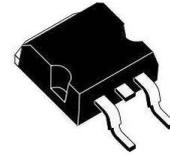


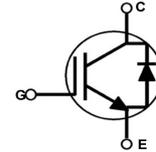
Features

- High Speed Switching & Low Power Loss
- High Input Impedance
- $V_{CE(sat)} = 1.6V @ I_C = 20A$
- High Input Impedance
- Short circuit withstand time 10 μs



Applications

- PFC
- UPS
- Inverter



Absolute Maximum Ratings

Parameter		Symbol	Value	Unit
Collector-emitter voltage		V_{CES}	650	V
Gate-emitter voltage		V_{GES}	± 30	
Collector curre	$T_C = 25^\circ C$	I_C	40	A
	$T_C = 100^\circ C$		20	
Pulsed collector current, pulse time limited by T_{jmax}		I_{CM}	80	
Diode forward current @ $T_C = 100^\circ C$		I_F	20	
Diode pulsed current, Pulse time limited by T_{jmax}		I_{FM}	210	
Power dissipati	$T_C = 25^\circ C$	P_D	227	W
	$T_C = 100^\circ C$		100	
Operating Junction and storage temperature rang		T_J	-55 to 155	$^\circ C$
		T_{stg}	-55 to 155	

Thermal Characteristics

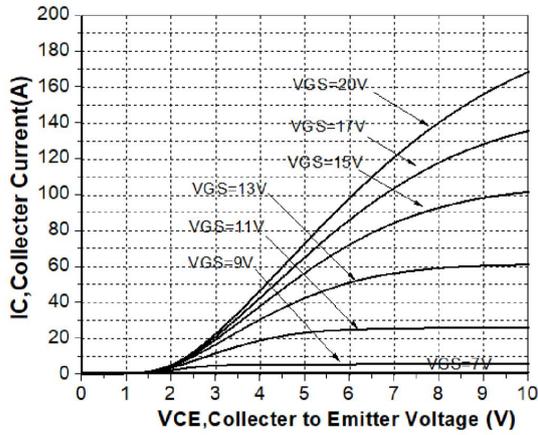
Parameter	Symbol	Value	Unit
Thermal resistance junction-to-ambien	$R_{\theta JA}$	62.5	$^\circ C/W$
Thermal resistance junction-to-case for IGBT	$R_{\theta JC}$	0.55	
Thermal resistance junction-to-case for Diod	$R_{\theta JC}$	0.8	

Electrical Characteristics (T_c =25°C unless otherwise specified)

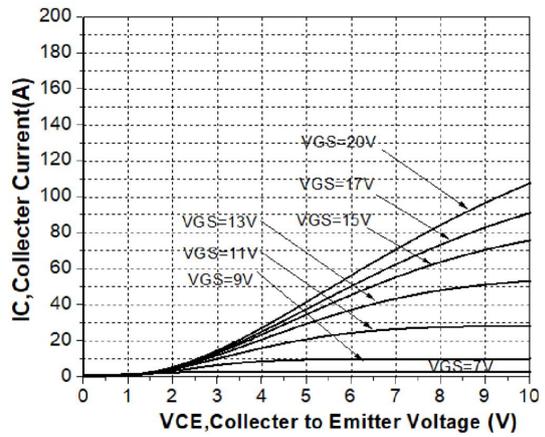
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static Characteristics						
Collector-emitter breakdown voltag	BV _{CES}	I _C = 500 μ A, V _{GE} = 0V	650	-	-	V
Gate-emitter threshold voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C = 250 μ A	4.5	-	6.5	
Zero gate voltage collector current	I _{CES}	V _{CE} = 650V, V _{GE} = 0V	-	-	1	μ A
Gate-emitter leakage current	I _{GES}	V _{GE} = 20V, V _{CE} = 0V	-	-	±200	nA
Collector-emitter saturation voltage	V _{CE(sat)}	I _C = 20A V _{GE} = 15V T _C = 25°C	-	1.6	2.0	V
		I _C = 20A, V _{GE} = 15V, T _C = 150°C	-	2.0	-	
Dynamic and Switching Characteristi						
Total gate charg	Q _g	V _{CE} = 400V, I _C = 20A, V _{GE} = 15V	-	43.9	-	nC
Gate-emitter charg	Q _{ge}		-	10	-	
Gate-collector charg	Q _{gc}		-	18.9	-	
Input capacitanc	C _{ies}	V _{CE} = 25V, V _{GE} = 0V, f = 1MHz	-	1173	-	pF
Reverse transfer capacitanc	C _{res}		-	28.7	-	
Output capacitance	C _{oes}		-	128	-	
Turn-on delay time	t _{d(on)}	V _{GE} = 15V, V _{CC} = 400V, I _C = 20A, R _G = 10Ω Inductive Load, T _C = 25°C	-	16	-	nS
Rise tim	t _r		-	56	-	
Turn-off delay time	t _{d(off)}		-	52	-	
Fall time	t _f		-	82	-	
Turn-on switching energy	E _{on}	Inductive Load, T _C = 25°C	-	0.79	-	mJ
Turn-off switching energy	E _{off}		-	0.3	-	
Total switching energ	E _{ts}		-	1.09	-	
Turn-on delay time	t _{d(on)}	V _{GE} = 15V, V _{CC} = 400V, I _C = 20A, R _G = 10Ω Inductive Load, T _C = 175°C	-	14	-	nS
Rise tim	t _r		-	54	-	
Turn-off delay time	t _{d(off)}		-	76	-	
Fall time	t _f		-	146	-	
Turn-on switching energy	E _{on}	Inductive Load, T _C = 175°C	-	0.8	-	mJ
Turn-off switching energ	E _{off}		-	0.49	-	
Total switching energ	E _{ts}		-	1.3	-	
Diode Characteristics (T_c =25oC unless otherwise specified)						
Forward voltag	V _F	I _F =15A, T _C =25°C	-	1.4	1.55	V
		I _F =15A, T _C =125°C	-	1.25	-	
Reverse recovery time	t _{rr}	I _F =20A, di/dt=100A/μS T _C =25°C	-	254	-	nS
Reverse recovery current	I _{rr}		-	2.7	-	A
Reverse recovery charge	Q _{rr}		-	347	-	nC

Typical Performance Characteristic

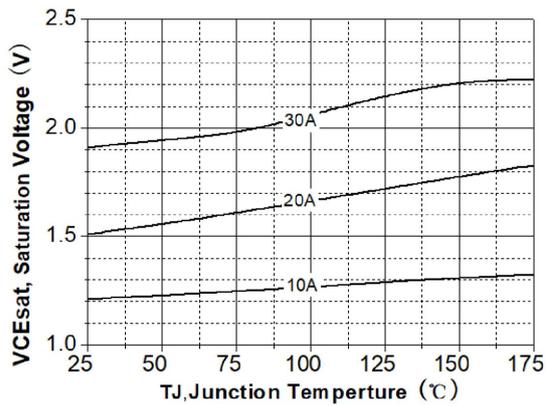
Output Characteristics $T_j=25^\circ\text{C}$



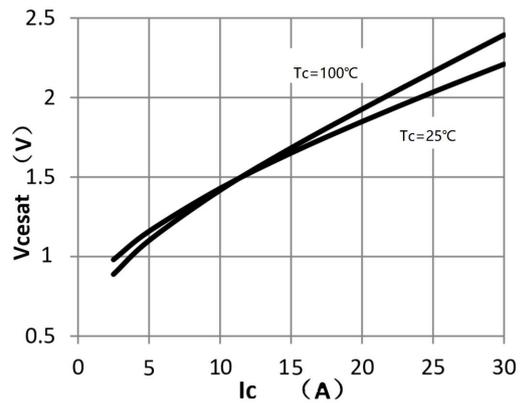
Output Characteristics $T_j=175^\circ\text{C}$



V_{CEsat} vs T_j

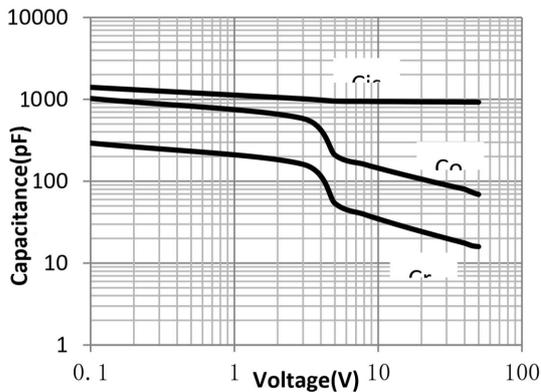


V_{CEsat} vs I_C

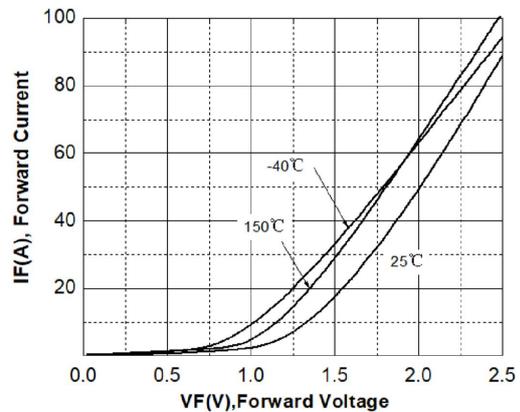


Capacitance Characteristic

$V_{ce}=25\text{V}, V_{GE}=0\text{V}, f=1.0\text{MHz}$

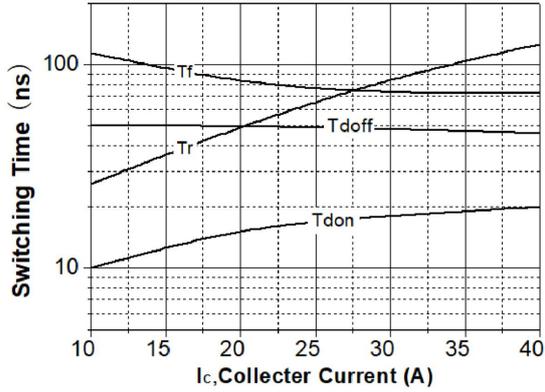


Diode Characteristic



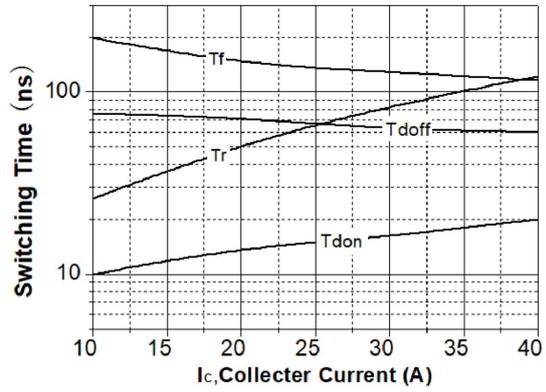
Switching Time vs. IC T_j=25°C

V_{GE}=15V, V_{CE}=400V, R_g=10 Ω



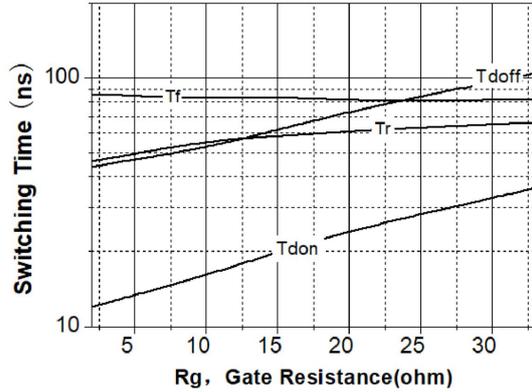
Switching Time vs. IC T_j=175°C

V_{GE}=15V, V_{CE}=400V, R_g=10 Ω



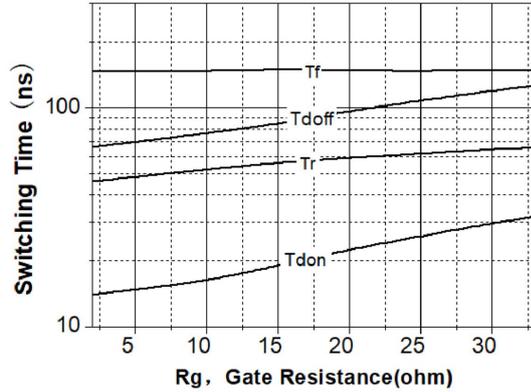
Switching Time vs. R_g T_j=25°C

V_{GE}=15V, V_{CE}=400V, I_C=20A

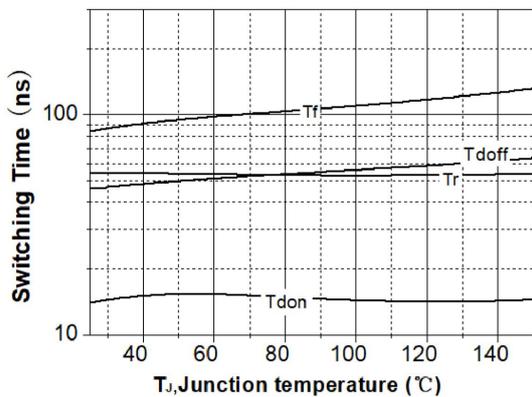


Switching Time vs. R_g T_j=175°C

V_{GE}=15V, V_{CE}=400V, I_C=20A

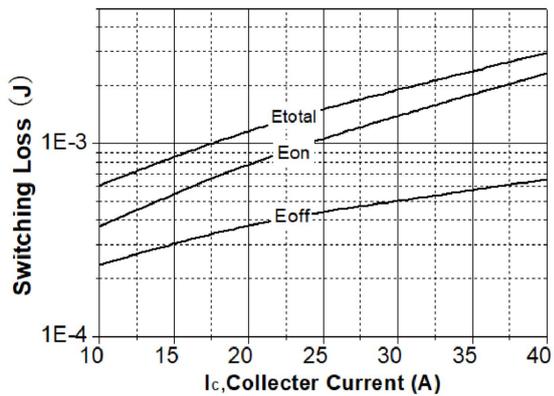


Switching Time vs. T_j



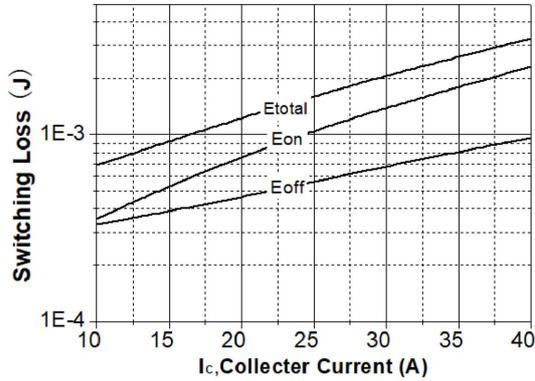
Switching Loss vs. IC T_j=25°C

V_{GE}=15V, V_{CE}=400V, R_g=7.9 Ω



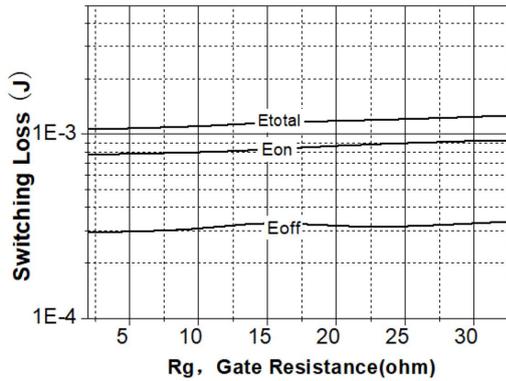
Switching Loss vs. IC Tj=175°C

VGE=15V, VCE=400V, Rg=7.9Ω



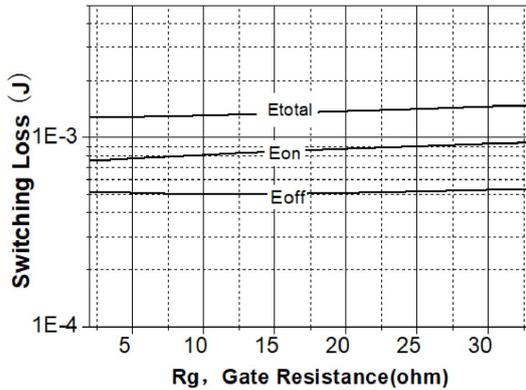
Switching Loss vs. Rg Tj=25°C

VGE=15V, VCE=400V, IC=20A



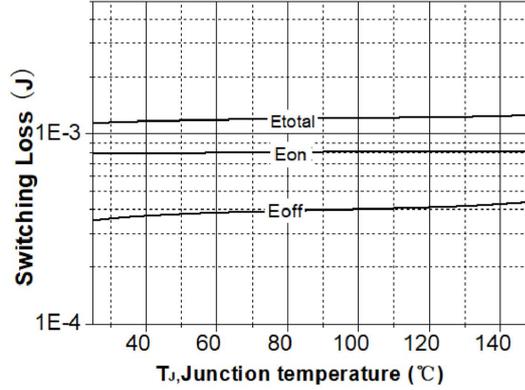
Switching Loss vs. Rg Tj=175°C

VGE=15V, VCE=400V, IC=20A



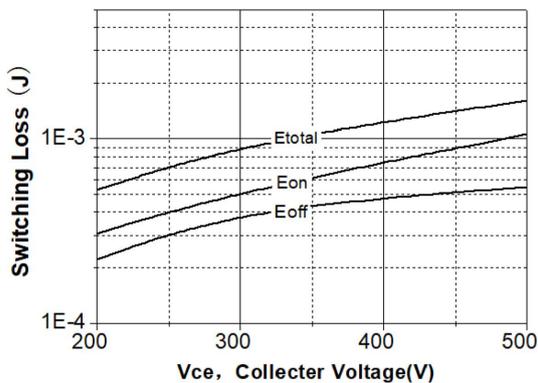
Switching Loss vs. Tj

VGE=15V, VCE=400V, IC=20A, Rg=10Ω

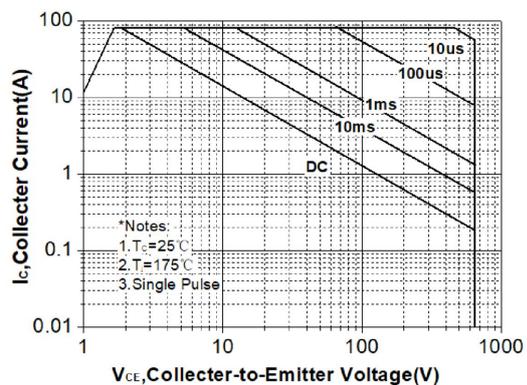


Switching Loss vs. Vce(V) Tj=175°C

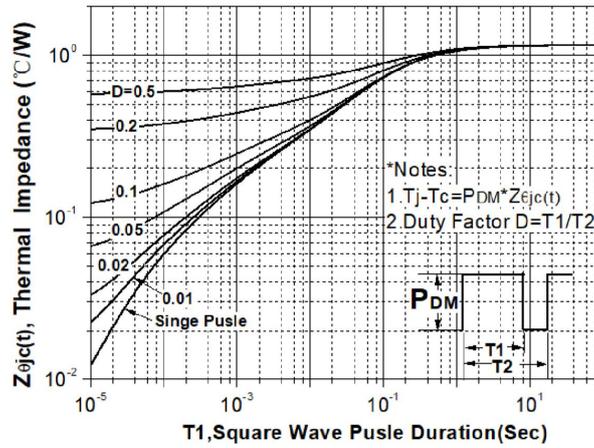
VGE=15V, IC=20A, Rg=10Ω



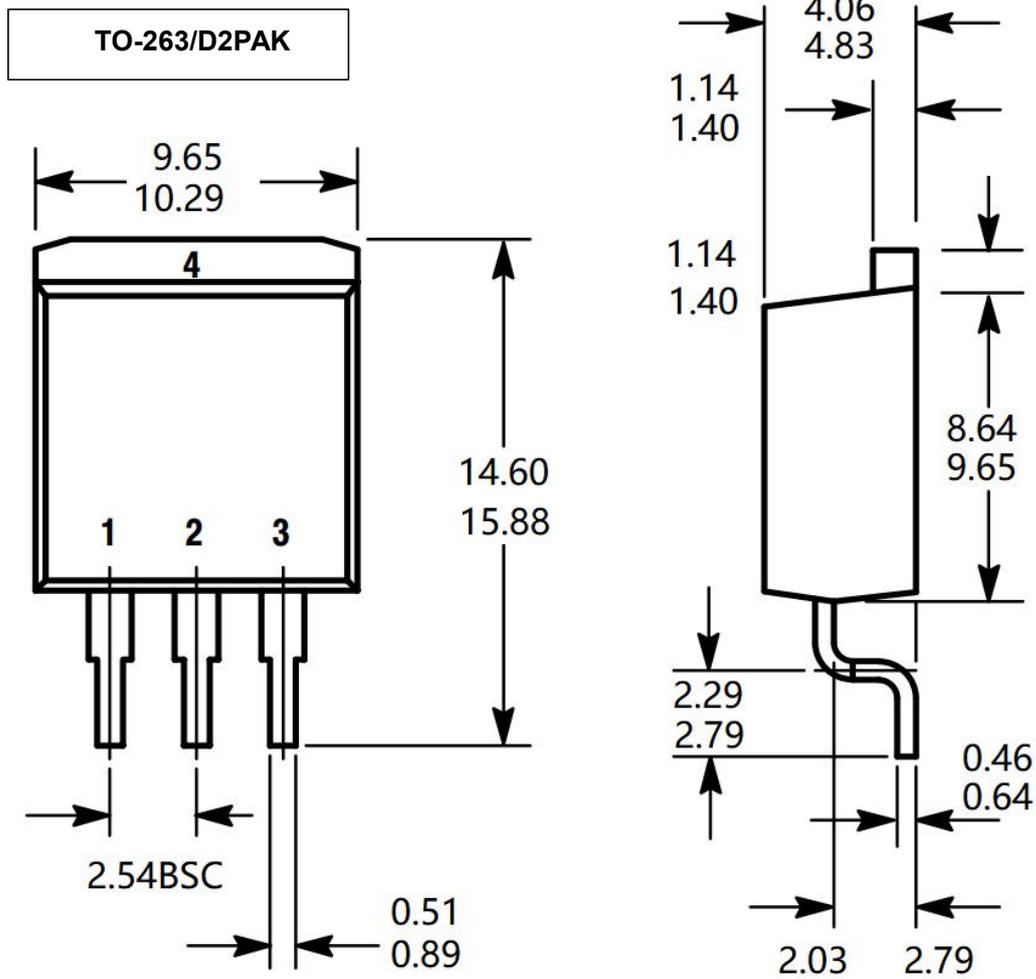
Safe Operating Area TO-220MF



Normalized Maximum Transient Thermal Impedance for IGBT



Package outline dimension



① FDL changed to FLE on January 1, 2019