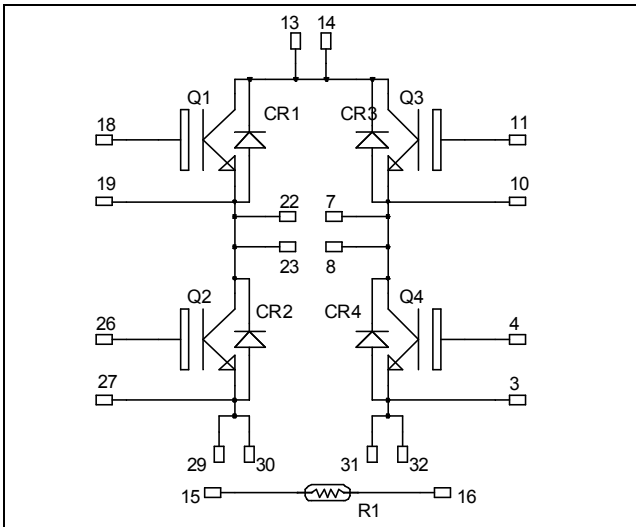


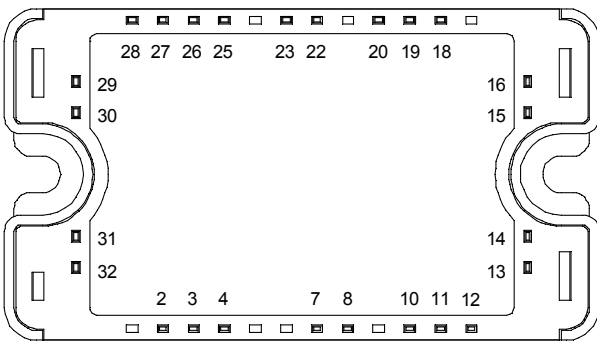
*Full - Bridge  
NPT & Trench + Field Stop<sup>®</sup> IGBT  
Power module*

**Trench & Field Stop<sup>®</sup> IGBT Q1, Q3:**  
 $V_{CES} = 1200V$  ;  $I_C = 25A$  @  $T_c = 80^\circ C$

**Fast NPT IGBT Q2, Q4:**  
 $V_{CES} = 1200V$  ;  $I_C = 25A$  @  $T_c = 80^\circ C$



Top switches : Trench + Field Stop IGBT<sup>®</sup>  
Bottom switches : FAST NPT IGBT<sup>®</sup>



All multiple inputs and outputs must be shorted together  
13/14 ; 15/16 ; 26/27 ; 31/32

## Application

- Solar converter

## Features

- **Q2, Q4 (FAST Non Punch Through (NPT) IGBT)**
  - Switching frequency up to 50 kHz
  - RBSOA & SCSOA rated
  - Low tail current
- **Q1, Q3 (Trench & Field Stop IGBT<sup>®</sup>)**
  - Low voltage drop
  - Switching frequency up to 20 kHz
  - RBSOA & SCSOA rated
  - Low tail current

- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

## Benefits

- Optimized conduction & switching losses
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- Easy paralleling due to positive  $T_C$  of  $V_{CESat}$
- RoHS Compliant

**CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on [www.microsemi.com](http://www.microsemi.com)

All ratings @  $T_j = 25^\circ\text{C}$  unless otherwise specified

**1. Top switches**
**1.1 Top Trench + Field Stop IGBT<sup>®</sup> characteristics**
**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
$V_{CES}$	Collector - Emitter Breakdown Voltage	1200	V
$I_C$	Continuous Collector Current	$T_C = 25^\circ\text{C}$	40
		$T_C = 80^\circ\text{C}$	25
$I_{CM}$	Pulsed Collector Current	$T_C = 25^\circ\text{C}$	50
$V_{GE}$	Gate - Emitter Voltage	$\pm 20$	V
$P_D$	Maximum Power Dissipation	$T_C = 25^\circ\text{C}$	156
RBSOA	Reverse Bias Safe Operation Area	$T_j = 125^\circ\text{C}$	50A @ 1150V

**Electrical Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}, V_{CE} = 1200\text{V}$			250	$\mu\text{A}$
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	$V_{GE} = 15\text{V}$		1.7	2.1	V
		$I_C = 25\text{A}$	$T_j = 25^\circ\text{C}$			
				2.0		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1\text{mA}$	5.0	5.8	6.5	V
$I_{GES}$	Gate - Emitter Leakage Current	$V_{GE} = 20\text{V}, V_{CE} = 0\text{V}$			400	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	$V_{GE} = 0\text{V}, V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		1800		pF
$C_{res}$	Reverse Transfer Capacitance			82		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $25^\circ\text{C}$ ) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 25\text{A}$ $R_G = 27\Omega$		90		ns
$T_r$	Rise Time			30		
$T_{d(off)}$	Turn-off Delay Time			420		
$T_f$	Fall Time			70		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $125^\circ\text{C}$ ) $V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 25\text{A}$ $R_G = 27\Omega$		90		ns
$T_r$	Rise Time			50		
$T_{d(off)}$	Turn-off Delay Time			520		
$T_f$	Fall Time			90		
$E_{on}$	Turn-on Switching Energy	$V_{GE} = \pm 15\text{V}$ $V_{Bus} = 600\text{V}$ $I_C = 25\text{A}$ $R_G = 27\Omega$	$T_j = 25^\circ\text{C}$	1.9		mJ
			$T_j = 125^\circ\text{C}$	2.5		
$E_{off}$	Turn-off Switching Energy		$T_j = 25^\circ\text{C}$	1.9		
			$T_j = 125^\circ\text{C}$	2.9		
$R_{thJC}$	Junction to Case Thermal resistance				0.8	$^\circ\text{C/W}$

**1.2 Top fast diode characteristics**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage			1200			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> =1200V	T <sub>j</sub> = 25°C			100	μA
			T <sub>j</sub> = 125°C			500	
I <sub>F</sub>	DC Forward Current	T <sub>c</sub> = 80°C			30		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 30A			2.6	3.1	V
		I <sub>F</sub> = 60A			3.2		
		I <sub>F</sub> = 30A	T <sub>j</sub> = 125°C		1.8		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 30A	T <sub>j</sub> = 25°C		300		ns
			T <sub>j</sub> = 125°C		380		
Q <sub>rr</sub>	Reverse Recovery Charge	V <sub>R</sub> = 800V di/dt = 200A/μs	T <sub>j</sub> = 25°C		360		nC
			T <sub>j</sub> = 125°C		1700		
R <sub>thJC</sub>	Junction to Case Thermal resistance					1.2	°C/W

**2. Bottom switches**
**2.1 Bottom Fast NPT IGBT characteristics**
**Absolute maximum ratings**

<i>Symbol</i>	<i>Parameter</i>	<i>Max ratings</i>		<i>Unit</i>
V <sub>CES</sub>	Collector - Emitter Breakdown Voltage	1200		V
I <sub>C</sub>	Continuous Collector Current	T <sub>C</sub> = 25°C	40	A
		T <sub>C</sub> = 80°C	25	
I <sub>CM</sub>	Pulsed Collector Current	T <sub>C</sub> = 25°C	100	
V <sub>GE</sub>	Gate - Emitter Voltage	±20		V
P <sub>D</sub>	Maximum Power Dissipation	T <sub>C</sub> = 25°C	208	W
RBSOA	Reverse Bias Safe Operating Area	T <sub>j</sub> = 125°C	50A@1150V	

**Electrical Characteristics**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
I <sub>CES</sub>	Zero Gate Voltage Collector Current	V <sub>GE</sub> = 0V V <sub>CE</sub> = 1200V	T <sub>j</sub> = 25°C			250	μA
			T <sub>j</sub> = 125°C			500	
V <sub>CE(sat)</sub>	Collector Emitter saturation Voltage	V <sub>GE</sub> = 15V I <sub>C</sub> = 25A	T <sub>j</sub> = 25°C	2.5	3.2	3.7	V
			T <sub>j</sub> = 125°C		4.0		
V <sub>GE(th)</sub>	Gate Threshold Voltage	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 1mA		4		6	V
I <sub>GES</sub>	Gate - Emitter Leakage Current	V <sub>GE</sub> = 20V, V <sub>CE</sub> = 0V				400	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C <sub>ies</sub>	Input Capacitance	V <sub>GE</sub> = 0V		1650		pF
C <sub>oes</sub>	Output Capacitance	V <sub>CE</sub> = 25V		250		
C <sub>res</sub>	Reverse Transfer Capacitance	f = 1MHz		110		
Q <sub>g</sub>	Total gate Charge	V <sub>GE</sub> = 15V		160		nC
Q <sub>ge</sub>	Gate – Emitter Charge	V <sub>Bus</sub> = 300V		10		
Q <sub>gc</sub>	Gate – Collector Charge	I <sub>C</sub> = 25A		70		
T <sub>d(on)</sub>	Turn-on Delay Time	Inductive Switching (25°C)		60		ns
T <sub>r</sub>	Rise Time	V <sub>GE</sub> = 15V		50		
T <sub>d(off)</sub>	Turn-off Delay Time	V <sub>Bus</sub> = 400V		305		
T <sub>f</sub>	Fall Time	I <sub>C</sub> = 25A R <sub>G</sub> = 22Ω		30		
T <sub>d(on)</sub>	Turn-on Delay Time	Inductive Switching (125°C)		60		ns
T <sub>r</sub>	Rise Time	V <sub>GE</sub> = 15V		50		
T <sub>d(off)</sub>	Turn-off Delay Time	V <sub>Bus</sub> = 400V		346		
T <sub>f</sub>	Fall Time	I <sub>C</sub> = 25A R <sub>G</sub> = 22Ω		40		
E <sub>on</sub>	Turn-on Switching Energy	V <sub>GE</sub> = 15V V <sub>Bus</sub> = 400V	T <sub>j</sub> = 125°C	3.5		mJ
E <sub>off</sub>	Turn-off Switching Energy	I <sub>C</sub> = 25A R <sub>G</sub> = 22Ω	T <sub>j</sub> = 125°C	1.5		
R <sub>thJC</sub>	Junction to Case Thermal resistance				0.6	°C/W

**2.2 Bottom diode characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V <sub>RRM</sub>	Maximum Peak Repetitive Reverse Voltage		1200			V
I <sub>RM</sub>	Maximum Reverse Leakage Current	V <sub>R</sub> = 1200V			100	μA
		T <sub>j</sub> = 25°C			500	
I <sub>F</sub>	DC Forward Current			30		A
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 30A		2.6	3.1	V
		I <sub>F</sub> = 60A		3.2		
		I <sub>F</sub> = 30A	T <sub>j</sub> = 125°C	1.8		
t <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> = 30A V <sub>R</sub> = 800V di/dt = 200A/μs	T <sub>j</sub> = 25°C	300		ns
			T <sub>j</sub> = 125°C	380		
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 30A V <sub>R</sub> = 800V di/dt = 200A/μs	T <sub>j</sub> = 25°C	360		nC
			T <sub>j</sub> = 125°C	1700		
R <sub>thJC</sub>	Junction to Case Thermal resistance				1.2	°C/W

**3. Temperature sensor**

**NTC** (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic	Min	Typ	Max	Unit
R <sub>25</sub>	Resistance @ 25°C		50		kΩ
B <sub>25/85</sub>	T <sub>25</sub> = 298.15 K		3952		K

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

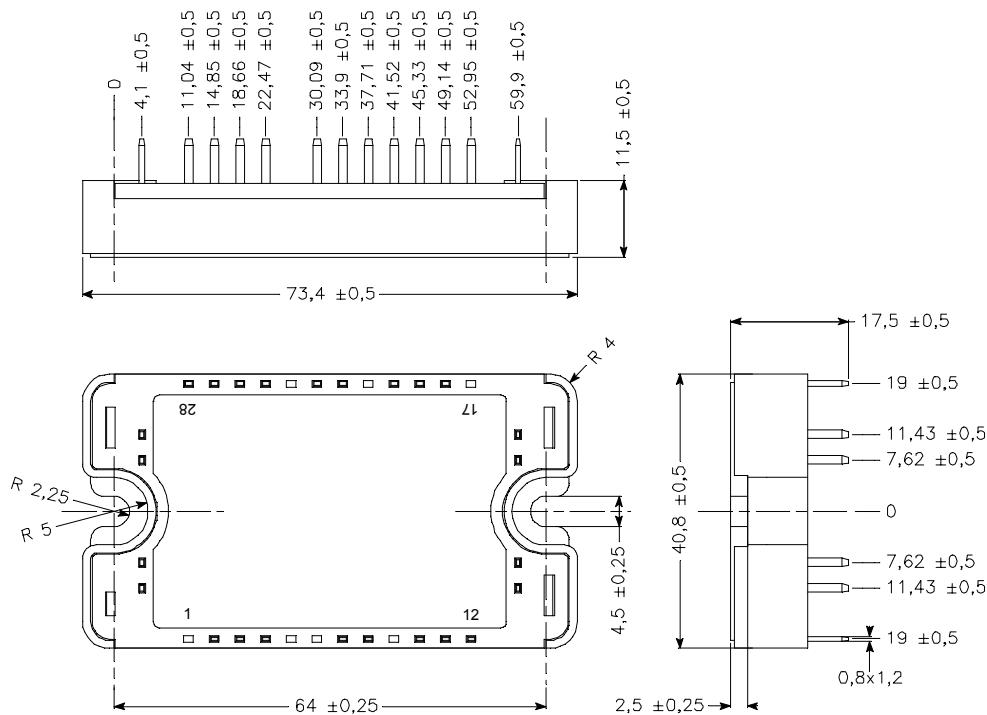
T: Thermistor temperature  
 R<sub>T</sub>: Thermistor value at T

## 4. Package characteristics

Symbol	Characteristic	Min	Typ	Max	Unit	
V <sub>ISOL</sub>	RMS Isolation Voltage, any terminal to case t=1 min, I <sub>isol</sub> <1mA, 50/60Hz	2500			V	
T <sub>J</sub>	Operating junction temperature range	-40		150*	°C	
T <sub>STG</sub>	Storage Temperature Range	-40		125		
T <sub>C</sub>	Operating Case Temperature	-40		100		
Torque	Mounting torque	To heatsink	M4	2.5	4.7	N.m
Wt	Package Weight				110	g

T<sub>j</sub>=175°C for Trench & Field Stop IGBT

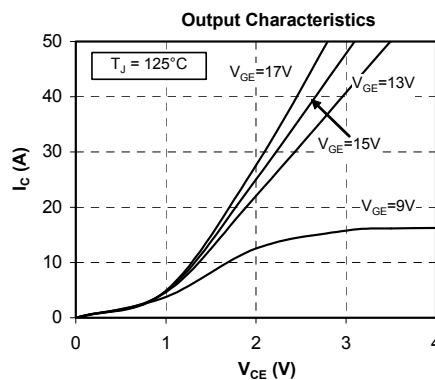
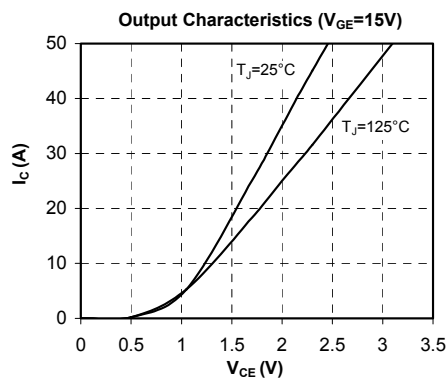
## 5. SP3 Package outline (dimensions in mm)

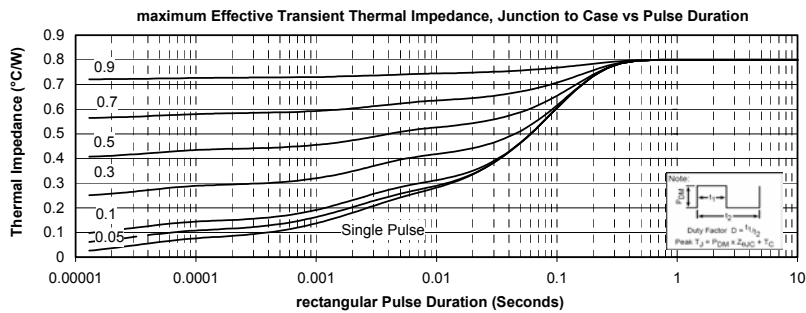
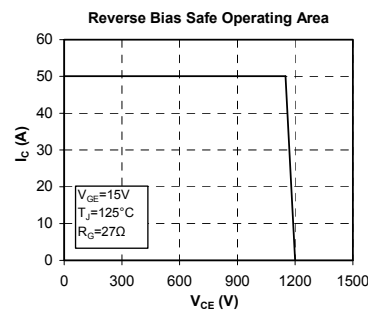
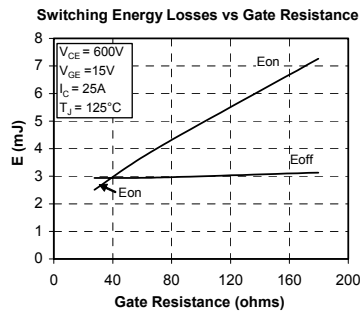
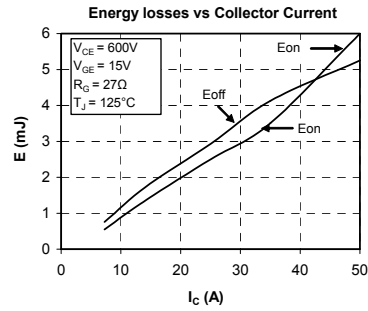
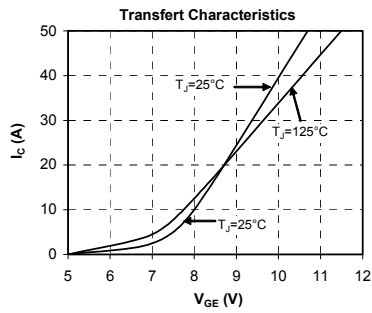


See application note 1901 - Mounting Instructions for SP3 Power Modules on [www.microsemi.com](http://www.microsemi.com)

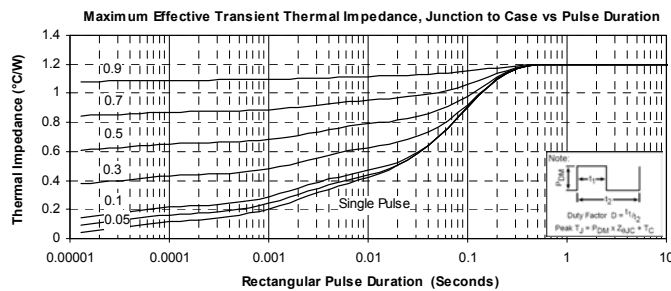
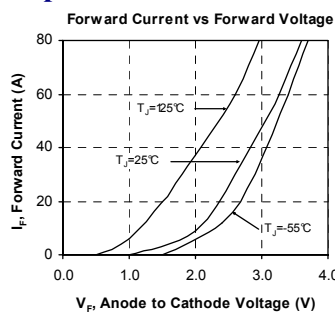
## 6. Top switches curves

### 6.1 Top Trench + Field Stop IGBT® typical performance curves



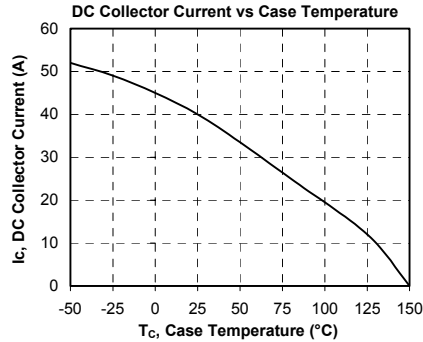
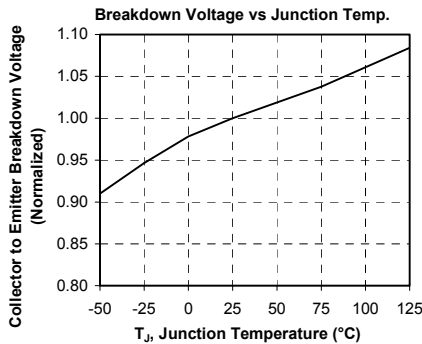
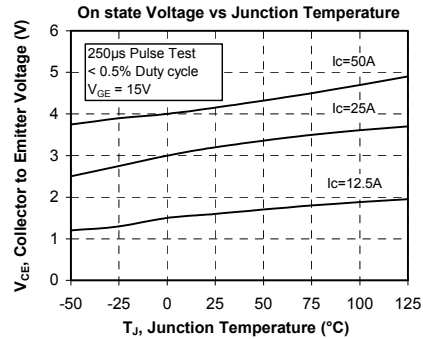
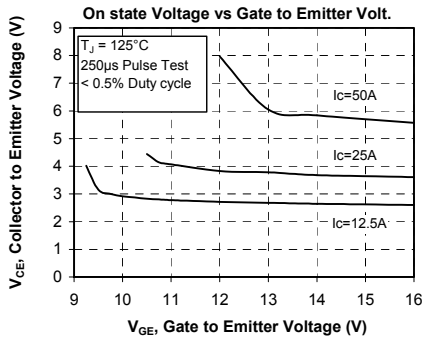
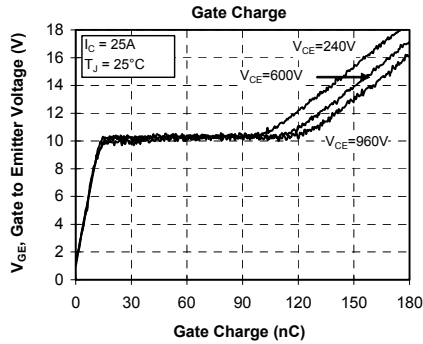
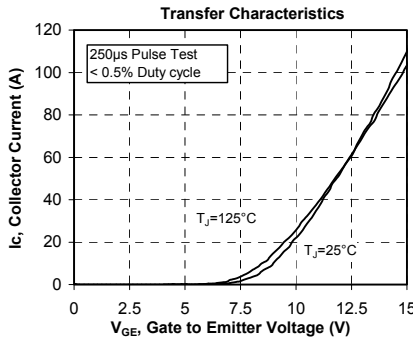
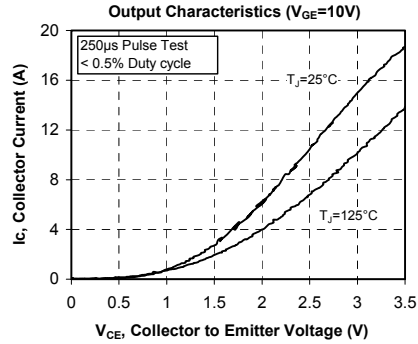
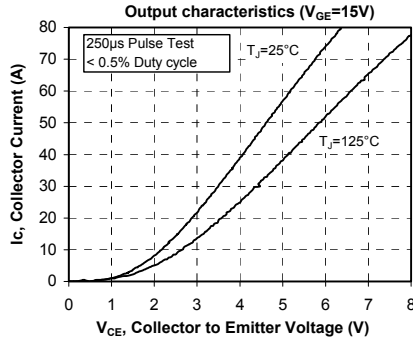


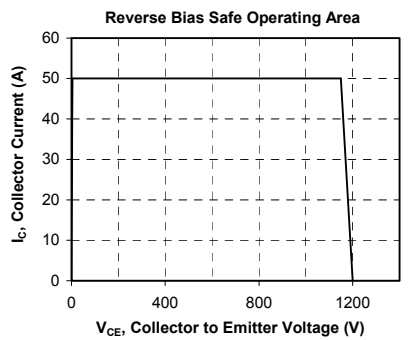
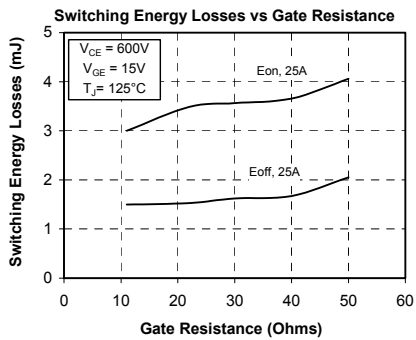
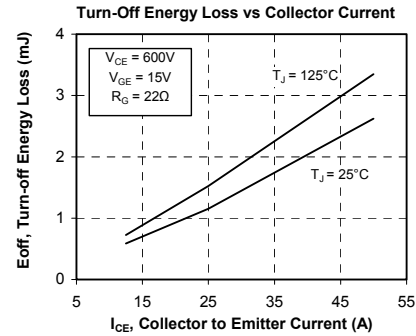
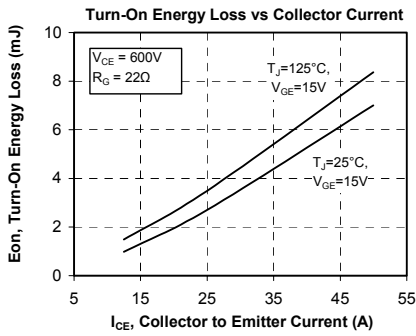
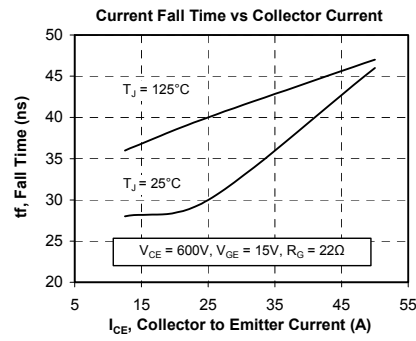
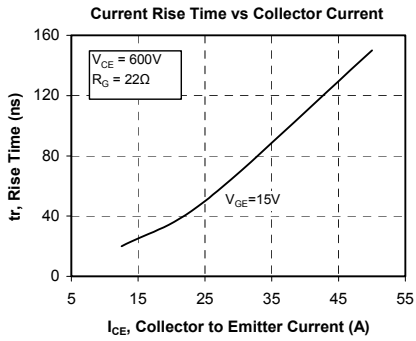
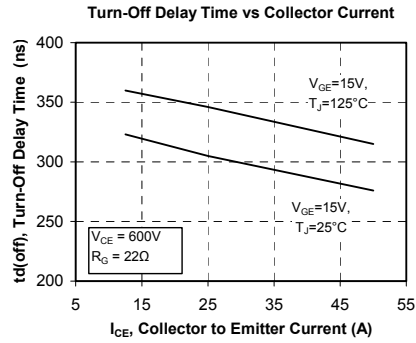
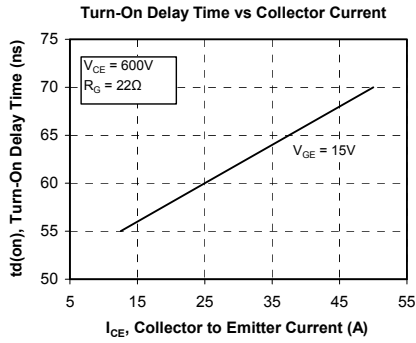
## 6.2 Top Fast diode typical performance curves



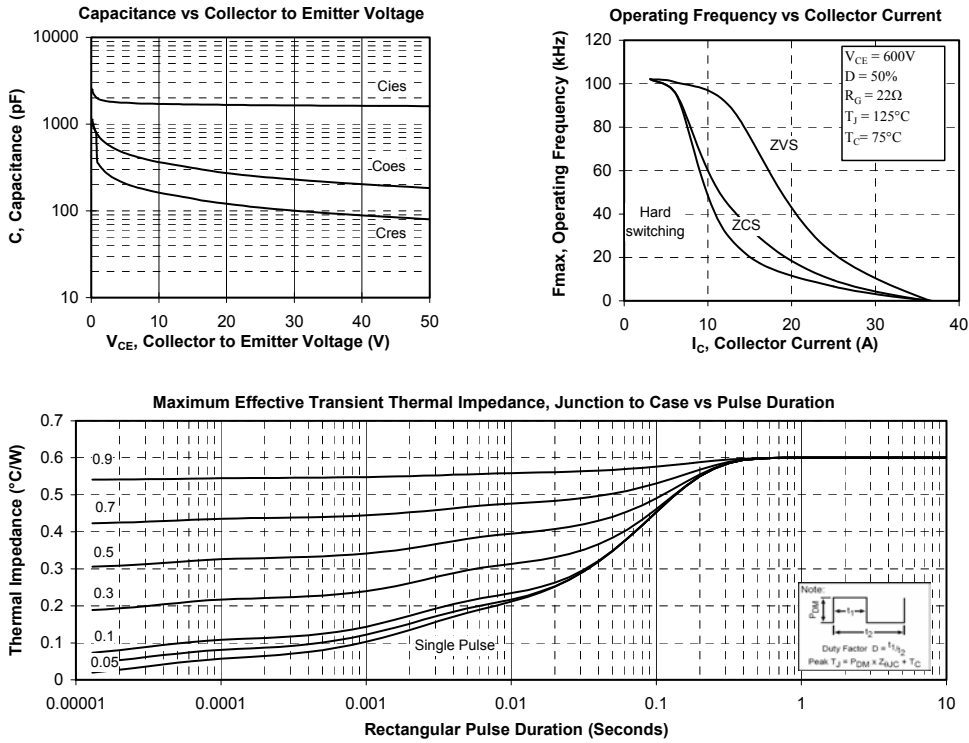
## 7. Bottom switches curves

### 7.1 Bottom fast NPT IGBT typical performance curves

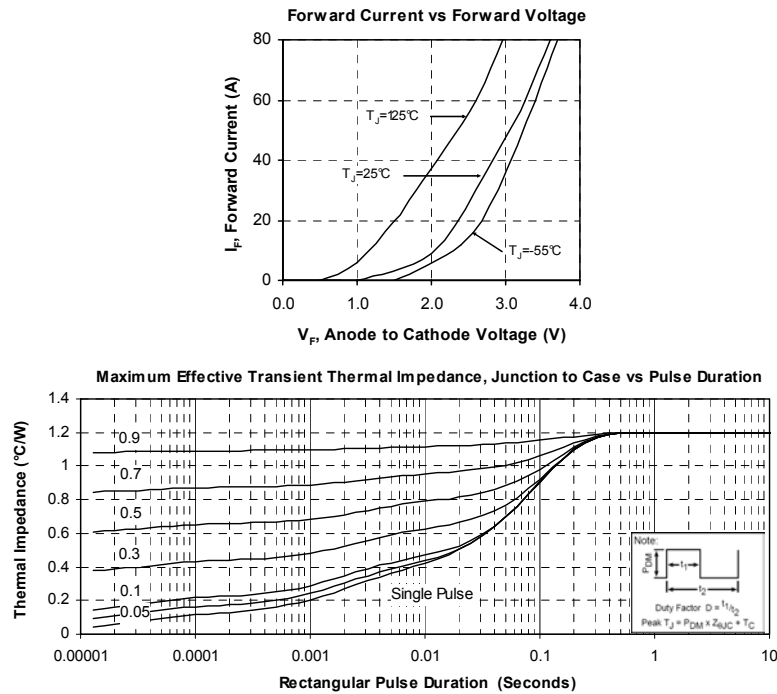








## 7.2 Bottom diode typical performance curves



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