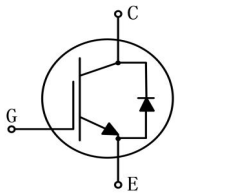
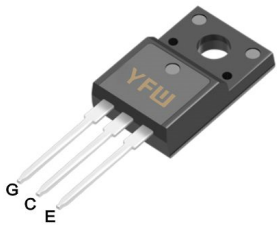
650V N-Channel Enhancement Mode Power IGBT

MAIN CHARACTERISTICS

$I_{C\ @TC=100℃}$	20A
V_{CE}	650V
VCE(sat)-typ	1.75V





TO-220F

FEATURES

- Positive temperature coefficient
- Fast Switching
- Low VCE(sat)
- Reliable and Rugged

APPLICATIONS

- Motor drives
- Air Condition
- Inverters

MECHANICAL DATA

- Case: TO-220F/AF
- Mounting Position: Any
- Molded Plastic: UL Flammability Classification Rating 94V-0
- Lead free in compliance with EU RoHS 2011/65/EU directive
- Solder bath temperature 275℃ maximum,10s per JESD 22-B106

Maximum Ratings

Characteristics	Symbol	Value	Unit
		TO-220F	
Collector-emitter voltage	V_{CES}	650	V
Gate-emitter voltage	V_{GES}	±30	V
Continuous collector current (TC=25℃)	I_C	40	A
Continuous collector current (TC=100℃)		20	A
Pulsed collector current, tp limited by Tvjmax	I_{CM}	60	A
Diode continuous forward current (TC=25℃)	I_F	40	A
Diode continuous forward current (TC=100℃)		20	A
Diode maximum current, tp limited by Tvjmax	I_{FM}	60	A
Short circuit withstand time	tsc	10	μs
Power dissipation (TC=25℃)	P_{tot}	176	W
Operating junction temperature range	T_{vj}	-55 to +175	°C
Storage temperature range	T_{stg}	-55 to +175	°C

Thermal characteristics

Characteristics	Symbol	Values		Unit
		Typ	Max.	
Thermal resistance, junction to case for IGBT	$R_{th(j-c)}$	-	0.85	°C/ W
Thermal resistance, junction to case for Diode	$R_{th(j-c)}$	-	0.98	°C/ W
Thermal resistance, junction to ambient	$R_{th(j-a)}$	-	40	°C/ W

Note1:Pulse test: 300 μs pulse width, 2 % duty cycle

Electrical characteristics of IGBT at Tvj=25℃ unless otherwise specified

Characteristics	Test Condition	Symbol	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	V_{GE}=0V, I_C=250μA	B_{VCES}	650	-	-	V
Collector-emitter leakage current	V_{CE}=650V, V_{GE}=0V	I_{CES}	-	-	10	μA
Gate leakage current, forward	V_{GE}=±20V, V_{CE}=0V	I_{GES}	-	-	±200	nA
Gate-emitter threshold voltage	V_{GE}=VCE, I_C=1mA	$V_{GE(th)}$	4.3	5.3	6.3	V
Collector-emitter saturation voltage	V_{GE}=15 V, I_C=20A	$V_{CE(sat)}$	-	1.75	2.05	V
	V_{GE}=15V, I_C=20A, T_{vj}=175℃		-	1.98	-	V
Input capacitance	V_{CE}=25V V_{GE}=0V f =1MHz	C_{ies}	-	780	-	pF
Output capacitance		C_{oes}	-	46	-	pF
Reverse transfer capacitance		C_{res}	-	22	-	pF
Total gate charge	V_{CC}=520V V_{GE}=15V I_C=20A	Q_g	-	45		nC
Gate-emitter charge		Q_{ge}	-	9		nC
Gate-collector charge		Q_{gc}	-	22		nC
Turn-on delay time	V_{CC}=400V V_{GE}=15V I_C=20A R_G=5Ω Inductive load	td(on)	-	12	-	ns
Rise time		tr	-	24	-	ns
Turn-off delay time		td(off)	-	40	-	ns
Fall time		tf	-	68	-	ns
Turn-on energy		Eon	-	0.26	-	mJ
Turn-off energy		Eoff	-	0.39	-	mJ
Total switching energy		Ets	-	0.65	-	mJ
Turn-on delay time	V_{CC}=400V VGE=15V I_C=20A R_G=5Ω Inductive load Tvj =175℃	td(on)	-	14	-	ns
Rise time		tr	-	32	-	ns
Turn-off delay time		td(off)	-	81	-	ns
Fall time		tf	-	60	-	ns
Turn-on energy		Eon	-	0.4	-	mJ
Turn-off energy		Eoff	-	0.57	-	mJ
Total switching energy		Ets	-	0.97	-	mJ
Diode forward voltage	I_F=20A	VF	-	1.46	1.76	V
	I_F=20A,Tvj=175℃		-	1.3	-	V
Diode reverse recovery time	V_R=400V I_F=20A diF/dt=-200A/μs	trr	-	47	-	ns
Diode peak reverse recovery current		Irrm	-	4.8	-	A
Diode reverse recovery charge		Qrr	-	67	-	nC
Diode reverse recovery time	V_R=400V I_F=20A diF/dt=-200A/μs Tvj=175℃	trr	-	62	-	ns
Diode peak reverse recovery current		Irrm	-	6.3	-	A
Diode reverse recovery charge		Qrr	-	102	-	nC

Ratings and Characteristic Curves

Figure 1: Power Dissipation

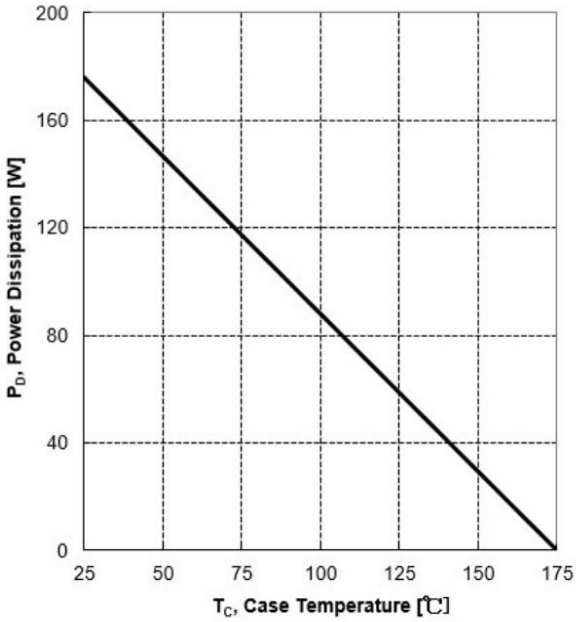


Figure 2: Collector Current vs. Case Temperature

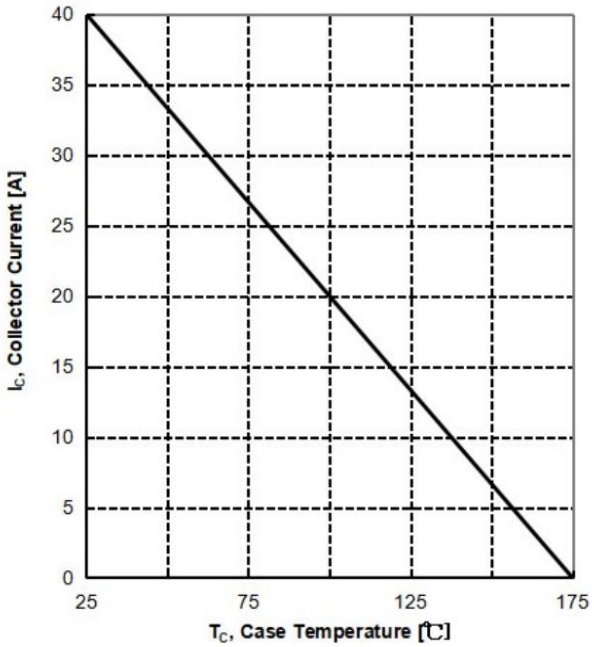


Figure 3: Safe Operation Area

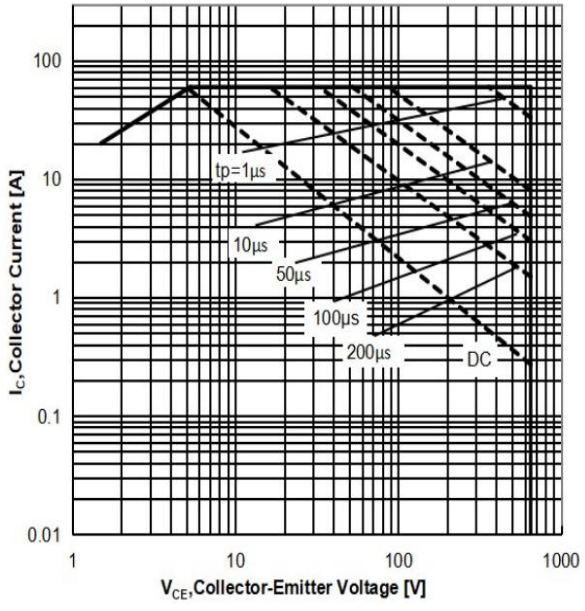
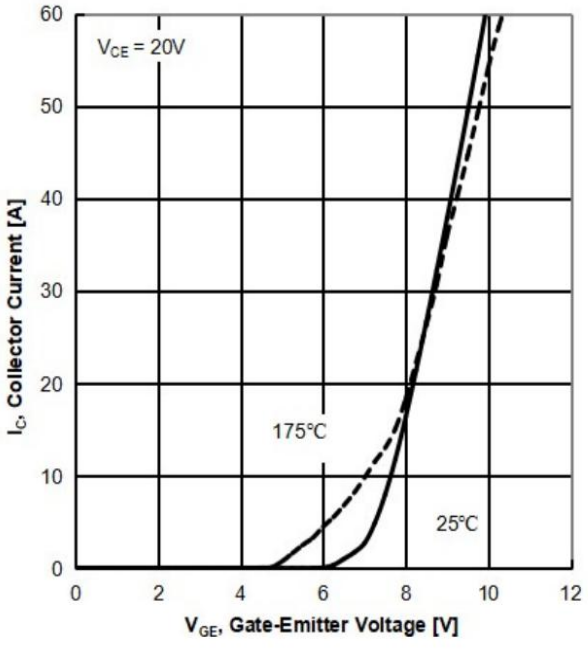


Figure 4: Typical Transfer Characteristics



Ratings and Characteristic Curves

Figure 5: Typical Output Characteristics

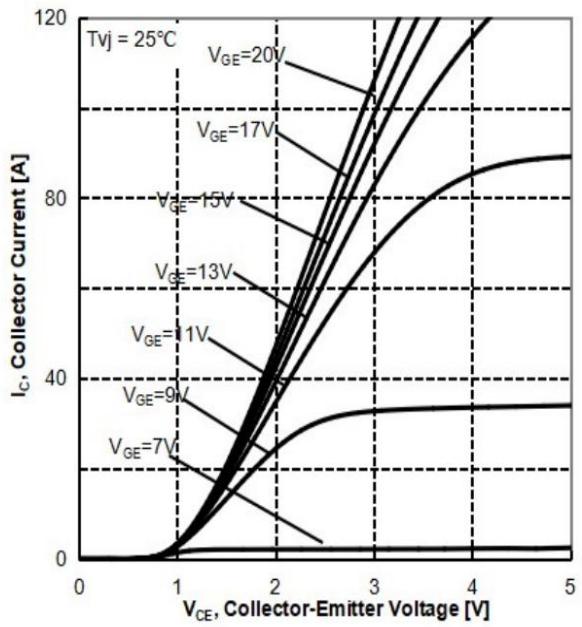


Figure 6: Typical Output Characteristics

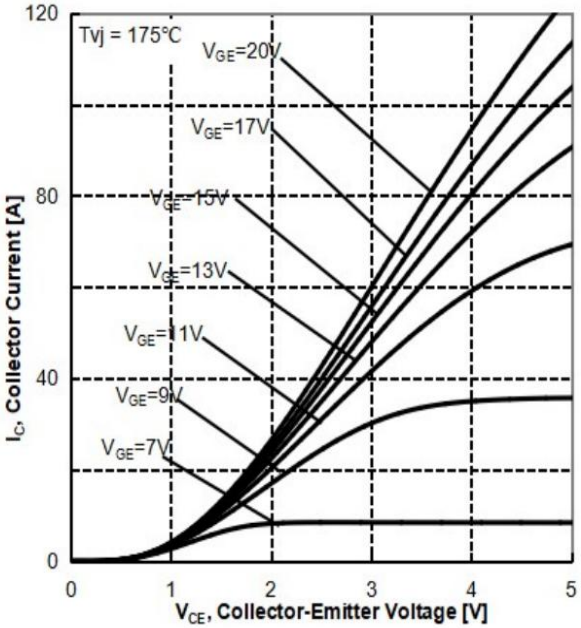


Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

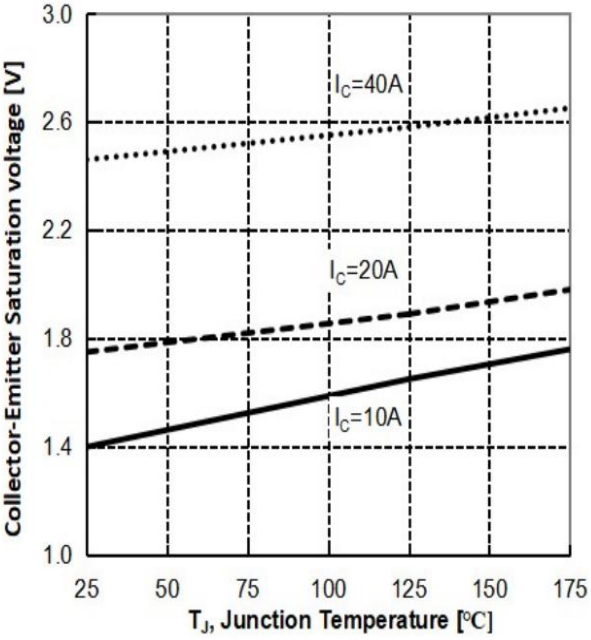
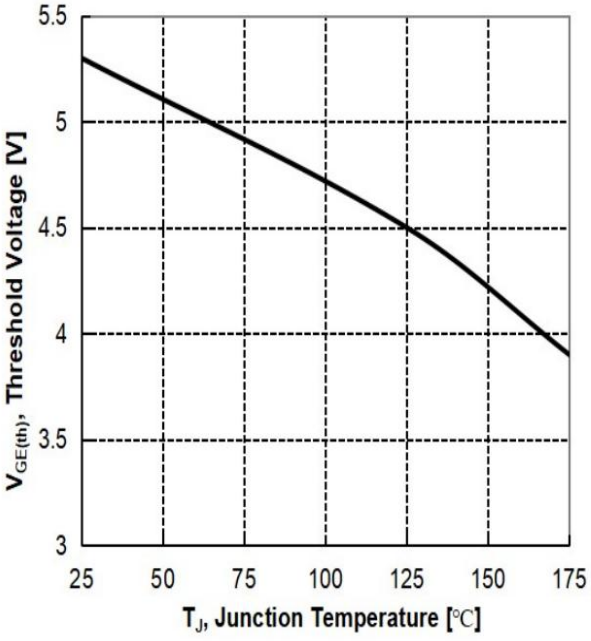


Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature



Ratings and Characteristic Curves

Figure 9: Typical Switching Times vs. Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15V, I_C=20A)

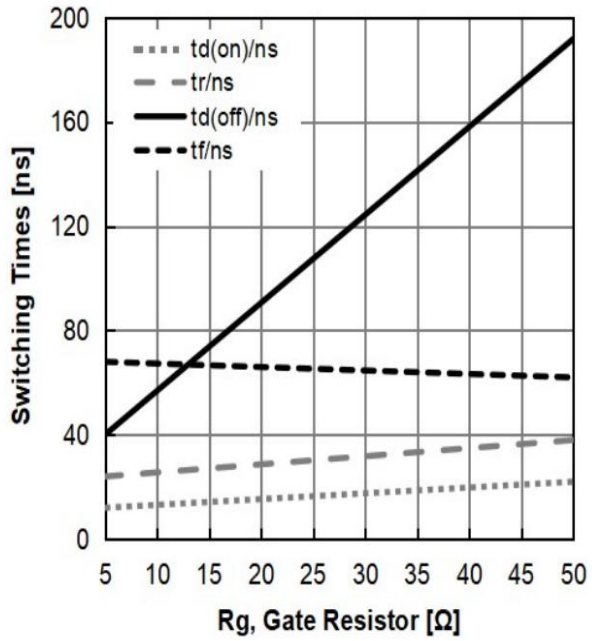


Figure 10: Typical Switching Energy vs. Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15V, I_C=20A)

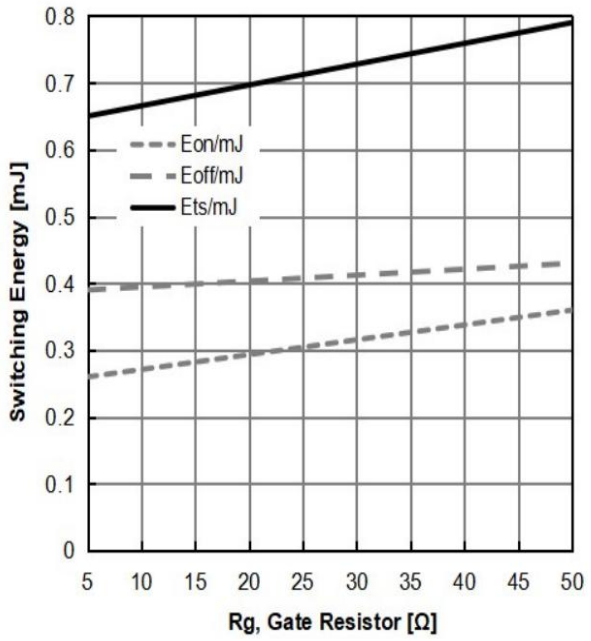


Figure 11: Typical Switching Times vs. Junction Temperature (V_{CE}=400V, V_{GE}=15V, I_C=20A,Rg=5Ω)

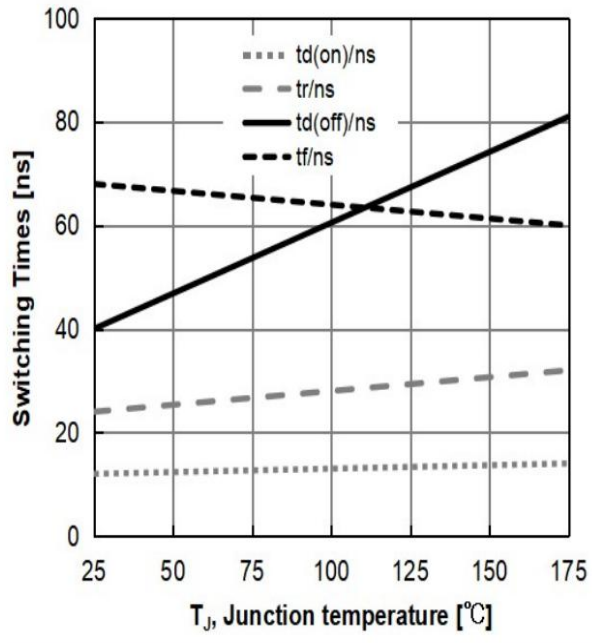
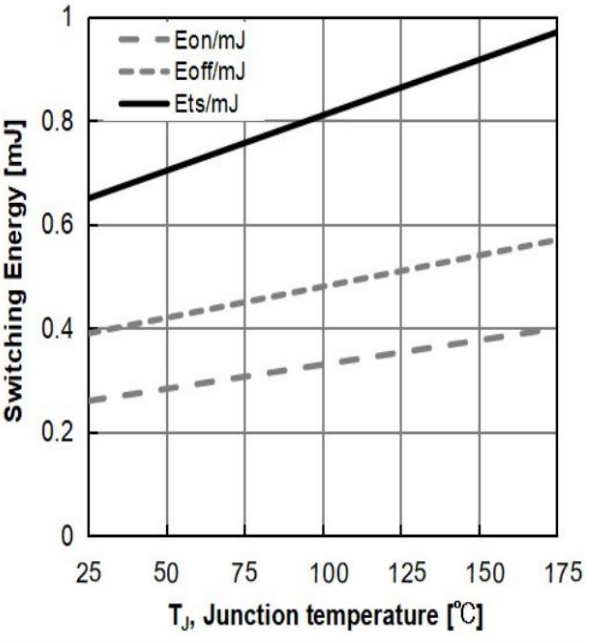


Figure 12: Typical Switching Energy vs. Junction Temperature (V_{CE}=400V, V_{GE}=15V, I_C=20A,Rg=5Ω)



Ratings and Characteristic Curves

Figure 13: Typical Switching Times vs. Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15V,Rg=5Ω)

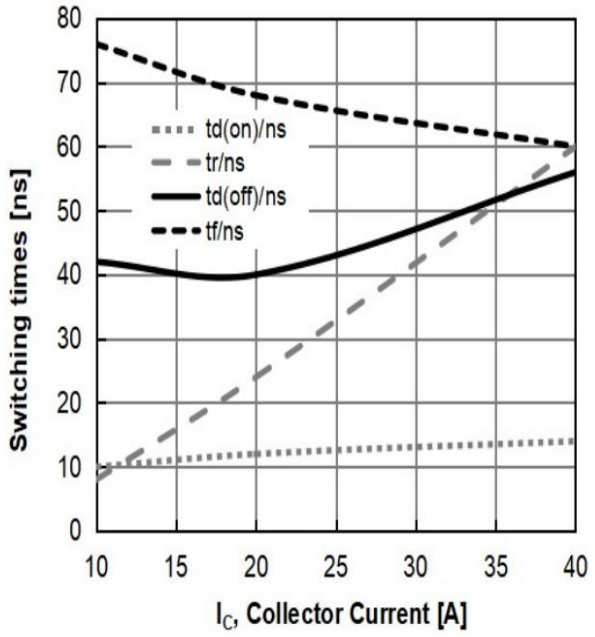


Figure 14: Typical Switching Energy vs. Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15V,Rg=5Ω)

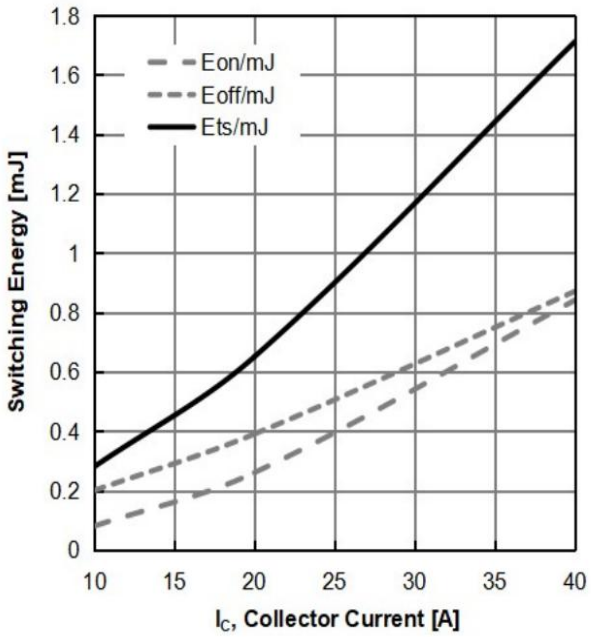


Figure 15: Typical Switching Times vs. VCE (T_J=25℃, V_{GE}=15V, I_C=20A,Rg=5Ω)

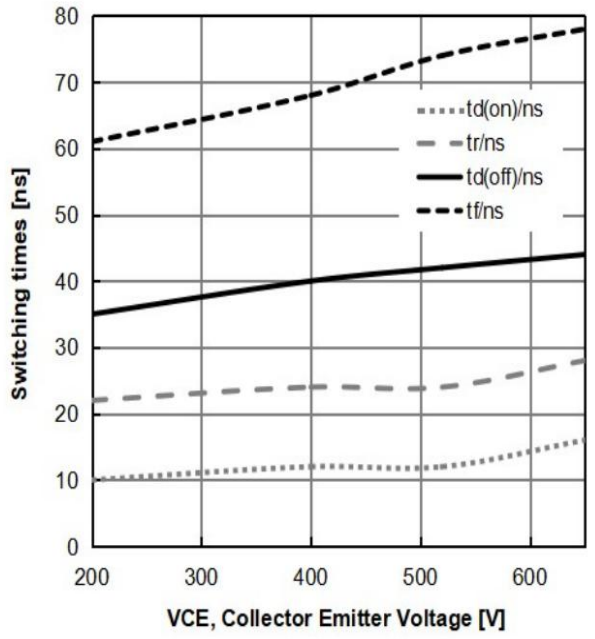
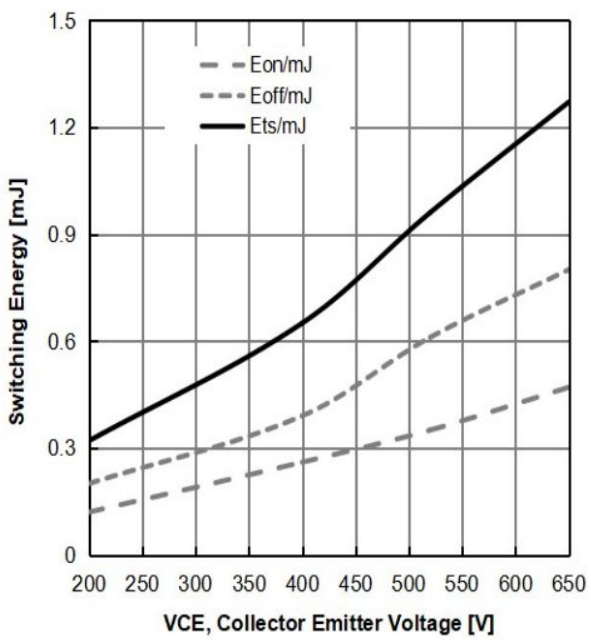


Figure 16: Typical Switching Energy vs. VCE (T_J=25℃, V_{GE}=15V, I_C=20A,Rg=5Ω)



Ratings and Characteristic Curves

Figure 17: Typical Capacitance vs. Collector- Emitter Voltage

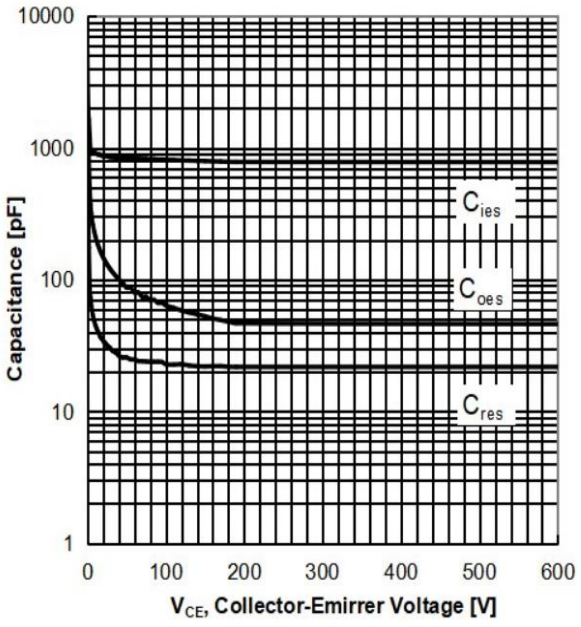


Figure 18: Typical Gate Charge

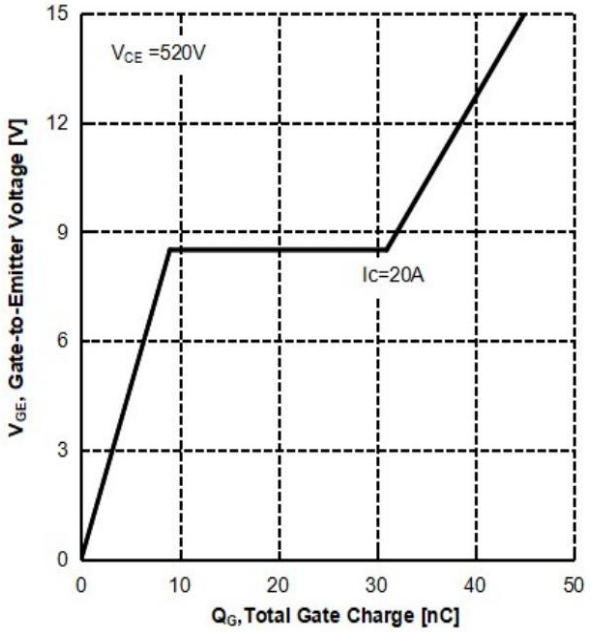


Figure 19: IGBT Transient Thermal Impedance vs. Pulse Width

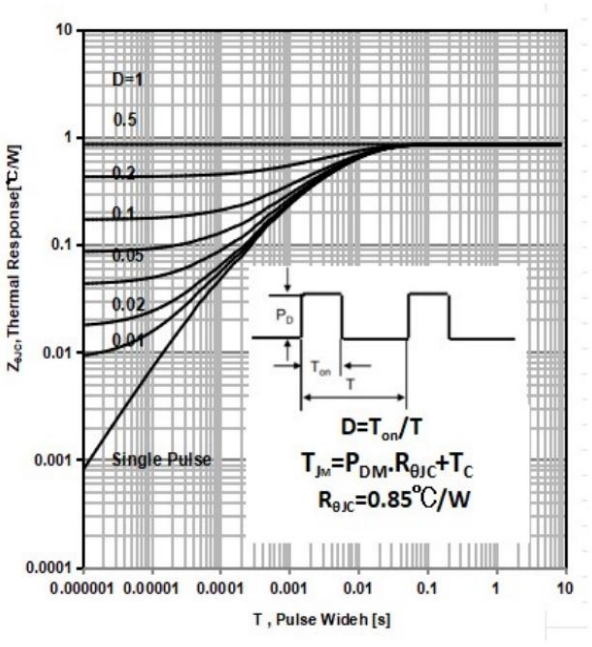
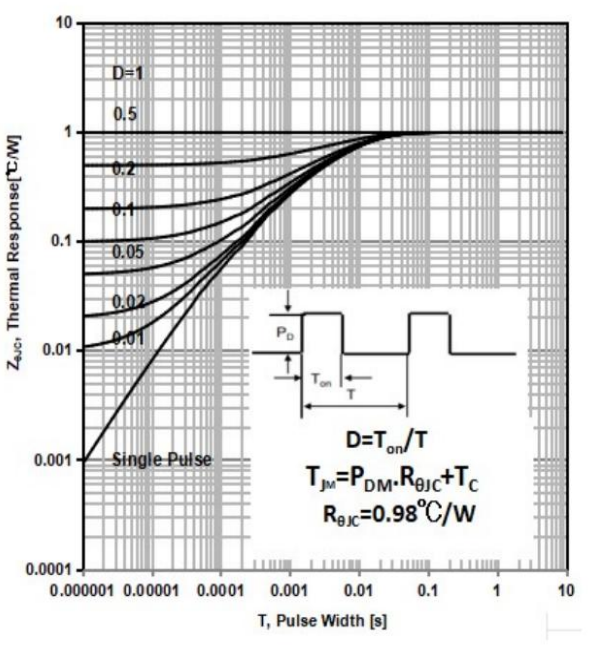
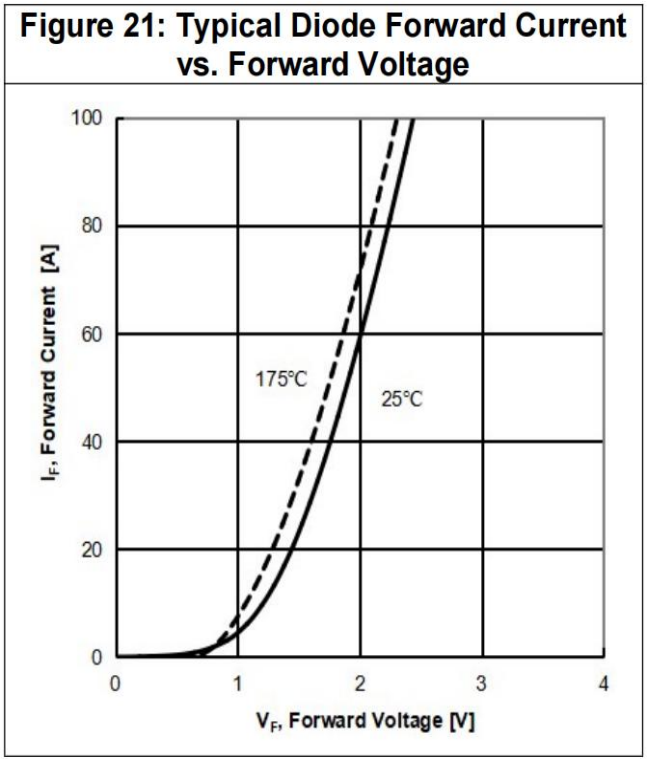


Figure 20: Diode Transient Thermal Impedance vs. Pulse Width

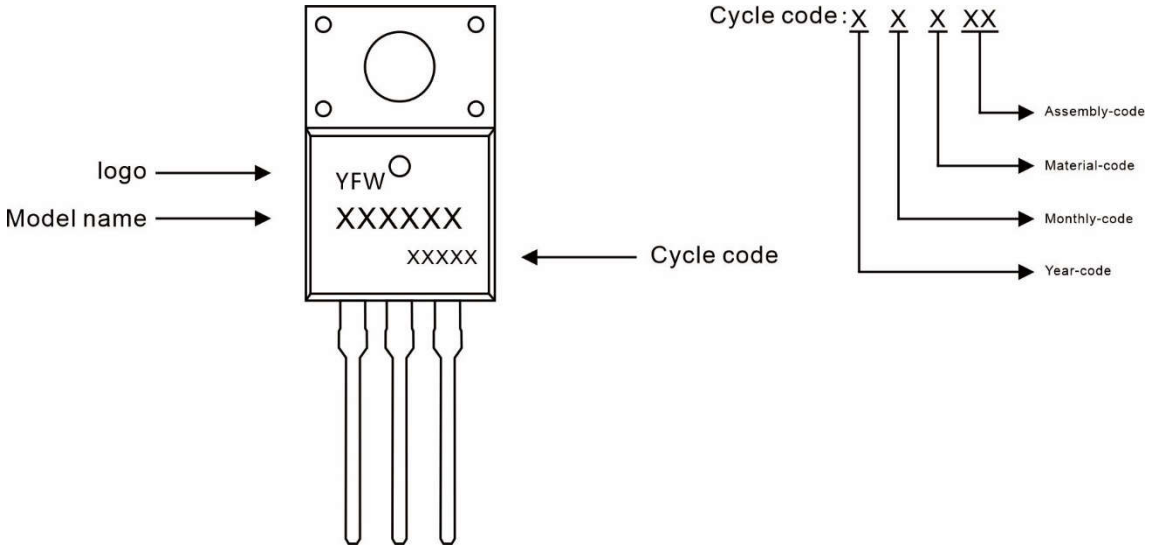


Ratings and Characteristic Curves

Figure 21: Typical Diode Forward Current vs. Forward Voltage



Marking Diagram

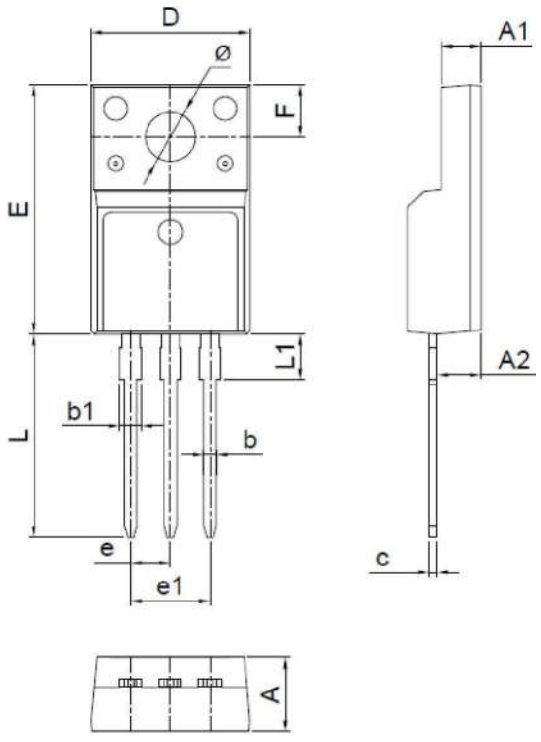


Ordering information

Model name	Package	Unit Weight	Base Quantity	Packing Quantity
YFWG20T65HAF	TO-220F	0.06oz(1.74g)	50pcs/tube	1000PCS/Box 5000PCS/Carton

Package Dimensions

TO-220F



Symbol	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.90	0.177	0.193
A1	2.34	2.74	0.092	0.108
A2	2.66	2.86	0.105	0.113
b	0.75	0.85	0.030	0.033
b1	1.24	1.44	0.049	0.057
c	0.40	0.60	0.016	0.024
D	10.00	10.32	0.394	0.406
E	15.75	16.05	0.620	0.632
e	2.44	2.64	0.096	0.104
e1	4.88	5.28	0.192	0.208
F	3.10	3.5	0.122	0.138
L	13.50	13.90	0.531	0.547
L1	2.90	3.30	0.114	0.130
Φ	3.10	3.30	0.122	0.130

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