

650V N-Channel Enhancement Mode Power IGBT

MAIN CHARACTERISTICS

I_c @TC=100°C	40A
V_{CE}	650V
VCE(sat)-typ	1.65V

FEATURES

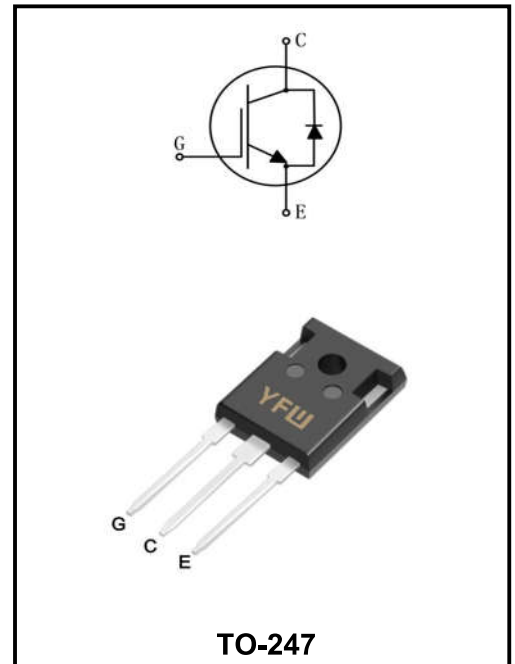
- ◆ Positive temperature coefficient
- ◆ Fast Switching
- ◆ Low VCE(sat)
- ◆ Reliable and Rugged

APPLICATIONS

- ◆ Motor drives
- ◆ Solar inverter
- ◆ Resonant converters

MECHANICAL DATA

- ◆ Case: Molded plastic
- ◆ 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°C maximum, 10s per JESD 22-B106



Maximum Ratings

Characteristics	Symbol	Value	Unit
Collector-emitter voltage	V_{CES}	650	V
Gate-emitter voltage	V_{GES}	±30	V
Continuous collector current (TC=25°C)	I_c	80	A
Continuous collector current (TC=100°C)		40	A
Pulsed collector current, tp limited by Tvjmax	I_{CM}	160	A
Diode continuous forward current (TC=25°C)	I_F	80	A
Diode continuous forward current (TC=100°C)		40	A
Diode maximum current, tp limited by Tvjmax		160	A
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)}	-	0.66	K/ W
Thermal resistance, junction to case for Diode	R_{th(j-c)}	-	0.58	K/ W
Thermal resistance, junction to ambient	R_{th(j-a)}	-	40	K/ W

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

Electrical characteristics of IGBT at $T_{vj}=25^{\circ}\text{C}$ unless otherwise specified

Characteristics	Test Condition	Symbol	Min	Typ	Max	Unit	
Collector-emitter breakdown voltage	$V_{GE}=0V, I_C=250\mu A$	$B_{V_{CES}}$	650	-	-	V	
Collector-emitter leakage current	$V_{CE}=650V, V_{GE}=0V$	I_{CES}	-	-	10	μA	
Gate leakage current, forward	$V_{GE}=\pm 20V, V_{CE}=0V$	I_{GES}	-	-	± 200	nA	
Gate-emitter threshold voltage	$V_{GE}=V_{CE}, I_C=1mA$	$V_{GE(th)}$	4.3	5.3	6.3	V	
Collector-emitter saturation voltage	$V_{GE}=15V, I_C=40A$	$V_{CE(sat)}$	-	1.65	1.95	V	
	$V_{GE}=15V, I_C=40A, T_{vj}=125^{\circ}\text{C}$		-	2	-	V	
	$V_{GE}=15V, I_C=40A, T_{vj}=175^{\circ}\text{C}$		-	2.15	-	V	
Input capacitance	$V_{CE}=25V$ $V_{GE}=0V$ $f=1MHz$	C_{ies}	-	2540	-	pF	
Output capacitance		C_{oes}	-	126	-	pF	
Reverse transfer capacitance		C_{res}	-	67	-	pF	
Total gate charge	$V_{CC}=520V, V_{GE}=15V, I_C=40A$	Q_g	-	146	-	nC	
Gate- Emitter Charge		Q_{ge}	-	24	-	nC	
Gate- Collector Charge		Q_{gc}	-	71	-	nC	
Short circuit collector current Max.1000 short circuits, times between short circuits: $\geq 1.0s$	$V_{GE}=15V, V_{CC}\leq 400V$ $T_{J}\leq 175^{\circ}\text{C}$	$t(SC)$	-	8	-	μs	
Turn-on delay time	$V_{CC}=400V$ $V_{GE}=15V$ $I_C=40A$ $R_G=5\Omega$ Inductive load	$t_d(on)$	-	20	-	ns	
Rise time		t_r	-	67	-	ns	
Turn-off delay time		$t_d(off)$	-	104	-	ns	
Fall time		t_f	-	74	-	ns	
Turn-on energy		E_{on}	-	0.95	-	mJ	
Turn-off energy		E_{off}	-	0.93	-	mJ	
Total switching energy		E_{ts}	-	1.88	-	mJ	
Turn-on delay time		$V_{CC}=400V$ $V_{GE}=15V$ $I_C=40A$ $R_G=5\Omega$ Inductive load $T_{vj}=175^{\circ}\text{C}$	$t_d(on)$	-	22	-	ns
Rise time			t_r	-	73	-	ns
Turn-off delay time			$t_d(off)$	-	178	-	ns
Fall time			t_f	-	70	-	ns
Turn-on energy			E_{on}	-	1.82	-	mJ
Turn-off energy			E_{off}	-	1.16	-	mJ
Total switching energy	E_{ts}		-	2.98	-	mJ	
Diode forward voltage	$I_F=40A$		V_F	-	2.2	2.55	V
	$I_F=40A, T_{vj}=125^{\circ}\text{C}$	-		1.84	-	V	
	$I_F=40A, T_{vj}=175^{\circ}\text{C}$	-		1.62	-	V	
Diode reverse recovery time	$V_R=400V$	t_{rr}	-	188	-	ns	
Diode peak reverse recovery current	$I_F=40A$ $diF/dt=-200A/\mu s$	I_{rrm}	-	6.8	-	A	
Diode reverse recovery charge		Q_{rr}	-	243	-	nC	
Diode reverse recovery time	$V_R=400V$ $I_F=40A$ $diF/dt=-200A/\mu s, T_{vj}=175^{\circ}\text{C}$	t_{rr}	-	215	-	ns	
Diode peak reverse recovery current		I_{rrm}	-	9.7	-	A	
Diode reverse recovery charge		Q_{rr}	-	278	-	nC	

Figure 1: Power Dissipation

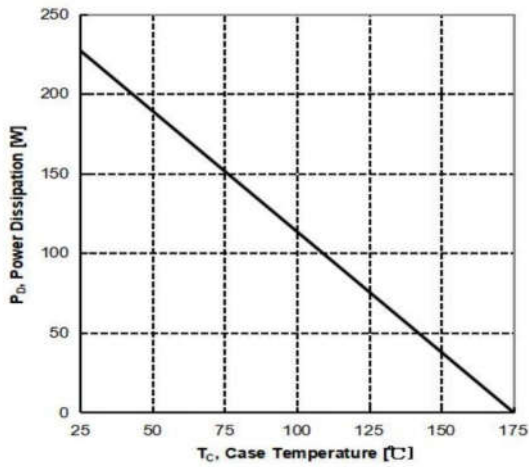


Figure 2: Collector Current vs. Case Temperature

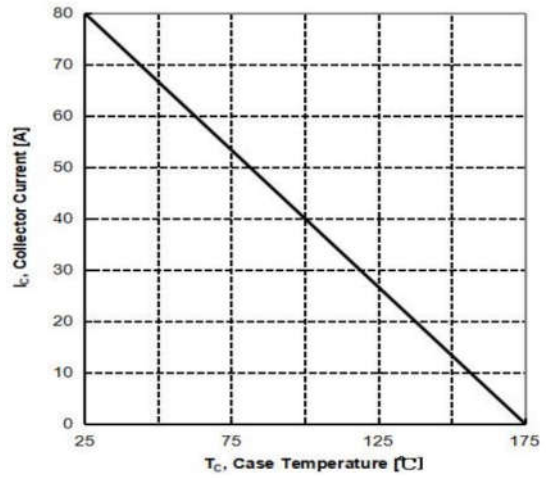


Figure 3: Safe Operation Area

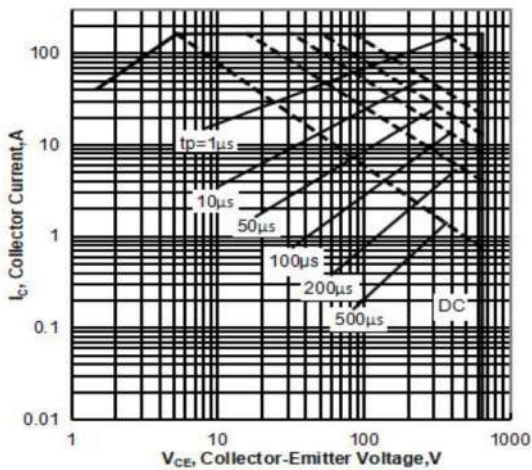


Figure 4: Typical Transfer Characteristics

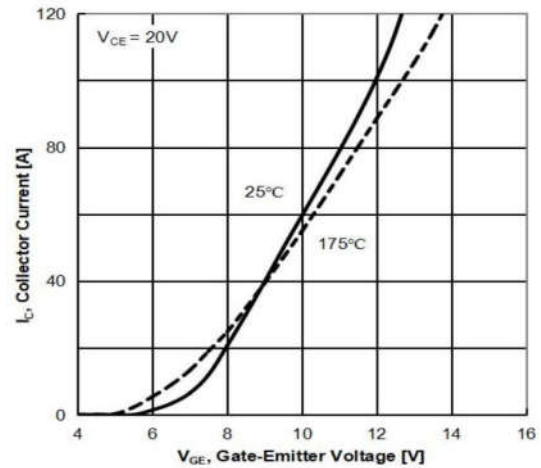


Figure 5: Typical Output Characteristics

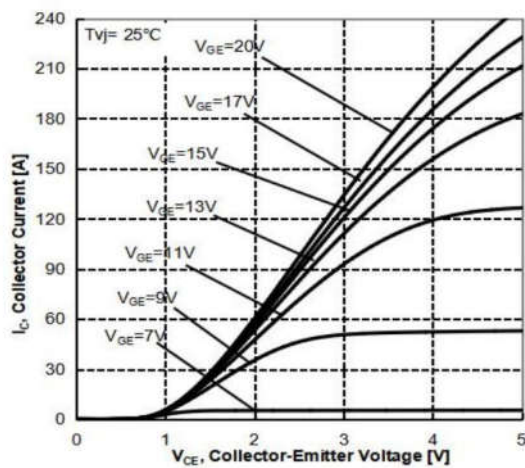


Figure 6: Typical Output Characteristics

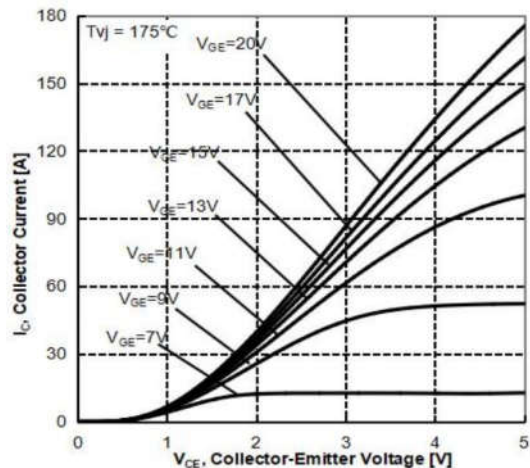


Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

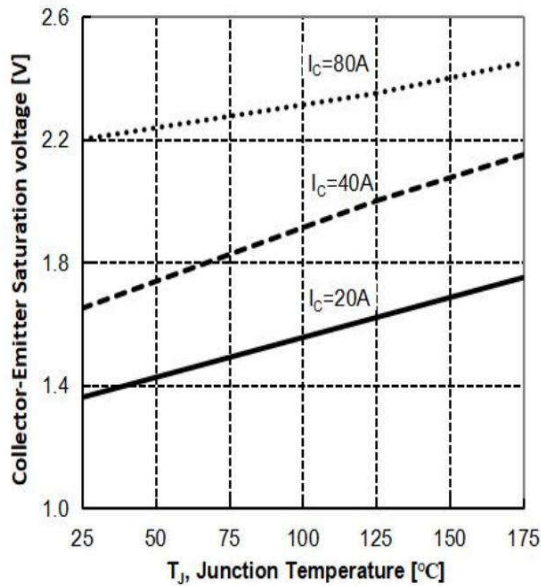


Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature

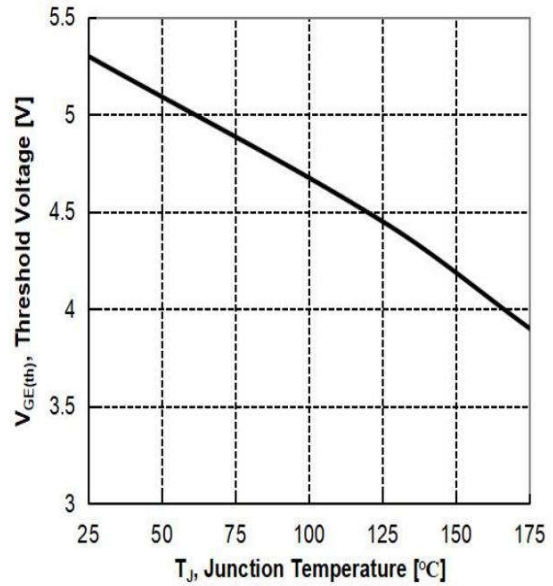


Figure 9: Typical Switching Times vs. Gate Resistor (T_J=25°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A)

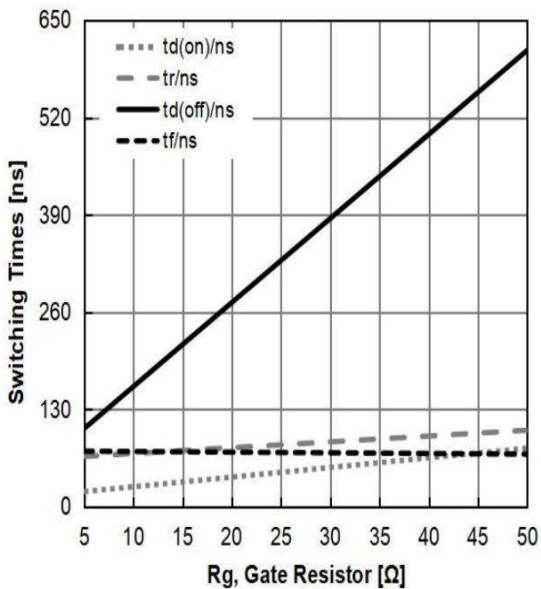
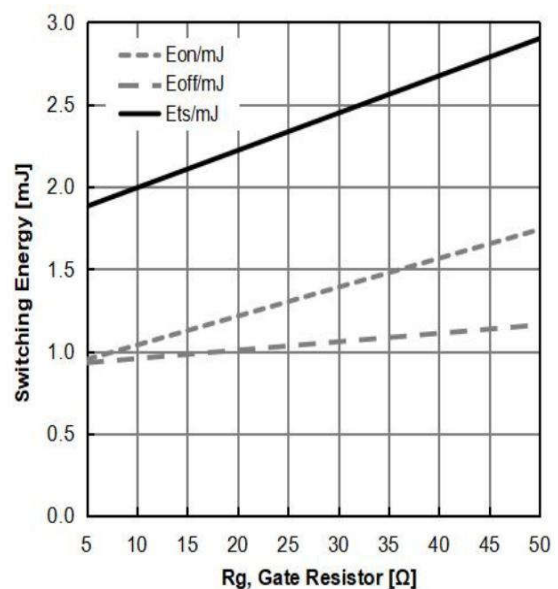


Figure 10: Typical Switching Energy vs. Gate Resistor (T_J=25°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A)



RATINGS AND CHARACTERISTIC CURVES

Figure 11: Typical Switching Times vs. Junction Temperature ($V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=40A$)

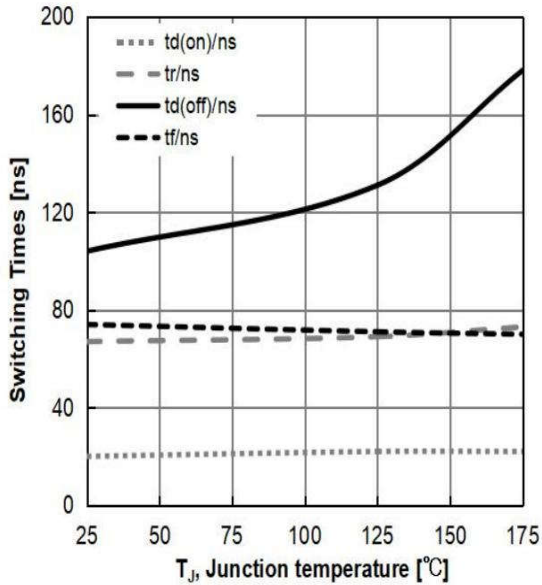


Figure 12: Typical Switching Energy vs. Junction Temperature ($V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=40A$)

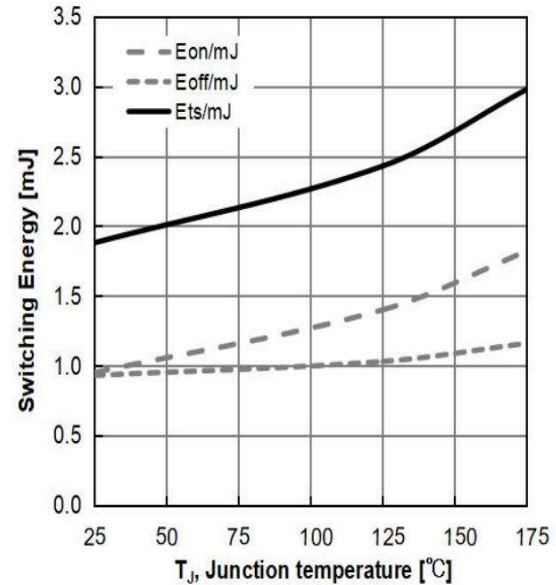


Figure 13: Typical Switching Times vs. Collector Current ($T_J=25^\circ C$, $V_{CE}=400V$, $V_{GE}=15/0V$)

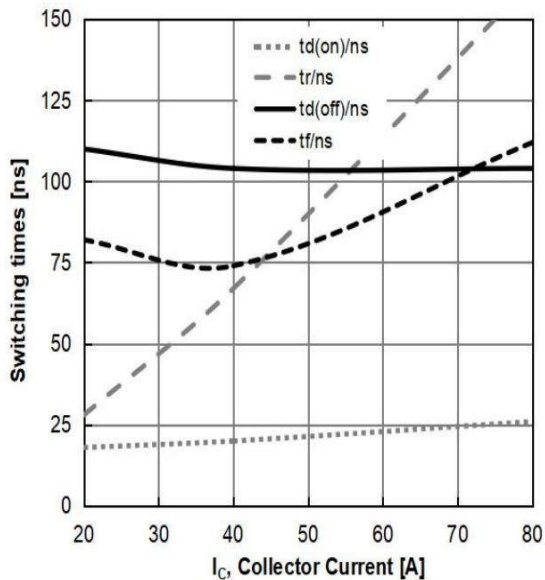
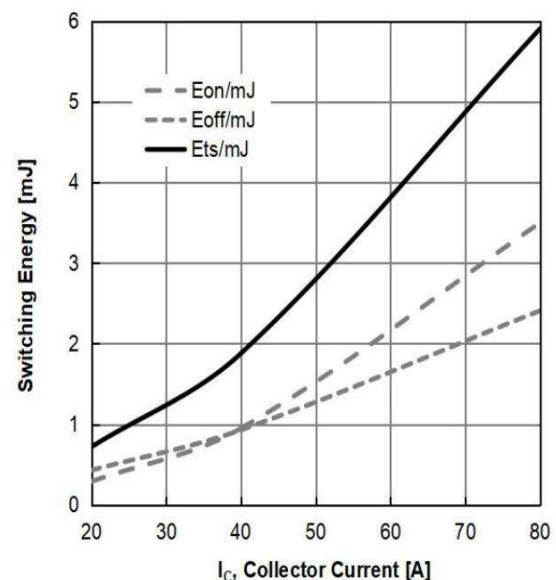
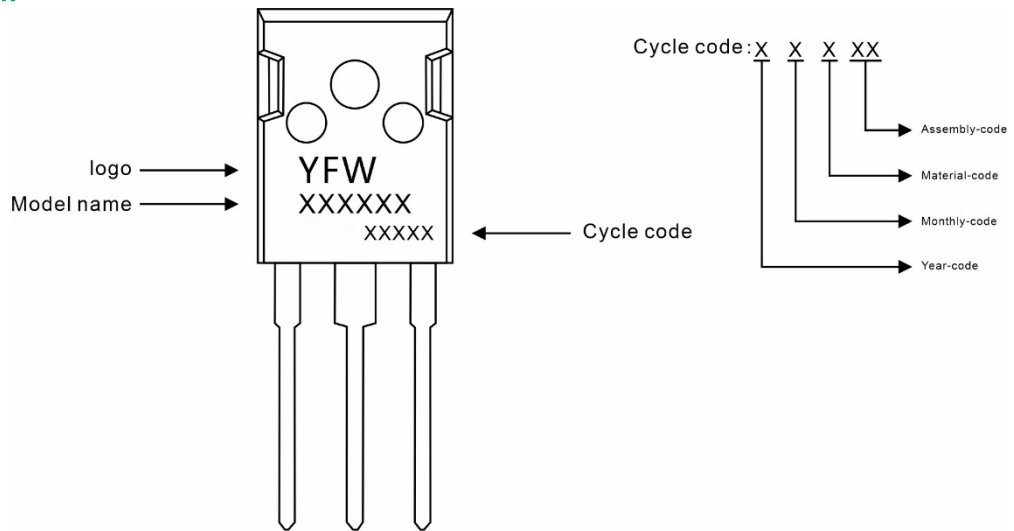


Figure 14: Typical Switching Energy vs. Collector Current ($T_J=25^\circ C$, $V_{CE}=400V$, $V_{GE}=15/0V$)



Marking Diagram



Ordering information

Model name	Package	Unit Weight	Base Quantity	Packing Quantity
YFWG40T65LAP	TO-247	0.209oz(5.93g)	30pcs/tube	600PCS/Box 2400PCS/Carton

Package Dimensions

TO-247

Symbol	Dimensions in mm		Dimensions in Inch	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	1.90	2.10	0.075	0.083
A2	2.29	2.54	0.090	0.100
b	1.00	1.40	0.039	0.055
b1	2.00	2.20	0.079	0.087
b2	3.00	3.20	0.118	0.126
c	0.50	0.70	0.020	0.028
D	15.75	16.05	0.620	0.632
E	20.20	20.80	0.795	0.819
e	5.45 (BSC)		0.215 (BSC)	
e1	10.90 (BSC)		0.429 (BSC)	
F	6.05	6.25	0.238	0.246
F1	5.80	6.00	0.228	0.236
L	20.10	20.40	0.791	0.803
L1	4.05	4.35	0.159	0.171
Φ	3.50	3.70	0.138	0.146

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