

Automotive 750 V, 820 A Single Side Direct Cooling 6-Pack Power Module



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VE-Trac™ Direct Module NVH820S75L4SPB

Product Description

The NVH820S75L4SPB is a power module from the VE-Trac™ Direct family of highly integrated power modules with industry standard footprints for Hybrid (HEV) and Electric Vehicle (EV) traction inverter application.

The module integrates six Field Stop 4 (FS4) 750V Narrow Mesa IGBTs in a 6-pack configuration, which excels in providing high current density while offering robust short circuit protection and increased blocking voltage. Additionally, FS4 750V Narrow Mesa IGBTs show low power losses during lighter loads, which helps to improve overall system efficiency in automotive applications.

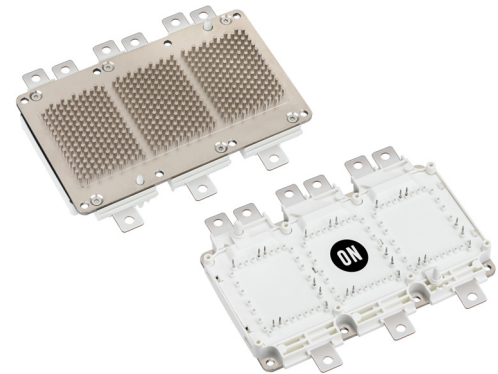
For assembly ease and reliability, a new generation of press-fit pins are integrated into the power module signal terminals. In addition, it also integrates an optimized pin-fin heatsink in the baseplate.

Features

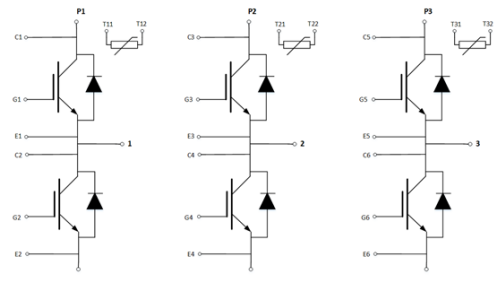
- Direct Cooling w/ Integrated Pin-fin Heatsink
- Ultra-low Stray Inductance
- $T_{jmax} = 175^{\circ}\text{C}$ Continuous Operation
- Low V_{CESAT} and Switching Losses
- Automotive Grade FS4 750V Narrow Mesa IGBT
- Fast Recovery Diode Chip Technologies
- 4.2 kV Isolated DBC Substrate
- Easy to Integrate 6-pack Topology
- This Device is Pb-Free and is RoHS Compliant

Typical Applications

- Hybrid and Electric Vehicle Traction Inverter
- High Power Converters



SSDC33, 154.50x92.0 (SPB)
CASE 183AB



ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

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Pin Description

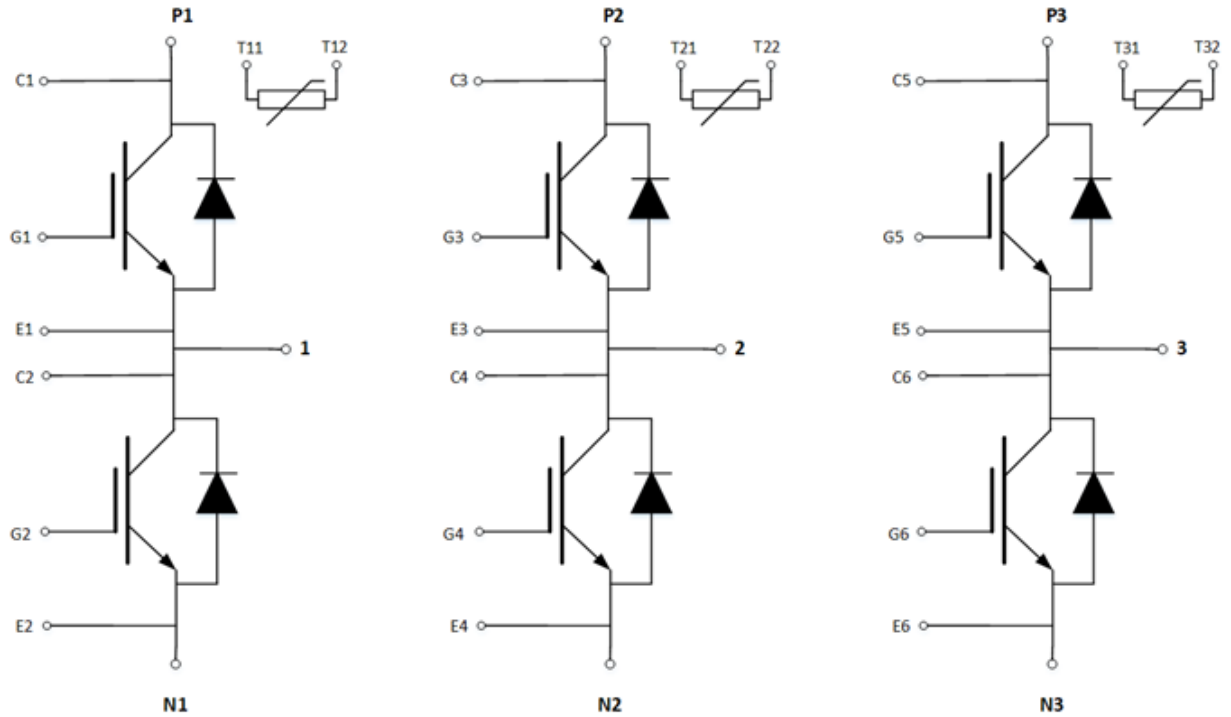


Figure 1. Pin Description

PIN FUNCTION DESCRIPTION

Pin #	Pin Function Description
P1, P2, P3	Positive Power Terminals
N1, N2, N3	Negative Power Terminals
1	Phase 1 Output
2	Phase 2 Output
3	Phase 3 Output
G1–G6	IGBT Gate
E1–E6	IGBT Gate return
C1–C6	Desat detect / collector sense
T11, T12	Phase 1 temperature sensor output
T21, T22	Phase 2 temperature sensor output
T31, T32	Phase 3 temperature sensor output

Materials

DBC Substrate: Al₂O₃ isolated substrate, basic isolation,
and copper on both sides

Terminals: Copper + Tin electro-plating

Signal Leads: Copper + Tin plating

Pin-fin Base plate: Copper + Ni plating

Flammability Information

The module frame meets UL94V-0 flammability rating.

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MODULE CHARACTERISTICS (T_{VJ} = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Rating	Unit
T _{vj}	Operating Junction Temperature	-40 to 175	°C
T _{STG}	Storage Temperature	-40 to 125	°C
V _{ISO}	Isolation Voltage(DC, 0 Hz, 1 s)	4200	V
L _{sCE}	Stray Inductance	8	nH
RCC'+EE'	Module lead resistance, terminals – chip	0.75	mΩ
G	Module weight	700	g
CTI	Comparative tracking index	>200	-
d _{creep}	Creepage; terminal to heatsink terminal to terminal	9.0 9.0	mm
d _{clear}	Clearance; terminal to heatsink terminal to terminal	4.5 4.5	mm

Parameters		Conditions	Min	Typ.	Max	Unit
Δp	Pressure drop in cooling circuit	10 L/min, 65°C, 50/50 EGW	-	95	-	mbar
P ⁽¹⁾	Maximum pressure in cooling loop	T _{Baseplate} < 40°C T _{Baseplate} > 40°C	-	-	2.5 2.0	bar

1. EPDM rubber 50 durometer 'O' ring used

ABSOLUTE MAXIMUM RATINGS (T_{VJ} = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Rating	Unit
IGBT			
V _{CES}	Collector to Emitter Voltage	750	V
V _{GES}	Gate to Emitter Voltage	±20	V
I _{CN}	Implemented Collector Current	820	A
I _{C nom}	Continuous DC Collector Current, T _{VJ} = 175°C, T _F = 65°C, ref. heatsink	600 ⁽²⁾	A
I _{CRM}	Pulsed Collector Current @ V _{GE} = 15 V, t _p = 1 mS	1640	A
P _{tot}	Total power dissipation T _{VJ} = 175°C, T _F = 65°C, ref. heatsink	1000	W

Diode

V _{R RM}	Repetitive peak reverse voltage	750	V
I _{F N}	Implemented Forward Current	820	A
I _F	Continuous Forward Current, T _{VJ} = 175°C, T _F = 65°C, ref. heatsink	400 ⁽²⁾	A
I _{F RM}	Repetitive Peak Forward Current, t _p = 1 mS	1640	A
I ² t value	Surge current capability, t _p = 1mS, T _{VJ} = 150°C	20000	A ² s

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. Verified by characterization / design, not by test.

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CHARACTERISTICS OF IGBT (T_{vj} = 25°C, Unless Otherwise Specified)

Parameters		Conditions	Min	Typ	Max	Unit
V _{CESAT}	Collector to Emitter Saturation Voltage (Terminal)	V _{GE} = 15 V, I _C = 600 A, T _{vj} = 25°C	–	1.30	1.55	V
	Collector to Emitter Saturation Voltage (Chip)	V _{GE} = 15 V, I _C = 600 A, T _{vj} = 25°C V _{GE} = 15 V, I _C = 600 A, T _{vj} = 150°C V _{GE} = 15 V, I _C = 600 A, T _{vj} = 175°C V _{GE} = 15 V, I _C = 820 A, T _{vj} = 25°C V _{GE} = 15 V, I _C = 820 A, T _{vj} = 150°C V _{GE} = 15 V, I _C = 820 A, T _{vj} = 175°C	–	1.25 1.30 1.30 1.30 1.45 1.45	1.50	
I _{CES}	Collector to Emitter Leakage Current	V _{GE} = 0, V _{CE} = 750V T _{vj} = 25°C T _{vj} = 150°C	– –	– 2.0	500 –	μA mA
I _{GES}	Gate – Emitter Leakage Current	V _{CE} = 0, V _{GE} = ± 20V	–	–	300	nA
V _{th}	Threshold Voltage	V _{CE} = V _{GE} , I _C = 600 mA	4.8	5.7	6.6	V
Q _G	Total Gate Charge	V _{GE} = –8 to 15 V, V _{CE} = 400 V	–	1.9	–	μC
R _{Gint}	Internal gate resistance		–	1.7	–	Ω
C _{ies}	Input Capacitance	V _{CE} = 30 V, V _{GE} = 0 V, f = 1 MHz	–	60	–	nF
C _{oes}	Output Capacitance	V _{CE} = 30 V, V _{GE} = 0 V, f = 1 MHz	–	1.3	–	nF
C _{res}	Reverse Transfer Capacitance	V _{CE} = 30 V, V _{GE} = 0 V, f = 1 MHz	–	0.2	–	nF
T _{d,on}	Turn on delay, inductive load	I _C = 600 A, V _{CE} = 400 V V _{GE} = +15/–8 V R _{g,on} = 8 Ω T _{vj} = 25°C T _{vj} = 150°C T _{vj} = 175°C	–	315 320 322	–	nS
T _r	Rise time, inductive load	I _C = 600 A, V _{CE} = 400 V V _{GE} = +15/–8 V R _{g,on} = 8 Ω T _{vj} = 25°C T _{vj} = 150°C T _{vj} = 175°C	–	108 127 132	–	nS
T _{d,off}	Turn off delay, inductive load	I _C = 600 A, V _{CE} = 400 V V _{GE} = +15/–8 V R _{g,off} = 12 Ω T _{vj} = 25°C T _{vj} = 150°C T _{vj} = 175°C	–	1063 1196 1203	–	nS
T _f	Fall time, inductive load	I _C = 600 A, V _{CE} = 400 V V _{GE} = +15/–8 V R _{g,off} = 12 Ω T _{vj} = 25°C T _{vj} = 150°C T _{vj} = 175°C	–	85 144 151	–	nS
E _{ON}	Turn-On Switching Loss (including diode reverse recovery loss)	I _C = 600 A, V _{CE} = 400 V, V _{GE} = +15/–8 V, L _s = 22 nH, R _{g,on} = 8 Ω di/dt = 4.5 A/nS, T _{vj} = 25°C di/dt = 3.9 A/nS, T _{vj} = 150°C di/dt = 3.6 A/nS, T _{vj} = 175°C	–	26 36 38	–	mJ
E _{OFF}	Turn-Off Switching Loss	I _C = 600 A, V _{CE} = 400 V, V _{GE} = +15/–8 V, L _s = 22 nH, R _{g,off} = 12 Ω dv/dt = 2.7 V/nS, T _{vj} = 25°C dv/dt = 1.9 V/nS, T _{vj} = 150°C dv/dt = 1.9 V/nS, T _{vj} = 175°C	–	25 40 43	–	mJ
E _{SC}	Minimum Short Circuit Energy withstand	V _{GE} = 15V, V _{CC} = 400V, T _{vj} = 175°C	3			J

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CHARACTERISTICS OF INVERSE DIODE (T_{VJ} = 25°C, Unless Otherwise Specified)

Parameters		Conditions	Min	Typ	Max	Unit
V _F	Diode Forward Voltage (Terminal)	I _F = 600 A, T _{VJ} = 25°C	–	1.70	1.95	V
	Diode Forward Voltage (Chip)	I _F = 600 A, T _{VJ} = 25°C I _F = 600 A, T _{VJ} = 150°C I _F = 600 A, T _{VJ} = 175°C I _F = 820 A, T _{VJ} = 25°C I _F = 820 A, T _{VJ} = 150°C I _F = 820 A, T _{VJ} = 175°C	–	1.60 1.55 1.50 1.70 1.70 1.65	1.85	
E _{rr}	Reverse Recovery Energy	I _F = 600 A, V _F = 400 V, V _{GE} = +15/-8 V, R _{g,on} = 8 Ω di/dt = 4.5 A/nS, T _{VJ} = 25°C di/dt = 3.9 A/nS, T _{VJ} = 150°C di/dt = 3.6 A/nS, T _{VJ} = 175°C	–	3 9 11	–	mJ
Q _{RR}	Recovered Charge	I _F = 600 A, V _F = 400 V, V _{GE} = +15/-8 V, R _{g,on} = 8 Ω di/dt = 4.5 A/nS, T _{VJ} = 25°C di/dt = 3.9 A/nS, T _{VJ} = 150°C di/dt = 3.6 A/nS, T _{VJ} = 175°C	–	9 26 28	–	°C
I _{rr}	Peak Reverse Recovery Current	I _F = 600 A, V _F = 400 V, V _{GE} = -8 V, R _{g,on} = 8 Ω di/dt = 4.5 A/nS, T _{VJ} = 25°C di/dt = 3.9 A/nS, T _{VJ} = 150°C di/dt = 3.6 A/nS, T _{VJ} = 175°C	–	171 275 302	–	A

NTC SENSOR CHARACTERISTICS (T_{VJ} = 25°C, Unless Otherwise Specified)

Parameters		Conditions	Min	Typ	Max	Unit
R ₂₅ ⁽³⁾	Rated Resistance	T _C = 25°C	–	5147	–	Ω
ΔR/R	Deviation of R105	T _C = 105°C, R ₁₀₅ = 472 Ω	5	–	5	%
P ₂₅	Power Dissipation	T _C = 25°C	–	–	32	mW
B _{25/55}	B-Value	R = R ₂₅ exp [B _{25/55} (1/T-1/298)]	–	3340	–	K
B _{25/85}	B-Value	R = R ₂₅ exp [B _{25/85} (1/T-1/298)]	–	3360	–	K
B _{25/105}	B-Value	R = R ₂₅ exp [B _{25/105} (1/T-1/298)]	–	3364	–	K

3. Measured value at terminals

THERMAL CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Unit
IGBT.R _{th,J-F}	R _{th} , Junction to Fluid, 10 L/min, 65°C, 50/50 EGW	–	0.11	0.13	°C/W
Diode.R _{th,J-F}	R _{th} , Junction to Fluid, 10 L/min, 65°C, 50/50 EGW	–	0.16	0.20	°C/W

ORDERING INFORMATION

Part Number	Package	Shipping
NVH820S75L4SPB	SSDC33, 154.50x92.0 (SPB) (Pb-Free)	4 units / Tray

IGBT Output Characteristic

$V_{GE} = +15V$

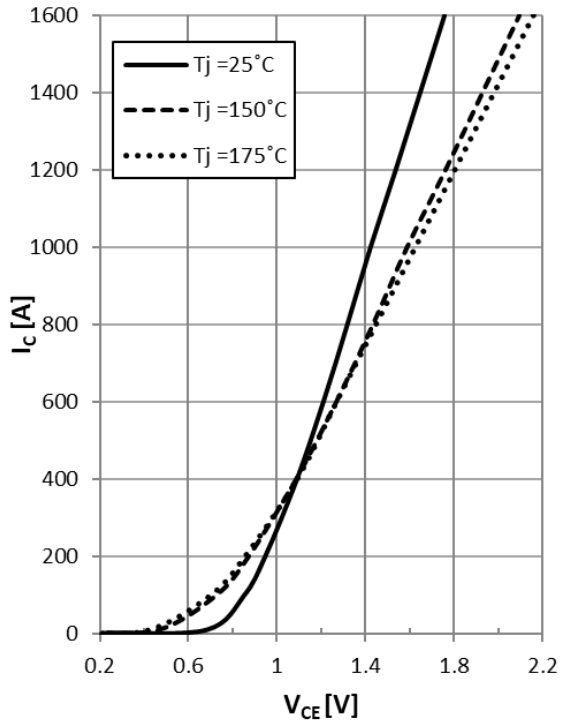


Figure 2. IGBT Output Characteristic

IGBT Output Characteristic

$T_j = +150^\circ C$

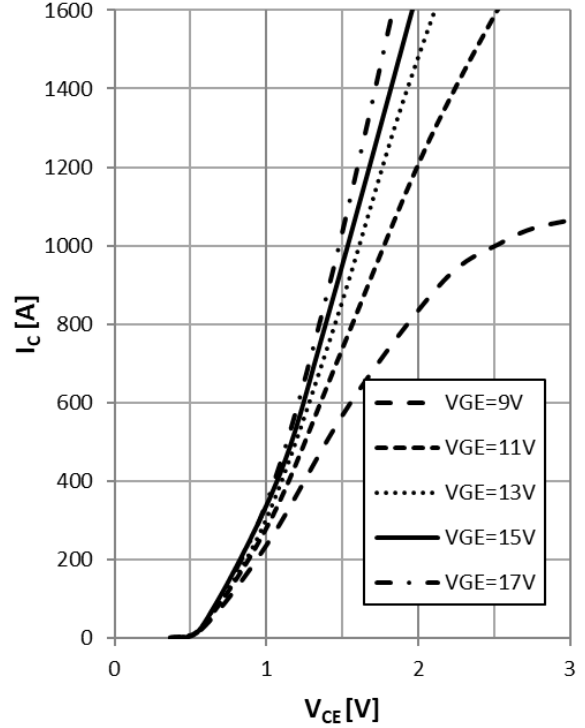


Figure 3. IGBT Output Characteristic

IGBT Transfer Characteristic

$V_{CE} = 20V$

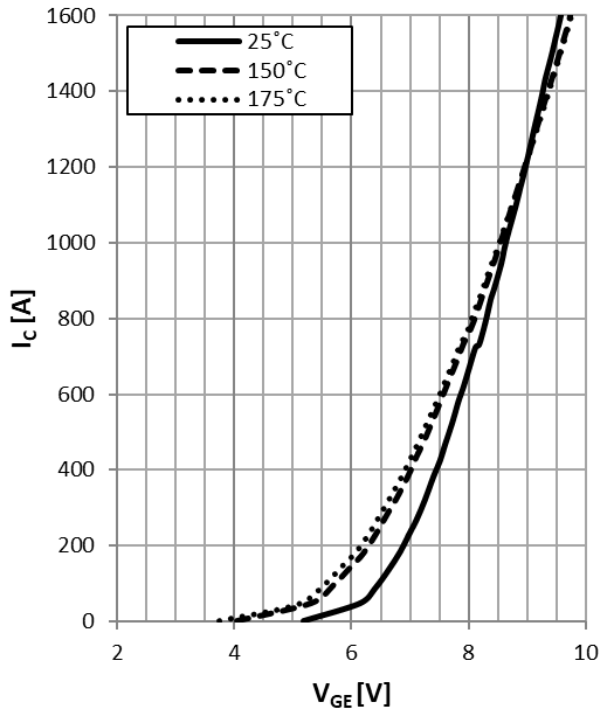


Figure 4. IGBT Transfer Characteristic

IGBT Turn-off losses vs I_c

$V_{GE} = +15V/-8V$, $R_{Goff} = 12\Omega$, $V_{CE} = 400V$

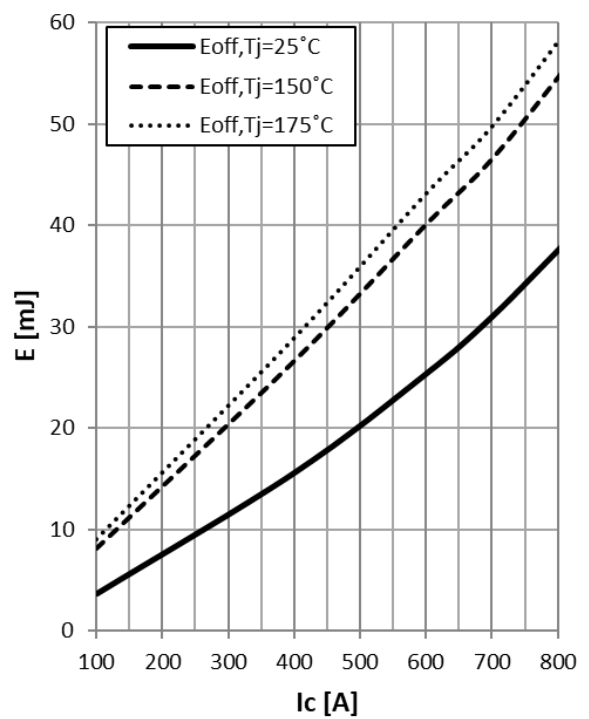


Figure 5. IGBT Turn-off Losses vs. I_c

IGBT Turn-on losses vs Ic

$V_{GE} = +15/-8V$, $R_{Gon} = 8\Omega$, $V_{CE} = 400V$

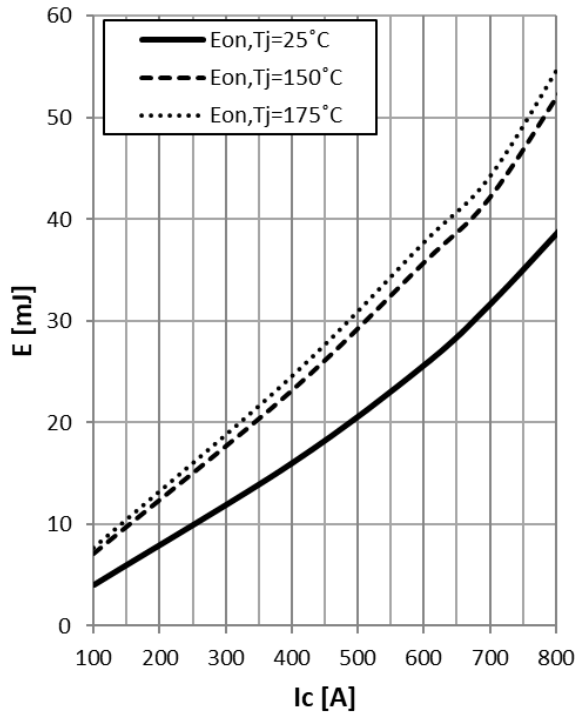


Figure 6. IGBT Turn-on Losses vs. Ic

Eon vs Rg

$V_{GE} = +15/-8V$, $I_C = 600A$, $V_{CE} = 400V$

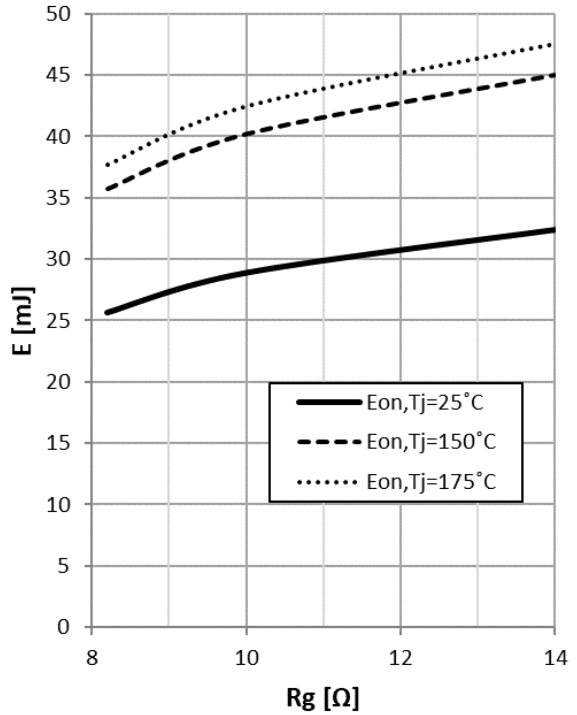


Figure 7. Eon vs. Rg

Eoff vs Rg

$V_{GE} = +15/-8V$, $I_C = 600A$, $V_{CE} = 400V$

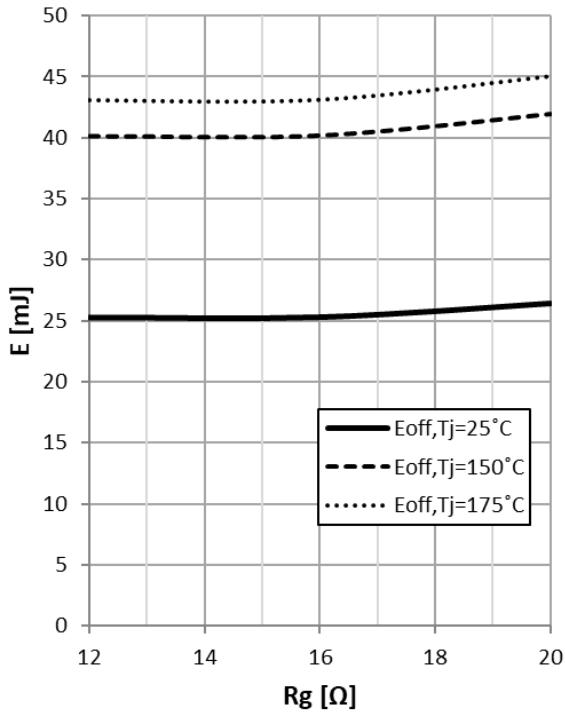


Figure 8. Eoff vs. Rg

Gate Charge Characteristic

$V_{CE} = 400V$, $I_C = 600A$, $T_j = 25^\circ C$

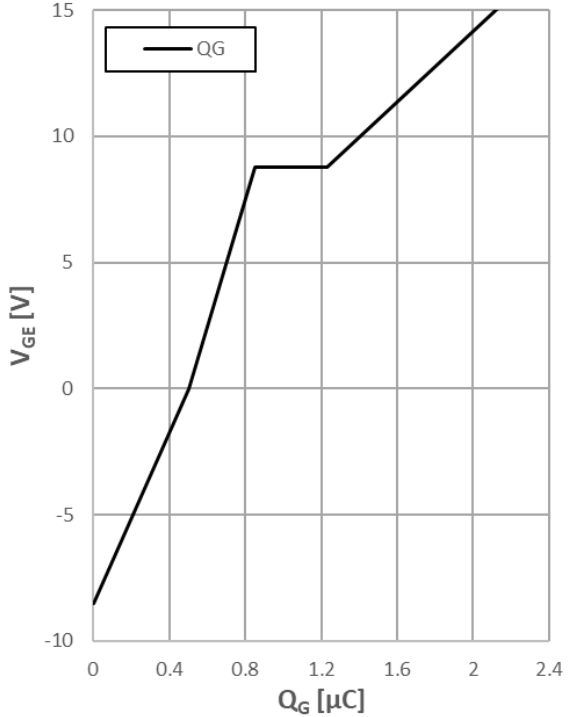


Figure 9. Gate Charge Characteristic

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Maximum allowed Vce

$I_{CES}=1\text{mA}$, $T_{vj} \leq 25^\circ\text{C}$; $I_{CES}=30\text{mA}$, $T_{vj} > 25^\circ\text{C}$

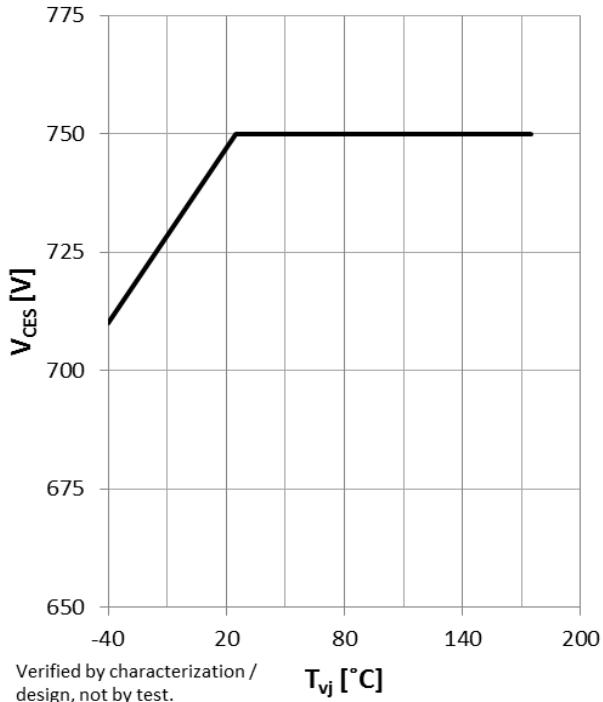


Figure 10. Maximum Allowed V_{CE}

Reverse Bias Safe Operating Area

$V_{GE} = +15/-8\text{V}$, $R_{Goff} = 10\Omega$, $T_{vj} = 175^\circ\text{C}$

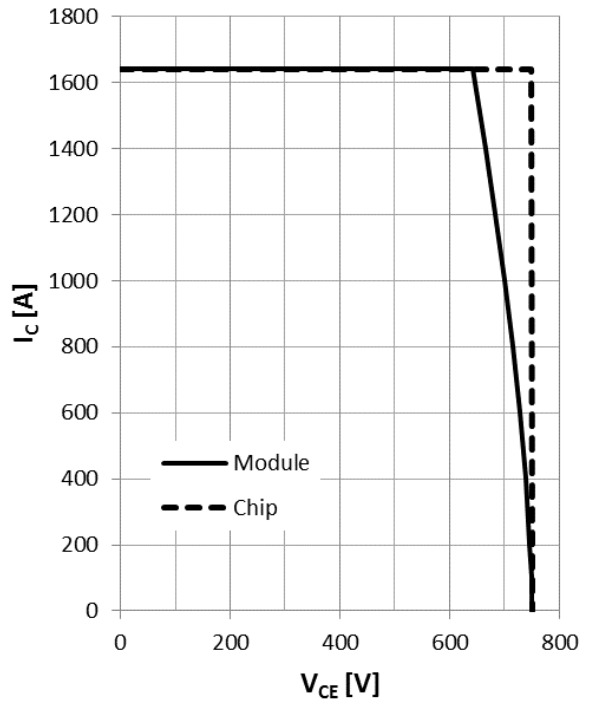


Figure 11. Reverse Bias Safe Operating Area

Capacitance Characteristic

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

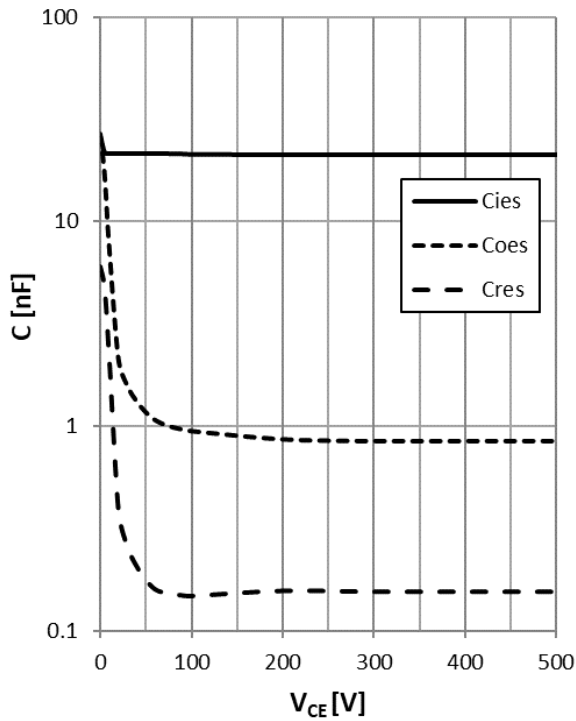


Figure 12. Capacitance Characteristic

Diode Forward Characteristic

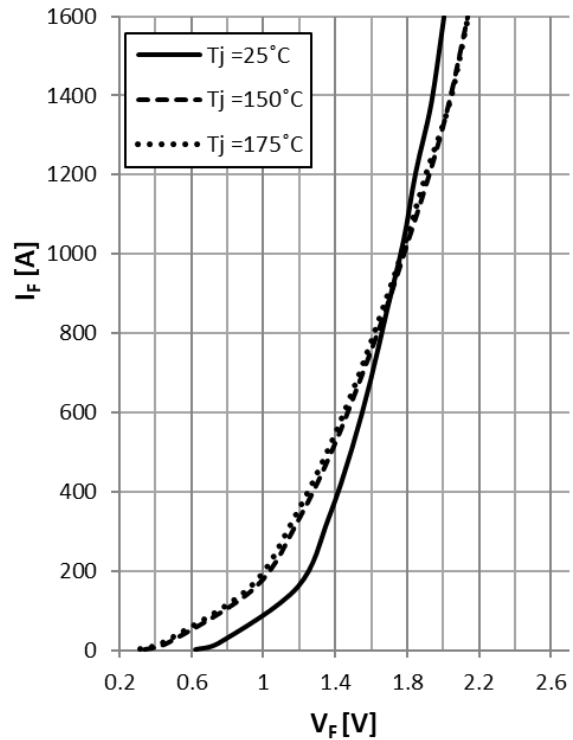


Figure 13. Diode Forward Characteristic

Diode Switching losses vs Rg

$I_F=600A, V_{CE}=400V$

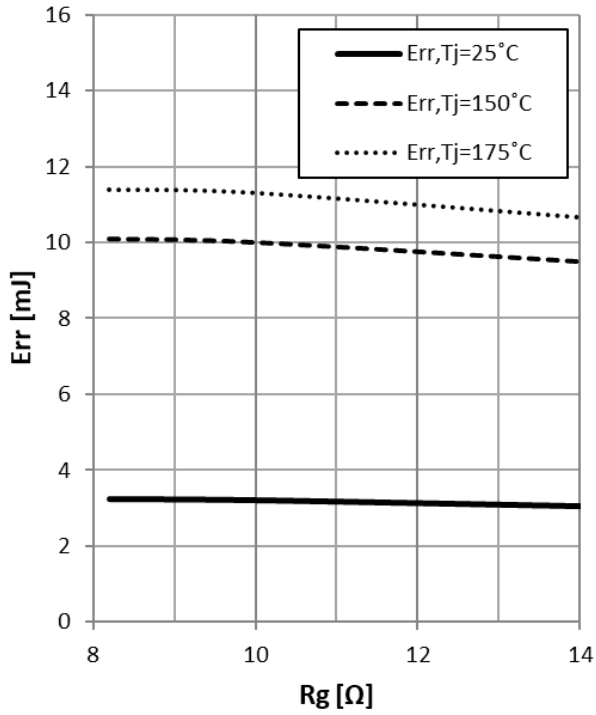


Figure 14. Diode Switching Losses vs. Rg

Diode Switching losses vs I_F

$R_{Gon}=8\Omega, V_{CE}=400V$

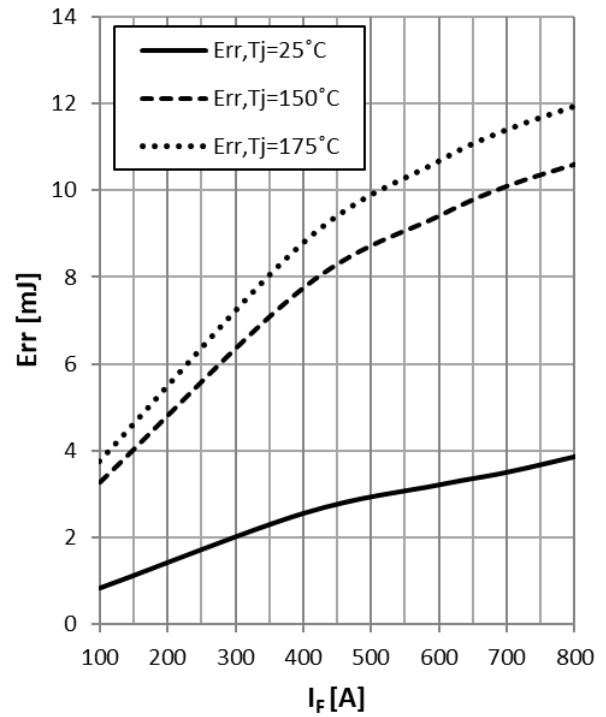


Figure 15. Diode Switching Losses vs. I_F

IGBT Transient Thermal Impedance

10 L/Min, Tf=65°C, 50/50 EGW, ref. cooler assy.

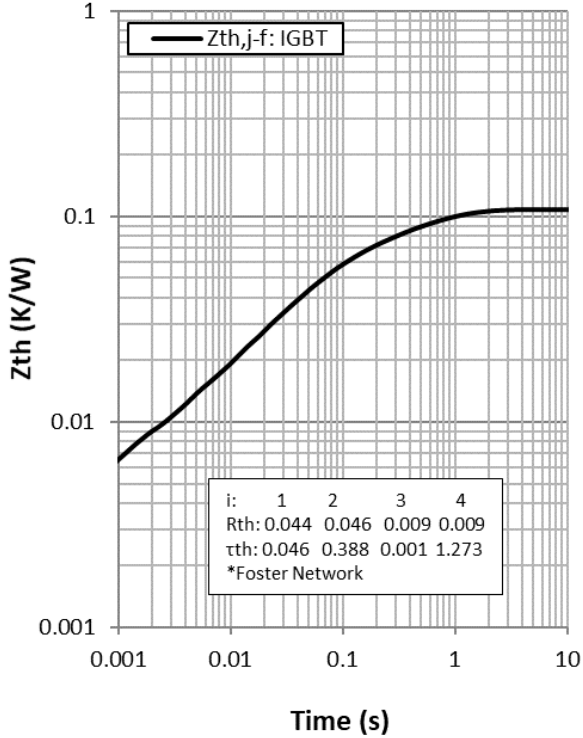


Figure 16. IGBT Transient Thermal Impedance

Diode Transient Thermal Impedance

10 L/Min, Tf=65°C, 50/50 EGW, ref. cooler assy.

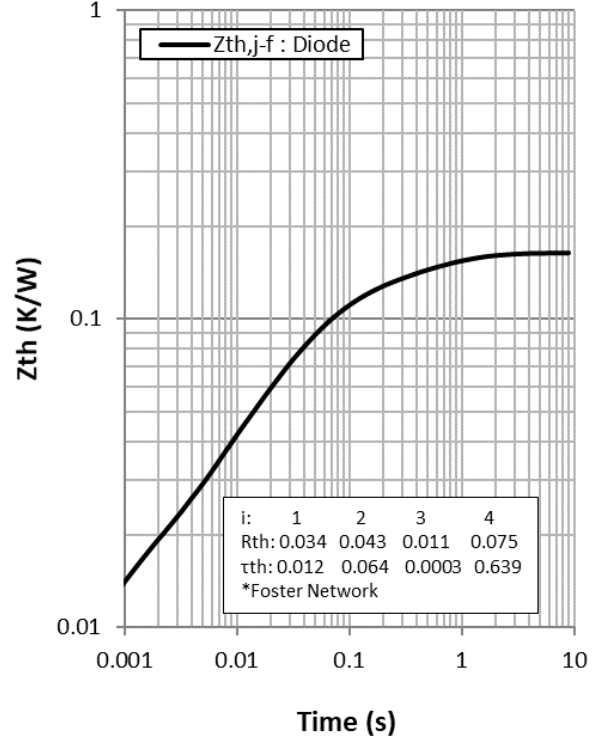


Figure 17. Diode Transient Thermal Impedance

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IGBT, Thermal Resistance
 $R_{th} = f(Q_v), T_f = 65^\circ\text{C}, 50/50 \text{ EGW},$
 ref. cooler assy.

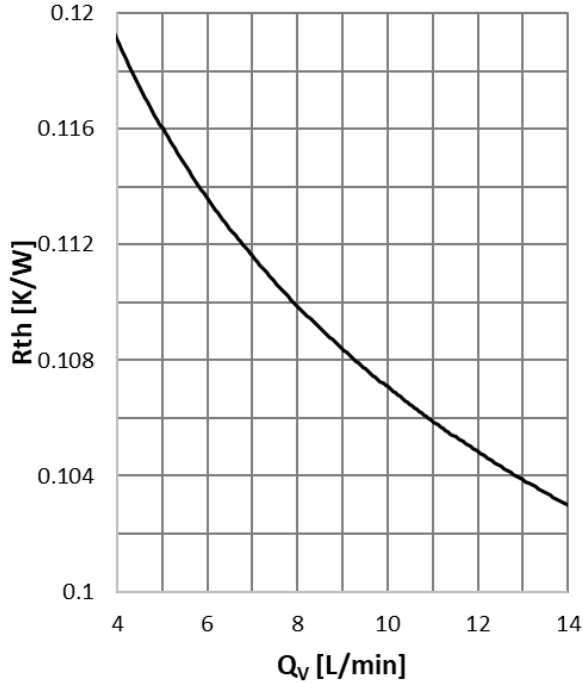


Figure 18. IGBT, Thermal Resistance

Diode, Thermal Resistance
 $R_{th} = f(Q_v), T_f = 65^\circ\text{C}, 50/50 \text{ EGW},$
 ref. cooler assy.

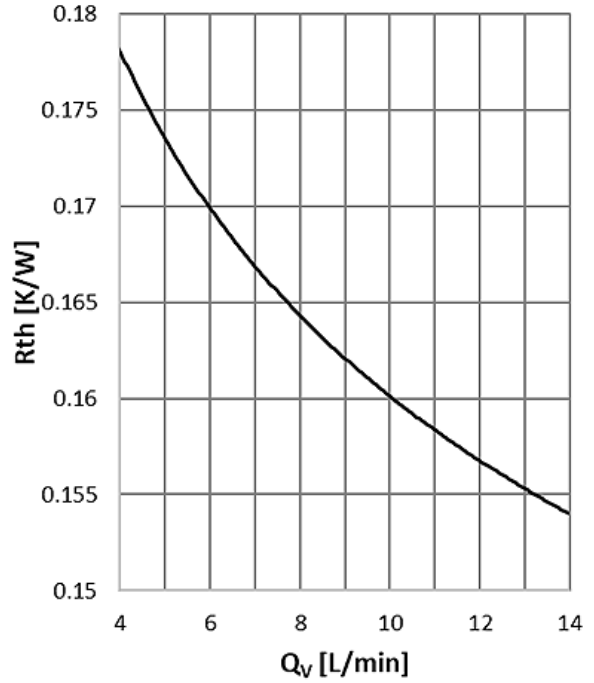


Figure 19. Diode, Thermal Resistance

Pressure drop in cooling circuit
 $\Delta p = f(Q_v), T_f = 65^\circ\text{C}, 50/50 \text{ EGW},$
 ref. cooler assy.

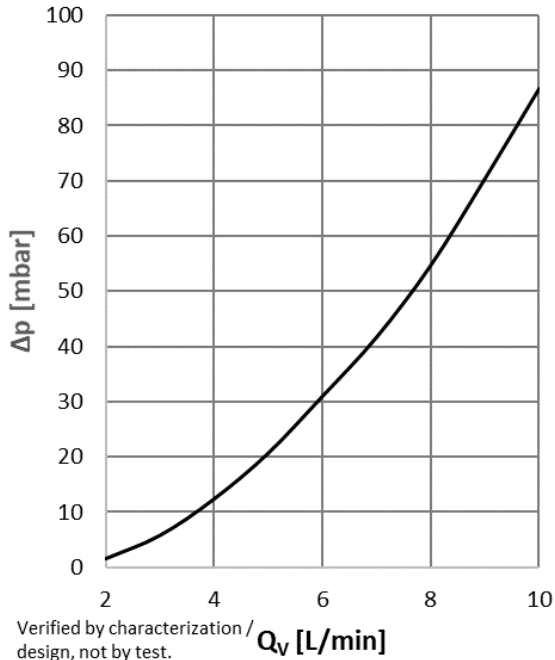


Figure 20. Pressure Drop In Cooling Circuit

NTC Thermistor-Temperature
 Characteristic (Typical)

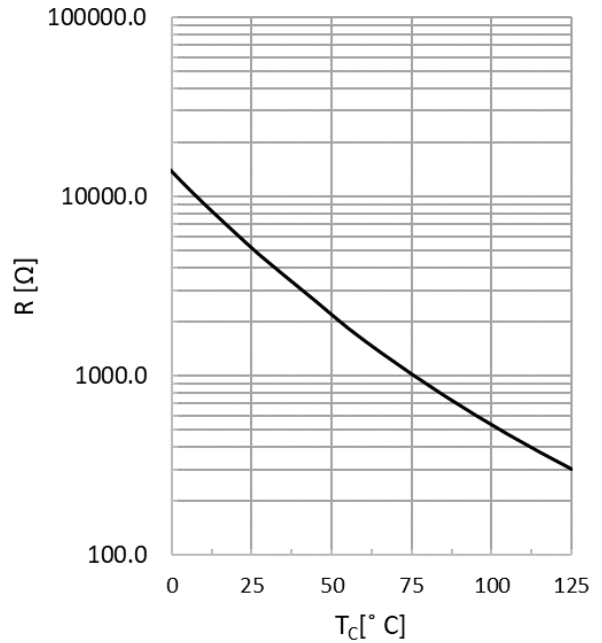


Figure 21. NTC Thermistor – Temperature Characteristic (Typical)

MECHANICAL CASE OUTLINE

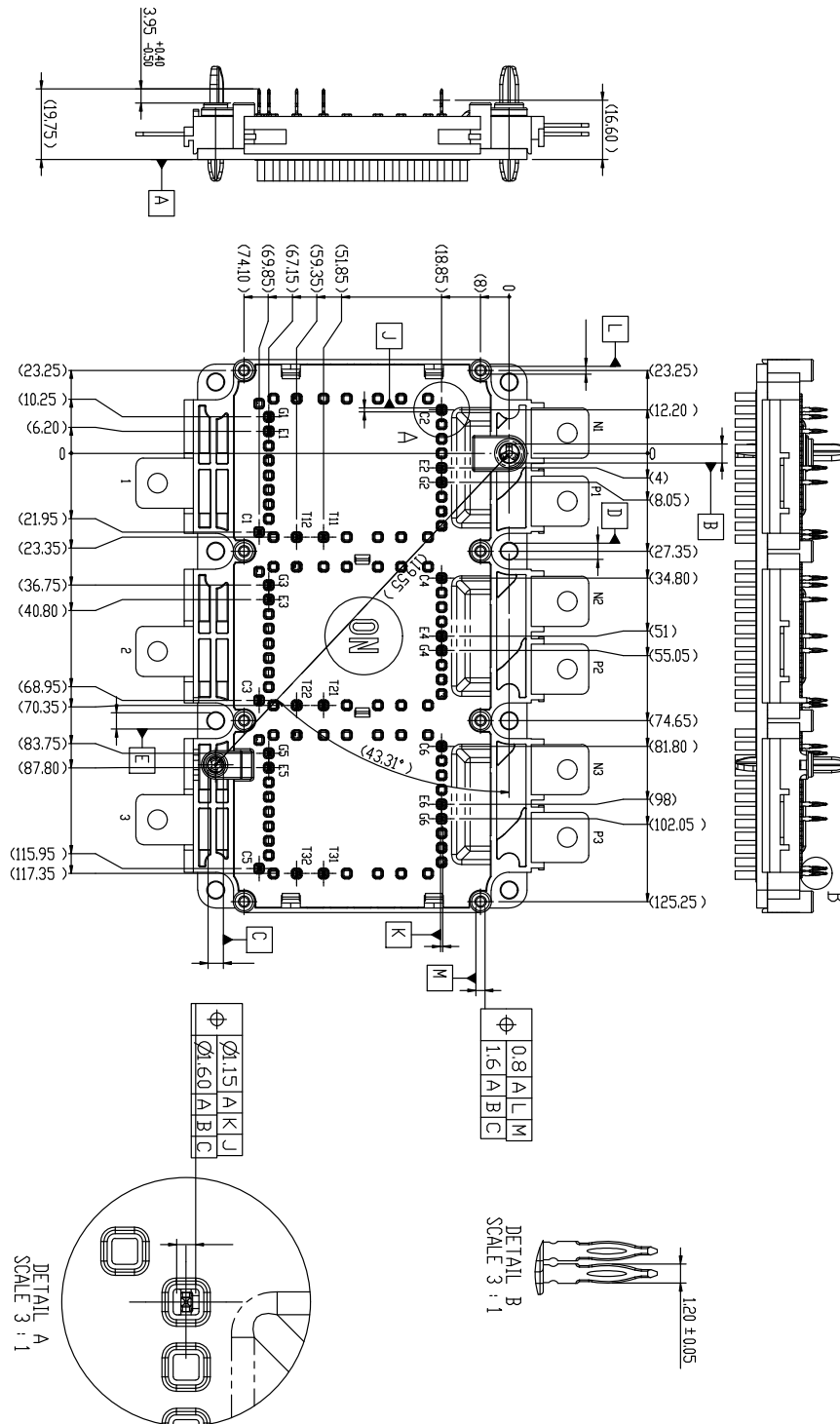
PACKAGE DIMENSIONS

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SSDC33, 154.50x92.0 (SPB) CASE 183AB ISSUE A

DATE 05 DEC 2019



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