650V, 60A, Trench FS II Fast IGBT

General Description:

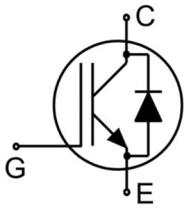
Using MJ's proprietary trench design and advanced FS (Field Stop) second generation technology, the 650V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

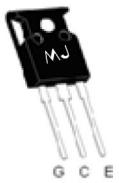
- ◆ Trench FSII Technology offering
- ◆ Very low $V_{CE\ (sat)}$
- ◆ High speed switching
- ◆ Positive temperature coefficient in $V_{CE\ (sat)}$
- ◆ Very tight parameter distribution
- ◆ High ruggedness, temperature stable behavior

Application

- ◆ Air Condition
- ◆ Inverters
- ◆ Motor drives



Schematic diagram



TO-247

Package Marking and Ordering Information

Device	Device Package	Device Marking
MJ60TD65BT	TO-247	MJ60TD65BT

Absolute Maximum Ratings (T_C=25°C unless otherwise noted)

Parameter	Symbol	Value	Units
Collector-Emitter Voltage	V_{CES}	650	V
Gate- Emitter Voltage	V_{GES}	±30	V
Collector Current	I_C	120	A
Collector Current @T_C = 100 °C	I_C	60	A
Pulsed Collector Current, t_p limited by T_{jmax}	I_{Cplus}	180	A
turn off safe operating area, V_{CE}=650V, Tj=150°C	-	180	A
Diode Continuous Forward Current @T_C = 100 °C	I_F	60	A
Diode Maximum Forward Current	I_{FM}	180	A
Power Dissipation @ T_C = 25°C	P_D	316	W
Power Dissipation @T_C = 100 °C	P_D	158	W
Operating Junction and Storage Temperature Range	T_J,T_{stg}	-55 to +175	℃
Maximum Temperature for Soldering	T_L	260	℃
Short circuit withstand time V_{GE}=15.0V, V_{CC}≤400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,Tj≤150°C	t_{sc}	5	us

Thermal Characteristic

Parameter	Symbol	Value	Units
Thermal Resistance, Junction to case for IGBT	$R_{\theta JC}$	0.47	°C/W
Thermal Resistance, Junction to case for Diode	$R_{\theta JC}$	1.72	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	°C/W

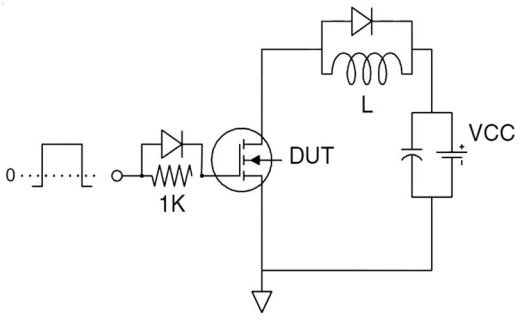
Electrical Characteristics (T_C=25°C unless otherwise noted)

Parameter	Symbol	Test Conditions		Value Min	Value Typ	Value Max	Units
Static Characteristics							
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	V_{GE}=0V,I_{CE}=1mA		650	-	-	V
Collector-Emitter Leakage Current	I_{CES}	V_{GE}=0V,V_{CE}=650V		-	-	5	μA
Gate to Emitter Forward Leakage	$I_{GES(F)}$	V_{GE}=+30V,V_{CE}=0V		-	-	200	nA
Gate to Source Reverse Leakage	$I_{GES(R)}$	V_{GE}=-30V,V_{CE}=0V		-	-	200	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=60A V_{GE}=15V	Tj=25°C	-	1.7	1.9	V
			Tj=150°C	-	1.9	-	V
Gate Threshold Voltage	$V_{GE(th)}$	I_C=1mA, V_{CE}=V_{GE}		4.0	5.0	6.0	V
Dynamic Characteristics							
Input Capacitance	C_{ies}	V_{CE}=25V,V_{GE}=0V, f=1MHz		-	7018	-	pF
Output Capacitance	C_{oss}			-	199	-	pF
Reverse Transfer Capacitance	C_{rss}			-	138	-	pF
Total Gate Charge	Q_g	V_{CC}=480V, I_C=60A V_{GE}=15V		-	262	-	nC
Gate to Emitter Charge	Q_{ge}			-	60	-	nC
Gate to Collector Charge	Q_{gc}			-	113	-	nC
Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	$I_{C(SC)}$	V_{GE}=15V,V_{CC}≤400V, t_{SC}≤5us,T_j≤150°C		-	360	-	A
Switching Characteristics							
Turn-on Delay Time	$t_{d(ON)}$	V_{CE}=400V,I_C=60A V_{GE}=0/15V, R_g=5Ω Inductive Load		-	19	-	ns
Rise Time	t_r			-	17	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$			-	170	-	ns
Fall Time	t_f			-	18	-	ns
Turn-On Switching Loss	E_{on}			-	2.2	-	mJ
Turn-Off Switching Loss	E_{off}			-	0.9	-	mJ
Turn-Off Switching Loss	E_{ts}			-	3.1	-	mJ

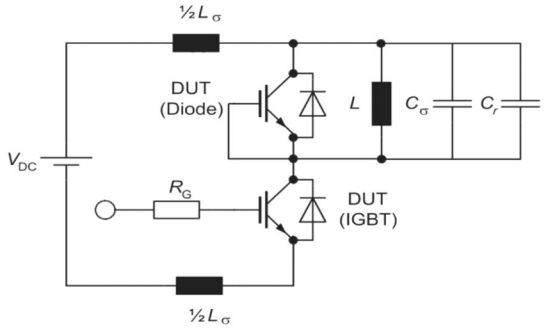
Electrical Characteristics of the Diode (T_C= 25°C unless otherwise specified):

Parameter	Symbol	Test Conditions	Rating			Units
			Min	Typ	Max	
Diode Forward Voltage	V_{FM}	I_F=60A	-	1.7	2.0	V
Reverse Recovery Time	T_{rr}	I_F=60A,di/dt=200A/uS	-	186	-	ns
Diode Peak Reverse Recovery Current	I_{RRM}		-	3.8	-	A
Reverse Transfer Capacitance	Q_{rr}		-	0.3	-	uC
Pulse width ttp≤380μs,δ≤2%						

Test Circuit

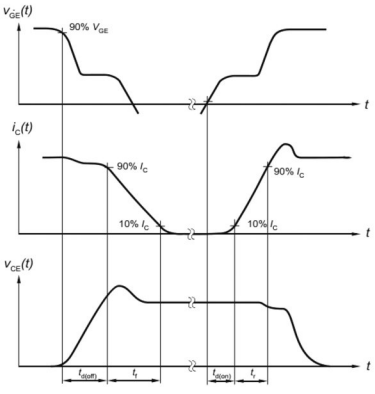


Gate Charge Test Circuit

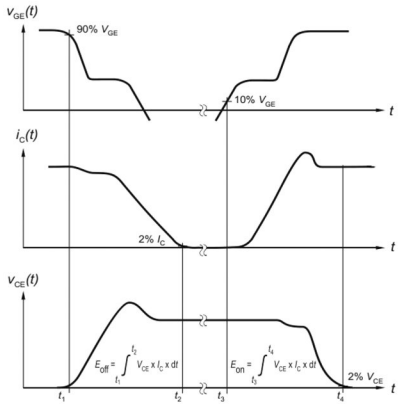


Switch Time Test Circuit

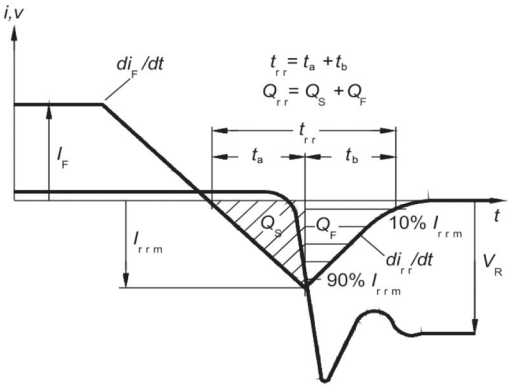
Switching characteristics



definition of switching times



definition of switching losses



Definition of diode switching characteristics

Typical Electrical and Thermal Characteristics

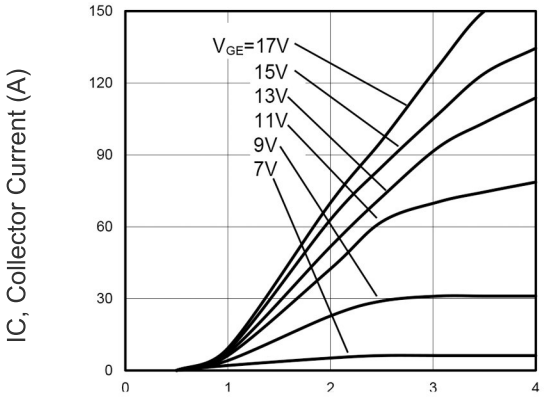


Figure 1 Output Characteristics

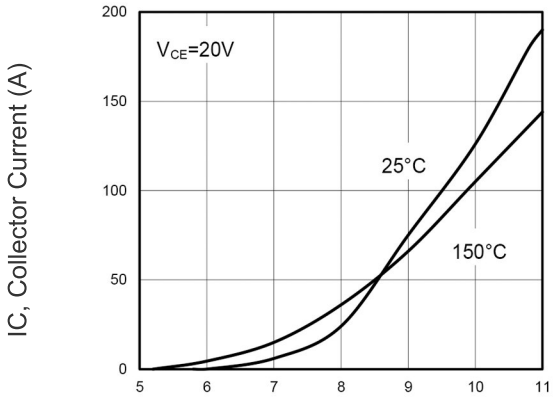


Figure 2 Transfer Characteristics

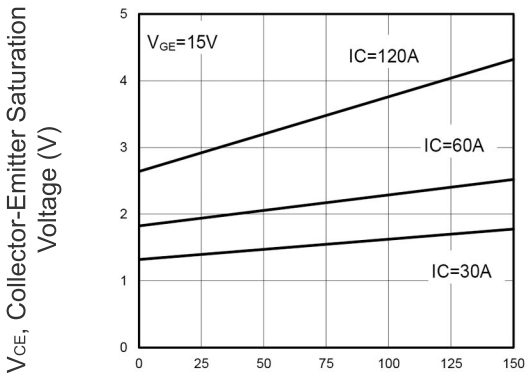


Figure 3 V_{CEsat} vs. Case Temperature

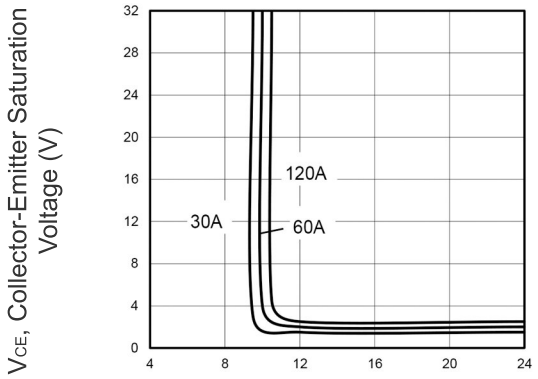


Figure 4 Saturation Voltage vs. V_{GE}

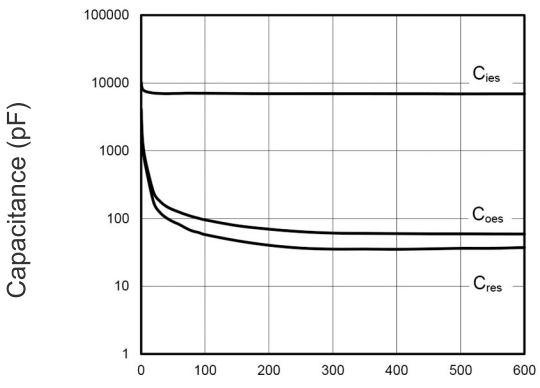


Figure 5 Capacitance Characteristics

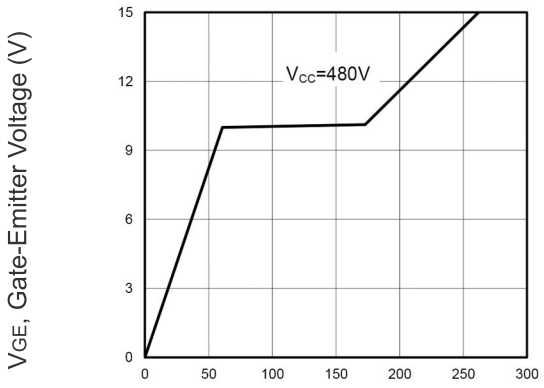


Figure 6 Gate charge waveform

Typical Electrical and Thermal Characteristics

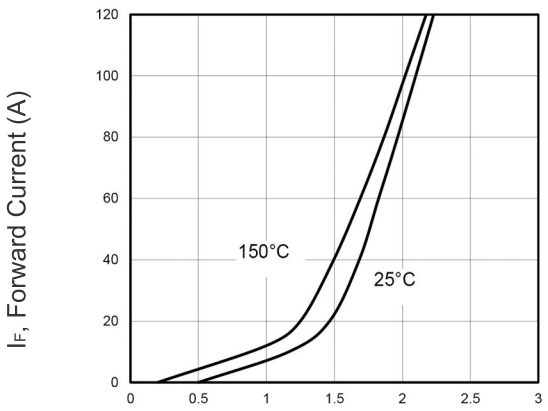


Figure 7 Forward Characteristics

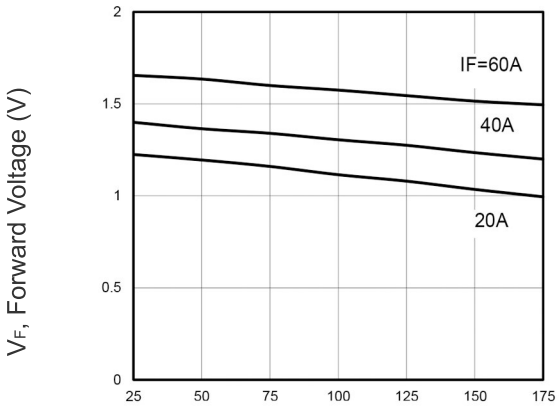


Figure 8 VF vs. Temperature

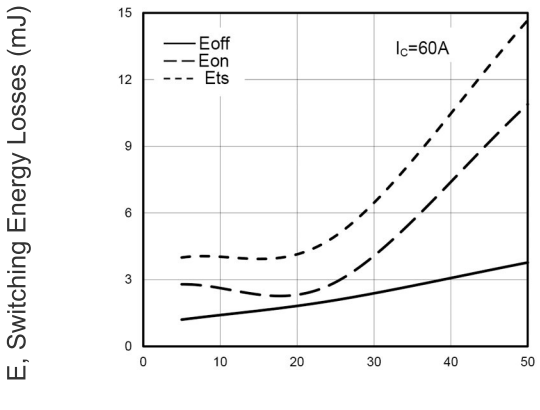


Figure 9 Typical Switching Times as a Function of Gate Resistor

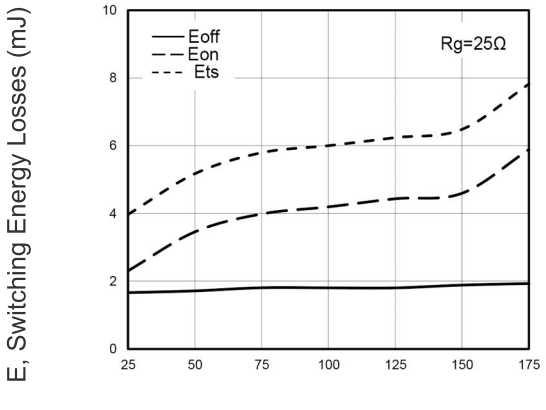


Figure 10 Typical Switching Times as a Function of Junction Temperature

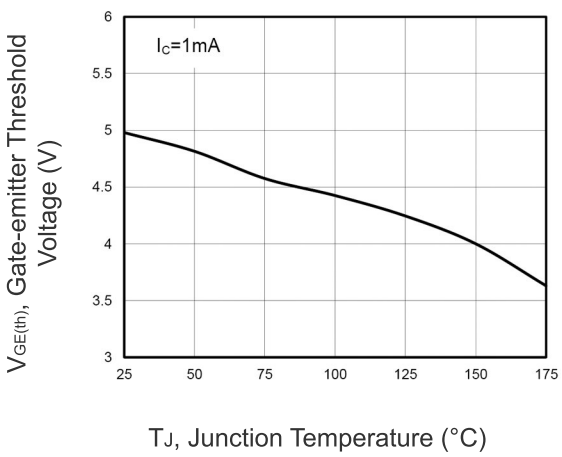


Figure 11 Gate-emitter Threshold Voltage as a Function of Junction Temperature

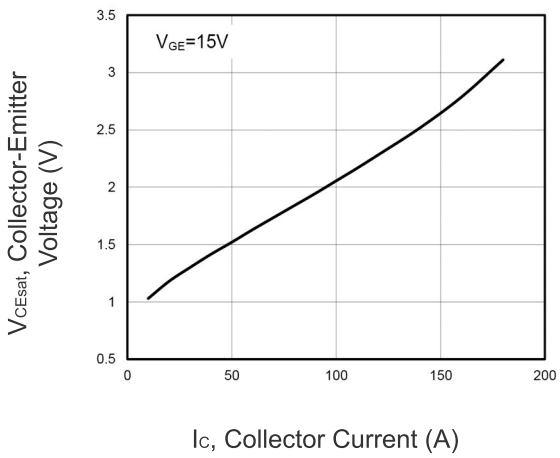


Figure 12 Typical Collector-emitter Saturation Voltage as a function of Collector Current

Typical Electrical and Thermal Characteristics

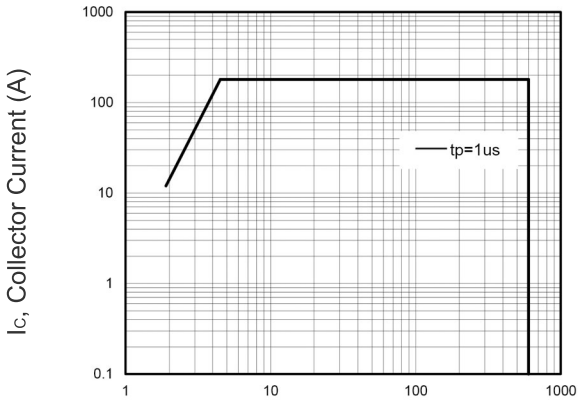
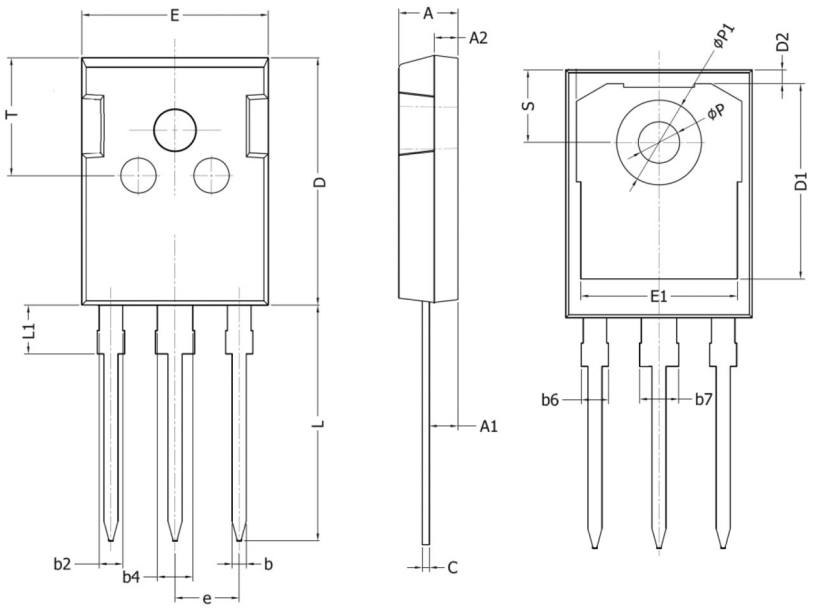


Figure 13 Forward Bias Safe Operating Area

TO-247-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.9	2.1	0.075	0.083
b	1.16	1.26	0.046	0.050
b2	1.96	2.06	0.077	0.081
b4	2.96	3.06	0.117	0.120
b6	-	2.25	-	0.089
b7	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
e	5.436 BSC		0.214 BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402

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