ITE60F06/ITE60C06

POWERLINE N-CHANNEL IGBT WITH OPTIONAL ULTRAFAST DIODE

The ITE60X06 is a 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 ultrasonic switching.

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

Each device in the Powerline range is available with or without an integral anti-parallel ultrafast soft recovery diode, see Ordering Information.

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

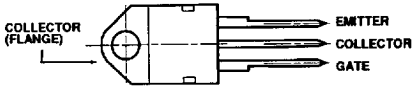
- Enhancement Mode n-Channel Device
- High Switching Speed
- Low On-state Saturation Voltage
- High Input Impedance Simplifies Gate Drive
- Latch-Free Operation
- Optionally Available With Integral Fast Recovery Diode

APPLICATIONS

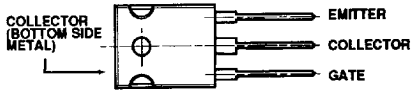
- High Frequency Inverters
- Motor Control
- Switched Mode Power Supplies
- High Frequency Welding
- Heating/Cooking Apparatus

ORDERING INFORMATION

ITE60C06	(TO218 With fast recovery diode)
ITE60F06	(TO247 Without fast recovery diode)



Outline type code: TO218



Outline type code: TO247

(See Package Outlines for further information)

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

IGBT KEY PARAMETERS

V_{CES}	600V
$V_{CE(sat)}$	2.5V
$I_{C(CONT)}$	60A
$I_{C(PK)}$	120A
t_r	150ns
t_f	200ns

DIODE KEY PARAMETERS

V_{RRM}	600V
I_F	55A
t_{rr}	50ns

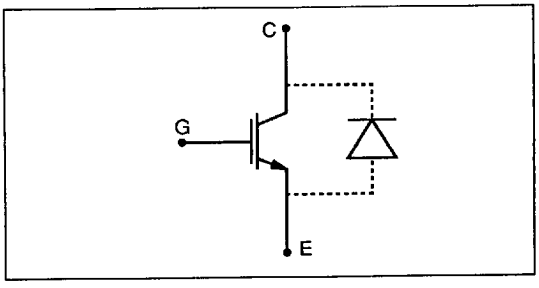


Fig.2 ITE60X06 circuit

IGBT ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

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_C	Collector current	DC, T_{case} = 85°C	60	A
I_{CM}		1ms, T_{case} = 85°C	120	A
P_{tot}	Power dissipation	T_{case} = 85°C	150	W

THERMAL AND MECHANICAL RATINGS

Symbol	Parameter	Conditions	Min.	Max.	Units
$R_{th(j-c)}$IGBT	Thermal resistance - IGBT	DC junction to case	-	0.42	°C/W
$R_{th(j-c)}$DIODE	Thermal resistance - Diode	DC junction to case	-	0.7	°C/W
T_j	Junction temperature (IGBT/Diode)	-	–40	150	°C
T_{op}/T_{stg}	Operating and storage temp. range (IGBT/Diode)	-	–40	150	°C

IGBT 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	-	-	1	mA
I_{GES}	Gate leakage current	V_{GE} = 15V, V_{CE} = 0V	-	-	500	nA
$V_{GE(TH)}$	Gate threshold voltage	I_C = 2mA, V_{GE} = V_{CE}	3.0	4.5	6.0	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	V_{GE} = 15V, I_C =60A	-	2.2	2.5	V

IGBT AC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
C_{ies}	Input capacitance	V_{CE} =25V, V_{GE} = 15V, f = 1MHz	-	4900	-	pF
C_{oes}	Output capacitance	V_{CE} = 25V, V_{GE} = 15V, f = 1MHz	-	1300	-	pF
C_{res}	Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 15V, f = 1MHz	-	1150	-	pF

IGBT RESISTIVE SWITCHING CHARACTERISTICS

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{d(ON)}$	Turn-on delay time	I_C = 60A, V_{GE} = ±15V, V_{CE} = 50%V_{ces} $R_{G(ON)}$ = $R_{G(OFF)}$ =2.7Ω	-	150	-	ns
t_r	Rise time		-	200	-	ns
E_{ON}	Turn-on energy loss - per cycle		-	1.1	-	mWs
$t_{d(OFF)}$	Turn-off delay time		-	200	-	ns
t_f	Fall time		-	200	300	ns
E_{OFF}	Turn-off energy loss - per cycle		-	1.5	-	mWs

IGBT INDUCTIVE SWITCHING CHARACTERISTICS

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{d(off)}$	Turn-off delay time	I_C = 60A, V_{GE} = ±15V V_{CE} = 50% V_{CES}, $R_{G(ON)}$ = $R_{G(OFF)}$ = 2.7Ω	-	300	-	ns
t_f	Fall time		-	170	200	ns
E_{OFF}	Turn-off energy loss - per cycle		-	1.4	-	mWs

DIODE ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

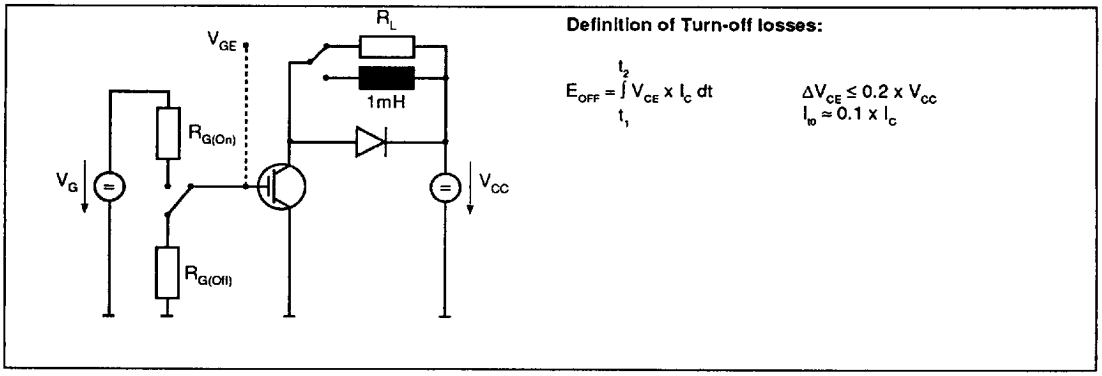
Symbol	Parameter	Conditions	Max.	Units
V_{RRM}	Repetitive peak reverse voltage	T_{case} = 150°C	600	V
I_F	Forward current	Half wave resistive load, T_{case} = 85°C	55	A

DIODE CHARACTERISTICS

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{FM}	Forward voltage	At I_F = 55A peak	-	-	1.6	V
I_{RM}	Peak reverse current	At V_{RRM}, T_{case} = 125°C	-	-	5.0	mA
t_{rr}	Reverse recovery time	I_F = 55A, di_{RR}/dt = 200A/µs	-	50	-	ns
I_{RRM}	Reverse recovery current	V_R = 50%V_{RRM}	-	25	-	A

MEASUREMENT OF SWITCHING TIMES AND POWER DISSIPATION



Definition of Turn-off losses:

$$E_{OFF} = \int_{t_1}^{t_2} V_{CE} \times I_C \, dt$$

$\Delta V_{CE} \leq 0.2 \times V_{CC}$
$I_{to} \approx 0.1 \times I_C$

Fig.3 Test circuit

DEFINITION OF SWITCHING TIMES

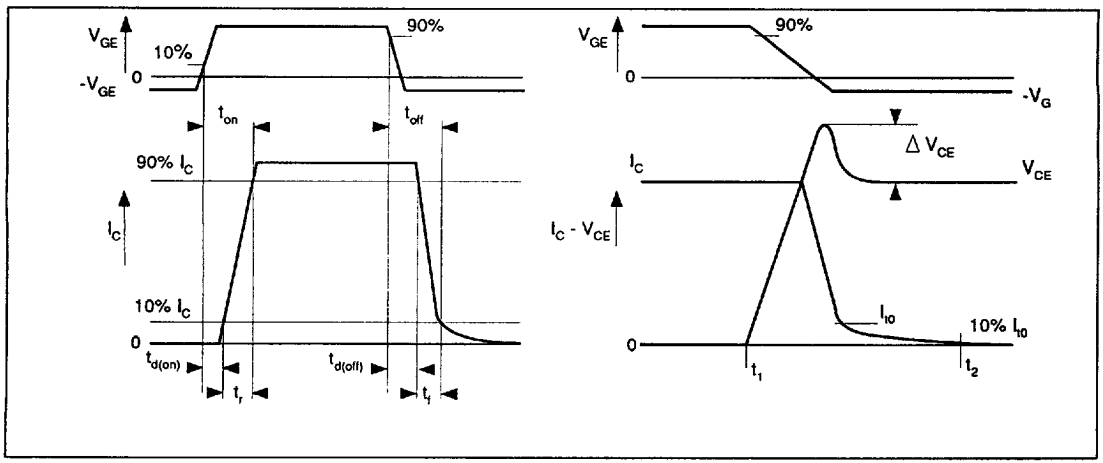
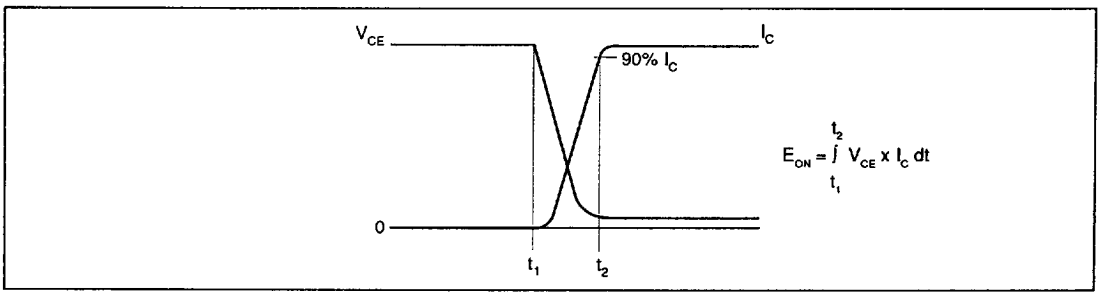


Fig.4 Definition of switching times



$$E_{ON} = \int_{t_1}^{t_2} V_{CE} \times I_C \, dt$$

Fig.5 Definition of turn on losses

CURVES

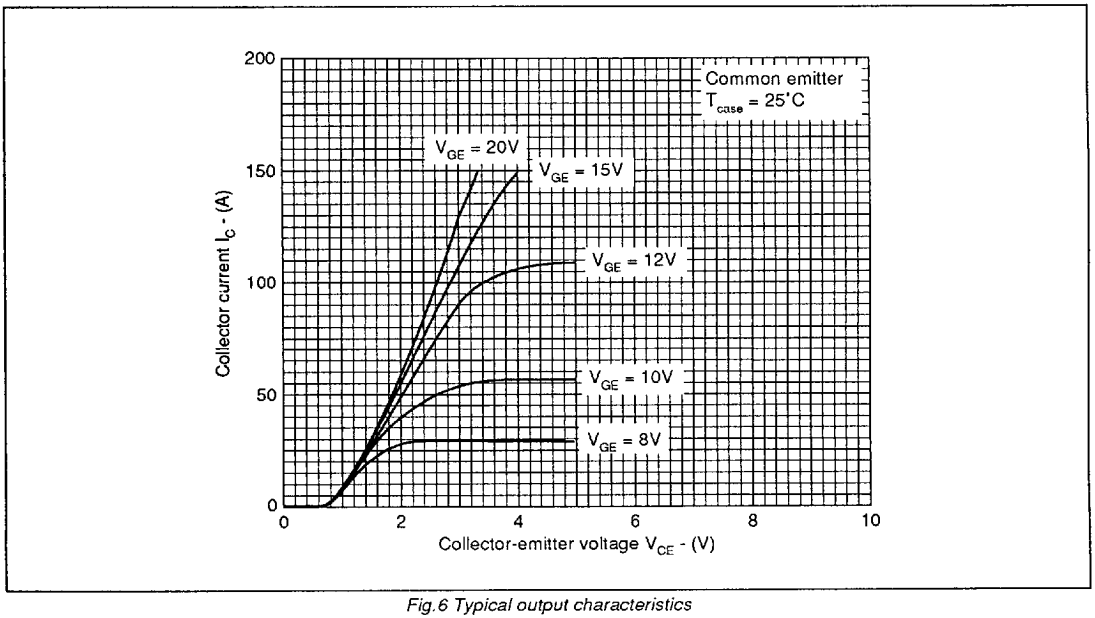


Fig.6 Typical output characteristics

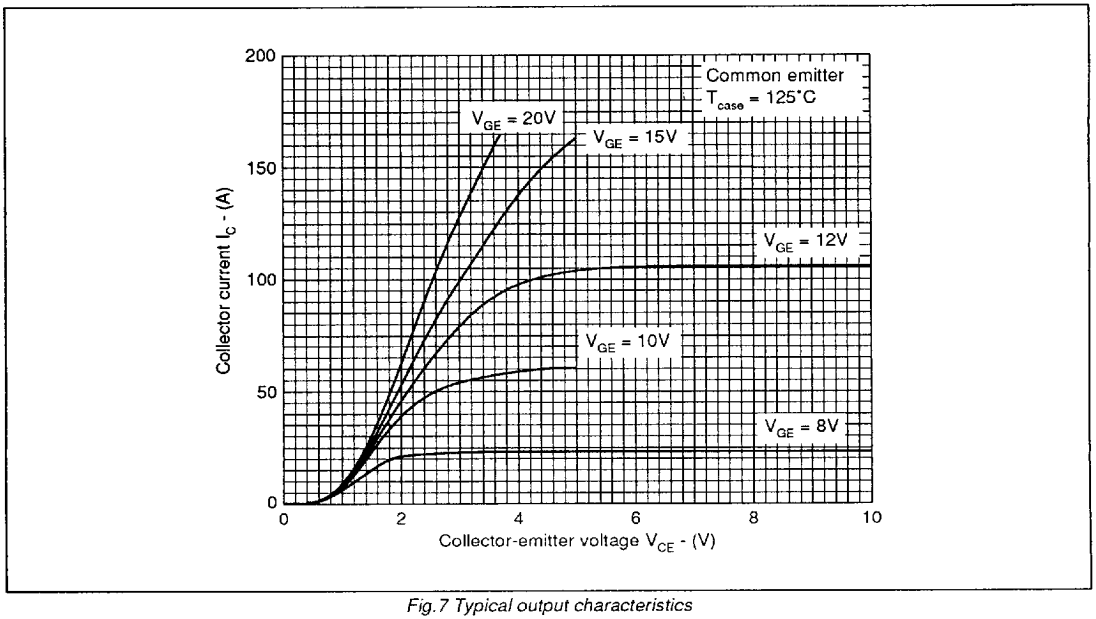


Fig.7 Typical output characteristics

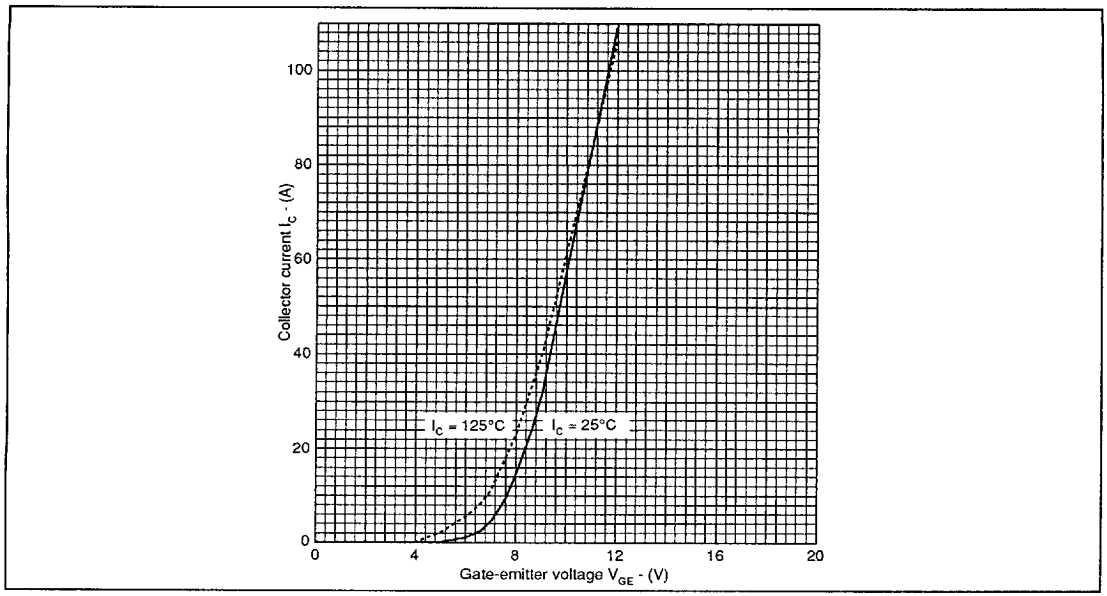


Fig.8 Typical on-state characteristics

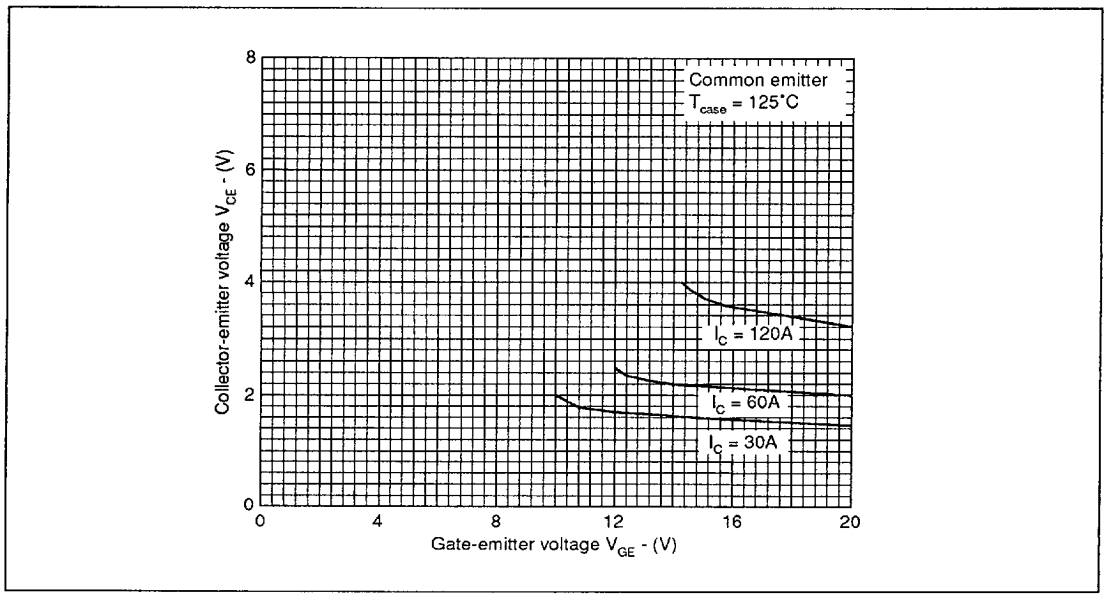


Fig.9 Typical on-state characteristics

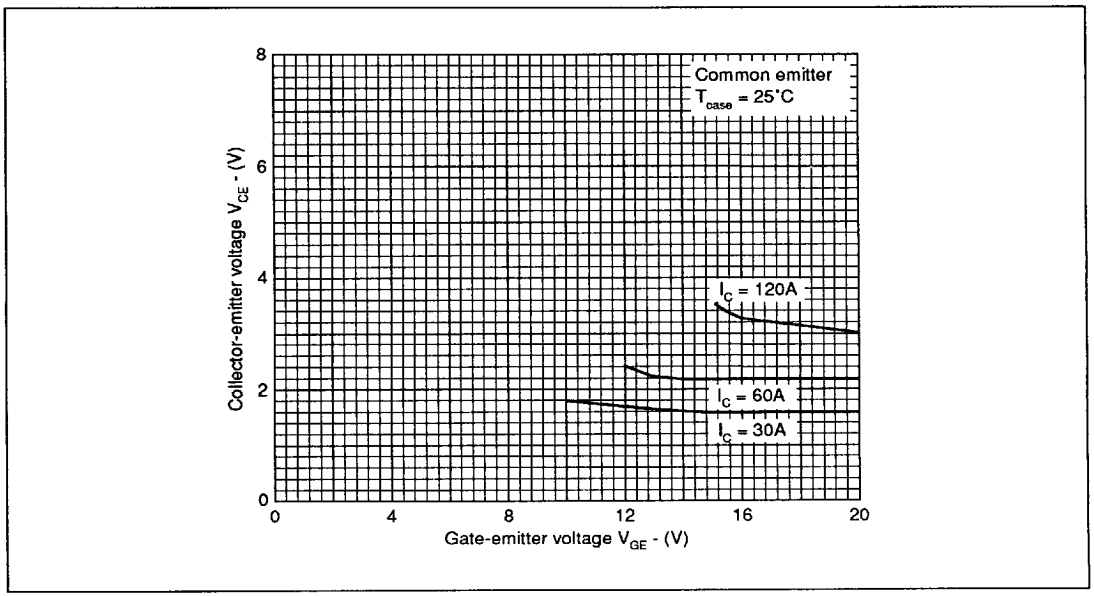


Fig.10 Typical on-state characteristics

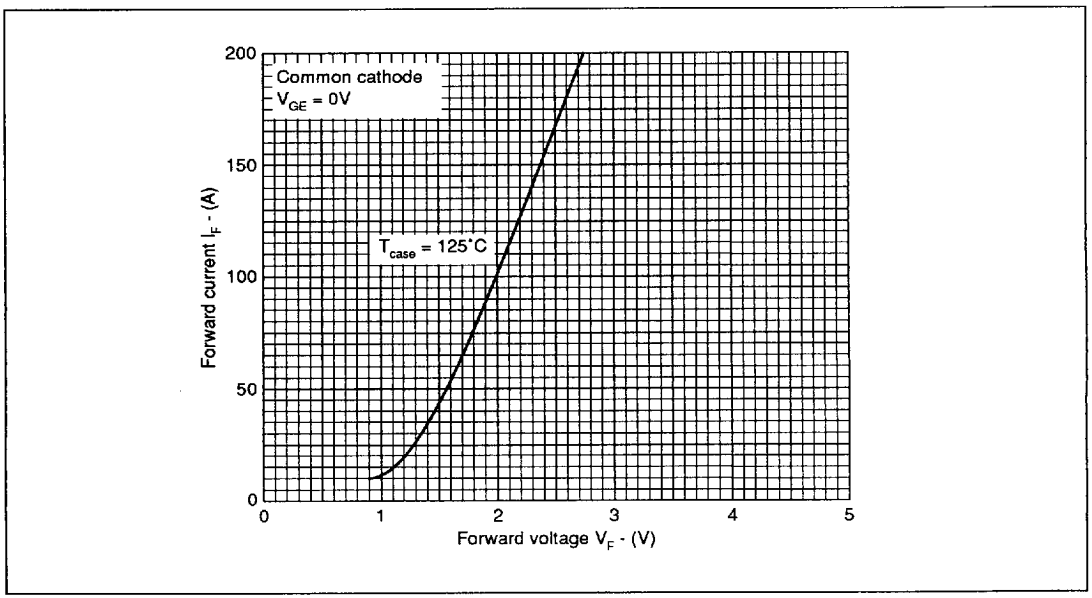


Fig.11 Diode forward characteristics

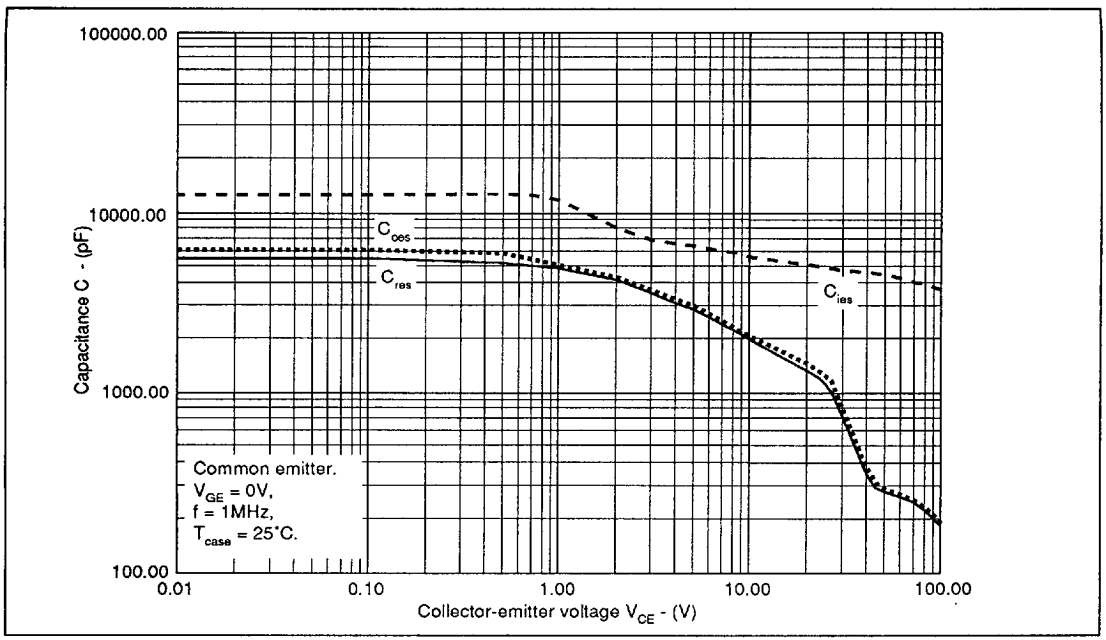


Fig.12 Typical capacitance

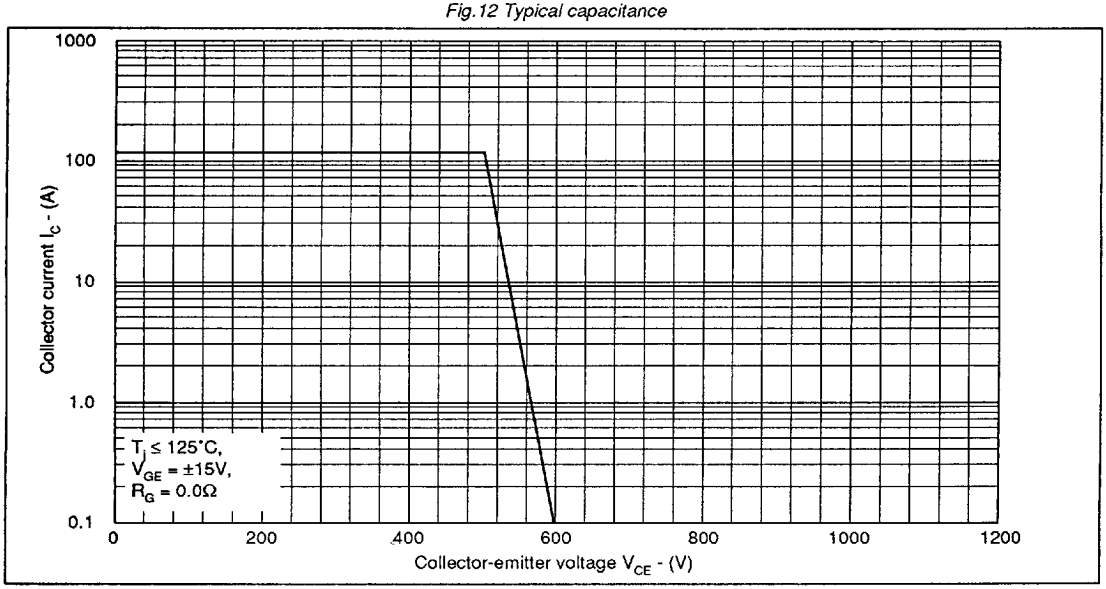


Fig.13 Reverse bias safe operating area