

High Frequency Powerline N-Channel IGBT with Ultrafast Diode

Supersedes October 1998, version DS5046-1.1

DS5046-2.0 April 1999

The ITH23C06 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 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 capacity. 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
- Short Circuit Rated
- 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)	2.2V
I_{C25}	(max)	37A
I_{C85}	(max)	23A
I_{CM}	(max)	69A
t_{sc}	(max)	10 μ s

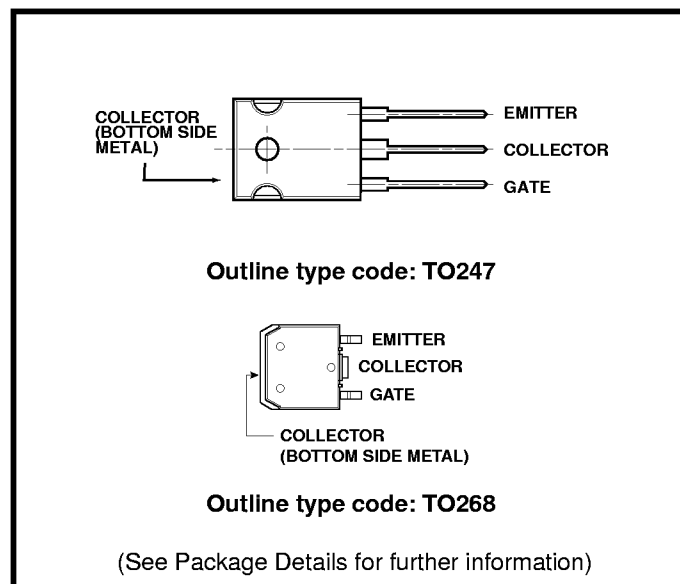


Fig.1 Pin connections - top view (not to scale)

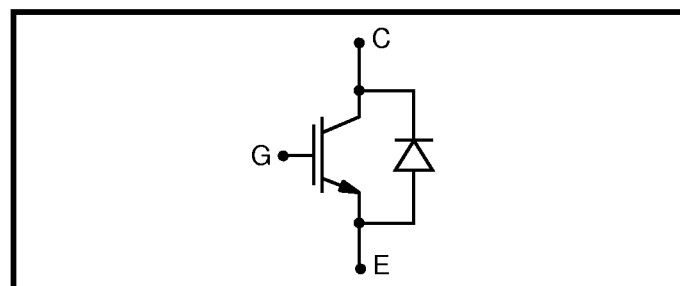


Fig.2 ITH23C06 circuit

Ordering Information

Order as:

ITH23C06P TO247 (with fast recovery diode)

ITH23C06J TO268 (D³ PACK) (with fast recovery diode)

Note: When ordering use 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. 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.

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

Symbol	Parameter	Test Conditions	Max.	Units
V_{CES}	Collector-emitter voltage	$V_{GE} = 0\text{V}$	600	V
V_{GES}	Gate-emitter voltage	-	± 20	V
I_{C25}	Continuous collector current	$T_{case} = 25^{\circ}\text{C}$	37	A
I_{C85}	Continuous collector current	$T_{case} = 85^{\circ}\text{C}$	23	A
I_{CM}	Pulsed collector current	1 ms, $T_{case} = 85^{\circ}\text{C}$	69	A
P_{tot}	Power dissipation	$T_{case} = 85^{\circ}\text{C}$	80	W

Thermal And Mechanical Ratings

Symbol	Parameter	Conditions	Min.	Max.	Units
$R_{th(j-c)}$	Thermal resistance - IGBT	DC junction to case	-	0.8	$^{\circ}\text{C/W}$
$R_{th(j-c)}$	Thermal resistance - Diode	DC junction to case	-	1.8	$^{\circ}\text{C/W}$
T_j	Operating junction temperature range	-	-40	150	$^{\circ}\text{C}$
T_{stg}	Storage temperature range	-	-40	150	$^{\circ}\text{C}$
-	Mounting torque	M3 Screw	-	1.1	Nm

DC Electrical Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{V}$, $V_{CE} = 600\text{V}$	-	-	0.5	mA
I_{GES}	Gate leakage current	$V_{GE} = 20\text{V}$, $V_{CE} = 0\text{V}$	-	-	± 500	nA
$V_{GE(TH)}$	Gate threshold voltage	$I_C = 1\text{mA}$, $V_{CE} = V_{GE}$	4.5	6	7.5	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$, $I_C = 23\text{A}$	-	2.2	2.8	V
		$V_{GE} = 15\text{V}$, $I_C = 23\text{A}$, $T_j = 125^{\circ}\text{C}$	-	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	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	2870	-	pF
C_{oes}	Output capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	205	-	pF
C_{res}	Reverse transfer capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 15\text{V}, f = 1\text{MHz}$	-	35.6	-	pF

Inductive Switching Characteristics

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{\text{d(ON)}}$	Turn-on delay time	$I_{\text{C}} = 23\text{A}$ $V_{\text{GE}} = 15\text{V},$ $V_{\text{CE}} = 50\%V_{\text{ces}}$ $R_{\text{G(ON)}} = R_{\text{G(OFF)}} = 10\Omega$	-	60	-	ns
t_{r}	Rise time		-	18	-	ns
E_{ON}	Turn-on energy loss - per cycle		-	240	-	μJ
$t_{\text{d(OFF)}}$	Turn-off delay time		-	130	-	ns
t_{f}	Fall time		-	160	300	ns
E_{OFF}	Turn-off energy loss - per cycle		-	710	-	μJ

$T_{\text{case}} = 125^{\circ}\text{C}$ unless stated otherwise.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$t_{\text{d(ON)}}$	Turn-on delay time	$I_{\text{C}} = 23\text{A}$ $V_{\text{GE}} = 15\text{V},$ $V_{\text{CE}} = 50\%V_{\text{ces}}$ $R_{\text{G(ON)}} = R_{\text{G(OFF)}} = 10\Omega$	-	60	-	ns
t_{r}	Rise time		-	20	-	ns
E_{ON}	Turn-on energy loss - per cycle		-	370	-	μJ
$t_{\text{d(OFF)}}$	Turn-off delay time		-	160	-	ns
t_{f}	Fall time		-	270	-	ns
E_{OFF}	Turn-off energy loss - per cycle		-	1200	-	μJ

Short Circuit Rating

$T_{\text{case}} = 125^{\circ}\text{C}$ unless stated otherwise.

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

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

Diode Characteristics

T_c = 25°C unless stated otherwise

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V _{FM}	Forward voltage	At I _F = 23A peak	-	1.4	-	V
		At I _F = 23A peak, T _{case} = 125°C	-	1.34	-	V
t _{rr}	Reverse recovery time	I _F = 23A, di _{RR} /dt = 200A/μs,	-	70	-	ns
I _{RRM}	Reverse recovery current	V _R = 50% V _{RRM}	-	12	-	A

Basic Test Circuit

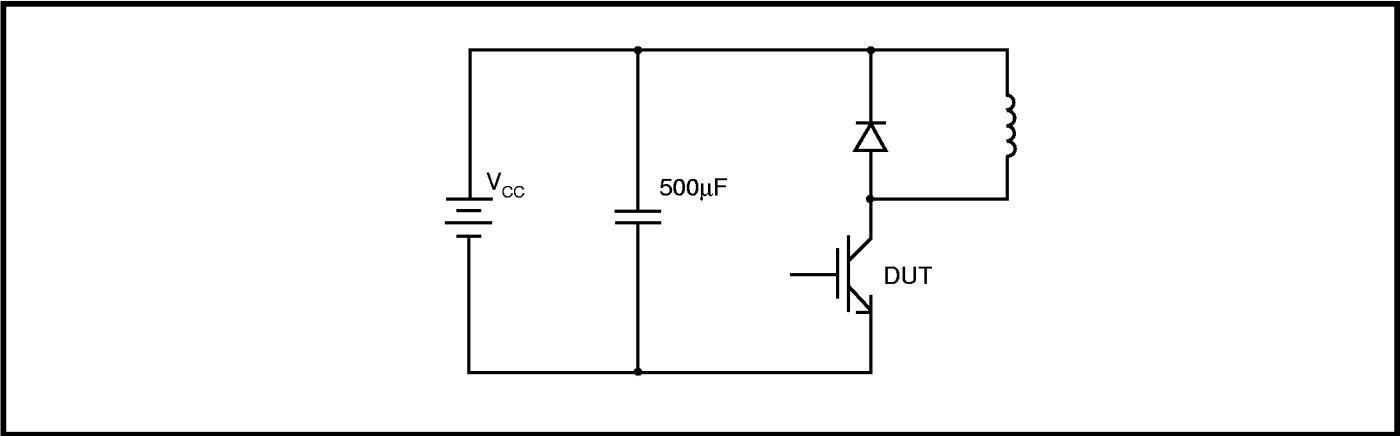


Fig.3 Basic d.c. chopper circuit

Switching Definitions

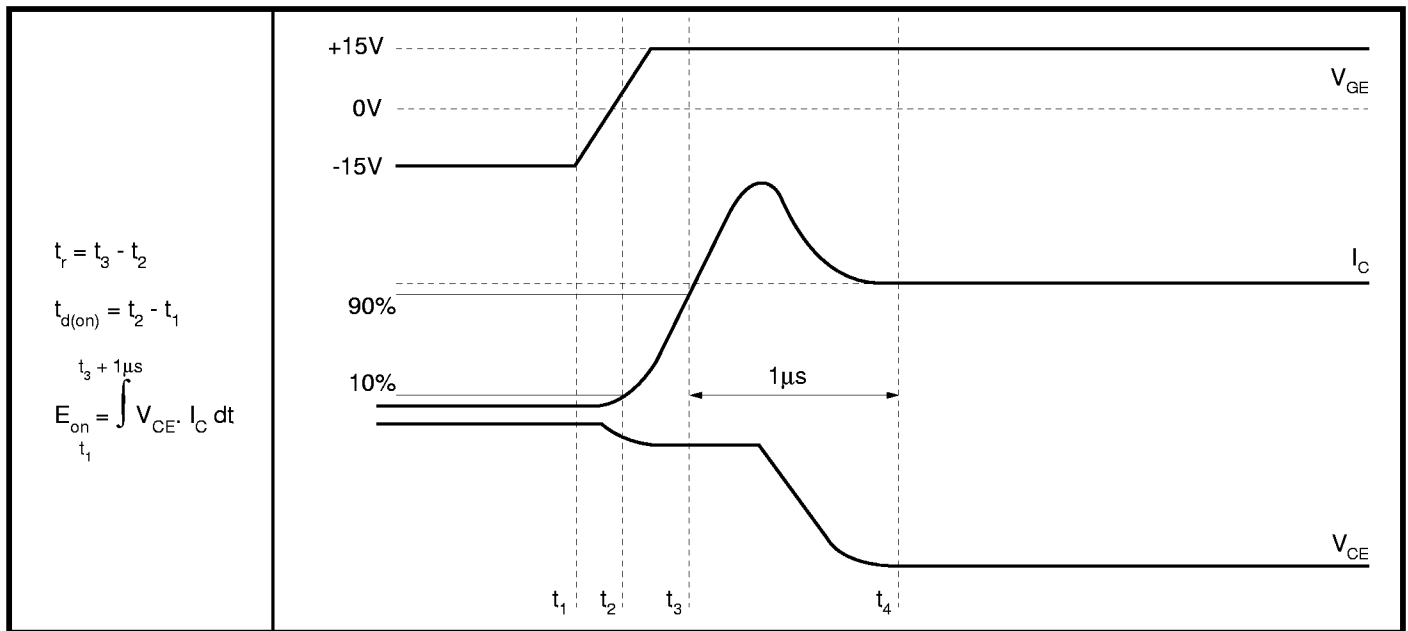


Fig.4 Turn-on characteristics

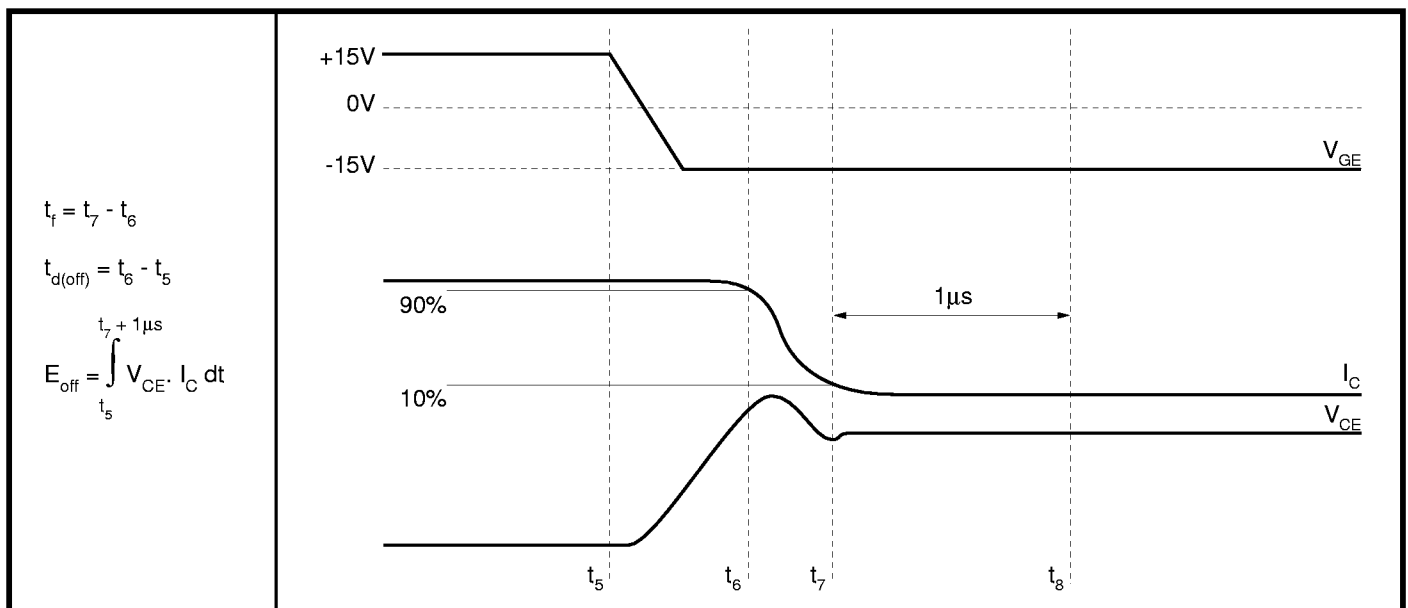


Fig.5 Turn-off characteristics

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Curves

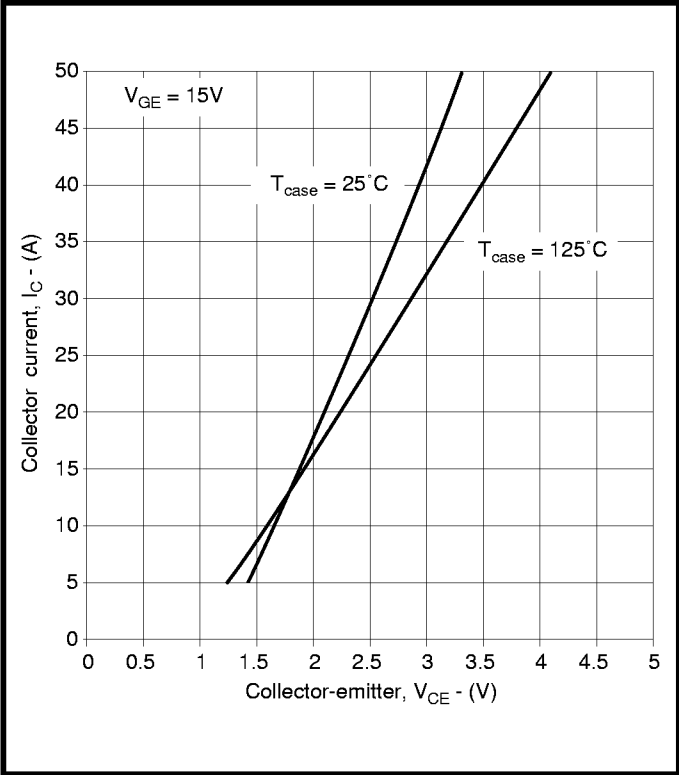


Fig.6 Typical output characteristics

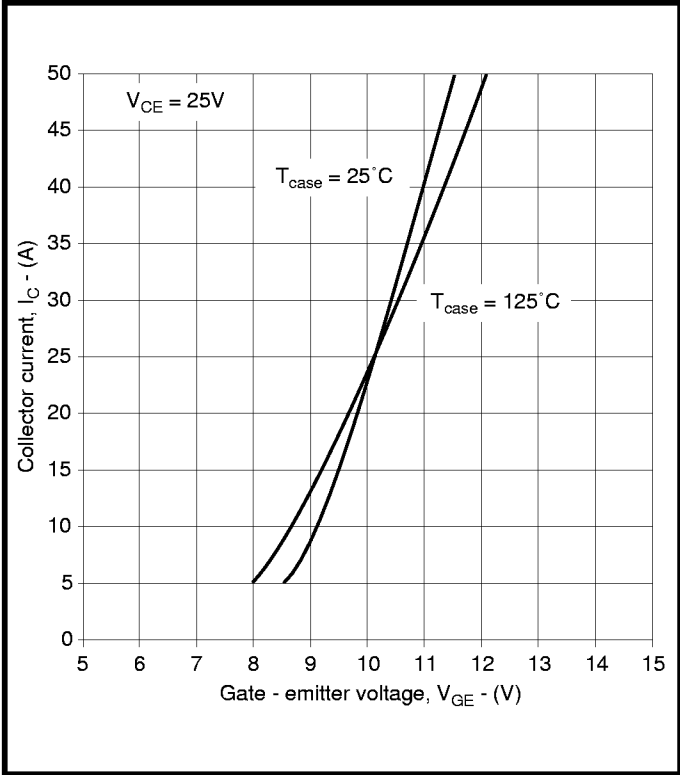


Fig.7 Typical transfer characteristics

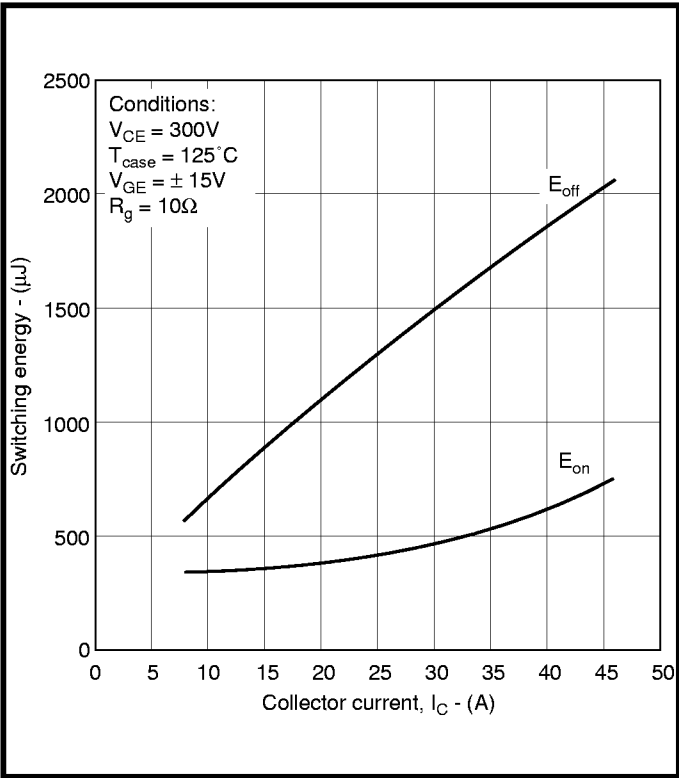


Fig.8 Typical switching losses vs collector current

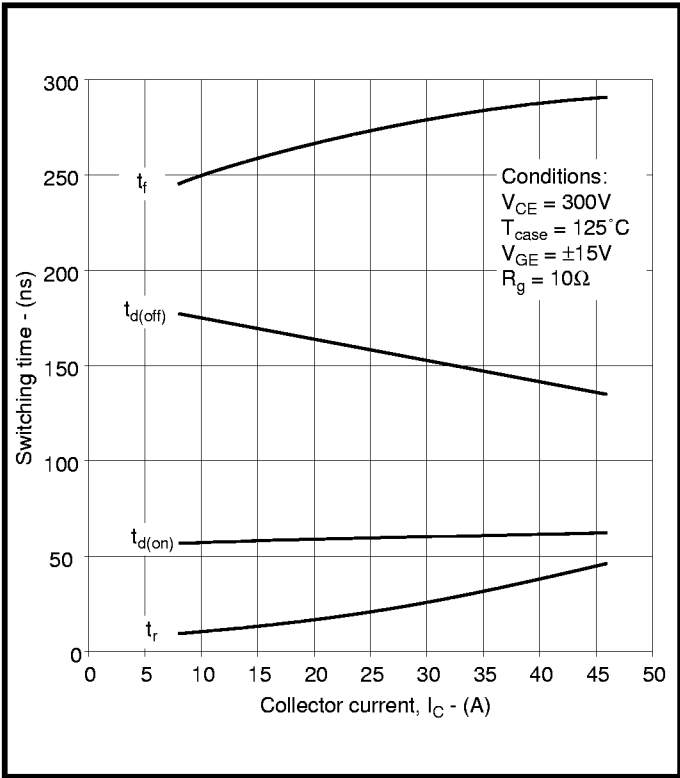


Fig.9 Typical switching times vs collector current

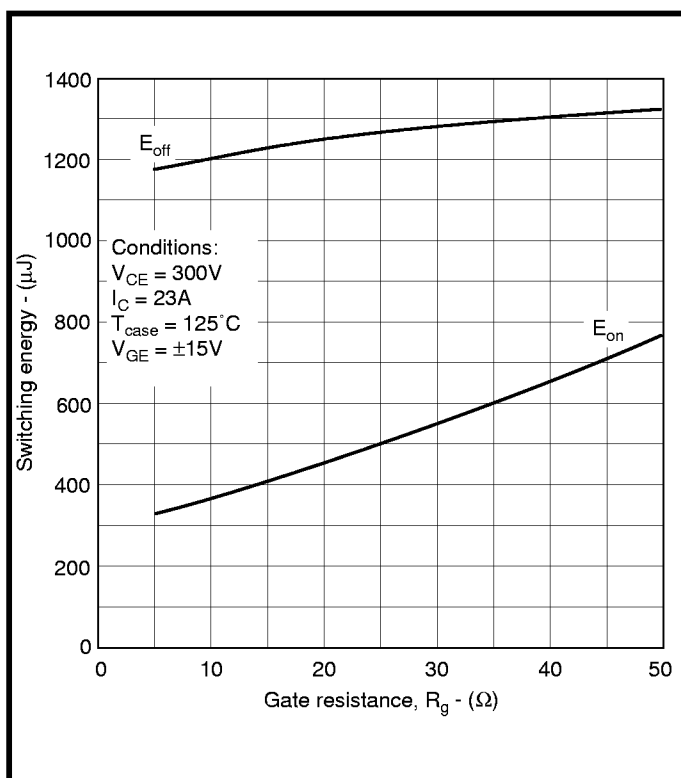


Fig.10 Typical switching losses vs gate resistance

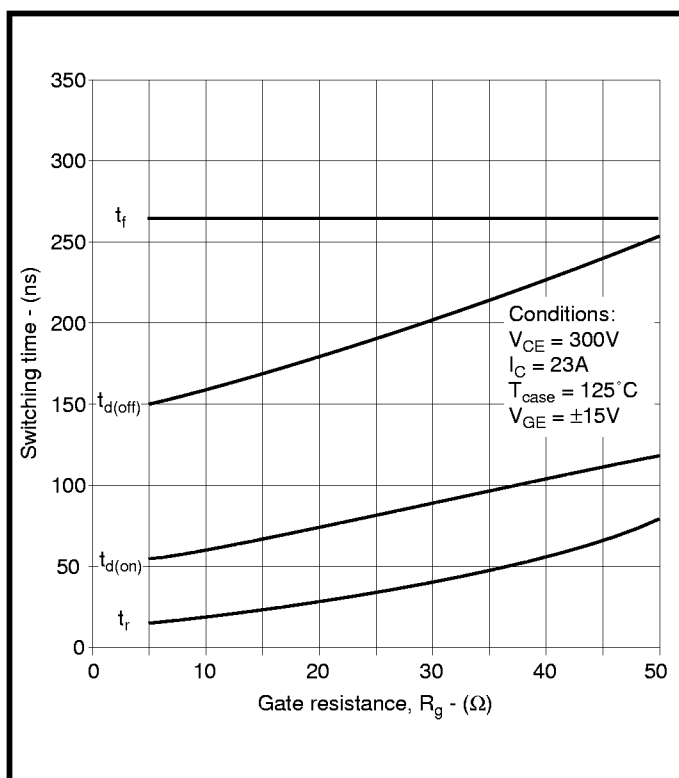


Fig.11 Typical switching times vs gate resistance

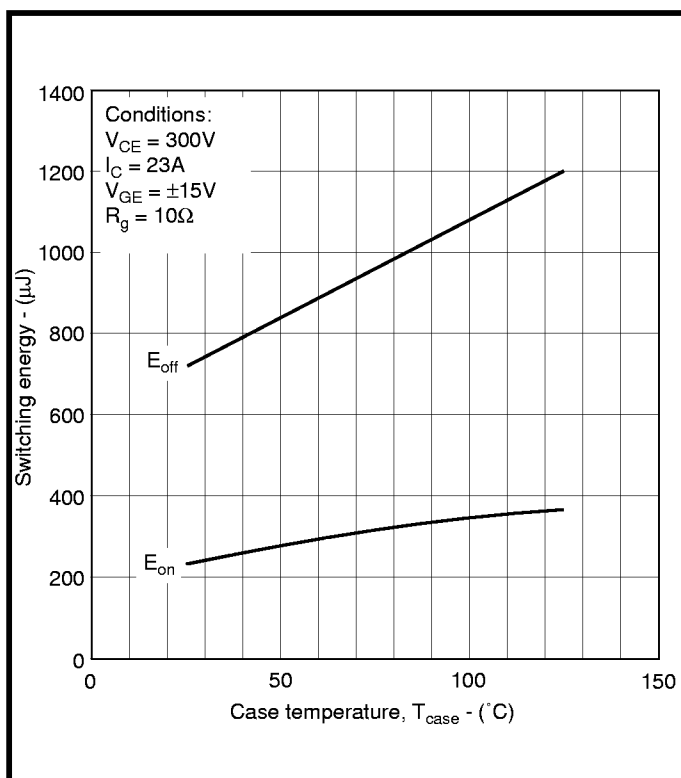


Fig.12 Typical switching losses vs case temperature

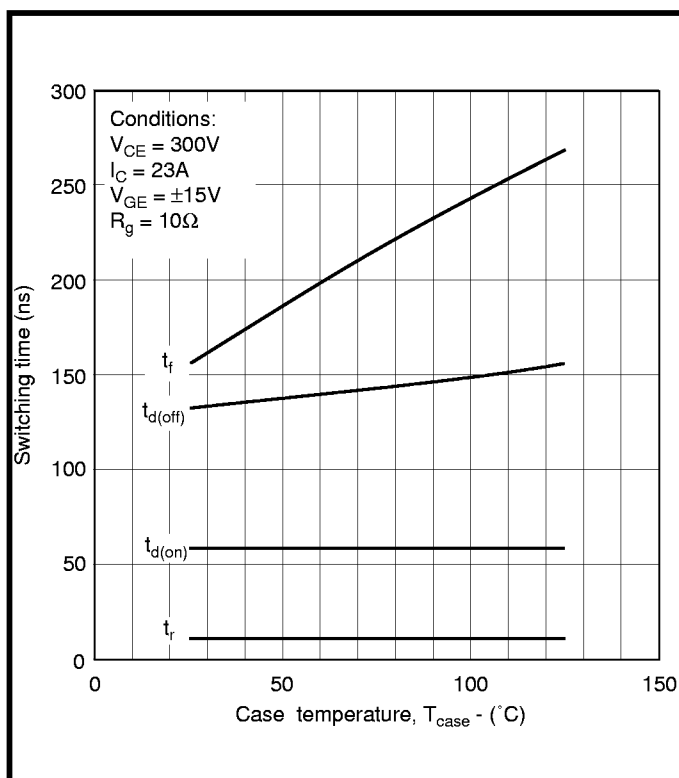


Fig.13 Typical switching times vs case temperature

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

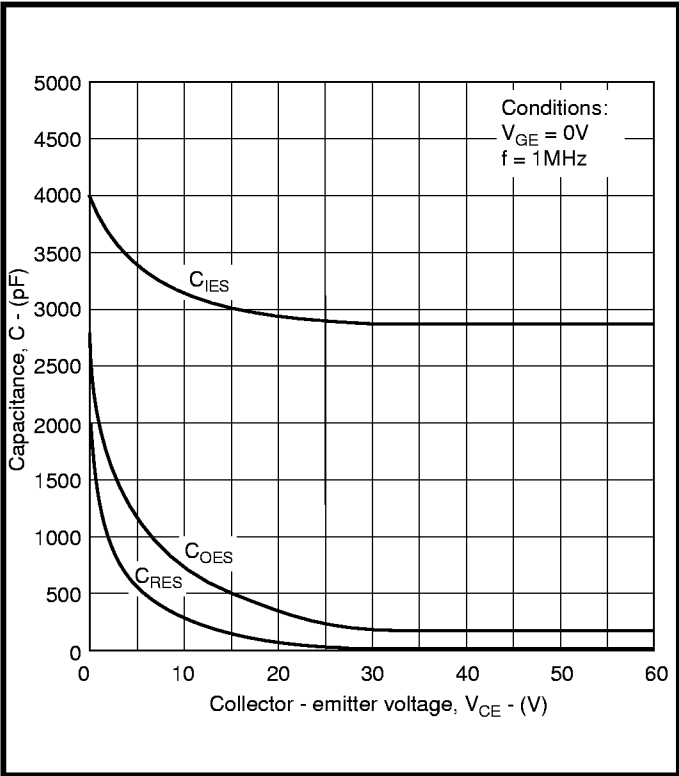


Fig.14 Typical capacitance

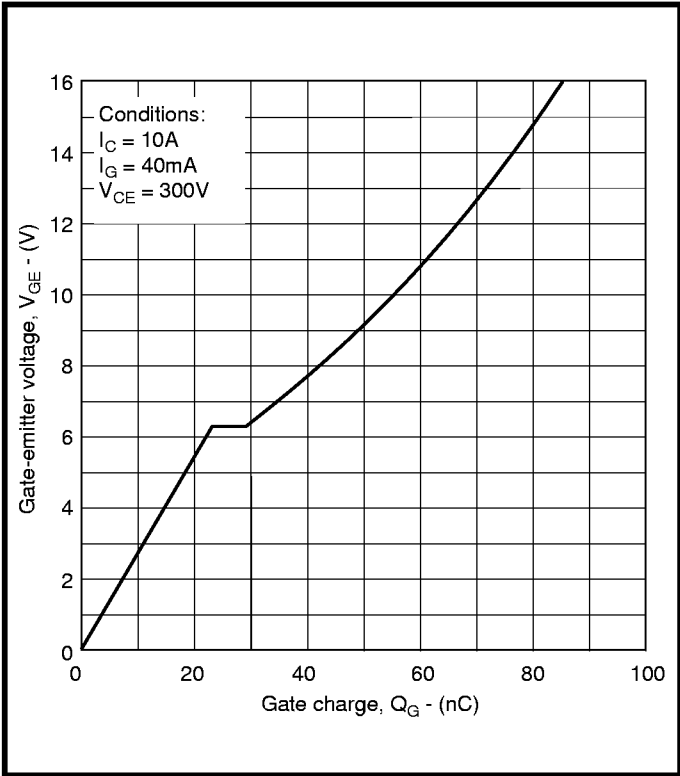


Fig.15 Typical gate charge

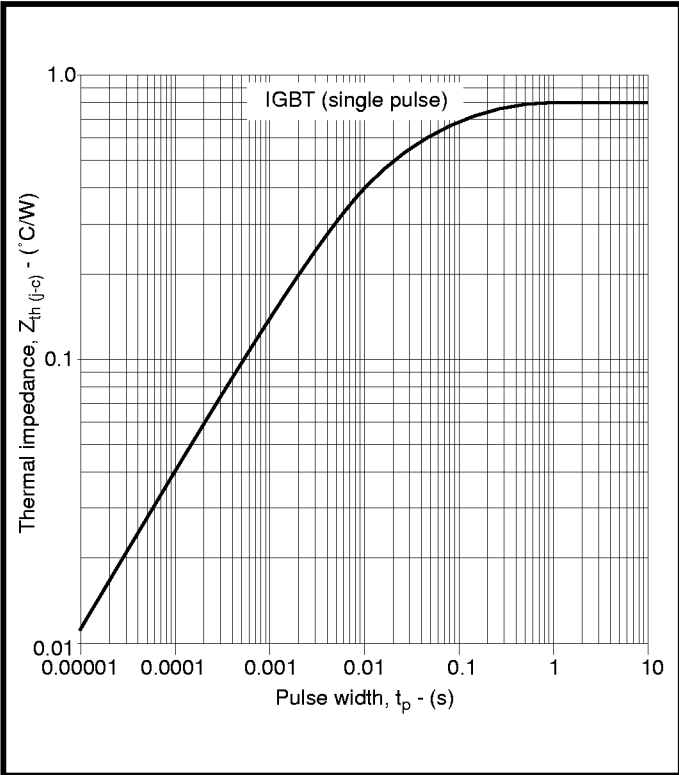


Fig.16 Transient thermal impedance - junction to case

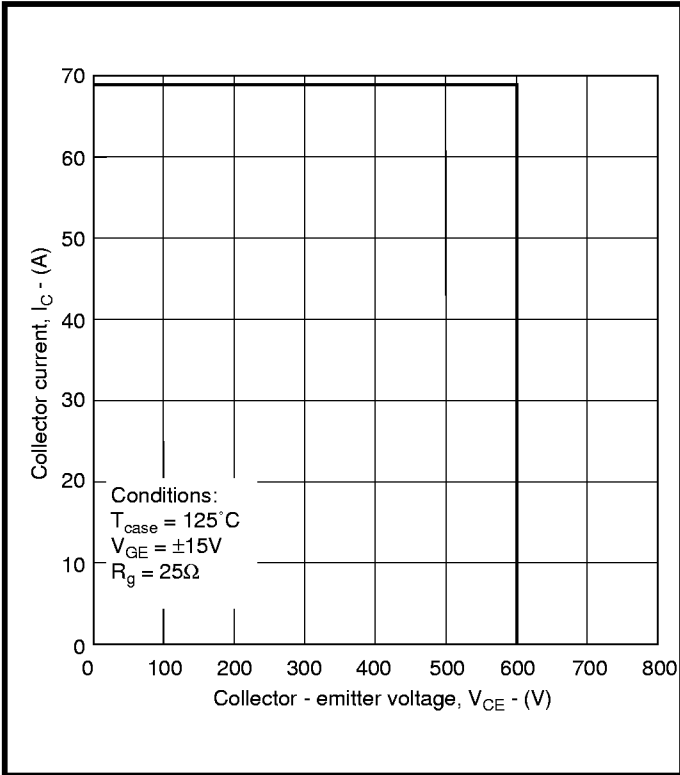


Fig.17 Reverse bias safe operating area

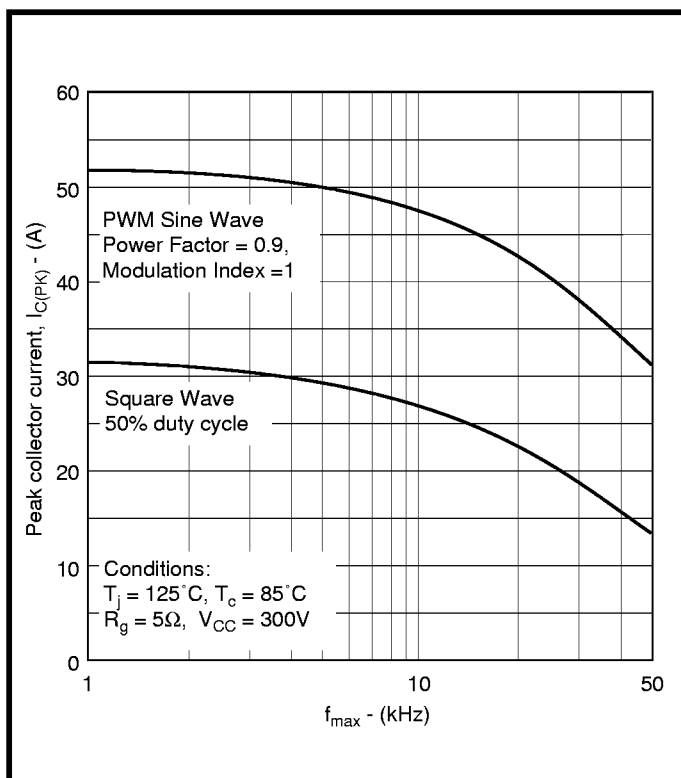


Fig.18 Three phase PWM inverter operating frequency

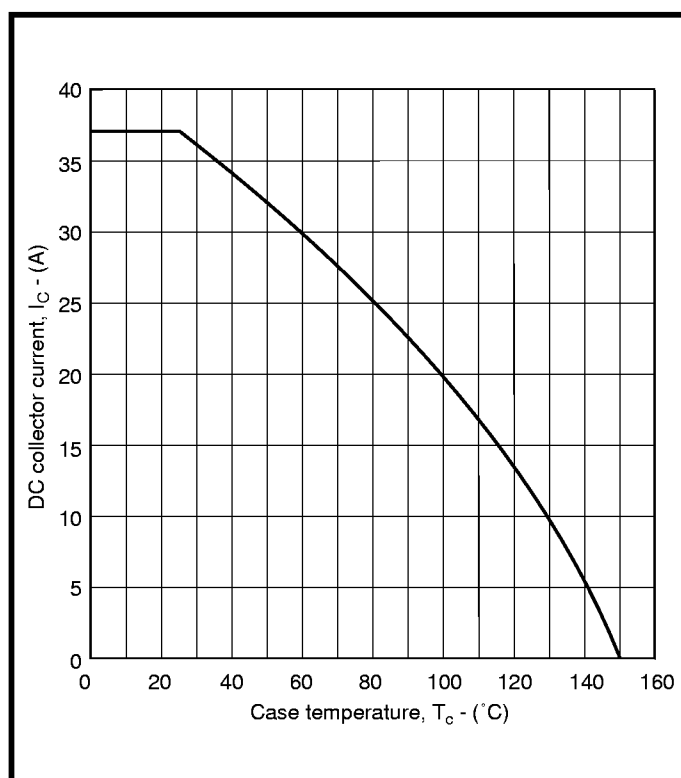


Fig.19 DC current vs case temperature

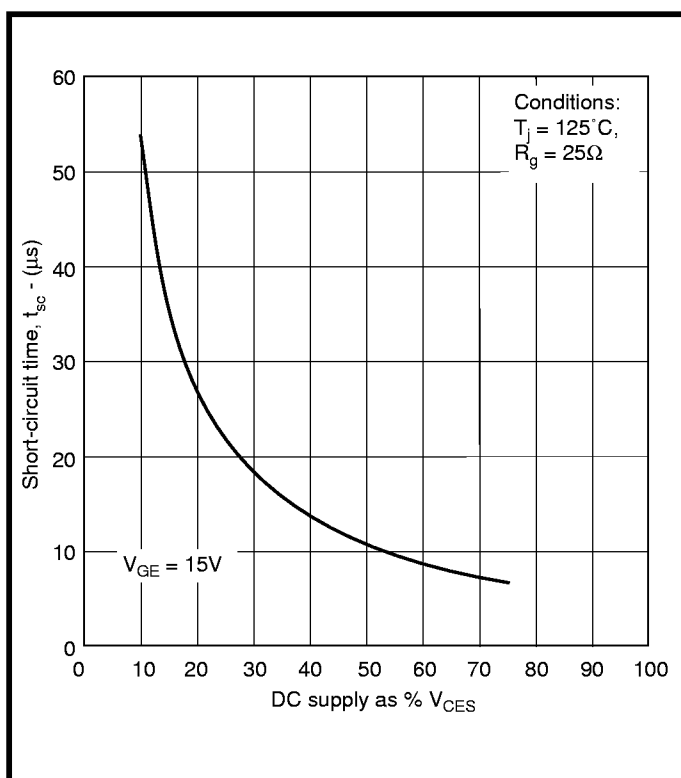


Fig.20 Short circuit withstand

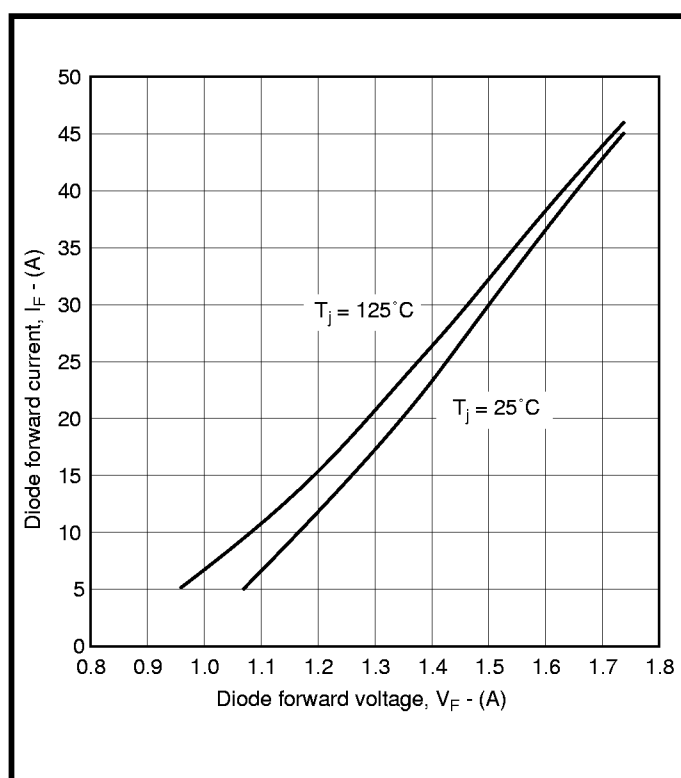


Fig.21 Diode typical forward characteristics

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

Package Details

For additional package information, please contact your nearest representative or Mitel Semiconductor Customer Service Centre. All dimensions in mm, unless stated otherwise. DO NOT SCALE.

