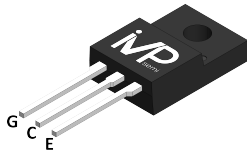
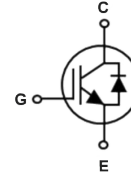


TO-220F

Symbol


Key Features

- High ruggedness for motor control
- $V_{CE(sat)}$ positive temperature coefficient
- Very soft, fast recovery anti-parallel diode
- Low EMI
- Maximum junction temperature 175°C

Applications

- Inverter for motor control

Ordering Information

Ordering part Number	Marking code	Package	Form
VPMIFB4000	4000	TO-220F	Tube

Maximum Ratings ($T_J = 25^\circ\text{C}$, unless otherwise specified)

Parameter		Symbol	Rating	Unit
Collector-emitter voltage		V_{CE}	650	V
DC collector current, limited by T_{vjmax}	$T_C=25^\circ\text{C}$	I_C	30	A
	$T_C=100^\circ\text{C}$		15	
Pulsed collector current, t_p limited by T_{vjmax}		I_{Cpuls}	60	A
Diode forward current, limited by T_{vjmax}	$T_C=25^\circ\text{C}$	I_F	30	A
	$T_C=100^\circ\text{C}$		15	
Diode pulsed current, t_p limited by T_{vjmax}		I_{Fpuls}	60	A
Gate-emitter voltage		V_{GE}	± 20	V
Power dissipation	$T_C=25^\circ\text{C}$	P_D	48	W
	$T_C=100^\circ\text{C}$		24	
Short circuit withstand time $V_{CC} \leq 360\text{V}$, $V_{GE} = 15\text{V}$, $T_{vj} = 150^\circ\text{C}$		t_{sc}	5	μs
Operating Junction temperature range		T_{vj}	-40~175	$^\circ\text{C}$
Storage temperature range		T_{stg}	-55~150	$^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Rating	Unit
Thermal resistance junction-to-ambient	$R_{th(j-a)}$	62	$^\circ\text{C/W}$
Thermal resistance junction-to-case for IGBT	$R_{th(j-c)}$	3.0	
Thermal resistance junction-to-case for Diode	$R_{th(j-c)}$	5.0	

Electrical Characteristics ($T_{vj} = 25^{\circ}\text{C}$ unless otherwise specified)

Static Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	BV_{CES}	650	-	-	V	$I_C = 2\text{mA}$, $V_{GE} = 0\text{V}$
Collector-emitter saturation voltage	$V_{CE(sat)}$	-	1.65	2.00	V	$I_C = 15\text{A}$, $V_{GE} = 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$
		-	1.90	-		$I_C = 15\text{A}$, $V_{GE} = 15\text{V}$, $T_{vj} = 175^{\circ}\text{C}$
Diode forward voltage	V_F	-	1.85	2.30	V	$V_{GE} = 0\text{V}$, $I_F = 15\text{A}$, $T_{vj} = 25^{\circ}\text{C}$
		-	1.95	-		$V_{GE} = 0\text{V}$, $I_F = 15\text{A}$, $T_{vj} = 175^{\circ}\text{C}$
Gate-emitter threshold voltage	$V_{GE(th)}$	4.5	5.5	6.5	V	$V_{CE} = V_{GE}$, $I_C = 0.5\text{mA}$
Zero gate voltage collector current	I_{CES}	-	-	20	μA	$V_{CE} = 650\text{V}$, $V_{GE} = 0\text{V}$, $T_{vj} = 25^{\circ}\text{C}$
Gate-emitter leakage current	I_{GES}	-	-	± 100	nA	$V_{GE} = 20\text{V}$, $V_{CE} = 0\text{V}$

Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Total gate charge	Q_G	-	61	-	nC	$V_{CE} = 520\text{V}$, $I_C = 15\text{A}$, $V_{GE} = 15\text{V}$
Gate-emitter charge	Q_{GE}	-	11	-		
Gate-collector charge	Q_{GC}	-	35	-		
Input capacitance	C_{ies}	-	1129	-	pF	$V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$, $f = 1\text{MHz}$
Output capacitance	C_{oes}	-	57	-		
Reverse transfer capacitance	C_{res}	-	31	-		

Switching Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Turn-on delay time	$t_{d(on)}$	-	19	-	ns	$V_{GE} = 15V, V_{CC} = 400V, I_C = 15A, R_G = 10\Omega$, Inductive Load, $T_{vj} = 25^{\circ}C$
Rise time	t_r	-	27	-		
Turn-off delay time	$t_{d(off)}$	-	128	-		
Fall time	t_f	-	32	-		
Turn-on switching energy	E_{on}	-	270	-	μJ	
Turn-off switching energy	E_{off}	-	86	-		
Total switching energy	E_{ts}	-	356	-		
Turn-on delay time	$t_{d(on)}$	-	17	-	ns	$V_{GE} = 15V, V_{CC} = 400V, I_C = 15A, R_G = 10\Omega$, Inductive Load, $T_{vj} = 175^{\circ}C$
Rise time	t_r	-	29	-		
Turn-off delay time	$t_{d(off)}$	-	150	-		
Fall time	t_f	-	130	-		
Turn-on switching energy	E_{on}	-	342	-	μJ	
Turn-off switching energy	E_{off}	-	288	-		
Total switching energy	E_{ts}	-	630	-		

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Reverse recovery time	t_{rr}	-	150	-	ns	$I_F = 15A$, $di_F/dt = 200A/\mu s$, $T_{vj} = 25^\circ C$
Reverse recovery current	I_{rr}	-	5.2	-	A	
Reverse recovery charge	Q_{rr}	-	390	-	nC	
Reverse recovery time	t_{rr}	-	207	-	ns	$I_F = 15A$, $di_F/dt = 200A/\mu s$, $T_{vj} = 175^\circ C$
Reverse recovery current	I_{rr}	-	6.1	-	A	
Reverse recovery charge	Q_{rr}	-	631	-	nC	

Electrical Characteristic Diagrams

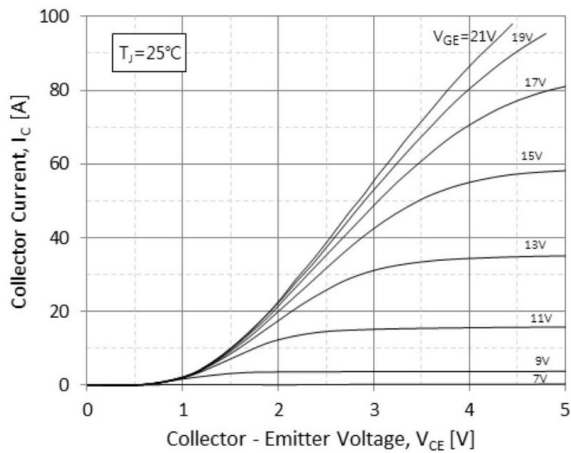


Figure 1. Typical Output Characteristics ($T_J=25^{\circ}\text{C}$)

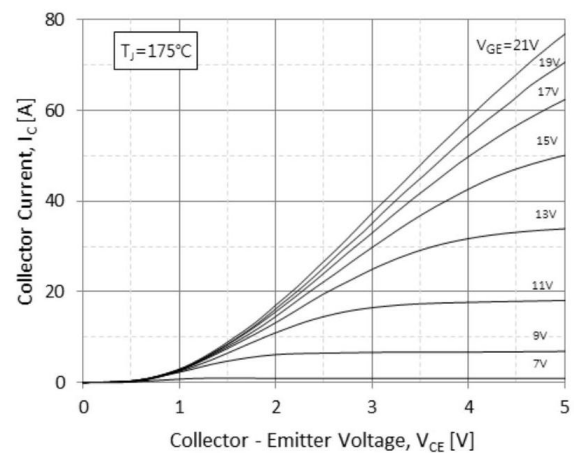


Figure 2. Typical Output Characteristics ($T_J=175^{\circ}\text{C}$)

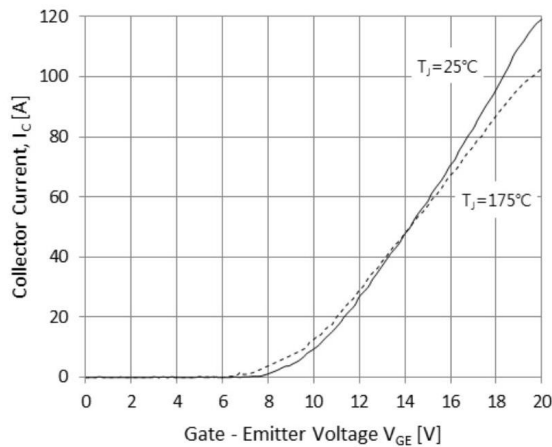


Figure 3. Typical Transfer Characteristics

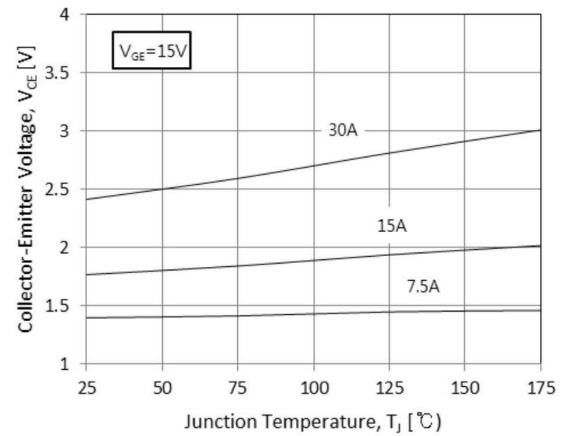


Figure 4. Typical Collector-Emitter Saturation Voltage-Junction Temperature

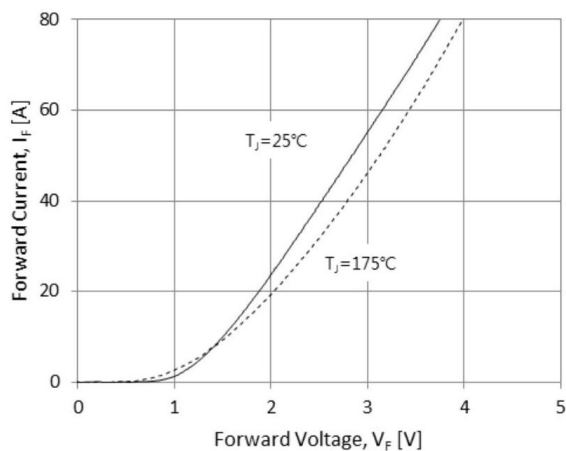


Figure 5. Diode Forward Characteristics

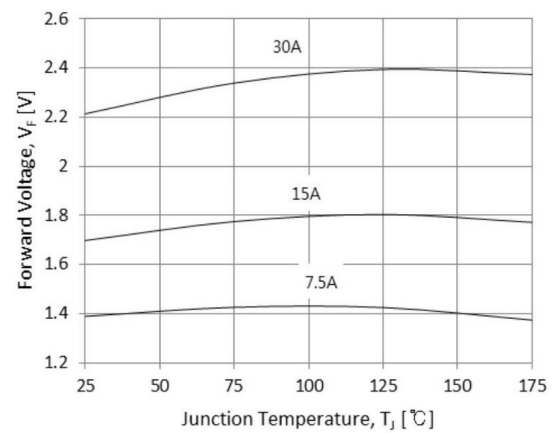


Figure 6. Diode Forward-Junction Temperature

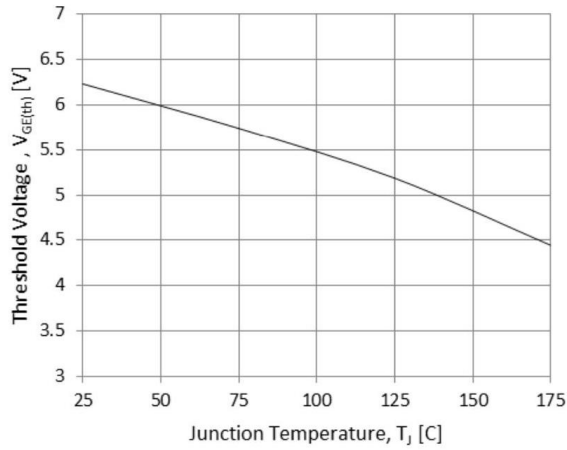


Figure 7. Threshold Voltage-Junction Temperature

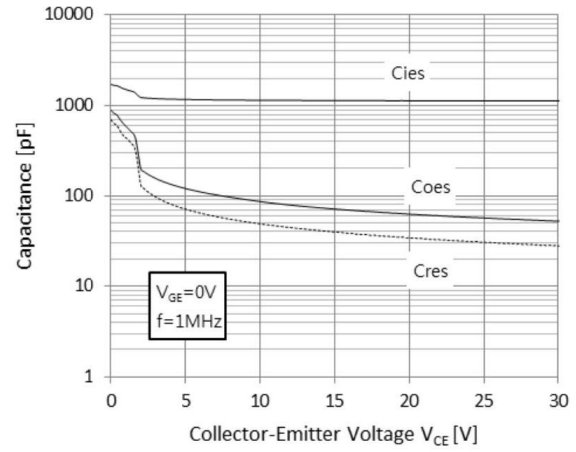


Figure 8. Typical Capacitance

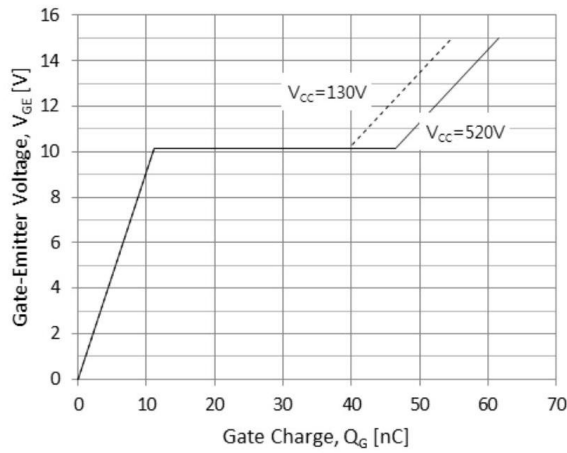


Figure 9. Typical Gate Charge

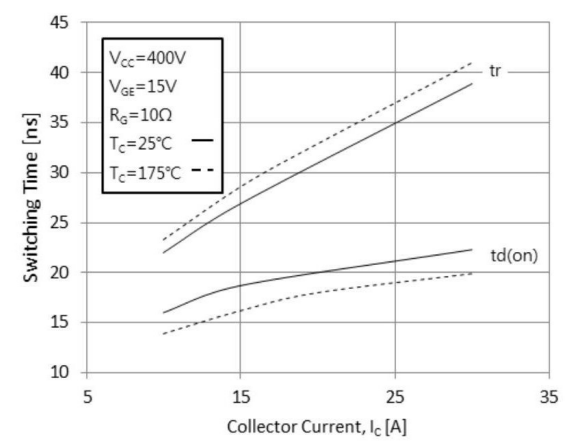


Figure 10. Typical Turn on-Collector Current

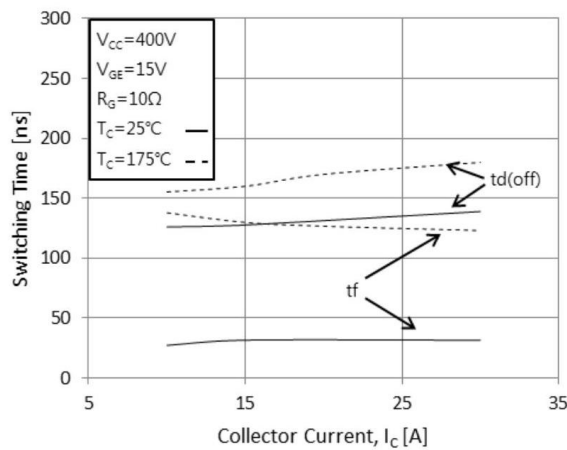


Figure 11. Typical Turn off-Collector Current

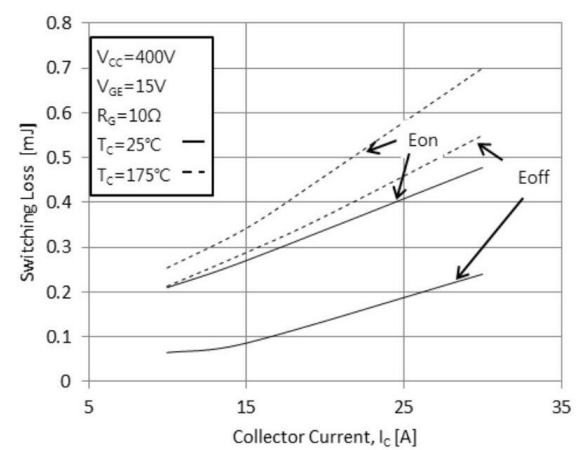


Figure 12. Switching Loss-Collector Current

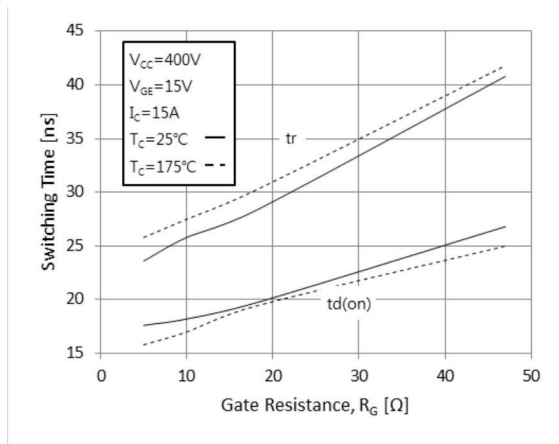


Figure 13. Turn on Characteristics-Gate Resistance

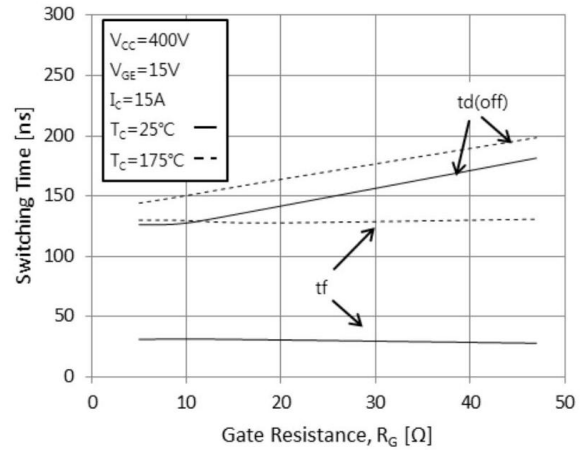


Figure 14. Turn off Characteristics-Gate Resistance

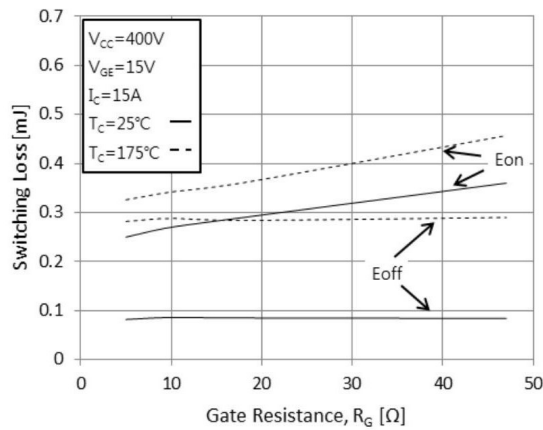


Figure 15. Switching Loss-Gate Resistance

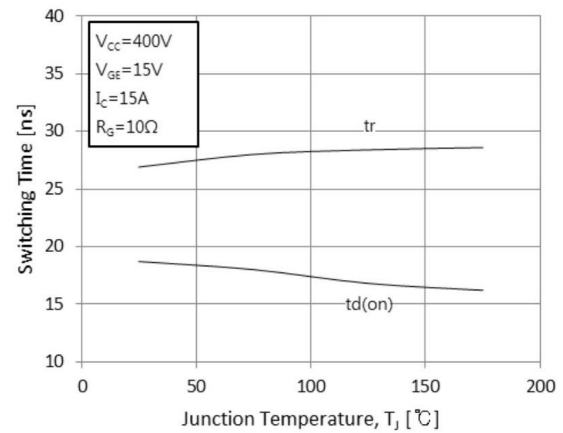


Figure 16. Turn on Characteristics-Junction Temperature

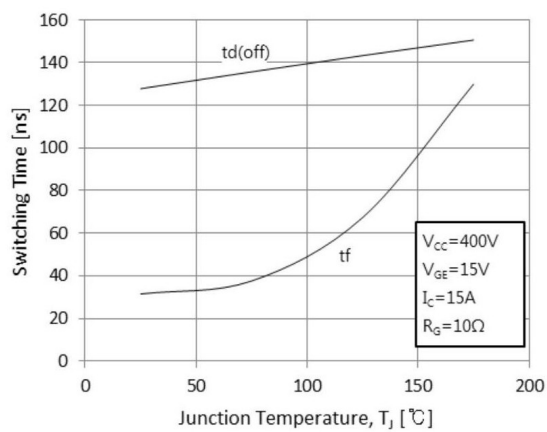


Figure 17. Turn off Characteristics-Junction Temperature

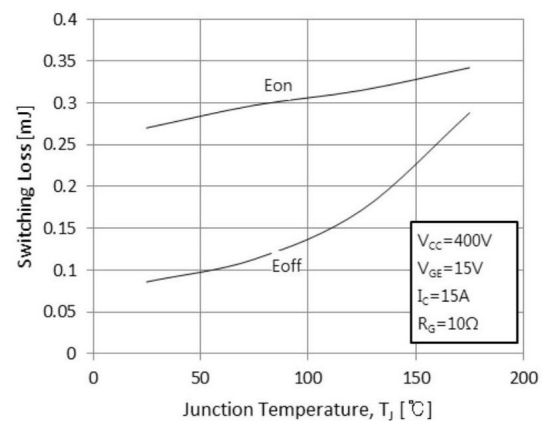


Figure 18. Switching Loss-Junction Temperature

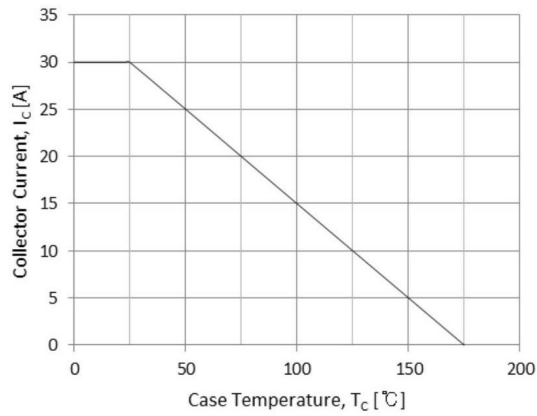


Figure 19. Case Temperature-Collector Current

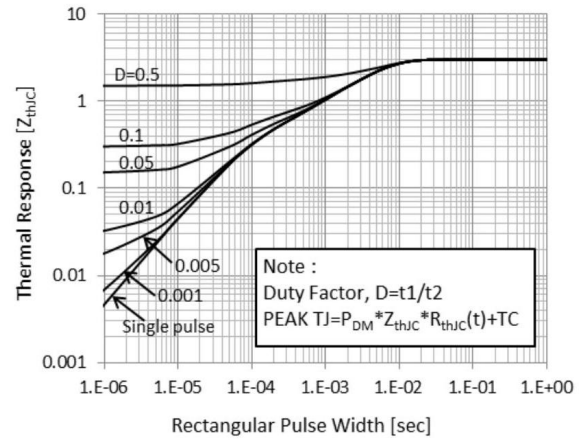


Figure 20. IGBT Transient Thermal Impedance

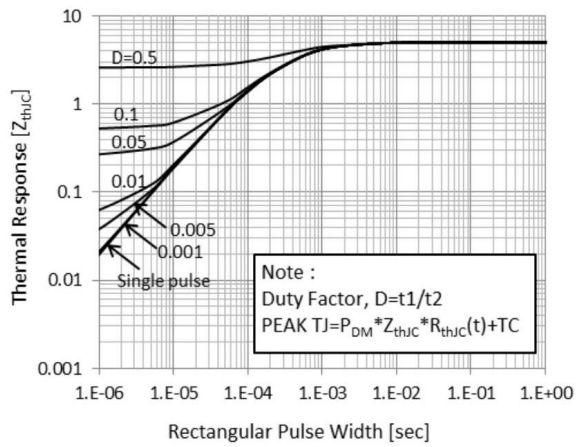
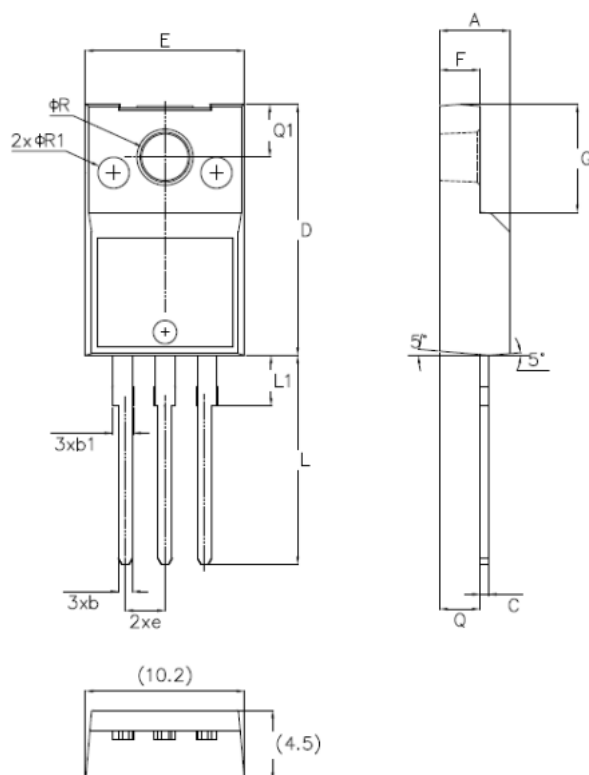


Figure 21. FRD Transient Thermal Impedance

Package Information (TO-220F)



Outline dimensions in mm

Symbol	Min	Nom	Max
A	4.3	-	4.8
b	0.5	-	1.0
b1	0.95	-	1.7
C	0.4	-	0.8
D	14.5	-	16.4
E	9.6	-	10.4
e	2.54 BSC		
F	2.5	-	3.1
G	6.2	-	7.2
L	12.2	-	14.2
L1	2.9	-	4.7
Q	2.3	-	2.9
Q1	2.4	-	3.5
ϕR	3.00	-	3.4
$\phi R1$	2.0		

Disclaimer

The information provided in this datasheet is believed to be accurate and reliable. Errors or omissions are expected. iVP Semiconductor Pvt. Ltd. reserves the right to make changes to the product specifications without prior notice. Users should verify the suitability of the product for their specific applications. Please visit our website for the latest datasheet.

Contact Information

iVP Semiconductor Pvt. Ltd.

Email: sales@ivpsemi.com

Website: www.ivpsemi.com