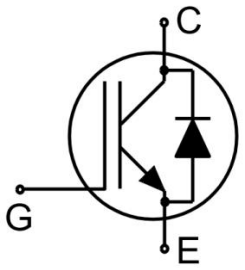
650V, 75A, Trench FS IGBT

1. Descriptions

TO-247

Schematic diagram



Key Performance Parameters

Parameters	Value	Unit
V_{CE}	650	V
I_c	75	A
$V_{CE(sat),Tj=25°C}$	1.72	V

Features

- Trench FS Technology offering.
- Very low $V_{CE(sat)}$.
- Positive temperature coefficient in $V_{CE(sat)}$.
- Very tight parameter distribution.
- High ruggedness, temperature stable behavior.
- Maximum Junction Temperature: T_J=175℃.

Applications

- PFC.
- Solar Converters.
- Uninterruptible Power Suppliers.
- Welding Converters.
- Mid to High Range Switching Frequency Converters.

Type/Ordering Code	Package	Marking	Related Links
FKW75N65F2J	TO-247	75N65F2J	see Appendix A

650V, 75A, Trench FS IGBT

2. Maximum ratings

at T_j = 25°C, Unless Otherwise Specified

Table 1. Absolute Maximum Ratings

Symbol	Parameter	Values	Unit	Test Condition
V_{CES}	Collector-Emitter Voltage	650	V	V_{GS}=0V
V_{GES}	Gate- Emitter Voltage Transient Gate-Emitter Voltage (tp≤10μs,D<0.010)	±20 ±30	V	
I_C	Collector Current	150 75	A	T_C=25°C T_C=100°C
$I_{C,pulse}$	Pulsed Collector Current，tp limited by Tjmax	300	A	
-	turn off safe operating area	300	A	V_{CE}=650V,Tj=150°C
I_F	Diode Continuous Forward Current	75	A	T_C=100°C
I_{FM}	Diode Maximum Forward Current	300	A	
P_D	Power Dissipation	395	W	T_C=25°C
		197	W	T_C=100°C
T_J,T_{stg}	Operating Junction and Storage Temperature Range	-55~175	°C	
T_L	Maximum Temperature for Soldering	260	°C	

3. Thermal characteristics

Table 2. Thermal Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
R_{thJC}	Thermal resistance, Junction to case for IGBT			0.38	°C/W	T_C = 25°C
R_{thJCD}	Thermal resistance, Junction to case for Diode			0.22	°C/W	T_C = 25°C
R_{thJA}	Thermal resistance, Junction to Ambient			40	°C/W	T_C = 25°C

650V, 75A, Trench FS IGBT

4. Electrical characteristics

at Tj = 25°C, Unless Otherwise Specified

Table 3. Static Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	650			V	V_{GE}=0V, I_{CE}=1mA
I_{CES}	Collector-Emitter Leakage Current			5	uA	V_{GE}=0V, V_{CE}=650V
I_{GES}	Gate to Emitter leakage current			±200	nA	V_{GE}=±30V, V_{CE}=0V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		1.72	2.0	V	V_{GE}=15V, I_C=75A, T_j =25°C
			2.22	2.5	V	V_{GE}=15V, I_C=75A, T_j =175°C
V_{FM}	Diode forward voltage		1.07		V	I_F=75A, T_f=25°C
			0.96		V	I_F=75A, T_f=175°C
$V_{GE(th)}$	Gate Threshold Voltage	3	3.8	5	V	I_C=1mA,V_{CE}=V_{GE}

Table 4. Dynamic Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
C_{ies}	Input capacitance		3327		pF	V_{GE}=0V, V_{CE}=25V, f=1MHz
C_{oes}	Output capacitance		280		pF	V_{GE}=0V, V_{CE}=25V, f=1MHz
C_{res}	Reverse transfer capacitance		40		pF	V_{GE}=0V, V_{CE}=25V, f=1MHz
Q_g	Total Gate Charge		134		nC	V_{CC}=480V, I_C=75A, V_{GE}=0 to 15V
Q_{ge}	Gate to Emitter Charge		25		nC	
Q_{gc}	Gate to Collector Charge		52		nC	

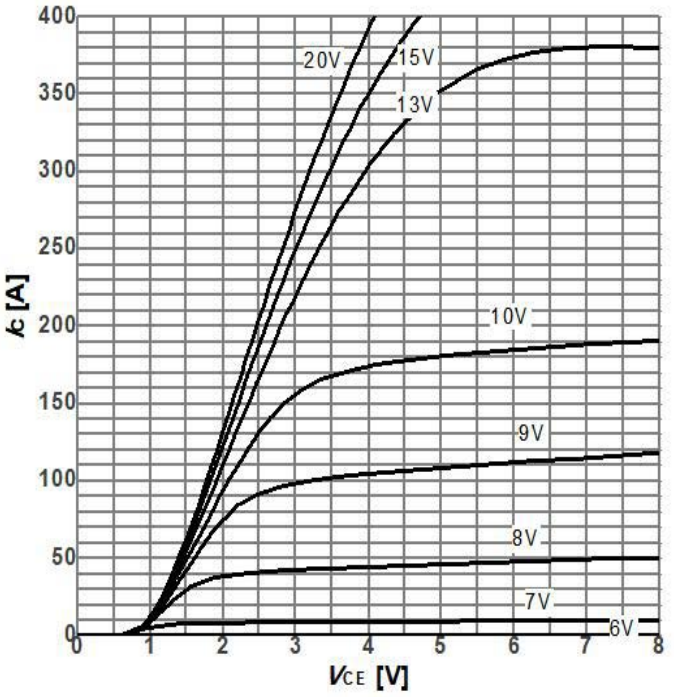
Table 5. Switching Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
$t_{d(on)}$	Turn-on delay time		37		ns	V_{CE}=400V,I_C=75A,V_{GE}=15V, R_g=10Ω, Inductive Load
t_r	Rise time		38		ns	
$t_{d(off)}$	Turn-off delay time		208		ns	
t_f	Fall time		87		ns	
E_{on}	Turn-On Switching Loss		1.68		mJ	
E_{off}	Turn-Off Switching Loss		1.54		mJ	
E_{ts}	Total Switching Loss		3.22		mJ	

650V, 75A, Trench FS IGBT

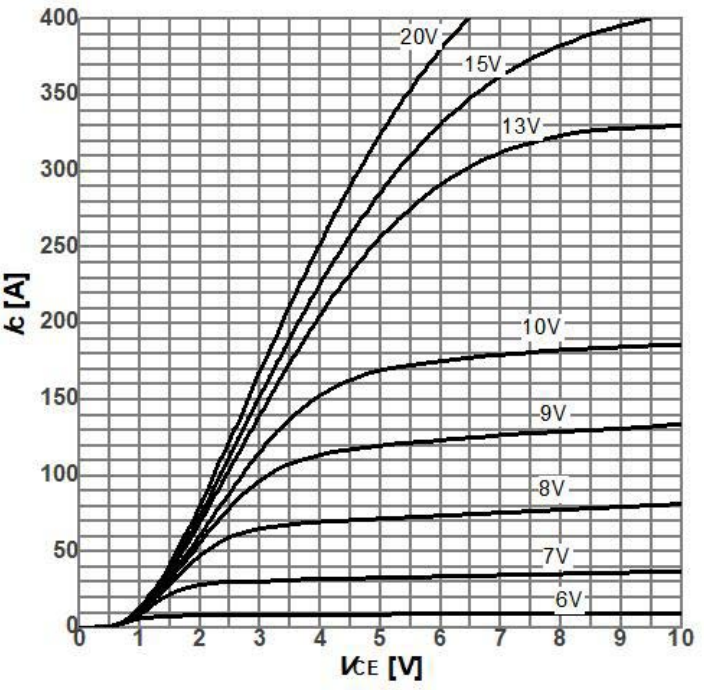
5. Electrical characteristics diagrams

Diagram 1: Typ. output characteristics



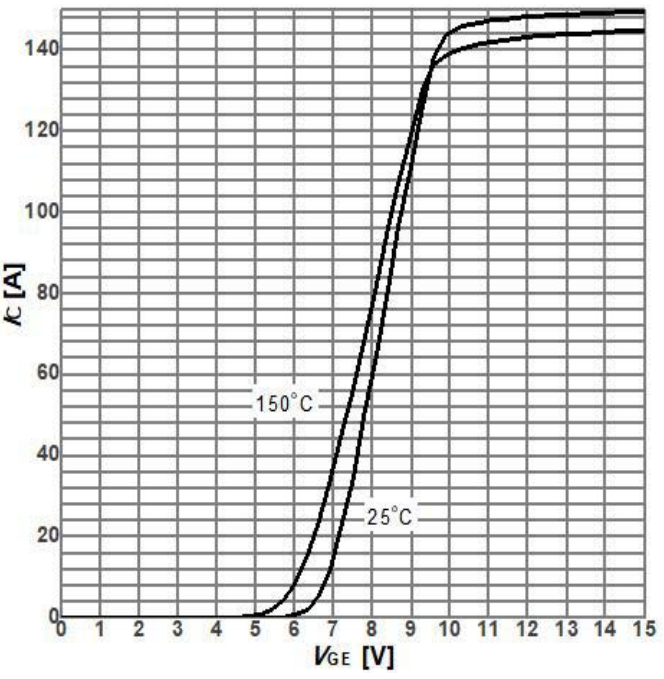
I_C=f(V_{ce}); T_j=25°C; parameter: V_{GE}

Diagram 2: Typ. output characteristics



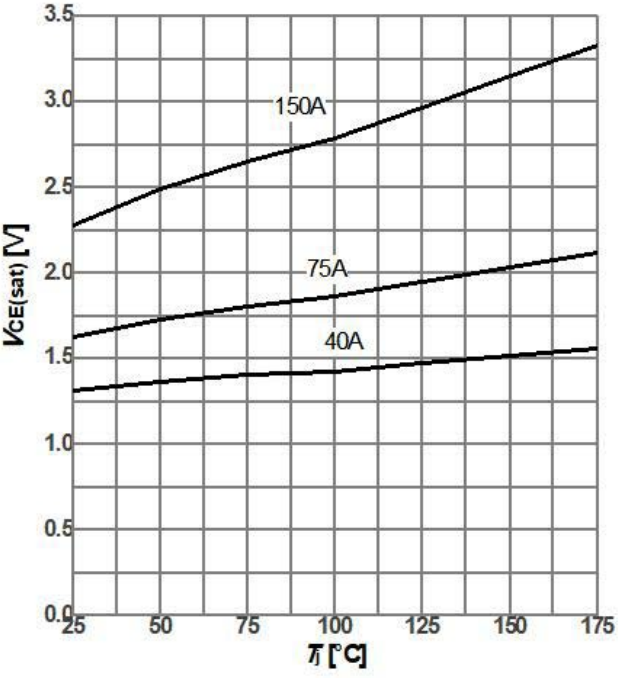
I_C=f(V_{ce}); T_j=150°C; parameter: V_{GE}

Diagram 3: Typ. transfer characteristics



I_C=f(V_{GE}); V_{CE}=20V; parameter: T_j

Diagram 4: V_{CE}(sat) vs. Case Temperature



$V_{CE(sat)}$=f(T_j);V_{GE}=15V; parameter: I_C

650V, 75A, Trench FS IGBT

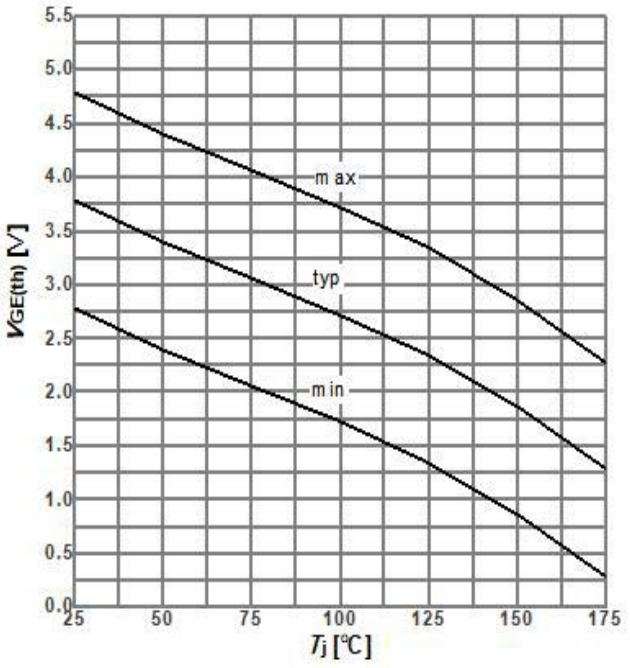
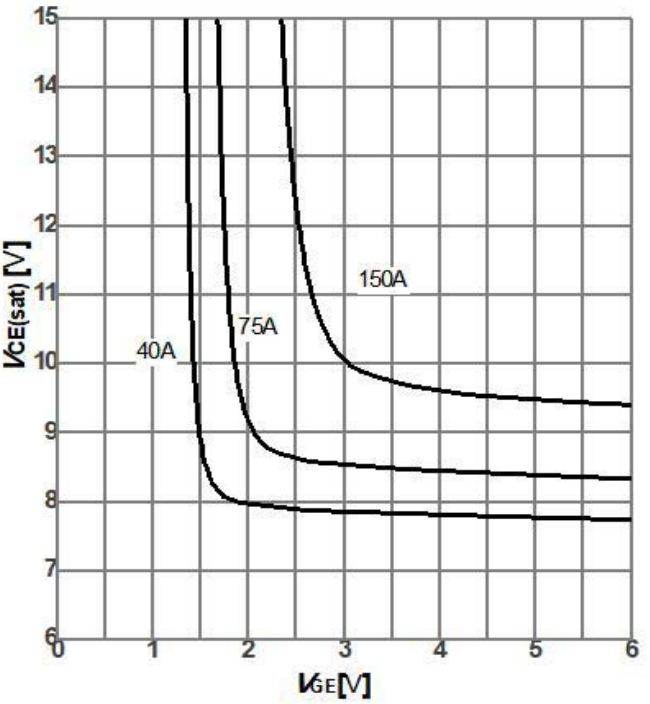
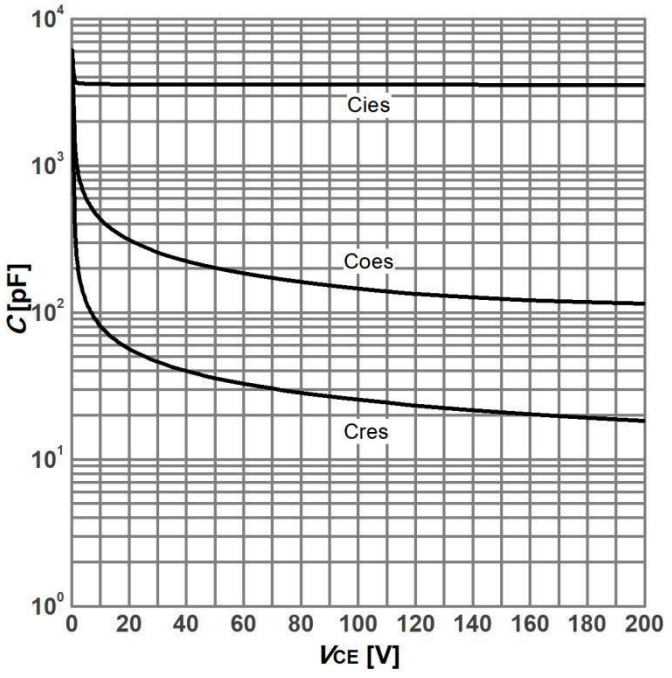
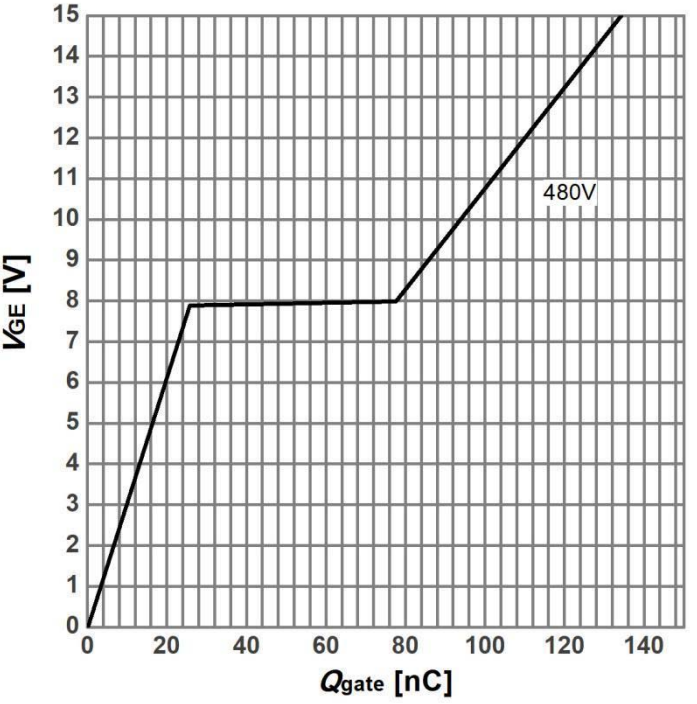
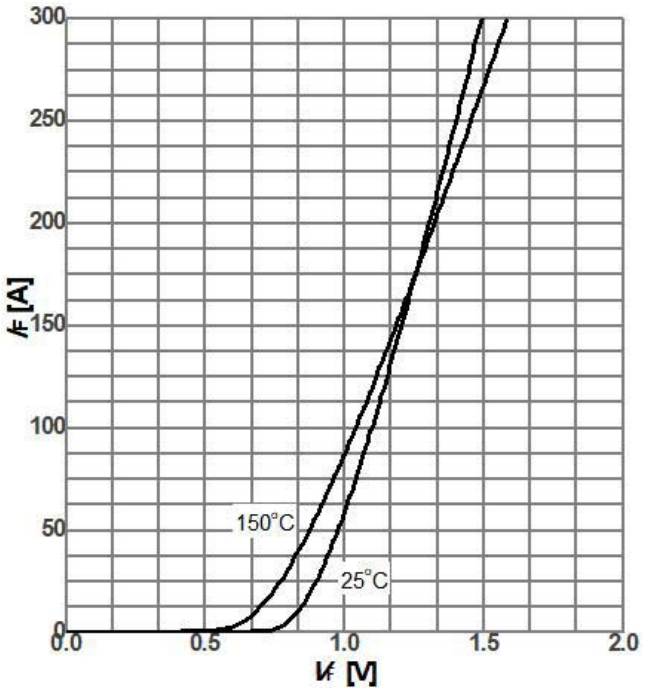
Diagram 5: V_{GE}(th) vs. Case Temperature	Diagram 6: Saturation Voltage vs. V_{GE}
	
$V_{GE(th)}$=f(T_j);V_{CE}=15V; parameter: I_C	$V_{CE(sat)}$= f(V_{GE}); parameter: I_C

Diagram 7: Typ. capacitances	Diagram 8: Typ. gate charge
	
C=f(V_{CE}); V_{GE}=0V; f=1MHz	V_{GE}=f(Q_{gate}); I_C=75A pulsed;

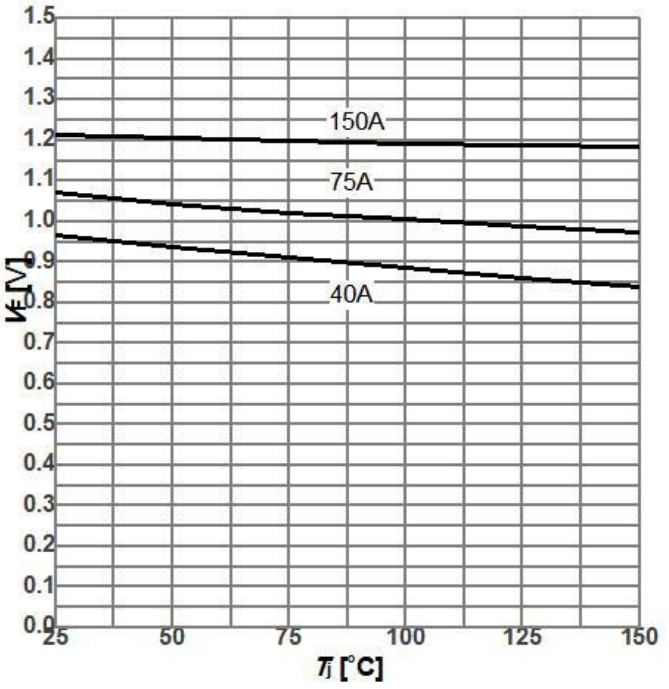
650V, 75A, Trench FS IGBT

Diagram 9: Typ. Diode forward current as A function of forward voltage



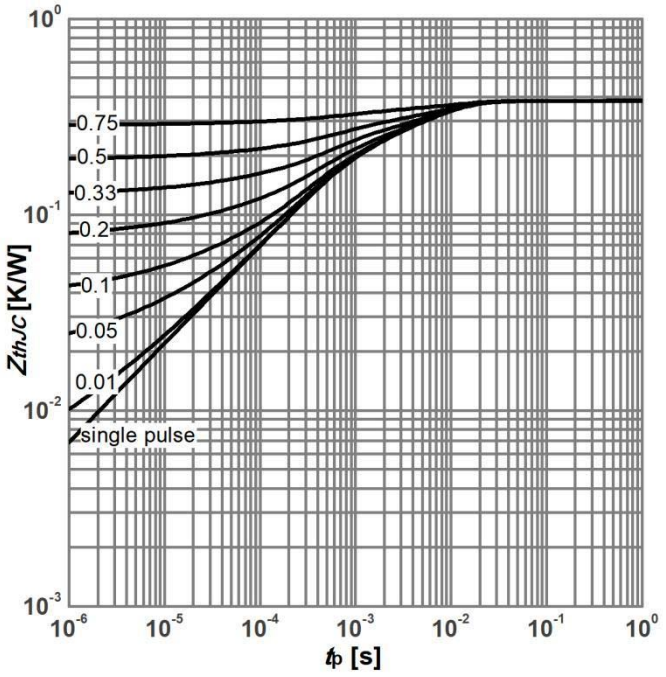
I_F=f(V_F); parameter: T_j

Diagram 10: Typ. Diode forward voltage as a function of junction temperatu



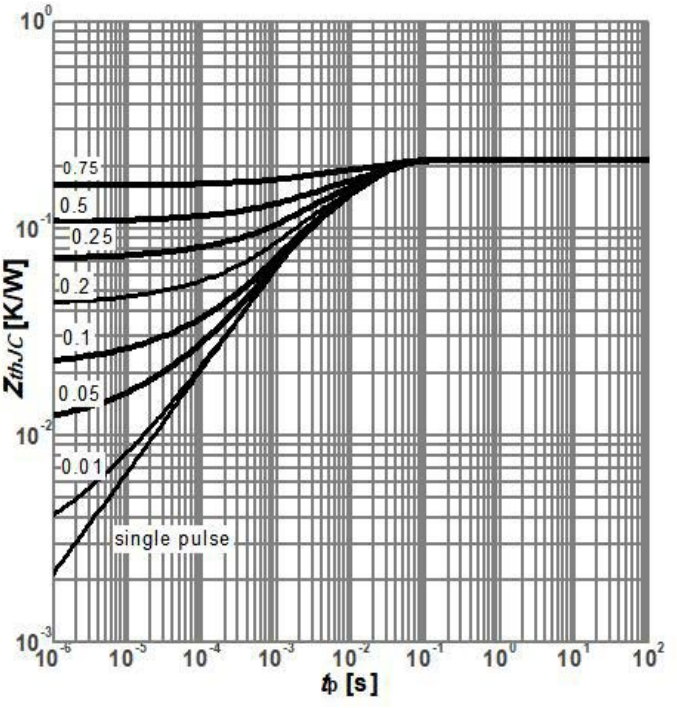
V_F=f(T_j);parameter: I_C

Diagram 11: Max. IGBT transient thermal impedance



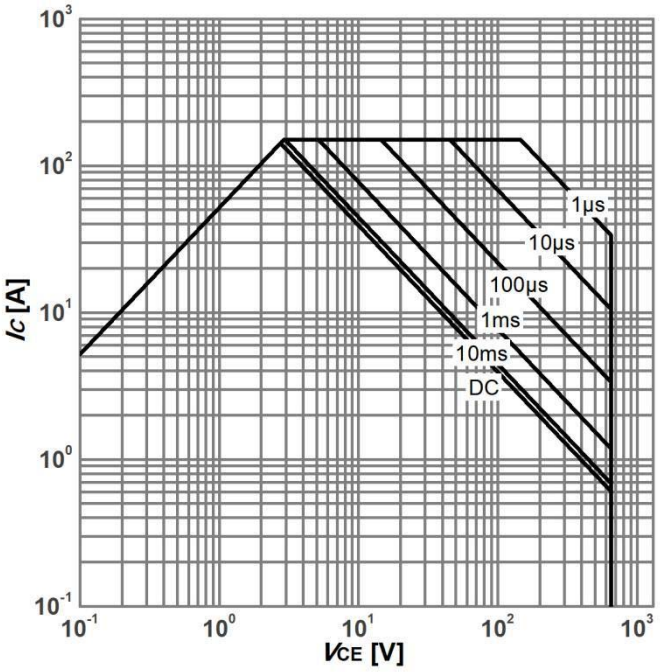
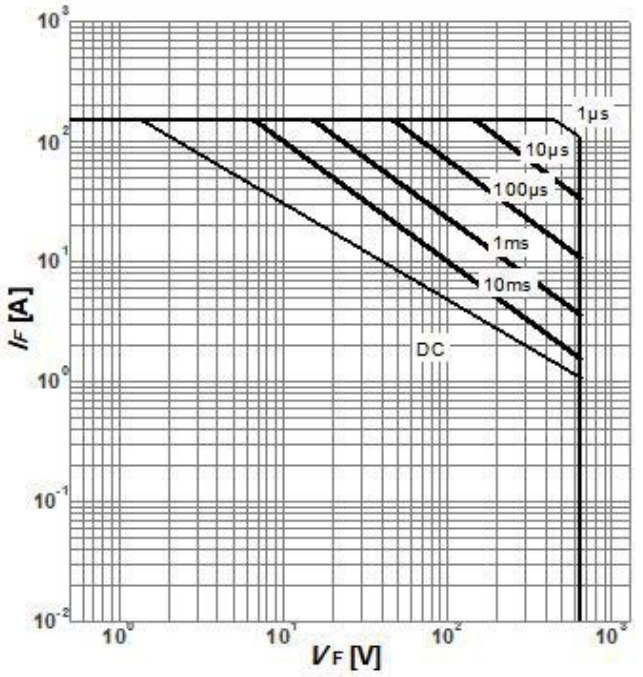
Z_{thJC}=f(t_p); parameter: D= t_p/T

Diagram 12: Max. Diode transient thermal impedance



Z_{thJC}=f(t_p); parameter: D= t_p/T

650V, 75A, Trench FS IGBT

Diagram 13: IGBT Safe operating area	Diagram 14: Diode Safe operating area
	
Z_{thJC}=f(t_p); parameter: D= t_p/T	Z_{thJC}=f(t_p); parameter: D= t_p/T

650V, 75A, Trench FS IGBT

6. Test Circuits

Table 7. Test Circuit

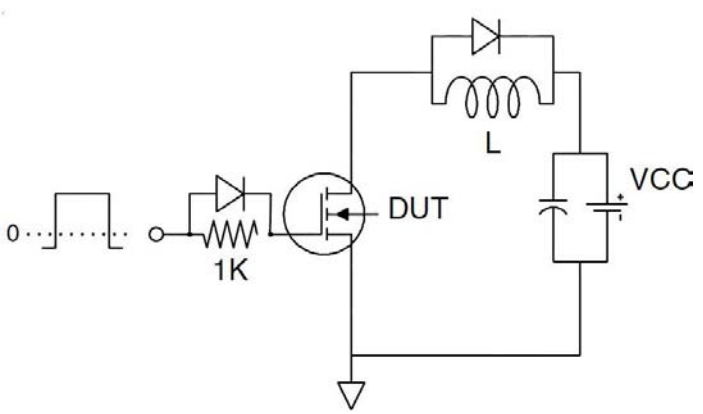
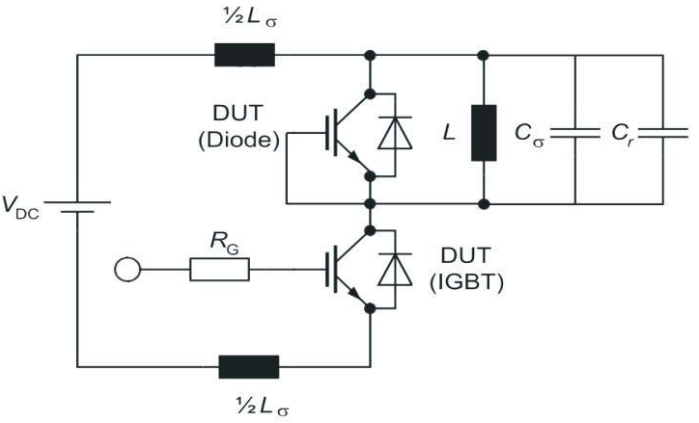
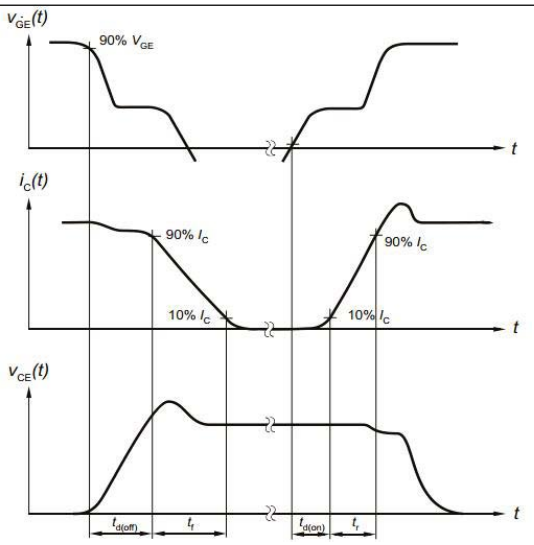
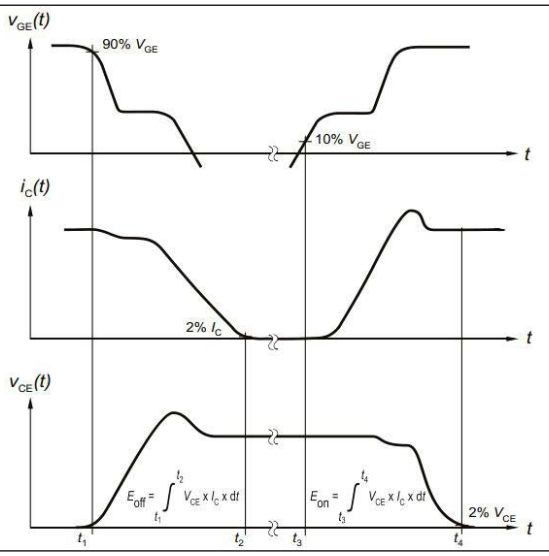
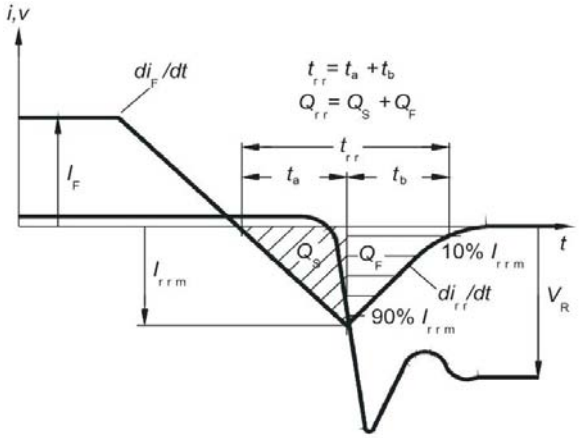
Gate Charge Test Circuit	Switch Time Test Circuit
	

Table 8. Switching characteristics

Definition of switching times	Definition of switching losses
	

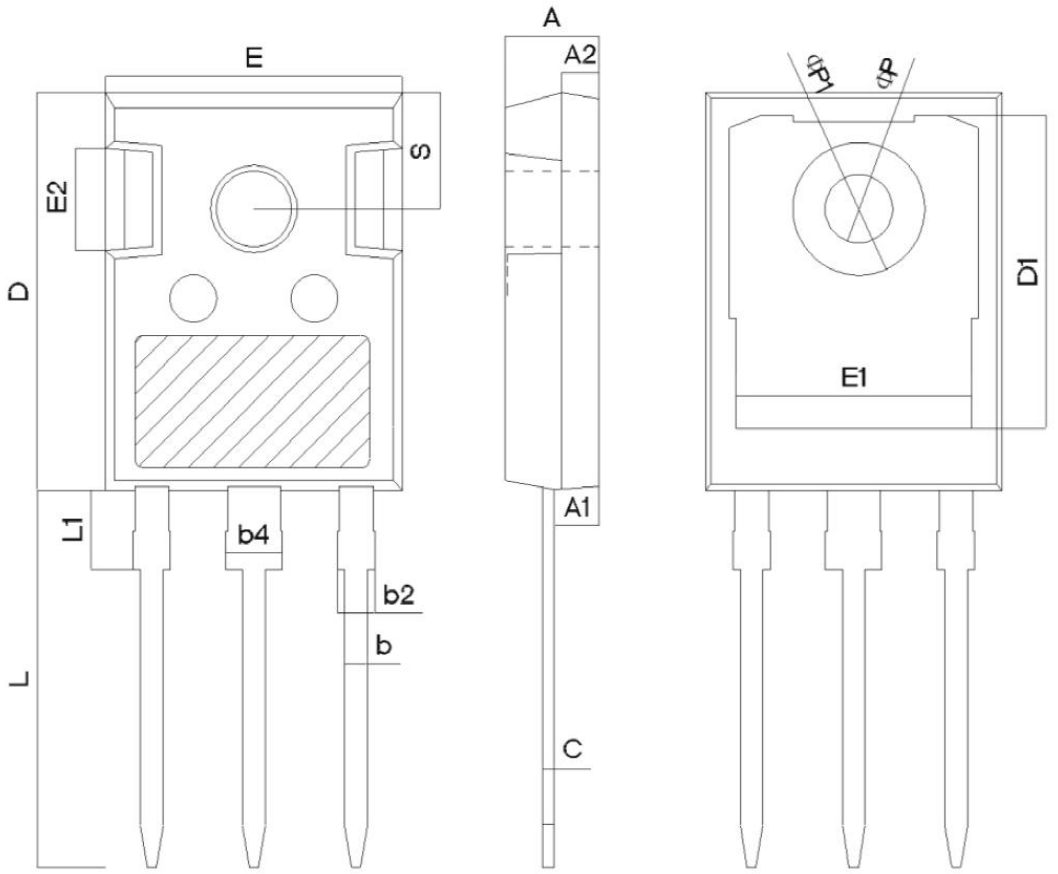
Definition of diode switching characteristics



650V, 75A, Trench FS IGBT

7. Package Outlines

Figure 1 Outline TO-247 dimensions in mm



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e		5.44BSC	
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S		6.15BSC	