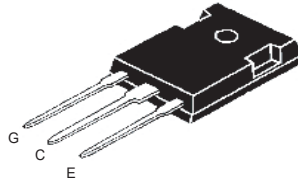


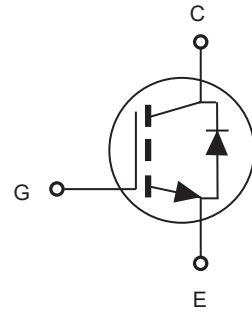
650V 40A Insulated Gate Bipolar Transistors

FEATURES

- $V_{CES} = 650V$, $I_C = 40A$ ($T_C = 100^\circ C$).
- Trench Gate and Field Stop Processes IGBT.
- Low $V_{CE(sat)}$ and High Switching Speed.
- Positive $V_{CE(sat)}$ Temperature Coefficient.
- 10us of Short - circuit Withstand Time.
- Soft and Fast Recover Antiparallel Diode.



TO-247



ABSOLUTE MAXIMUM RATINGS $T_C = 25^\circ C$ unless otherwise noted

Parameter	Symbol	Limit	Units
Collector-to-Emitter Breakdown Voltage	V_{CES}	650	V
Gate-to-Emitter Voltage	V_{GE}	± 30	V
Continuous Collector Current @ $T_C = 25^\circ C$ @ $T_C = 100^\circ C$	I_C	80	A
		40	A
Pulsed Collector Current	I_{CM}	120	A
Maximum Power Dissipation @ $T_C = 25^\circ C$ @ $T_C = 100^\circ C$	P_D	156	W
		63	W
Operating Junction Temperature	T_J	-55 to 150	$^\circ C$
Storage Temperature Range	T_{STG}	-55 to 150	$^\circ C$

Thermal Characteristics

Parameter	Symbol	Limit	Units
Thermal Resistance, Junction-to-Case for IGBT	$R_{\theta JC}$	0.8	$^\circ C/W$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	40	$^\circ C/W$

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min	Typ	Max	Units	
Collector-Emitter Breakdown Voltage	BV_{CES}	$V_{GE} = 0V, I_C = 1mA$	650			V	
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 650V, V_{GE} = 0V$			1	μA	
Gate Body Leakage Current, Forward	I_{GESF}	$V_{GE} = 30V, V_{CE} = 0V$			200	nA	
Gate Body Leakage Current, Reverse	I_{GESR}	$V_{GE} = -30V, V_{CE} = 0V$			-200	nA	
Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 1mA$	4.2		6.8	V	
Collector-Emitter saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C = 40A$		1.5	2	V	
Input Capacitance	C_{ies}	$V_{CE} = 25V, V_{GE} = 0V,$ $f = 1MHz$		4712		pF	
Output Capacitance	C_{oes}			151		pF	
Reverse Transfer Capacitance	C_{res}			43		pF	
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 300V, I_C = 30A,$ $V_{GE} = 15V, R_{GEN} = 10\Omega$ Inductive Load $T_a = 25^\circ\text{C}$		110		ns	
Turn-On Rise Time	t_r			98		ns	
Turn-Off Delay Time	$t_{d(off)}$			81		ns	
Turn-Off Fall Time	t_f			282		ns	
Turn-On Switching Loss	E_{on}			0.85		mJ	
Turn-Off Switching Loss	E_{off}			0.8		mJ	
Total Gate Charge	Q_g		$V_{CC} = 480V, I_C = 30A,$ $V_{GE} = 15V$		126		nC
Gate-Emitter Charge	Q_{ge}				31		nC
Gate-Collector Charge	Q_{gc}				38		nC

Electrical Characteristics of Diode $T_C = 25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Diode Forward Voltage	V_F	$I_F = 40A$		1.6	2.2	V
Diode Reverse Recovery Time	t_{rr}	$I_F = 30A$ $di_F / dt = 100A / \mu s$		50		ns
Diode peak Reverse Recovery Current	I_{rr}			8		A
Diode Reverse Recovery Charge	Q_{rr}			260		nC

Notes :Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

TYPICAL PERFORMANCE CHARACTERISTICS

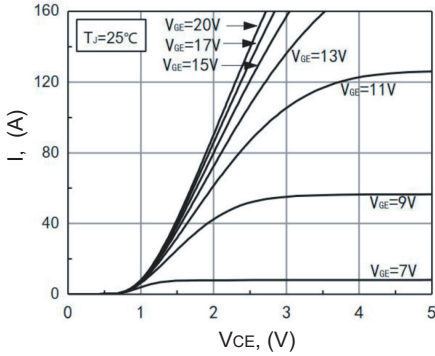


Figure 1. Output Characteristics

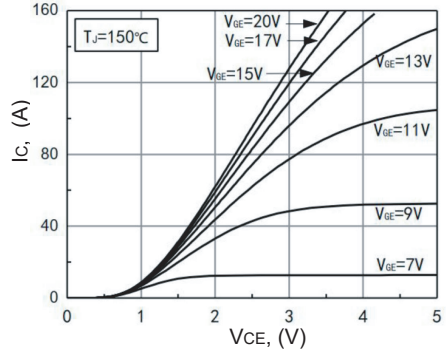


Figure 2. Output Characteristics

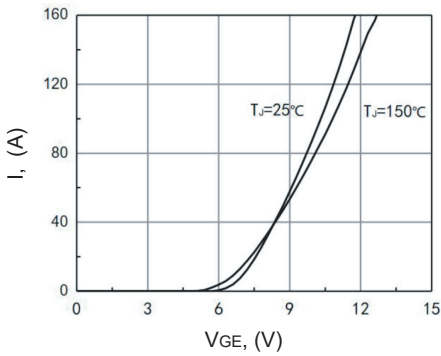


Figure 3. Typical Transfer Characteristics

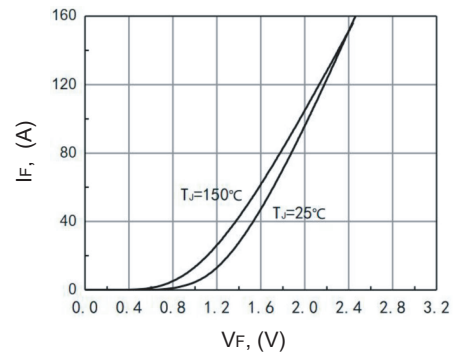


Figure 4. Saturation Voltage vs Tc Characteristics

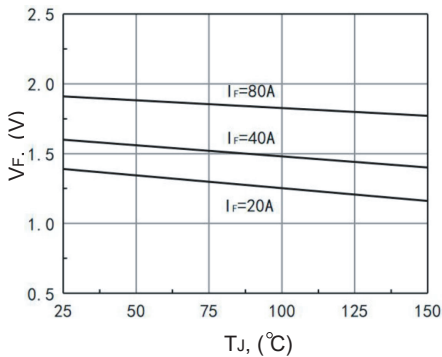


Figure 5. Forward Voltage vs Junction Temperature

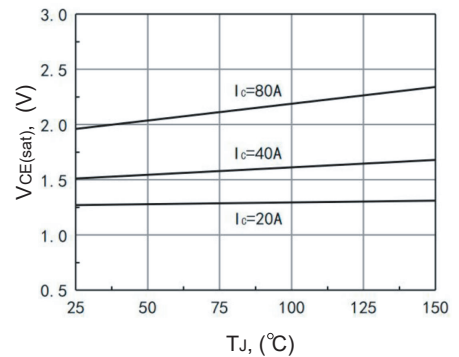


Figure 6. Typical Vce(sat) vs Tj Characteristics

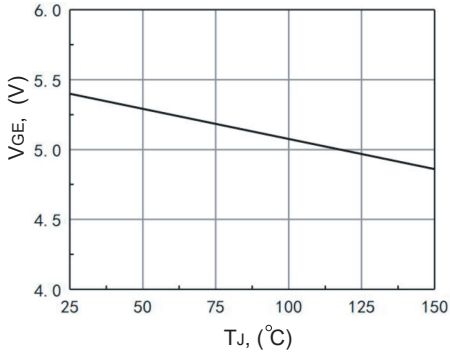


Figure 7. $V_{GE(th)}$ vs T_J Characteristics

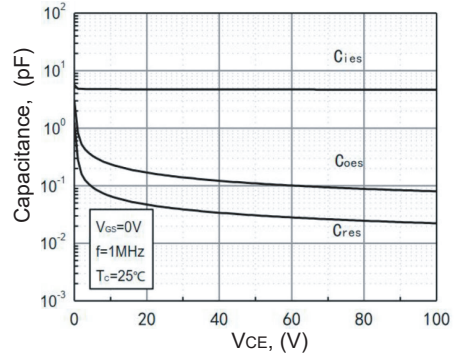


Figure 8. Capacitance Characteristics

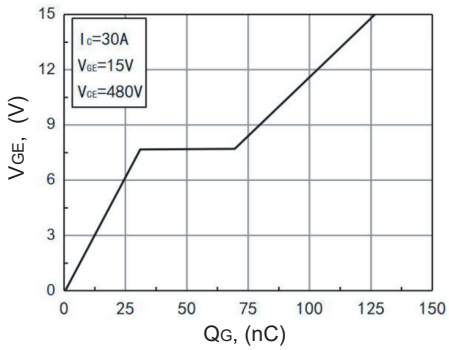


Figure 9. Gate Charge Wave Form

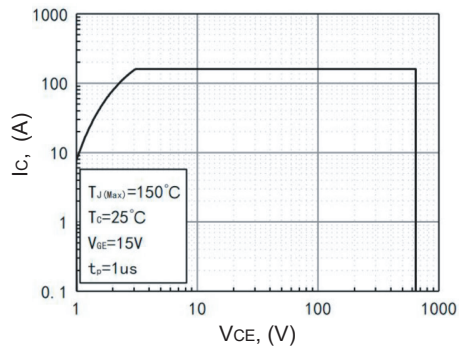


Figure 10. Forward Bias Safe Operating Area

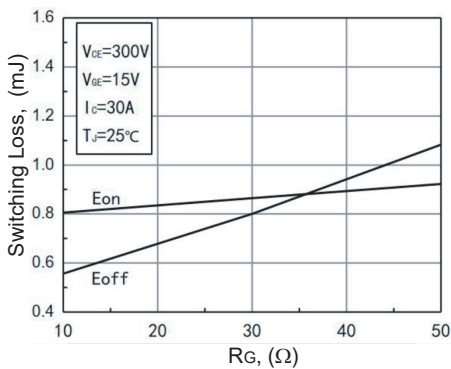


Figure 11. Switching Loss vs Gate Resistances

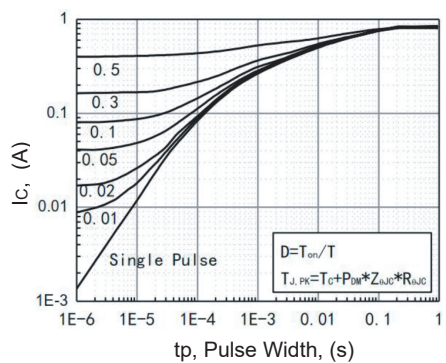
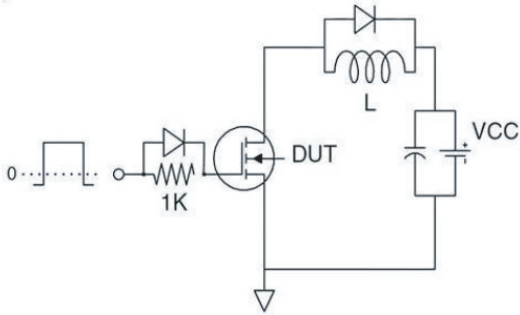
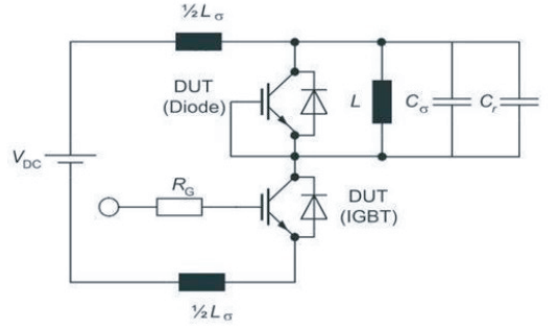


Figure 12. Transient Thermal Resistances

TEST CIRCUIT

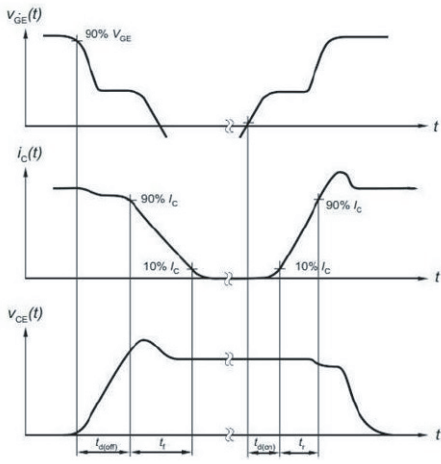


Gate Charge Test Circuit

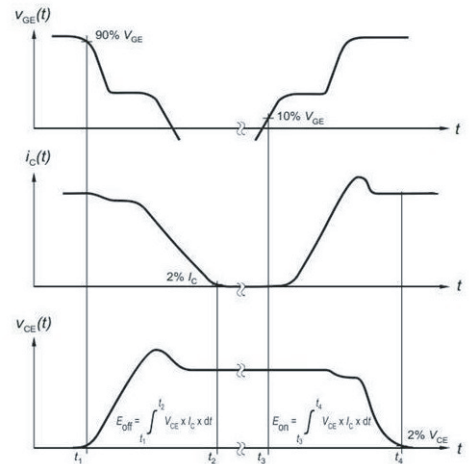


Switch Time Test Circuit

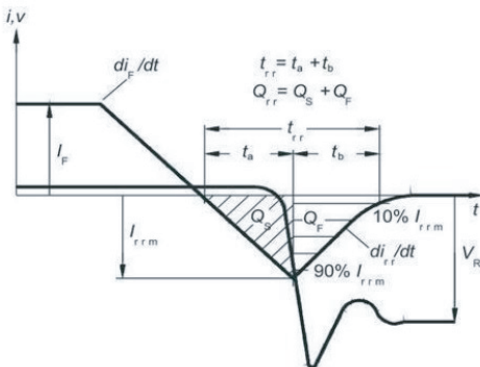
SWITCHING CHARACTERISTICS



Definition of switching times



Definition of switching losses



Definition of diode switching characteristics