

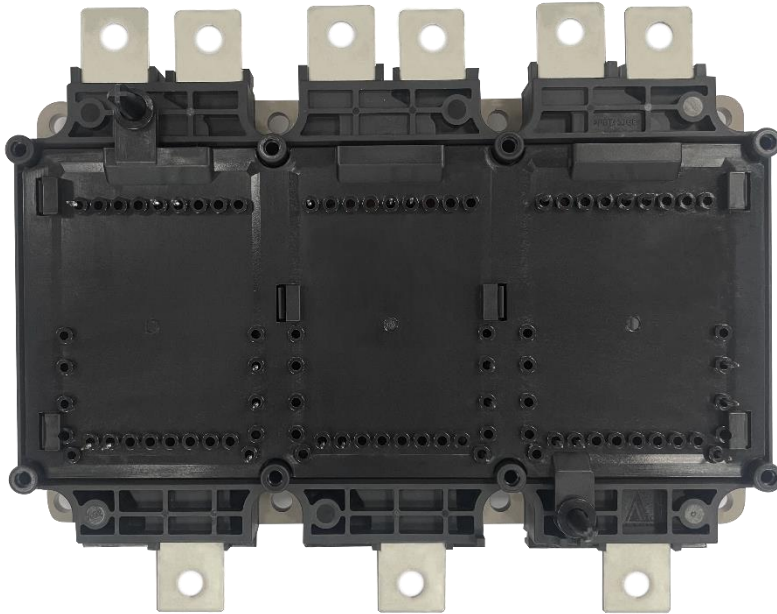


# Power Module

AEP380B12TFST

**DATASHEET**

V1.0, 2022/12



## Applications

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

## Electrical Features

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- Low  $Q_g$
- $T_j \text{ op} = 150^\circ\text{C}$
- Low Inductive Design
- Blocking voltage 1200V
- Fast and soft reverse recovery
- Low  $V_{CEsat}$  and Switching Losses

## Mechanical Features

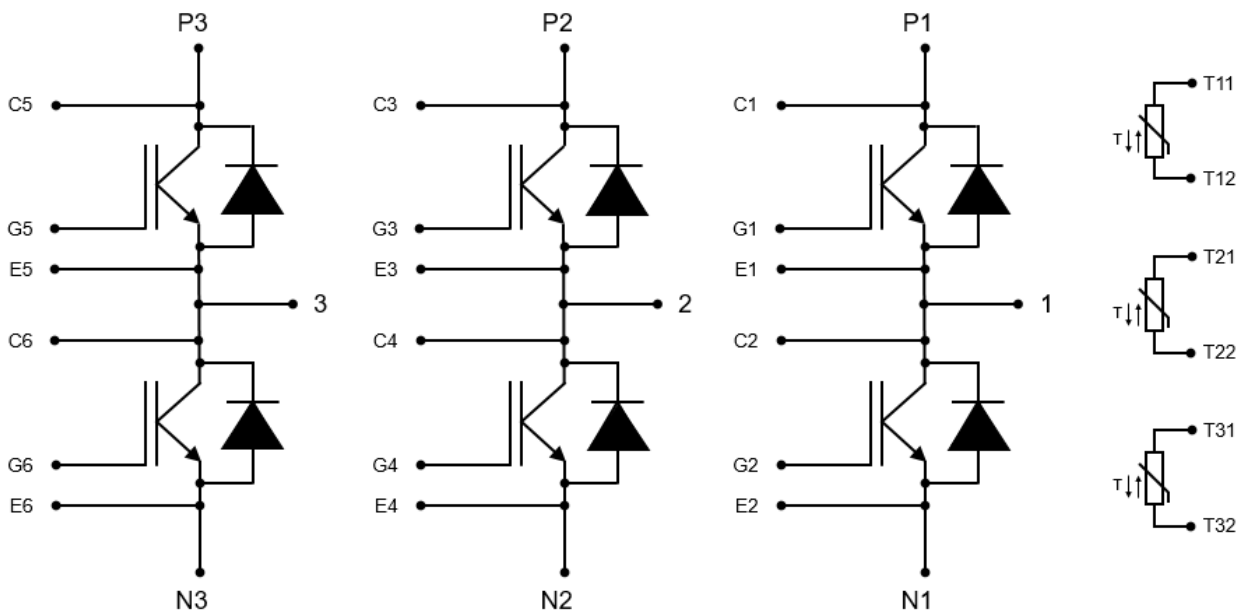
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- Compact design
- 4.2KV DC Insulation
- UL 94 Module frame
- Temperature sense included
- Direct Water Cooling Base Plate
- Easy to Integrate 6-pack Topology
- Pb-free device and RoHS compliant
- Guiding elements for PCB and cooler assembly

## 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	$T_j = 25^\circ\text{C}$	$V_{CES}$	1200	V
Gate-emitter peak voltage		$V_{GES}$	$\pm 20$	V
Implemented collector current		$I_{CN}$	380	A
Continuous DC collector current	$T_F = 70^\circ\text{C}, T_j = 175^\circ\text{C}$	$I_{C\text{ nom}}$	250	A
Repetitive peak collector current	$t_p = 1\text{ ms}$	$I_{CRM}$	760	A
Maximum Junction Temperature		$T_{j,\text{max}}$	175	$^\circ\text{C}$

### Characteristics Values

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	
Collector-emitter saturation voltage	$I_C = 250\text{A}, V_{GE} = 15\text{V}$	$V_{CE,\text{sat}}$			1.50	V	
	$I_C = 250\text{A}, V_{GE} = 15\text{V}$				1.70		
	$I_C = 380\text{A}, V_{GE} = 15\text{V}$				1.75		
	$I_C = 380\text{A}, V_{GE} = 15\text{V}$				2.05		
Gate threshold voltage	$I_C = 9.75\text{mA}, V_{CE} = V_{GE}$	$T_j = 25^\circ\text{C}$	$V_{G\text{Eth}}$	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	$V_{GE} = -8\text{ V} / +15\text{ V}, V_{CE} = 600\text{V}$	$T_j = 25^\circ\text{C}$	$Q_g$		1.6		$\mu\text{C}$
Input capacitance	$f = 1\text{MHz}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$	$C_{ies}$		25		nF
Output capacitance	$f = 1\text{MHz}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$	$C_{oes}$		2.5		nF
Reverse transfer capacitance	$f = 1\text{MHz}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{V}$	$T_j = 25^\circ\text{C}$	$C_{res}$		1.0		nF
Turn-on delay time, inductive load	$I_C = 250\text{A}, V_{CE} = 600\text{V}, V_{GE} = -8\text{ V} / +15\text{ V}, R_{GON} = 2.0\ \Omega$	$T_j = 25^\circ\text{C}$	$t_{d(\text{on})}$		0.13		$\mu\text{s}$
Rise time, inductive load	$I_C = 250\text{A}, V_{CE} = 600\text{V}, V_{GE} = -8\text{ V} / +15\text{ V}, R_{GON} = 2.0\ \Omega$	$T_j = 25^\circ\text{C}$	$t_r$		0.05		$\mu\text{s}$



Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Turn-on energy loss per pulse	$I_C = 250A, V_{CE} = 600V,$ $L_S = 30nH$ $V_{GE} = -8V / +15V,$ $R_{GON} = 2.0\ \Omega$ $di/dt = 4500\ A/\mu s (25^\circ C)$	$T_j = 25^\circ C$	$E_{on}$		18.5		mJ
Turn-off delay time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / +15V$ $R_{Goff} = 2.0\ \Omega$	$T_j = 25^\circ C$	$t_{d(off)}$		0.35		$\mu s$
Fall time, inductive load	$I_C = 250A, V_{CE} = 600V,$ $V_{GE} = -8V / +15V$ $R_{Goff} = 2.0\ \Omega$	$T_j = 25^\circ C$	$t_f$		0.12		$\mu s$
Turn-off energy loss per pulse	$I_C = 250A, V_{CE} = 600V,$ $L_S = 30nH$ $V_{GE} = -8V / +15V,$ $R_{Goff} = 2.0\ \Omega$ $dv/dt = 4800\ V/\mu s (25^\circ C)$	$T_j = 25^\circ C$	$E_{off}$		16.5		mJ
SC data	$V_{GE} \leq 15V, V_{CC} = 800V$ $t_p \leq 8\ \mu s$	$T_j = 25^\circ C$	$I_{SC}$		1400		A
Thermal resistance, junction to cooling fluid	Per IGBT; $\Delta V/\Delta T = 10\ dm^3/min,$ $T_F = 75^\circ C$		$R_{thJF}$		0.135	0.155	K/W

## Diode Inverter

### Maximum Rated Values

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



## Characteristics Values

Parameter	Conditions	Symbol	Typ.	Max.	Unit
Forward voltage	$I_F = 250A, V_{GE} = 0V$	$V_F$	1.60	2.00	V
	$I_F = 250A, V_{GE} = 0V$		1.55		
	$I_F = 380A, V_{GE} = 0V$		1.85		
	$I_F = 380A, V_{GE} = 0V$		1.80		
Recovered charge	$I_F = 250A, V_R = 600V,$ $V_{GE} = -8V,$ $-di_F/dt = 6000 A/\mu s (25^\circ C)$	$T_j = 25^\circ C$	$Q_{rr}$	16.0	$\mu C$
Reverse recovery energy	$I_F = 250A, V_R = 600V,$ $V_{GE} = -8V,$ $-di_F/dt = 6000 A/\mu s (25^\circ C)$	$T_j = 25^\circ C$	$E_{rec}$	4.5	mJ
Thermal resistance, junction to cooling fluid	Per diode; $\Delta V/\Delta T = 10 dm^3/min,$ $T_F = 75^\circ C$	$R_{thJF}$	0.210	0.240	K/W
Peak reverse recovery current	$I_F = 250A, V_R = 600V,$ $V_{GE} = -8V,$ $-di_F/dt = 6000 A/\mu s (25^\circ C)$	$T_j = 25^\circ C$	$I_{RM}$	215	A

## NTC-Thermistor

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Rated resistance	$T_c = 25^\circ C$	$R_{25}$		5.0		k $\Omega$
Resistance tolerance	$T_c = 100^\circ C$	$\Delta R/R$	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	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298.15 K))]$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15 K))]$	$B_{25/100}$		3433		K



## Module

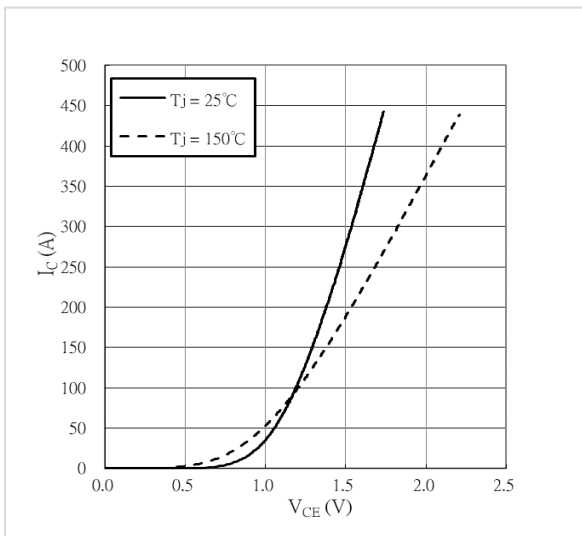
Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 0 Hz, t = 1 sec	$V_{ISOL}$	4.2	kV
Module baseplate material			Cu + Ni	
Module internal isolation material			Al <sub>2</sub> O <sub>3</sub>	
Creepage distance	Terminal to Heat sink	$d_{cree}$	9.0	mm
	Terminal to Terminal		9.0	
Clearance	Terminal to heat sink	$d_{clear}$	4.5	mm
	Terminal to Terminal		4.5	
Comparative tracking index <sup>1)</sup>		CTI	> 200	

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance				8		
Storage temperature		$T_{stg}$	-40		125	°C
Weight		G		755		g

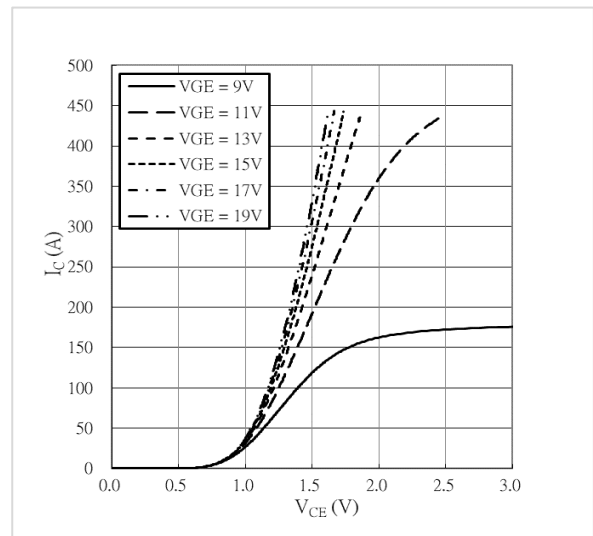
<sup>1)</sup> Extracted by following UL 746A

## Characteristics Diagrams

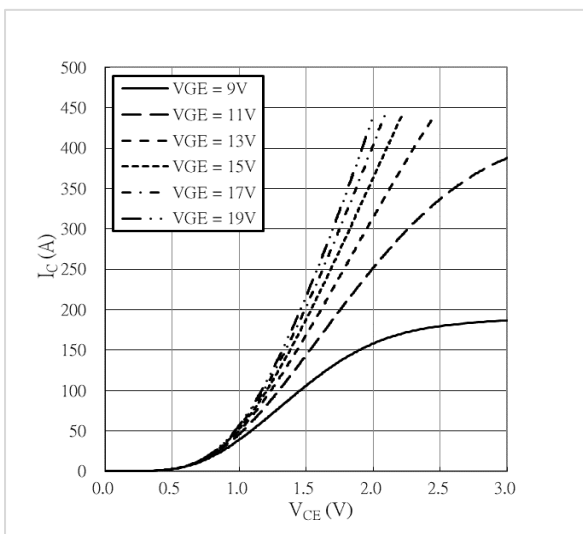
Output characteristics IGBT, Inverter  
 $V_{GE} = 15\text{ V}$



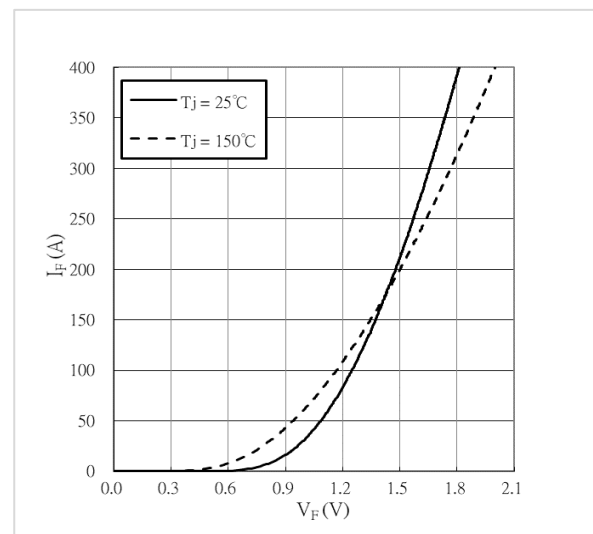
Output characteristics IGBT, Inverter  
 $T_j = 25^\circ\text{C}$



Output characteristics IGBT, Inverter  
 $T_j = 150^\circ\text{C}$

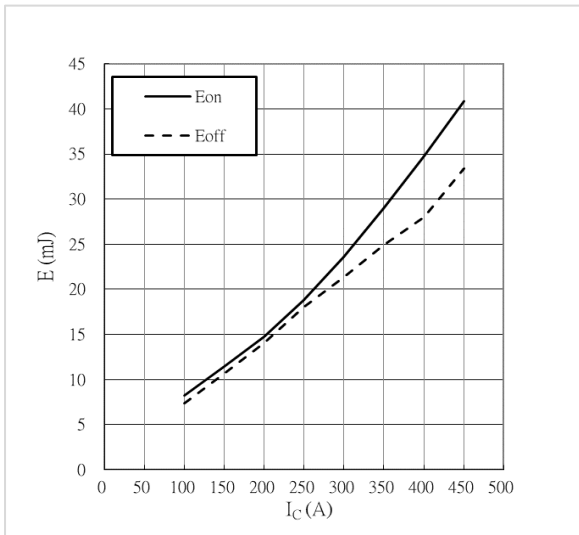


Forward characteristics of Diode, Inverter

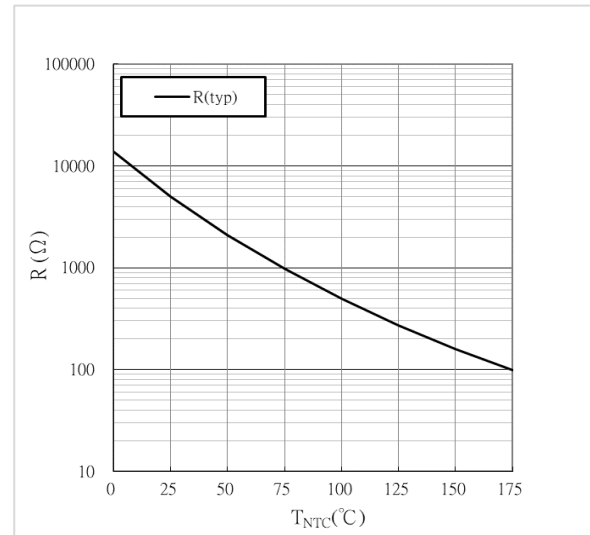




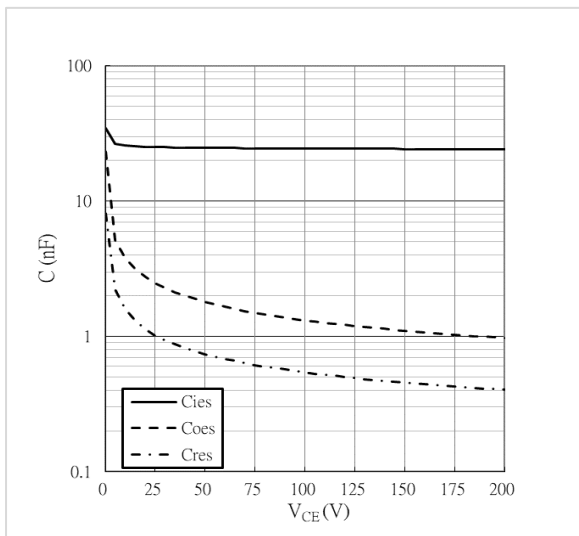
Switching losses IGBT, Inverter  
 $V_{GE} = +15\text{ V} / -8\text{ V}$ ,  $R_{GON} = 2.0\ \Omega$ ,  
 $R_{Goff} = 2.0\ \Omega$ ,  $V_{CE} = 600\text{V}$ ,  $T_j = 25^\circ\text{C}$



NTC-Thermistor-temperature characteristic

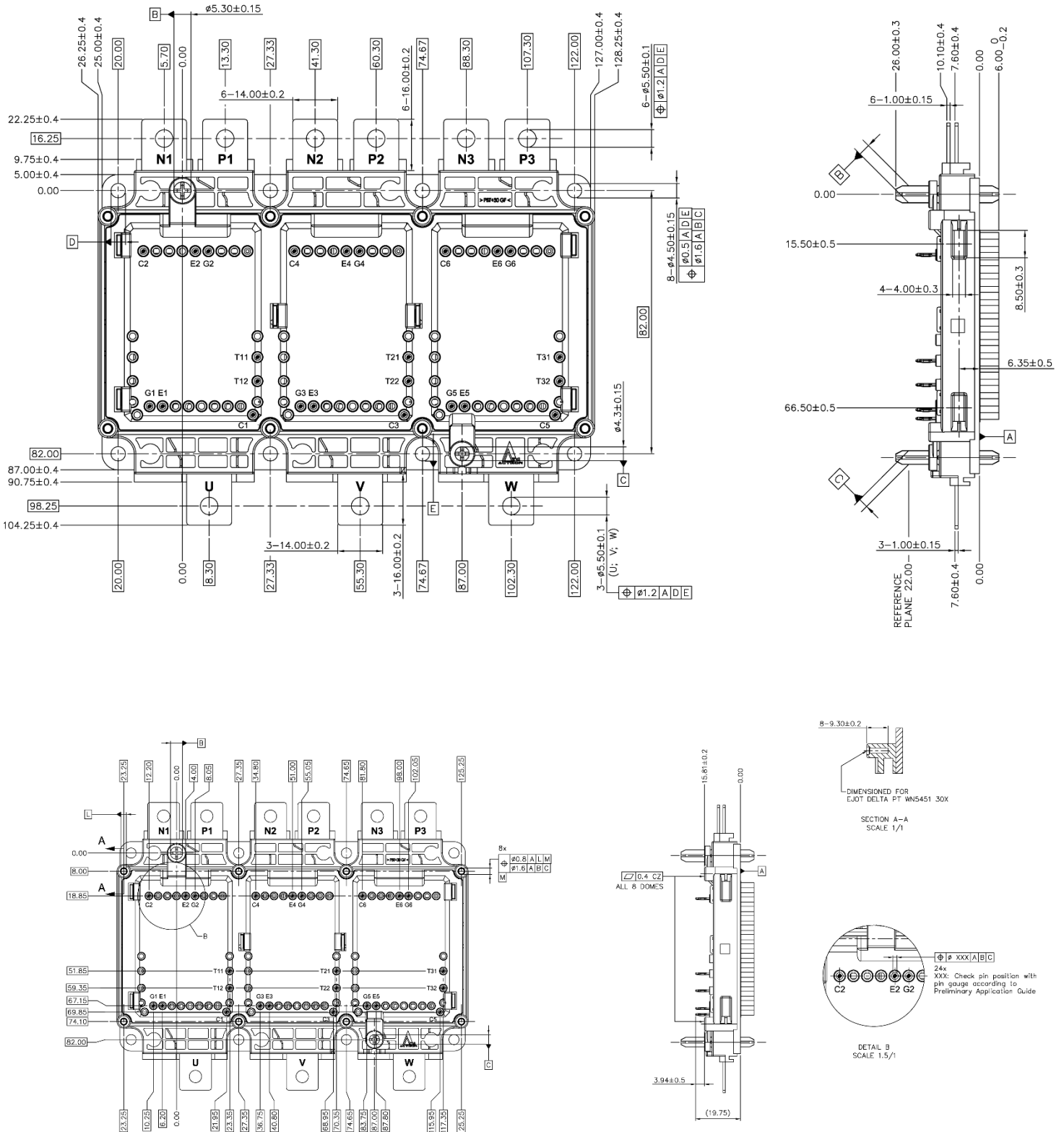


Capacitance characteristics IGBT, inverter  
 $V_{GE} = 0\text{ V}$ ,  $T_j = 25^\circ\text{C}$ ,  $f = 1\text{ MHz}$





## Package Outlines



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