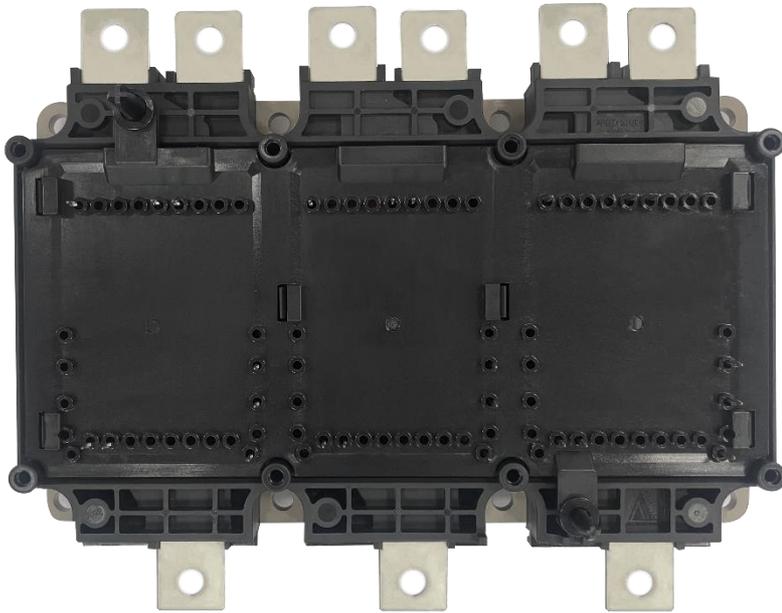




1200V HPD IGBT Power Module AEP380B12TFST

DATASHEET

V0.2, 2024



Applications

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

Features

Electrical Features

- Low Q_G
- $T_{j,op} = 150^{\circ}C$
- 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



IGBT

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Collector-emitter voltage	$T_j = 25^\circ\text{C}$	V_{CES}	1200	V
Gate-emitter peak voltage		V_{GES}	± 20	V
Implemented collector current		I_{CN}	380	A
Continuous DC collector current	$T_F = 70^\circ\text{C}, T_{j,max} = 175^\circ\text{C}$	$I_{C,nom}$	250	A
Repetitive peak collector current	$t_p = 1\text{ ms}$	I_{CRM}	760	A
Maximum Junction Temperature		$T_{j,max}$	175	$^\circ\text{C}$
Total power dissipation	$T_F = 70^\circ\text{C}, T_j = 175^\circ\text{C}$	P_{tot}	875	W

Characteristics Values

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



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Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Turn-on delay time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / + 15V$ $R_{G,on} = 2.0 \Omega$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	$t_{d(on)}$	0.28 0.29 0.28		μs
Rise time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / + 15V$ $R_{G,on} = 2.0 \Omega$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	t_r	0.06 0.07 0.07		μs
Turn-on energy loss per pulse	$I_C = 250A, V_{CE} = 600V,$ $L_S = 30nH$ $V_{GE} = -8V / + 15V,$ $R_{G,on} = 2.0 \Omega$ $di/dt = 3200A/\mu s (25^\circ C)$ $di/dt = 2800 A/\mu s (150^\circ C)$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	E_{on}	13.5 30.5 35.8		mJ
Turn-off delay time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / + 15V$ $R_{G,off} = 2.0 \Omega$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	$t_{d(off)}$	0.51 0.54 0.55		μs
Fall time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / + 15V$ $R_{G,off} = 2.0 \Omega$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	t_f	0.18 0.38 0.40		μs
Turn-off energy loss per pulse	$I_C = 250A, V_{CE} = 600V,$ $L_S = 30nH$ $V_{GE} = -8V / + 15V,$ $R_{G,off} = 2.0\Omega$ $dv/dt = 3800V/\mu s (25^\circ C)$ $dv/dt = 3450 V/\mu s (150^\circ C)$	$T_j = 25^\circ C$ $T_j = 125^\circ C$ $T_j = 150^\circ C$	E_{off}	17.5 25.0 26.5		mJ
Short circuit current	$V_{GE} = -8V/15 V,$ $V_{CC} = 800 V$ $t_p \leq 8 \mu s(25^\circ C)$ $t_p \leq 6 \mu s(150^\circ C)$	$T_j = 25^\circ C$ $T_j = 150^\circ C$	I_{SC}	1700 1500		A
Thermal resistance, junction to cooling fluid	Per IGBT; $\Delta V/\Delta t = 10 dm^3/min,$ $T_F = 70^\circ C$		$R_{th,JF}$	0.120	0.145	K/W
Operated temperature condition			$T_{j,op}$	-40	150	$^\circ C$



Diode

Maximum Rated Values

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

Characteristics Values

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

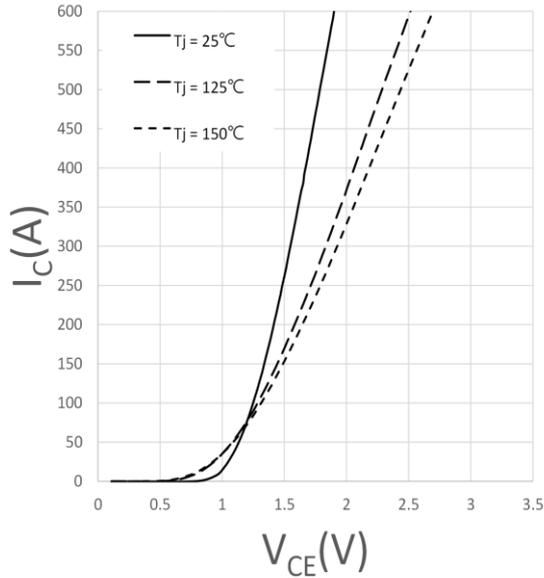
¹⁾ Extracted by following UL 746A



Characteristics Diagrams

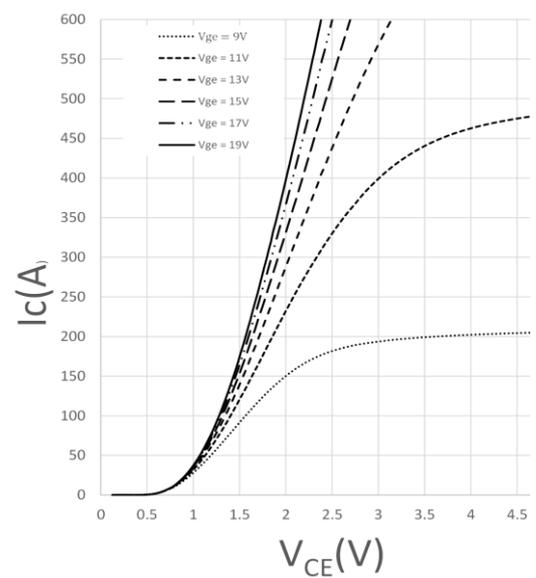
IGBT, Output characteristics

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

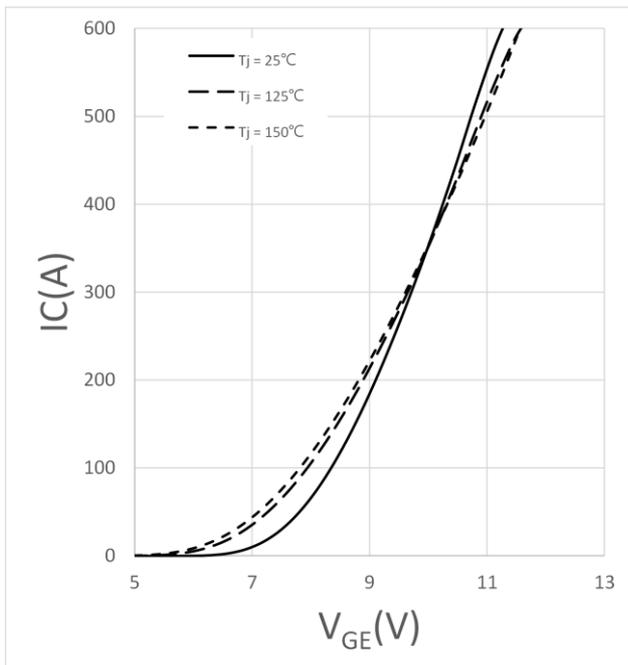


IGBT, Output characteristics

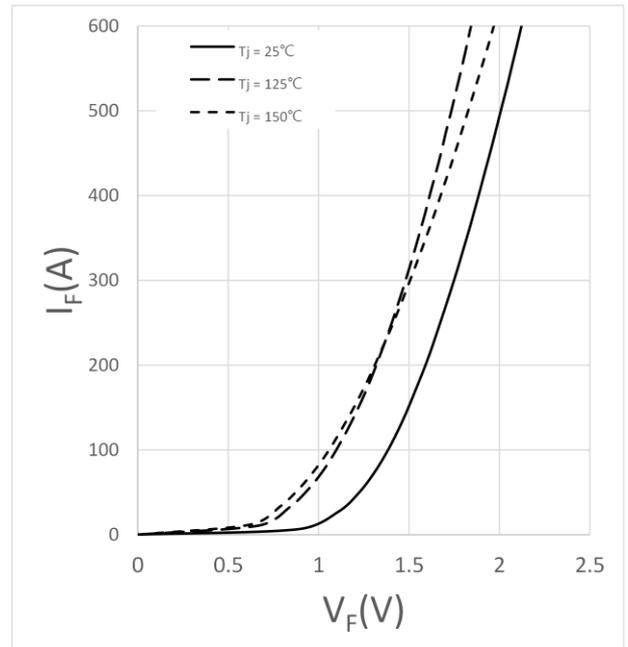
$T_J = 150^\circ C, I_C = f(V_{CE})$



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



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

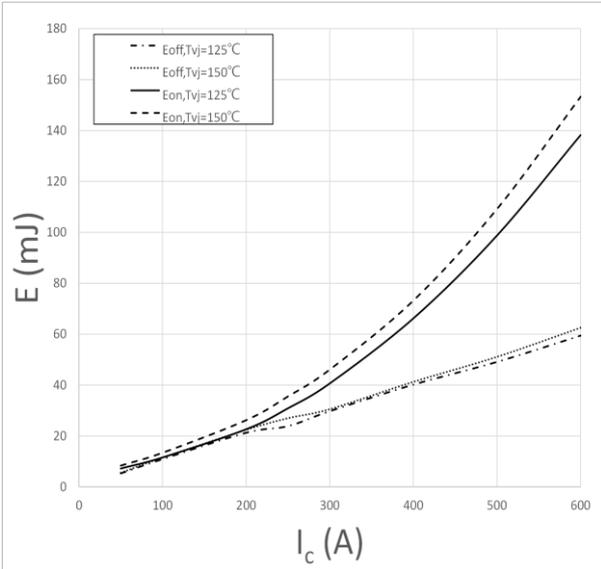




IGBT, Switching losses vs. I_c

$V_{GE} = -8V / +15V$, $R_{G,on} = 2.0 \Omega$,

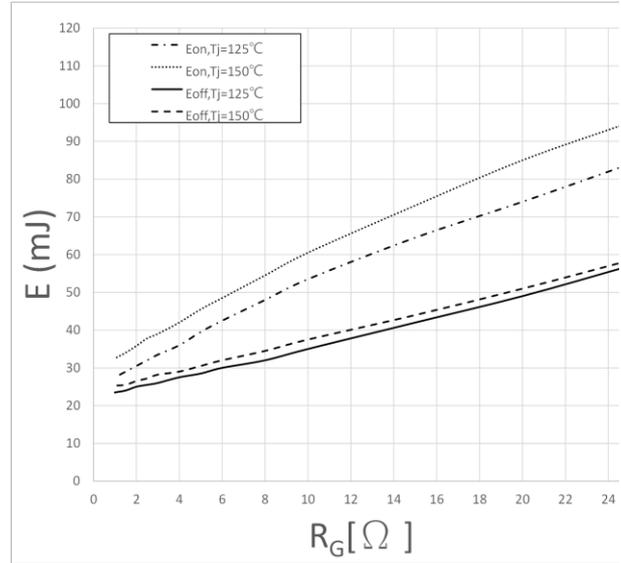
$R_{G,off} = 2.0 \Omega$, $V_{CE} = 600V$, E_{on} & $E_{off} = f(I_c)$



IGBT, Switching losses vs. R_G

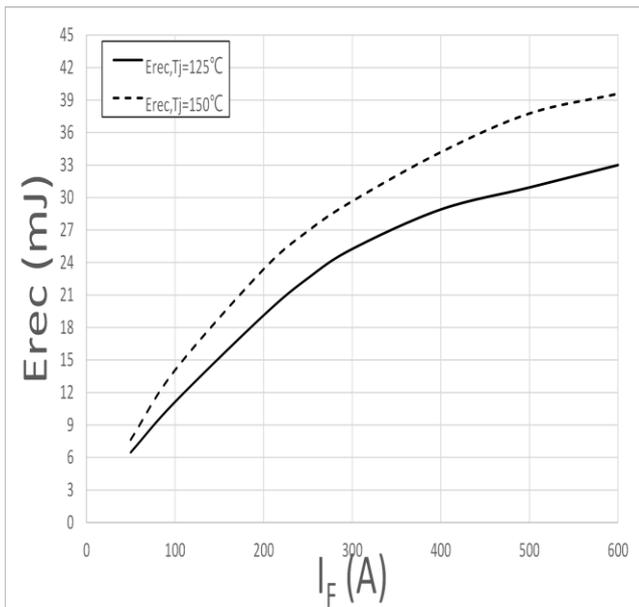
$V_{GE} = -8V / +15V$, $V_{CE} = 600V$, $I_c = 250A$

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



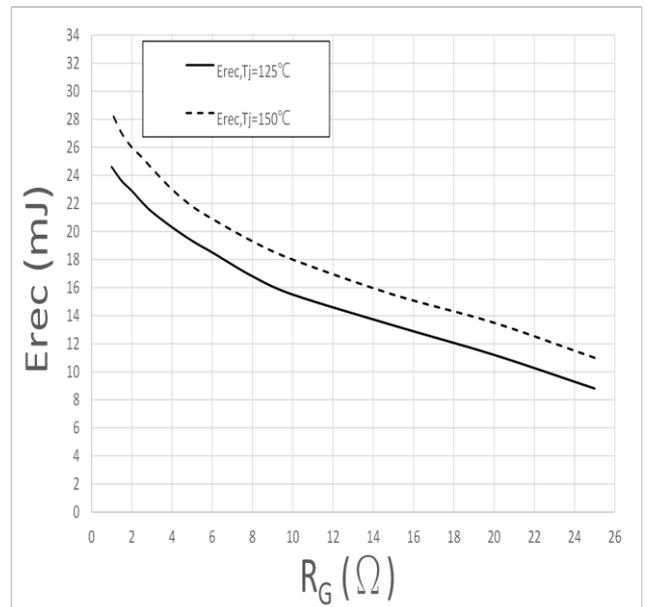
Diode, Switching losses vs. I_c

$R_{G,on} = 2.0 \Omega$, $V_R = 600V$, $E_{rec} = f(I_F)$



Diode, Switching losses vs. R_G

$I_F = 250A$, $V_R = 600V$, $E_{rec} = f(R_G)$

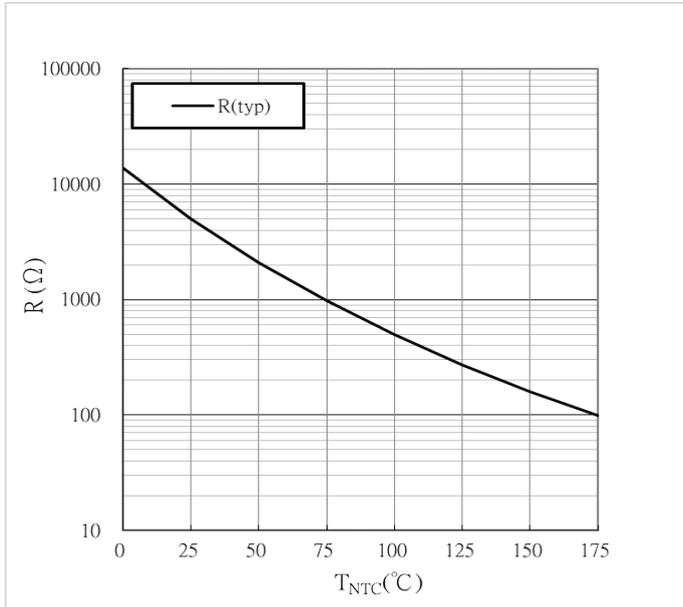




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NTC-Thermistor-temperature characteristic
 $R = f(T_{NTC})$

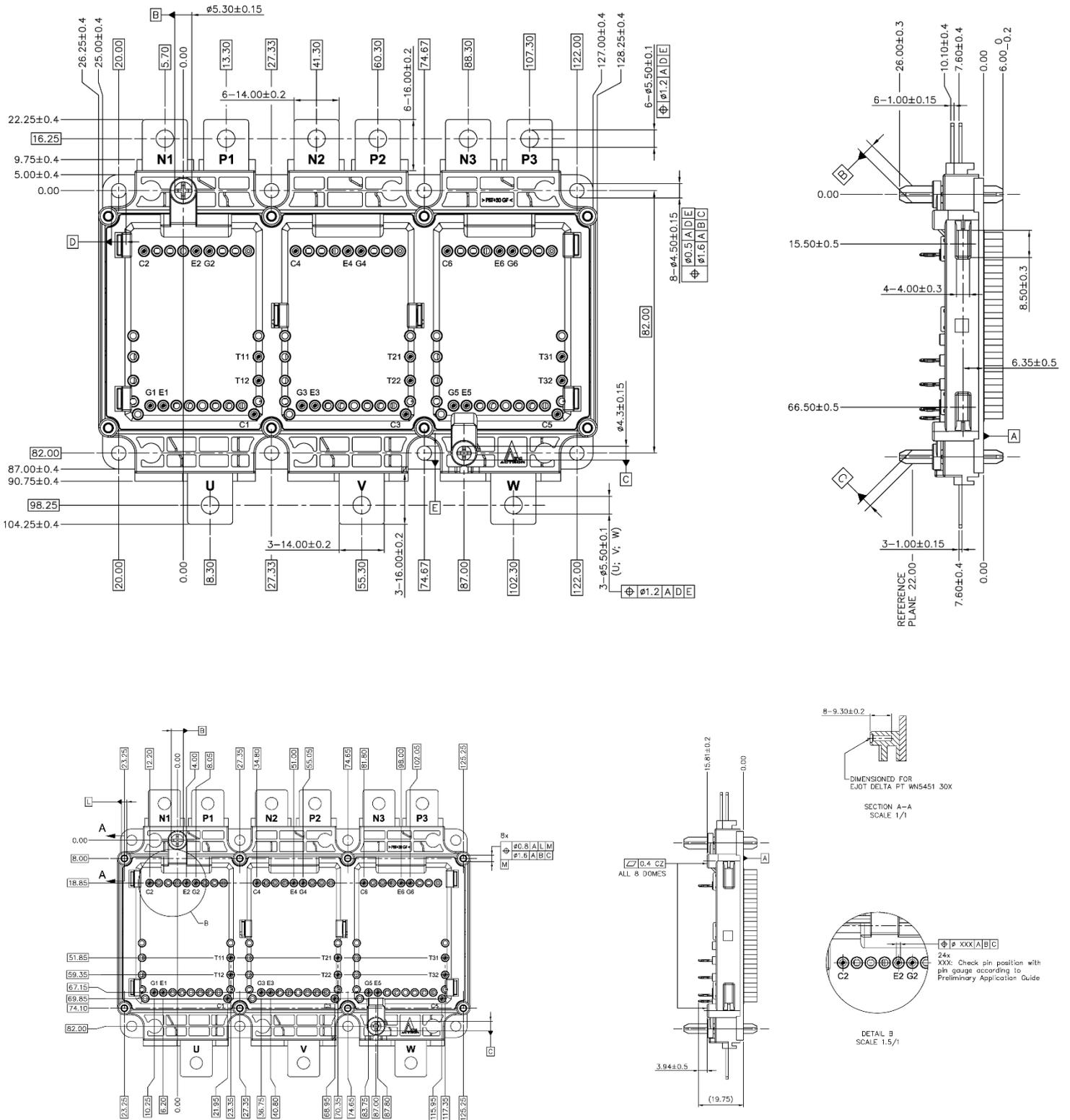




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Package Outlines





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