

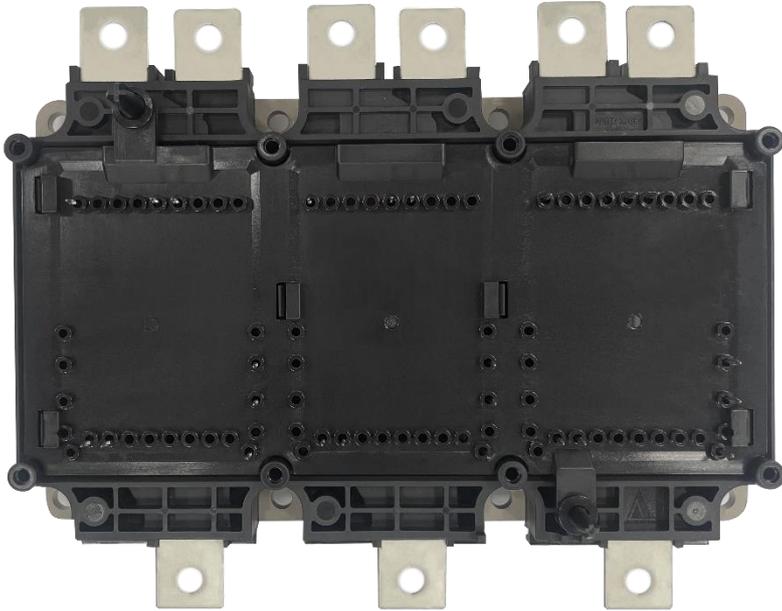


# 750V HPD IGBT Power Module

AEP550B08TFST

**DATASHEET**

V1.1, 2024/11



## Applications

- Motor Drives
- All-Terrain Vehicles
- Automotive Applications
- Hybrid Electrical Vehicles (H) EV
- Commercial Agriculture Vehicles

## Features

### Electrical Features

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- Low  $Q_G$
- $T_{j,op} = 150^\circ\text{C}$
- Low Inductance Design
- Blocking Voltage 750V
- Fast and Soft Reverse Recovery
- Low  $V_{CEsat}$  and Switching Losses

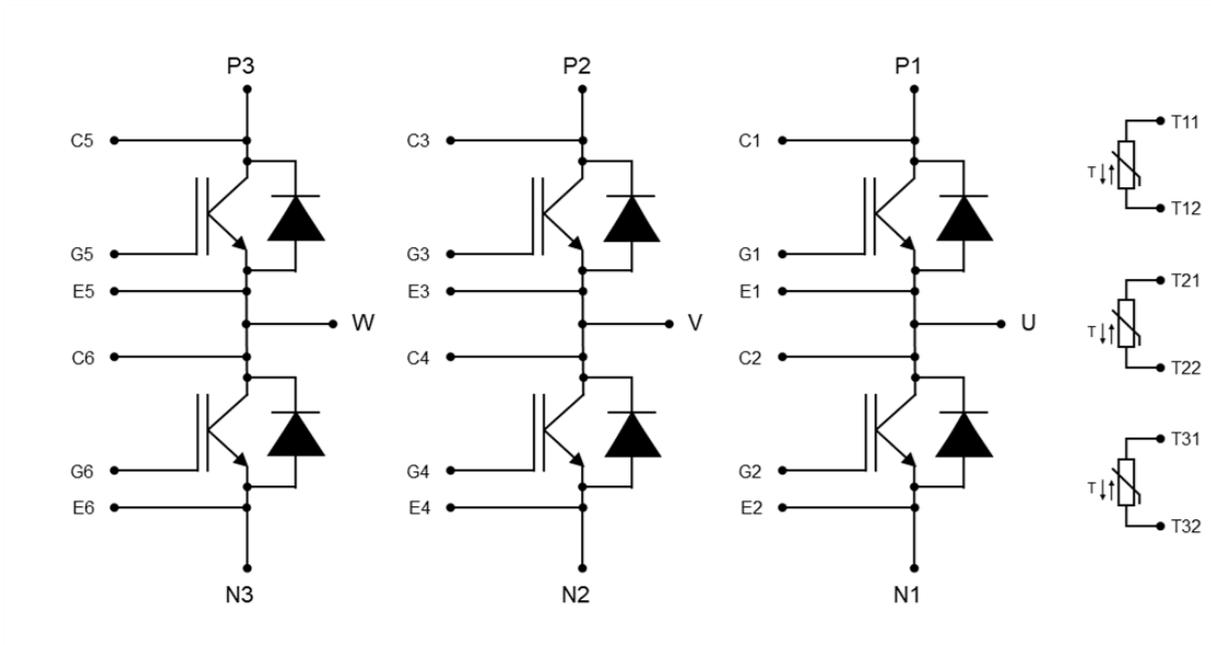
### Mechanical Features

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- Compact Design
- 4.2kV DC Insulation
- UL 94 Module Frame
- Temperature Sensor Included
- Direct Water Cooling Pin-Fin Base Plate
- Easy to Integrate 6-pack Topology
- Pb-free Device and RoHS Compliant
- Guiding Elements for PCB and cooler Assembly



## Circuit Diagram





## IGBT

### Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	$T_j = 25^\circ\text{C}$	$V_{CES}$	750	V
Gate-emitter peak voltage		$V_{GES}$	$\pm 20$	V
Implemented collector current		$I_{CN}$	550	A
Continuous DC collector current	$T_F = 70^\circ\text{C}, T_{j,max} = 175^\circ\text{C}$	$I_{C\ nom}$	300	A
Repetitive peak collector current	$t_p = 1\ \text{ms}$	$I_{CRM}$	1100	A
Maximum junction temperature		$T_{j,max}$	175	$^\circ\text{C}$

### Characteristics Values

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	
Collector-emitter saturation voltage	$I_C = 300\text{A}, V_{GE} = 15\text{V}$	$V_{CE,sat}$		$T_j = 25^\circ\text{C}$	1.20	1.50	V
	$I_C = 300\text{A}, V_{GE} = 15\text{V}$			$T_j = 150^\circ\text{C}$	1.30		
	$I_C = 300\text{A}, V_{GE} = 15\text{V}$			$T_j = 175^\circ\text{C}$	1.35		
	$I_C = 550\text{A}, V_{GE} = 15\text{V}$			$T_j = 25^\circ\text{C}$	1.40		
	$I_C = 550\text{A}, V_{GE} = 15\text{V}$			$T_j = 150^\circ\text{C}$	1.55		
	$I_C = 550\text{A}, V_{GE} = 15\text{V}$			$T_j = 175^\circ\text{C}$	1.65		
Gate threshold voltage	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$	$V_{GE,th}$	5.10	$T_j = 25^\circ\text{C}$	5.70	6.50	V
	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$			$T_j = 150^\circ\text{C}$	4.00		
	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$			$T_j = 175^\circ\text{C}$	3.30		
Collector-emitter cut-off current	$V_{CE} = 750\text{V}, V_{GE} = 0\text{V}$	$I_{CES}$		$T_j = 25^\circ\text{C}$		1.0	mA
	$V_{CE} = 750\text{V}, V_{GE} = 0\text{V}$			$T_j = 150^\circ\text{C}$	5.0		
	$V_{CE} = 750\text{V}, V_{GE} = 0\text{V}$			$T_j = 175^\circ\text{C}$	10.0		
Gate-emitter leakage current	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$	$I_{GES}$			400	nA	
Gate charge	$V_{GE} = -8\text{V} / +15\text{V}$ $V_{CE} = 400\text{V}$	$Q_G$		1.2		$\mu\text{C}$	
Internal gate resistance		$R_{G,int}$		1.7		$\Omega$	
Input capacitance	$f = 100\text{kHz}, V_{CE} = 50\text{V}$ $V_{GE} = 0\text{V}$	$C_{ies}$		29.0		nF	
Output capacitance	$f = 100\text{kHz}, V_{CE} = 50\text{V}$ $V_{GE} = 0\text{V}$	$C_{oes}$		1.0		nF	



# AEP550B08TFST HPD IGBT Power Module

ACTRON TECHNOLOGY CORP.

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Reverse transfer capacitance	$f = 100\text{kHz}$ , $V_{CE} = 50\text{V}$ $V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$ $C_{res}$		0.5		nF
Turn-on delay time, inductive load	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,on} = 2.5\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $t_{d(on)}$		0.085 0.090 0.095		$\mu\text{s}$
Rise time, inductive load	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,on} = 2.5\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $t_r$		0.057 0.060 0.061		$\mu\text{s}$
Turn-on energy loss per pulse	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $L_S = 30\text{nH}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,on} = 2.5\ \Omega$ $di/dt = 4.2\ \text{A/ns}$ (25°C) $di/dt = 3.9\ \text{A/ns}$ (175°C)	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $E_{on}$		6.0 7.5 8.5		mJ
Turn-off delay time, inductive load	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,off} = 5.0\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $t_{d(off)}$		0.37 0.42 0.43		$\mu\text{s}$
Fall time, inductive load	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,off} = 5.0\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $t_f$		0.27 0.42 0.43		$\mu\text{s}$
Turn-off energy loss per pulse	$I_C = 300\text{A}$ , $V_{CE} = 400\text{V}$ $L_S = 30\text{nH}$ $V_{GE} = -8\text{V} / +15\text{V}$ $R_{G,off} = 5.0\ \Omega$ $dv/dt = 3.3\ \text{V/ns}$ (25°C) $dv/dt = 2.65\ \text{V/ns}$ (175°C)	$T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $E_{off}$		18.5 24.5 26.5		mJ
Short circuit current	$V_{GE} = 15\text{V}$ , $V_{CC} = 400\text{V}$ $t_p = 6\ \mu\text{s}$ $t_p = 3\ \mu\text{s}$	$T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$ $I_{sc}$		4200 3500		A
Thermal resistance, junction to cooling fluid	Per IGBT $dv/dT = 10\ \text{dm}^3/\text{min}$ $T_F = 70^\circ\text{C}$	$R_{th,jF}$		0.145	0.170	K/W
Operated temperature condition		$T_{j,op}$	-40		150	$^\circ\text{C}$



## Diode

### Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	$T_j = 25^\circ\text{C}$	$V_{RRM}$	750	V
Implemented forward current		$I_{FN}$	550	A
Continuous DC forward current	$T_F = 70^\circ\text{C}, T_{j,max} = 175^\circ\text{C}$	$I_{Cnom}$	300	A
Repetitive peak forward current	$t_p = 1\text{ ms}$	$I_{FRM}$	1100	A

### Characteristics Values

Parameter	Conditions	Symbol	Typ.	Max.	Unit	
Forward voltage	$I_F = 300\text{A}, V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$	$V_F$	1.50	1.70	V
	$I_F = 300\text{A}, V_{GE} = 0\text{V}$	$T_j = 150^\circ\text{C}$		1.55		
	$I_F = 300\text{A}, V_{GE} = 0\text{V}$	$T_j = 175^\circ\text{C}$		1.60		
	$I_F = 550\text{A}, V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$		1.80		
	$I_F = 550\text{A}, V_{GE} = 0\text{V}$	$T_j = 150^\circ\text{C}$		2.00		
	$I_F = 550\text{A}, V_{GE} = 0\text{V}$	$T_j = 175^\circ\text{C}$		2.10		
Peak reverse recovery current	$I_F = 300\text{A}, V_R = 400\text{V}$ $V_{GE} = -8\text{V}$ $-di_F/dt = 4.2\text{ A/ns (25}^\circ\text{C)}$ $-di_F/dt = 3.3\text{ A/ns (175}^\circ\text{C)}$	$T_j = 25^\circ\text{C}$	$I_{RM}$	195	A	
		$T_j = 150^\circ\text{C}$		235		
		$T_j = 175^\circ\text{C}$		250		
Recovered charge	$I_F = 300\text{A}, V_R = 400\text{V}$ $V_{GE} = -8\text{V}$ $-di_F/dt = 4.2\text{ A/ns (25}^\circ\text{C)}$ $-di_F/dt = 3.3\text{ A/ns (175}^\circ\text{C)}$	$T_j = 25^\circ\text{C}$	$Q_{rr}$	10.8	$\mu\text{C}$	
		$T_j = 150^\circ\text{C}$		17.8		
		$T_j = 175^\circ\text{C}$		20.1		
Reverse recovery energy	$I_F = 300\text{A}, V_R = 400\text{V}$ $V_{GE} = -8\text{V}$ $-di_F/dt = 4.2\text{ A/ns (25}^\circ\text{C)}$ $-di_F/dt = 3.3\text{ A/ns (175}^\circ\text{C)}$	$T_j = 25^\circ\text{C}$	$E_{rec}$	1.5	mJ	
		$T_j = 150^\circ\text{C}$		4.7		
		$T_j = 175^\circ\text{C}$		5.5		
Thermal resistance, junction to cooling fluid	Per diode $dV/dT = 10\text{ dm}^3/\text{min}$ $T_F = 70^\circ\text{C}$	$R_{th,JF}$	0.255	0.290	K/W	



## NTC-Thermistor

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Rated resistance	$T_c = 25^\circ\text{C}$	$R_{25}$		5.0		$\text{k}\Omega$
Resistance tolerance	$T_c = 100^\circ\text{C}$ , $R_{100}=493 \Omega$	$\Delta R/R$	-5		5	%
B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298 \text{ K}))]$	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298 \text{ K}))]$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298 \text{ K}))]$	$B_{25/100}$		3433		K

## Module

Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, $f = 0 \text{ Hz}$ , $t = 1 \text{ sec}$	$V_{\text{ISOL}}$	4.2	kV
Module baseplate material			Cu + Ni	
Module internal isolation material	Basic isolation (class 1, IEC 61140)		$\text{Al}_2\text{O}_3$	
Creepage distance	Terminal to heatsink	$d_{\text{Creep,TH}}$	9.0	mm
Creepage distance	Terminal to terminal	$d_{\text{Creep,TT}}$	9.0	mm
Clearance distance	Terminal to heatsink	$d_{\text{Clear,TH}}$	4.5	mm
Clearance distance	Terminal to terminal	$d_{\text{Clear,TT}}$	4.5	mm
Comparative tracking index <sup>1)</sup>		CTI	> 200	

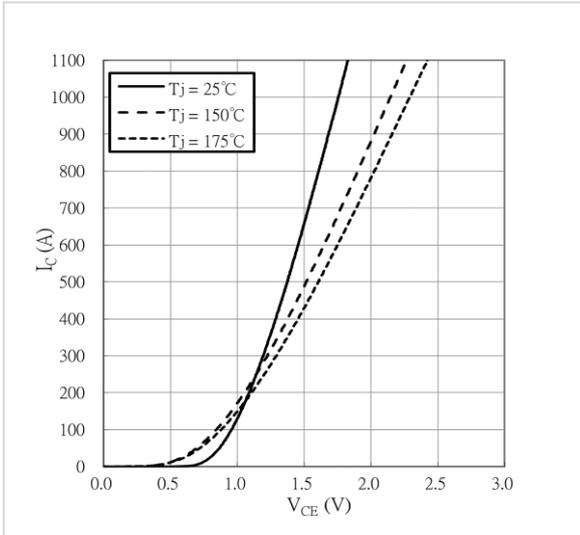
Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance		$L_{\text{SCE}}$		8		nH
Storage temperature		$T_{\text{stg}}$	-40		125	$^\circ\text{C}$
Mounting torque for module mounting	Screw M4 baseplate to heatsink	M	1.80	2.00		Nm
Weight		G		750		g

<sup>1)</sup> Extracted by following UL 746A

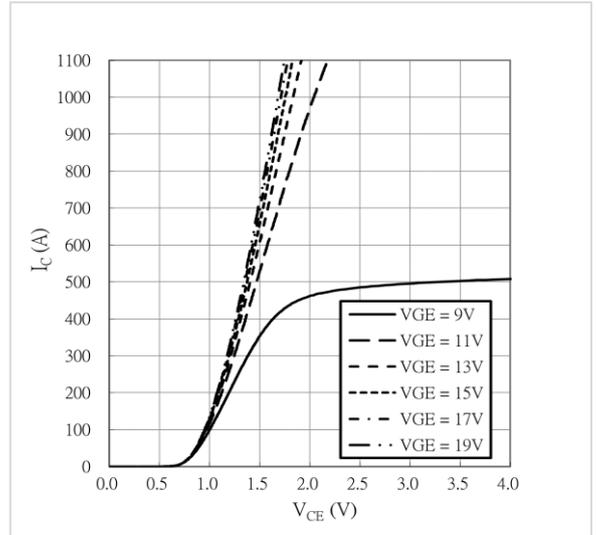


## Characteristics Diagrams

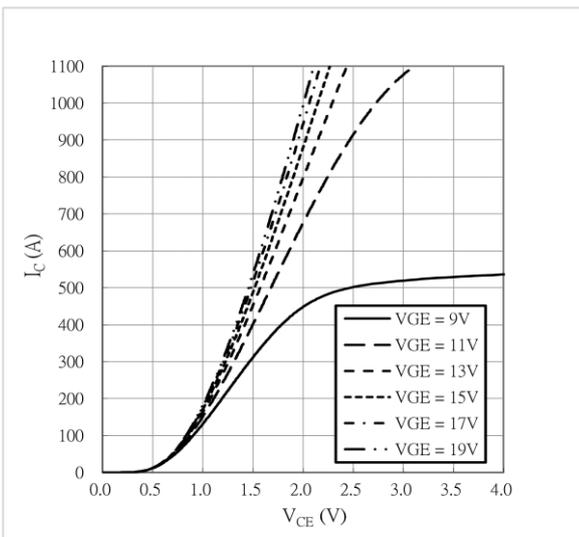
IGBT, Output characteristics  
 $V_{GE} = 15V, I_C = f(V_{CE})$



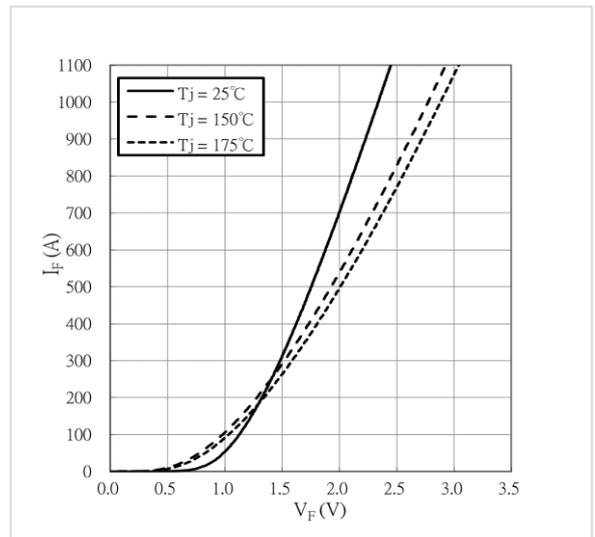
IGBT, Output characteristics  
 $T_j = 25^\circ\text{C}, I_C = f(V_{CE})$



IGBT, Output characteristics  
 $T_j = 150^\circ\text{C}, I_C = f(V_{CE})$



Diode, Forward characteristics  
 $I_F = f(V_F)$

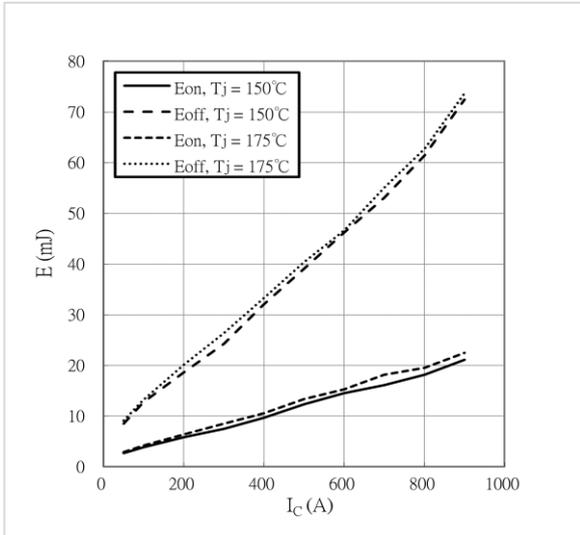




### IGBT, Switching losses vs. $I_C$

$V_{GE} = -8V / +15V$ ,  $R_{G,on} = 2.5 \Omega$

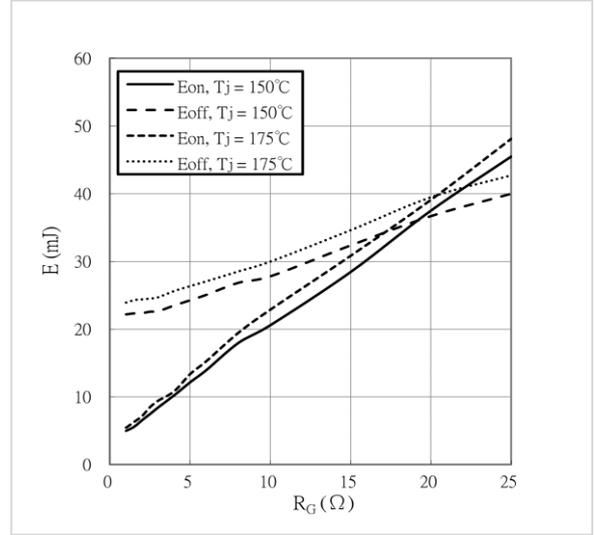
$R_{G,off} = 5.0 \Omega$ ,  $V_{CE} = 400V$ ,  $E_{on}$  &  $E_{off} = f(I_C)$



### IGBT, Switching losses vs. $R_G$

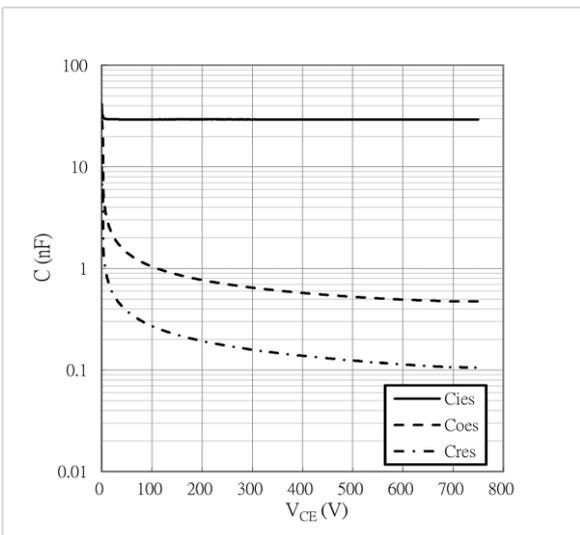
$V_{GE} = -8V / +15V$ ,  $V_{CE} = 400V$ ,  $I_C = 300A$

$E_{on}$  &  $E_{off} = f(R_G)$



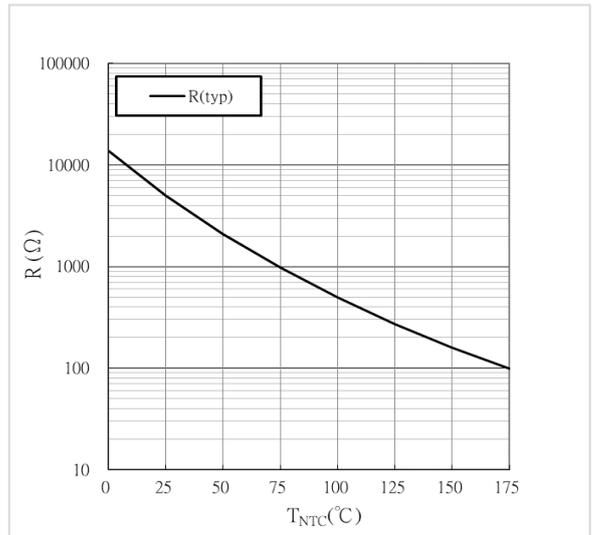
### IGBT Capacitance characteristics

$V_{GE} = 0V$ ,  $T_j = 25^\circ C$ ,  $f = 100kHz$ ,  $C = f(V_{CE})$



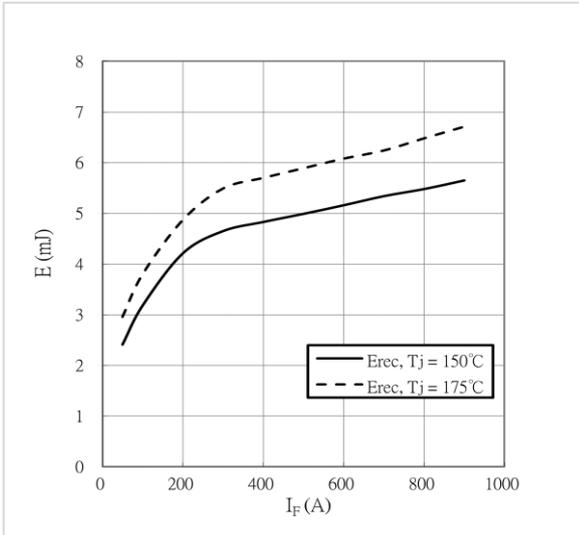
### NTC-Thermistor-temperature characteristics

$R = f(T_{NTC})$

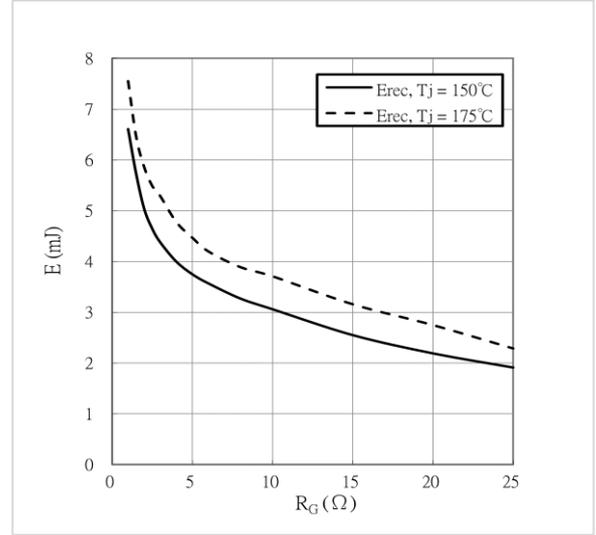




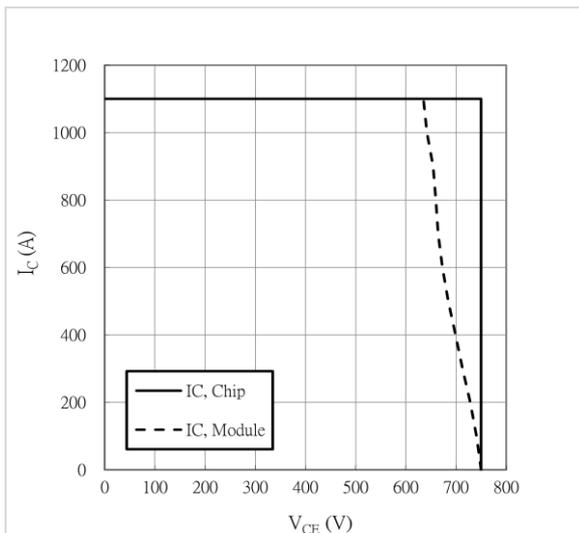
Diode, Switching losses vs.  $I_F$   
 $R_G = 2.5 \Omega$ ,  $V_R = 400V$ ,  $E_{rec} = f(I_F)$



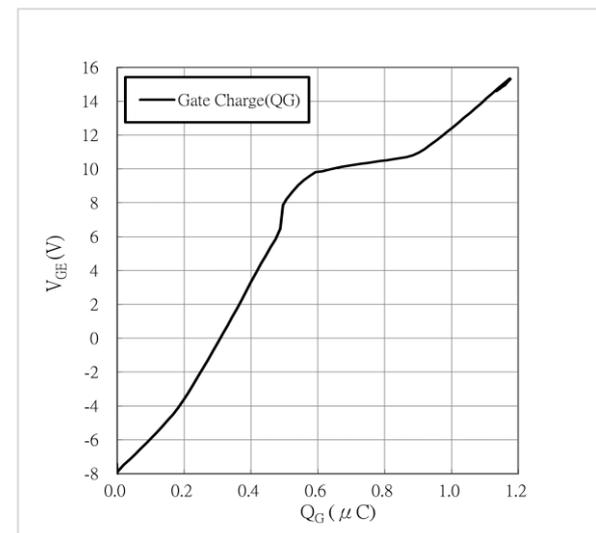
Diode, Switching losses vs.  $R_G$   
 $I_F = 300A$ ,  $V_R = 400V$ ,  $E_{rec} = f(R_G)$



Reverse bias safe operating area (RBSOA)  
 $V_{GE} = -8V / +15V$ ,  $R_{G,off} = 5.0 \Omega$ ,  $T_j = 175^\circ C$



IGBT Total gate charge characteristic  
 $V_{CE} = 400 V$ ,  $I_C = 300A$ ,  $T_j = 25^\circ C$   
 $V_{GE} = f(Q_G)$

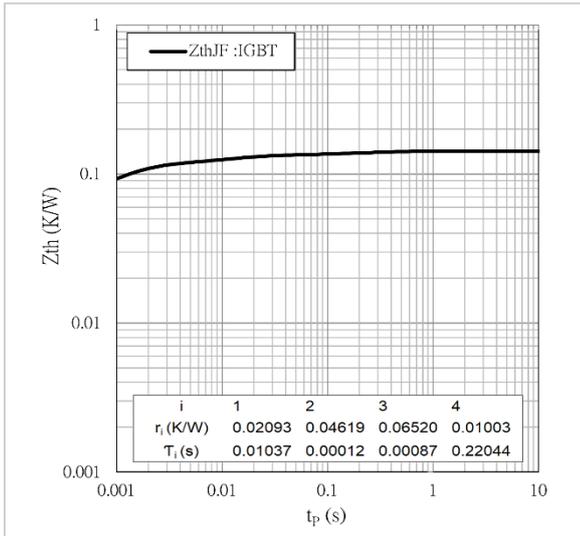




### IGBT Transient thermal impedance

$$Z_{thJF} = f(t_p)$$

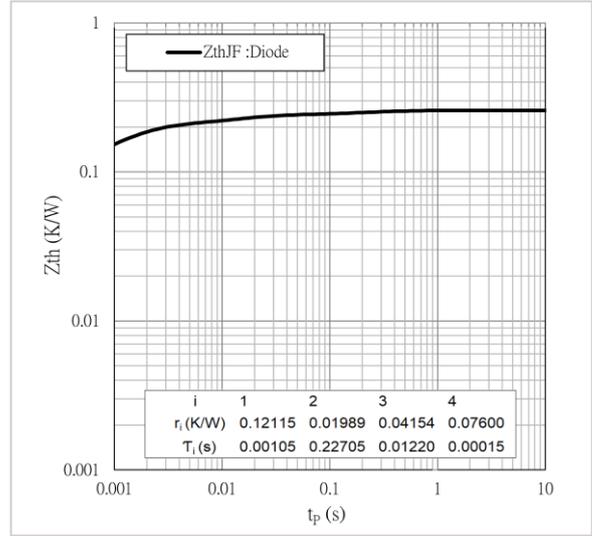
$\Delta V/\Delta t = 10 \text{ dm}^3/\text{min}$ ,  $T_F = 70^\circ\text{C}$



### Diode Transient thermal impedance

$$Z_{thJF} = f(t_p)$$

$\Delta V/\Delta t = 10 \text{ dm}^3/\text{min}$ ,  $T_F = 70^\circ\text{C}$





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