

## 650 V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
$V_{CE}$ (V)	650	
$I_C$ (A)	90 (TC=25 °C)	75 (TC=100 °C)
$V_{CE(sat)}$ (V)	1.8	
$Q_g$ (nC)	175	
$I_{CM}$ (A)	225	

### FEATURES

- Very Low  $V_{CEsat}$
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

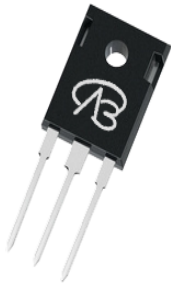
### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)

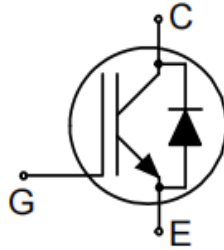
### Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

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Top View



ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)					
PARAMETER			SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage			V <sub>CE</sub>	650	V
Gate-Emitter Voltage			V <sub>GE</sub>	±30	
Continuous Collector Current (T <sub>J</sub> = 150 °C)	V <sub>GE</sub> at 15 V	T <sub>C</sub> = 25 °C	I <sub>C</sub>	90	A
		T <sub>C</sub> = 100 °C		75	
Pulsed Collector Current <sup>a</sup>			I <sub>CM</sub>	225	
Diode Forward Current <sup>b</sup>			I <sub>F</sub>	90	A
Maximum Power Dissipation		T <sub>C</sub> = 25 °C	P <sub>D</sub>	400	W
		T <sub>C</sub> = 100 °C		220	W
Operating Junction and Storage Temperature Range			T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Short Circuit Withstand Time <sup>TC=150</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 400V		t <sub>sc</sub>	3	μs
Short Circuit Withstand Time <sup>TC=100</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 330V			5	
Soldering Recommendations (Peak Temperature) <sup>c</sup>		for 10 s		260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

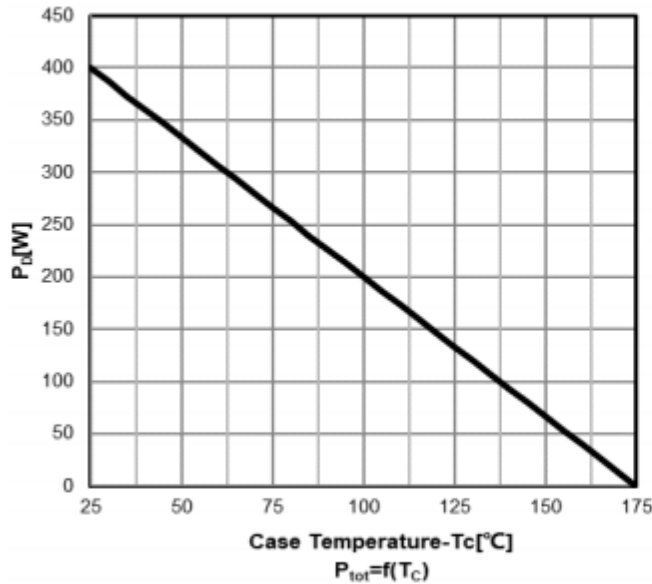
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case	$R_{thJC}$	-	0.5	

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

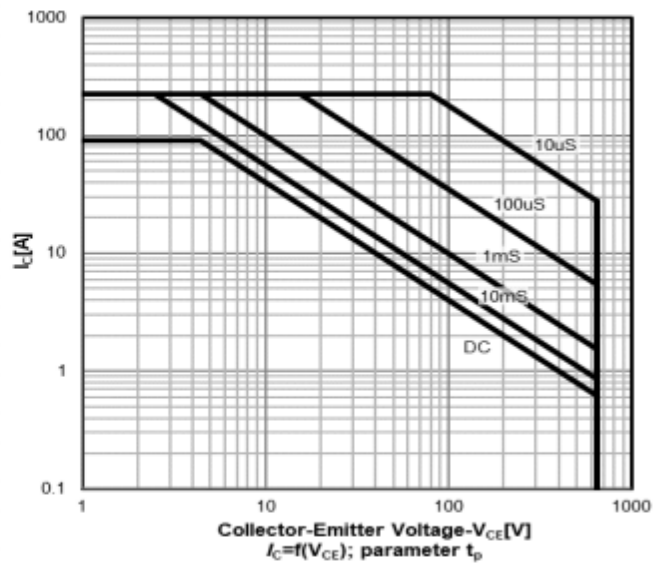
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Collector-Emitter Breakdown Voltage	BV <sub>CE</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 μA V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA		650 650	- -	- -	V
Gate-Source Threshold Voltage (N)	V <sub>GE(th)</sub>	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>D</sub> = 250 μA		4	5	6	V
Zero Gate Voltage Collector Current	I <sub>CES</sub>	V <sub>CE</sub> = 650 V, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 25 °C		-	1	20	μA
		V <sub>CE</sub> = 650 V, V <sub>GE</sub> = 0 V, T <sub>J</sub> = 150 °C		-	1000	-	μA
Gate-Emitter Leakage Current	I <sub>GES</sub>	V <sub>CE</sub> = 0 V, V <sub>GS</sub> = ± 2 0 V		-	-	100	nA
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> = 15 V	I <sub>C</sub> = 75 A	-	1.8	2.1	V
Forward Transconductance	g <sub>fs</sub>	V <sub>CE</sub> = 20 V, I <sub>C</sub> = 75 A		-	40	-	S
Dynamic							
Input Capacitance	C <sub>ies</sub>	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 25 V, f = 500 KHz		-	4500	-	pF
Output Capacitance	C <sub>oes</sub>			-	235	-	
Reverse Transfer Capacitance	C <sub>res</sub>			-	72	-	
Turn-on Energy	E <sub>on</sub>	V <sub>CE</sub> = 400 V , V <sub>GE</sub> = 0 /15V, I <sub>C</sub> = 75 A, R <sub>g</sub> = 10Ω		-	0.62	-	ns
Turn-off Energy	E <sub>off</sub>			-	0.31	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>GE</sub> = 15 V	I <sub>C</sub> = 75 A, V <sub>CE</sub> = 400 V	-	175	-	nC
Gate-Emitter Charge	Q <sub>ge</sub>			-	14	-	
Gate to Collector Charge	Q <sub>gc</sub>			-	33	-	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>CE</sub> = 400 V , V <sub>GE</sub> = 0 /15V, I <sub>C</sub> = 75 A, R <sub>g</sub> = 10Ω		-	60	-	ns
Rise Time	t <sub>r</sub>			-	43	-	
Turn-Off Delay Time	t <sub>d(off)</sub>			-	184	-	
Fall Time	t <sub>f</sub>			-	30	-	
Internal emitter inductance measured 5 mm	L <sub>E</sub>			-	13	-	nH
Diode Characteristics							
Diode Forward Current	I <sub>F</sub>	IGBT symbol showing the integral reverse junction diode		-	-	90	A
Pulsed Diode Forward Current	I <sub>FM</sub>			-	-	225	
Diode Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 30 A		-	1.65	2.0	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25 °C, I <sub>F</sub> = 30 A, dI <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 400 V		-	73	-	ns
Reverse Recovery Charge	Q <sub>rr</sub>			-	80	-	μC
Reverse Recovery Current	I <sub>RRM</sub>			-	13	-	A

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

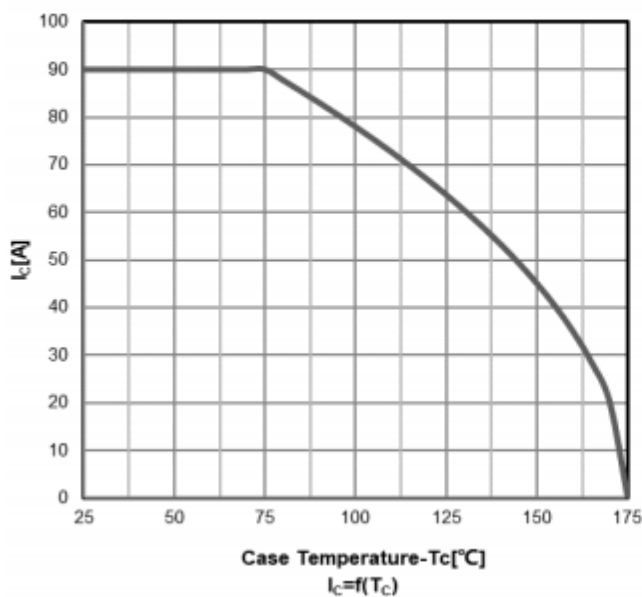
Power dissipation



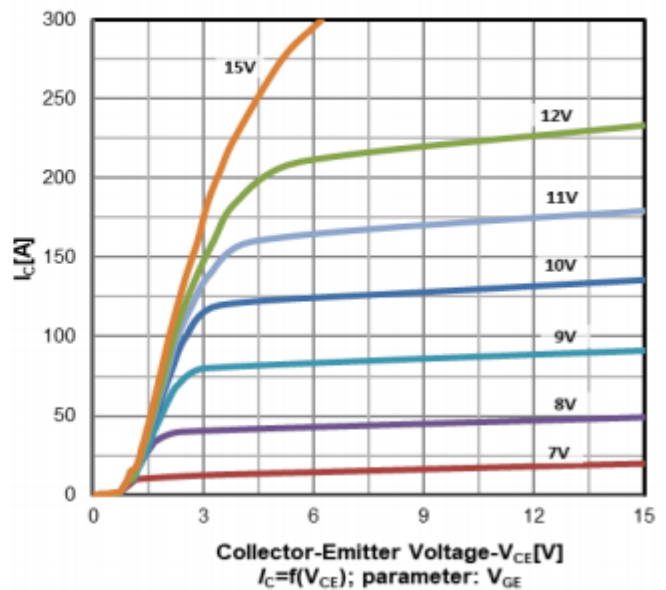
Safe operating area Ta=25 °C



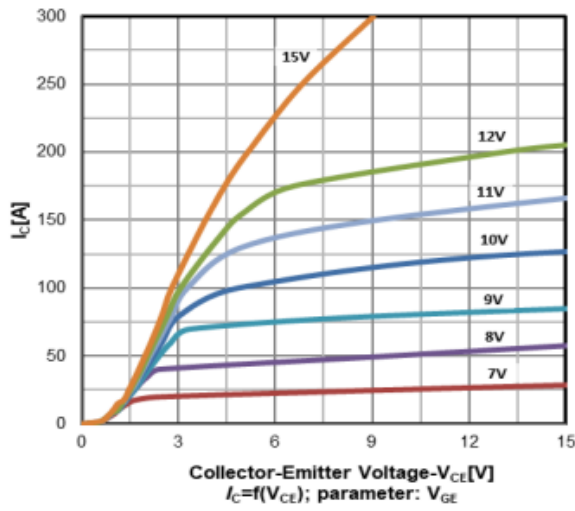
Collector current as a function of  
Case temperature



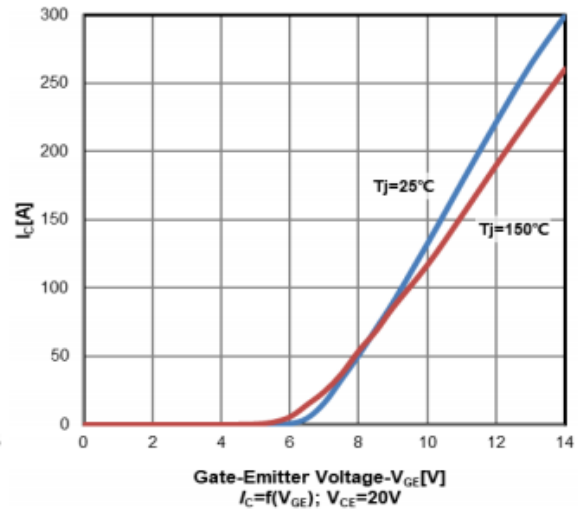
Typ. Output characteristics  
Tj=25 °C



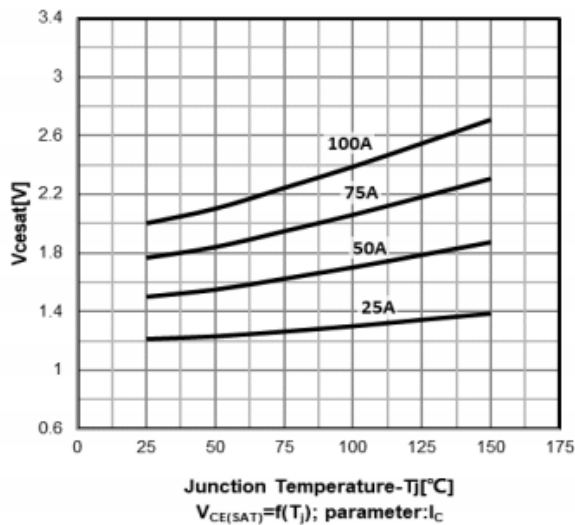
Typ. Output characteristics  
 $T_J = 150^\circ\text{C}$



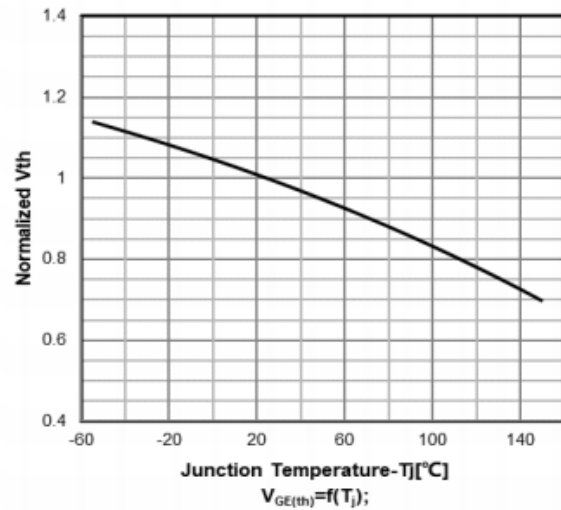
Typ. Transfer characteristics



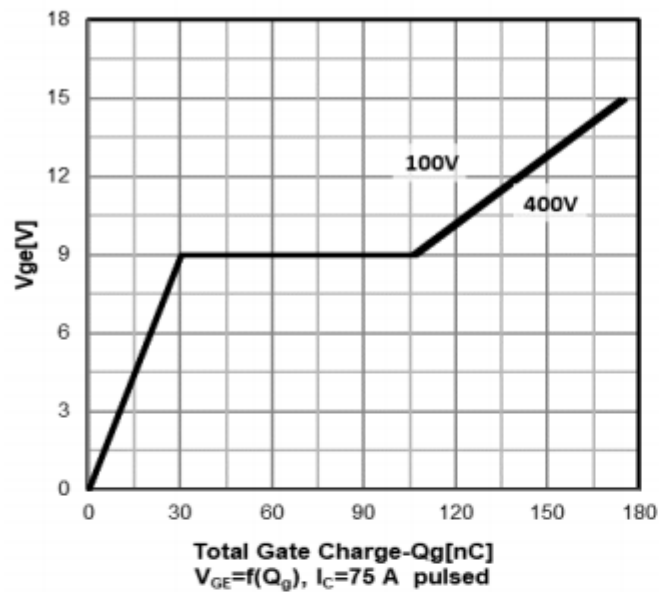
Typ. Collector-emitter saturation voltage as a function of junction temperature ( $V_{GE} = 15\text{V}$ )



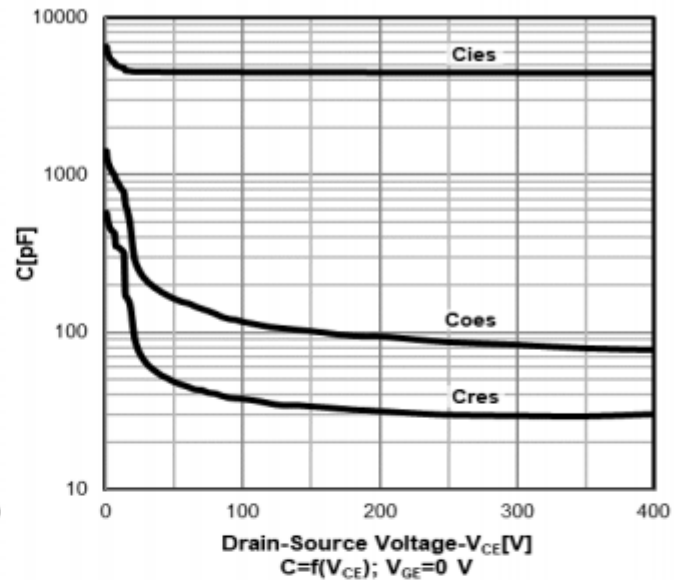
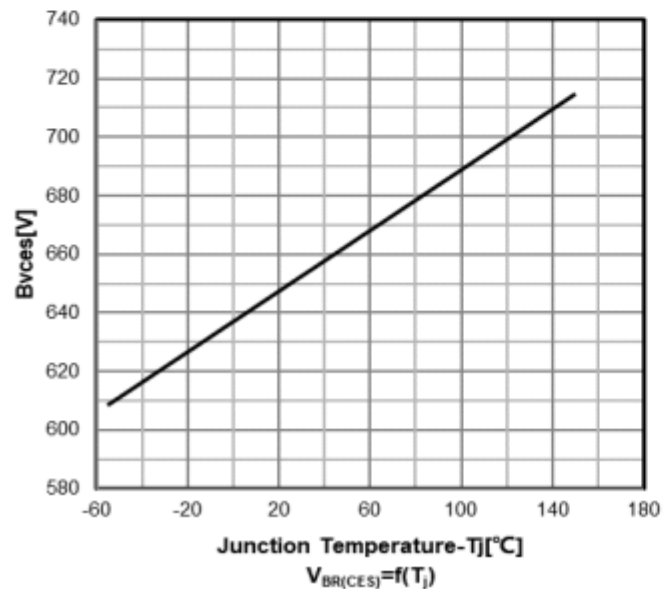
Normalized  $V_{GE(th)}$  vs. temperature



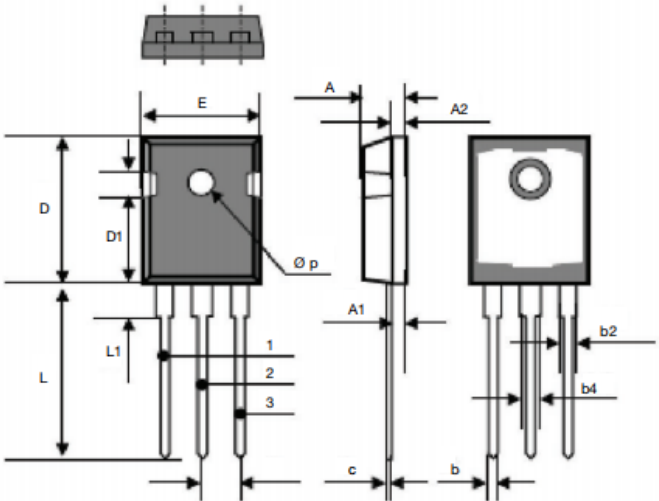
Gate charge characteristics



Capacitance characteristics

Collector-emitter breakdown voltage  
vs. temperature

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DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.31	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.41	0.065	0.095
b4	2.59	3.43	0.102	0.135
c	0.61 BSC		0.024 BSC	
D	20.80	21.46	0.819	0.845
D1	3.68	5.49	0.145	0.216
(e)	5.46 BSC		0.215 BSC	
E	15.49	16.26	0.610	0.640
L	19.81	20.32	0.780	0.800
L1	4.06	4.50	0.160	0.177
$\varnothing p$	3.51	3.66	0.138	0.144

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