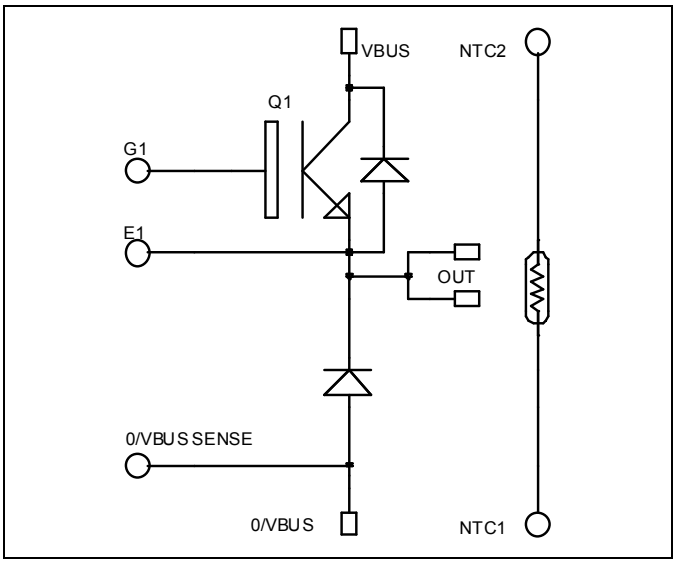
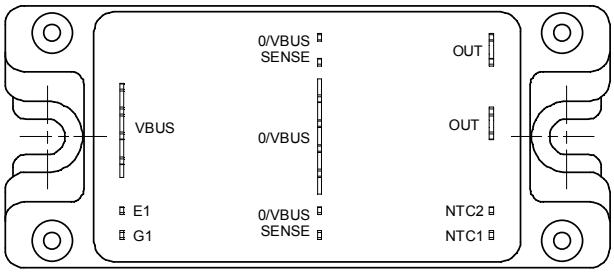
Buck chopper
NPT IGBT Power Module

V_{CES} = 600V
I_C = 180A @ Tc = 80°C





Application

- AC and DC motor control
- Switched Mode Power Supplies

Features

- Non Punch Through (NPT) THUNDERBOLT IGBT®
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 100 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - Avalanche energy rated
  - RBSOA and SCSOA rated
- Kelvin emitter for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

Benefits

- Outstanding performance at high frequency operation
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Easy paralleling due to positive TC of VCEsat
- Low profile

Absolute maximum ratings

Symbol	*Parameter*		*Max ratings*	*Unit*
V_{CES}	Collector - Emitter Breakdown Voltage		600	V
I_C	Continuous Collector Current	T_c = 25°C	220	A
		T_c = 80°C	180	
I_{CM}	Pulsed Collector Current	T_c = 25°C	630	
V_{GE}	Gate – Emitter Voltage		±20	V
P_D	Maximum Power Dissipation	T_c = 25°C	833	W
RBSOA	Reverse Bias Safe Operating Area	T_j = 150°C	630A @ 600V	

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handing Procedures Should Be Followed.

All ratings @ T_j = 25°C unless otherwise specified

Electrical Characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
BV_{CES}	Collector - Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 150µA		600			V
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V V_{CE} = 600V	T_j = 25°C			150	µA
			T_j = 125°C			3000	
$V_{CE(on)}$	Collector Emitter on Voltage	V_{GE} =15V I_C = 180A	T_j = 25°C		2.0	2.5	V
			T_j = 125°C		2.2		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE}, I_C = 2mA		3		5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0V				±200	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz		8.6		nF
C_{oes}	Output Capacitance			0.94		
C_{res}	Reverse Transfer Capacitance			0.8		
Q_g	Total gate Charge	V_{GS} = 15V V_{Bus} = 300V I_C = 180A		660		nC
Q_{ge}	Gate – Emitter Charge			580		
Q_{gc}	Gate – Collector Charge			400		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) V_{GE} = 15V V_{Bus} = 400V I_C = 180A R_G = 2.5 Ω		26		ns
T_r	Rise Time			25		
$T_{d(off)}$	Turn-off Delay Time			150		
T_f	Fall Time			30		
E_{on}	Turn-on Switching Energy ❶			6.74		mJ
E_{off}	Turn-off Switching Energy ❷			5.74		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = 15V V_{Bus} = 400V I_C = 180A R_G = 2.5 Ω		26		ns
T_r	Rise Time			25		
$T_{d(off)}$	Turn-off Delay Time			170		
T_f	Fall Time			40		
E_{on}	Turn-on Switching Energy ❶			8.6		mJ
E_{off}	Turn-off Switching Energy ❷			7		

Reverse diode ratings and characteristics

Symbol	*Characteristic*	*Test Conditions*		*Min*	*Typ*	*Max*	*Unit*
$I_{F(AV)}$	Maximum Average Forward Current	50% duty cycle	T_c = 80°C		200		A
V_F	Diode Forward Voltage	I_F = 200A			1.6	1.8	V
		I_F = 400A			1.9		
		I_F = 200A	T_j = 125°C		1.4		
t_{rr}	Reverse Recovery Time	I_F = 200A V_R = 400V di/dt =400A/µs	T_j = 25°C		180		ns
			T_j = 125°C		220		
Q_{rr}	Reverse Recovery Charge	I_F = 200A V_R = 400V di/dt =400A/µs	T_j = 25°C		780		nC
			T_j = 125°C		2900		

❶ E_{on} includes diode reverse recovery
❷ In accordance with JEDEC standard JESD24-1

Thermal and package characteristics

Symbol	Characteristic			Min	Typ	Max	Unit
R_{thJC}	Junction to Case		IGBT			0.15	°C/W
			Diode			0.32	
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz			2500			V
T_J	Operating junction temperature range			-40		150	°C
T_{STG}	Storage Temperature Range			-40		125	
T_C	Operating Case Temperature			-40		100	
Torque	Mounting torque	To Heatsink	M5			4.7	N.m
Wt	Package Weight					160	g

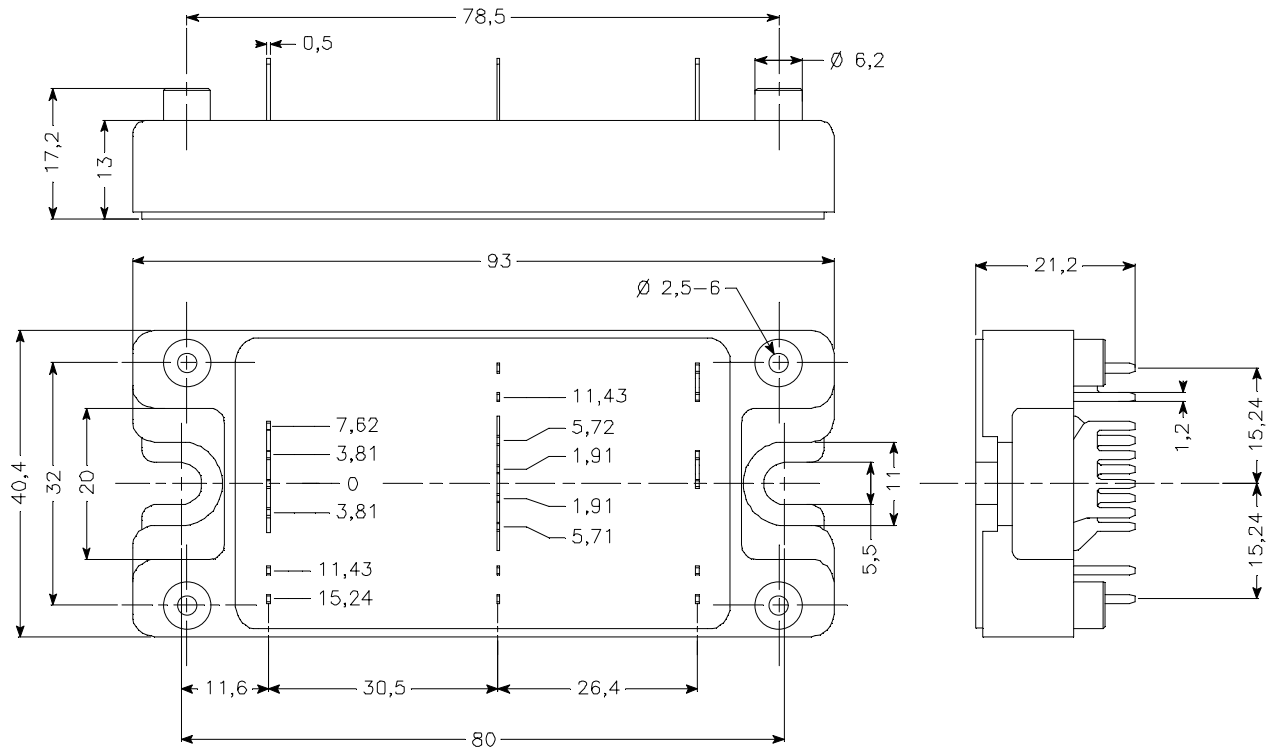
Temperature sensor NTC

Symbol	Characteristic	Min	Typ	Max	Unit
R_{25}	Resistance @ 25°C		68		kΩ
$B_{25/85}$	T_{25} = 298.16 K		4080		K

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

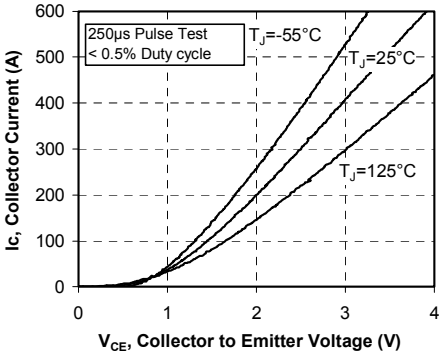
T: Thermistor temperature
R_T: Thermistor value at T

Package outline

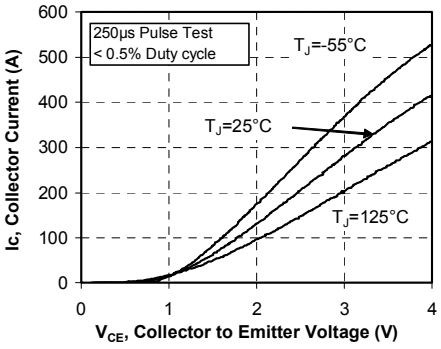


Typical Performance Curve

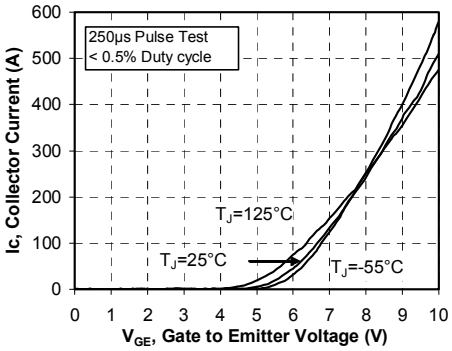
Output characteristics (V_{GE}=15V)



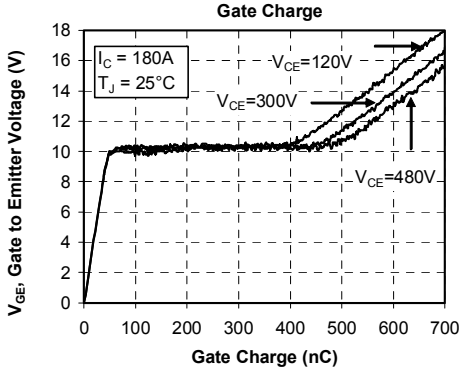
Output Characteristics (V_{GE}=10V)



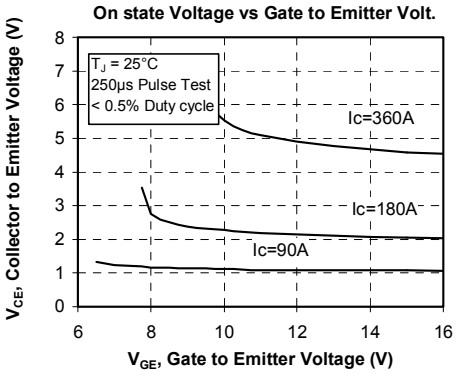
Transfer Characteristics



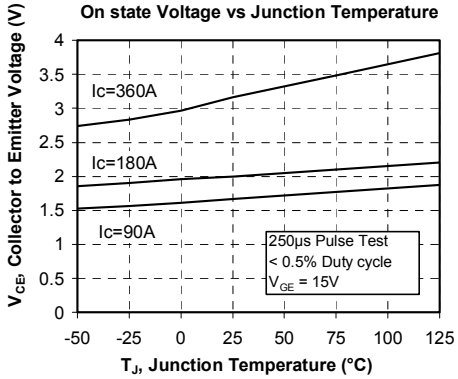
Gate Charge



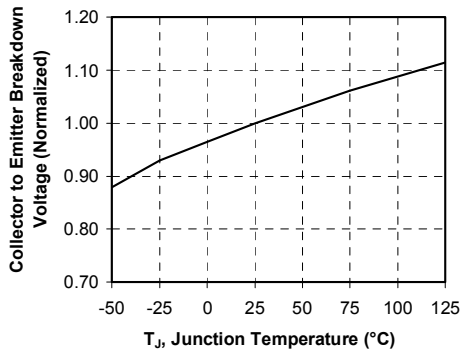
On state Voltage vs Gate to Emitter Volt.



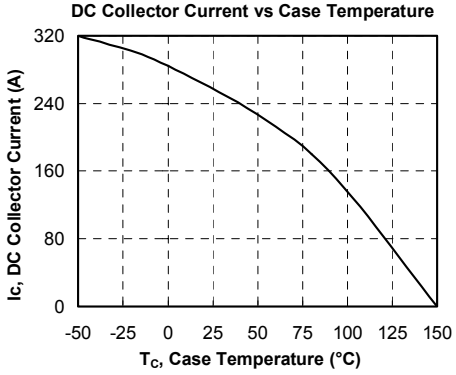
On state Voltage vs Junction Temperature



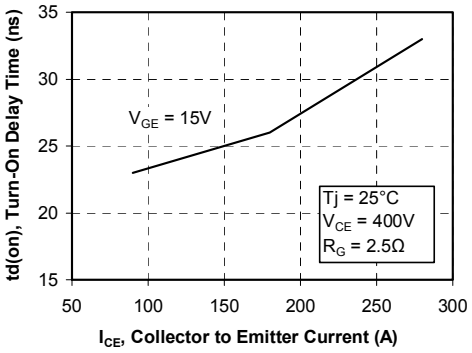
Breakdown Voltage vs Junction Temp.



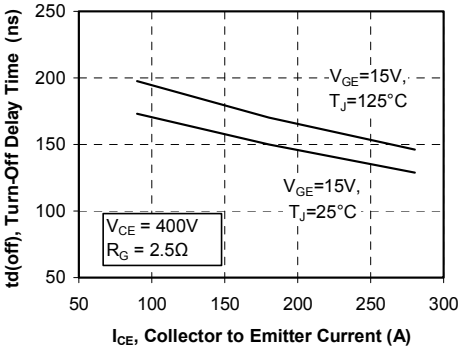
DC Collector Current vs Case Temperature



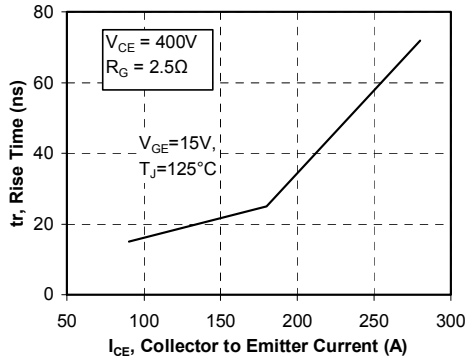
Turn-On Delay Time vs Collector Current



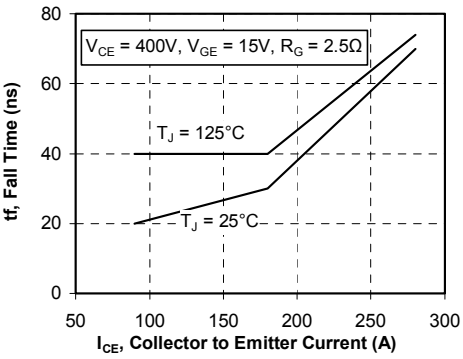
Turn-Off Delay Time vs Collector Current



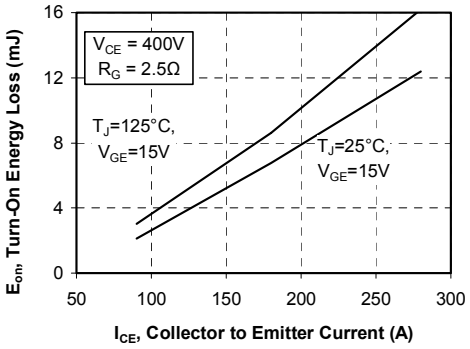
Current Rise Time vs Collector Current



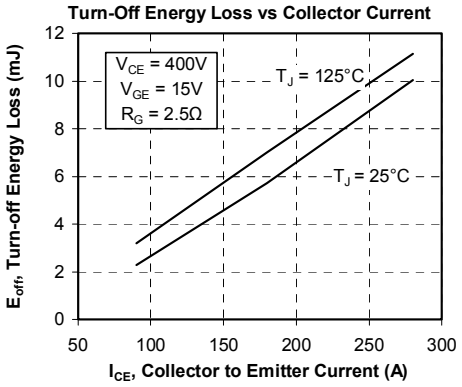
Current Fall Time vs Collector Current



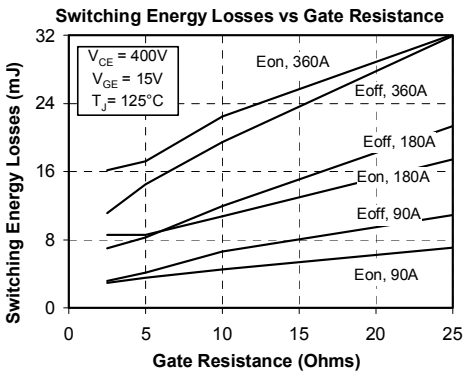
Turn-On Energy Loss vs Collector Current



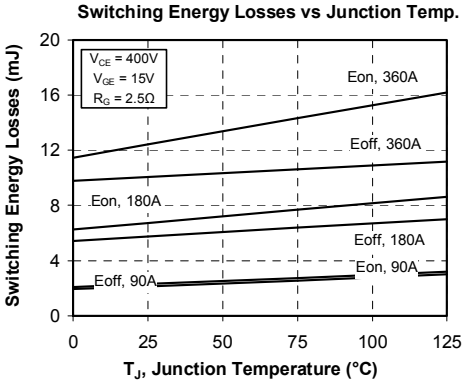
Turn-Off Energy Loss vs Collector Current



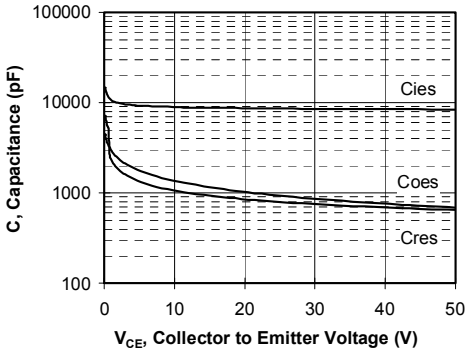
Switching Energy Losses vs Gate Resistance



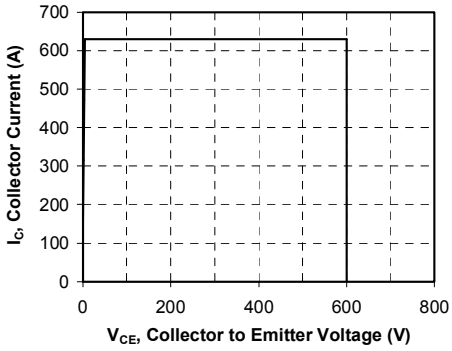
Switching Energy Losses vs Junction Temp.



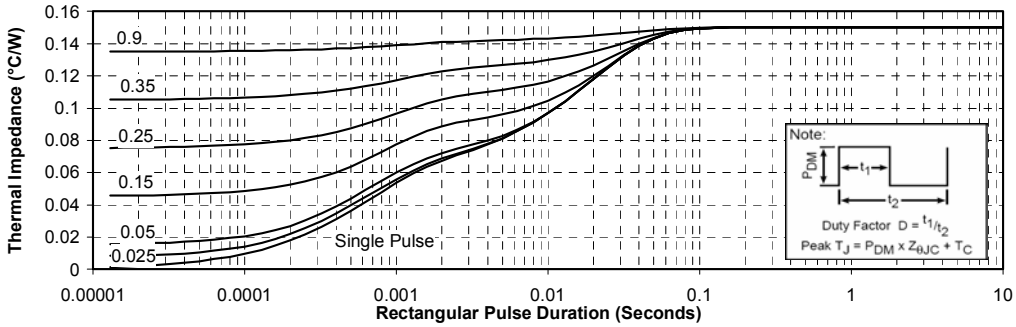
Capacitance vs Collector to Emitter Voltage



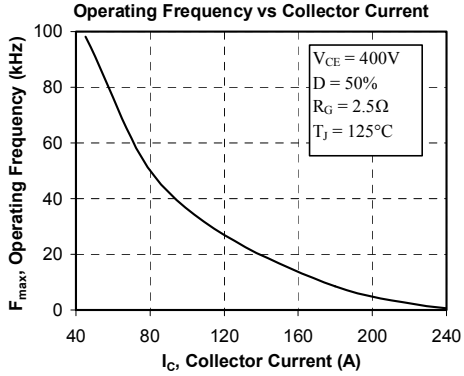
Minimum Switching Safe Operating Area



Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



Operating Frequency vs Collector Current



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