

$$V_{CES} = 600V$$

$$I_C = 160A, T_C = 100^{\circ}C$$

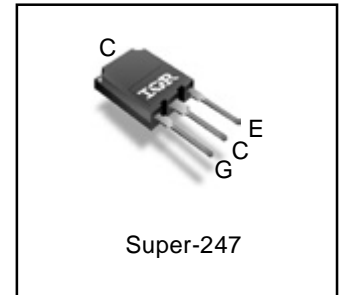
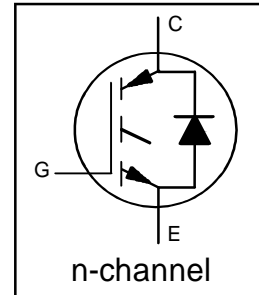
$$t_{SC} \geq 5\mu s, T_{J(max)} = 175^{\circ}C$$

$$V_{CE(on)} \text{ typ.} = 1.70V @ I_C = 120A$$

### Applications

- Industrial Motor Drive
- Inverters
- UPS
- Welding

### INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



<b>G</b>	<b>C</b>	<b>E</b>
Gate	Collector	Emitter

Features	Benefits
Low $V_{CE(ON)}$ and Switching Losses	High efficiency in a wide range of applications and switching frequencies
Square RBSOA and Maximum Junction Temperature 175°C	Improved reliability due to rugged hard switching performance and higher power capability
Positive $V_{CE(ON)}$ Temperature Coefficient	Excellent current sharing in parallel operation
5μs short circuit SOA	Enables short circuit protection scheme
Lead-Free, RoHS compliant	Environmentally friendly

Base part number	Package Type	Standard Pack		Orderable part number
		Form	Quantity	
IRGPS46160DPbF	Super-247	Tube	25	IRGPS46160DPbF

### Absolute Maximum Ratings

Parameter	Max.	Units
$V_{CES}$ Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^{\circ}C$ Continuous Collector Current	240 <sup>Ⓞ</sup>	A
$I_C @ T_C = 100^{\circ}C$ Continuous Collector Current	160	
$I_{CM}$ Pulse Collector Current, $V_{GE} = 15V$	360	
$I_{LM}$ Clamped Inductive Load Current, $V_{GE} = 20V$ ①	480	
$I_F @ T_C = 25^{\circ}C$ Diode Continuous Forward Current	240 <sup>Ⓞ</sup>	
$I_F @ T_C = 100^{\circ}C$ Diode Continuous Forward Current	160 <sup>Ⓞ</sup>	
$I_{FM}$ Diode Maximum Forward Current ②	480	V
$V_{GE}$ Continuous Gate-to-Emitter Voltage	±20	
$V_{GE}$ Transient Gate-to-Emitter Voltage	±30	W
$P_D @ T_C = 25^{\circ}C$ Maximum Power Dissipation	750	
$P_D @ T_C = 100^{\circ}C$ Maximum Power Dissipation	375	°C
$T_J$ Operating Junction and Storage Temperature Range	-55 to +175	
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N-m)

### Thermal Resistance

Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT) ② Junction-to-Case (IGBT)	—	—	0.20	°C/W
$R_{\theta JC}$ (Diode) ② Junction-to-Case (Diode)	—	—	0.63	
$R_{\theta CS}$ Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$ Junction-to-Ambient (typical socket mount)	—	—	40	

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ③
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	—	0.27	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 4.0mA (25°C-175°C)
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.70	2.05	V	I <sub>C</sub> = 120A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C
		—	2.15	—		I <sub>C</sub> = 120A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C
		—	2.20	—		I <sub>C</sub> = 120A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 175°C
V <sub>GE(th)</sub>	Gate Threshold Voltage	4.0	—	6.5	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 5.6mA
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 5.6mA (25°C - 175°C)
g <sub>fe</sub>	Forward Transconductance	—	77	—	S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 120A
I <sub>CES</sub>	Collector-to-Emitter Leakage Current	—	1.0	150	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	2.3	—	mA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 175°C
V <sub>FM</sub>	Diode Forward Voltage Drop	—	2.4	3.0	V	I <sub>F</sub> = 120A
		—	1.9	—		I <sub>F</sub> = 120A, T <sub>J</sub> = 175°C
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±400	nA	V <sub>GE</sub> = ±20V

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge	—	240	—	nC	I <sub>C</sub> = 120A V <sub>GE</sub> = 15V V <sub>CC</sub> = 400V
Q <sub>ge</sub>	Gate-to-Emitter Charge	—	70	—		
Q <sub>gc</sub>	Gate-to-Collector Charge	—	90	—		
E <sub>on</sub>	Turn-On Switching Loss	—	5750	—	μJ	I <sub>C</sub> = 120A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 4.7Ω, L = 66μH, T <sub>J</sub> = 25°C
E <sub>off</sub>	Turn-Off Switching Loss	—	3430	—		
E <sub>total</sub>	Total Switching Loss	—	9180	—		
t <sub>d(on)</sub>	Turn-On delay time	—	80	—	ns	Energy losses include tail & diode reverse recovery ⑤
t <sub>r</sub>	Rise time	—	70	—		
t <sub>d(off)</sub>	Turn-Off delay time	—	190	—		
t <sub>f</sub>	Fall time	—	40	—		
E <sub>on</sub>	Turn-On Switching Loss	—	7740	—	μJ	I <sub>C</sub> = 120A, V <sub>CC</sub> = 400V, V <sub>GE</sub> = 15V R <sub>G</sub> = 4.7Ω, L = 66μH, T <sub>J</sub> = 175°C
E <sub>off</sub>	Turn-Off Switching Loss	—	4390	—		
E <sub>total</sub>	Total Switching Loss	—	12130	—		
t <sub>d(on)</sub>	Turn-On delay time	—	80	—	ns	Energy losses include tail & diode reverse recovery ⑤
t <sub>r</sub>	Rise time	—	75	—		
t <sub>d(off)</sub>	Turn-Off delay time	—	230	—		
t <sub>f</sub>	Fall time	—	55	—		
C <sub>ies</sub>	Input Capacitance	—	7750	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0Mhz
C <sub>oes</sub>	Output Capacitance	—	550	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	225	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T <sub>J</sub> = 175°C, I <sub>C</sub> = 480A V <sub>CC</sub> = 480V, V <sub>p</sub> ≤ 600V R <sub>G</sub> = 4.7Ω, V <sub>GE</sub> = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V <sub>CC</sub> = 400V, V <sub>p</sub> ≤ 600V R <sub>G</sub> = 4.7Ω, V <sub>GE</sub> = +15V to 0V
E <sub>rec</sub>	Reverse Recovery Energy of the Diode	—	500	—	μJ	T <sub>J</sub> = 175°C
t <sub>rr</sub>	Diode Reverse Recovery Time	—	130	—	ns	V <sub>CC</sub> = 400V, I <sub>F</sub> = 120A
I <sub>rr</sub>	Peak Reverse Recovery Current	—	36	—	A	V <sub>GE</sub> = 15V, R <sub>G</sub> = 4.7Ω, L = 100μH

**Notes:**

- V<sub>CC</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 20V, L = 66μH, R<sub>G</sub> = 4.7Ω, tested in production I<sub>LM</sub> ≤ 400A.
- Pulse width limited by max. junction temperature.
- Refer to AN-1086 for guidelines for measuring V<sub>(BR)CES</sub> safely.
- R<sub>θ</sub> is measured at T<sub>J</sub> of approximately 90°C.
- Values influenced by parasitic L and C in measurement.
- Calculated continuous current based on maximum allowable junction temperature. Package IGBT current limit is 195A. Package diode current limit is 120A. Note that current limitations arising from heating of the device leads may occur.