1200V HPD IGBT
Power Module

AEP380B12TFLT

DATASHEET

V0.2, 2024

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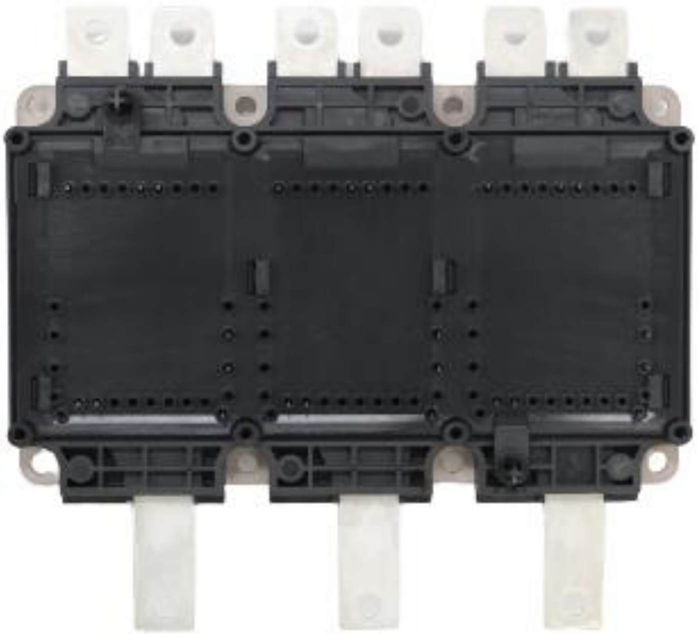


Applications

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

Features

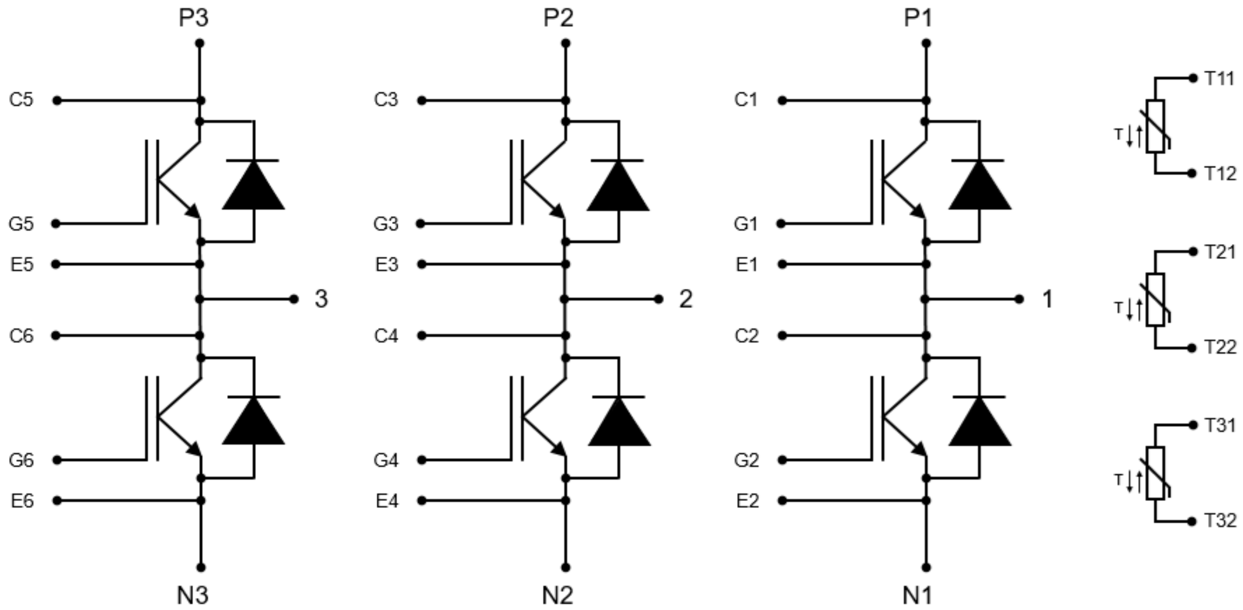
Electrical Features

- Low Q_G
- $Tj_{,op}$ = 150°C
- Low Inductance Design
- Blocking Voltage 1200V
- 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}	1200	V
Gate-emitter peak voltage		V_{GES}	±20	V
Implemented collector current		I_{CN}	380	A
Continuous DC collector current	$T_F = 70°C$, $T_{j,max} = 175°C$	$I_{C\ nom}$	250	A
Repetitive peak collector current	$t_p = 1$ ms	I_{CRM}	760	A
Maximum Junction Temperature		$Tj_{,max}$	175	°C
Total power dissipation	$T_F = 70°C$, $T_j = 175°C$	Ptot	875	W

Characteristics Values

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Collector-emitter saturation voltage	$I_C = 250A$, $V_{GE} = 15V$	Tj = 25°C	$V_{CE,sat}$		1.45	1.8	V
	$I_C = 250A$, $V_{GE} = 15V$	Tj =125°C			1.70		
	$I_C = 250A$, $V_{GE} = 15V$	Tj =150°C			1.75		
	$I_C = 380A$, $V_{GE} = 15V$	Tj = 25°C			1.7		
	$I_C = 380A$, $V_{GE} = 15V$	Tj =150°C			2.2		
Gate threshold voltage	$I_C = 9.75mA$, $V_{CE} = V_{GE}$	Tj = 25°C	$V_{GE,th}$	5.1	5.8	6.4	V
Collector-emitter cut-off current	$V_{CE} = 1200V$, $V_{GE} = 0V$	Tj = 25°C	I_{CES}		-	1.0	mA
Gate-emitter leakage current	$V_{CE} = 0V$, $V_{GE} = 20V$	Tj = 25°C	I_{GES}			400	nA
Gate Charge	$V_{GE} = -8V / +15V$, $V_{CE} = 600V$	Tj = 25°C	Q_G		2.85		µC
Internal gate resistance		Tj = 25°C	$R_{G,int}$		1.0		Ω
Input capacitance	f = 100kHz, $V_{CE} = 25V$, $V_{GE} = 0V$	Tj = 25°C	C_{ies}		77		nF
Output capacitance	f = 100kHz, $V_{CE} = 25V$, $V_{GE} = 0V$	Tj = 25°C	C_{oes}		2.0		nF
Reverse transfer capacitance	f = 100kHz, $V_{CE} = 25V$, $V_{GE} = 0V$	Tj = 25°C	C_{res}		0.49		nF

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Turn-on delay time, inductive load	I_C = 250A, V_{CE} = 600V, V_{GE} = -8V / + 15V $R_{G,on}$ = 2.0 Ω	Tj = 25°C Tj =125°C Tj =150°C	$t_{d(on)}$		0.28 0.29 0.28		µs
Rise time, inductive load	I_C = 250A, V_{CE} = 600V, V_{GE} = -8V / + 15V $R_{G,on}$ = 2.0 Ω	Tj = 25°C Tj =125°C Tj =150°C	t_r		0.06 0.07 0.07		µs
Turn-on energy loss per pulse	I_C = 250A, V_{CE} = 600V, L_S =30nH V_{GE} = -8V / + 15V, $R_{G,on}$ = 2.0 Ω di/dt = 3200A/µs (25°C) di/dt = 2800 A/µs (150°C)	Tj = 25°C Tj =125°C Tj =150°C	E_{on}		13.5 30.5 35.8		mJ
Turn-off delay time, inductive load	I_C = 250A, V_{CE} = 600V, V_{GE} = -8V / + 15V $R_{G,off}$ = 2.0 Ω	Tj = 25°C Tj =125°C Tj =150°C	$t_{d(off)}$		0.51 0.54 0.55		µs
Fall time, inductive load	I_C = 250A, V_{CE} = 600V, V_{GE} = -8V / + 15V $R_{G,off}$ = 2.0 Ω	Tj = 25°C Tj =125°C Tj =150°C	t_f		0.18 0.38 0.40		µs
Turn-off energy loss per pulse	I_C = 250A, V_{CE} = 600V, L_S = 30nH V_{GE} = -8V / + 15V, $R_{G,off}$ = 2.0Ω dv/dt = 3800V/µs (25°C) dv/dt =3450 V/µs (150°C)	Tj = 25°C Tj =125°C Tj =150°C	E_{off}		17.5 25.0 26.5		mJ
Short circuit current	V_{GE} =-8V/15 V, V_{CC} = 800 V t_p ≦ 8 µs(25°C) t_p ≦ 6 µs(150°C)	Tj = 25°C Tj =150°C	I_{SC}		1700 1500		A
Thermal resistance, junction to cooling fluid	Per IGBT; ΔV/Δt = 10 dm³/min, T_F = 70°C		$R_{th,JF}$		0.120	0.145	K/W
Operated temperature condition			$Tj_{,op}$	-40		150	˚C

Diode

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Repetitive peak reverse voltage	Tj = 25°C	V_{RRM}	1200	V
Implemented forward current		I_{FN}	380	A
Continuous DC forward current	T_F = 70°C, $T_{j,max}$= 175°C	I_F	250	A
Repetitive peak forward current	t_p = 1 ms	I_{FRM}	760	A

Characteristics Values

Parameter	Conditions		Symbol	Typ.	Max.	Unit
Forward voltage	I_F = 250A, V_{GE} = 0V	Tj = 25°C	V_F	1.65	2.00	V
	I_F = 250A, V_{GE} = 0V	Tj =125°C		1.45		
	I_F = 250A, V_{GE} = 0V	Tj =150°C		1.43		
	I_F = 380A, V_{GE} = 0V	Tj = 25°C		1.85		
	I_F = 380A, V_{GE} = 0V	Tj =150°C		1.65		
Recovered charge	I_F = 250A, V_R = 600V, V_{GE} = -8V, -di_F/dt = 5200A/µs (25°C) -di_F/dt = 2500A/µs (150°C)	Tj = 25°C Tj =125°C Tj =150°C	Q_{rr}	17.5 58.4 67.0		µC
Reverse recovery energy	I_F = 250A, V_R = 600V, V_{GE} = -8V, -di_F/dt = 5200A/µs (25°C) -di_F/dt =2500 A/µs (150°C)	Tj = 25°C Tj =125°C Tj =150°C	E_{rec}	6.9 22.8 26.0		mJ
Peak reverse recovery current	I_F = 250A, V_R = 600V, V_{GE} = -8V, -di_F/dt = 5200A/µs (25°C) -di_F/dt = 2500A/µs (150°C)	Tj = 25°C Tj =125°C Tj =150°C	I_{RM}	235 322 331		A
Thermal resistance, junction to cooling fluid	Per diode; $\Delta V/\Delta T$ = 10 dm^3/min, T_F = 70°C		$R_{th,JF}$	0.195	0.235	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/R100=493Ω	ΔR/R	-5		5	%
B-value	$R_2 = R_{25}\ exp\ [B_{25/50}(1/T_2 - 1/(298.15\ K))$	$B_{25/50}$		3375		K
B-value	R2 = R25 exp [B25/80(1/T2 – 1/(298.15 K))	$B_{25/80}$		3411		K
B-value	R2 = R25 exp [B25/100(1/T2 – 1/(298.15 K))	$B_{25/100}$		3433		K

Module

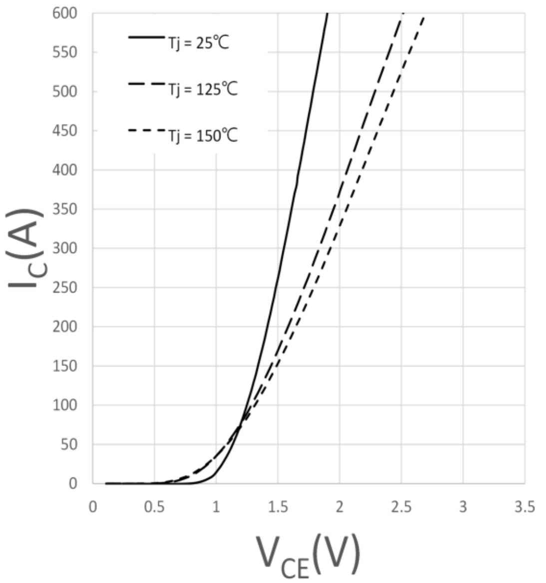
Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 0 Hz, t = 1 sec	V_{ISOL}	4.2	kV
Module baseplate material			Cu + Ni	
Module internal isolation material	Basic isolation (class 1, IEC 61140)		Al_2O_3	
Creepage distance	Terminal to heatsink	$d_{Creep,TH}$	9.0	mm
Creepage distance	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				8		nH
Storage temperature		T_{stg}	-40		125	°C
Mounting torque for module mounting	Screw M4 baseplate to heatsink	M	1.8	2.0		Nm
Weight		G		755		g

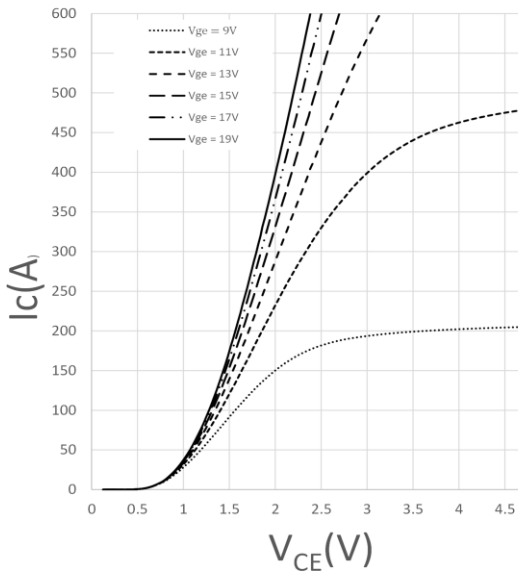
1) Extracted by following UL 746A

Characteristics Diagrams

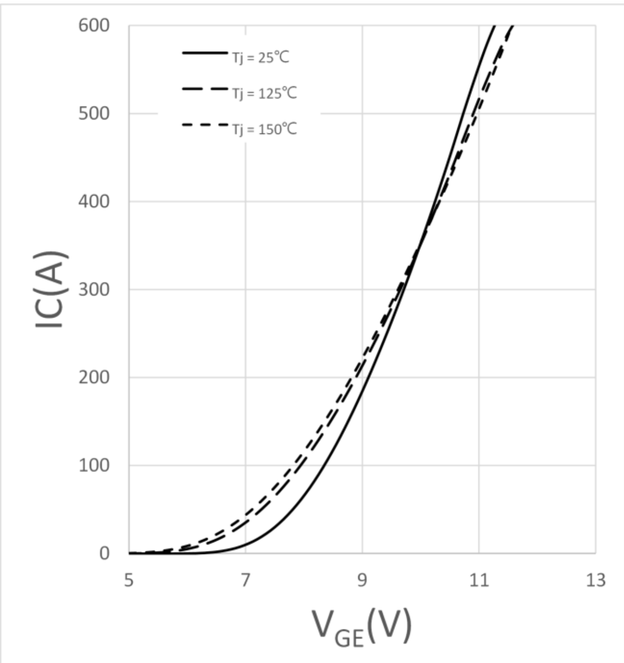
IGBT, Output characteristics
V_{GE} = 15V, $I_C = f(V_{CE})$



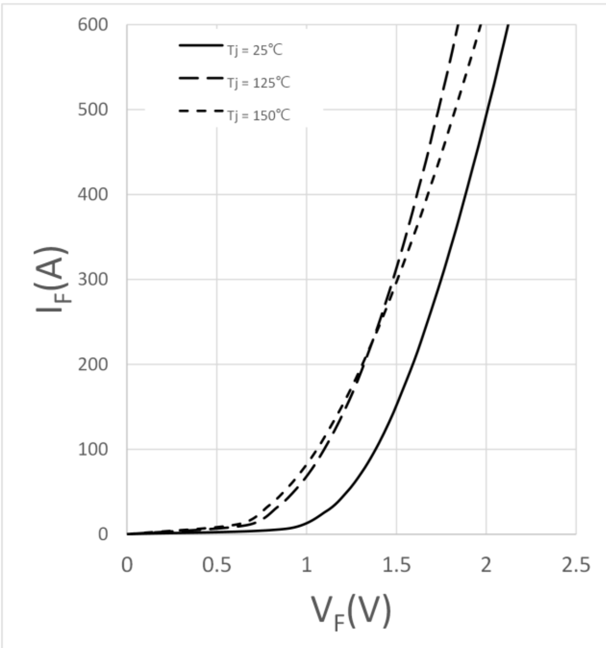
IGBT ,Output characteristics
T_j = 150°C, $I_C = f(V_{CE})$



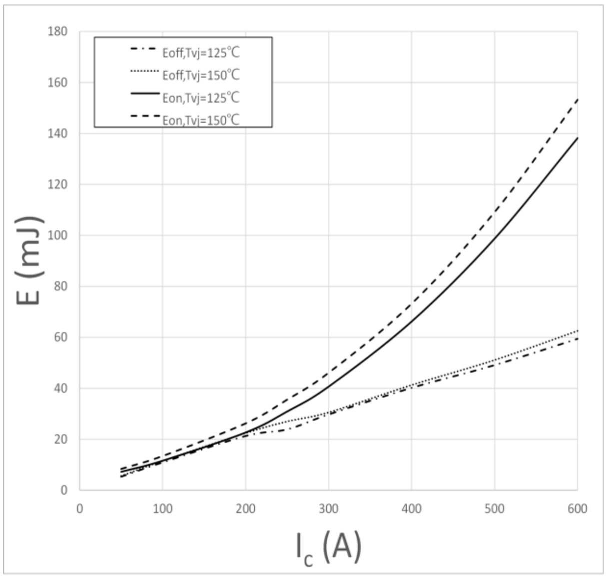
IGBT,transfer characteristics$I_C=f(V_{GE})$; V_{CE}=20V



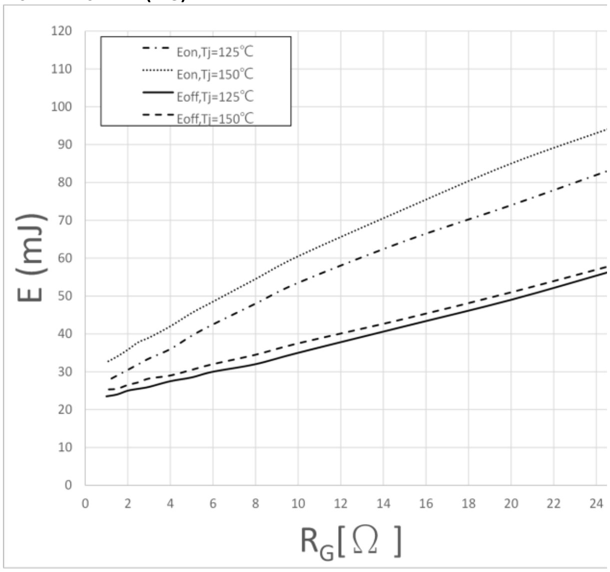
Diode,Forward characteristics V_{GE}=0V ,$I_F = f(V_F)$



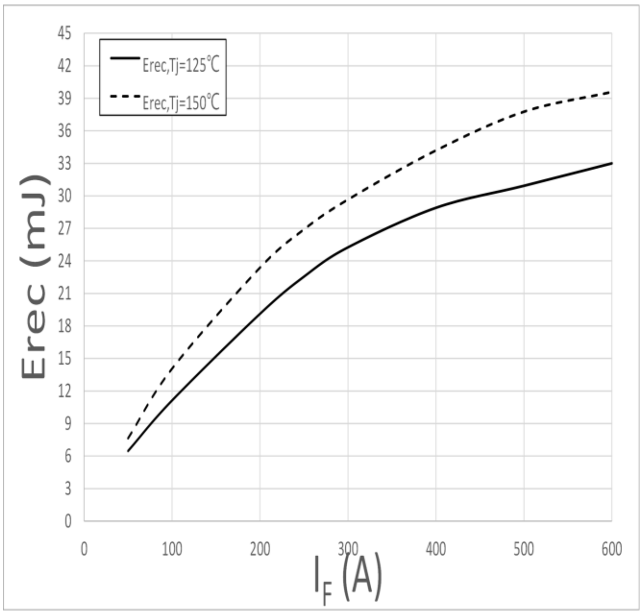
IGBT,Switching losses vs. I_C
V_{GE} = -8V / +15V, $R_{G,on}$ = 2.0 Ω,
$R_{G,off}$ = 2.0 Ω, V_{CE} = 600 V, E_{on} & E_{off} = f(Ic)



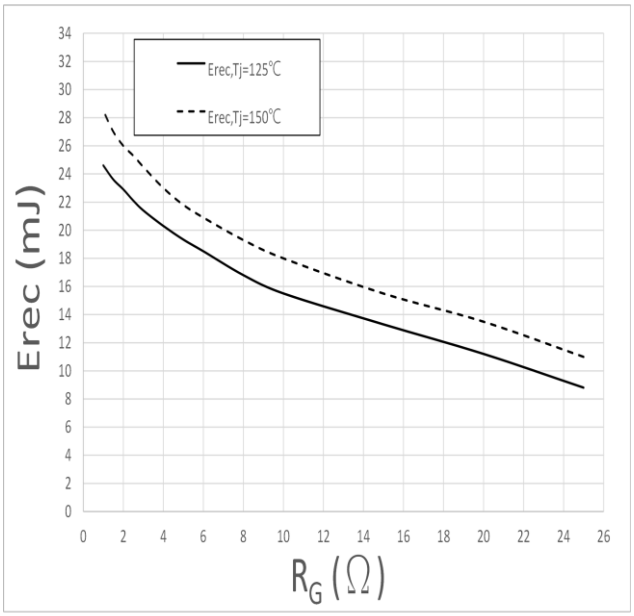
IGBT,Switching losses vs. R_G
V_{GE} = -8V / +15V, V_{CE} = 600 V, I_C = 250 A
E_{on} & E_{off} = f(R_G)



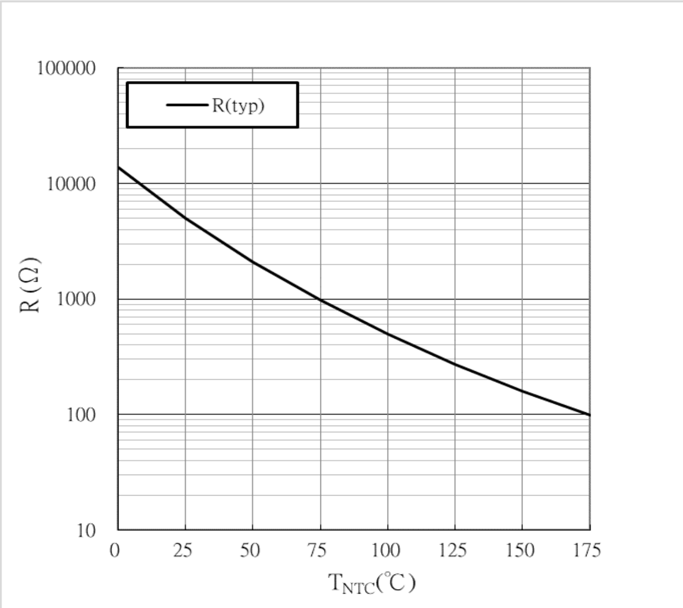
Diode , Switching losses vs. I_C
$R_{G,on}$ = 2.0 Ω, V_R = 600V, E_{rec} = f(I_F)



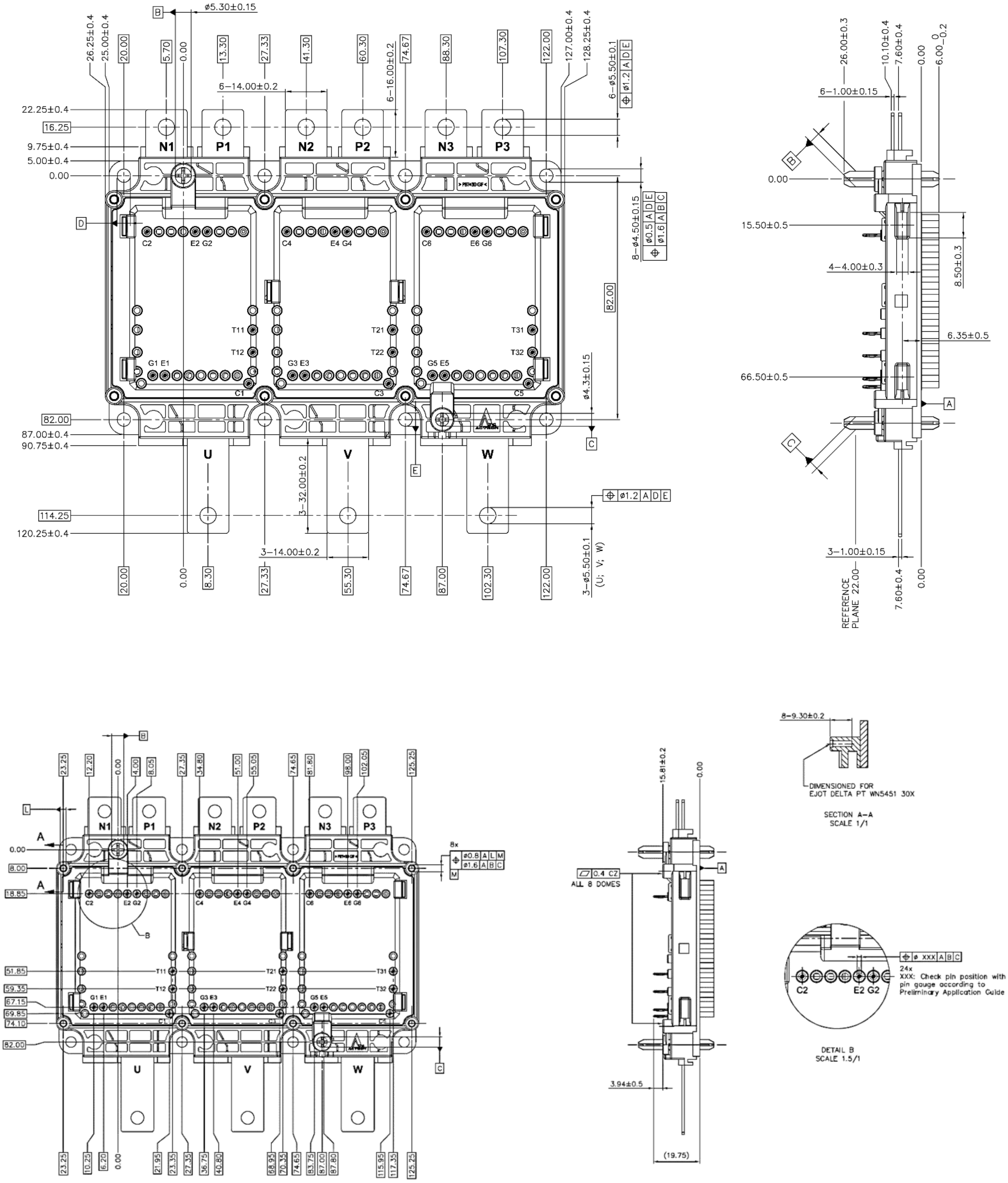
Diode, Switching losses vs. R_G
I_F = 250 A, V_R = 600V, E_{rec} = f(R_G)



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



Package Outlines



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