plastic package.

The 1.5W performance and outstanding electrical characteristics permit use in a wide range of industrial and consumer applications including lamp and solenoid drivers.

In addition the excellent gain characteristics at high collector current levels make the device ideal in pulsed applications.

The specially selected SILICONE encapsulation provides resistance to severe environments comparable with metal can devices.

Complementary to the ZTX649

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX749	Unit
Collector-Base Voltage	V_{CBO}	−35	V
Collector-Emitter Voltage	V_{CEO}	−25	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current*	I_{CM}	−6	amps
Continuous Collector Current	I_C	−2	amps
Practical Power Dissipation§	P_{totP}	1.5	watts
Power Dissipation at $T_{amb} = 25°C$ derate above 25°C	P_{tot}	1 5.7	watt mW/°C
Operating and Storage Temperature Range		−55 to +200	°C

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

§The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1 sq. inch minimum.

ZTX749

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−35	—	—	V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−25	—	—	V	$I_C = -10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	—	V	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}	— —	— —	−0.1 −10	μA μA	$V_{CB} = -30V$ $V_{CB} = -30V$, $T_{amb} = 100°C$
Emitter cut-off current	I_{EBO}	—	—	−0.1	μA	$V_{EB} = -4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.12 −0.23	−0.3 −0.5	V V	$I_C = -1A$, $I_B = -100mA$* $I_C = -2A$, $I_B = -200mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−0.9	−1.25	V	$I_C = -1A$, $I_B = -100mA$*
Base-emitter turn-on voltage	$B_{BE(on)}$	—	−0.8	−1.0	V	$I_C = -1A$, $V_{CE} = -2V$*
Static forward current transfer ratio	h_{FE}	70 100 75 15	200 200 150 50	— 300 — —		$I_C = -50mA$, $V_{CE} = -2V$* $I_C = -1A$, $V_{CE} = -2V$* $I_C = -2A$, $V_{CE} = -2V$* $I_C = -6A$, $V_{CE} = -2V$*
Transition frequency	f_T	100	160	—	MHz	$I_C = -100mA$, $V_{CE} = -5V$ $f = 100MHz$
Output capacitance	C_{obo}	—	55	100	pF	$V_{CB} = -10V$, $f = 1MHz$
Switching times	t_{on} t_{off}	— —	40 500	— —	ns ns	$I_C = -500mA$ $V_{CC} = -10V$ $I_{B1} = I_{B2} = -50mA$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

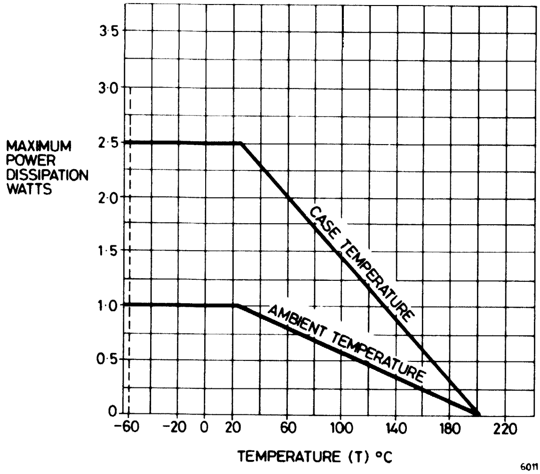
THERMAL CHARACTERISTICS

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient₁	$R_{th(j-amb)1}$	175	°C/W
	Junction to Ambient₂	$R_{th(j-amb)2}$§	116	°C/W
	Junction to Case	$R_{th(j-case)}$	70	°C/W

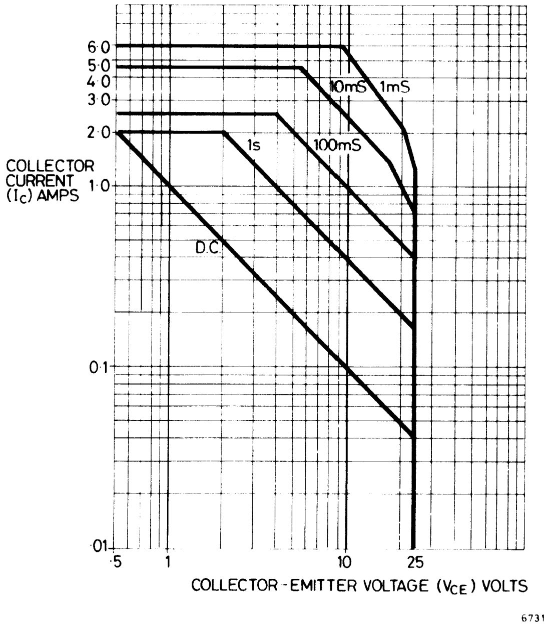
§Device mounted on P.C.B. with copper equal to 1sq. inch minimum.

Note: Practical Power Dissipation. Where space does not permit 1sq. inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

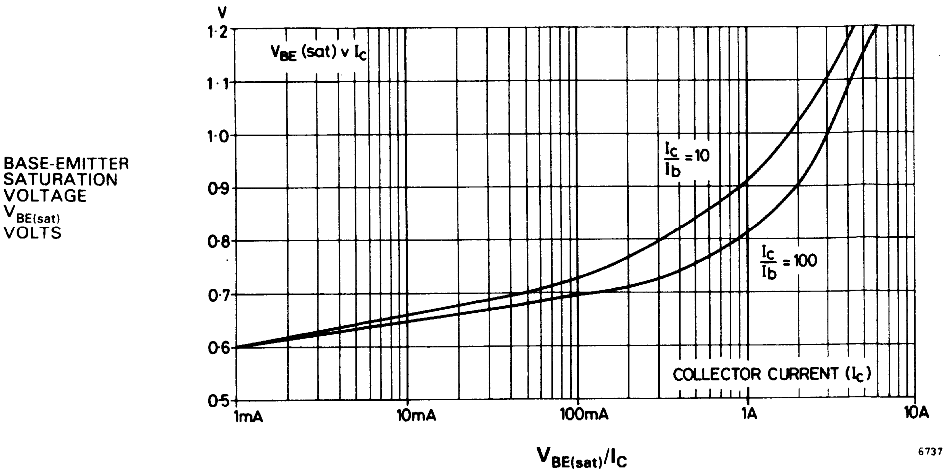
Power Dissipation at $T_{amb} = 25°C$ (P_{tot}) 1.4Watts
Derate above 25°C . . . . 8.0mW/°C
Thermal resistance, Junction to Ambient . . . . 125°C/W



DISSIPATION DERATING CURVE

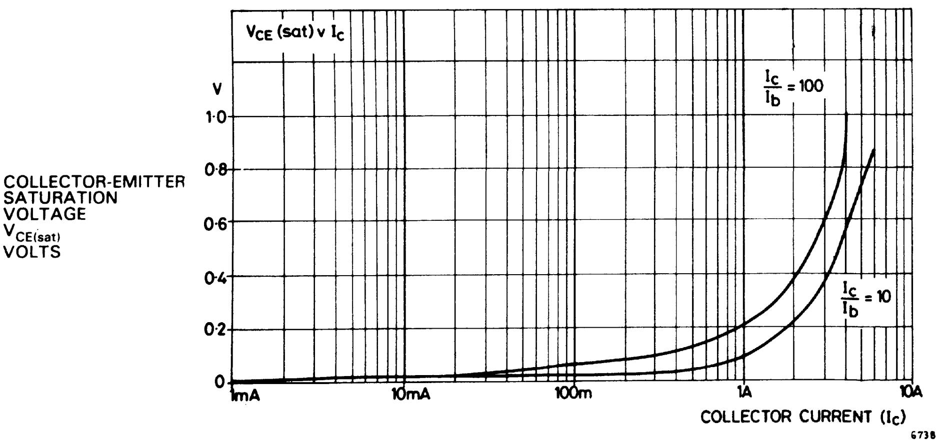


SAFE OPERATING AREA
at T_{amb} = 25°C (SINGLE PULSE)



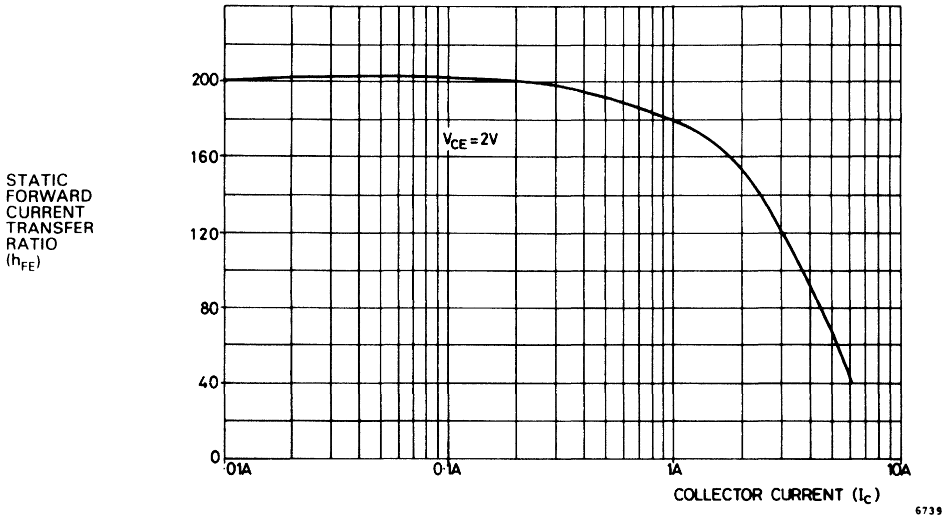
$V_{BE(sat)}/I_C$

TYPICAL BASE-EMITTER SATURATION VOLTAGES PLOTTED AGAINST COLLECTOR CURRENT



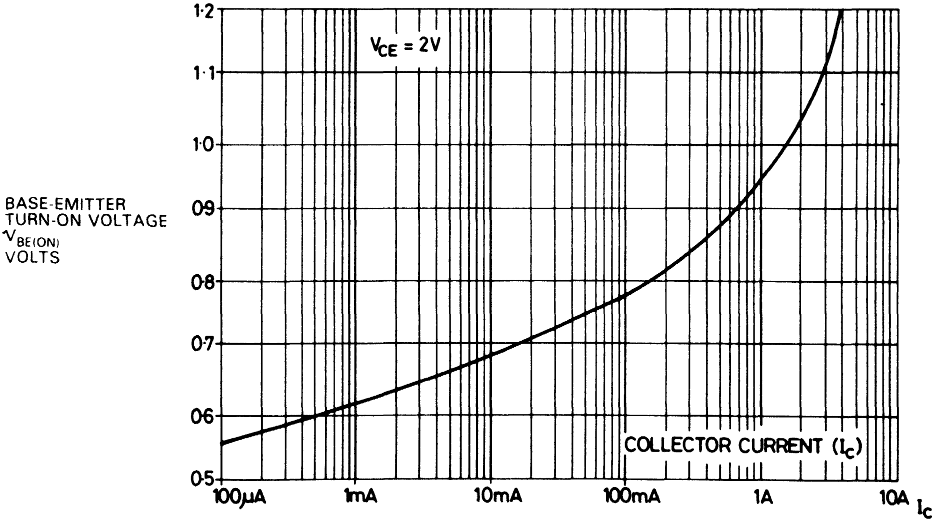
$V_{CE(sat)}/I_C$

TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGES PLOTTED AGAINST COLLECTOR CURRENT



h_{FE}/I_C

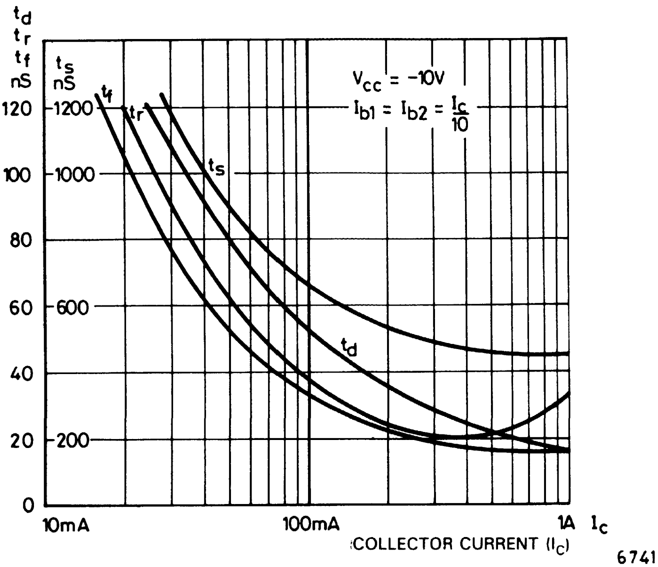
TYPICAL STATIC FORWARD CURRENT TRANSFER RATIO PLOTTED AGAINST COLLECTOR CURRENT



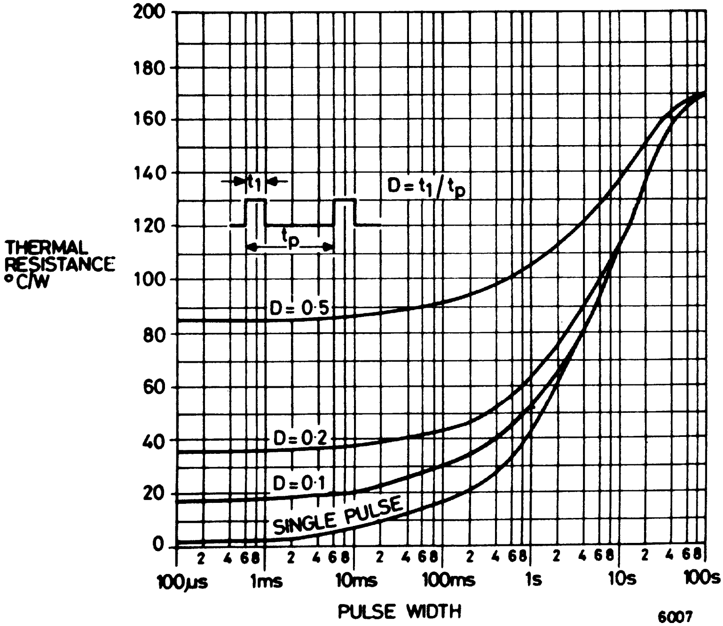
$V_{BE(ON)}/I_C$

TYPICAL BASE-EMITTER TURN-ON VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT

ZTX749



TYPICAL SWITCHING SPEEDS



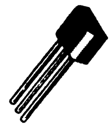
TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

FERRANTI semiconductors®

ZTX750
ZTX751
ZTX752
ZTX753

PNP Silicon Planar Medium Power Transistors

FEATURES
- **1.5W Power dissipation at $T_{amb} = 25°C$§**
- **2A continuous I_C**
- **Excellent gain characteristics to 2A**
- **High V_{CEO}: up to 100 volts**
- **Low saturation voltages**
- **Guaranteed h_{FE} specified up to 2A**
- **Fast switching**
- **Exceptional price-to-power ratio**
- **Complementary types**



PLASTIC E-LINE (TO-92)

DESCRIPTION

A range of high performance medium power transistors encapsulated in the popular E-line (TO-92) plastic package.

The 1.5W performance and outstanding electrical characteristics permit use in a wide variety of industrial and consumer applications including lamp and solenoid drivers, audio amplifiers, complementary drivers for hi-fi amplifiers.

In addition to achieving excellent linearity the devices are designed to function as high speed power switching transistors.

The specially selected SILICONE encapsulation provides resistance to severe environments comparable with metal can devices.

Complementary to ZTX650 series.

ABSOUTE MAXIUM RATINGS

Parameter	Symbol	ZTX750	ZTX751	ZTX752	ZTX753	Unit
Collector-Base Voltage	V_{CBO}	−60	−80	−100	−120	Volts
Collector-Emitter Voltage	V_{CEO}	−45	−60	−80	−100	Volts
Emitter-Base Voltage	V_{EBO}	−5	−5	−5	−5	Volts
Peak Pulse Current*	I_{CM}	−6	−6	−6	−6	Amps
Continuous Collector Current	I_C	−2	−2	−2	−2	Amps
Practical Power Dissipation§	P_{totP}	1.5	1.5	1.5	1.5	Watts
Power Dissipation: at $T_{amb} = 25°C$ derate above 25°C at $T_{case} = 25°C$	P_{tot}	1 5.7 2.5	1 5.7 2.5	1 5.7 2.5	1 5.7 2.5	Watts mW/°C Watts
Operating and Storage Temperature Range		−55 to +200				°C

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.
§The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1sq. inch minimum. See also note on Page SE93.

ZTX750/1

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX750			ZTX751			Unit	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	–60	—	—	–80	—	—	V	$I_C = -100\,\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	–45	—	—	–60	—	—	V	$I_C = -10$ mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	–5	—	—	–5	—	—	V	$I_E = -100\,\mu A$
Collector cut off current	I_{CBO}	— — — —	— — — —	–0.1 –10 — —	— — — —	— — — —	— — –0.1 –10	µA µA µA µA	$V_{CB} = -45V$ $V_{CB} = -45V$, $T_{amb} = 100°C$ $V_{CB} = -60V$ $V_{CB} = -60V$, $T_{amb} = 100°C$
Emitter cut off current	I_{EBO}	—	—	–0.1	—	—	–0.1	µA	$V_{EB} = -4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.15 0.28	–0.3 –0.5	— —	0.15 0.28	–0.3 –0.5	V V	$I_C = -1A$*, $I_B = -100$ mA* $I_C = -2A$*, $I_B = -200$ mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	–0.90	–1.25	—	–0.90	–1.25	V	$I_C = -1A$*, $I_B = -100$ mA*
Base-emitter turn on voltage	$V_{BE(on)}$	—	–0.8	–1.0	—	–0.8	–1.0	V	$I_C = -1A$*, $V_{CE} = -2V$*
Static forward current transfer ratio	h_{FE}	70 100 80 40	200 200 170 150	— 300 — —	70 100 80 40	200 200 170 150	— 300 — —		$I_C = -50$ mA*, $V_{CE} = -2V$* $I_C = -500$ mA*, $V_{CE} = -2V$* $I_C = -1A$*, $V_{CE} = -2V$* $I_C = -2A$*, $V_{CE} = -2V$*
Transition frequency	f_T	100	140	—	100	140	—	MHz	$I_C = -100$ mA, $V_{CE} = -5V$ f = 100 MHz
Switching times	T_{on} T_{off}	— —	40 450	— —	— —	40 450	— —	ns ns	$I_C = -500$ mA, $I_{B_1} = -50$ mA $I_{B_2} = -50$ mA, $V_{CC} = -10V$

*Measured under pulsed conditions. Pulse width = 300 µs. Duty cycle ≤2%.

THERMAL CHARACTERISTICS (ZTX750/1/2/3)

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient$_1$ Junction to Ambient$_2$ Junction to Case	$R_{th(j-amb)1}$ $R_{th(j-amb)2}$† $R_{th(j-case)}$	175 116 70	°C/W °C/W °C/W

†Device mounted on P.C.B. with copper equal to 1 sq. inch minimum.

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

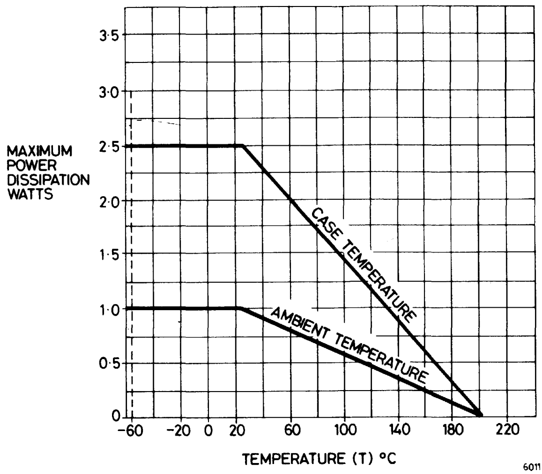
Parameter	Symbol	ZTX752			ZTX753			Unit	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−100	—	—	−120	—	—	V	$I_C = -100\,\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−80	—	—	−100	—	—	V	$I_C = -10$ mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	—	−5	—	—	V	$I_E = -100\,\mu A$
Collector cut off current	I_{CBO}	— — — —	— — — —	−0.1 −10 — —	— — — —	— — — —	— — −0.1 −10	µA µA µA µA	$V_{CB} = -80V$ $V_{CB} = -80V$, $T_{amb} = 100°C$ $V_{CB} = -100V$ $V_{CB} = -100V$, $T_{amb} = 100°C$
Emitter cut off current	I_{EBO}	—	—	−0.1	—	—	−0.1	µA	$V_{EB} = -4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.17 0.30	−0.3 −0.5	— —	0.17 0.30	−0.3 −0.5	V V	$I_C = -1A^*$, $I_B = -100$ mA* $I_C = -2A^*$, $I_B = -200$ mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−0.90	−1.25	—	−0.90	−1.25	V	$I_C = -1A^*$, $I_B = -100$ mA*
Base-emitter turn on voltage	$V_{BE(on)}$	—	−0.8	−1.0	—	−0.8	−1.0	V	$I_C = -1A^*$, $V_{CE} = -2V^*$
Static forward current transfer ratio	h_{FE}	70 100 55 25	200 200 170 55	— 300 — —	70 100 55 25	200 200 170 55	— 300 — —		$I_C = -50$ mA*, $V_{CE} = -2V^*$ $I_C = -500$ mA*, $V_{CE} = -2V^*$ $I_C = -1A^*$, $V_{CE} = -2V^*$ $I_C = -2A^*$, $V_{CE} = -2V^*$
Transition frequency	f_T	100	140	—	100	140	—	MHz	$I_C = -100$ mA, $V_{CE} = -5V$ f = 100 MHz
Switching times	T_{on} T_{off}	— —	40 600	— —	— —	40 600	— —	ns ns	$I_C = -500$ mA, $I_{B1} = -50$ mA $I_{B2} = -50$ mA, $V_{CC} = -10V$

*Measured under pulsed conditions. Pulse width = 300 µs. Duty cycle ≤2%.

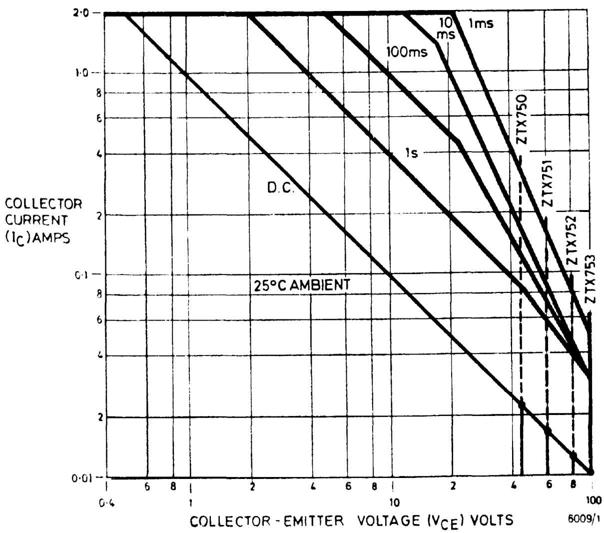
Note: Practical Power Dissipation. Where space does not permit 1 sq. inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

Power Dissipation at $T_{amb} = 25°C$ (P_{tot}) .. 1.4 Watts
Derate above 25°C .. .. 8.0 mW/°C
Thermal resistance, Junction to Ambient .. 125°C/W

ZTX750 Series

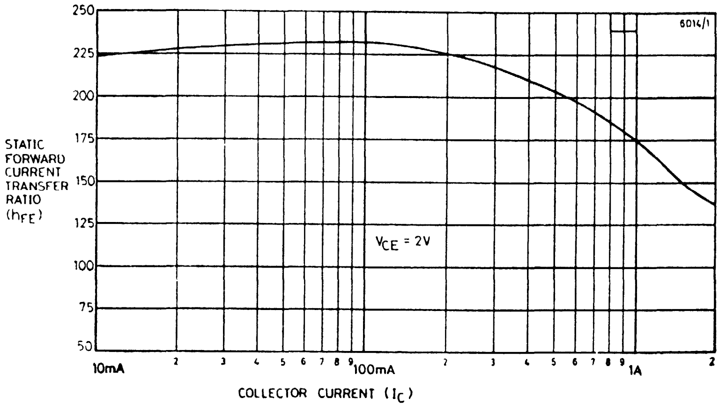


DISSIPATION DERATING CURVE FOR ALL TYPES



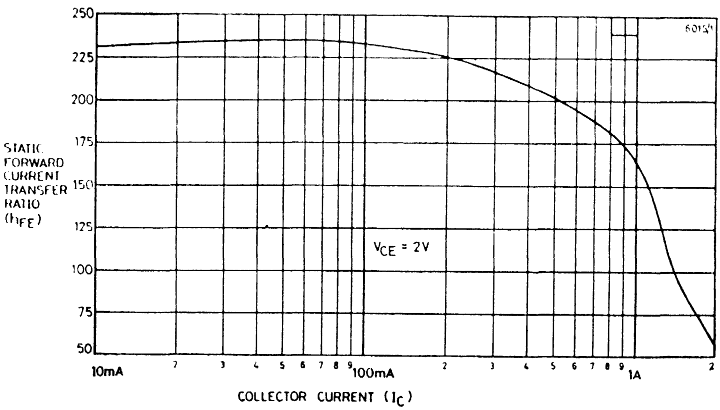
SAFE OPERATING AREA at $T_{amb} = 25°C$
(SINGLE PULSE)

TYPICAL CHARACTERISTICS



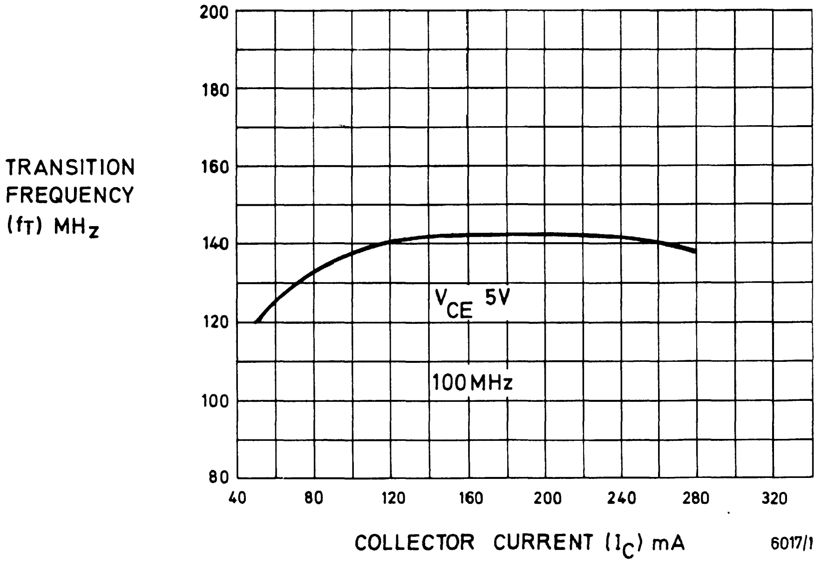
h_{FE}/I_C

STATIC FORWARD CURRENT TRANSFER RATIO
PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX750/751



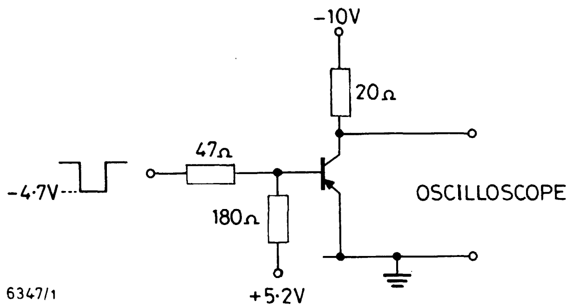
h_{FE}/I_C

STATIC FORWARD CURRENT TRANSFER RATIO
PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX752/753

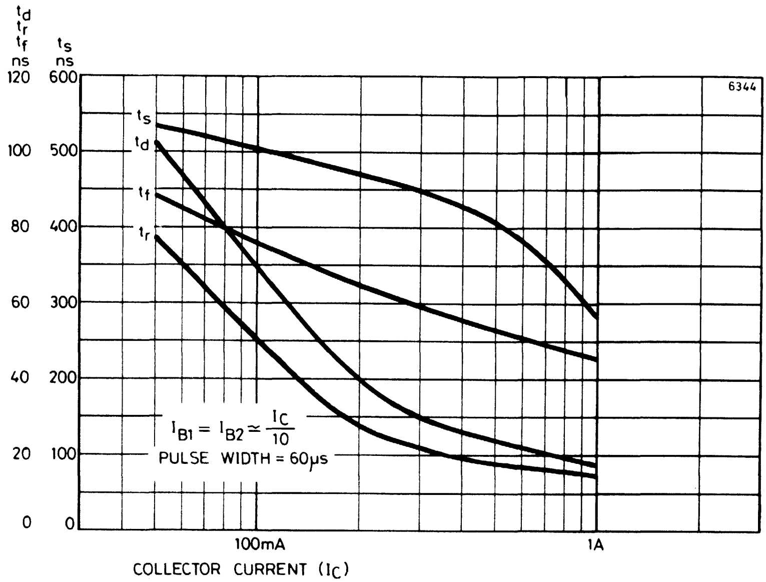


f_T/I_C

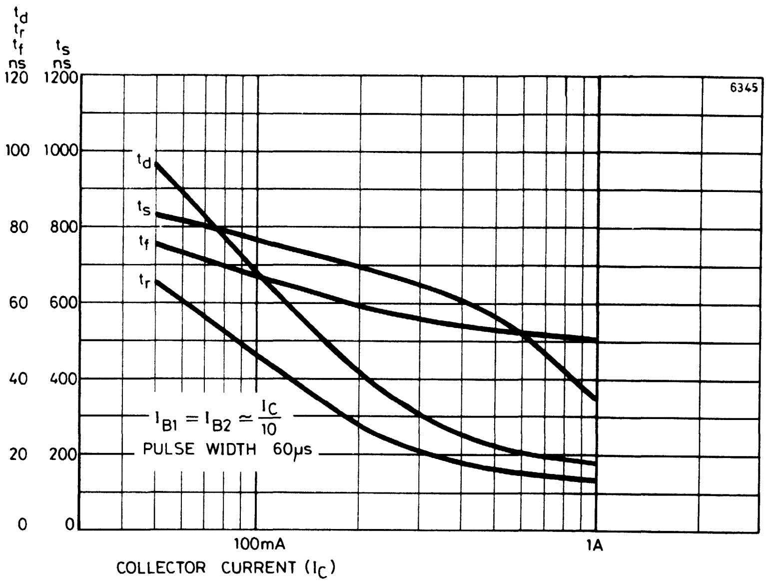
TYPICAL TRANSITION FREQUENCY PLOTTED AGAINST COLLECTOR CURRENT FOR ZTX750



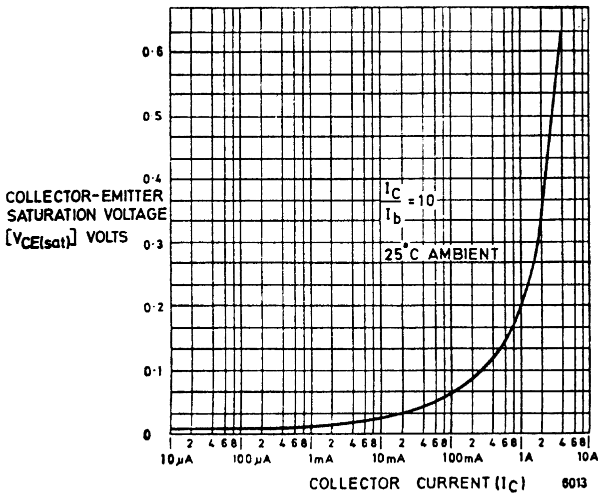
SWITCHING SPEEDS TEST CIRCUIT



TYPICAL SWITCHING SPEEDS (ZTX750/751)

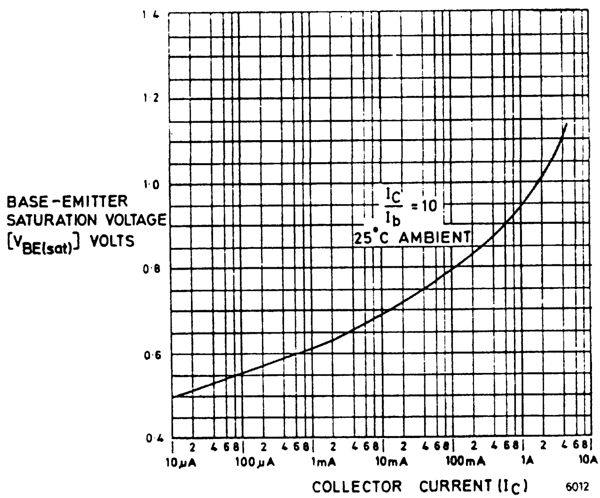


TYPICAL SWITCHING SPEEDS (ZTX752/753)



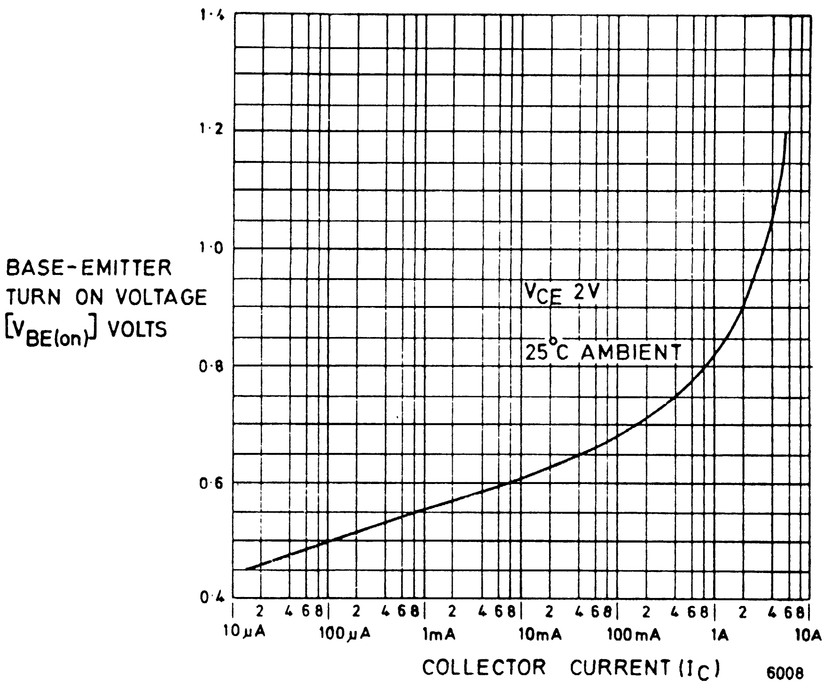
$V_{CE(sat)}/I_C$

TYPICAL COLLECTOR-EMITTER SATURATION VOLTAGES PLOTTED AGAINST COLLECTOR CURRENT FOR ALL TYPES



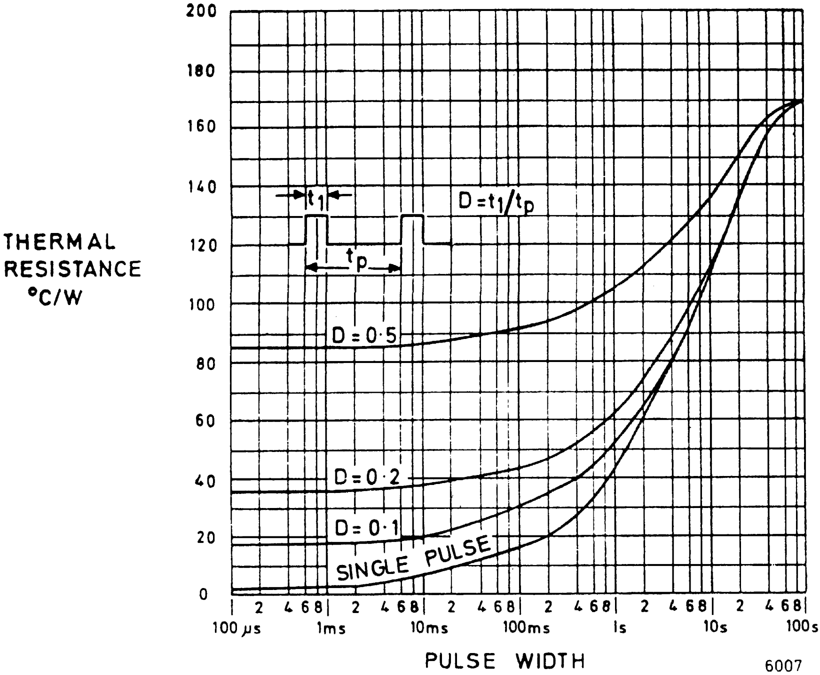
$V_{BE(sat)}/I_C$

TYPICAL BASE-EMITTER SATURATION VOLTAGES PLOTTED AGAINST COLLECTOR CURRENT FOR ALL TYPES



$V_{BE(on)}/I_C$

TYPICAL BASE-EMITTER TURN ON VOLTAGES
PLOTTED AGAINST COLLECTOR CURRENT FOR ALL TYPES



TYPICAL TRANSIENT THERMAL IMPEDANCE CURVES

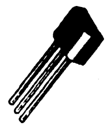
FERRANTI semiconductors®

ZTX 756
ZTX 757

PNP Silicon Planar Medium Power High Voltage Transistors

FEATURES

- 1W power dissipation at $T_{amb} = 25°C$
- Excellent gain characteristics at $I_C = 100mA$
- Voltages up to 300 volts
- Low saturation voltages
- Complementary types



PLASTIC E-LINE (TO-92)

DESCRIPTION

These plastic encapsulated, medium power transistors are designed for applications requiring high breakdown voltages and low saturation voltages.

The E-line package is formed by injection moulding a SILICONE plastic specially selected to provide a rugged one-piece encapsulation resistant to severe environments and allow the high junction temperature operation normally associated with metal can devices.

E-line encapsulated devices are approved for use in military, industrial and professional equipments.

Alternative lead configurations are available as plug-in replacements of TO-5/39 and TO-18 metal can types, and for flat mounting. Also available on tape for automatic handling.

Complementary to
ZTX656
ZTX657

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	ZTX756	ZTX757	Unit
Collector-Base Voltage	V_{CBO}	−200	−300	Volts
Collector-Emitter Voltage	V_{CEO}	−200	−300	Volts
Emitter-Base Voltage	V_{EBO}	−5	−5	Volts
Peak Collector Current*	I_{CM}	−1	−1	Amps
Continuous Collector Current	I_C	−0.5	−0.5	Amps
Practical Power Dissipation†	P_{totP}	1.5	1.5	Watts
Power Dissipation : at $T_{amb} = 25°C$ derate above 25°C	P_{tot}	1.0 5.7	1.0 5.7	Watts mW/°C
Operating and Storage Temperature Range		−55 to +200		°C

*Measured under pulsed conditions. Pulse width = 300μS. Duty cycle $\leqslant$ 2%.

†The power which can be dissipated assuming device mounted in typical manner on P.C.B. with copper equal to 1 sq.inch minimum. See also note overleaf.

ZTX756/757

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	ZTX756		ZTX757		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−200		−300		volts	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−200		−300		volts	$I_C = -10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5		−5		volts	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}		−100		 −100	nA nA	$V_{CB} = -160V$ $V_{CB} = -200V$
Emitter cut-off current	I_{EBO}		−100		−100	nA	$V_{EB} = -3V$
Collector-emitter saturation voltage	$V_{CE(SAT)}$		−0.5		−0.5	volts	$I_C = -100mA$* $I_B = -10mA$
Base-emitter saturation voltage	$V_{BE(SAT)}$		−1.0		−1.0	volts	$I_C = -100mA$* $I_B = -10mA$
Static forward current transfer ratio	h_{FE}	50 40		50 40			$I_C = -100mA$*, $V_{CE} = 5V$ $I_C = -10mA$*, $V_{CE} = 5V$
Base-emitter turn on voltage	$V_{BE(ON)}$		−1.0		−1.0	volts	$I_C = -100mA$* $V_{CE} = -5V$
Transition frequency	f_T	30		30		MHz	$I_C = -10mA$ $V_{CE} = -20V$, $f = 20MHz$
Output capacitance	C_{obo}		20		20	pF	$V_{CB} = -20V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μS. Duty cycle ≤2%.

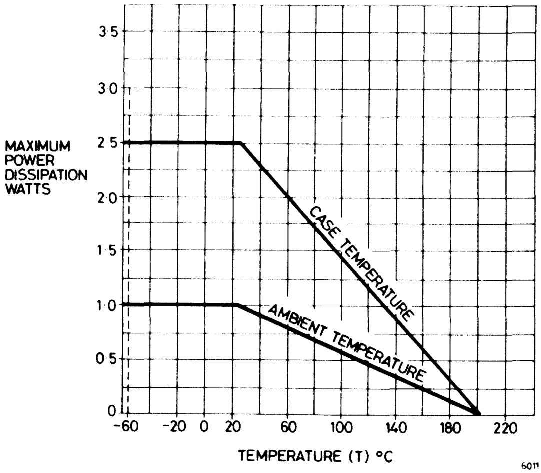
THERMAL CHARACTERISTICS (ZTX756/757)

Parameter		Symbol	Maximum	Unit
Thermal Resistance:	Junction to Ambient$_1$	$R_{th(j-amb)1}$	175	°C/W
	Junction to Ambient$_2$	$R_{th(j-amb)2}$†	116	°C/W
	Junction to Case	$R_{th(j-case)}$	70	°C/W

†Device mounted on P.C.B. with copper equal to 1 sq.inch minimum.

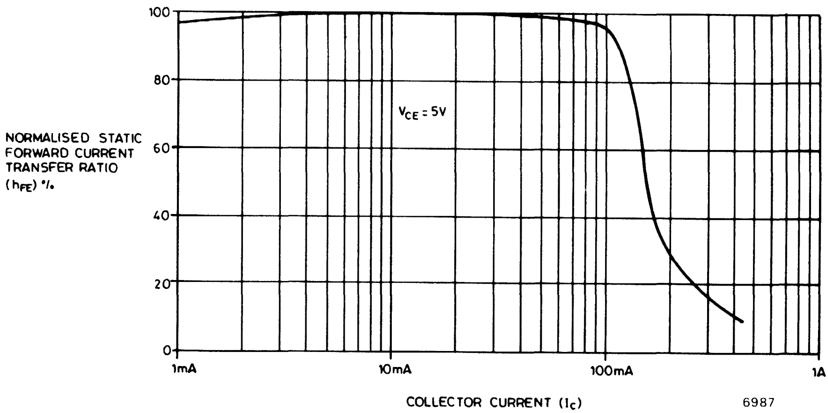
Note: Practical Power Dissipation. Where space does not permit 1 sq.inch copper the device fitted with Staver heat clip type F2-7 will offer the following:

Power Dissipation at $T_{amb} = 25°C$ (P_{tot}) . . . . 1.4 Watts
Derate above 25°C . . . . 8.0mW/°C
Thermal Resistance, Junction to Ambient . . 125°C/W



Dissipation Derating Curve for all types

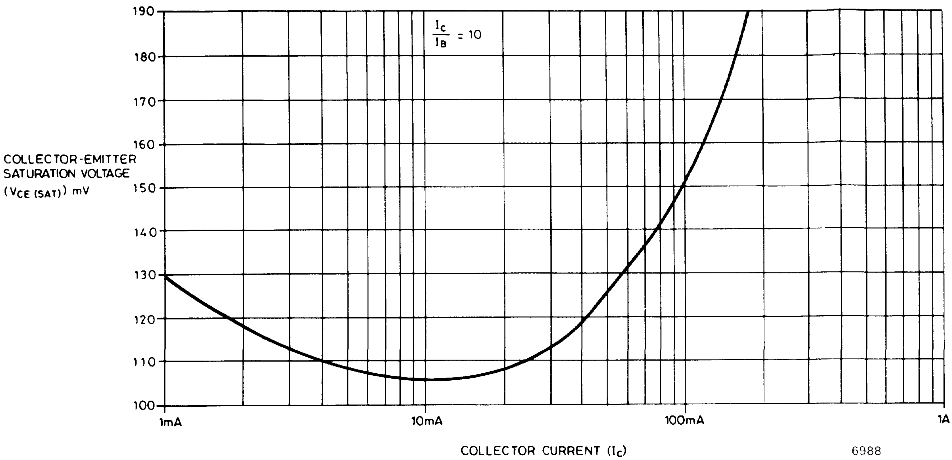
Typical Characteristics



h_{FE}/I_C

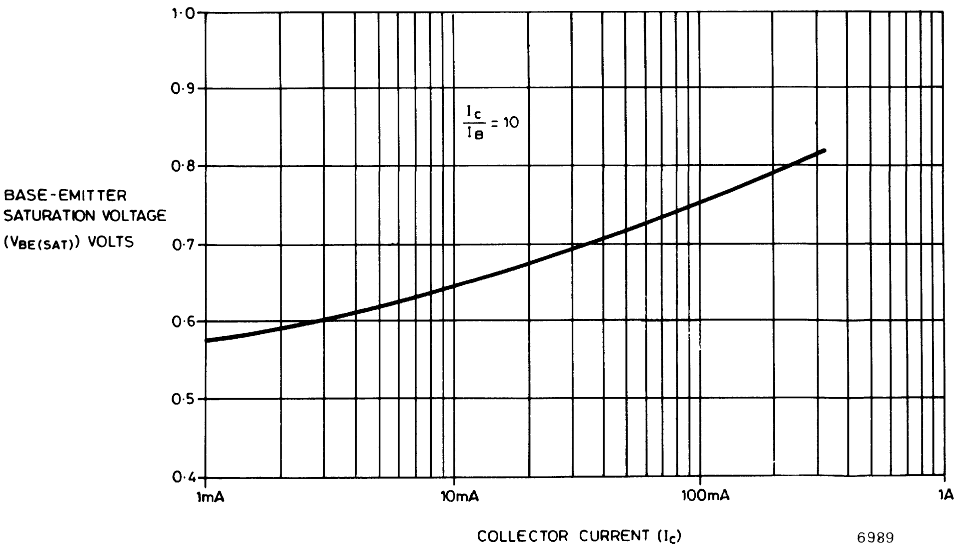
Typical Static Forward Current Transfer Ratio Plotted against Collector Current

Typical Characteristics



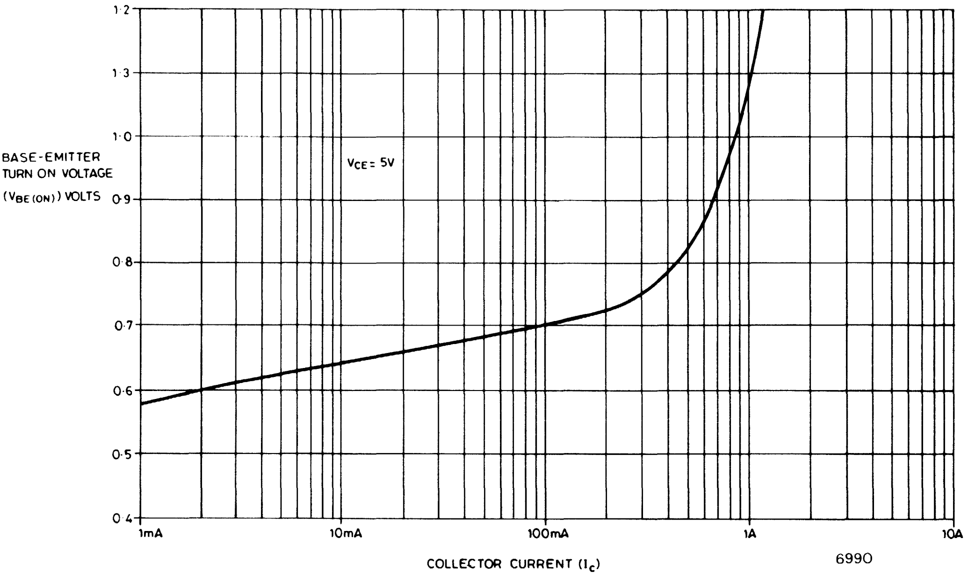
$V_{CE(sat)}/I_C$

Typical Collector-Emitter Saturation Voltages Plotted against Collector Current



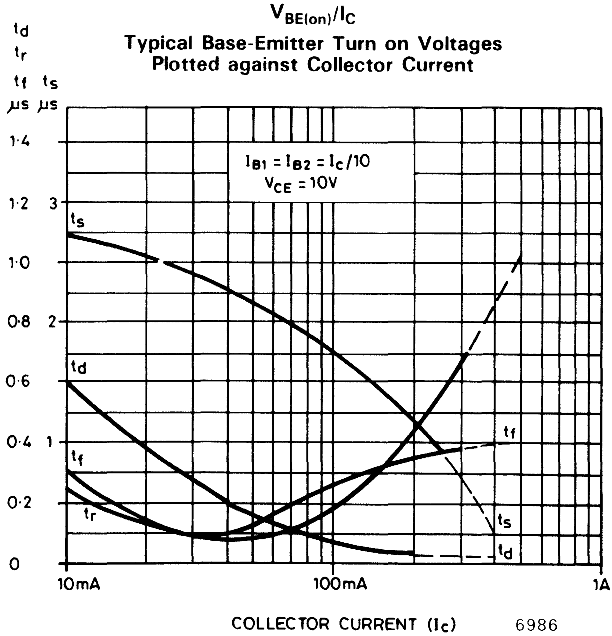
$V_{BE(sat)}/I_C$

Typical Base-Emitter Saturation Voltages Plotted against Collector Current

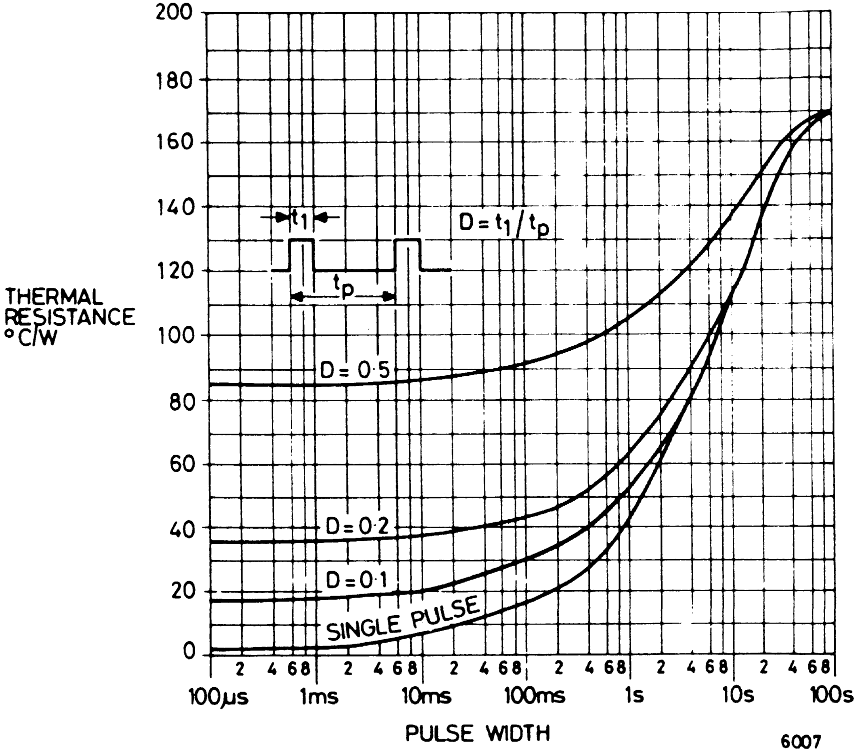


$V_{BE(on)}/I_C$

Typical Base-Emitter Turn on Voltages Plotted against Collector Current



Typical Switching Speeds



Typical Transient Thermal Impedance Curves

APPLICATIONS

A series of notes written to give engineers and designers guidance and ideas in the application of the transistors featured in this product guide.

CONTENTS

APPLICATIONS

1. D.C. MOTOR SPEED CONTROL USING ZTX450

The function of the following circuit is to improve the load/speed regulation of a d.c. machine. One of the main reasons why the speed of a permanent magnet field d.c. motor varies with load is that a voltage drop is current and hence load dependent. The circuit given stabilises the speed of the motor by cancelling out the effect of the motor rotor resistance using a bridge circuit.

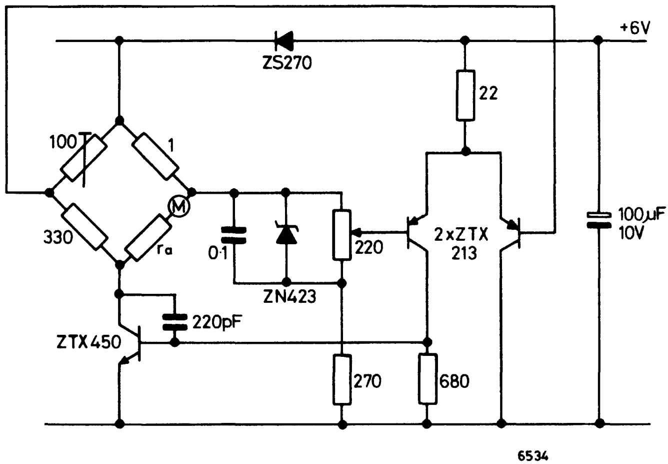


Fig. 1.1.

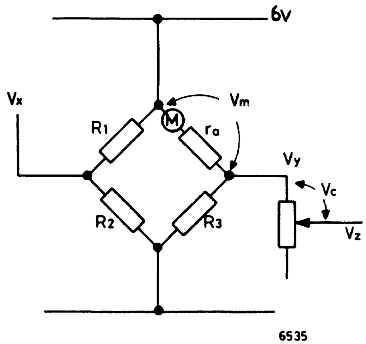


Fig. 1.2.

Theory

If the bridge and variable resistor are analysed on their own, the following proof can be derived.

$$V_x = [V_m + I_m R_3] \times \frac{R_2}{R_1 + R_2} \qquad \ldots 1$$

$$V_y = I_m R_3 \qquad \ldots 2a$$

$$V_z = V_y + V_c = I_m R_3 + V_c \qquad \ldots 2b$$

but $V_m = V_a + I_m r_a$

substituting in 1.

$$V_x = [V_a + I_m r_a + I_m R_3] \times \frac{R_2}{R_1 + R_2} = [V_a + I_m(r_a + R_3)] \times \frac{R_2}{R_1 + R_2} = \frac{V_a R_2}{R_1 + R_2} + I_m R_2 \frac{(r_a + R_3)}{R_1 + R_2}$$

now $V_x = V_z$ (1st Assumption)

$$\text{so } V_z = \frac{V_a R_2}{R_1 + R_2} + I_m R_2 \frac{(r_a + R_3)}{R_1 + R_2}$$

from 2b $V_z = I_m R_3 + V_c$

$$V_c + I_m R_3 = \frac{V_a R_2}{R_1 + R_2} + I_m R_2 \times \frac{r_a + R_3}{R_1 + R_2}$$

Dividing by R_3 gives

$$\frac{V_c}{R_3} + I_m = \frac{V_a R_2}{R_3(R_1 + R_2)} + I_m R_2 \frac{r_a + R_3}{R_3(R_1 + R_2)}$$

$$\frac{V_c}{R_3} + I_m = \frac{V_a R_2}{R_3(R_1 + R_2)} + I_m \left[\frac{R_2 r_a + R_2 R_3}{R_1 R_3 + R_2 R_3} \right]$$

now $R_1 R_3 = r_a R_2$ (2nd Assumption)

$$\frac{V_c}{R_3} + I_m = \frac{V_a R_2}{R_3(R_1 + R_2)} + I_m$$

$$V_c = \frac{V_a R_2}{R_1 + R_2}$$

Hence the control voltage (i.e. the speed) is not directly dependent on the motor current.

The value of r_a varies from motor to motor, so the bridge must be balanced to suit the motor employed. This can be done by calculation and measurement of the motor rotor resistance, or by adjusting the value of the 100Ω preset resistor until the motor speed just becomes unstable and then backing off a fraction.

The current/speed and torque/speed characteristics of a test motor have been plotted in fig. 1.3 and fig. 1.4, with and without the control circuit to show the improvement in speed stability. Variations in motor speed due to supply changes are also greatly reduced by the circuit. On the test motor a speed change of $\pm 2\%$ was recorded for a supply change of $\pm 20\%$.

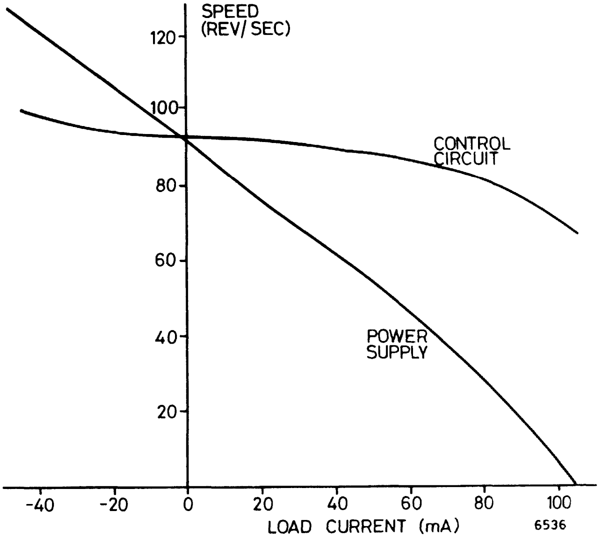


Fig. 1.3.

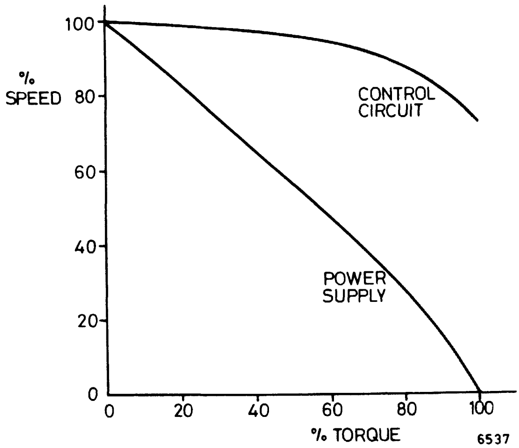


Fig. 1.4.

2. 60 WATTS FLASHING LIGHT

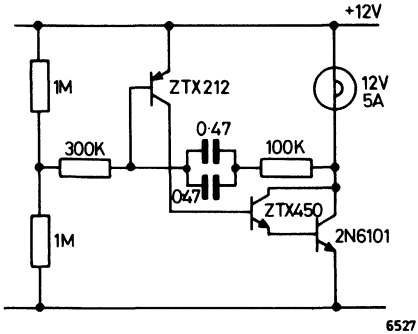


Fig. 2.1.

The 2N6101 transistor should be mounted on a small heat sink. The 300kΩ resistor controls the OFF period and may need adjustment if transistor gains are high. The 100kΩ resistor controls the ON period.

3. MICROPHONE AMPLIFIER

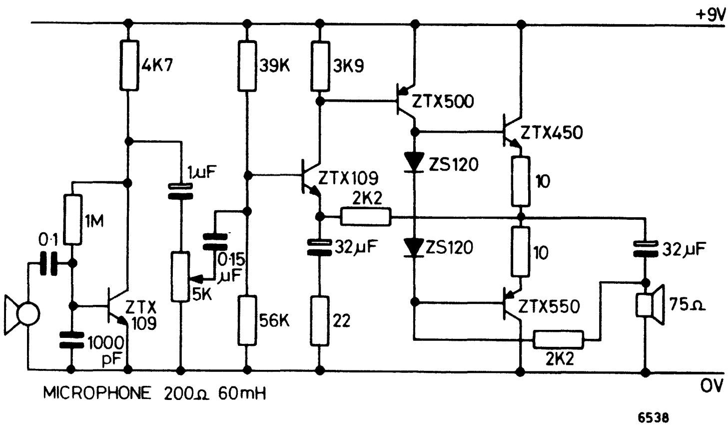


Fig. 3.1.

This circuit features the ZTX450/ZTX550 transistors in a push-pull output stage. The following readings were taken at maximum volume:

Input 0.4mV rms

Output 1.8V rms

Voltage Gain 4500

Max. output before distortion 2.25V rms – Supply current = 15mA

Zero output – Supply Current = 3.5mA

Wattage 0.034W

Frequency Response 250Hz to 28kHz

4. 12 VOLT LATCH CIRCUIT

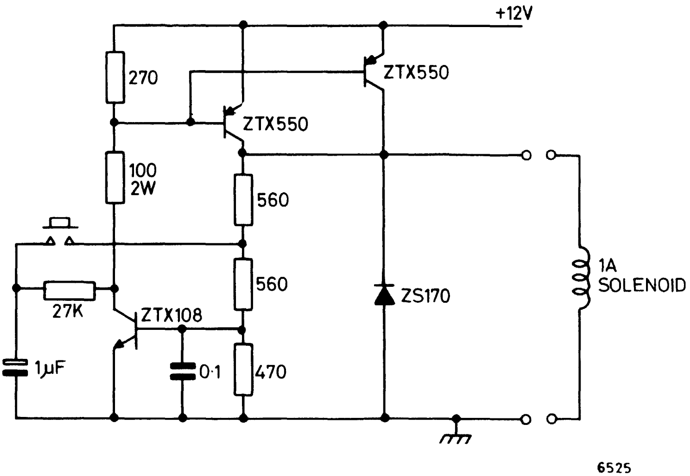


Fig. 4.1.

The above circuit has been designed to control a solenoid by the operation of a single push-button switch. It will supply loads of over 1 amp and can be operated up to a maximum speed of once every 0.6 seconds. When power is first applied to the circuit, the solenoid will always start in its off position. Other features of the circuit are its automatic turn-off if the load is shorted, and its virtually zero power consumption when off.

When the supply is connected, the 470Ω and 270Ω base-emitter resistors ensure all three transistors remain off. The 1μF capacitor charges up to a value approaching that of the supply rail. If the push-button switch is then closed, the charge is transferred to the bias network of the ZTX108, turning it on. This, through the 100Ω and 270Ω bias resistors of the ZTX550's turn these devices on, which energises the load and also through the two 560Ω resistors holds the ZTX108 on, once the charge on the 1μF capacitor has decayed.

Since the ZTX108 is now on, when the push button is released the 1μF capacitor will be discharged through the transistor via the bleed resistor.

If the push-button is operated again it will connect this discharged capacitor to the bias network of the ZTX108 turning it and thus the output off. Any excess energy stored in the solenoid will be dissipated in the ZS170 protection diode.

When the push-button switch is released, the 1μF capacitor will charge up ready to trigger the latch on again when the switch is operated. The 0.1μF capacitor inhibits false triggering due to transient voltages.

5. DELAYED EXTRA BRAKE LIGHT

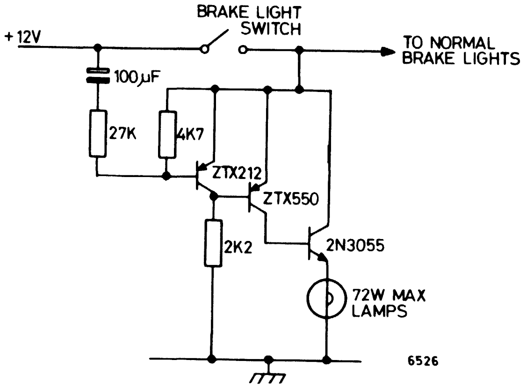


Fig. 5.1.

Operating the brake pedal of the car brings on the normal brake lights and then, after a delay, the extra lights are turned on.

A bimetal strip in series with the lights would make them flash.

6. INFRA-RED TRANSMITTER

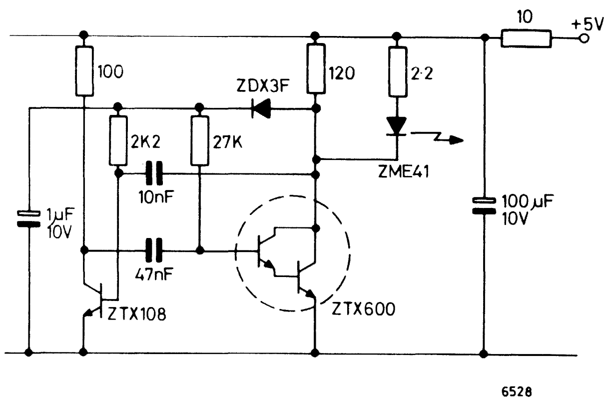


Fig. 6.1.

The transmitter consists of an oscillator which drives a high output infra-red emitting diode. The oscillator is a sure start multivibrator circuit that provides an output of 15 to 1000 mark to space ratio at a frequency of 1kHz. This large mark to space ratio allows the infra-red diode to be operated at a high peak current, provided by the ZTX600 Darlington transistor, to maximise the transmitter range. A decoupling network is included in the power supply lead to isolate it from any logic circuitry using the same 5V power supply source. The transmitter supply current is approximately 65mA.

7. THE ZTX600 AS A LAMP DRIVER

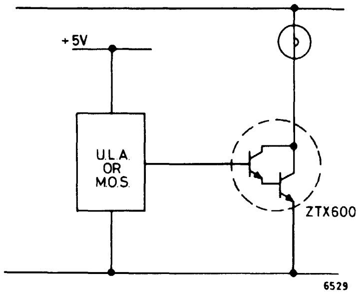


Fig. 7.1.

There is often a requirement to drive lamps directly from integrated circuits, for example CMOS or ULA arrays where the drive current is limited to 5mA. In these circumstances the high gain and 1 amp capability of the ZTX600 can be used to advantage. The following table indicates the performance with various lamps.

Lamp	Peak Cold Current (amps)	Peak V_{CE} (volts)	Mean Power dissipation (mW)	Transistor dissipation
12V 2×2.2W	1.6	1.25	310	1.15W/40msec
12V 1×6.0W	2.7	2.25	382	4.5W/10msec
12V 4×2.2W	3.3	2.30	770	5.4W/20msec

8. A 6 WATT INVERTER FOR MOS LOGIC SUPPLIES

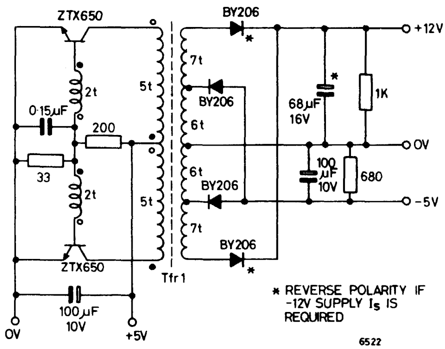


Fig. 8.1.

Transformer details: FX3437 cores wound with:
2-0-2t, 29swg.
5-0-5t, 26swg. Bifilar
13-6-0-6-13t, 29swg.

The 6W inverter shown in fig. 8.1 has been designed to generate the extra power supplies required by popular MOS memories from a normal 5V TTL supply source. It may be used to supply up to eight '2808' Read Only Memories which require supplies of +5V, −5V, and +12V, or if the output components of the 12V section are reversed, the circuit will power over ten '5204' ROM's which require +5V and −12V supplies.

The inverter is a simple push-pull circuit which takes advantage of the high current handling capability of the ZTX650 range. It oscillates at a frequency of approx. 25kHz to use a very small transformer (RM6) and also to render the inverter inaudible. The output characteristics are given in fig. 8.2. Output ripple is approx. 0.15V peak to peak on both outputs.

$I_{5V} = 250mA$ Output Volts	$R_{5V} = 20\Omega$ Output Current (mA)
12.1	10
11.6	100
11.4	200
11.2	300
11.0	400
10.7	500

$I_{5V} = 10mA$ Output Volts	$R_{5V} = 500\Omega$ Output Current (mA)
12.2	10
11.8	100
11.6	200
11.4	300
11.2	400
10.8	500
10.6	600

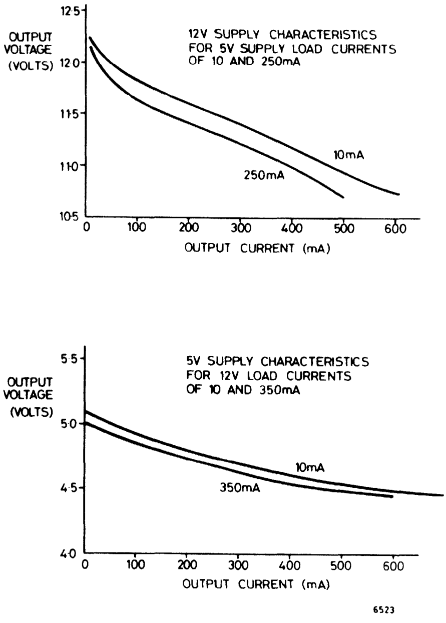


Fig. 8.2.

9. COURTESY LIGHT DELAY SWITCH

This circuit holds on the internal light for approximately 1 minute after the car doors are closed.

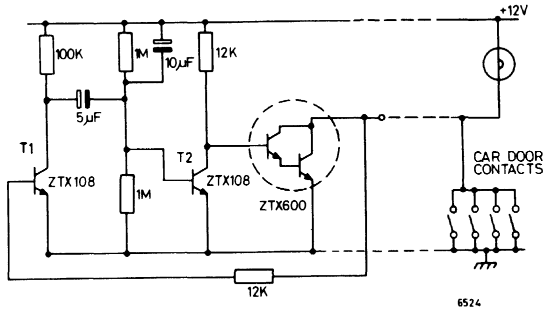


Fig. 9.1.

When the door contacts open, a +ve pulse is applied to the base of T_1. This transistor turns on, turning off T_2 and charging the 10μF capacitor. T_3 turns on, holding on the internal light. The capacitor takes 1 minute to discharge when the circuit reverts to its original state.

10. 8 WATT FLUORESCENT LAMP INVERTER

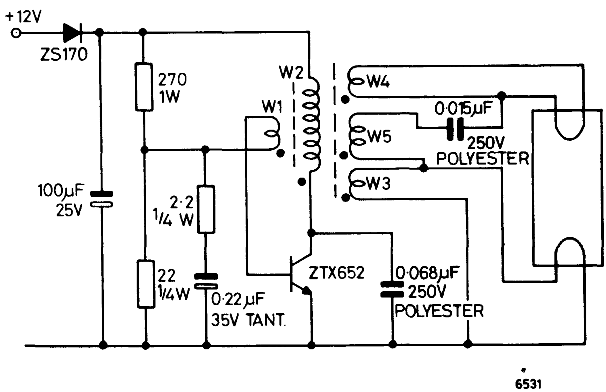


Fig. 10.1

Transformer details. Core type FX3439 with 0.005 in (0.125mm) spacer.

Former type DT 2523

W1 4 turns 34swg. Enamelled Copper Wire

W2 17 turns 26swg. ,, ,, ,,

W3 7 turns 28swg. ,, ,, ,,

W4 7 turns 28swg. ,, ,, ,,

W5 130 turns 36swg ,, ,, ,,

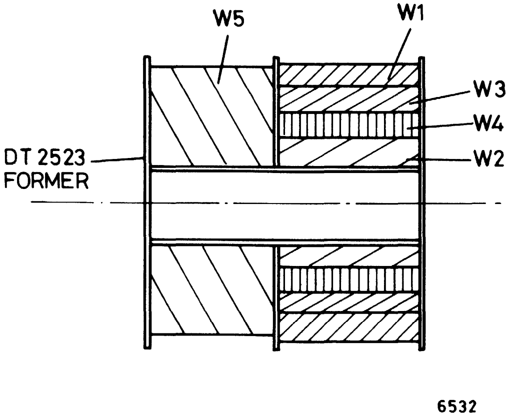


Fig. 10.2

The circuit shown in fig. 10.1 has been designed to drive an 8W fluorescent lamp from a 12V source using an inexpensive inverter based on the ZTX652 transistor. The inverter will operate from supplies in the range of 10V to 16.5V, thus making it suitable for use in on-charge systems such as caravanettes as well as periodically charged systems such as camping lights or outhouse lights etc. Other features of the inverter are that it oscillates at an inaudible 20kHz and that it includes reverse polarity protection.

CIRCUIT OPERATION

The 270Ω and 22Ω resistors bias a ZTX652 transistor into conduction, where the positive feedback given to the transistor by W_1 drives it into saturation, thus applying the supply voltage across W_2. This causes a magnetising current to build up in W_2 until the transformer's ferrite core saturates. When this happens, the base drive given to the transistor by W_1 decays, causing the transistor to rapidly turn off.

Until the fluorescent tube strikes, the transformer is only loaded by the tube heater filaments which present only a minimal load. Thus when the transistor turns off the transformer 'rings' for half a cycle at a frequency governed by the windings inductance and the 0.068μF capacitor, reversing the magnetising current and turning the transistor on again. This 'ring' induces a high voltage pulse across the fluorescent tube which will cause it to strike once the heaters have warmed up.

Once the tube has struck, it loads the transformer heavily, swamping this ringing action and so greatly reducing the peak voltage induced across W_2 and the transistor. This extends the non-conducting period of the inverter cycle and during this period, energy stored in the transformer in the form of magnetising current is dumped into the fluorescent tube. When all this energy has been dumped, the voltage on the transistor collector falls and it switches on once more.

The voltage required to pass current through the tube has now fallen enough for it to conduct during both half cycles of inverter oscillation. Thus when the transistor now turns on, it both drives the fluorescent tube directly and also stores energy in the transformer which drives the tube during the transistor's non-conducting period. The current passed through the tube is controlled by the transformer's leakage inductance and also a series connected 0.015μF capacitor. Waveforms of the transistor's collector voltage and emitter current under normal operating conditions are given in fig. 10.3.

The 2.2Ω resistor and 0.22μF capacitor included in the circuit give the inverter a rapid turn-off characteristic which limits the power dissipation in the transistor to approximately 0.5 watts with the tube lit and with a 12V supply. However the power dissipation in the transistor is much higher if the tube is broken or removed. Taking the worst case conditions of 16.5V supply and no tube, the transistor will dissipate approx. 1.5W. Thus if the inverter may be operated under these conditions as for instance Public Transport applications etc., the transistor should be clamped to a heatsink better than 15°C per watt.

Where the inverter will not remain energised if the tube does not strike, as in the case of camping lights and similar applications, no heatsink is necessary.

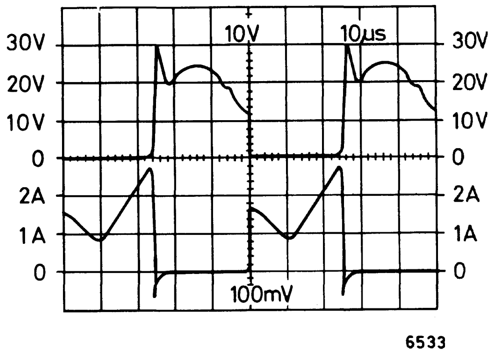


Fig. 10.3.

CONSTRUCTION

Apart from keeping component lead lengths short, the layout of the circuit is not critical. Care should be taken however in winding the transformer (see fig. 10.2). It is advisable to mount the unit in a metal case as this will provide RF screening of the inverter and also provides a ground plain for the fluorescent tube which significantly reduces its striking voltage. The case could also be used as heatsinking for the ZTX652 transistor when required.

11. THE ZTX650/ZTX750 AS LAMP DRIVERS

A 6V, 6W lamp, having a normal on current of 1A, can have an initial peak current of 10A. Switched repeatedly with equal mark and space periods of one second, the peak current reduces to 2.5A as shown in fig. 11.1.

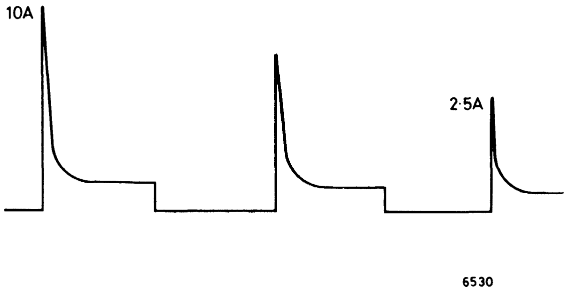


Fig. 11.1.

A transistor with a limited current gain at high currents, will be unable to turn on completely. There will thus be a higher ON voltage across the device and a higher transient power dissipation.

The ZTX650/ZTX750 series, due to their good hold up of gain at high collector currents will reduce this transient dissipation to a minimum.

12. 2 WATT AMPLIFIER USING ZTX650/ZTX750

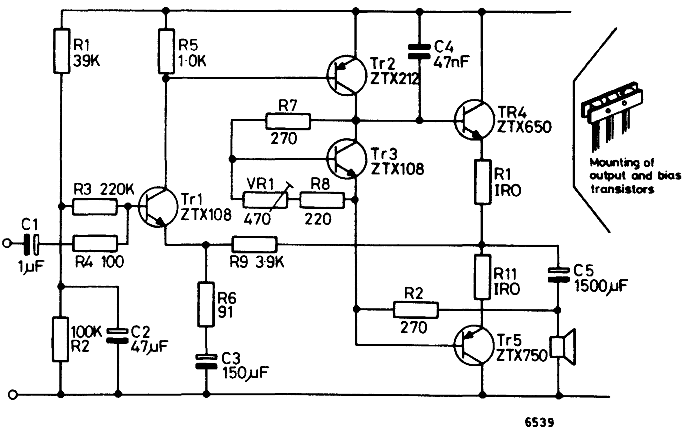


Fig. 12.1.

Readings: Output 2W rms – 8Ω load
Supply Voltage = 15V
Supply Current at 2W = 260mA
Supply Current at zero output = 18mA
Frequency response >20kHz

13. 4.5 WATT AMPLIFIER USING ZTX650/750

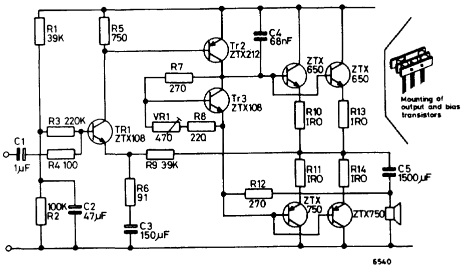


Fig. 13.1.

Readings: Output 4.5 Watts – 8Ω load
Supply Voltage = 20V
Supply Current at 4.5W = 370mA
Supply Current at zero output = 35mA
Frequency response >20kHz

14. STEPPING MOTOR DRIVE

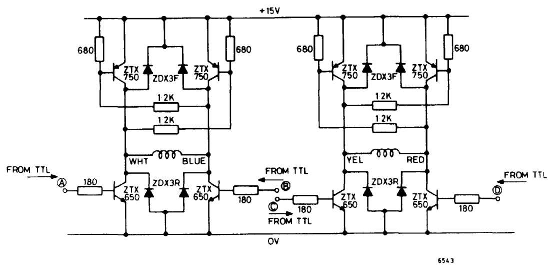


Fig. 14.1.

The circuit shown in fig. 14.1 is designed to drive a 15V two phase bipolar stepping motor, providing a bidirectional single level voltage across each winding at currents of up to 0.6A.

The circuit consists of two identical transistor bridge stages employing complementary NPN and PNP devices. The transistor conduction sequence is determined by external control logic, and the circuit will interface directly with standard TTL. A suitable control logic system is illustrated in fig. 14.2.

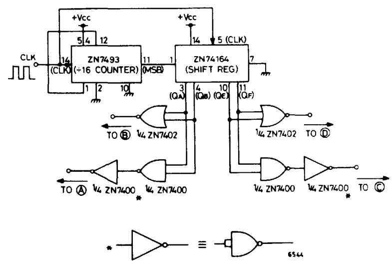


Fig. 14.2.

15. HIGH VOLTAGE TRANSISTORS IN TELEPHONE CIRCUITS

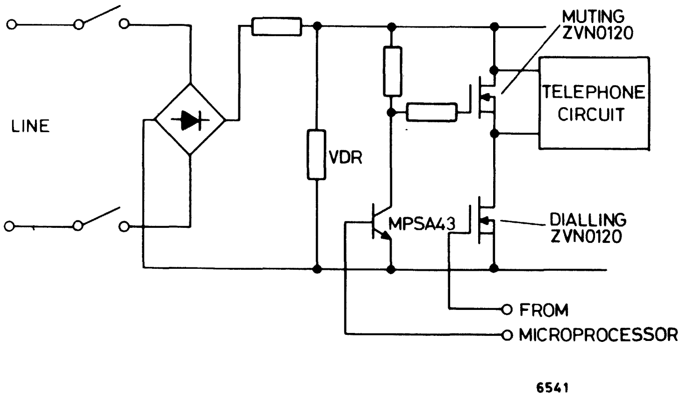


Fig. 15.1.

The MPSA43 is shown as a driving transistor for the VMOS muting switch in a typical modern telephone instrument.

British Telecom Regulations require the instrument to pass a simulated lightning strike test. A voltage dependent resistor reduces the transient voltage to less than 200V and the high voltage rating of the MPSA43 enables it to survive the remaining surge.

16. VIDEO DRIVING TRANSISTORS FOR COLOUR TELEVISION

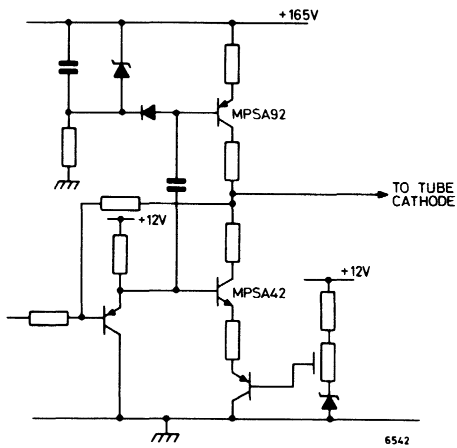


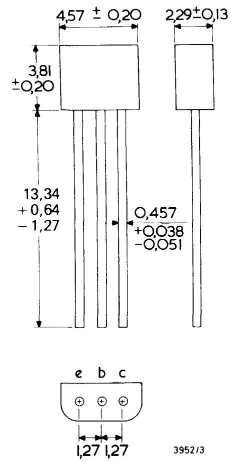
Fig. 16.1.

The MPSA42/MPSA92 are shown in a push-pull circuit suitable for driving the cathode of a colour television tube.

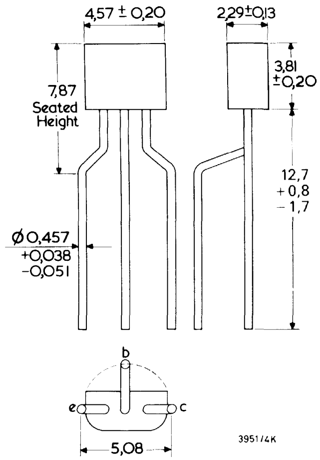
PACKAGE OUTLINES

LEAD CONFIGURATIONS

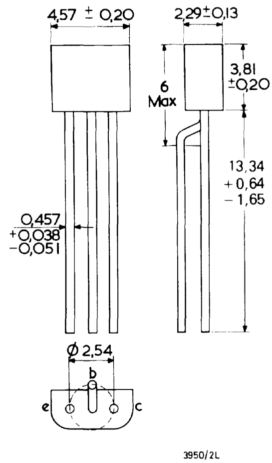
Devices can be ordered with the following lead configurations by adding the indicated suffix to the part number.



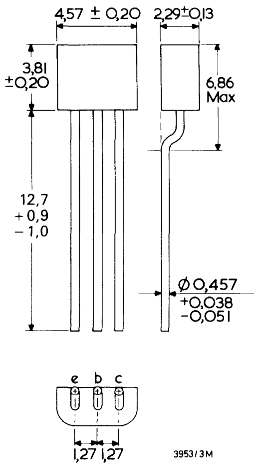
STANDARD PACKAGE
BS 3934 .. SO-94



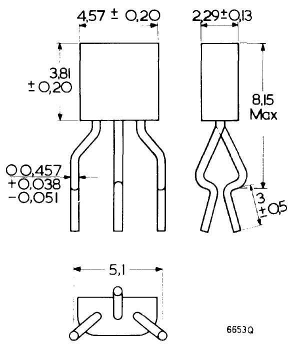
'K' LEAD FORMATION
for TO-5 and TO-39 compatibility
BS 3934 .. SO-95



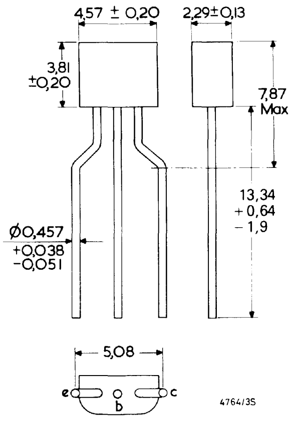
'L' LEAD FORMATION
for TO-18 compatibility
BS 3934 .. SO-97



'M' LEAD FORMATION
for flat mounting
BS 3934 .. SO-96



'Q' LEAD FORMATION



'S' LEAD FORMATION

TO-92

NOTE

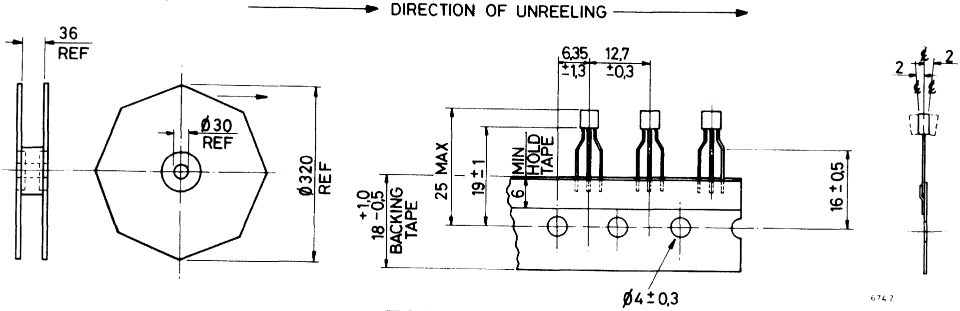
The 'S' type lead formation is pin compatible with the popular TO-202 PLASTIC POWER transistor.

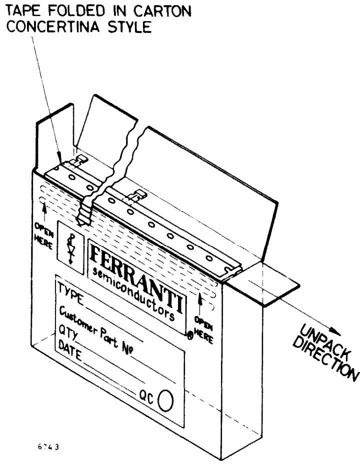
TAPED PRODUCT

E-line transistors can be supplied on tape for automatic insertion. Two types of packaging are available:

(a) The tape, bearing the devices, is wound on a reel and supplied in a cardboard box.

(b) The tape, bearing the devices, is folded in a concertina (or Z) form and supplied in a cardboard box (Ammo Pack).





TAPE FEATURES

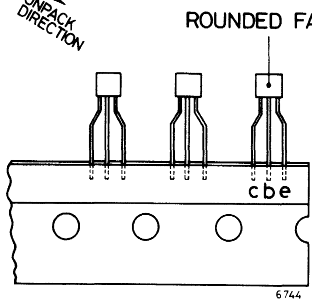
- Each Reel or Box contains 2000 devices.
- No more than 2 consecutive vacant spaces on the tape.
- Minimum of 5 vacant spaces at beginning and end of tape.
- Available with choice of orientation

To order E-line transistors on tape, the following format should be used.

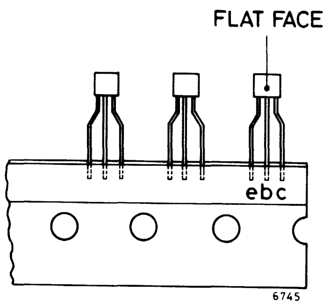
(a) Suffix 'STO' for product taped and put on reels.

(b) Suffix 'STZ' for product taped and folded (Ammo Pack).

(c) Orientation (option A or B).
e.g. ZTX 650 STOA.



OPTION A



OPTION B

STAVER HEAT CLIP

The Staver Heat Clip type F2-7 referred to on certain data sheets can be obtained from:

STAVER THERMAL PRODUCTS (U.K.) Ltd.,
Industrial Estate, Wickford,
Essex SS1 8QR
Tel: Wickford (03744) 3346   Telex: 995689

GLOSSARY

Explanation of Symbols used in Tables and Data

Symbol	Parameter
C_{obo}	Output capacitance
$-C_{re}$	Feedback capacitance
f	Frequency
f_T	Transition frequency
h_{FE}	Static forward current transfer ratio
I_B	Base current
I_{B1}	Control current
I_{B2}	Turn-off base current
I_C	Collector current
I_{CBO}	Collector-base cut-off current
I_{CEO}	Collector-emitter cut-off current
I_{CER}	Collector-emitter cut-off current (with external resistor)
I_{CM}	Peak pulse current
I_E	Emitter current
I_{EBO}	Emitter-base cut-off current
P_{tot}	Maximum continuous package dissipation
P_{totp}	Practical power dissipation
t_d	Delay time
t_f	Fall time
t_{off}	Turn-off time ($t_{off} = t_r + t_{stg}$)
t_{on}	Turn-on time ($t_{on} = t_d + t_r$)
t_r	Rise time
t_{stg}	Storage time
T_{amb}	Ambient temperature
T_{case}	Case temperature
T_j	Junction temperature
T_{stg}	Storage temperature
V_{BE}	Base-emitter voltage
$V_{BE(ON)}$	Base-emitter turn-on voltage
$V_{BE(sat)}$	Base-emitter saturation voltage
$V_{(BR)CBO}$	Collector-base breakdown voltage
$V_{(BR)CEO}$	Collector-emitter breakdown voltage
$V_{(BR)EBO}$	Emitter-base breakdown voltage
V_{CB}	Collector-base voltage
V_{CBO}	Collector-base voltage with emitter open ($I_E = 0$)
V_{CEO}	Collector-emitter voltage with base open ($I_B = 0$)
$V_{CEO(sus)}$	Collector-emitter sustaining voltage
$V_{CE(sat)}$	Collector-emitter saturation voltage