EconoDUAL™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and PressFIT / NTC / current sense shunt

Features

Typical Appearance

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 750 A / I_{CRM} = 1500 A
  - Integrated temperature sensor
  - TRENCHSTOP™ IGBT7
  - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
  - PressFIT contact technology
  - Standard housing
  - Isolated base plate
  - High power density

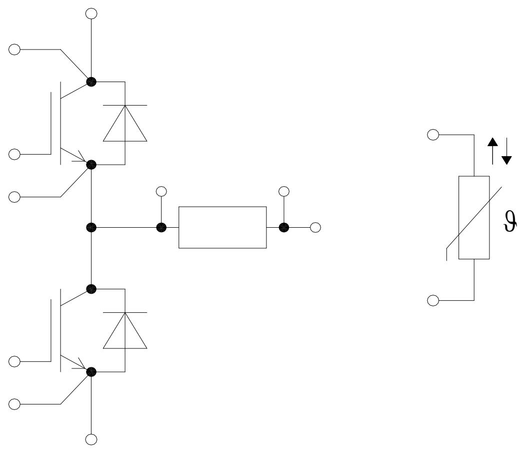
Potential applications

- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- UPS systems

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 Hz, t = 1 min	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	14.5	mm
Creepage distance	d_{Creep}	terminal to terminal	13.0	mm
Clearance	d_{Clear}	terminal to heatsink	12.5	mm
Clearance	d_{Clear}	terminal to terminal	10.0	mm
Comparative tracking index	*CTI*		> 200	
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}				27		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C = 25 °C, per switch			1		mΩ
Storage temperature	T_{stg}			-40		125	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note	M5, Screw	3		6	Nm
Terminal connection torque	*M*	- Mounting according to valid application note	M6, Screw	3		6	Nm
Weight	*G*				345		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 95 °C	750	A
Maximum RMS module DC-terminal current	I_{tRMS}		$T_{Terminal}$ = 90 °C, T_C = 90 °C	562	A
			$T_{Terminal}$ = 105 °C, T_C = 90 °C	545	

(table continues...)

Table 3 **(continued) Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$	1500	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 = 750 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	1.75	V
			T_{vj} = 125 °C		1.65		
			T_{vj} = 175 °C		1.75		
Gate threshold voltage	V_{GEth}	I_C = 15.3 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 600 V			12		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.5		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			115		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.58		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			51	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 750 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.51 Ω	T_{vj} = 25 °C		0.293		µs
			T_{vj} = 125 °C		0.322		
			T_{vj} = 175 °C		0.341		
Rise time (inductive load)	t_r	I_C = 750 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.51 Ω	T_{vj} = 25 °C		0.081		µs
			T_{vj} = 125 °C		0.090		
			T_{vj} = 175 °C		0.095		
Turn-off delay time (inductive load)	t_{doff}	I_C = 750 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 0.51 Ω	T_{vj} = 25 °C		0.450		µs
			T_{vj} = 125 °C		0.540		
			T_{vj} = 175 °C		0.587		
Fall time (inductive load)	t_f	I_C = 750 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 0.51 Ω	T_{vj} = 25 °C		0.108		µs
			T_{vj} = 125 °C		0.249		
			T_{vj} = 175 °C		0.347		
Turn-on energy loss per pulse	E_{on}	I_C = 750 A, V_{CC} = 600 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Gon} = 0.51 Ω, di/dt = 6800 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		36.7		mJ
			T_{vj} = 125 °C		56.4		
			T_{vj} = 175 °C		70.5		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 750 A, V_{CC} = 600 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Goff} = 0.51 Ω, dv/dt = 3100 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		63.6		mJ
			T_{vj} = 125 °C		101		
			T_{vj} = 175 °C		123		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 800 V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	t_P ≤ 8 µs, T_{vj}=150 °C		3300		A
			t_P ≤ 6 µs, T_{vj}=175 °C		3150		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.0520	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.0260		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

Note: *Tvj op > 150°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 °C	1200	V
Continuous DC forward current	I_F			750	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		1500	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	46800	A^2s
			T_{vj} = 175 °C	35000	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 750 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.80	2.10	V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.60		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 750 A, V_{GE} = -15 V, -di_F/dt = 6800 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		392		A
			T_{vj} = 125 °C		503		
			T_{vj} = 175 °C		555		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 750 A, V_{GE} = -15 V, -di_F/dt = 6800 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		44.5		µC
			T_{vj} = 125 °C		93.8		
			T_{vj} = 175 °C		124		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 750 A, V_{GE} = -15 V, -di_F/dt = 6800 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		18.2		mJ
			T_{vj} = 125 °C		37.7		
			T_{vj} = 175 °C		48.9		
Thermal resistance, junction to case	R_{thJC}	per diode				0.101	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.0380		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: *Tvj op > 150°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 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °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.*

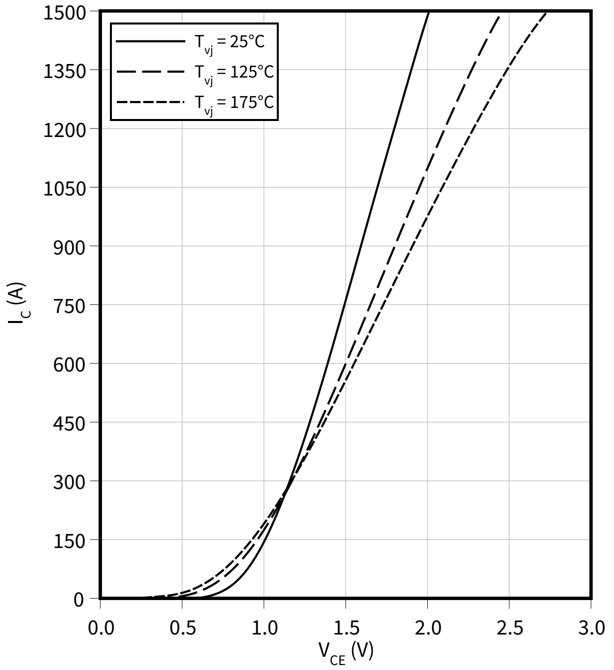
5 Shunt

Table 8 Characteristic values

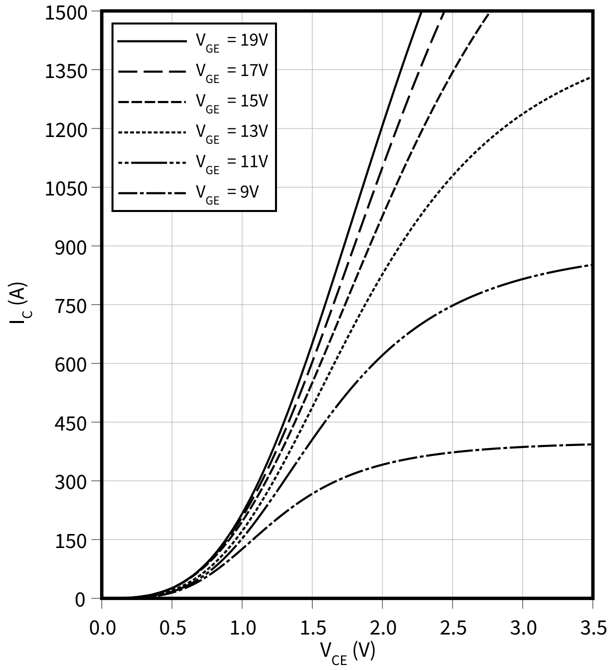
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{20}	T_C = 20 °C		0.169		mΩ
Temperature coefficient	TCR	20 °C ≤ T_{Range} ≤ 150 °C		175		ppm/K
Load capacity per shunt resistor	P	T_C = 80 °C			39	W
Operation temperature	$T_{vj\,op}$				200	°C
Thermal resistance, junction to case	R_{thJC}	per shunt			3.07	K/W

6 Characteristics diagrams

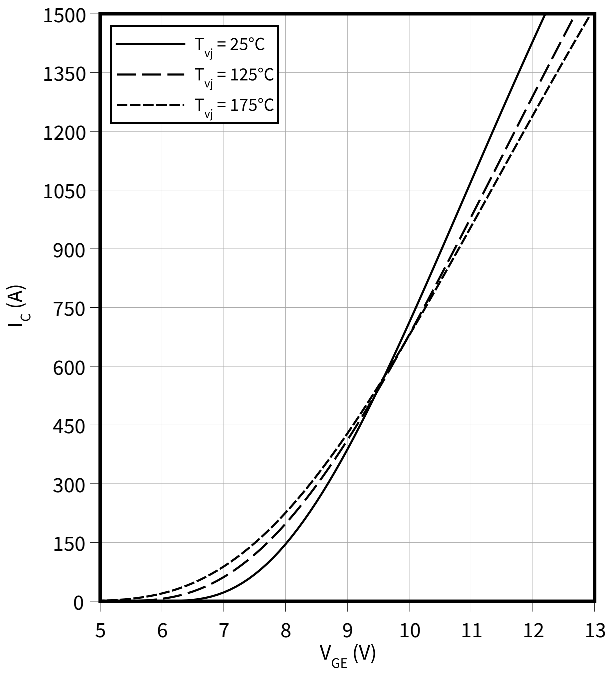
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



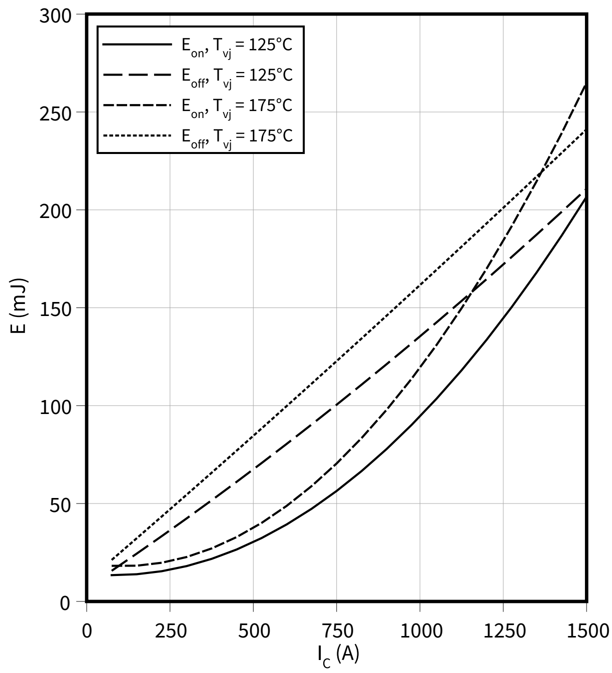
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



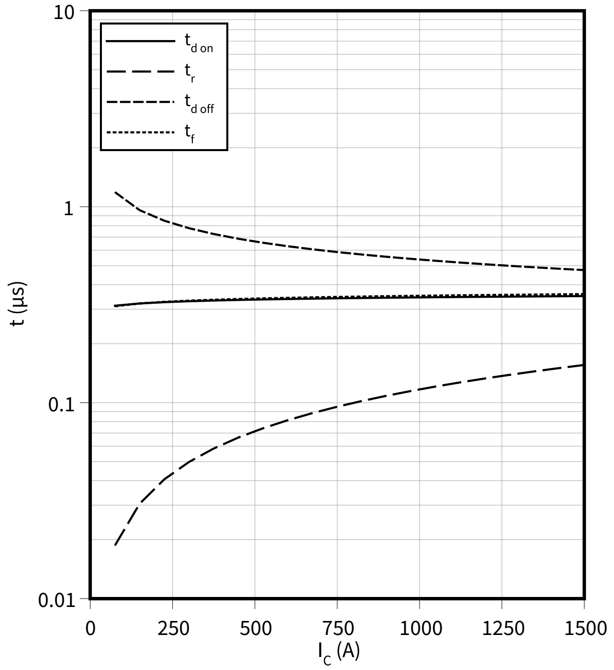
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 0.51$ Ω, $R_{Gon} = 0.51$ Ω, $V_{CC} = 600$ V, $V_{GE} = -15$ / 15 V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

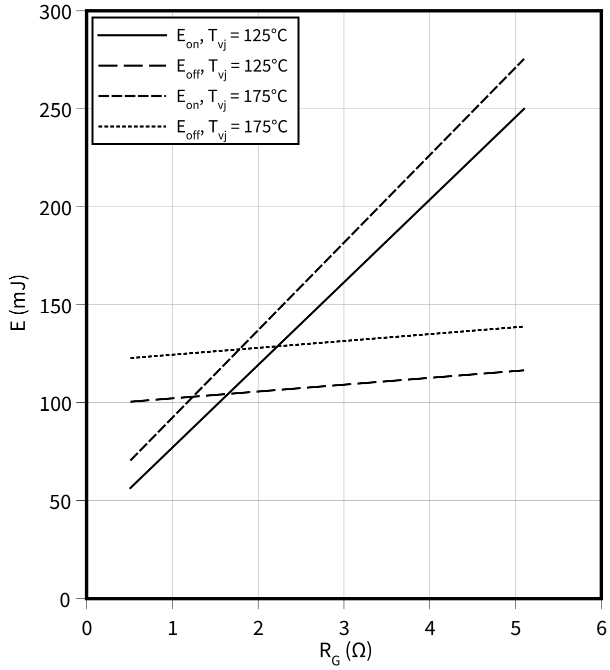
$R_{Goff} = 0.51\ \Omega$, $R_{Gon} = 0.51\ \Omega$, $V_{GE} = \pm15$ V, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



Switching losses (typical), IGBT, Inverter

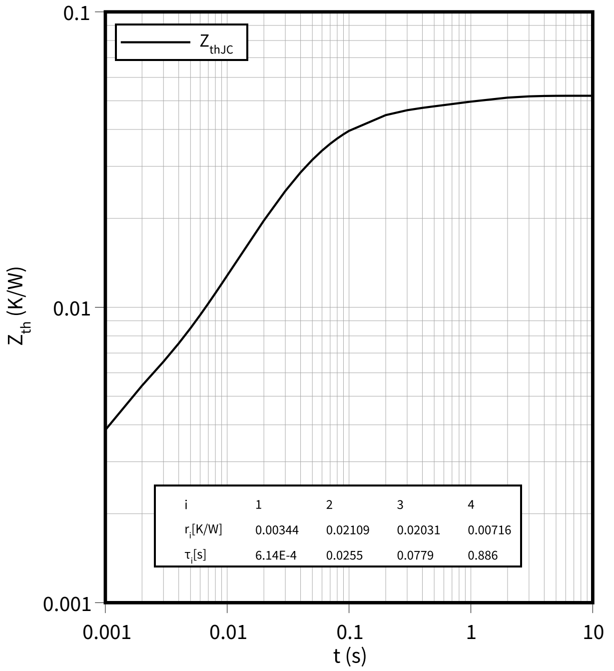
$E = f(R_G)$

$I_C = 750$ A, $V_{CC} = 600$ V, $V_{GE} = -15 / 15$ V



Transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$

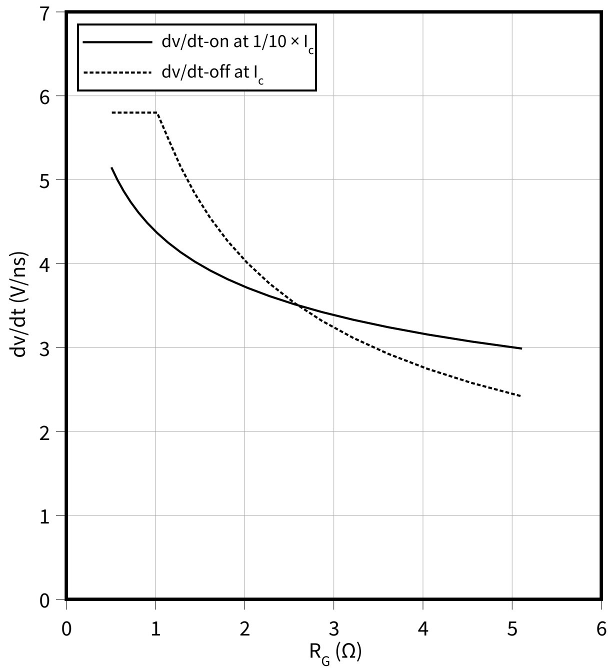


i	1	2	3	4
r_i[K/W]	0.00344	0.02109	0.02031	0.00716
τ_i[s]	6.14E-4	0.0255	0.0779	0.886

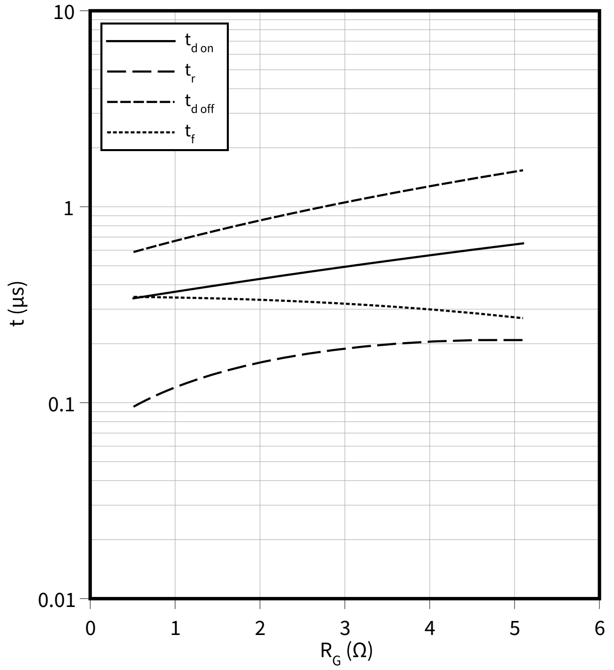
Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

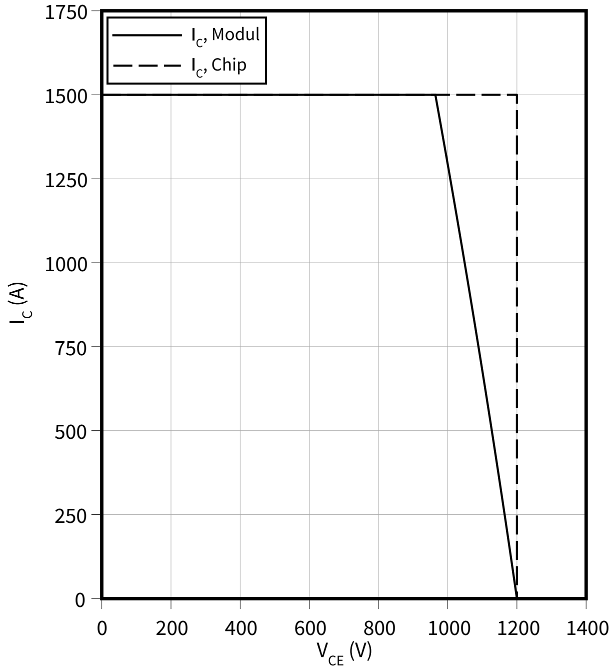
$I_C = 750$ A, $V_{CE} = 600$ V, $V_{GE} = \pm15$ V, $T_{vj} = 25$ °C



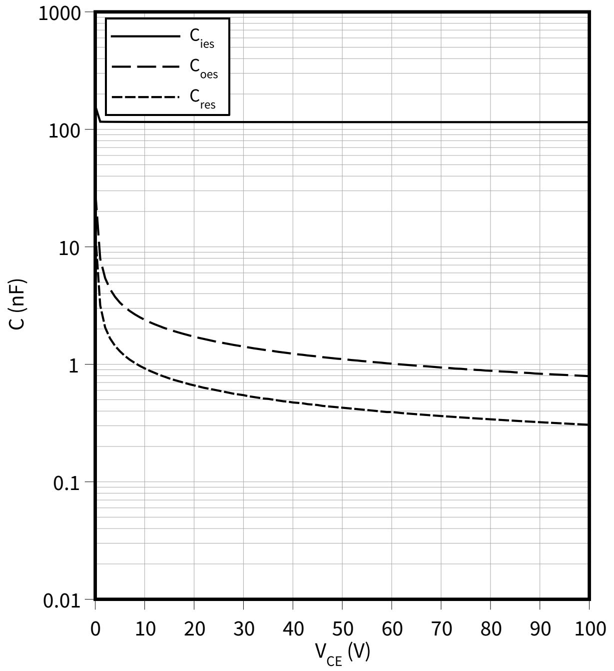
Switching times (typical), IGBT, Inverter
$t = f(R_G)$
V_{GE} = ±15 V, I_C = 750 A, V_{CC} = 600 V, T_{vj} = 175 °C



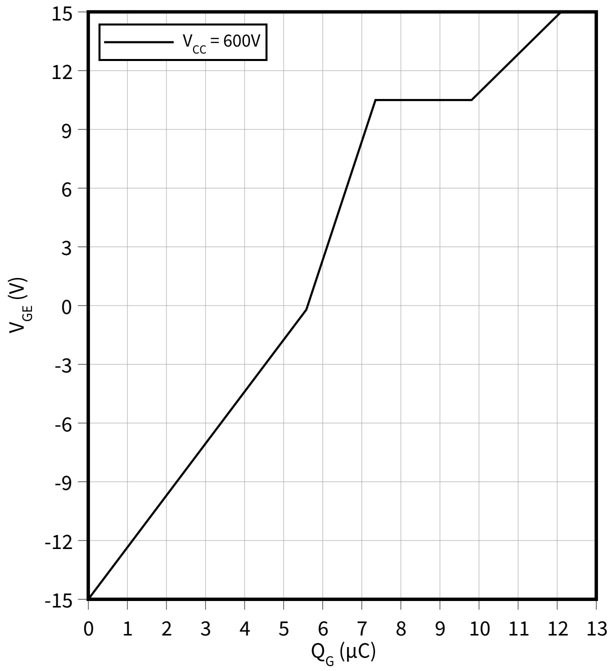
Reverse bias safe operating area (RBSOA), IGBT, Inverter
$I_C = f(V_{CE})$
R_{Goff} = 0.51 Ω, V_{GE} = ±15 V, T_{vj} = 175 °C



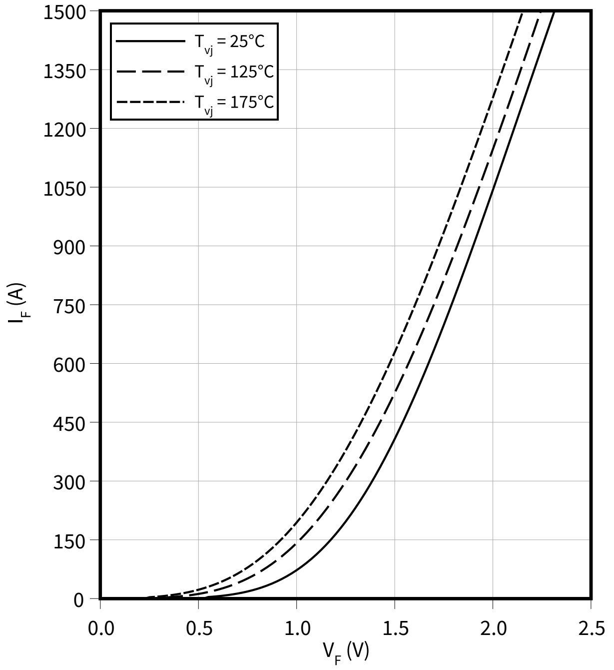
Capacity characteristic (typical), IGBT, Inverter
$C = f(V_{CE})$
f = 100 kHz, V_{GE} = 0 V, T_{vj} = 25 °C



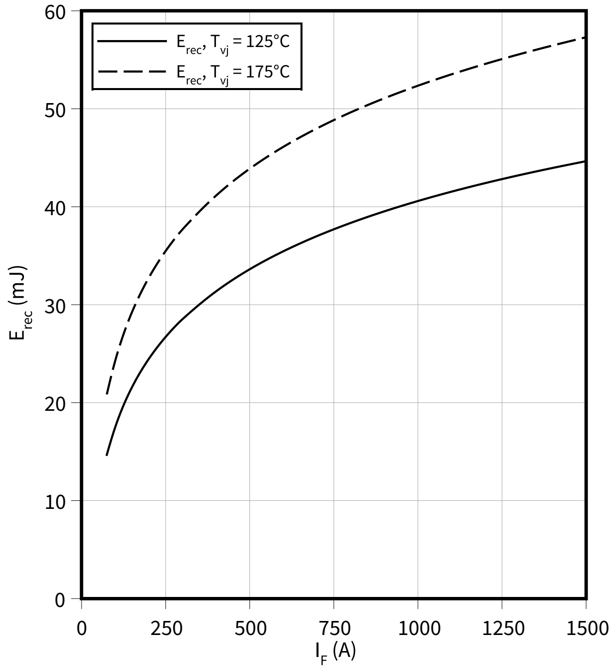
Gate charge characteristic (typical), IGBT, Inverter
$V_{GE} = f(Q_G)$
I_C = 750 A, T_{vj} = 25 °C



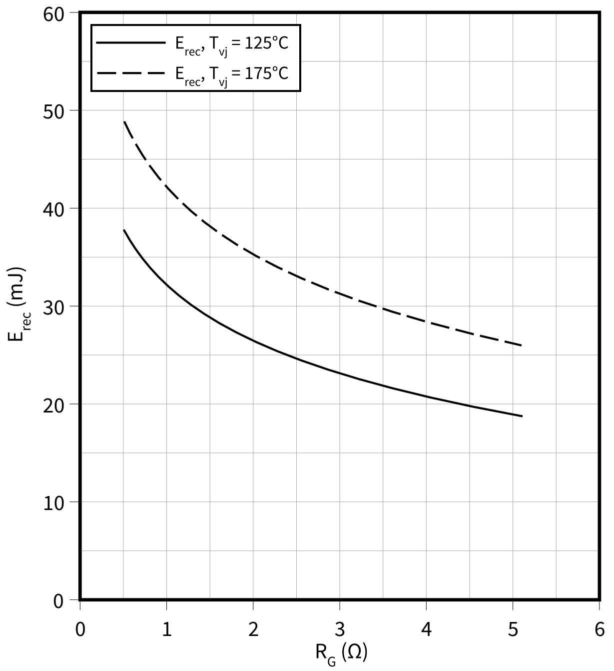
Forward characteristic (typical), Diode, Inverter
$I_F = f(V_F)$



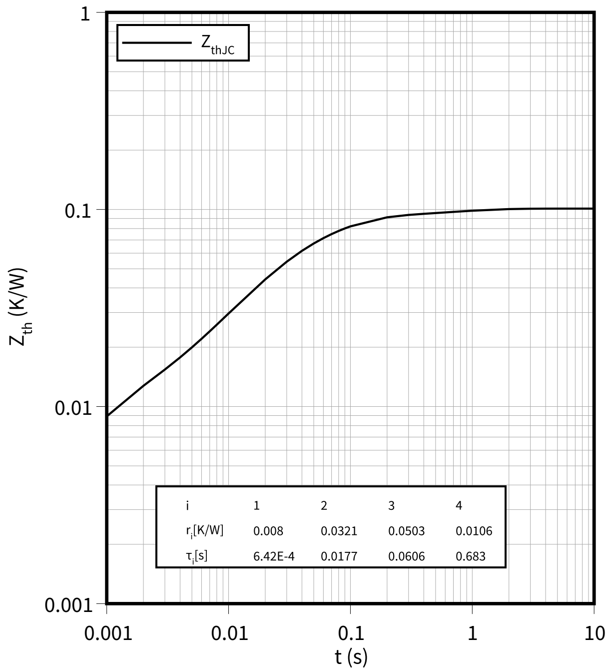
Switching losses (typical), Diode, Inverter
$E_{rec} = f(I_F)$
$R_{Gon} = 0.51\ \Omega$, $V_{CE} = 600$ V



Switching losses (typical), Diode, Inverter
$E_{rec} = f(R_G)$
$V_{CE} = 600$ V, $I_F = 750$ A

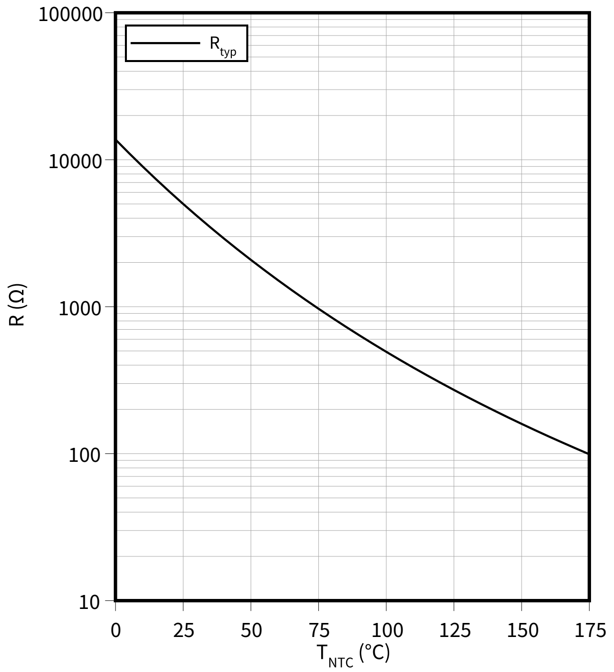


Transient thermal impedance, Diode, Inverter
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.008	0.0321	0.0503	0.0106
τ_i[s]	6.42E-4	0.0177	0.0606	0.683

Temperature characteristic (typical), NTC-Thermistor
$R = f(T_{NTC})$



7 Circuit diagram

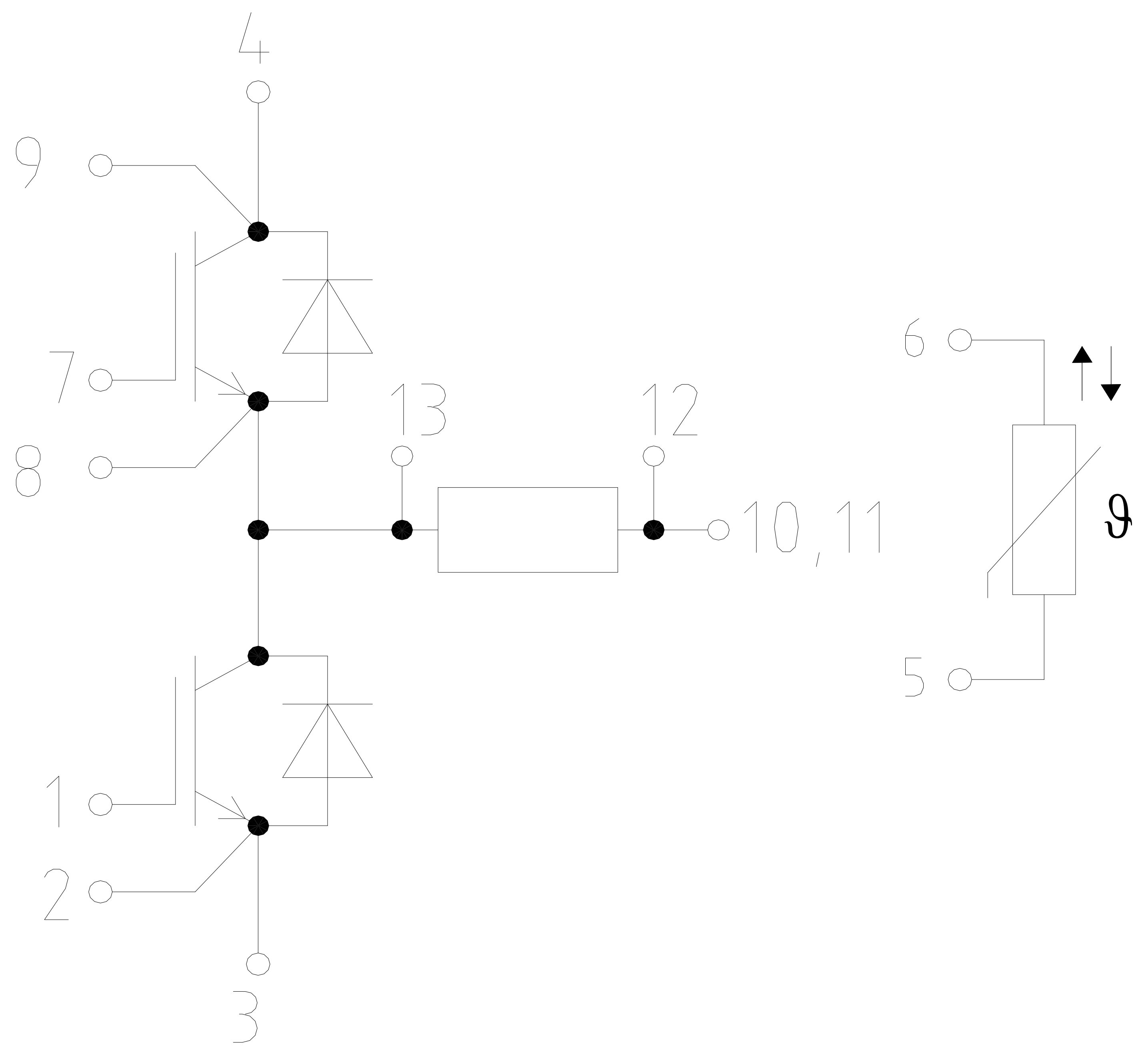


Figure 1

8 Package outlines

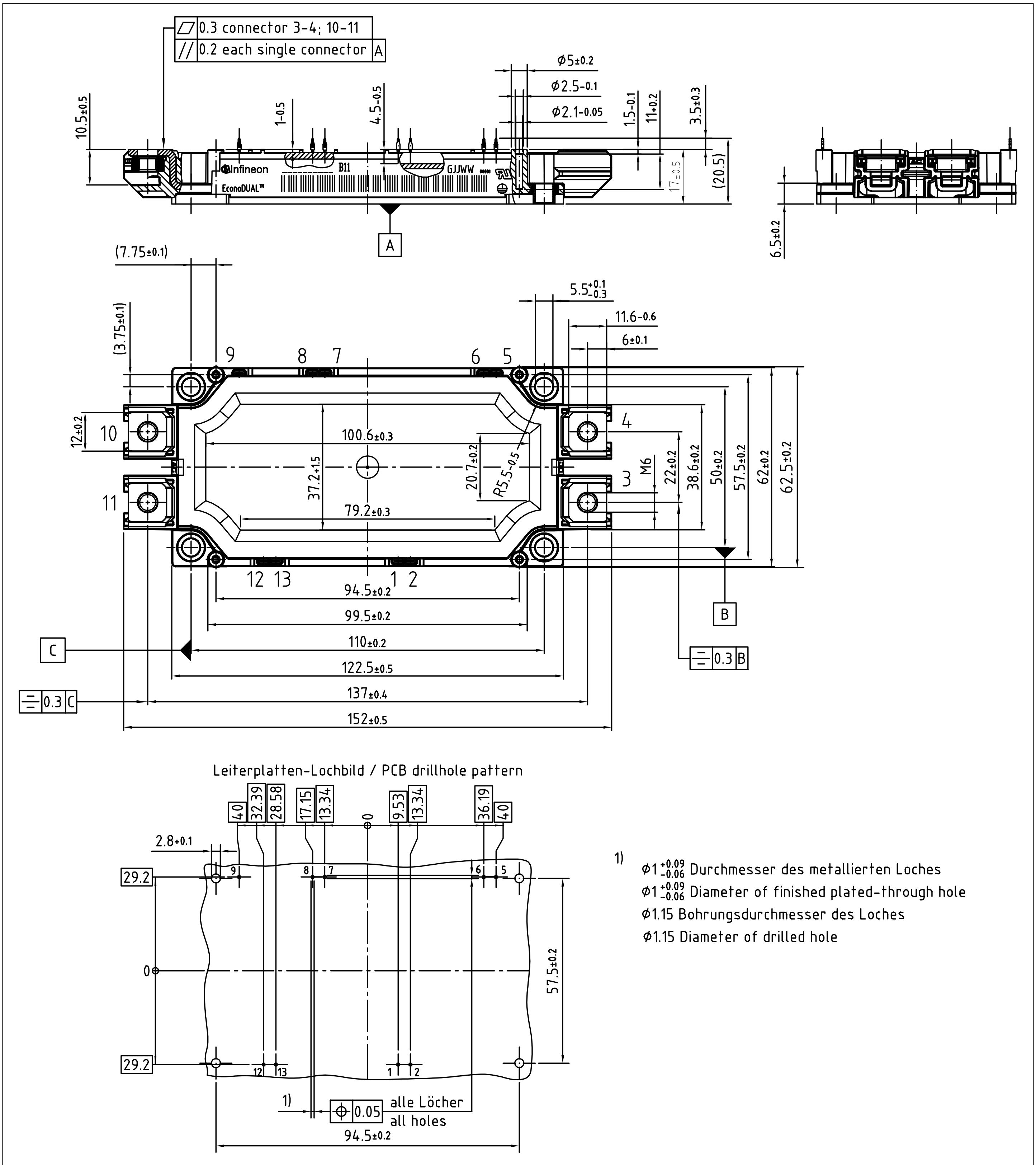


Figure 2

9 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

Revision history

Document revision	Date of release	Description of changes
0.10	2022-02-04	Initial version
1.00	2022-10-07	Final datasheet
1.10	2023-03-20	Final datasheet

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