

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

Features

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



Typical Appearance

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

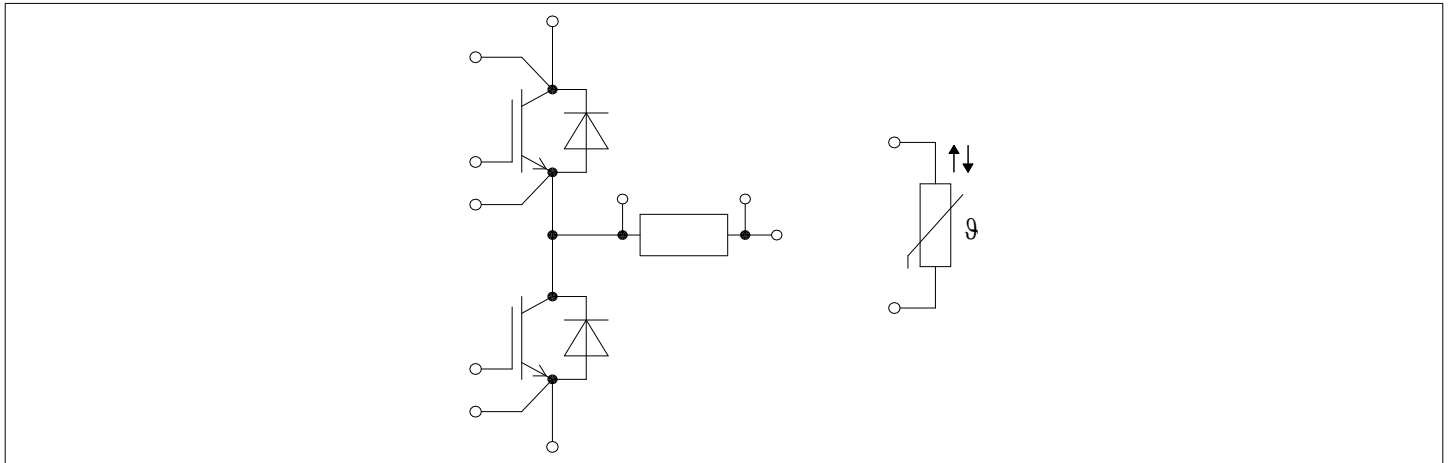


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	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	$R_{CC'+EE'}$	$T_C = 25 \text{ °C}$, 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}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_C = 95 \text{ °C}$	750	A
Maximum RMS module DC-terminal current	I_{tRMS}	$T_{Terminal} = 90 \text{ °C}$, $T_C = 90 \text{ °C}$	562	A
		$T_{Terminal} = 105 \text{ °C}$, $T_C = 90 \text{ °C}$	545	

(table continues...)
Datasheet

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	$V_{CE\ sat}$	$I_C = 750\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.50	1.75	V
			$T_{vj} = 125\ ^\circ C$	1.65		
			$T_{vj} = 175\ ^\circ C$	1.75		
Gate threshold voltage	V_{GEth}	$I_C = 15.3\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CC} = 600\ V$		12		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$		0.5		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		115		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		0.58		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V, T_{vj} = 25\ ^\circ C$			51	μA
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}	$I_C = 750\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.293		μs
			$T_{vj} = 125\ ^\circ C$	0.322		
			$T_{vj} = 175\ ^\circ C$	0.341		
Rise time (inductive load)	t_r	$I_C = 750\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.081		μs
			$T_{vj} = 125\ ^\circ C$	0.090		
			$T_{vj} = 175\ ^\circ C$	0.095		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 750\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.450		μs
			$T_{vj} = 125\ ^\circ C$	0.540		
			$T_{vj} = 175\ ^\circ C$	0.587		
Fall time (inductive load)	t_f	$I_C = 750\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.108		μs
			$T_{vj} = 125\ ^\circ C$	0.249		
			$T_{vj} = 175\ ^\circ C$	0.347		
Turn-on energy loss per pulse	E_{on}	$I_C = 750\ A, V_{CC} = 600\ V, L_\sigma = 25\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega, di/dt = 6800\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	36.7		mJ
			$T_{vj} = 125\ ^\circ C$	56.4		
			$T_{vj} = 175\ ^\circ C$	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}	$I_C = 750\text{ A}$, $V_{CC} = 600\text{ V}$, $L_\sigma = 25\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 0.51\ \Omega$, $dv/dt = 3100\text{ V}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	63.6		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	101		
			$T_{vj} = 175\text{ }^\circ\text{C}$	123		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 800\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8\ \mu\text{s}$, $T_{vj} = 150\text{ }^\circ\text{C}$	3300		A
			$t_p \leq 6\ \mu\text{s}$, $T_{vj} = 175\text{ }^\circ\text{C}$	3150		
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.0520	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		0.0260		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ\text{C}$

Note: $T_{vj\ op} > 150\text{ }^\circ\text{C}$ 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}	$T_{vj} = 25\text{ }^\circ\text{C}$	1200	V	
Continuous DC forward current	I_F		750	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1500	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	46800	A^2s
			$T_{vj} = 175\text{ }^\circ\text{C}$	35000	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 750\text{ A}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1.80	2.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	1.70		
			$T_{vj} = 175\text{ }^\circ\text{C}$	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}	$V_{CC} = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 6800\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	392		A
			$T_{vj} = 125\text{ °C}$	503		
			$T_{vj} = 175\text{ °C}$	555		
Recovered charge	Q_r	$V_{CC} = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 6800\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	44.5		μC
			$T_{vj} = 125\text{ °C}$	93.8		
			$T_{vj} = 175\text{ °C}$	124		
Reverse recovery energy	E_{rec}	$V_{CC} = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 6800\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	18.2		mJ
			$T_{vj} = 125\text{ °C}$	37.7		
			$T_{vj} = 175\text{ °C}$	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, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		0.0380		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	$^{\circ}\text{C}$

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

5 Shunt

Table 8 Characteristic values

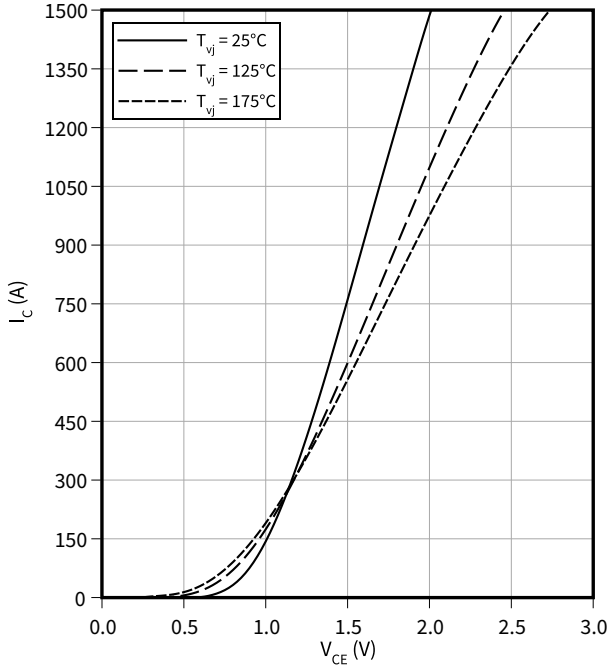
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{20}	$T_C = 20\text{ °C}$		0.169		mΩ
Temperature coefficient	TCR	$20\text{ °C} \leq T_{\text{Range}} \leq 150\text{ °C}$		175		ppm/ K
Load capacity per shunt resistor	P	$T_C = 80\text{ °C}$			39	W
Operation temperature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

6 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

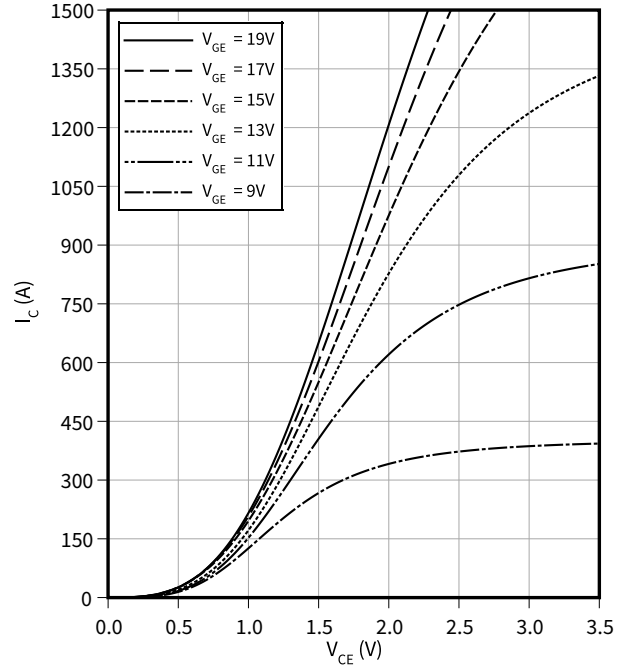
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

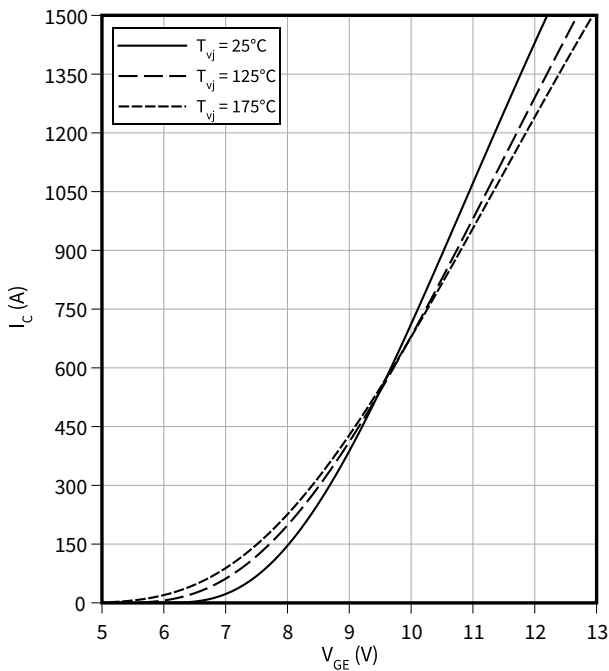
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

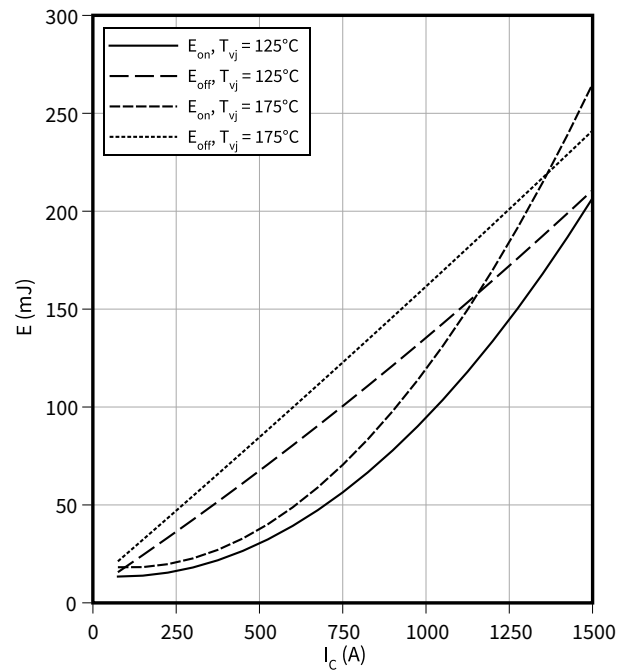
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 0.51 \text{ } \Omega, R_{Gon} = 0.51 \text{ } \Omega, V_{CC} = 600 \text{ V}, V_{GE} = -15 / 15 \text{ V}$$

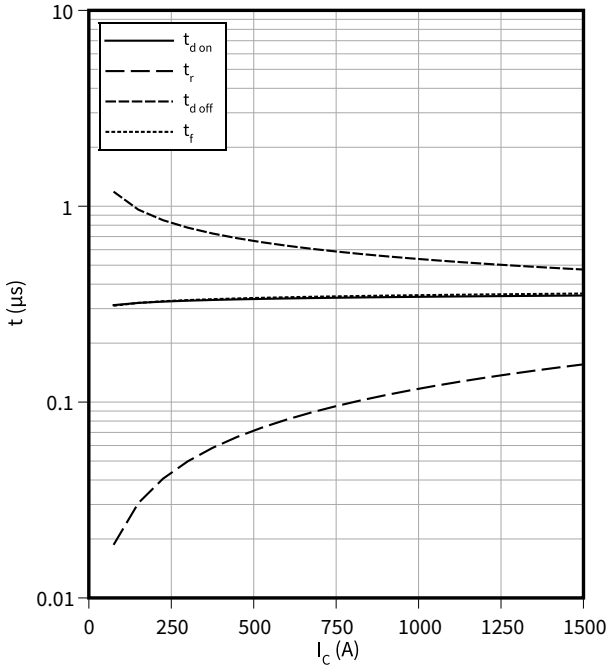


6 Characteristics diagrams

Switching times (typical), IGBT, Inverter

$t = f(I_C)$

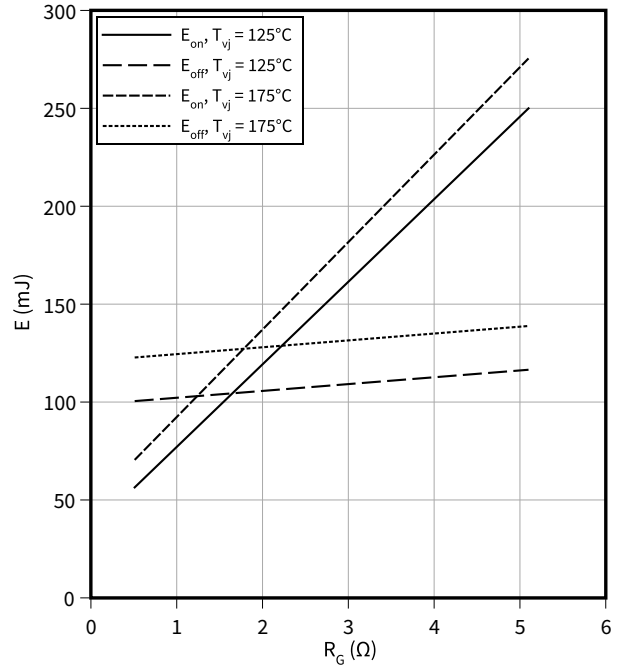
$R_{Goff} = 0.51 \Omega$, $R_{Gon} = 0.51 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^\circ\text{C}$



Switching losses (typical), IGBT, Inverter

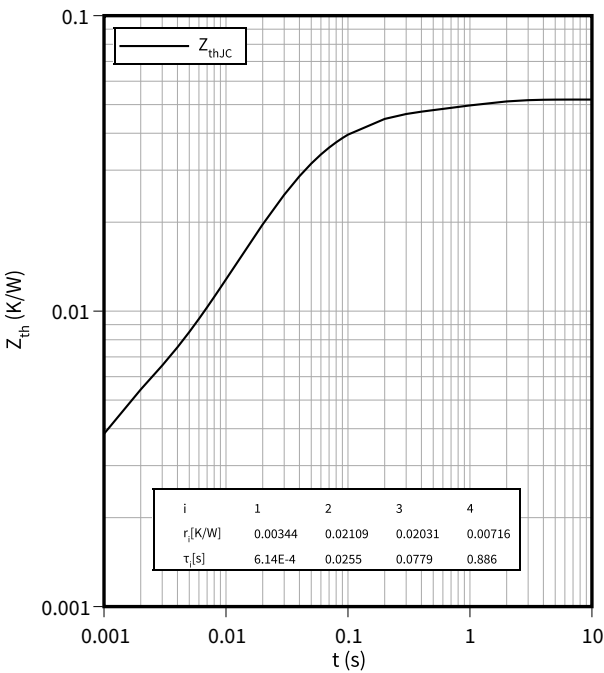
$E = f(R_G)$

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



Transient thermal impedance, IGBT, Inverter

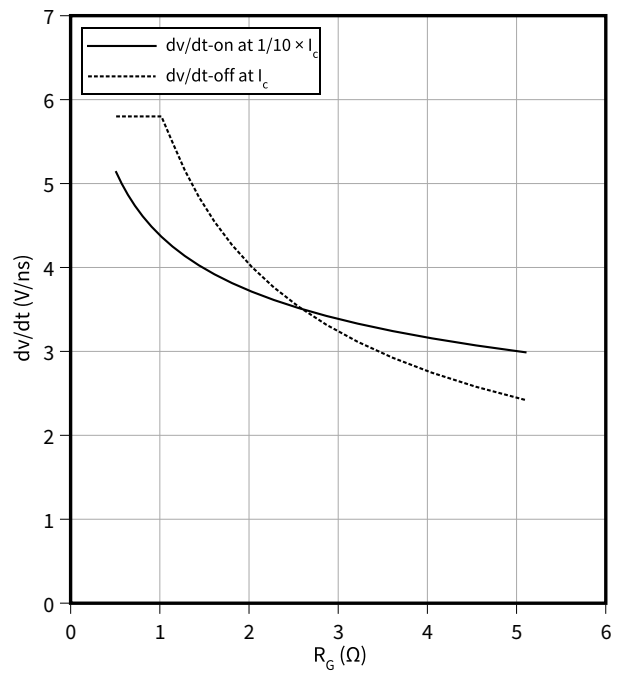
$Z_{th} = f(t)$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

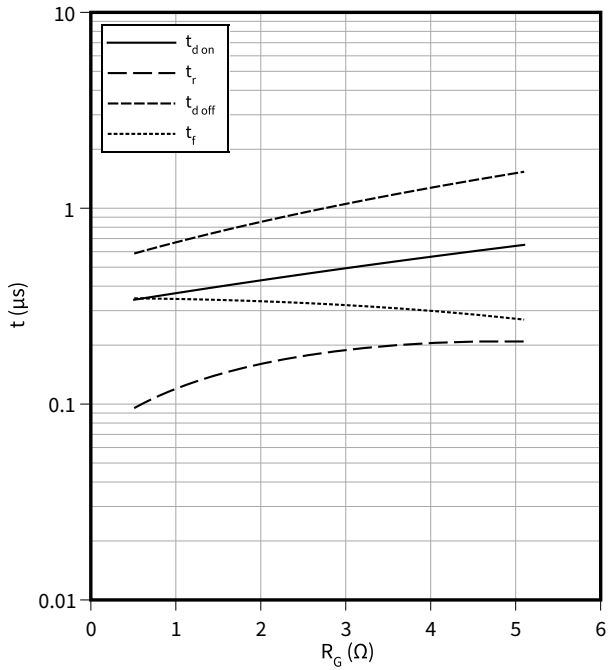
$I_C = 750 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 25 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

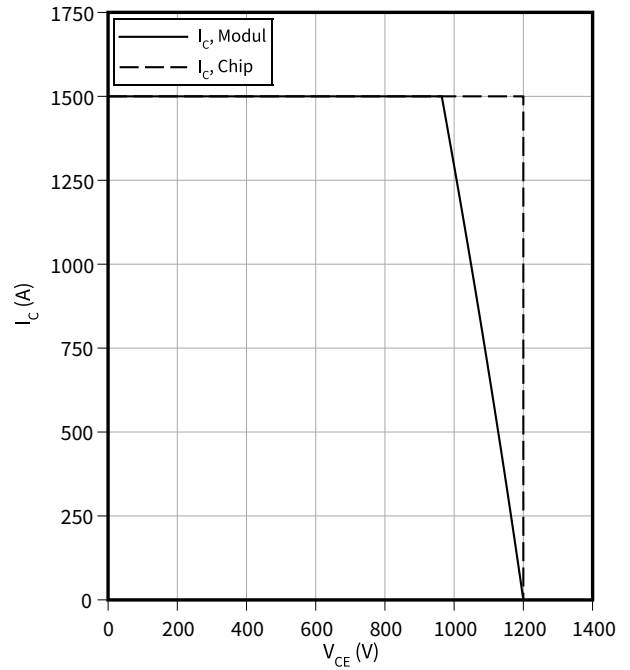
$V_{GE} = \pm 15 \text{ V}$, $I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ °C}$



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

$I_C = f(V_{CE})$

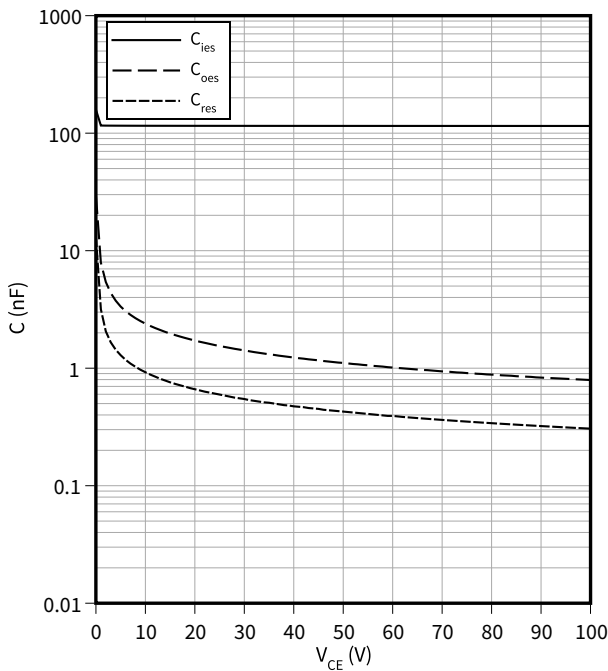
$R_{Goff} = 0.51 \text{ }\Omega$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 175 \text{ °C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

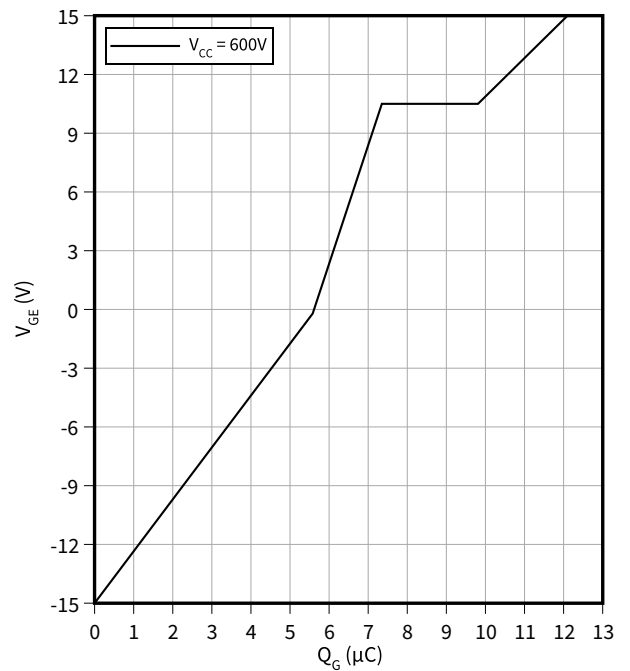
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ °C}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

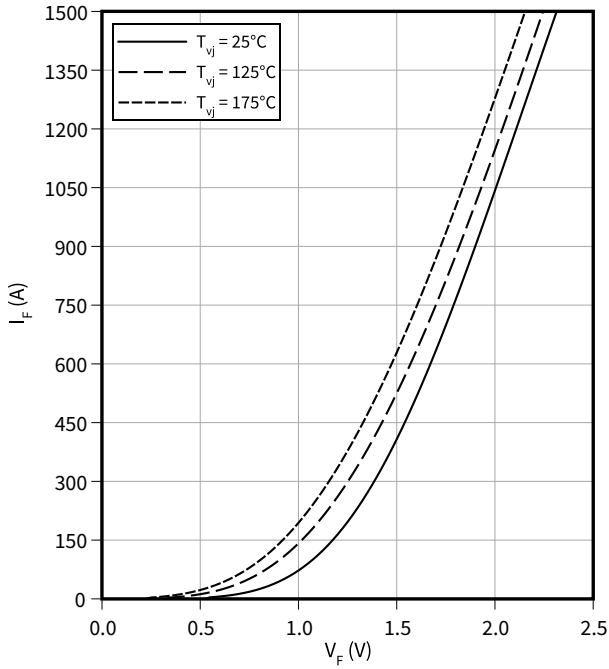
$I_C = 750 \text{ A}$, $T_{vj} = 25 \text{ °C}$



6 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

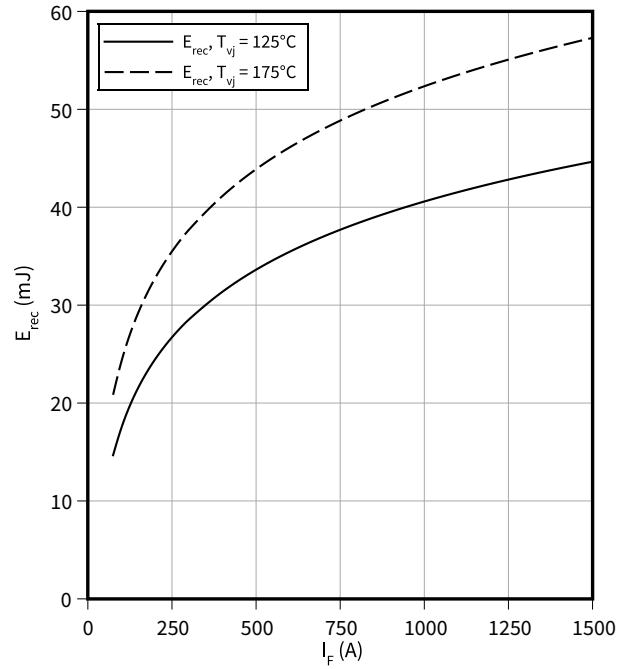
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

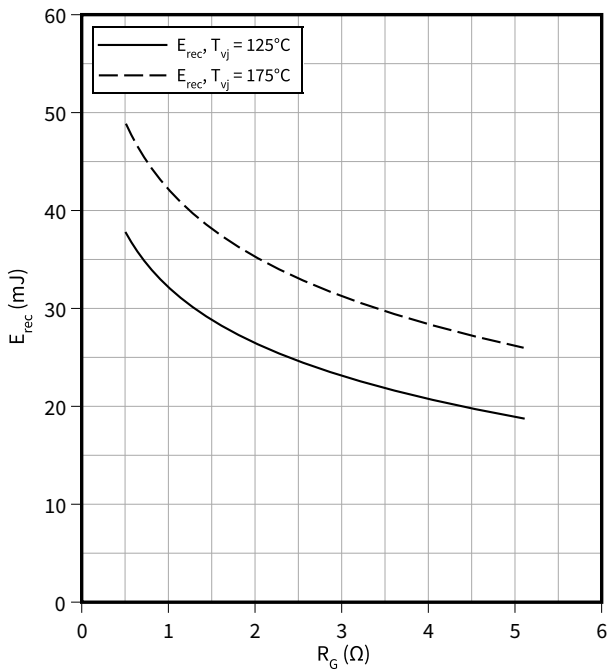
$R_{Gon} = 0.51 \Omega, V_{CE} = 600 \text{ V}$



Switching losses (typical), Diode, Inverter

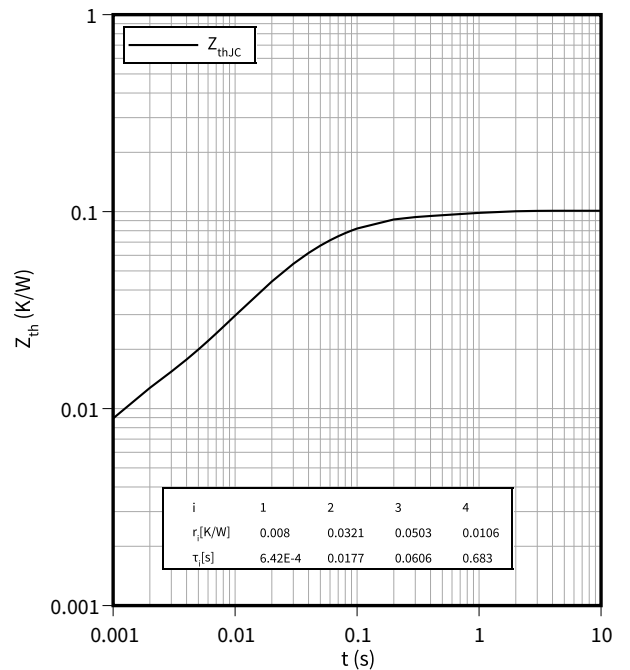
$E_{rec} = f(R_G)$

$V_{CE} = 600 \text{ V}, I_F = 750 \text{ A}$



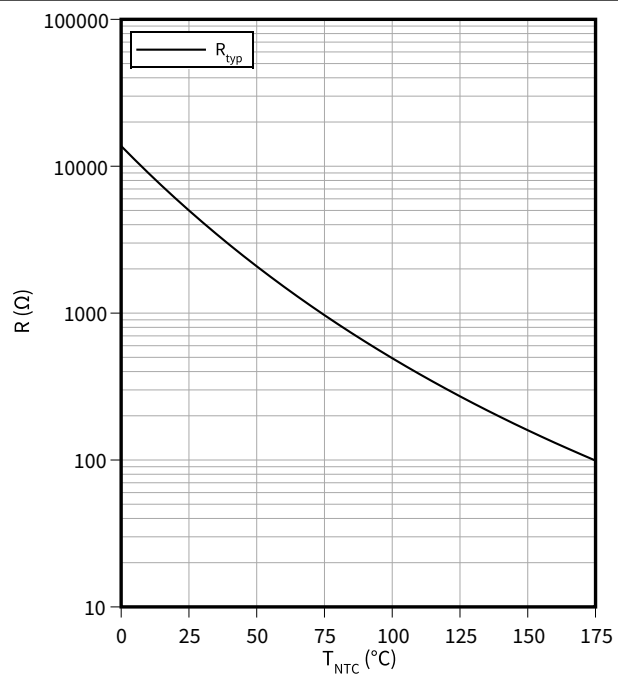
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

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



7 Circuit diagram

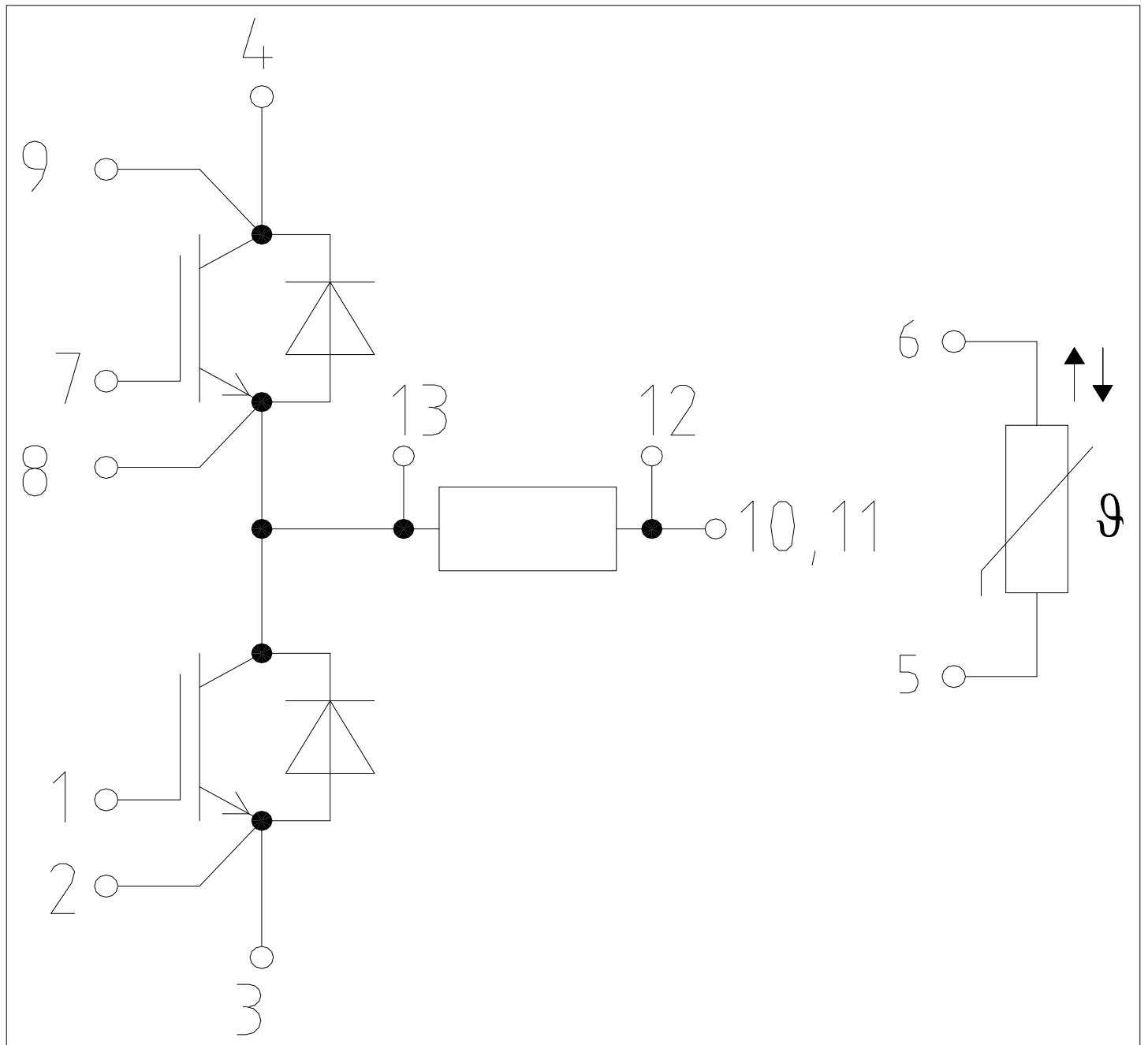


Figure 1

8 Package outlines

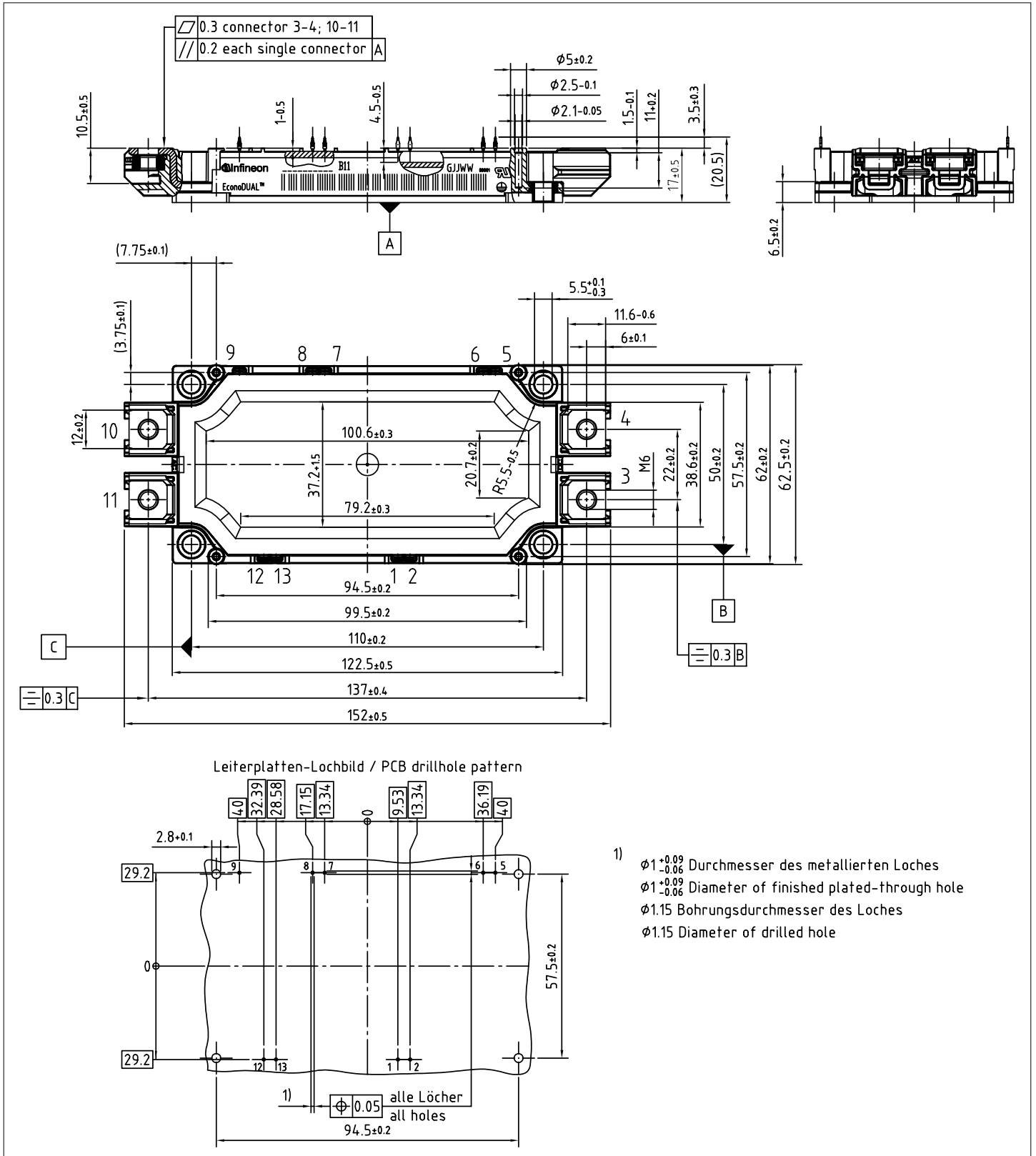


Figure 2

9 Module label code


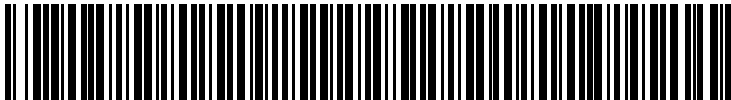
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content	Digit	Example
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production order number	12 -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