

650V N-Channel Enhancement Mode Power IGBT

MAIN CHARACTERISTICS

I_c @TC=100°C	50A
V_{CE}	650V
VCE(sat)-typ	1.8V

FEATURES

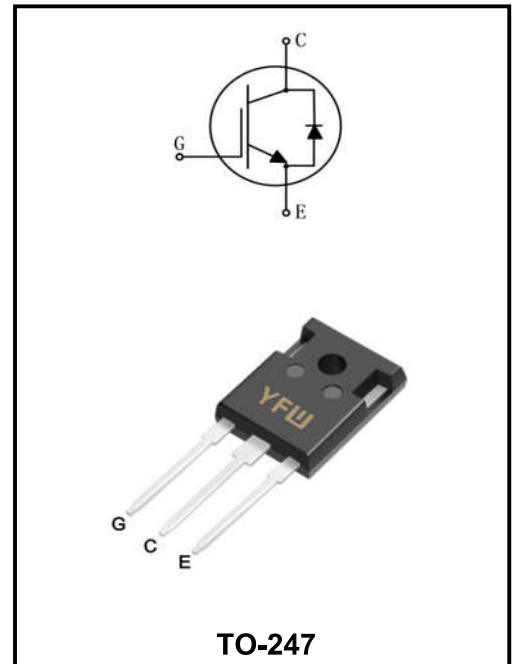
- ◆ Trench and field-stop technology
- ◆ Easy parallel switching capability

APPLICATIONS

- ◆ PFC applications
- ◆ Uninterruptible power supplies
- ◆ Solar inverters

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}	±20	V
Continuous collector current (TC=25°C)	I_c	100	A
Continuous collector current (TC=100°C)		50	A
Pulsed collector current, tp limited by Tvjmax	I_{CM}	200	A
Diode continuous forward current (TC=25°C)	I_F	100	A
Diode continuous forward current (TC=100°C)		50	A
Diode maximum current, tp limited by Tvjmax	I_{FM}	200	A
Power dissipation (TC=25°C)	P_{tot}	535	W
Power dissipation (TC=100°C)		267	W
Operating junction temperature range	T_{vj}	-40 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	$R_{th(j-c)}$	-	0.28	K/ W
Thermal resistance, junction to case for Diode	$R_{th(j-c)}$	-	0.42	K/ W
Thermal resistance, junction to ambient	$R_{th(j-a)}$	-	40	K/ W

Note1:Pulse test: 300 μ s 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}	-	-	50	μA	
Gate leakage current, forward	$V_{GE}=\pm 20V, V_{CE}=0V$	I_{GES}	-	-	± 100	nA	
Gate-emitter threshold voltage	$V_{GE}=V_{CE}, I_c=1mA$	$V_{GE(th)}$	5	5.4	5.6	V	
Collector-emitter saturation voltage	$V_{GE}=15V, I_c=50A$	$V_{CE(sat)}$	-	1.8	-	V	
	$V_{GE}=15V, I_c=50A, T_{vj}=175^{\circ}\text{C}$		-	2.3	-	V	
Input capacitance	$V_{CE}=30V$ $V_{GE}=0V$ $f=1MHz$	C_{ies}	-	4820	-	pF	
Output capacitance		C_{oes}	-	170	-	pF	
Reverse transfer capacitance		C_{res}	-	37	-	pF	
Total gate charge	$V_{CC}=520V, V_{GE}=15V, I_c=50A$	Q_g	-	158	-	nC	
Turn-on delay time	$V_{CC}=400V$ $V_{GE}=15V$ $I_c=50A$ $R_G=10\Omega$ Inductive load	$t_d(on)$	-	52	-	ns	
Rise time		t_r	-	82	-	ns	
Turn-off delay time		$t_d(off)$	-	193	-	ns	
Fall time		t_f	-	61	-	ns	
Turn-on energy		E_{on}	-	1.7	-	mJ	
Turn-off energy		E_{off}	-	1	-	mJ	
Total switching energy		E_{ts}	-	2.7	-	mJ	
Turn-on delay time		$V_{CC}=400V$ $V_{GE}=15V$ $I_c=50A$ $R_G=10\Omega$ Inductive load $T_{vj}=175^{\circ}\text{C}$	$t_d(on)$	-	49	-	ns
Rise time			t_r	-	85	-	ns
Turn-off delay time			$t_d(off)$	-	210	-	ns
Fall time	t_f		-	68	-	ns	
Turn-on energy	E_{on}		-	2.5	-	mJ	
Turn-off energy	E_{off}		-	1	-	mJ	
Total switching energy	E_{ts}		-	3.5	-	mJ	
Diode forward voltage	$I_F=50A$		V_F	-	1.8	-	V
	$I_F=50A, T_{vj}=175^{\circ}\text{C}$	-		1.4	-	V	
Diode reverse recovery time	$V_R=400V$ $I_F=50A$ $di_F/dt=-800A/\mu s$	t_{rr}	-	82	-	ns	
Diode peak reverse recovery current	$V_R=400V$ $I_F=50A$ $di_F/dt=-800A/\mu s, T_{vj}=175^{\circ}\text{C}$	I_{rrm}	-	15	-	A	
Diode reverse recovery charge		Q_{rr}	-	698	-	nC	
Diode reverse recovery time		t_{rr}	-	132	-	ns	
Diode peak reverse recovery current	$V_R=400V$ $I_F=50A$ $di_F/dt=-800A/\mu s, T_{vj}=175^{\circ}\text{C}$	I_{rrm}	-	26	-	A	
Diode reverse recovery charge		Q_{rr}	-	2194	-	nC	

RATINGS AND CHARACTERISTIC CURVES

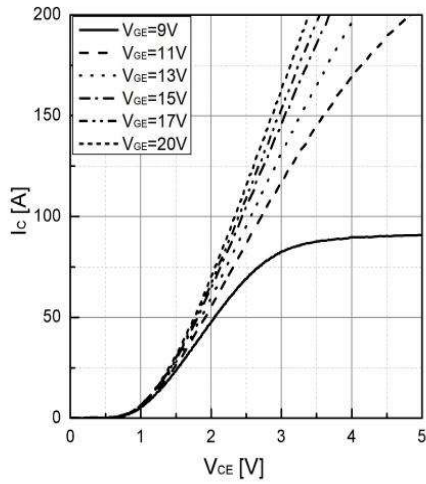


Fig 1. Typical output characteristic ($T_{vj}=25^{\circ}\text{C}$)

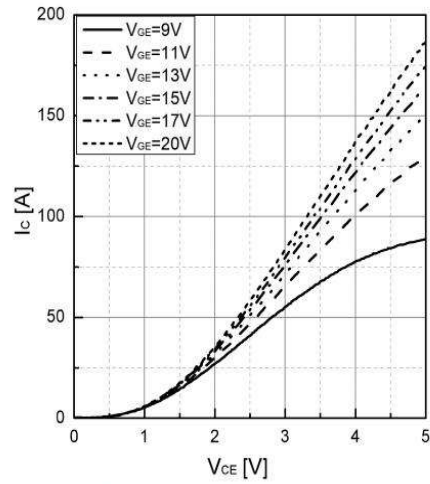


Fig 2. Typical output characteristic ($T_{vj}=175^{\circ}\text{C}$)

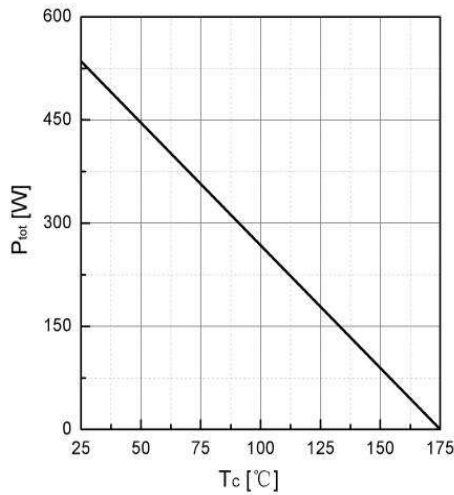


Fig 3. Power dissipation as a function of T_c

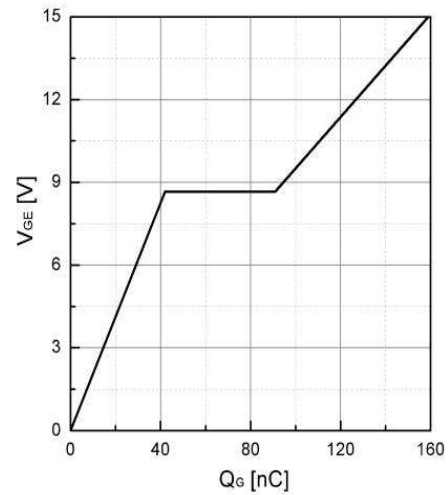


Fig 4. Typical Gate charge

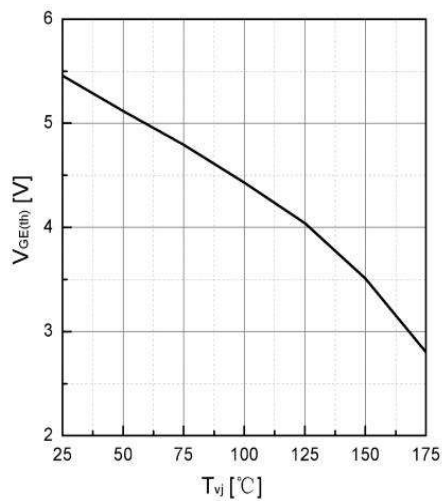


Fig 5. Typical $V_{GE(th)}$ as a function of T_{vj}
($I_c=1\text{mA}$)

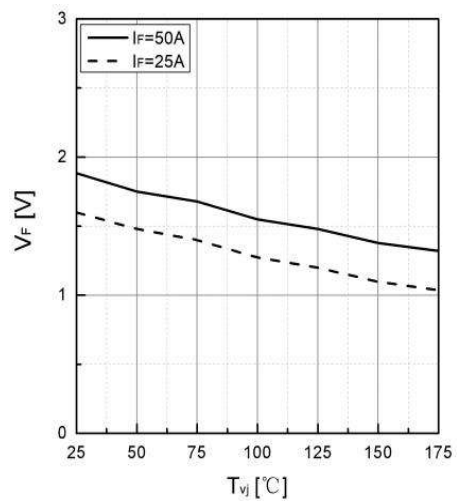


Fig 6. Typical V_F as a function of T_{vj}

RATINGS AND CHARACTERISTIC CURVES

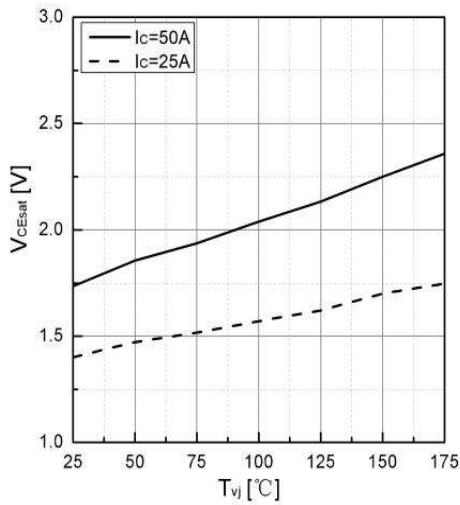


Fig 7. Typical V_{CEsat} as a function of T_{vj}

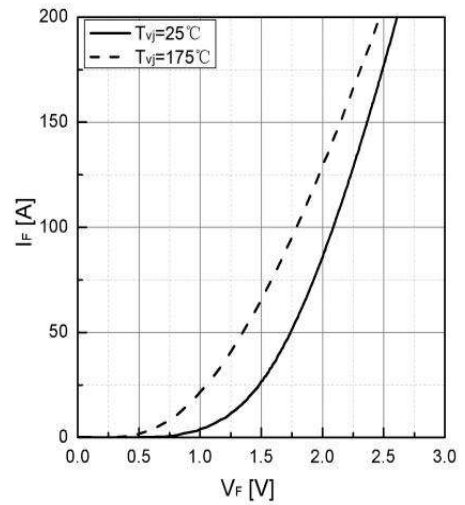


Fig 8. Typical I_F as a function of V_F

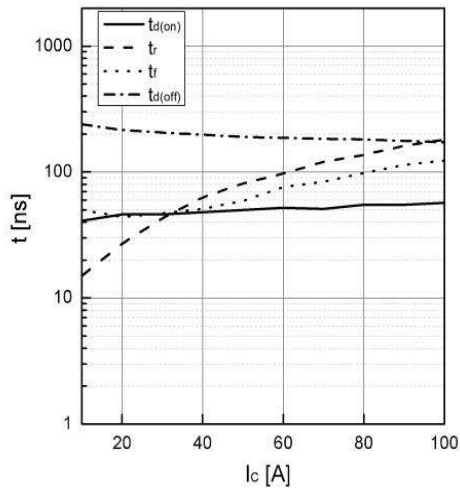


Fig 9. Typical switching time as a function of I_c

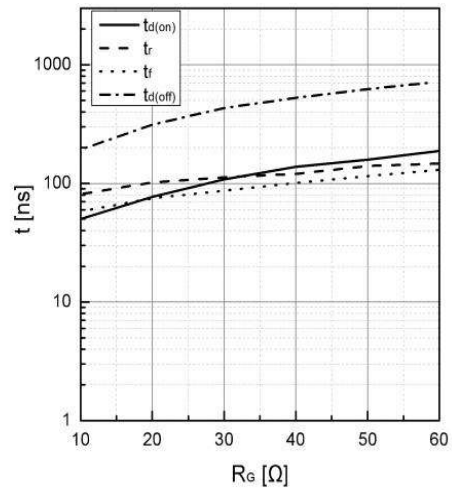


Fig 10. Typical switching times as a function of R_G

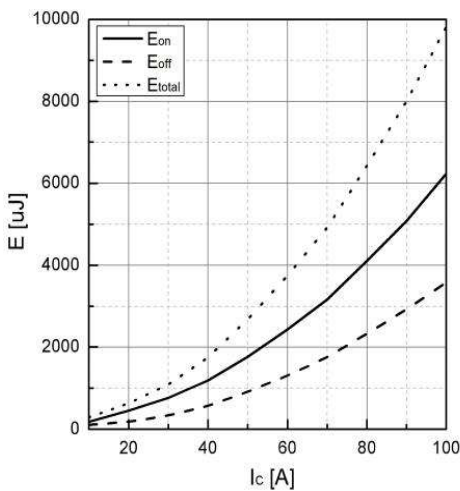


Fig 11. Typical switching energy losses as a function of I_c

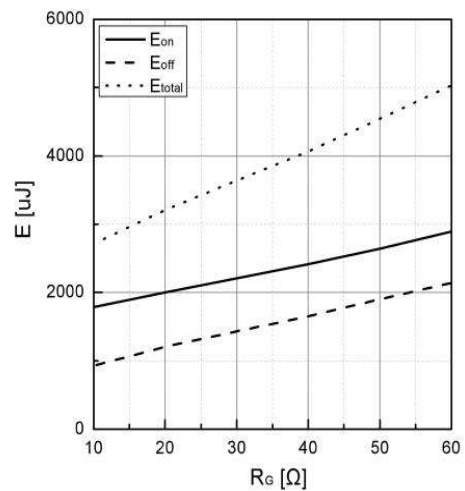


Fig 12. Typical switching energy losses as a function of R_G

RATINGS AND CHARACTERISTIC CURVES

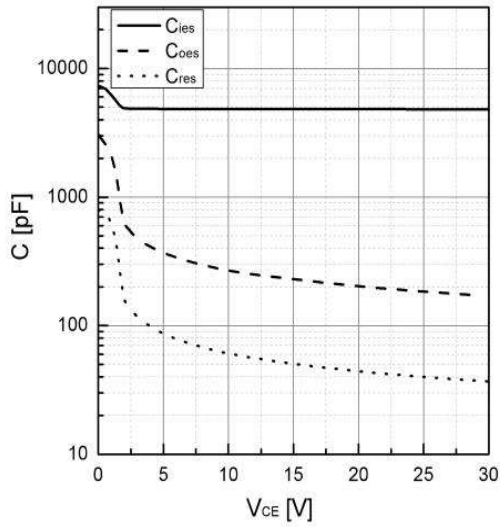


Fig 13. Typical capacitance as a function of V_{CE}
($f=1\text{Mhz}$, $V_{GE}=0\text{V}$)

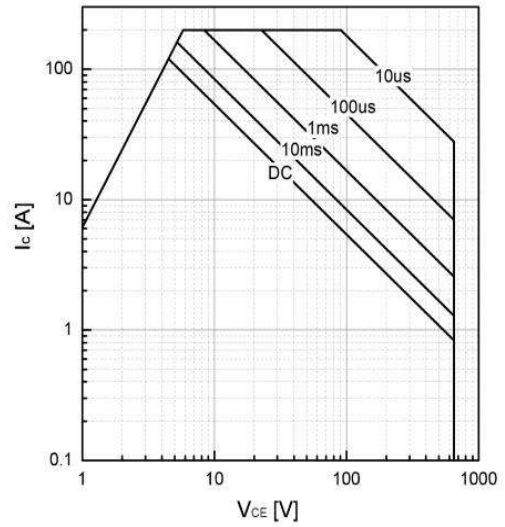


Fig 14. Safe operating area

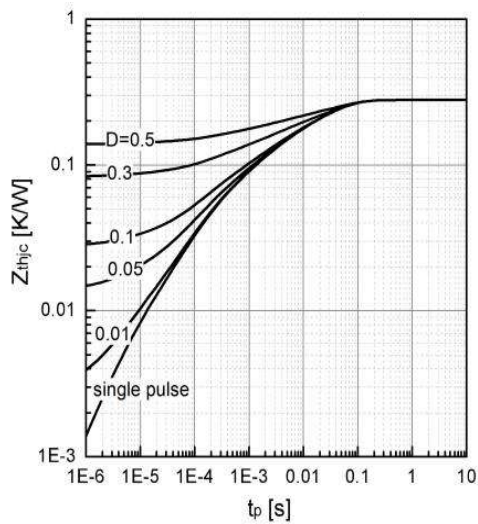
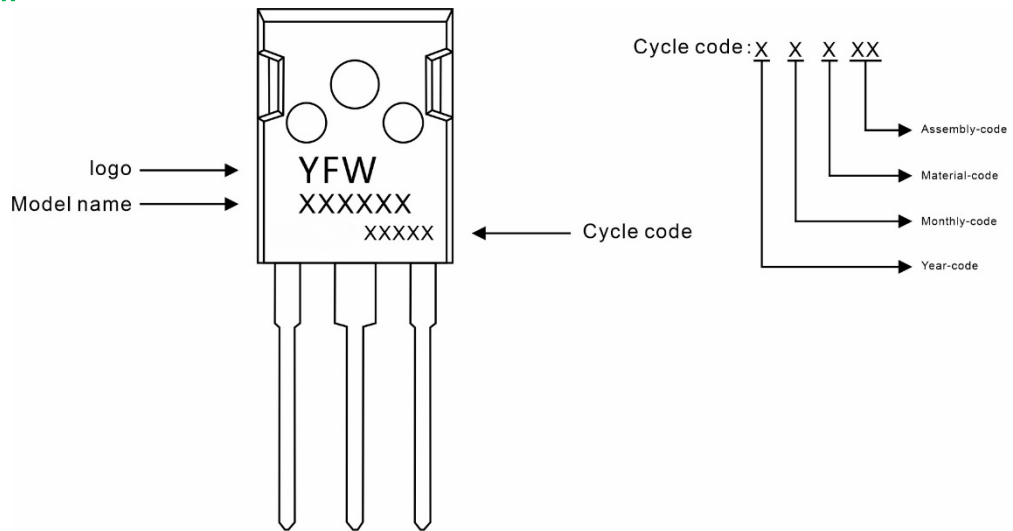


Fig 15. Transient thermal impedance of IGBT

Marking Diagram



Ordering information

Model name	Package	Unit Weight	Base Quantity	Packing Quantity
YFWG50T65HAP	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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