

High Frequency Powerline N-Channel IGBT With Ultrafast Diode

Supersedes October 1998, version DS5045-1.2

DS5045-2.1 March 1999

The ITH13C06 is a very robust n-channel, enhancement mode insulated gate bipolar transistor (IGBT) designed for low power dissipation in a wide range of high voltage applications such as power supplies and motor drives. The high impedance gate simplifies gate drive considerations, allowing operation directly from low power control circuitry.

Fast rise and fall times allow very high frequency switching making the device suitable for modern systems employing high frequency switching.

Low saturation voltages minimise power dissipation, thereby reducing the cost of the overall system in which they are used.

The ITH is fully short circuit rated making it especially suited for motor control and other applications requiring short circuit with stand capability. Each device in the Powerline range is available with or without an integral anti-parallel ultrafast soft recovery diode, see separate datasheet for discrete device

Typical applications include high frequency inverters for motor control, welding and heating apparatus. The Powerline range of IGBTs is also applicable to switched mode and uninterruptible power supplies.

Features

- Enhancement Mode n-Channel Device
- High Switching Speed
- Low On-state Saturation Voltage
- High Input Impedance Simplifies Gate Drive
- Latch-Free Operation
- Fully Short Circuit Rated To 10μs
- Square RBSOA
- Integral Fast Recovery Diode

Applications

- High Frequency Inverters
- Motor Control
- Switched Mode Power Supplies
- High Frequency Welding
- Heating/Cooking Apparatus

Key Parameters

V_{CES}	(max)	600V
$V_{CE(sat)}$	(typ)	2.3V
I_{C25}	(max)	23A
I_{C85}	(max)	13A
I_{CM}	(max)	39A
t_{sc}	(max)	10μs

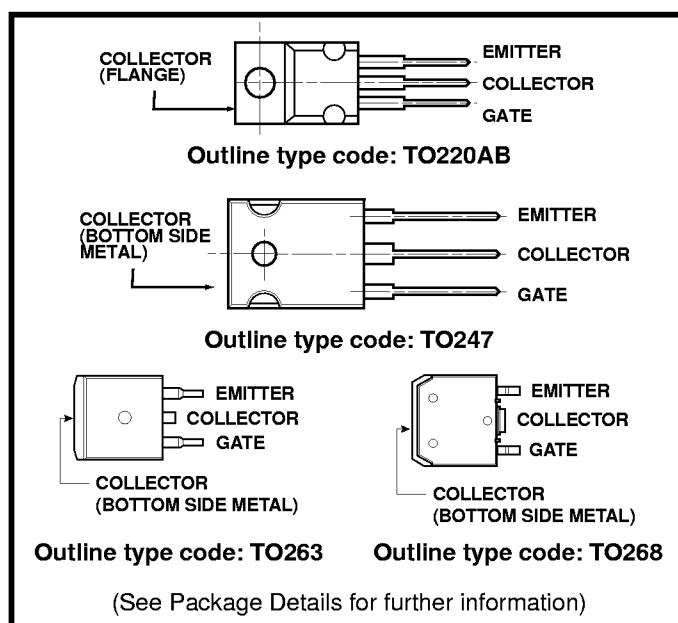


Fig.1 Pin connections - top view (not to scale)

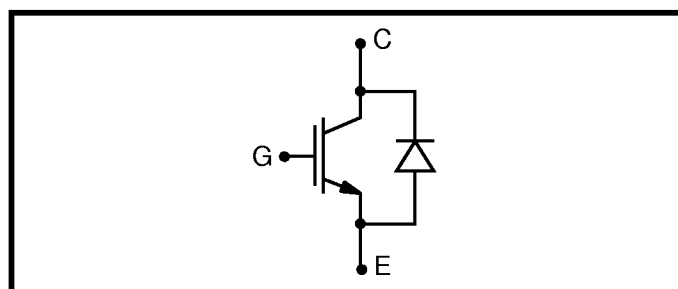


Fig.2 ITH13C06 circuit

Ordering Information

ITH13C06B	TO220 (with fast recovery diode)
ITH13C06A	TO263 (D2 PACK) (with fast recovery diode)
ITH13C06J	TO268 (D3 PACK) (with fast recovery diode)
ITH13C06P	TO247 (with fast recovery diode)

Note: When ordering, use the complete part number.

Caution: These devices are sensitive to electrostatic discharge. Users should observe proper ESD handling precautions.

Absolute Maximum Ratings

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device.

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Max.	Units
V _{CES}	Collector-emitter voltage	V _{GE} = 0V	600	V
V _{GES}	Gate-emitter voltage	-	±20	V
I _{C25}	Continuous collector current	T _{case} = 25°C	23	A
I _{C85}	Continuous collector current	T _{case} = 85°C	13	A
I _{CM}	Pulsed collector current	1 ms, T _{case} = 85°C	39	A
P _{tot}	Power dissipation	T _{case} = 85°C	54	W

Thermal and Mechanical Ratings

Symbol	Parameter	Conditions	Min.	Max.	Units
R _{th(j-c)}	Thermal resistance - IGBT	DC junction to case	-	1.2	°C/W
R _{th(j-c)}	Thermal resistance - Diode	DC junction to case	-	3.0	°C/W
T _{OP}	Operating junction temperature range	-	-40	150	°C
T _{stg}	Storage temperature range	-	-40	150	°C
-	Maximum lead temperature for soldering	5 seconds, 3mm from package	-	300	°C
-	Mounting torque (TO220)	M3 screw	-	1.1	Nm

DC Electrical Characteristics

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I _{CES}	Collector cut-off current	V _{GE} = 0V, V _{CE} = 600V	-	-	0.25	mA
I _{GES}	Gate leakage current	V _{GE} = 20V, V _{CE} = 0V	-	-	±500	nA
V _{GE(TH)}	Gate threshold voltage	I _C = 0.5mA, V _{CE} = V _{GE}	4.5	6	7.5	V
V _{CE(SAT)}	Collector-emitter saturation voltage	V _{GE} = 15V, I _C = 13A	-	2.3	2.8	V
		V _{GE} = 15V, I _C = 13A, T _j = 125°C	-	2.5	-	V

AC Electrical Characteristics

$T_{\text{case}} = 25^{\circ}\text{C}$ unless stated otherwise.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
C_{ies}	Input capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	1470	-	pF
C_{oes}	Output capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	118	-	pF
C_{res}	Reverse transfer capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	15.6	-	pF

Inductive Switching Characteristics - see figures 3 to 5

$T_{\text{case}} = 25^{\circ}\text{C}$ unless stated otherwise.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{d(ON)}$	Turn-on delay time	$I_C = 13A,$ $V_{GE} = 15V,$ $V_{CE} = 50\%V_{ces}$ $R_{G(ON)} = R_{G(OFF)} = 5\Omega$	-	85	-	ns
t_r	Rise time		-	32	-	ns
E_{ON}	Turn-on energy loss - per cycle		-	180	-	μJ
$t_{d(OFF)}$	Turn-off delay time		-	145	-	ns
t_f	Fall time		-	150	300	ns
E_{OFF}	Turn-off energy loss - per cycle		-	380	-	μJ
$T_{case} = 125^{\circ}C$ unless stated otherwise.						
$t_{d(ON)}$	Turn-on delay time	$I_C = 13A,$ $V_{GE} = 15V,$ $V_{CE} = 50\%V_{ces}$ $R_{G(ON)} = R_{G(OFF)} = 5\Omega$	-	85	-	ns
t_r	Rise time		-	35	-	ns
E_{ON}	Turn-on energy loss - per cycle		-	300	-	μJ
$t_{d(OFF)}$	Turn-off delay time		-	160	-	ns
t_f	Fall time		-	290	-	ns
E_{OFF}	Turn-off energy loss - per cycle		-	600	-	μJ

For additional switching information please refer to figures 8 to 13.

Short Circuit Rating

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
t_{sc}	Short circuit withstand time	$T_{\text{c}} = 125^{\circ}\text{C}, V_{\text{GE}} = 15\text{V}, V_{\text{CE}} = 50\% V_{\text{CES}}$	-	-	10	μs

Diode Characteristics

T_c = 25°C unless stated otherwise.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V _{FM}	Forward voltage	At I _F = 13A peak	-	1.4	-	V
		At I _F = 13A peak, T _{case} = 125°C	-	1.3	-	V
t _{rr}	Reverse recovery time	I _F = 13A, di _{RR} /dt = 200A/μs	-	60	-	ns
I _{RRM}	Reverse recovery current	V _R = 50%V _{RRM}	-	10	-	A

Basic Test Circuit and Switching Definitions

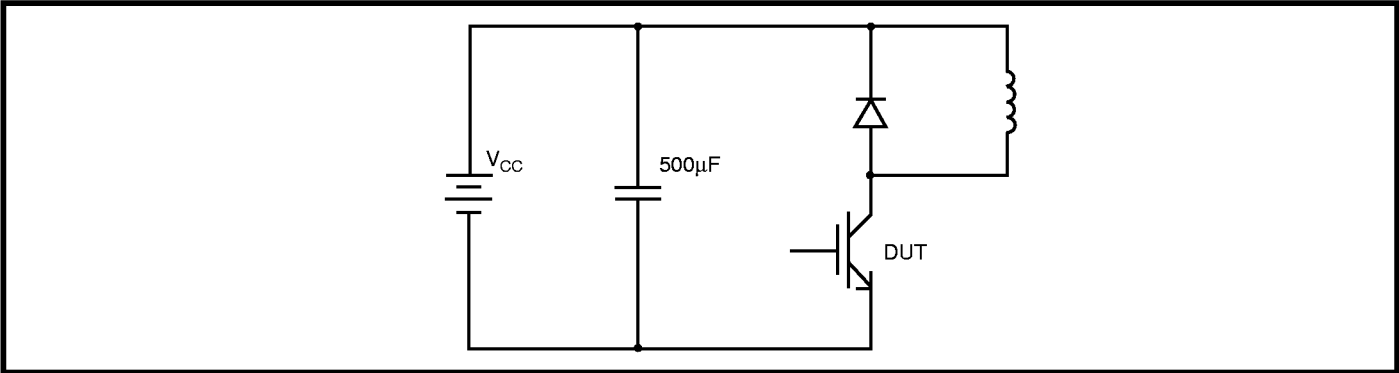


Fig.3 Basic d.c. chopper clruit

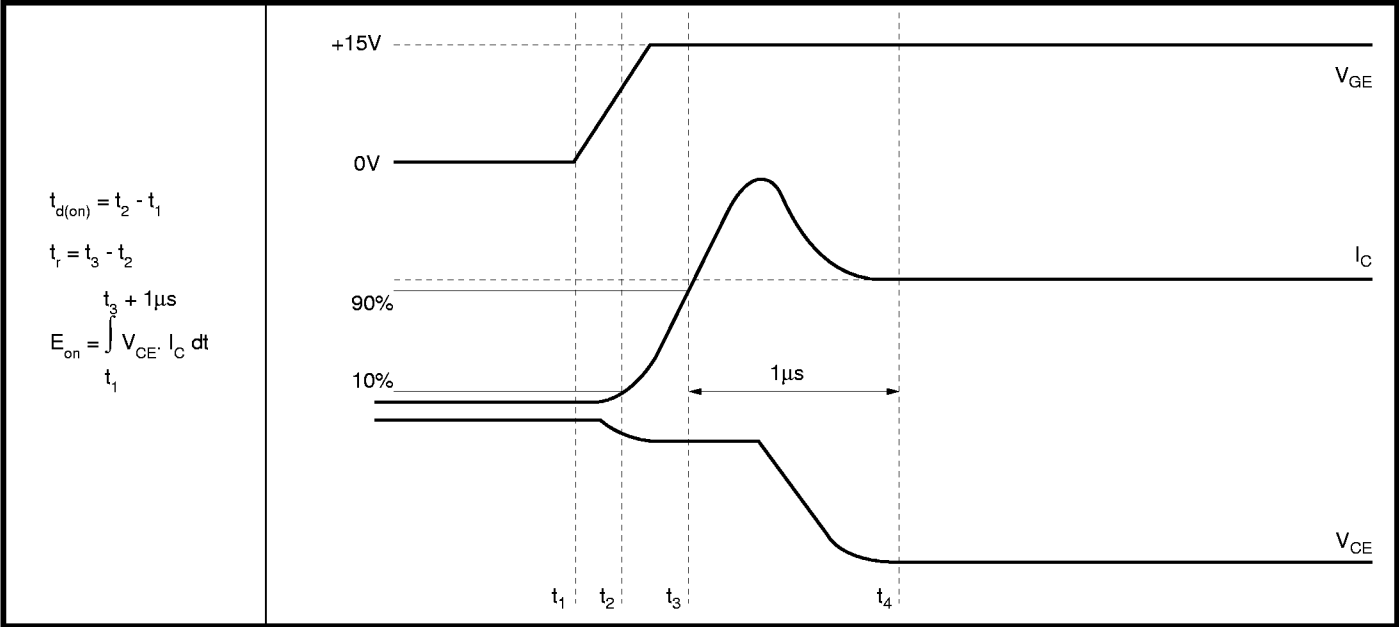


Fig.4 Turn-on characteristics

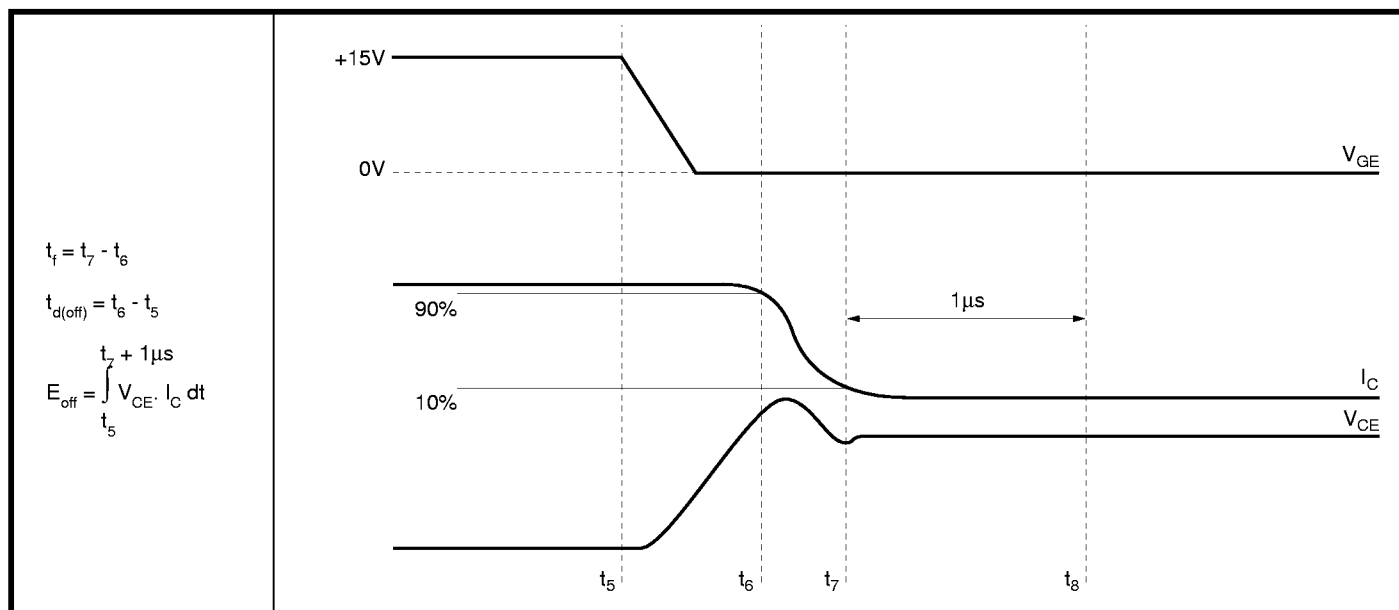


Fig.5 Turn-off characteristics

Curves

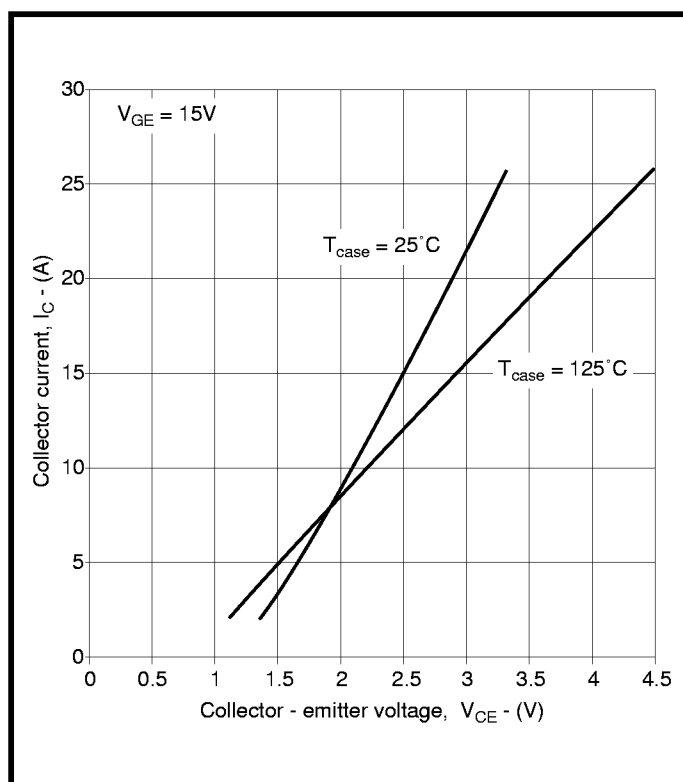


Fig.6 Typical output characteristics

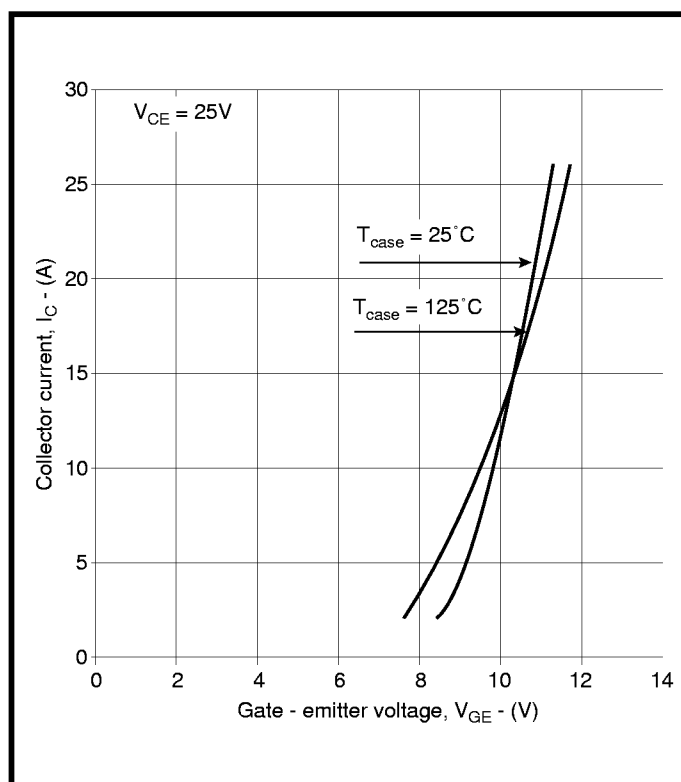


Fig.7 Typical transfer characteristics

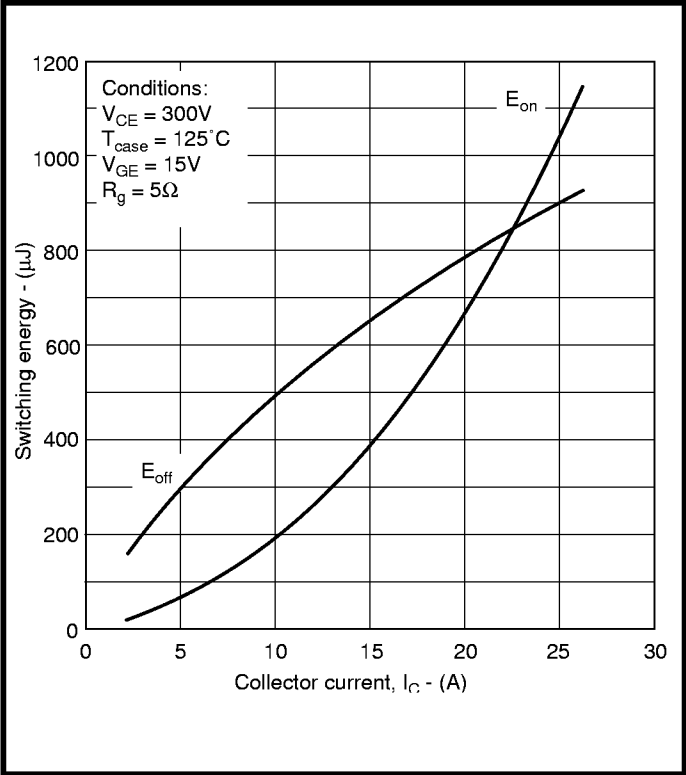


Fig.8 Typical switching losses vs collector current

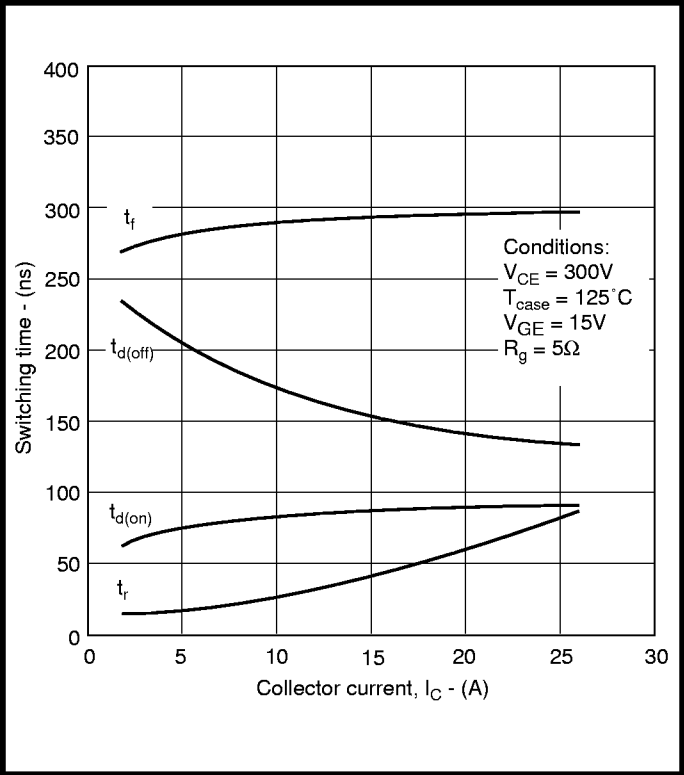


Fig.9 Typical switching times vs collector current

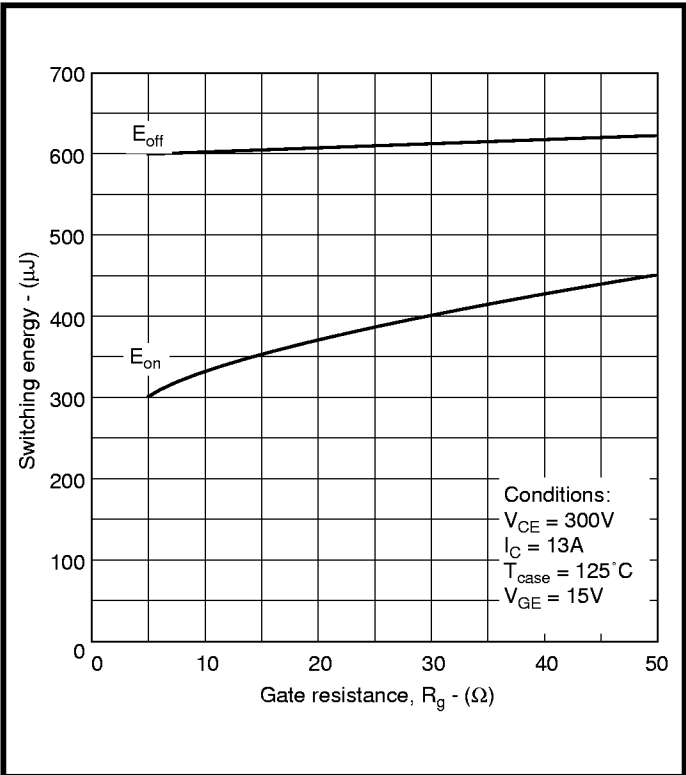


Fig.10 Typical switching losses vs gate resistance

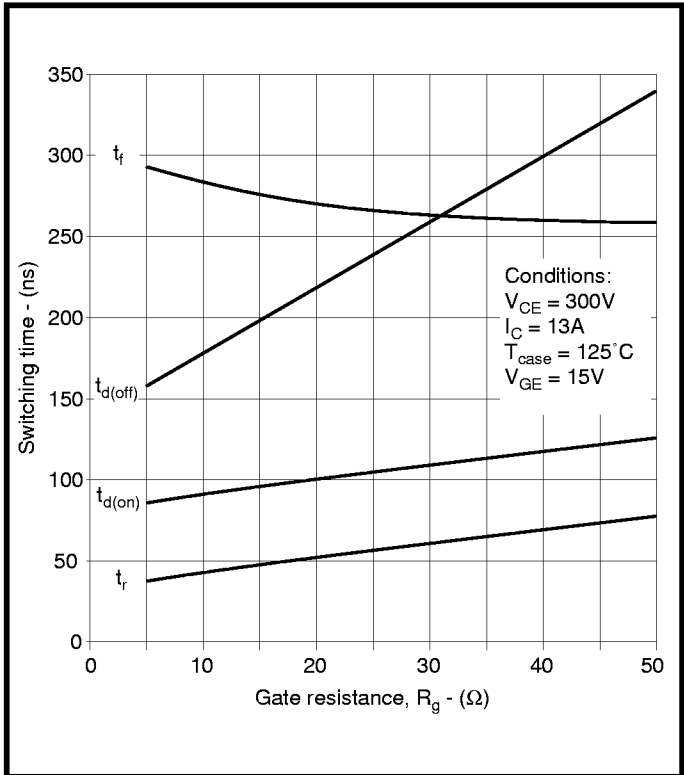


Fig.11 Typical switching times vs gate resistance

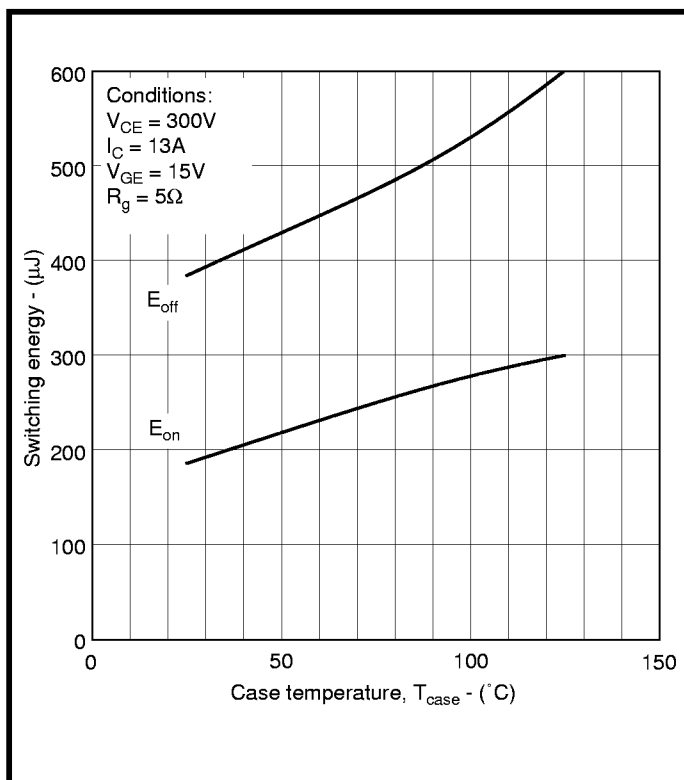


Fig.12 Typical switching losses vs case temperature

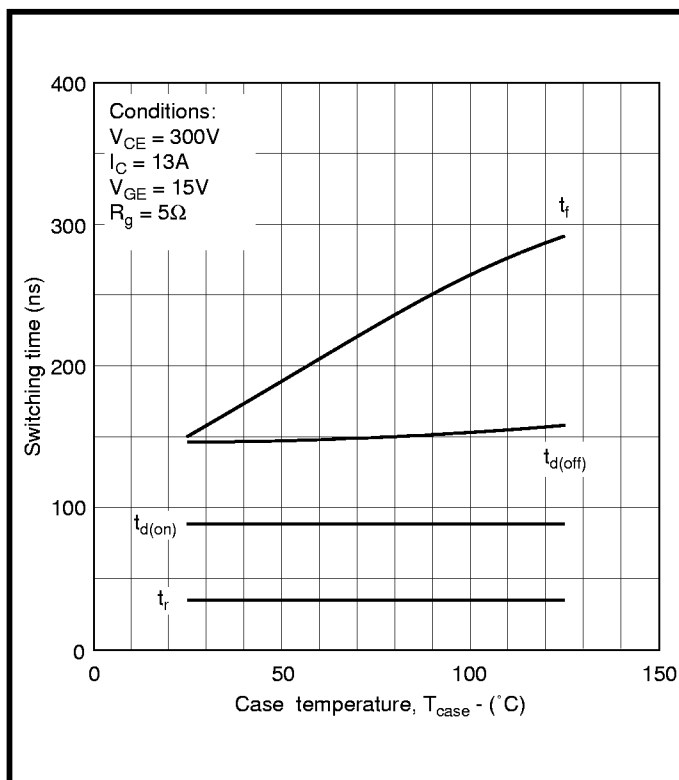


Fig.13 Typical switching times vs case temperature

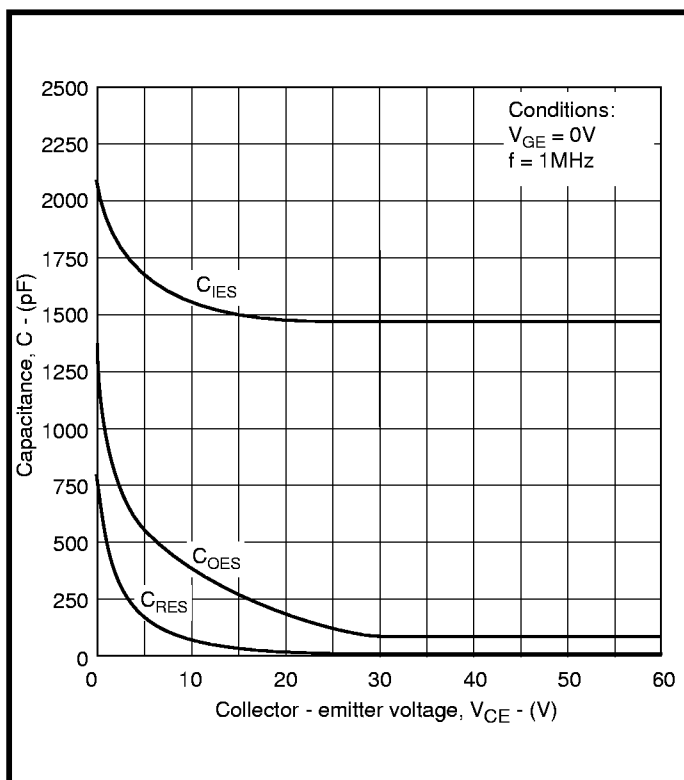


Fig.14 Typical capacitance

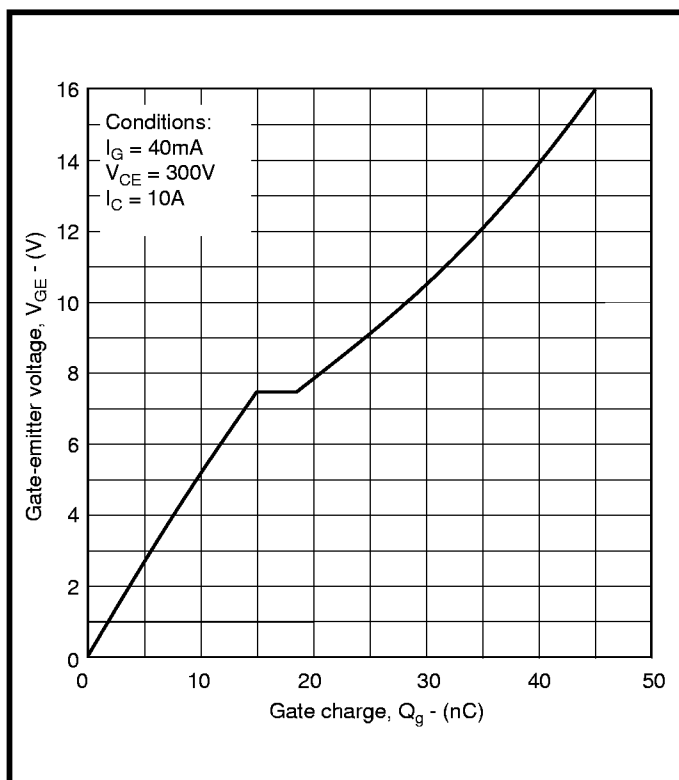


Fig.15 Typical gate charge

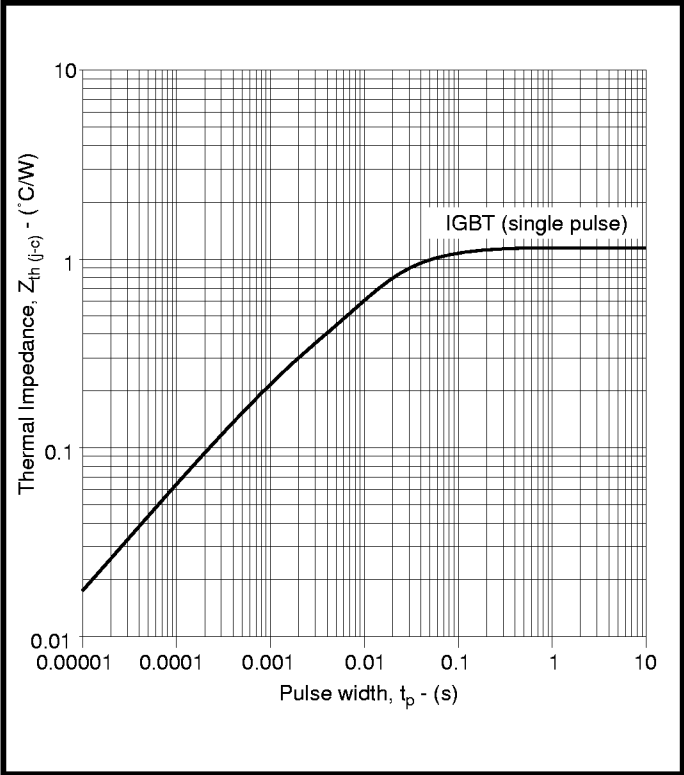


Fig.16 Transient thermal impedance - junction to case

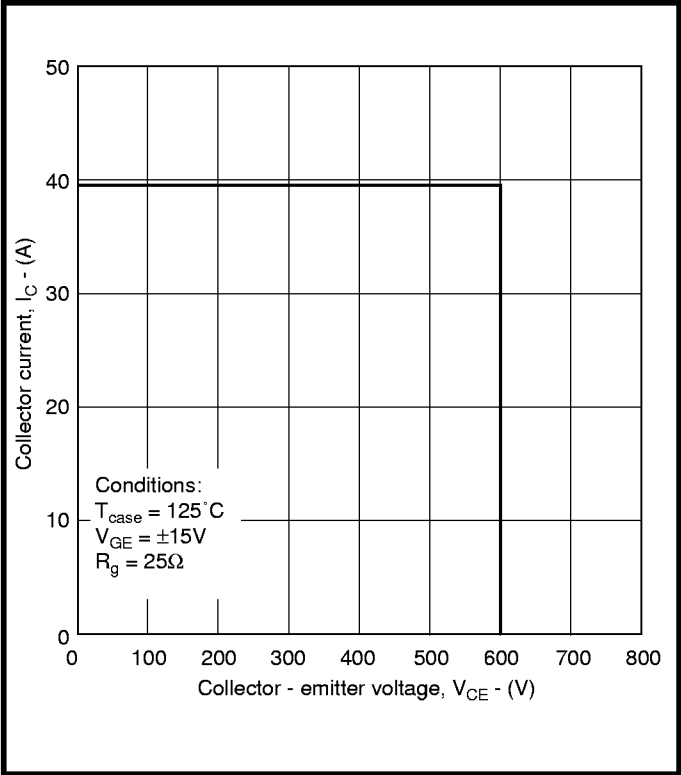


Fig.17 Reverse bias safe operating area

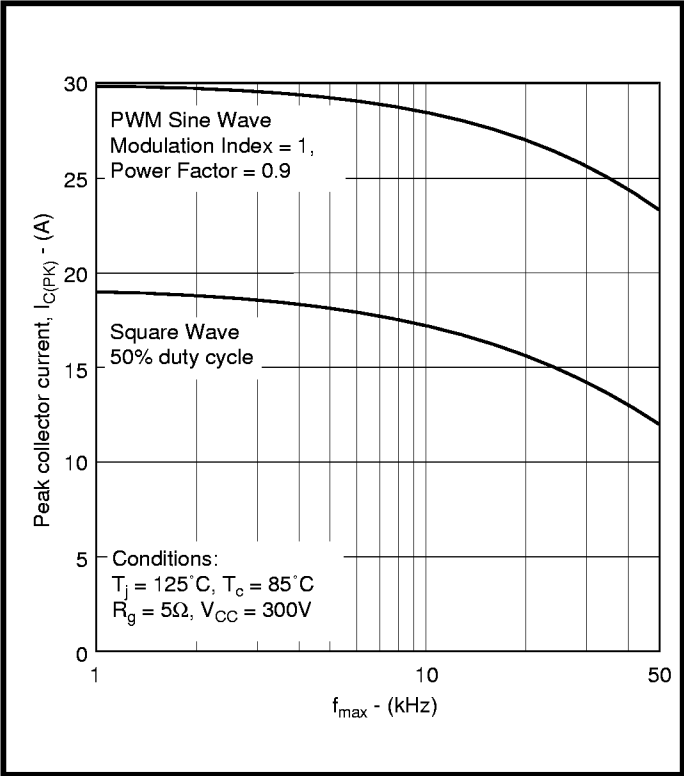


Fig.18 Three Phase PWM inverter operating frequency

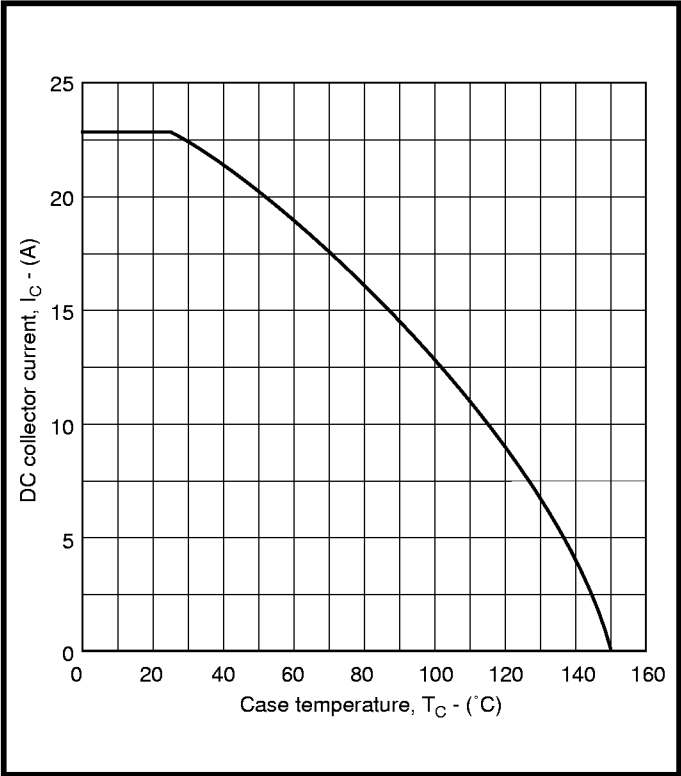


Fig.19 DC current vs case temperature

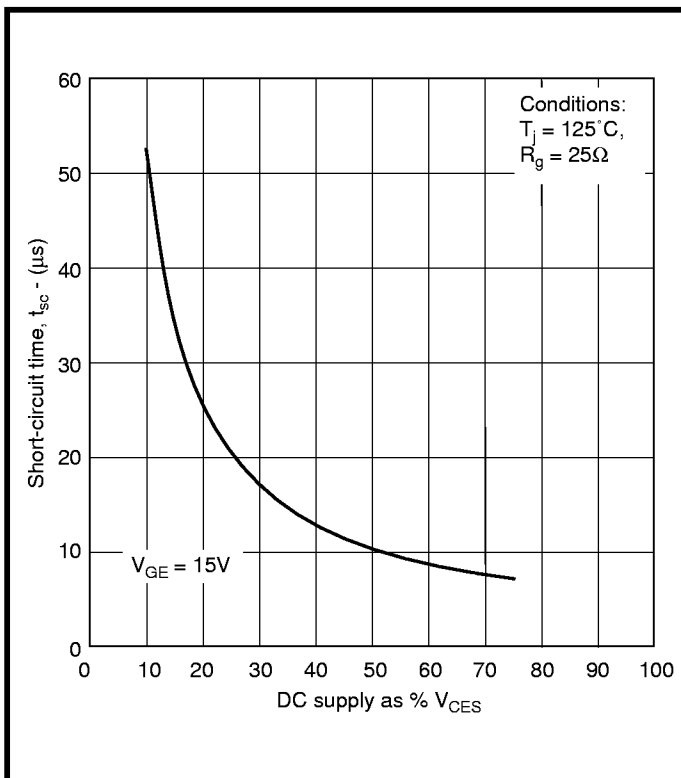


Fig.20 Short-circuit withstand

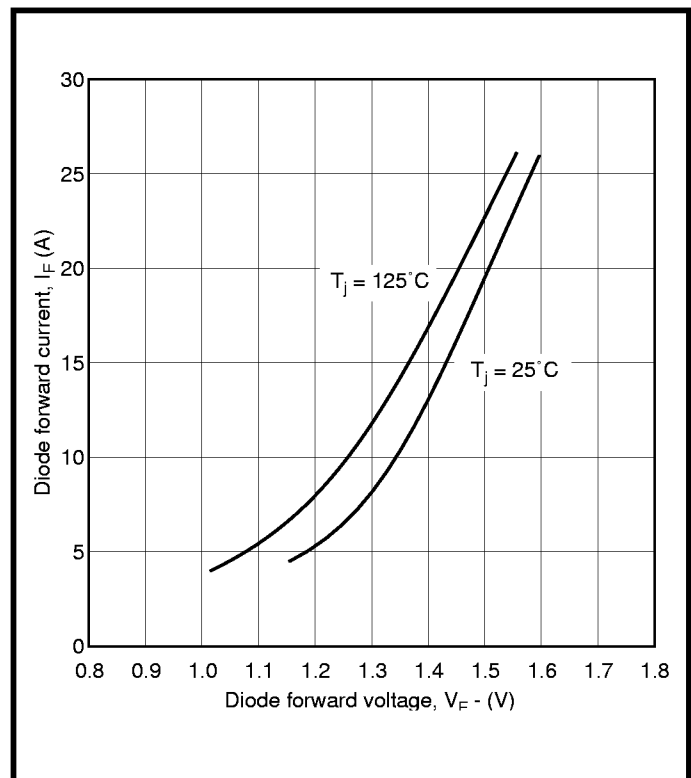
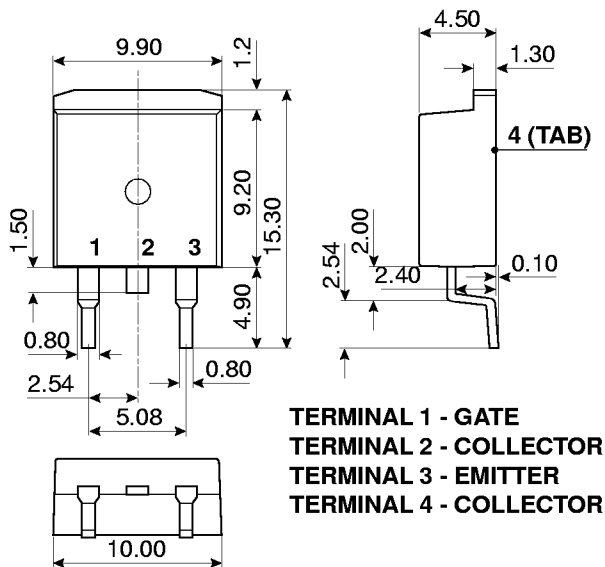
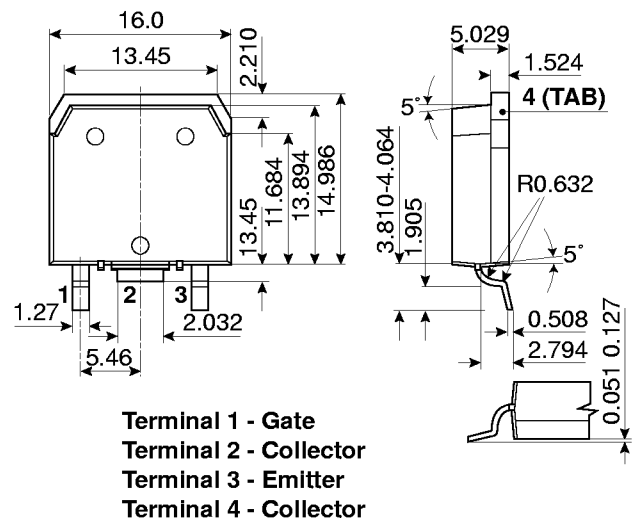
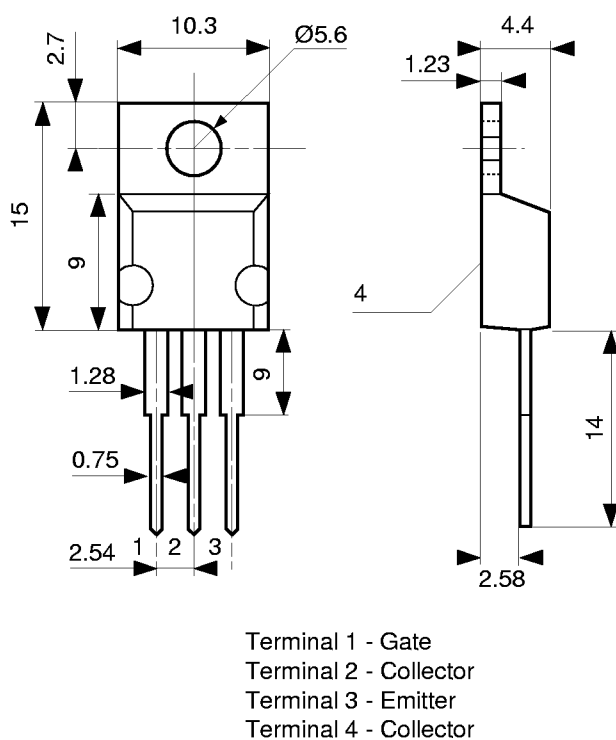
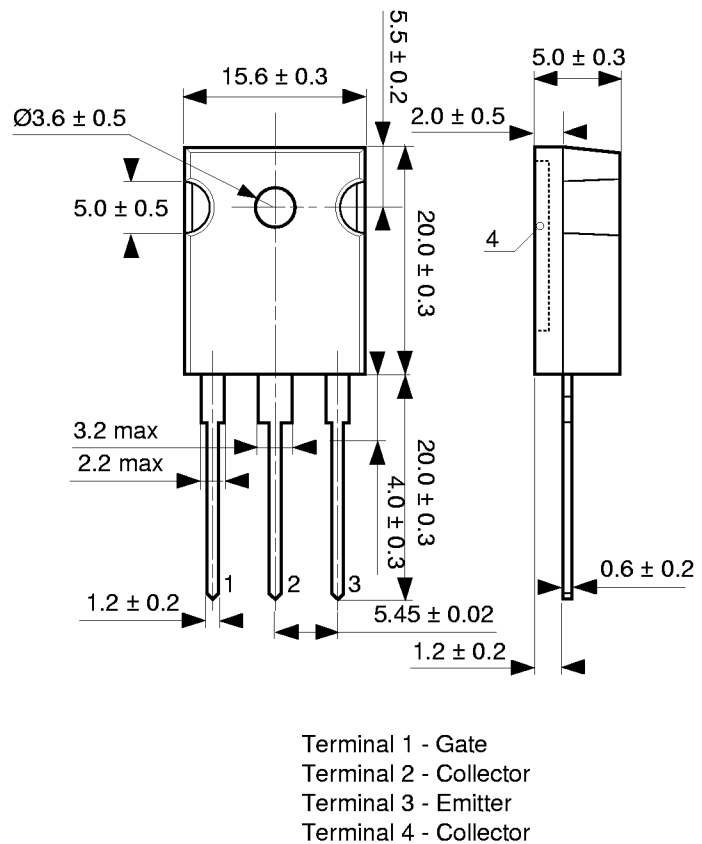


Fig.21 Diode typical forward characteristics

Package Details

For further package information, please contact your local Customer Service Centre. All dimensions in mm, unless stated otherwise. DO NOT SCALE.

**PACKAGE OUTLINE TYPE: TO263 (D2 PACK)****PACKAGE OUTLINE TYPE: TO268 (D3 PACK)****PACKAGE OUTLINE TYPE: TO220AB****PACKAGE OUTLINE TYPE: TO247**