

FS150R12W3T7_B11

EasyPACK™ module



EasyPACK™ module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and PressFIT / NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 150\text{ A} / I_{CRM} = 300\text{ A}$
 - Low $V_{CE,sat}$
 - TRENCHSTOP™ IGBT7
 - Overload operation up to 175°C
- Mechanical features
 - Al_2O_3 substrate with low thermal resistance
 - High power and thermal cycling capability
 - Integrated NTC temperature sensor
 - PressFIT contact technology



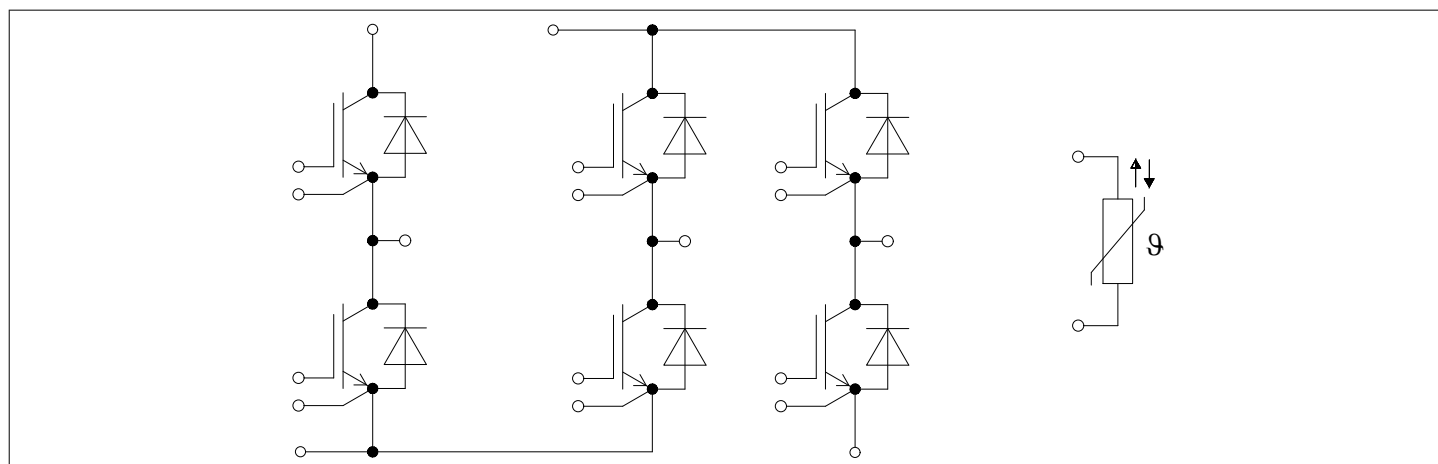
Potential applications

- Auxiliary inverters
- Motor drives
- Servo drives

Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description





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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	2.5	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	11.2	mm
Creepage distance	d_{Creep}	terminal to terminal	6.8	mm
Clearance	d_{Clear}	terminal to heatsink	9.4	mm
Clearance	d_{Clear}	terminal to terminal	5.5	mm
Comparative tracking index	CTI		>400	
Relative thermal index (electrical)	RTI	housing	140	°C

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{sCE}			15		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25^\circ\text{C}$, per switch		1.9		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	1.3	1.5	Nm
Weight	G			78		g

Note: The current under continuous operation is limited to 25A rms per connector pin.

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \max} = 175^\circ\text{C}$	$T_H = 45^\circ\text{C}$	150	A
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$		300	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 4 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 150\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.55	1.80	V
			$T_{vj} = 125\ ^\circ C$		1.69		
			$T_{vj} = 175\ ^\circ C$		1.77		
Gate threshold voltage	V_{GEth}	$I_C = 3.5\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$			2.5		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			1		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			30.1		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.105		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			0.0012	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.156		μs
			$T_{vj} = 125\ ^\circ C$		0.169		
			$T_{vj} = 175\ ^\circ C$		0.174		
Rise time (inductive load)	t_r	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.065		μs
			$T_{vj} = 125\ ^\circ C$		0.068		
			$T_{vj} = 175\ ^\circ C$		0.071		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.339		μs
			$T_{vj} = 125\ ^\circ C$		0.417		
			$T_{vj} = 175\ ^\circ C$		0.460		
Fall time (inductive load)	t_f	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.100		μs
			$T_{vj} = 125\ ^\circ C$		0.189		
			$T_{vj} = 175\ ^\circ C$		0.251		
Turn-on energy loss per pulse	E_{on}	$I_C = 150\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega, di/dt = 1600\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		16.2		mJ
			$T_{vj} = 125\ ^\circ C$		22.1		
			$T_{vj} = 175\ ^\circ C$		25.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 150\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega, dv/dt = 3250\ V/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		9.65		mJ
			$T_{vj} = 125\ ^\circ C$		15.1		
			$T_{vj} = 175\ ^\circ C$		18.6		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 8\ \mu s, T_{vj} = 150\ ^\circ C$		480		A
			$t_P \leq 7\ \mu s, T_{vj} = 175\ ^\circ C$		450		

(table continues...)

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3 Diode, Inverter

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, $\lambda_{grease} = 3.3 \text{ W/(m}^2\text{K)}$		0.418		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	°C

Note: $T_{vj\text{ op}} > 150^\circ\text{C}$ is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC forward current	I_F			150	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		300	A
I^2t - value	I^2t	$V_R = 0 \text{ V}$, $t_p = 10 \text{ ms}$	$T_{vj} = 125^\circ\text{C}$	2250	A^2s
			$T_{vj} = 175^\circ\text{C}$	1950	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$		1.72	V
			$T_{vj} = 125^\circ\text{C}$		1.59	
			$T_{vj} = 175^\circ\text{C}$		1.52	
Peak reverse recovery current	I_{RM}	$I_F = 150 \text{ A}$, $V_R = 600 \text{ V}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 1600 \text{ A}/\mu\text{s}$ ($T_{vj} = 175^\circ\text{C}$)	$T_{vj} = 25^\circ\text{C}$		66.2	A
			$T_{vj} = 125^\circ\text{C}$		93.6	
			$T_{vj} = 175^\circ\text{C}$		112	
Recovered charge	Q_r	$I_F = 150 \text{ A}$, $V_R = 600 \text{ V}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 1600 \text{ A}/\mu\text{s}$ ($T_{vj} = 175^\circ\text{C}$)	$T_{vj} = 25^\circ\text{C}$		10.7	μC
			$T_{vj} = 125^\circ\text{C}$		20.5	
			$T_{vj} = 175^\circ\text{C}$		26.9	
Reverse recovery energy	E_{rec}	$I_F = 150 \text{ A}$, $V_R = 600 \text{ V}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 1600 \text{ A}/\mu\text{s}$ ($T_{vj} = 175^\circ\text{C}$)	$T_{vj} = 25^\circ\text{C}$		3.28	mJ
			$T_{vj} = 125^\circ\text{C}$		6.13	
			$T_{vj} = 175^\circ\text{C}$		8.32	

(table continues...)

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4 NTC-Thermistor

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 3.3 \text{ W/(m}^2\text{K)}$		0.687		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	°C

Note: $T_{vj\text{ op}} > 150^\circ\text{C}$ is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25^\circ\text{C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100^\circ\text{C}$, $R_{100} = 493 \Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25^\circ\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

Note: Specification according to the valid application note.

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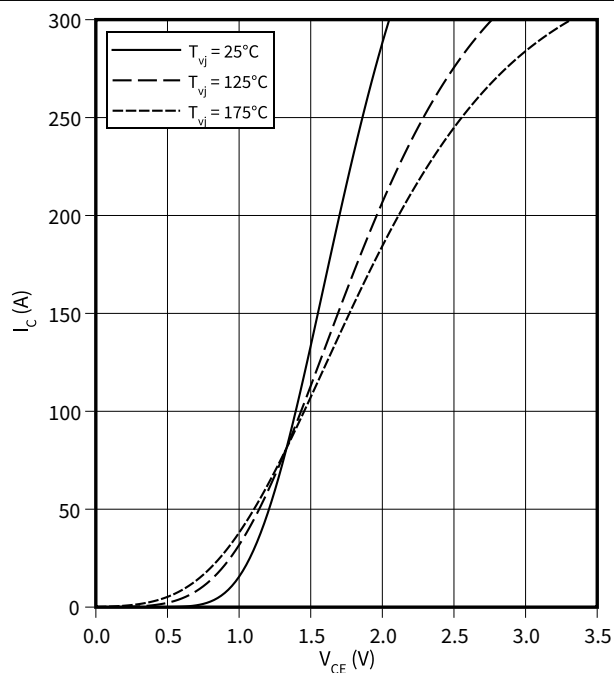
5 Characteristics diagrams

5 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

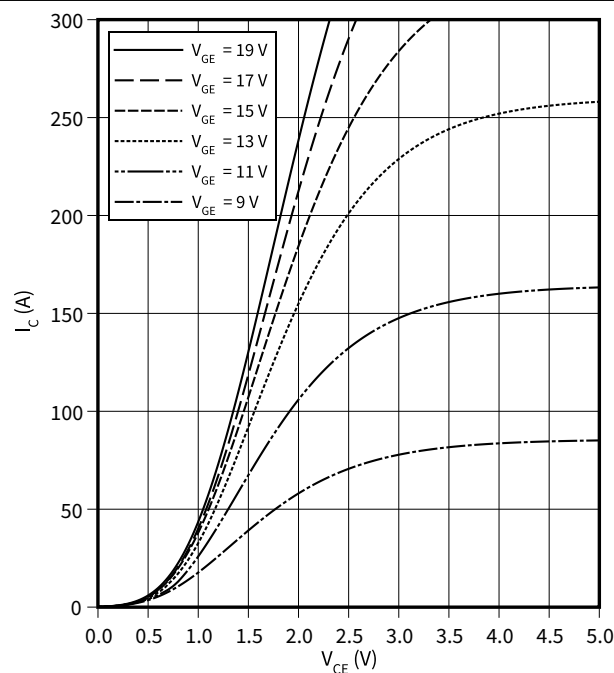
$$V_{GE} = 15 \text{ V}$$



output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

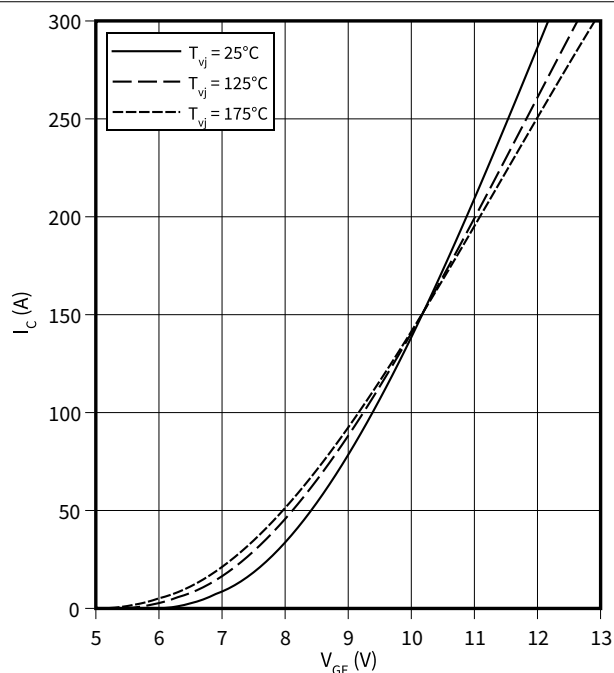
$$T_{vj} = 175 \text{ °C}$$



transfer characteristic (typical), IGBT, Inverter

$$I_C = f(V_{GE})$$

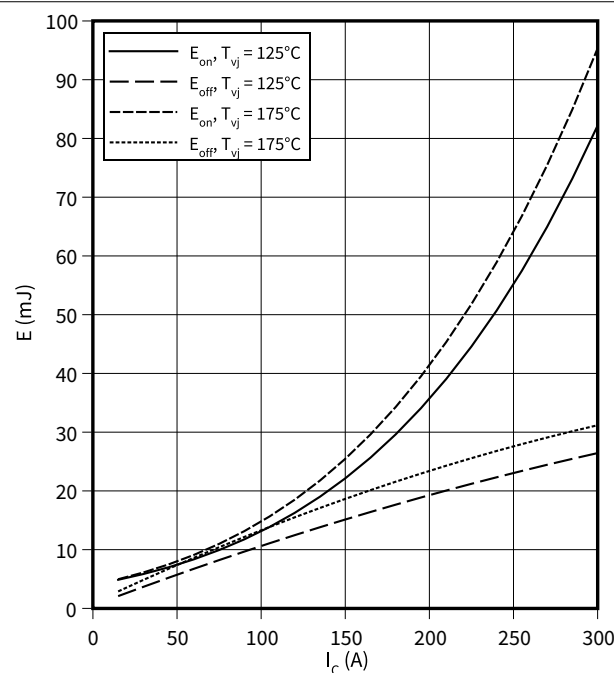
$$V_{CE} = 20 \text{ V}$$



switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 3.6 \text{ } \Omega, R_{Gon} = 3.6 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



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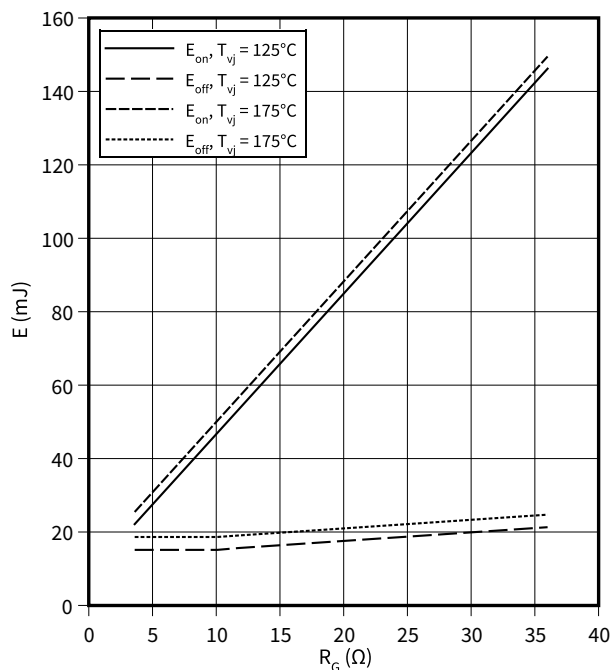
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5 Characteristics diagrams

switching losses (typical), IGBT, Inverter

$$E = f(R_G)$$

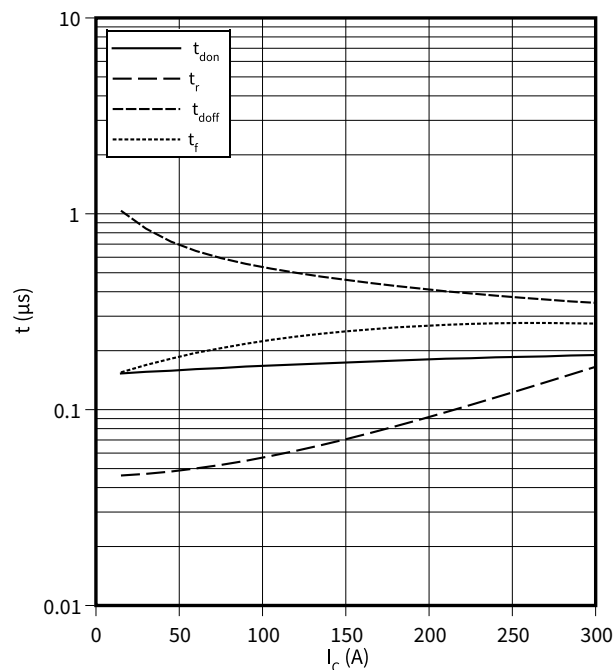
$$I_C = 150 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



switching times (typical), IGBT, Inverter

$$t = f(I_C)$$

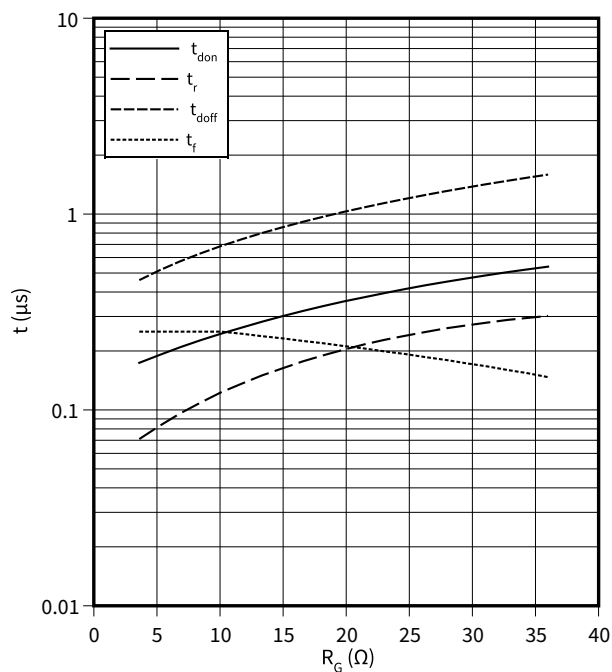
$$R_{Goff} = 3.6 \Omega, R_{Gon} = 3.6 \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175^\circ\text{C}$$



switching times (typical), IGBT, Inverter

$$t = f(R_G)$$

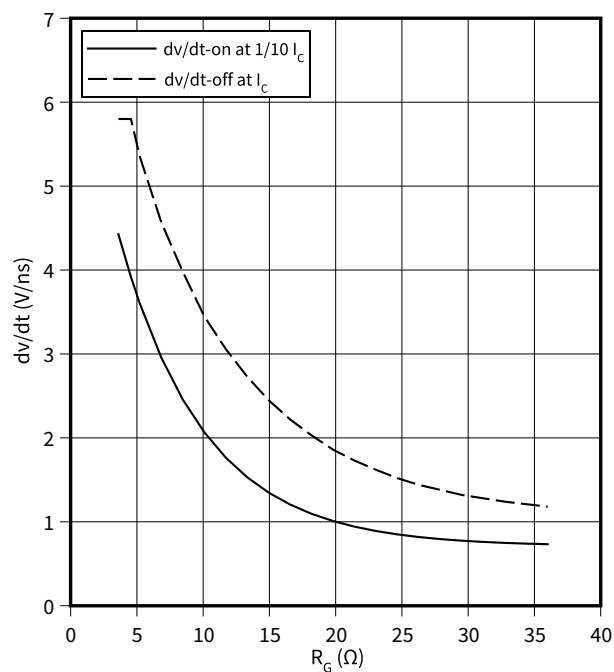
$$I_C = 150 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175^\circ\text{C}$$



Voltage slope (typical), IGBT, Inverter

$$dv/dt = f(R_G)$$

$$I_C = 150 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25^\circ\text{C}$$



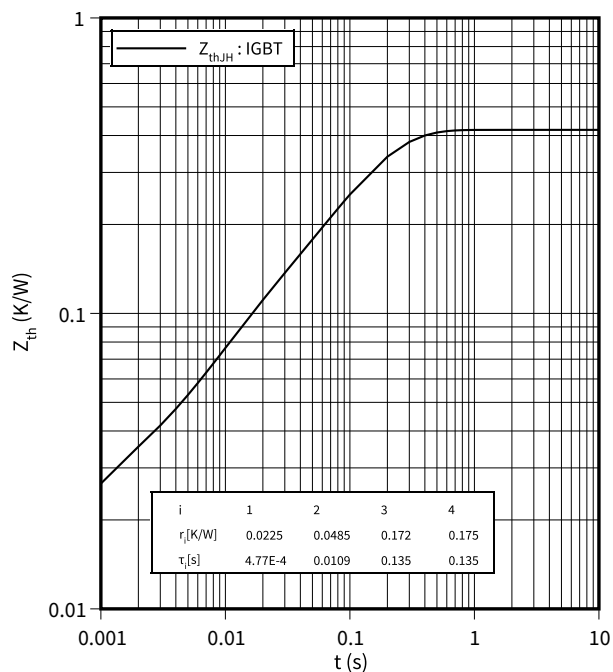
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5 Characteristics diagrams

transient thermal impedance , IGBT, Inverter

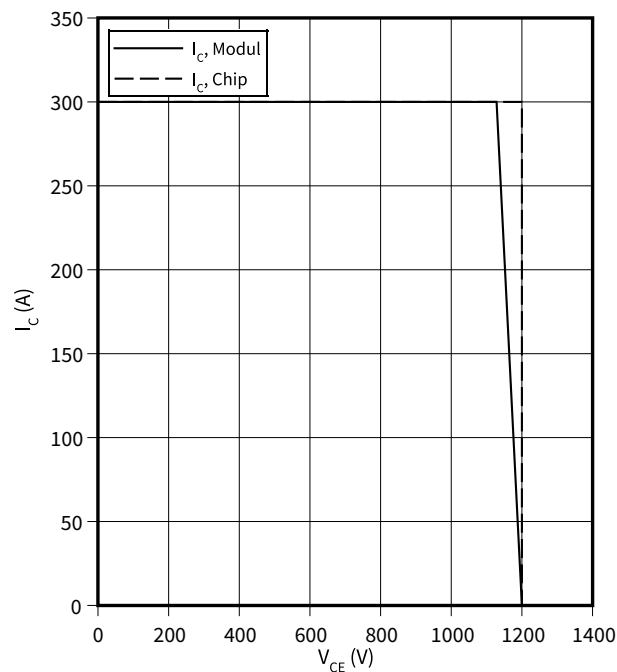
$$Z_{th} = f(t)$$



reverse bias safe operating area (RBSOA), IGBT, Inverter

$$I_C = f(V_{CE})$$

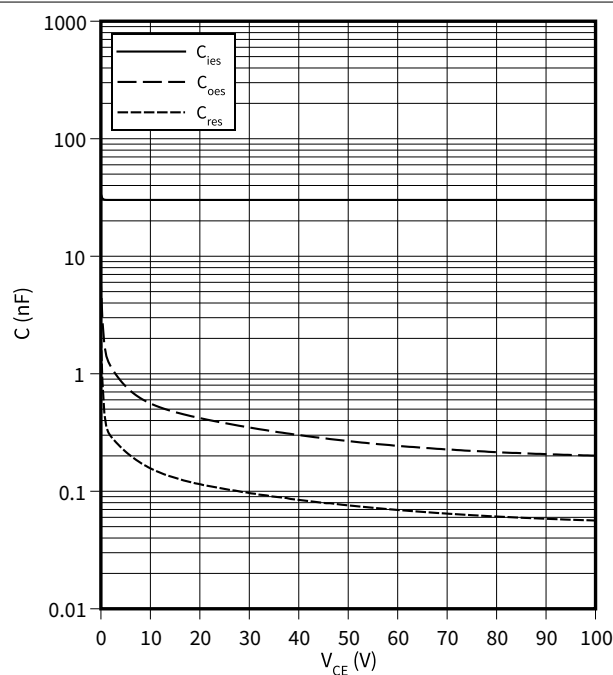
$$R_{Goff} = 3.6 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$$



capacity characteristic (typical), IGBT, Inverter

$$C = f(V_{CE})$$

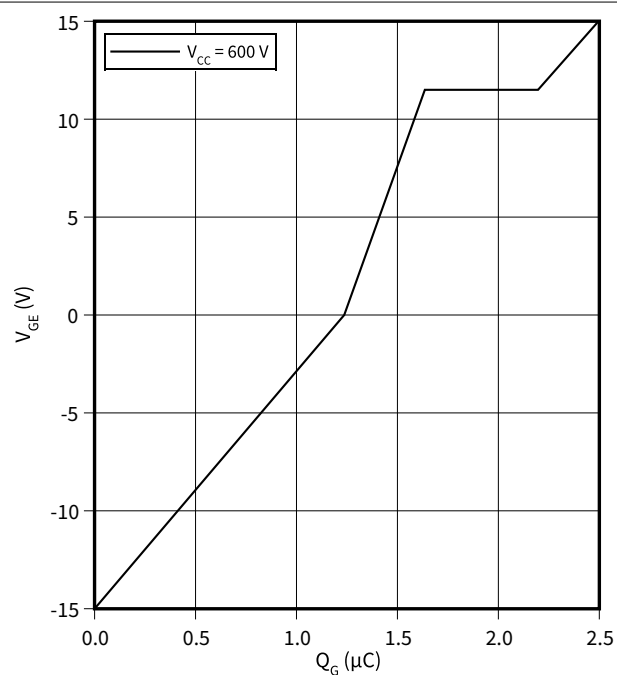
$$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$$



gate charge characteristic (typical), IGBT, Inverter

$$V_{GE} = f(Q_G)$$

$$I_C = 150 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$$

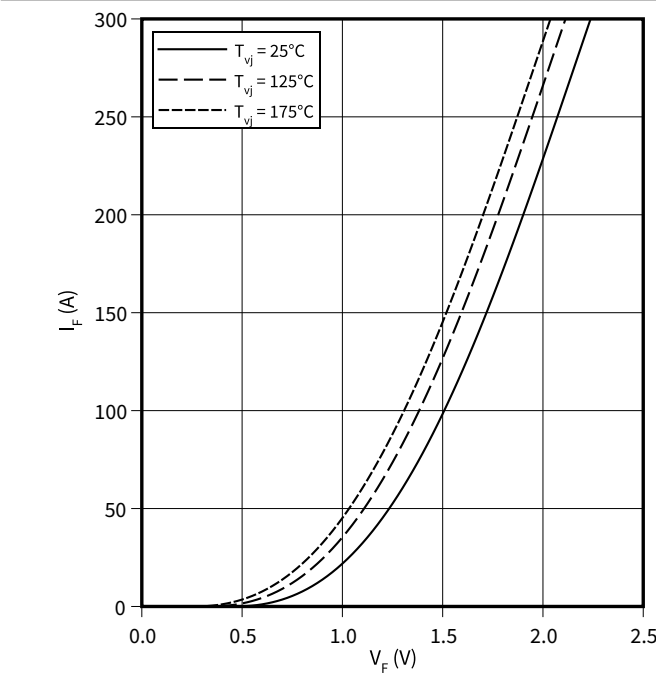




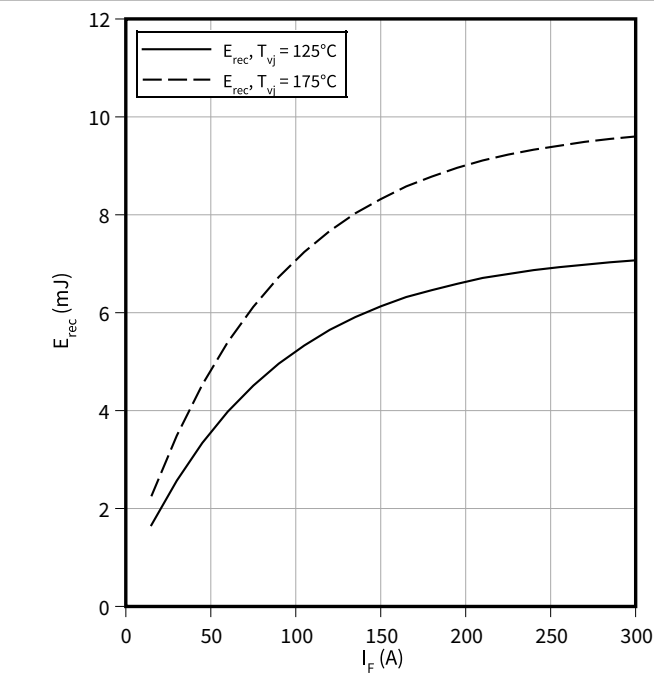
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5 Characteristics diagrams

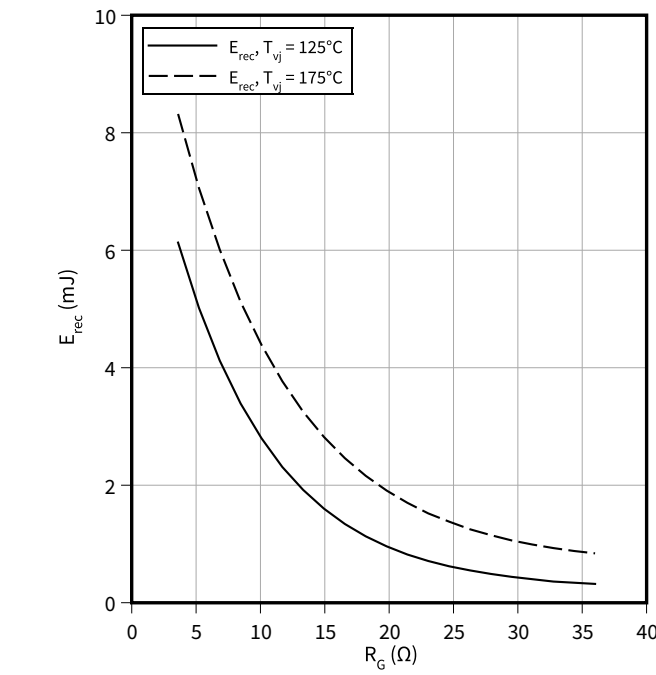
forward characteristic of (typical), Diode, Inverter
 $I_F = f(V_F)$



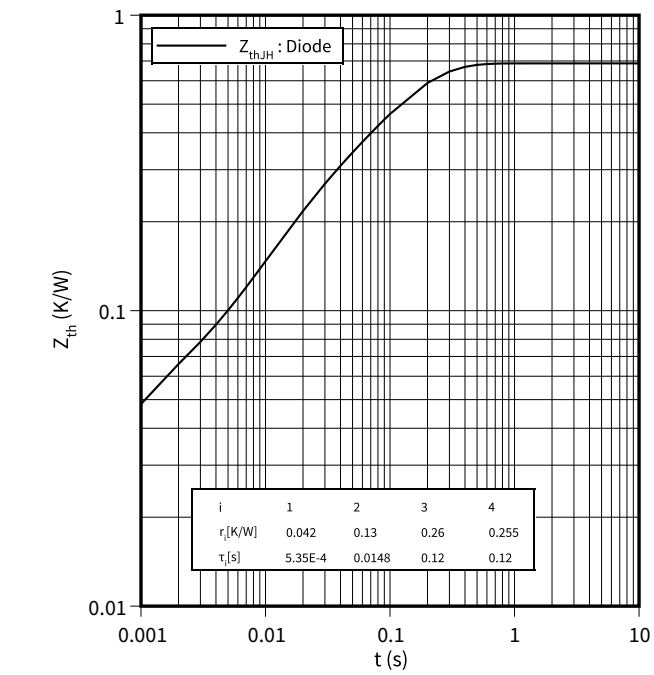
switching losses (typical), Diode, Inverter
 $E_{rec} = f(I_F)$
 $R_G = 3.6\ \Omega$, $V_R = 600\ \text{V}$



switching losses (typical), Diode, Inverter
 $E_{rec} = f(R_G)$
 $I_F = 150\ \text{A}$, $V_R = 600\ \text{V}$



transient thermal impedance , Diode, Inverter
 $Z_{th} = f(t)$



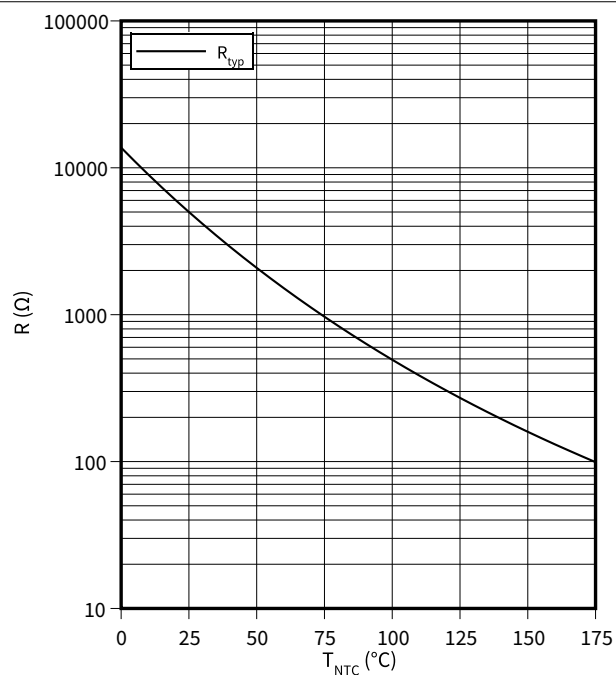
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5 Characteristics diagrams

temperature characteristic (typical), NTC-Thermistor

$$R = f(T_{NTC})$$



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6 Circuit diagram

6 Circuit diagram

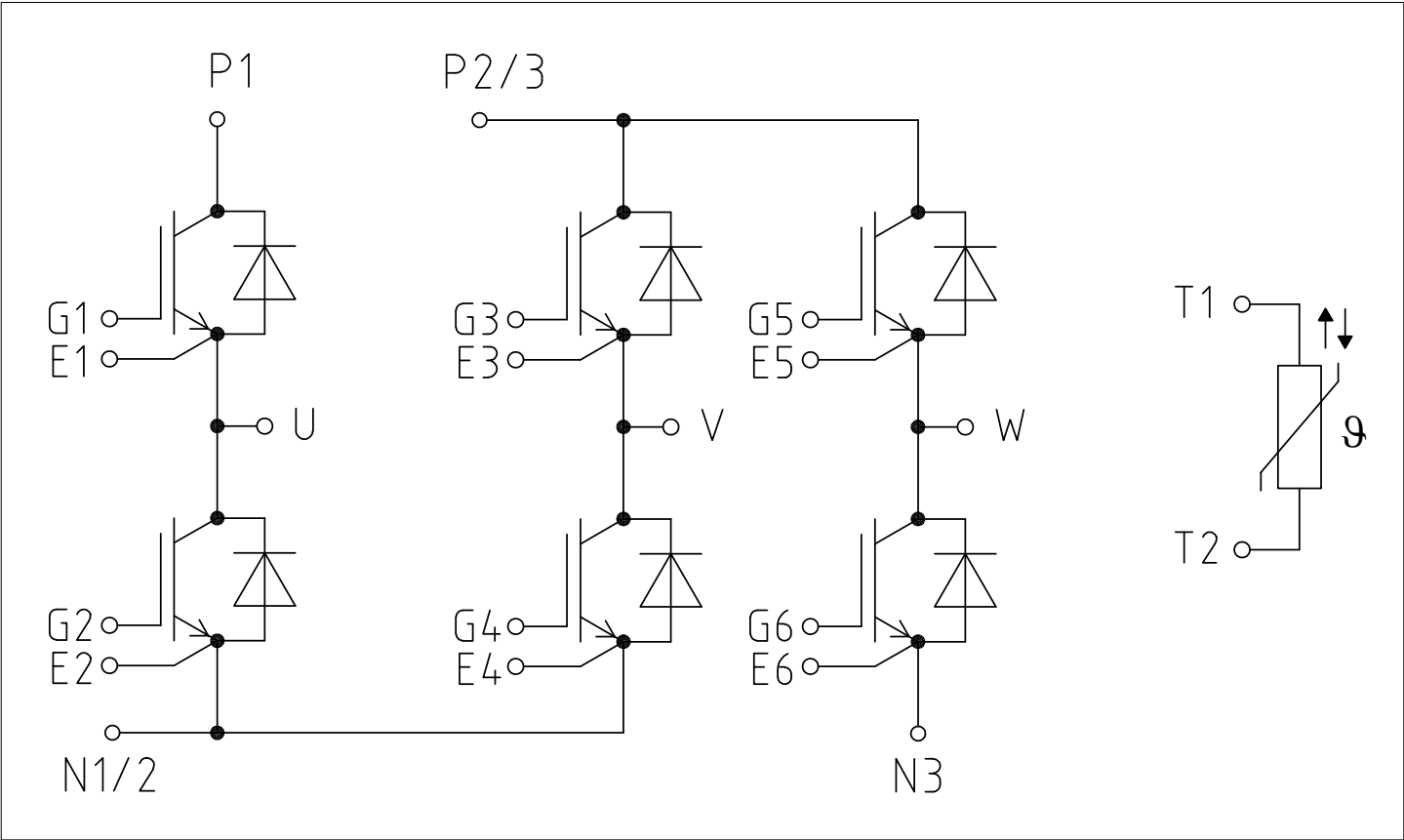


Figure 1

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7 Package outlines

7 Package outlines

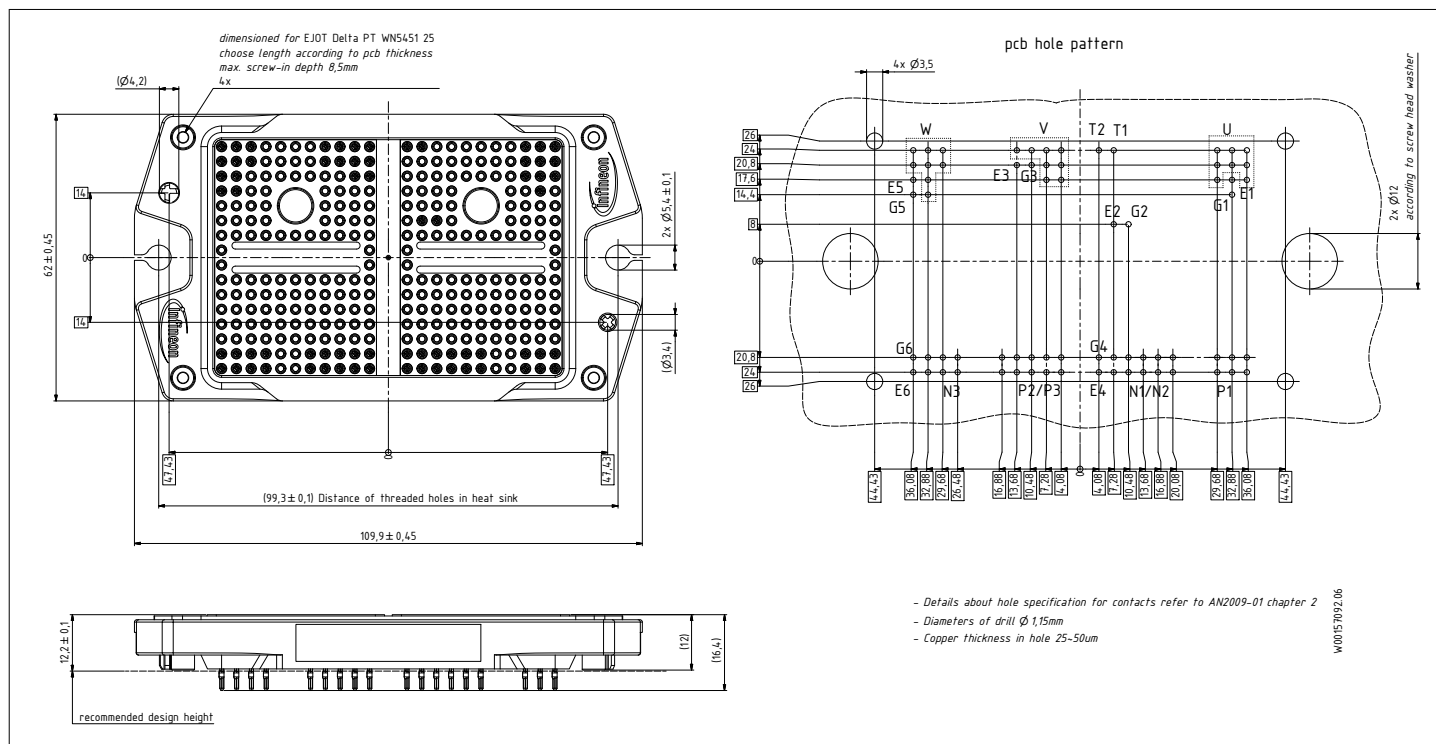


Figure 2

8 Module label code

Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content Module serial number Module material number Production order number Date code (production year) Date code (production week)	Digit 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	Example 71549 142846 55054991 15 30
Example	71549142846550549911530 71549142846550549911530		

Figure 3



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Revision history

Revision history

Document revision	Date of release	Description of changes
1.00	2021-11-02	Final datasheet

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