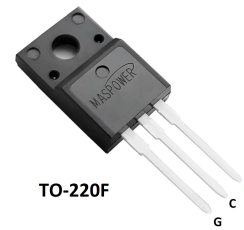


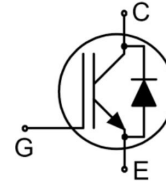
Features

- Low gate charge
- Trench FS Technology
- RoHS product



Applications

- General purpose inverters
- Induction heating(IH)
- UPS



Absolute Ratings($T_C=25^{\circ}\text{C}$, unless otherwise noted)

Parameter	Symbol		Value	Unit
Collector-Emitter Voltage	V _{CES}		600	V
Gate-Emitter Voltage	V _{GES}		±20	V
*Collector Current-continuous	I _C	T=25℃	10	A
		T=100℃	5	A
Collector Current-pulse(note 1)	I _{CM}		20	A
Diode Continuous forward current	I _F	T=25℃	10	A
		T=100℃	5	
Diode Maximum Forward Current (Note 1)	I _{FM}		20	A
Short-circuit withstand time (note 2)	t _{sc}		10	μs
Short-circuit current(note 1)	I _{SC}		55	A
Power Dissipation(TO-220F)	P _D	TC=25℃	58	W
		TC=100℃	29	
Operating Temperature Range	T _J		-40~+175	℃
Storage Temperature Range	T _{STG}		-55~+150	℃
Maximum Lead Temperature for Soldering Purposes	T _L		300	℃

*Collector current limited by maximum Junction temperature

Electrical Characteristic($T_C=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Tests conditions		Min	Typ	Max	Units
Off-Characteristics							
Collector-Emitter Voltage	BV_{CES}	$I_C=250\mu A, V_{GE}=0V$		600	-	-	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE}=300V, V_{GE}=0V, T_C=25^{\circ}C$		-	-	1	μA
Gate-body leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$		-	-	± 100	nA
On-Characteristics							
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}, I_C=400\mu A$		4.8	5.3	6.0	V
Collector-Emitter saturation Voltage	V_{CEsat}	$V_{GE}=15V, I_C=5A$	$T_C=25^{\circ}C$	-	1.7	1.9	V
			$T_C=125^{\circ}C$	-	1.9	-	V
			$T_C=175^{\circ}C$	-	2.0	-	V
Transconductance	g_{fs}	$V_{GE}=15V, I_C=5A$			25		S
Dynamic Characteristics							
Input capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1.0MHz$		-	1050	-	pF
Output capacitance	C_{oes}			-	24	-	pF
Reverse transfer capacitance	C_{res}			-	6	-	pF
Total Gate Charge	Q_g	$V_{CC}=480V, I_C=5A, V_{GE}=0V \text{ to } 15V^{3,4}$		-	35.5	-	nC
Gate to emitter charge	Q_{ge}			-	5.8	-	
Gate to collector charge	Q_{gc}			-	15	-	
Switching Characteristics							
Turn-On delay time	$t_{d(on)}$	$V_{CE}=300V, I_C=5A, R_G=40\Omega, \text{Inductive load } T_C=25^{\circ}C$		-	35	-	ns
Turn-On rise time	t_r			-	24	-	ns
Turn-off delay time	$t_{d(off)}$			-	110	-	ns
Turn-off Fall time	t_f			-	34	-	ns
Turn-on energy	E_{on}			-	0.28	-	mJ
Turn-off energy	E_{off}			-	0.10	-	mJ
Total switching Energy	E_{tot}			-	0.38	-	mJ
Anti-Parallel Diode Characteristics and Maximum Ratings							
Diode Forward Voltage	V_F	$V_{GE}=0V, I_F=5A$	$T_C=25^{\circ}C$	-	1.6	-	V
			$T_C=125^{\circ}C$	-	1.55	-	
			$T_C=175^{\circ}C$	-	1.45	-	
Diode Reverse recovery	t_{rr}	$V_{GE}=0V, V_R=300V,$		-	63	-	ns

time		$I_F = 5A$, $-di_F/dt = 500A/\mu s$				
Reverse recovery charge	Q_{rr}		-	180	-	nC
Reverse recovery current	I_{rrm}		-	3	-	A

Thermal Characteristics

Symbol	Parameter	Max. Value	Units
$R_{th\ j-c, IGBT}$	Thermal Resistance, Junction to case for IGBT	2.2	$^{\circ}C/W$
$R_{th\ j-c, FRD}$	Thermal Resistance, Junction to case for FRD	3.2	$^{\circ}C/W$
$R_{th\ j-a}$	Thermal Resistance, Junction to Ambient	50	$^{\circ}C/W$

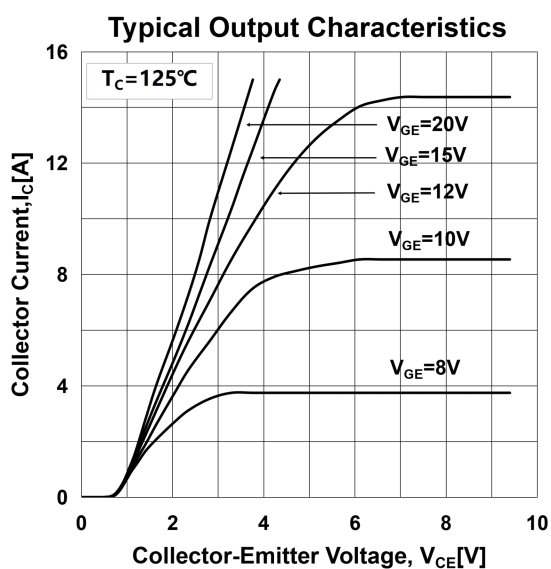
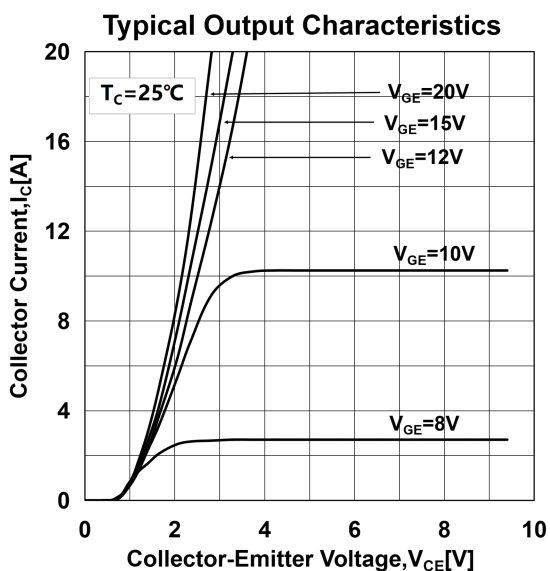
Notes:

- 1: Pulse width limited by maximum junction temperature
- 2: Allowed number of short circuits: <1000; time between short circuits: >1s.
- 3: Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$
- 4: Essentially independent of operating temperature

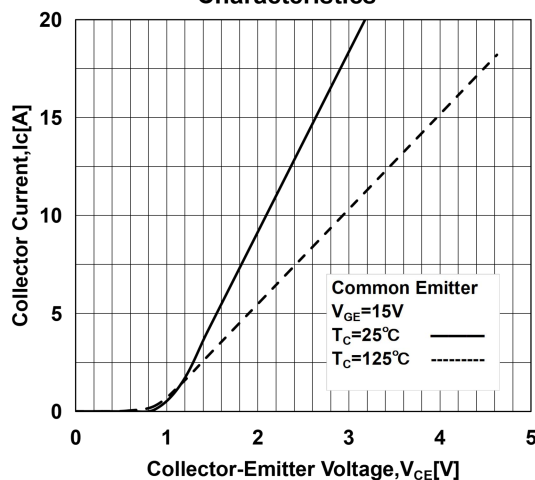
Order Message

Order codes	Package	Packaging
MSG5T60HLT1	TO-220F	tube

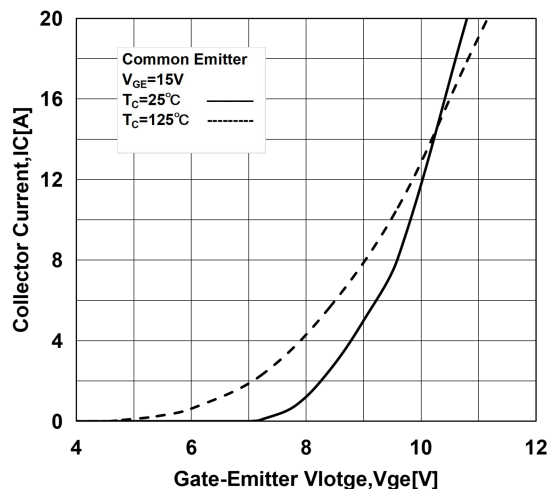
Electrical Characteristics(curves)



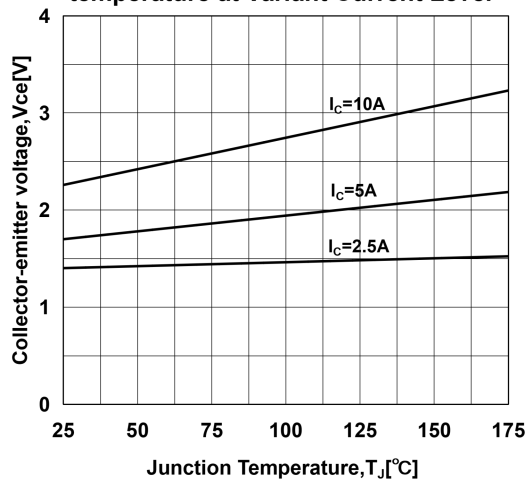
Typical Saturation Voltage Characteristics



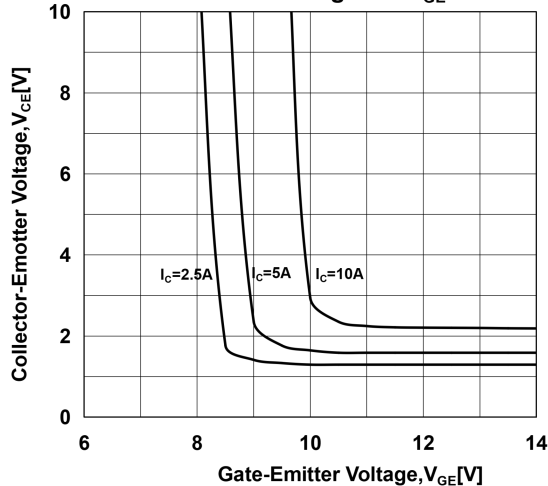
Transfer Characteristics



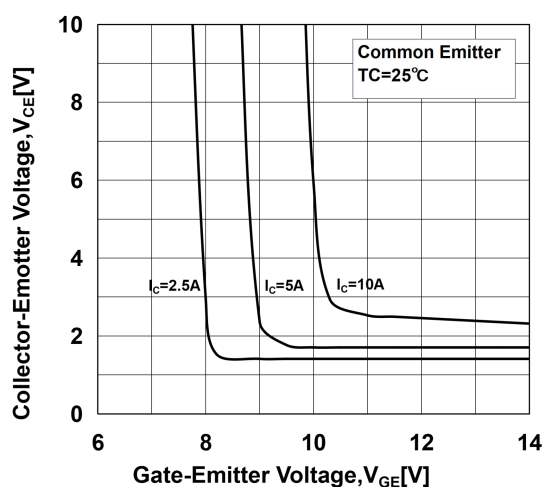
Saturation Voltage vs. Junction temperature at Variant Current Level



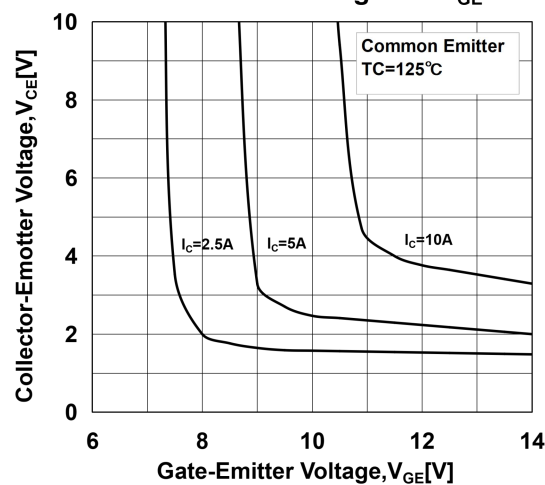
Saturation Voltage vs. V_{GE}



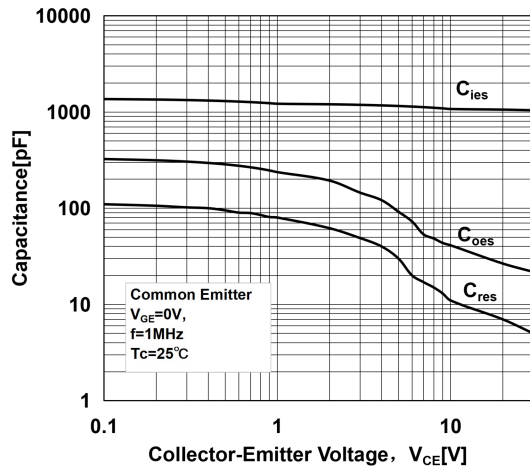
Saturation Voltage vs. V_{GE}



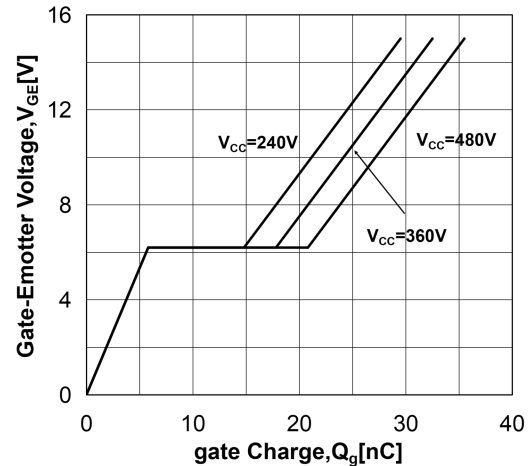
Saturation Voltage vs. V_{GE}



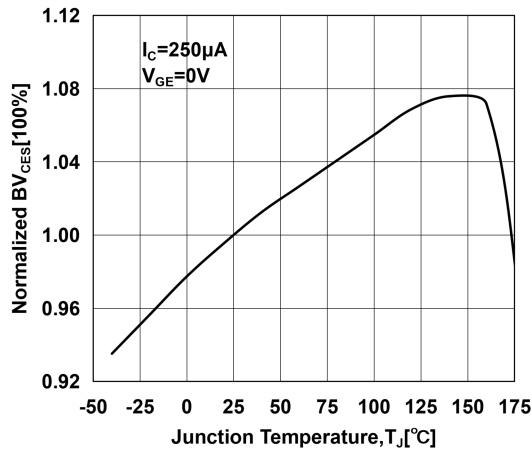
Capacitance Characteristics



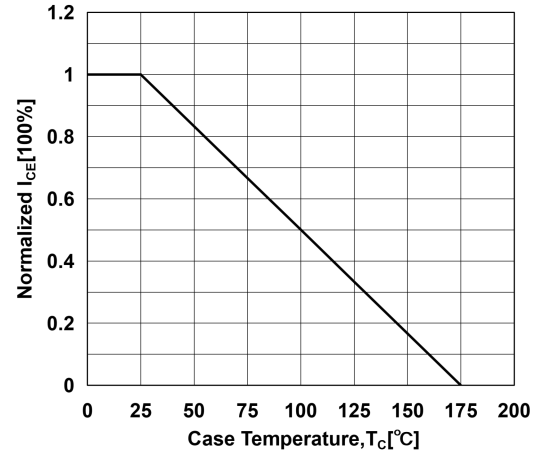
Gate Charge Characteristics



Normalized Collector to Emitter Breakdown Voltage vs. Junction Temperature

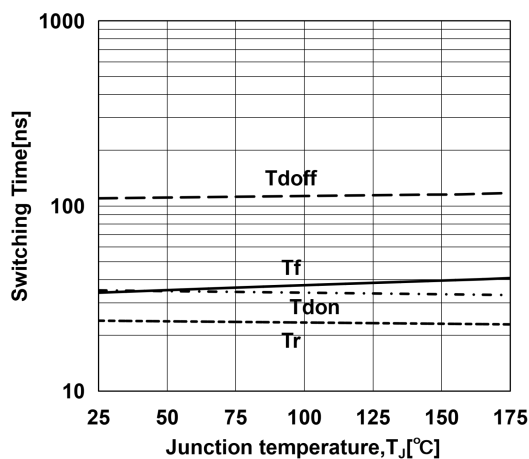


Normalized Collector-Emmitter Current Standard Derating Curve



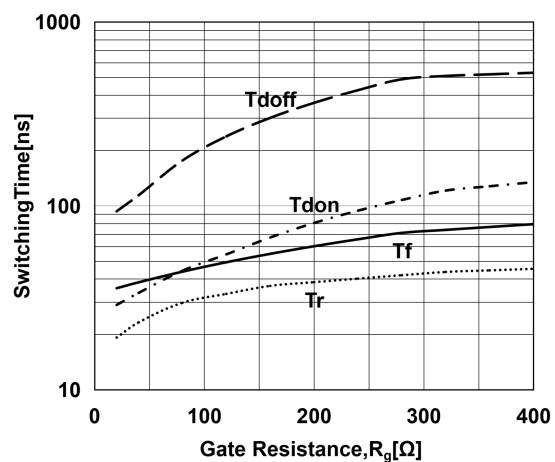
Switching Time vs. T_J

$V_{ge}=15V, V_{CE}=300V, I_C=5A, R_g=40\Omega$

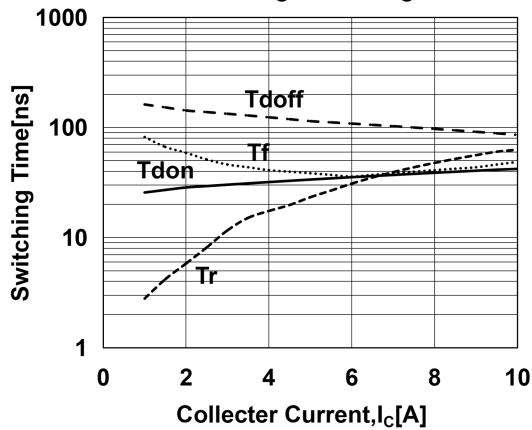


Switching Time Vs. R_g (125 $^\circ C$)

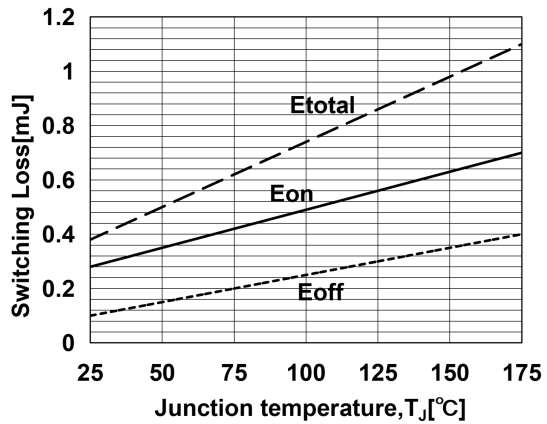
$V_{ge}=15V, V_{ce}=300V, I_c=5A$



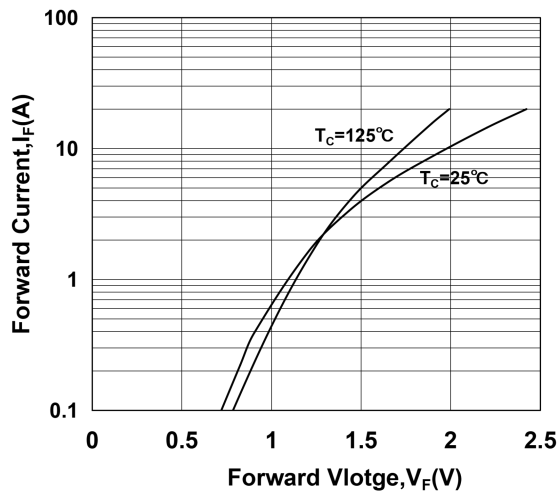
Switching Time vs. I_c (125°C)
 $V_{ce}=300V, V_{ge}=15V, R_g=40\Omega$



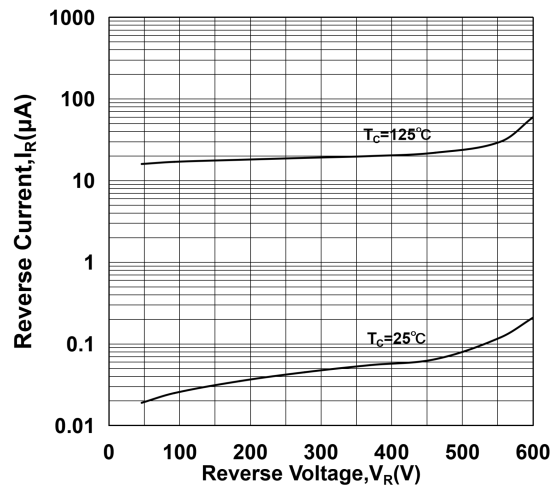
Switching Loss vs. T_j
 $V_{ge}=15V, V_{ce}=300V, I_c=5A, R_g=40\Omega$



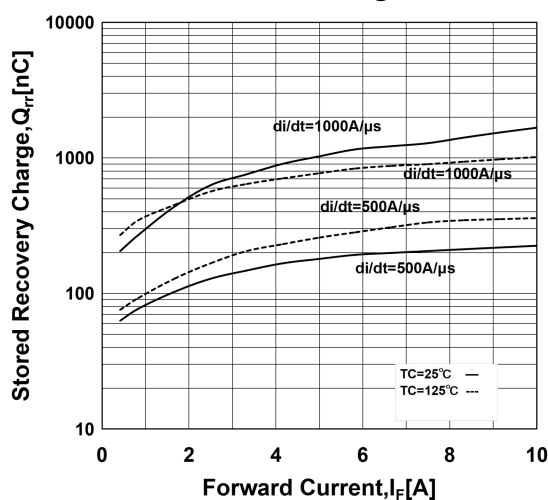
Forward Characteristics



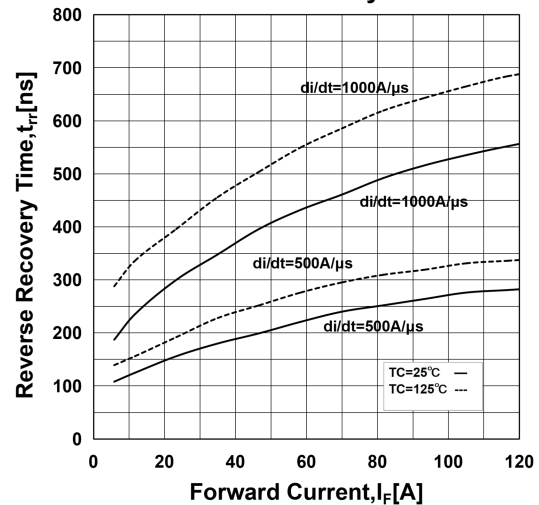
Reverse Current



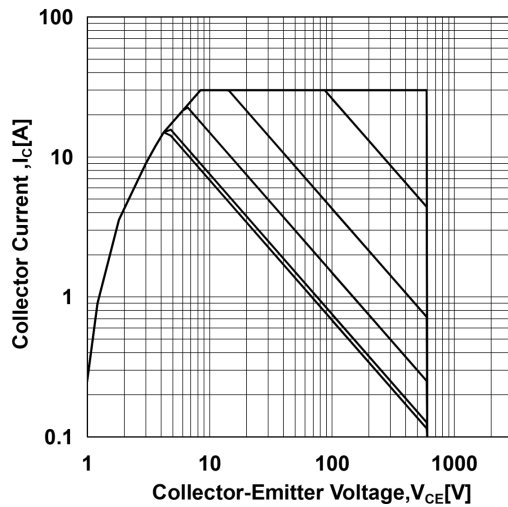
Stored Charge



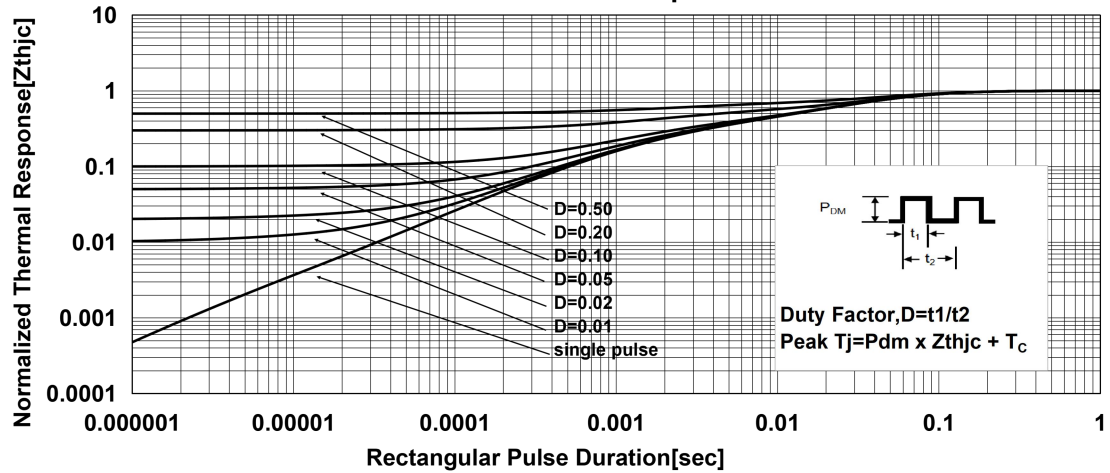
Reverse Recovery Time



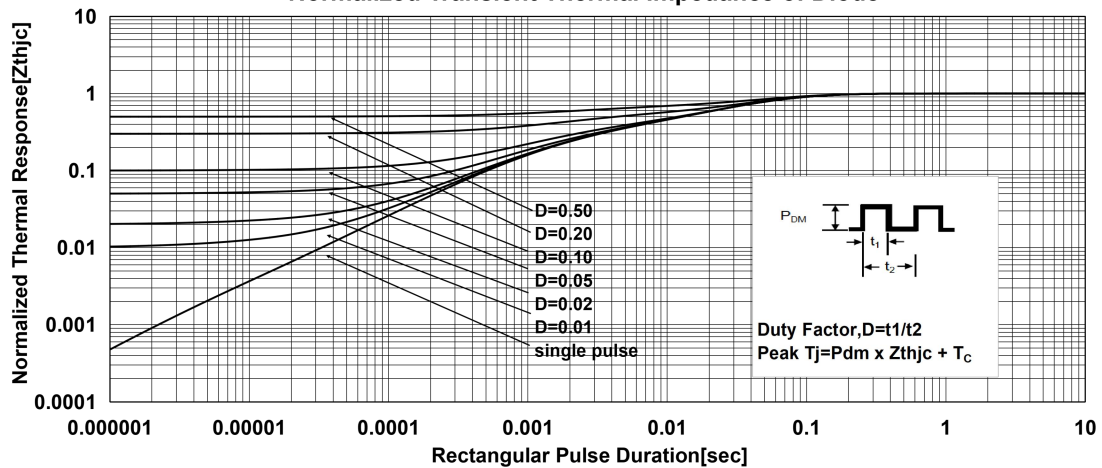
Forward Bias Safe Operating Area



Normalized Transient Thermal Impedance of IGBT



Normalized Transient Thermal Impedance of Diode



Package Mechanical DATA

