

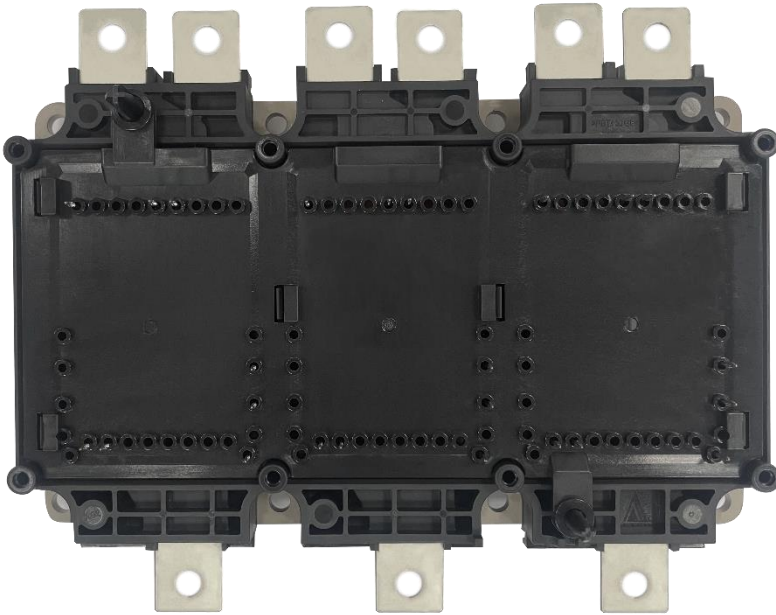


Power Module

AEP820B08TFST

DATASHEET

V1.2, 2022/12



Applications

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

Electrical Features

- Low Q_g
- $T_{j,op} = 150^{\circ}\text{C}$
- Low Inductive Design
- Blocking voltage 750V
- Fast and soft reverse recovery
- Low V_{CEsat} and Switching Losses

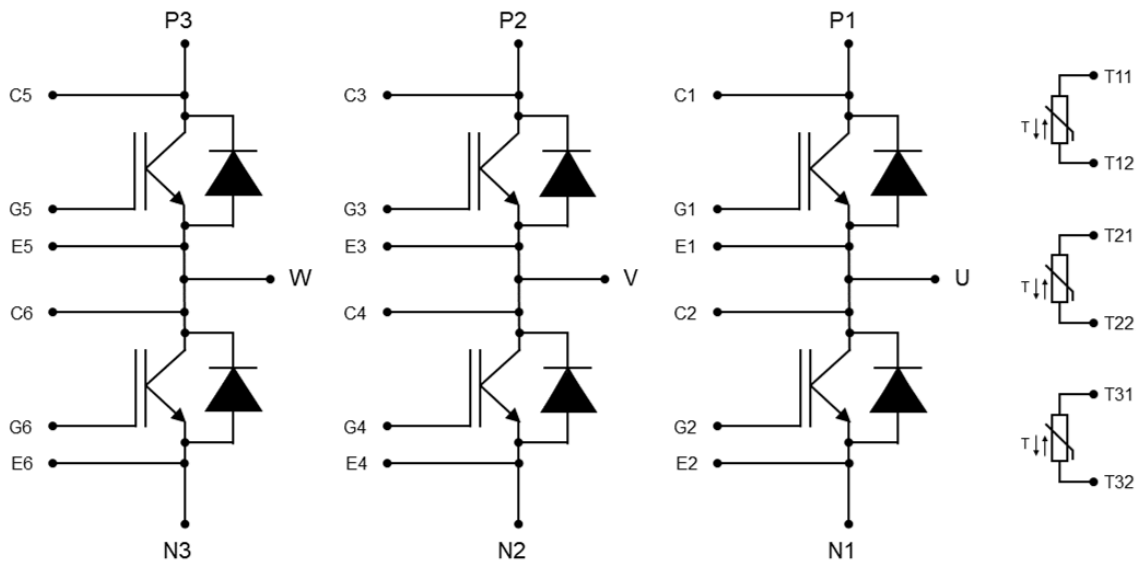
Mechanical Features

- Compact design
- 4.2KV DC Insulation
- UL 94 V0 Module frame
- Temperature sense included
- Direct Water Cooling Base Plate
- Easy to Integrate 6-pack Topology
- Pb-free device and RoHS compliant
- Guiding elements for PCB and cooler assembly

FEATURES

- High speed, low loss IGBT module
- High reliability, high durability module

Circuit Diagram





IGBT Inverter

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}	± 20	V
Implemented collector current		I_{CN}	820	A
Continuous DC collector current	$T_F = 70^\circ\text{C}, T_j = 175^\circ\text{C}$	$I_{C\ nom}$	450	A
Repetitive peak collector current	$t_p = 1\ \text{ms}$	I_{CRM}	1640	A
Maximum Junction Temperature		$T_{j,max}$	175	$^\circ\text{C}$

Characteristics Values

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	
Collector-emitter saturation voltage	$I_C = 450\text{A}, V_{GE} = 15\text{V}$	$V_{CE,sat}$			$T_j = 25^\circ\text{C}$	1.15	V
	$I_C = 450\text{A}, V_{GE} = 15\text{V}$				$T_j = 150^\circ\text{C}$	1.25	
	$I_C = 450\text{A}, V_{GE} = 15\text{V}$				$T_j = 175^\circ\text{C}$	1.30	
	$I_C = 820\text{A}, V_{GE} = 15\text{V}$				$T_j = 25^\circ\text{C}$	1.40	
	$I_C = 820\text{A}, V_{GE} = 15\text{V}$				$T_j = 150^\circ\text{C}$	1.60	
	$I_C = 820\text{A}, V_{GE} = 15\text{V}$				$T_j = 175^\circ\text{C}$	1.70	
Gate threshold voltage	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$	V_{Geth}		5.10	$T_j = 25^\circ\text{C}$	5.70	V
	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$				$T_j = 150^\circ\text{C}$	4.20	
	$I_C = 9.6\ \text{mA}, V_{CE} = V_{GE}$				$T_j = 175^\circ\text{C}$	3.95	
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				2.2	μC
Internal gate resistor		R_{Gint}				1.7	Ω
Input capacitance	$f = 1\text{MHz}, V_{CE} = 50\ \text{V},$ $V_{GE} = 0\text{V}$	C_{ies}				45	nF
Output capacitance	$f = 1\text{MHz}, V_{CE} = 50\ \text{V},$ $V_{GE} = 0\text{V}$	C_{oes}				2.8	nF
Reverse transfer capacitance	$f = 1\text{MHz}, V_{CE} = 50\ \text{V},$ $V_{GE} = 0\text{V}$	C_{res}				1.5	nF



AEP820B08TFST Power Module

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Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Turn-on delay time, inductive load	$I_C = 450A, V_{CE} = 400V,$ $V_{GE} = -8V / +15V$ $R_{GON} = 2.5\ \Omega$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	$t_{d(on)}$	0.14 0.11 0.11		μs
Rise time, inductive load	$I_C = 450A, V_{CE} = 400V,$ $V_{GE} = -8V / +15V$ $R_{GON} = 2.5\ \Omega$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	t_r	0.069 0.070 0.072		μs
Turn-on energy loss per pulse	$I_C = 450A, V_{CE} = 400V,$ $L_S = 30nH$ $V_{GE} = -8V / +15V,$ $R_{GON} = 2.5\ \Omega$ $di/dt = 5500\ A/\mu s (25^\circ C)$ $di/dt = 5100\ A/\mu s (150^\circ C)$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	E_{on}	13.5 15.5 17.5		mJ
Turn-off delay time, inductive load	$I_C = 450A, V_{CE} = 400V,$ $V_{GE} = -8V / +15V$ $R_{Goff} = 5.0\ \Omega$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	$t_{d(off)}$	0.55 0.56 0.57		μs
Fall time, inductive load	$I_C = 450A, V_{CE} = 400V,$ $V_{GE} = -8V / +15V$ $R_{Goff} = 5.0\ \Omega$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	t_f	0.27 0.42 0.45		μs
Turn-off energy loss per pulse	$I_C = 450A, V_{CE} = 400V,$ $L_S = 30nH$ $V_{GE} = -8V / +15V,$ $R_{Goff} = 5.0\ \Omega$ $dv/dt = 2500\ V/\mu s (25^\circ C)$ $dv/dt = 2200\ V/\mu s (150^\circ C)$	$T_j = 25^\circ C$ $T_j = 150^\circ C$ $T_j = 175^\circ C$	E_{off}	35.5 45.5 50.5		mJ
SC data	$V_{GE} \leq 15V, V_{CC} = 400V$ $t_p \leq 6\ \mu s$ $t_p \leq 3\ \mu s$	$T_j = 25^\circ C$ $T_j = 175^\circ C$	I_{sc}	4800 3800		A
Thermal resistance, junction to cooling fluid	Per IGBT; $dV/dT = 10\ dm^3/min,$ $T_F = 70^\circ C$		R_{thJF}	0.120	0.140	K/W



Diode Inverter

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}	820	A
Continuous DC forward current		I_F	450	A
Repetitive peak forward current	$t_p = 1 \text{ ms}$	I_{FRM}	1640	A
I^2t (value)	$V_R = 0 \text{ V}$, $t_p = 10 \text{ ms}$, $T_j = 150^\circ\text{C}$	I^2t	19000	A^2s

Characteristics Values

Parameter	Conditions	Symbol	Typ.	Max.	Unit	
Forward voltage	$I_F = 450\text{A}$, $V_{GE} = 0\text{V}$	V_F	$T_j = 25^\circ\text{C}$	1.45	1.65	V
	$I_F = 450\text{A}$, $V_{GE} = 0\text{V}$		$T_j = 150^\circ\text{C}$	1.50		
	$I_F = 450\text{A}$, $V_{GE} = 0\text{V}$		$T_j = 175^\circ\text{C}$	1.55		
	$I_F = 820\text{A}$, $V_{GE} = 0\text{V}$		$T_j = 25^\circ\text{C}$	1.80		
	$I_F = 820\text{A}$, $V_{GE} = 0\text{V}$		$T_j = 150^\circ\text{C}$	1.85		
	$I_F = 820\text{A}$, $V_{GE} = 0\text{V}$		$T_j = 175^\circ\text{C}$	1.90		
Peak reverse recovery current	$I_F = 450\text{A}$, $V_R = 400\text{V}$, $V_{GE} = -8\text{V}$, $-di_F/dt = 5000 \text{ A}/\mu\text{s}$ (25°C) $-di_F/dt = 4100 \text{ A}/\mu\text{s}$ (150°C)	I_{RM}	$T_j = 25^\circ\text{C}$	225	A	
			$T_j = 150^\circ\text{C}$	275		
			$T_j = 175^\circ\text{C}$	290		
Recovered charge	$I_F = 450\text{A}$, $V_R = 400\text{V}$, $V_{GE} = -8\text{V}$, $-di_F/dt = 5000 \text{ A}/\mu\text{s}$ (25°C) $-di_F/dt = 4100 \text{ A}/\mu\text{s}$ (150°C)	Q_{rr}	$T_j = 25^\circ\text{C}$	14.0	μC	
			$T_j = 150^\circ\text{C}$	26.5		
			$T_j = 175^\circ\text{C}$	31.0		
Reverse recovery energy	$I_F = 450\text{A}$, $V_R = 400\text{V}$, $V_{GE} = -8\text{V}$, $-di_F/dt = 5000 \text{ A}/\mu\text{s}$ (25°C) $-di_F/dt = 4100 \text{ A}/\mu\text{s}$ (150°C)	E_{rec}	$T_j = 25^\circ\text{C}$	3.5	mJ	
			$T_j = 150^\circ\text{C}$	8.3		
			$T_j = 175^\circ\text{C}$	9.6		
Thermal resistance, junction to cooling fluid	Per diode; $dV/dT = 10 \text{ dm}^3/\text{min}$, $T_F = 70^\circ\text{C}$	R_{thJF}	0.175	0.200	K/W	



NTC-Thermistor

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Rated resistance	$T_c = 25^\circ\text{C}$	R_{25}		5.0		k Ω
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

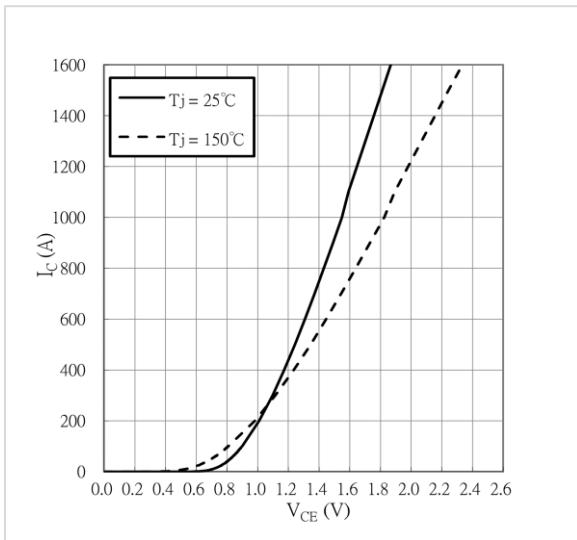
Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, $f = 0 \text{ Hz}$, $t = 1 \text{ sec}$	V_{ISOL}	4.2	kV
Module baseplate material			Cu + Ni	
Module internal isolation material			Al_2O_3	
Creepage distance	Terminal to Heat sink	d_{cree}	9.0	mm
	Terminal to Terminal		9.0	
Clearance	Terminal to heat sink	d_{clear}	4.5	mm
	Terminal to Terminal		4.5	
Comparative tracking index ¹⁾		CTI	> 200	

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance		L_{SCE}		7		nH
Storage temperature		T_{stg}	-40		125	$^\circ\text{C}$
Weight		G		750		g

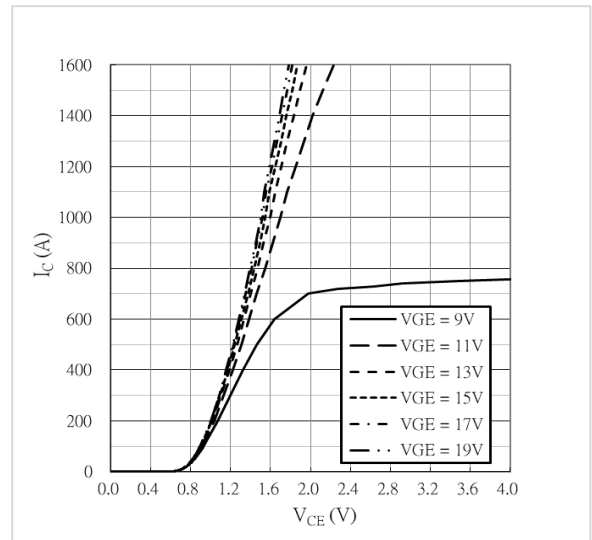
¹⁾ Extracted by following UL 746A

Characteristics Diagrams

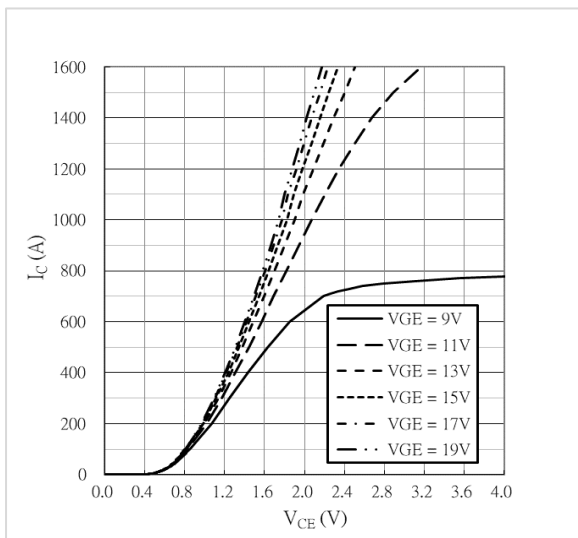
Output characteristics IGBT, Inverter
 $V_{GE} = 15\text{ V}$, $I_C = f(V_{CE})$



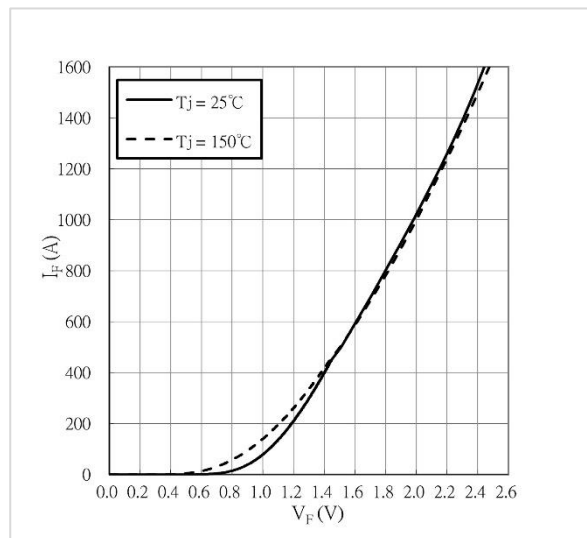
Output characteristics IGBT, Inverter
 $T_j = 25^\circ\text{C}$, $I_C = f(V_{CE})$



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



Forward characteristics of Diode, Inverter
 $I_f = f(V_f)$





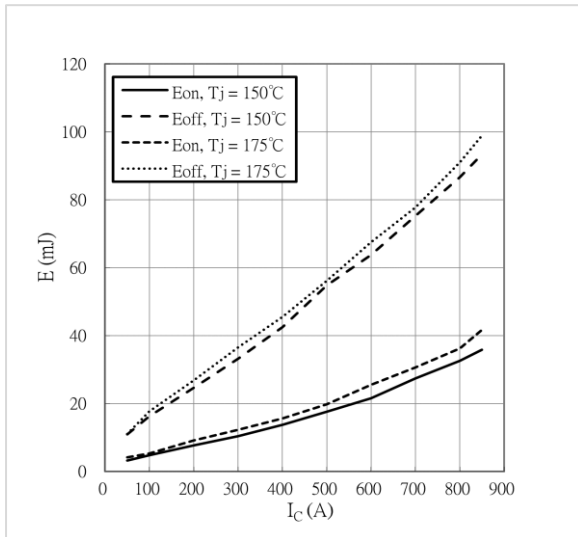
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Switching losses IGBT, Inverter

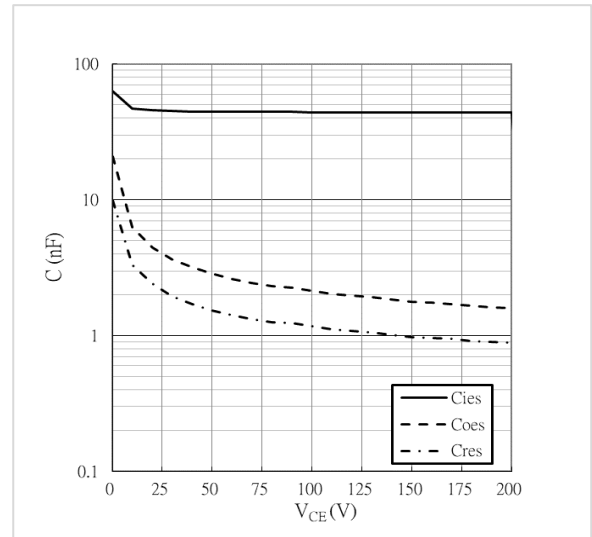
$V_{GE} = +15\text{ V} / -8\text{ V}$, $R_{GON} = 2.5\ \Omega$,

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



Capacitance characteristics IGBT, inverter

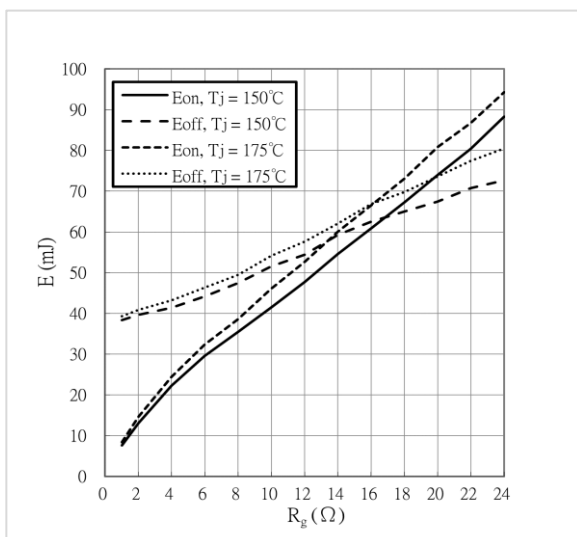
$V_{GE} = 0\text{ V}$, $T_j = 25^\circ\text{C}$, $f = 1\text{ MHz}$, $C = f(V_{CE})$



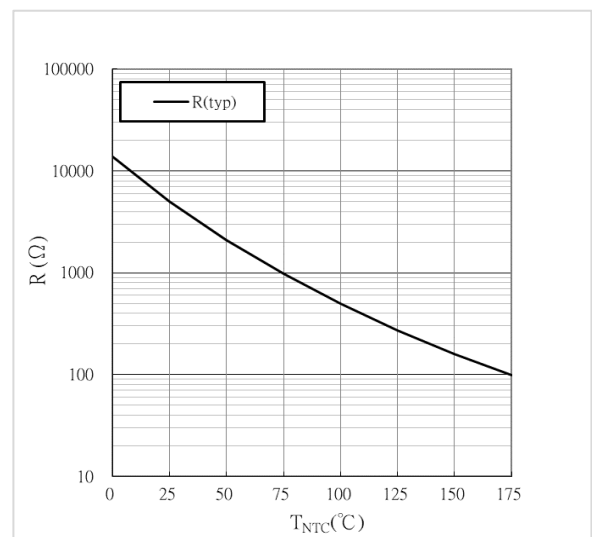
Switching losses IGBT, Inverter

$V_{GE} = +15\text{ V} / -8\text{ V}$, $V_{CE} = 400\text{ V}$, $I_C = 450\text{ A}$

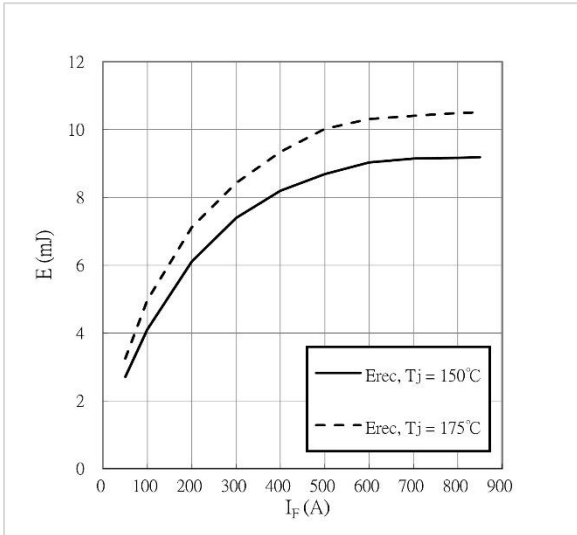
E_{ON} & $E_{off} = f(R_g)$



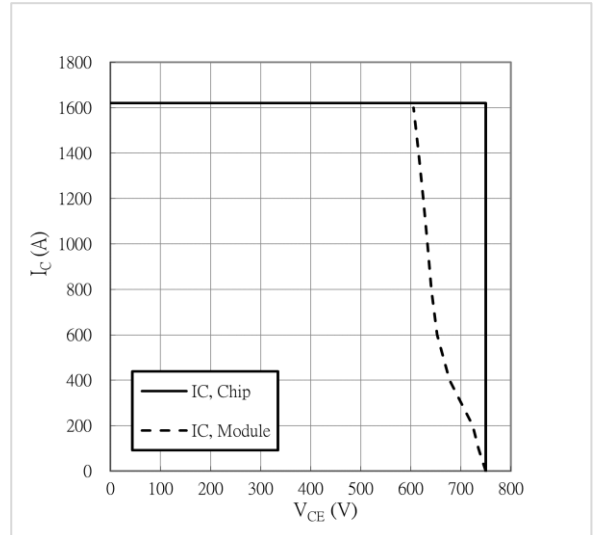
NTC-Thermistor-temperature characteristic



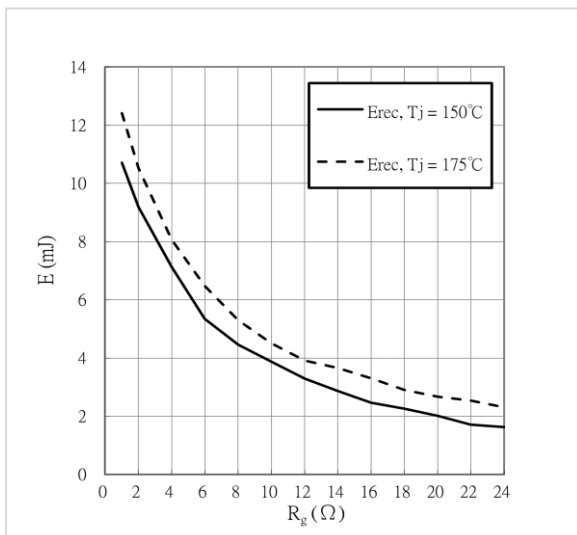
Switching losses Diode, Inverter
 $R_G = 2.5 \Omega$, $V_R = 400 \text{ V}$, $E_{rec} = f(I_f)$



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



Switching losses Diode, Inverter
 $I_F = 450\text{A}$, $V_R = 400 \text{ V}$, $E_{rec} = f(R_g)$



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