

Features

- ◆ Offers high breakdown voltage to 650V
- ◆ Low V_{CEsat}
- ◆ Easy parallel switching capability due to positive temperature coefficient in V_{CEsat}
- ◆ Very fast and soft antiparallel diode
- ◆ Qualified according to JEDEC for target applications
- ◆ Pb-Free lead plating
- ◆ RoHS and Halogen-Free compliant



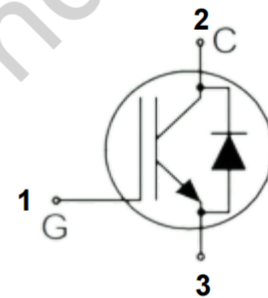
TO-220F

Product Validation

- ◆ Qualified for industrial applications according to the relevant tests of JESD-022

Potential applications

- ◆ UPS
- ◆ Air Condition
- ◆ Motor Drives
- ◆ PFC



Equivalent Circuit

V_{CE}	650	V
I_C	15	A
$V_{CEsat, Typ}$ $T_{vj} = 25^\circ C$	1.65	V
T_{jmax}	150	$^\circ C$

1. Absolute Maximum Ratings

Table 2. Maximum Ratings

Parameter		Symbol	Value	Unit
Collector-emitter voltage		V_{CE}	650	V
DC collector current, limited by $T_{vj\max}$	$T_c = 25\text{ }^{\circ}\text{C}$	I_C	30	A
	$T_c = 100\text{ }^{\circ}\text{C}$		15	A
Pulsed collector current, t_p limited by $T_{vj\max}^2$		$I_{C,puls}$	60	A
Diode forward current, limited by $T_{vj\max}$	$T_c = 25\text{ }^{\circ}\text{C}$	I_F	30	A
	$T_c = 100\text{ }^{\circ}\text{C}$		15	A
Diode pulsed current, t_p limited by $T_{vj\max}$		$I_{F,puls}$	60	A
Gate-emitter voltage		V_{GE}	± 20	V
Short circuit withstand time $V_{GE} = 15\text{V}$, $V_{CC} \leq 360\text{V}$, Allowed number of short circuits < 1000 , Times between short circuits: $\geq 1.0\text{s}$, $T_j \leq 25\text{ }^{\circ}\text{C}$		t_{sc}	12	μs
Power dissipation $T_c = 25\text{ }^{\circ}\text{C}$		P_{tot}	91	W
Operating junction temperature		T_{Stg}	$-55 \dots +150$	$^{\circ}\text{C}$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s		T_L	260	$^{\circ}\text{C}$

2. Thermal Characteristics

Table 3. Thermal Characteristics

Parameter	Symbol	Value	Unit
IGBT Thermal Resistance, Junction to Case max.	$R_{\theta JC}$	1.37	$^{\circ}\text{C/W}$
Diode Thermal Resistance, Junction to Case max.	$R_{\theta JC}$	1.98	$^{\circ}\text{C/W}$
Thermal Resistance, Junction to Ambient max.	$R_{\theta JA}$	39.2	$^{\circ}\text{C/W}$

3. Electrical Characteristics (@T_J = +25°C, unless otherwise specified.)

Table 4. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Static Characteristics						
Collector-emitter breakdown voltage	V _{(BR)CES}	650	-	-	V	V _{GE} = 0V, I _C = 250μA
Collector-emitter saturation voltage	V _{CEsat}	-	1.65	2.3	V	V _{GE} = 15V, I _C = 15A, T _{vj} = 25 °C
Diode forward voltage	V _F	-	1.45	1.7	V	V _{GE} = 0V, I _F = 15A, T _{vj} = 25 °C
Gate-emitter threshold voltage	V _{GE(th)}	4.5	-	6.8	V	I _C = 250μA, V _{GE} = V _{CE}
Zero gate voltage collector current	I _{CES}	-	-	1	μA	V _{CE} = 650V, V _{GE} = 0V, T _{vj} = 25 °C
Gate-emitter leakage current	I _{GES}	-	-	100	nA	V _{CE} = 0V, V _{GE} = ±20V
Dynamic Characteristics						
Input capacitance	C _{ies}	-	1270.3	-	PF	V _{CE} = 25V, V _{GE} = 0V, f = 1MHz
Output capacitance	C _{oes}	-	78.0	-	PF	
Reverse transfer capacitance	C _{res}	-	28.3	-	PF	
Gate total charge	Q _G	-	42	-	nC	V _{CE} = 520V, I _C = 15A, V _{GE} = 15V
Gate-Emitter charge	Q _{ge}	-	10.7	-	nC	
Gate-Collector charge	Q _{gc}	-	18.3	-	nC	
Short circuit collector current Max.1000 short circuits, Times between short circuits: ≥ 1.0s	I _{SC}	-	100	-	A	V _{CC} ≤ 360V, V _{GE} = 15V, t _{SC} ≤ 8us, T _J ≤ 25°C
Switching Characteristic, Inductive Load						
IGBT Characteristic, at T _{vj} = 25°C						
Turn-on delay time	t _{d(on)}	-	12	-	ns	T _{vj} = 25°C, V _{CE} = 400V, I _C = 15A, V _{GE} = 10.0V, R _G = 10.0Ω
Rise time	t _r	-	26	-	ns	
Turn-off delay time	t _{d(off)}	-	30	-	ns	
Fall time	t _f	-	244	-	ns	
Turn-on energy	E _{on}	-	0.24	-	mj	
Turn-off energy	E _{off}	-	0.57	-	mj	
Diode Characteristic, at T _{vj} = 25°C						
Diode reverse recovery time	t _{rr}	-	36	-	ns	T _{vj} = 25°C, V _R = 400V, I _F = 15A, dI _F /d _t = 200A/μs
Diode reverse recovery charge	Q _{rr}	-	85	-	nC	
Diode peak reverse recovery current	I _{rrm}	-	4.6	-	A	

4. Electrical Characteristics diagrams

Figure 1. Diode Forward Voltage

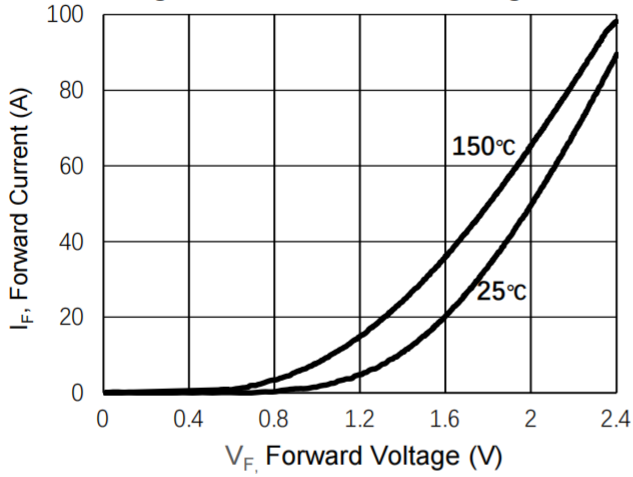


Figure 2. Typical Transfer Characteristics

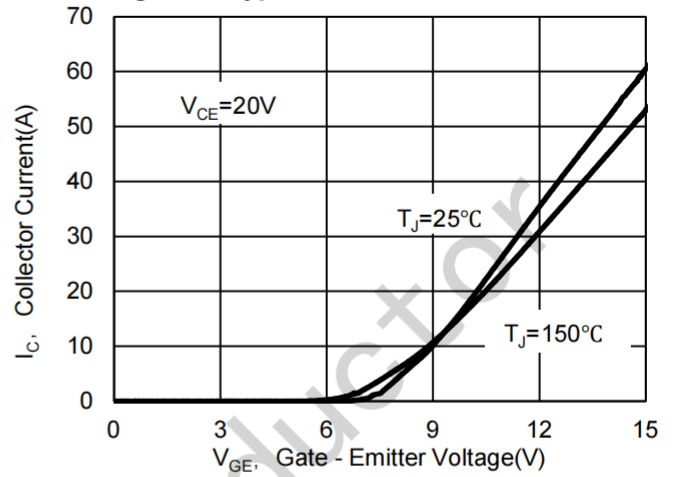


Figure 3. Power Dissipation vs. Temperature

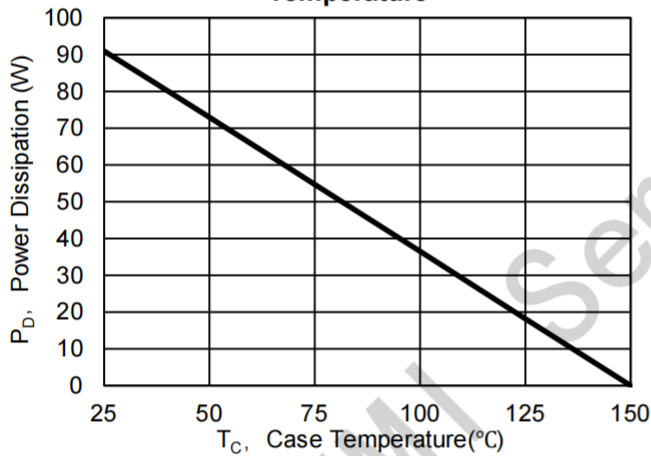


Figure 4. Collector Current vs. Temperature

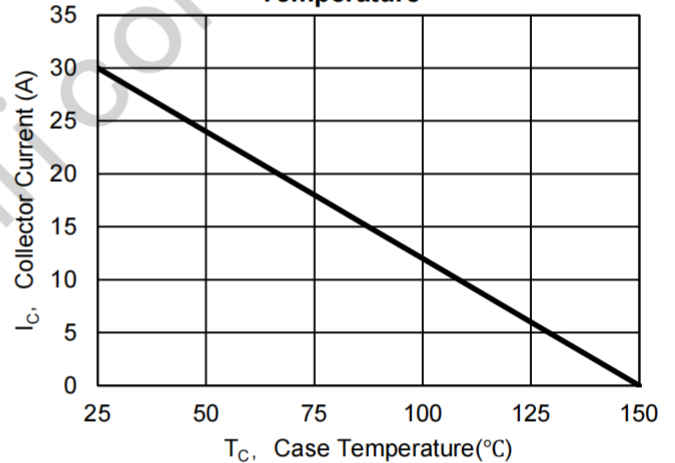


Figure 5. Typical Output Characteristics

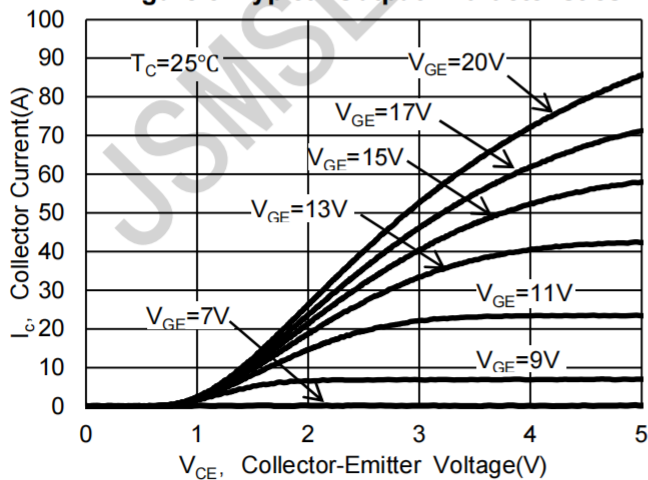


Figure 6. Gate-Charge Characteristics

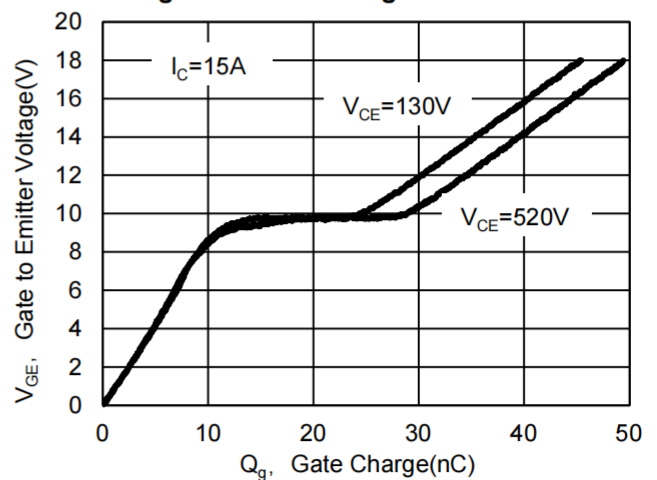


Figure 7. Capacitance Characteristics

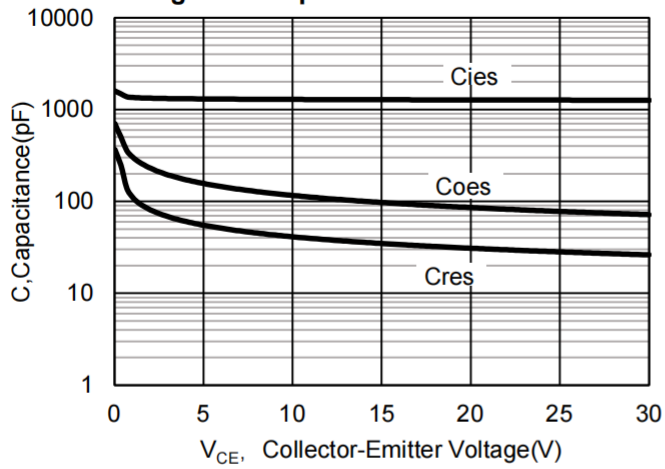


Figure 8. Safe Operating Area

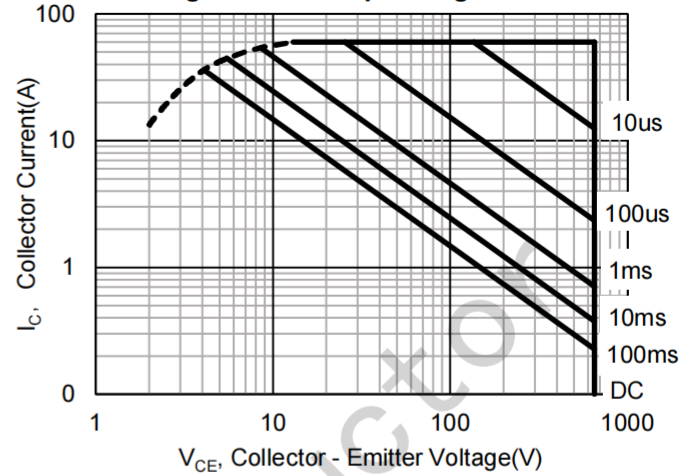


Figure 9. IGBT Thermal Impedance

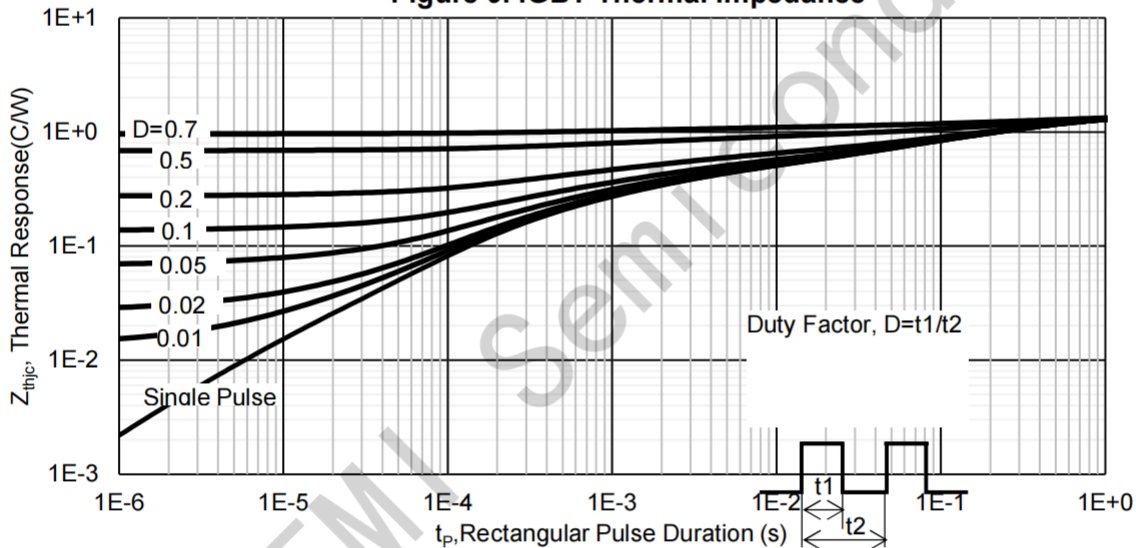
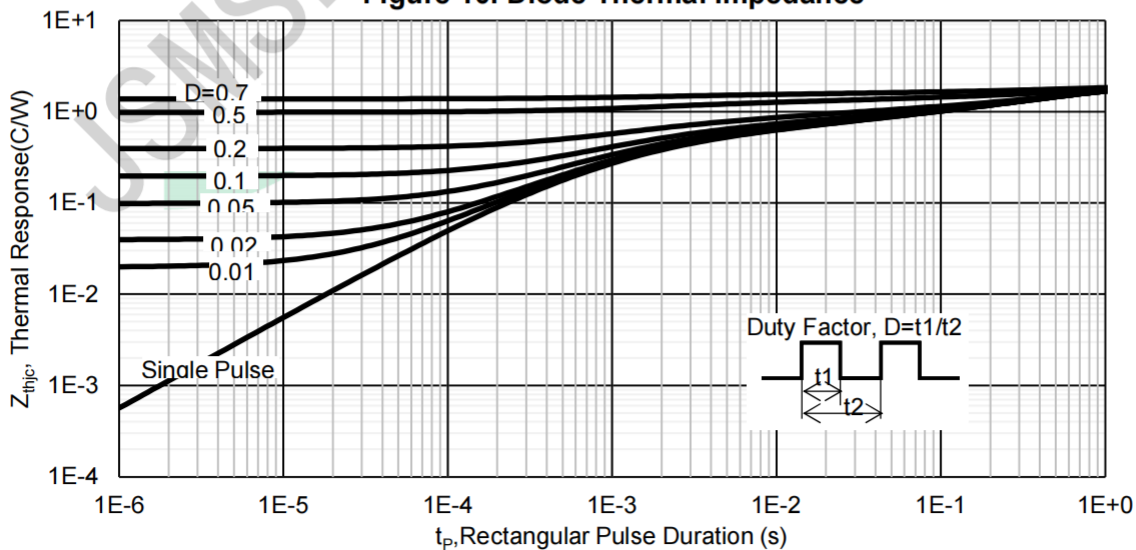


Figure 10. Diode Thermal Impedance



5. Package Outline Dimensions

Fig 11. TO-220F drawing

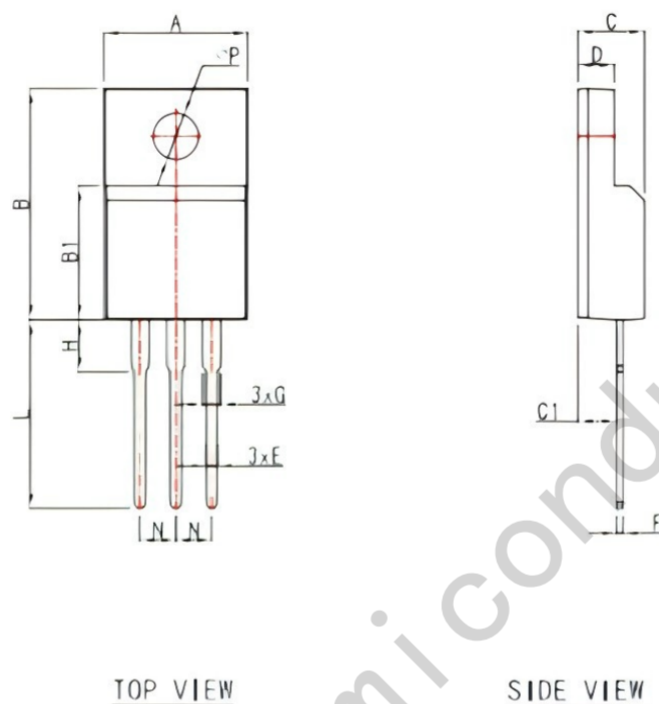


Table 5. Mechanical data

SYMBOL	MIN	TYP	MAX
A	9.60	10.00	10.40
B	15.40	15.80	16.20
B1	8.90	9.20	9.50
C	4.30	4.60	4.90
C1	2.10	2.55	3.00
D	2.40	2.70	3.00
E	0.60	0.80	1.00
F	0.3	0.45	0.6
G	1.12	1.27	1.42
H	3.40	-	3.80
	2.40	-	2.90
L	12.00	13.00	14.00
N	2.34	2.54	2.74
Q	3.15	3.35	3.55
ϕP	2.90	3.10	3.30
All Dimensions in mm			