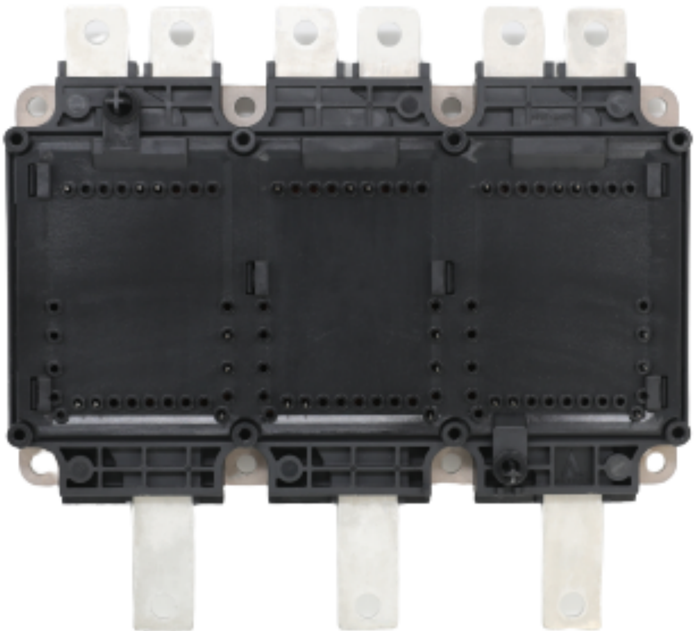
750V HPD IGBT Power Module

AEP820B08TFLTMM

DATASHEET

V1.0, 2024/09

HPD IGBT Power Module



Applications

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

Features

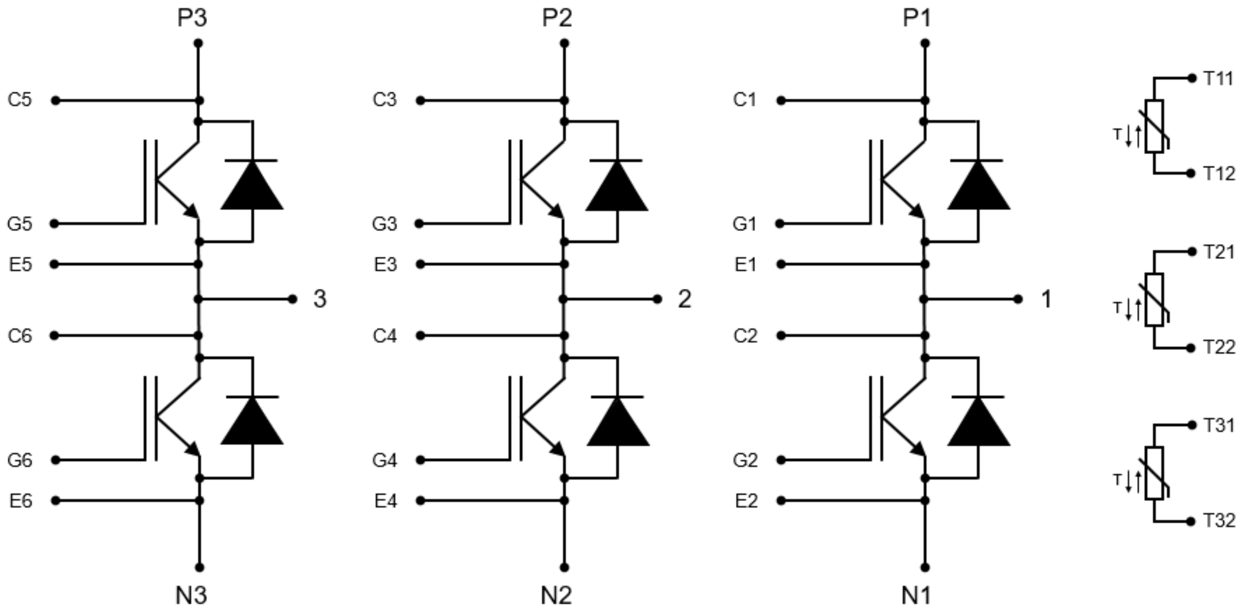
Electrical Features

- Low Q_G
- $T_{j,op}$ = 150°C
- Low Inductance Design
- Blocking Voltage 750V
- Fast and Soft Reverse Recovery
- Low $V_{CE,sat}$ and Switching Losses

Mechanical Features

- 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°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°C, $T_{j,max}$ = 175°C	$I_{C\ nom}$	450	A
Repetitive peak collector current	t_p = 1 ms	I_{CRM}	1640	A
Maximum junction temperature		$T_{j,max}$	175	ºC

Characteristics Values

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	I_C = 450A, V_{GE} = 15V	T_j = 25°C	$V_{CE,sat}$		1.15	1.45	V
	I_C = 450A, V_{GE} = 15V	T_j = 150°C			1.25		
	I_C = 450A, V_{GE} = 15V	T_j = 175°C			1.30		
	I_C = 820A, V_{GE} = 15V	T_j = 25°C			1.40		
	I_C = 820A, V_{GE} = 15V	T_j = 150°C			1.60		
	I_C = 820A, V_{GE} = 15V	T_j = 175°C			1.70		
Gate threshold voltage	I_C = 9.6 mA, V_{CE} = V_{GE}	T_j = 25°C	$V_{GE,th}$	5.10	5.70	6.50	V
	I_C = 9.6 mA, V_{CE} = V_{GE}	T_j = 150°C			4.20		
	I_C = 9.6 mA, V_{CE} = V_{GE}	T_j = 175°C			3.95		
Collector-emitter cut-off current	V_{CE} = 750V, V_{GE} = 0V	T_j = 25°C	I_{CES}			1.0	mA
	V_{CE} = 750V, V_{GE} = 0V	T_j = 150°C				5.0	
	V_{CE} = 750V, V_{GE} = 0V	T_j = 175°C				10.0	
Gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V	T_j = 25°C	I_{GES}			400	nA
Gate charge	V_{GE} = -8V / + 15 V I_C = 450A, V_{CE} = 400V	T_j = 25°C	Q_G		1.8		µC
Internal gate resistance		T_j = 25°C	$R_{G,int}$		1.7		Ω
Input capacitance	f = 100kHz, V_{CE} = 50V V_{GE} = 0V	T_j = 25°C	C_{ies}		43		nF
Output capacitance	f = 100kHz, V_{CE} = 50V V_{GE} = 0V	T_j = 25°C	C_{oes}		2.1		nF
Reverse transfer capacitance	f = 100kHz, V_{CE} = 50V V_{GE} = 0V	T_j = 25°C	C_{res}		0.6		nF

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Turn-on delay time, inductive load	I_C = 450A, V_{CE} = 400V V_{GE} = -8V / + 15V $R_{G,on}$ = 2.5 Ω	T_j = 25°C T_j = 150°C T_j = 175°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 $R_{G,on}$ = 2.5 Ω	T_j = 25°C T_j = 150°C T_j = 175°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 $R_{G,on}$ = 2.5 Ω di/dt = 5.5 A/ns (25°C) di/dt = 5.1 A/ns (150°C)	T_j = 25°C T_j = 150°C T_j = 175°C	E_{on}		8.7 12.5 13.2		mJ
Turn-off delay time, inductive load	I_C = 450A, V_{CE} = 400V V_{GE} = -8V / + 15V $R_{G,off}$ = 5.0 Ω	T_j = 25°C T_j = 150°C T_j = 175°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 $R_{G,off}$ = 5.0 Ω	T_j = 25°C T_j = 150°C T_j = 175°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 $R_{G,off}$ = 5.0 Ω dv/dt = 2.5 V/ns (25°C) dv/dt = 2.2 V/ns (150°C)	T_j = 25°C T_j = 150°C T_j = 175°C	E_{off}		30.5 40.5 44.7		mJ
Short circuit current	V_{GE} = 15 V, V_{CC} = 400V t_p = 6 µs t_p = 3 µs	T_j = 25°C T_j = 175°C	I_{SC}		4800 3800		A
Thermal resistance, junction to cooling fluid	Per IGBT dV/dT = 10 dm³/min T_F = 70°C		$R_{th,JF}$		0.120	0.140	K/W
Operated temperature condition			$T_{j,op}$	-40		150	°C

Diode

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	T_j = 25°C	V_{RRM}	750	V
Implemented forward current		I_{FN}	820	A
Continuous DC forward current	T_F = 70°C, $T_{j,max}$ = 175°C	I_F	450	A
Repetitive peak forward current	t_p = 1 ms	I_{FRM}	1640	A

Characteristics Values

Parameter	Conditions		Symbol	Typ.	Max.	Unit
Forward voltage	I_F = 450A, V_{GE} = 0V	T_j = 25°C	V_F	1.45	1.65	V
	I_F = 450A, V_{GE} = 0V	T_j = 150°C		1.50		
	I_F = 450A, V_{GE} = 0V	T_j = 175°C		1.55		
	I_F = 820A, V_{GE} = 0V	T_j = 25°C		1.80		
	I_F = 820A, V_{GE} = 0V	T_j = 150°C		1.85		
	I_F = 820A, V_{GE} = 0V	T_j = 175°C		1.90		
Peak reverse recovery current	I_F = 450A, V_R = 400V V_{GE} = -8V $-di_F/dt$ = 5.0 A/ns (25°C) $-di_F/dt$ = 4.1 A/ns (150°C)	T_j = 25°C T_j = 150°C T_j = 175°C	I_{RM}	225 275 290		A
Recovered charge	I_F = 450A, V_R = 400V V_{GE} = -8V $-di_F/dt$ = 5.0 A/ns (25°C) $-di_F/dt$ = 4.1 A/ns (150°C)	T_j = 25°C T_j = 150°C T_j = 175°C	Q_{rr}	12.5 31.3 35.8		µC
Reverse recovery energy	I_F = 450A, V_R = 400V V_{GE} = -8V $-di_F/dt$ = 5.0 A/ns (25°C) $-di_F/dt$ = 4.1 A/ns (150°C)	T_j = 25°C T_j = 150°C T_j = 175°C	E_{rec}	3.5 7.7 9.1		mJ
Thermal resistance, junction to cooling fluid	Per diode dV/dT = 10 dm³/min T_F = 70°C		$R_{th,JF}$	0.175	0.200	K/W

NTC-Thermistor

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

Module

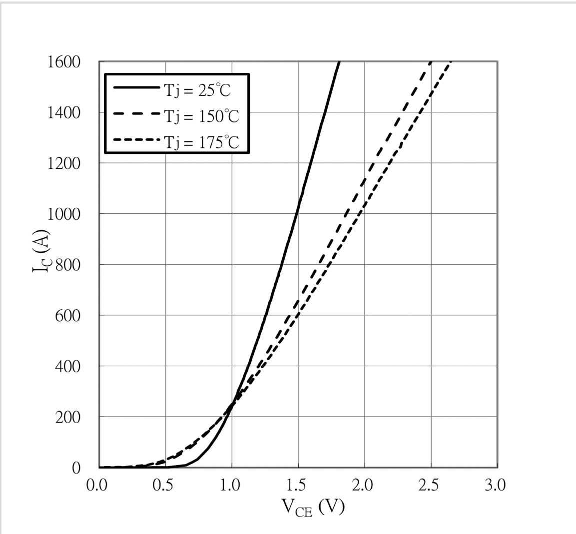
Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 0 Hz, t = 1 sec	V_{ISOL}	4.2	kV
Module baseplate material			Cu + Ni	
Module internal isolation material	Basic isolation (class 1, IEC 61140)		Al_2O_3	
Creepage distance	Terminal to heatsink	$d_{Creep,TH}$	9.0	mm
Creepage distance	Terminal to terminal	$d_{Creep,TT}$	9.0	mm
Clearance distance	Terminal to heatsink	$d_{Clear,TH}$	4.5	mm
Clearance distance	Terminal to terminal	$d_{Clear,TT}$	4.5	mm
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	°C
Mounting torque for module mounting	Screw M4 baseplate to heatsink	M	1.80	2.00		Nm
Weight		G		750		g

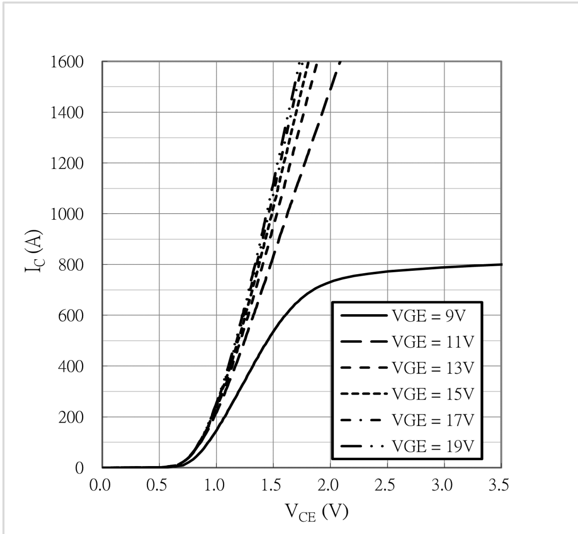
1) Extracted by following UL 746A

Characteristics Diagrams

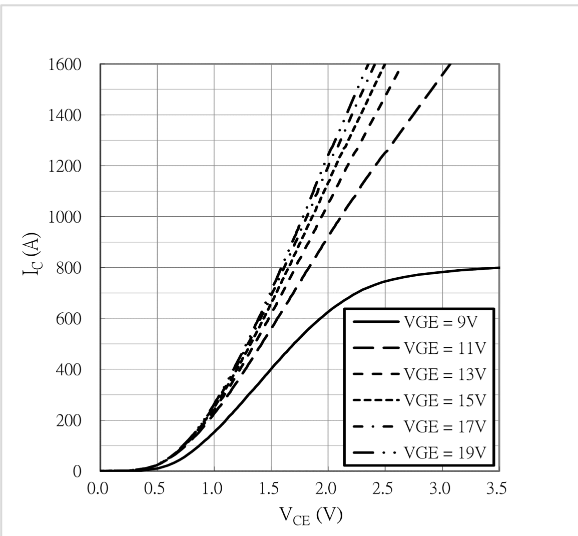
IGBT, Output characteristics
V_{GE} = 15V, $I_C = f(V_{CE})$



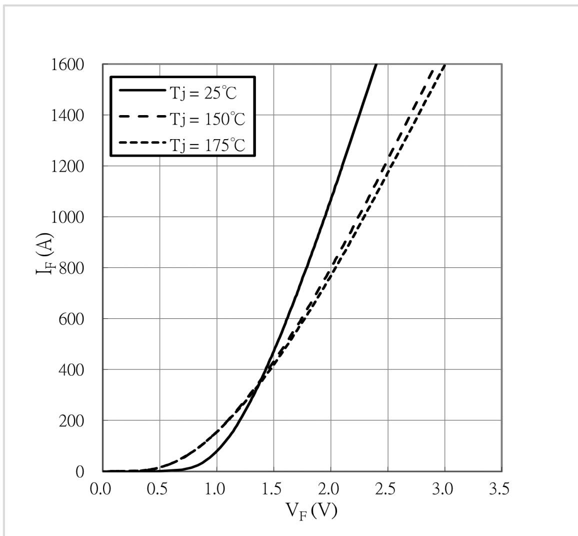
IGBT, Output characteristics
T_j = 25°C, $I_C = f(V_{CE})$



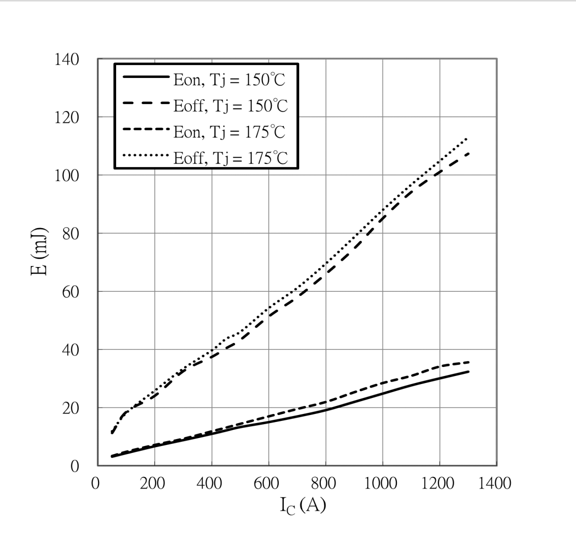
IGBT, Output characteristics
T_j = 150°C, $I_C = f(V_{CE})$



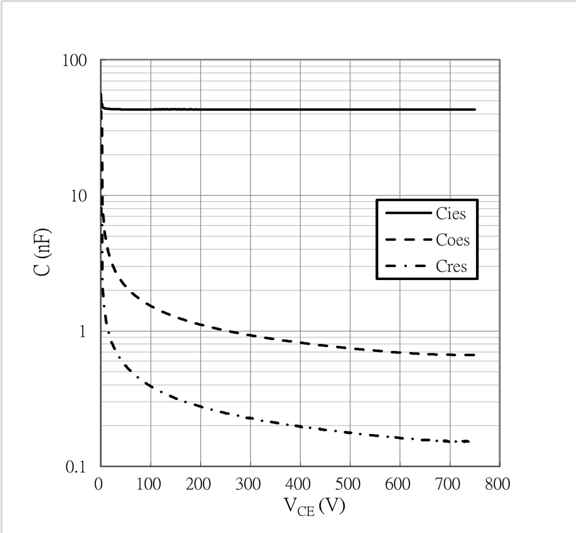
Diode, Forward characteristics
$I_f = f(V_F)$



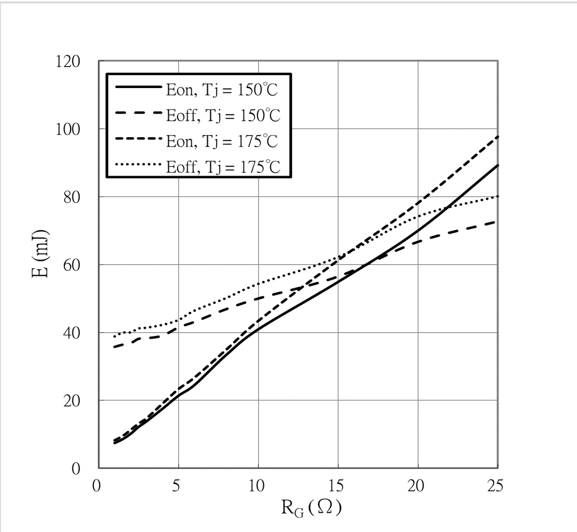
IGBT, Switching losses vs. I_C
V_{GE} = -8V / + 15V, $R_{G,on}$ = 2.5 Ω
$R_{G,off}$ = 5.0 Ω, V_{CE} = 400V, E_{on} & E_{off} = f(I_c)



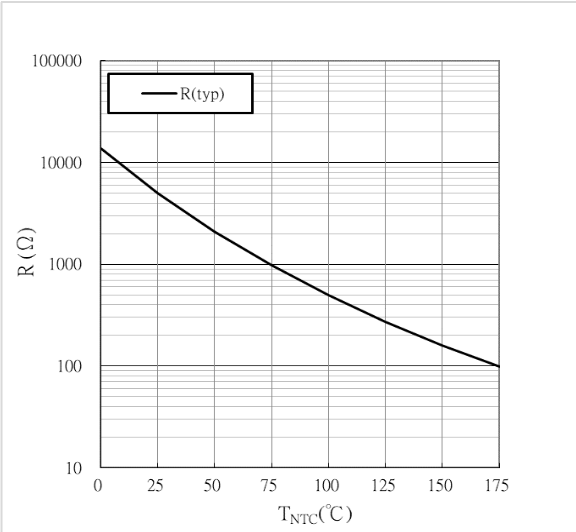
IGBT, Capacitance characteristics
V_{GE} = 0V, T_j = 25°C, f = 100 kHz, C = f(V_{CE})



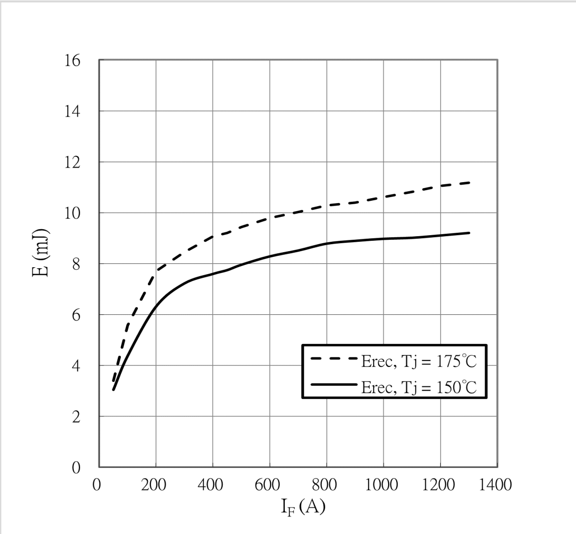
IGBT, Switching losses vs. R_G
V_{GE} = -8V / + 15V, V_{CE} = 400V, I_C = 450A
E_{on} & E_{off} = f(R_G)



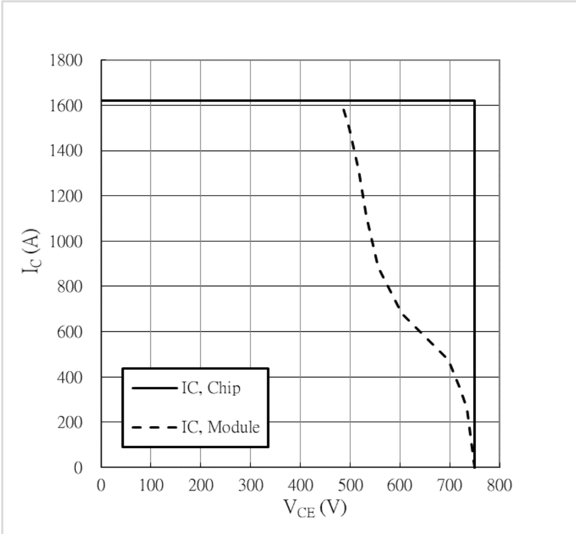
NTC-Thermistor-temperature characteristic
R = f(T_{NTC})



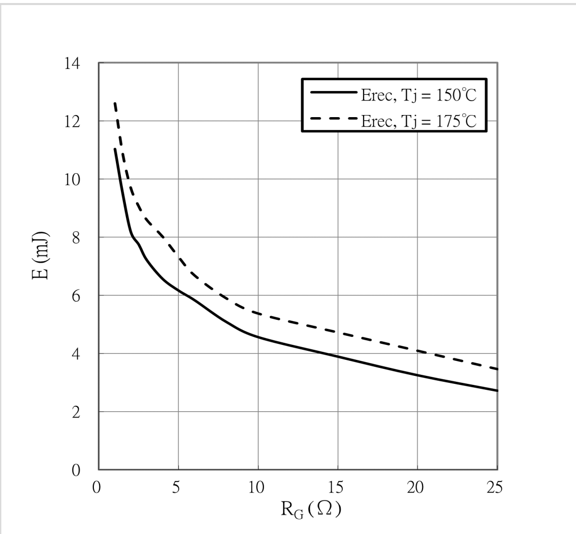
Diode, Switching losses vs. I_F
R_G = 2.5 Ω, V_R = 400V, $E_{rec} = f(I_F)$



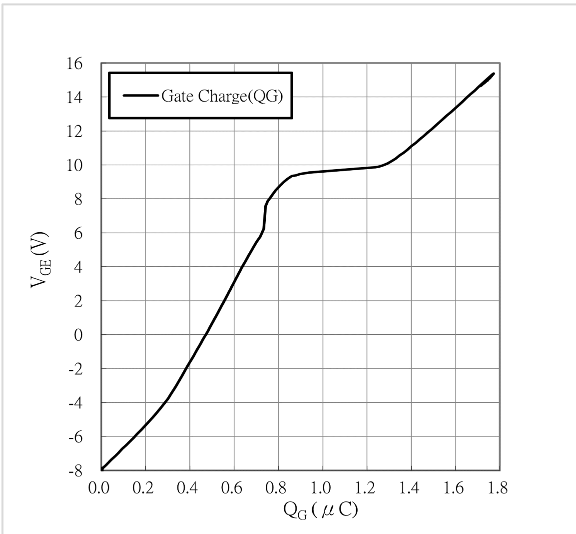
Reverse bias safe operating area (RBSOA)
V_{GE} = -8V / + 15V, $R_{G,off}$ = 5.0 Ω, T_j = 175°C



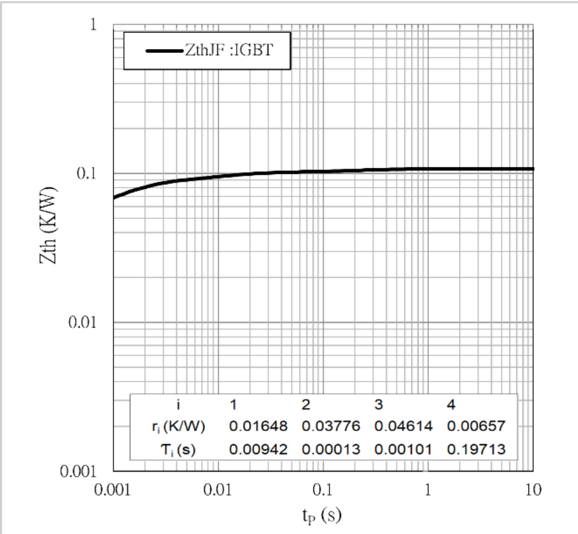
Diode, Switching losses vs. R_G
I_F = 450A, V_R = 400V, $E_{rec} = f(R_G)$



IGBT Total gate charge characteristic
V_{CE} = 400V, I_C = 450A, T_j = 25°C
$V_{GE} = f(Q_G)$



IGBT Transient thermal impedance
$Z_{thJF} = f(t_P)$
$\Delta V/\Delta t = 10\ dm^3/min,\ T_F = 70°C$



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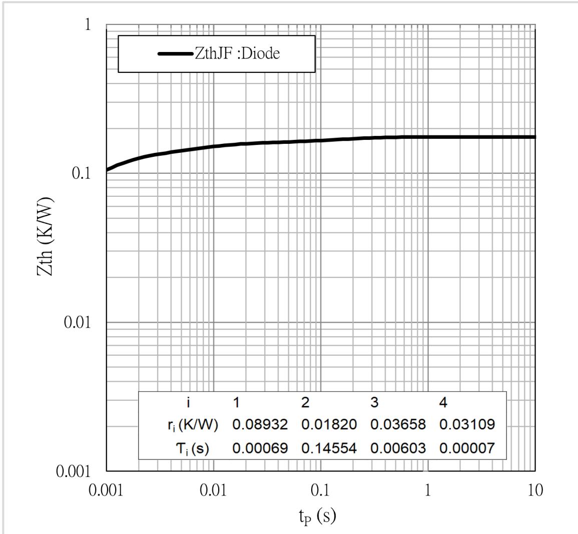
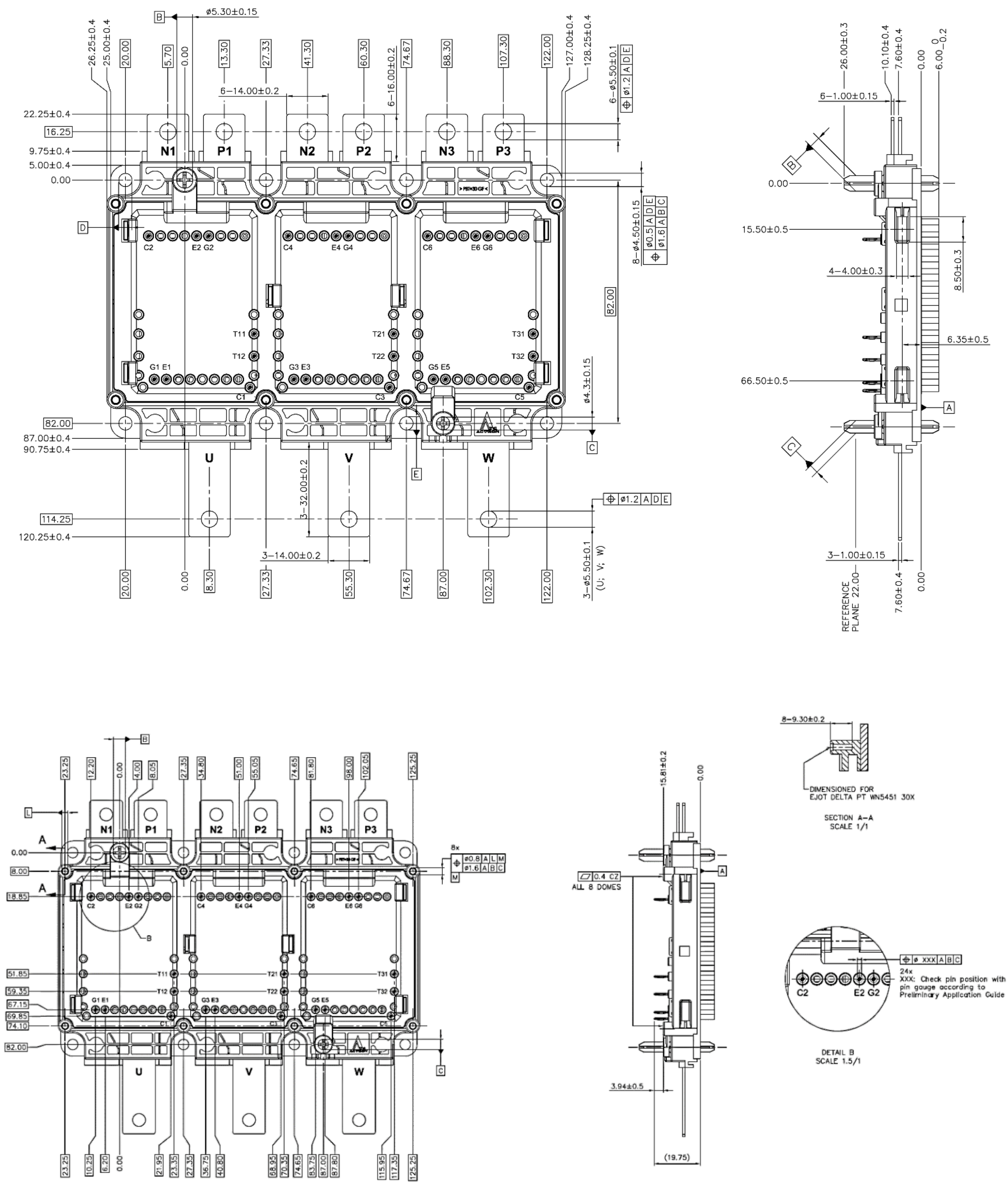


Package Outlines



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