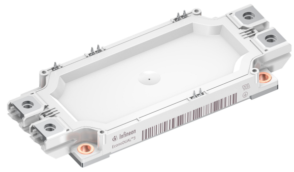
Final datasheet

EconoDUAL™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC

Features



- Electrical features
  - V_{CES} = 1700 V
  - $I_{C\,nom}$ = 450 A / I_{CRM} = 900 A
  - Integrated temperature sensor
  - High current density
  - Low $V_{CE,sat}$
  - Overload operation up to 175°C
  - TRENCHSTOP™ IGBT7
  - $V_{CE,sat}$ with positive temperature coefficient
  - Suitable Infineon gate drivers can be found under https://www.infineon.com/gdfinder
- Mechanical features
  - High power density
  - Isolated base plate
  - PressFIT contact technology
  - Standard housing

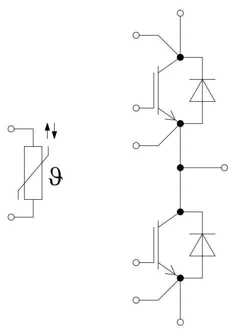
Potential applications

- High-power converters
- Medium-voltage converters
- Motor drives
- Wind turbines

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	15.0	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}				20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C = 25 °C, per switch			0.8		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, T1 / T2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1700	V
Implemented collector current	I_{CN}			450	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 90 °C	450	A

(table continues...)

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

Parameter	Symbol	Note or test condition		Values	Unit
Maximum RMS module DC-terminal current	I_{tRMS}		$T_{Terminal}$ = 90 °C, T_C = 90 °C	580	A
			$T_{Terminal}$ = 105 °C, T_C = 90 °C	565	
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		900	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 = 450 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.70	1.85	V
			T_{vj} = 125 °C		1.95		
			T_{vj} = 150 °C		2.05		
			T_{vj} = 175 °C		2.10		
Gate threshold voltage	V_{GEth}	I_C = 9.3 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} = 900 V			4.2		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.57		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			45.9		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.162		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1700 V, V_{GE} = 0 V	T_{vj} = 25 °C			5	mA
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 = 450 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.62 Ω	T_{vj} = 25 °C		0.144		µs
			T_{vj} = 125 °C		0.162		
			T_{vj} = 150 °C		0.165		
			T_{vj} = 175 °C		0.168		
Rise time (inductive load)	t_r	I_C = 450 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Gon} = 0.62 Ω	T_{vj} = 25 °C		0.034		µs
			T_{vj} = 125 °C		0.038		
			T_{vj} = 150 °C		0.040		
			T_{vj} = 175 °C		0.043		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Turn-off delay time (inductive load)	t_{doff}	I_C = 450 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.599		µs
			T_{vj} = 125 °C		0.678		
			T_{vj} = 150 °C		0.684		
			T_{vj} = 175 °C		0.689		
Fall time (inductive load)	t_f	I_C = 450 A, V_{CC} = 900 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.248		µs
			T_{vj} = 125 °C		0.443		
			T_{vj} = 150 °C		0.515		
			T_{vj} = 175 °C		0.587		
Turn-on energy loss per pulse	E_{on}	I_C = 450 A, V_{CC} = 900 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Gon} = 0.62 Ω, di/dt = 9000 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		44.4		mJ
			T_{vj} = 125 °C		87.1		
			T_{vj} = 150 °C		100		
			T_{vj} = 175 °C		114		
Turn-off energy loss per pulse	E_{off}	I_C = 450 A, V_{CC} = 900 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω, dv/dt = 3800 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		72.1		mJ
			T_{vj} = 125 °C		111		
			T_{vj} = 150 °C		125		
			T_{vj} = 175 °C		139		
SC data	I_{SC}	V_{GE} = 15 V, V_{CC} = 1000 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 8 µs, T_{vj}=150 °C		1600		A
			t_P ≤ 6 µs, T_{vj}=175 °C		1500		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.0812	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.0368		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: *T_{vjop} > 150 °C is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.*

3 Diode, D1 / D2

Table 5 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	1700	V

(table continues...)

Table 5 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC forward current	I_F			450	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		900	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	14500	A^2s
			T_{vj} = 175 °C	12500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 450 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.35	2.50	V
			T_{vj} = 125 °C		2.25		
			T_{vj} = 150 °C		2.20		
			T_{vj} = 175 °C		2.10		
Peak reverse recovery current	I_{RM}	V_{CC} = 900 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 9300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		574		A
			T_{vj} = 125 °C		605		
			T_{vj} = 150 °C		605		
			T_{vj} = 175 °C		605		
Recovered charge	Q_r	V_{CC} = 900 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 9300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		59.4		µC
			T_{vj} = 125 °C		113		
			T_{vj} = 150 °C		130		
			T_{vj} = 175 °C		146		
Reverse recovery energy	E_{rec}	V_{CC} = 900 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 9300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		32.9		mJ
			T_{vj} = 125 °C		66.6		
			T_{vj} = 150 °C		76.1		
			T_{vj} = 175 °C		85.5		
Thermal resistance, junction to case	R_{thJC}	per diode				0.143	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.0479		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: *T_{vjop} > 150 °C is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.*

4 NTC-Thermistor

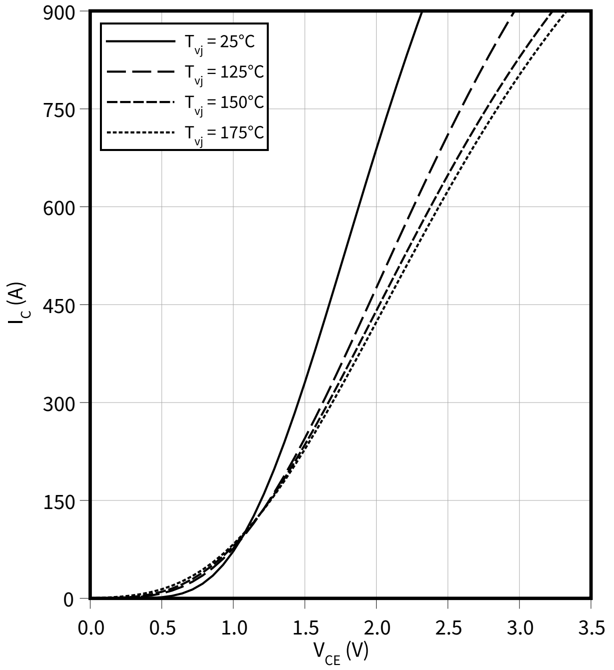
Table 7 Characteristic values

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	$B_{25/50}$	$R_2 = R_{25}\ \exp[B_{25/50}(1/T_2 - 1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25}\ \exp[B_{25/80}(1/T_2 - 1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25}\ \exp[B_{25/100}(1/T_2 - 1/(298{,}15\ K))]$		3433		K

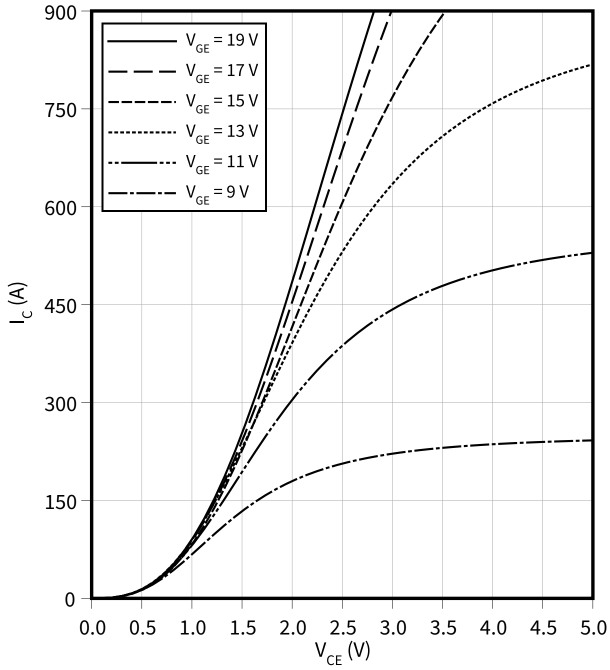
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

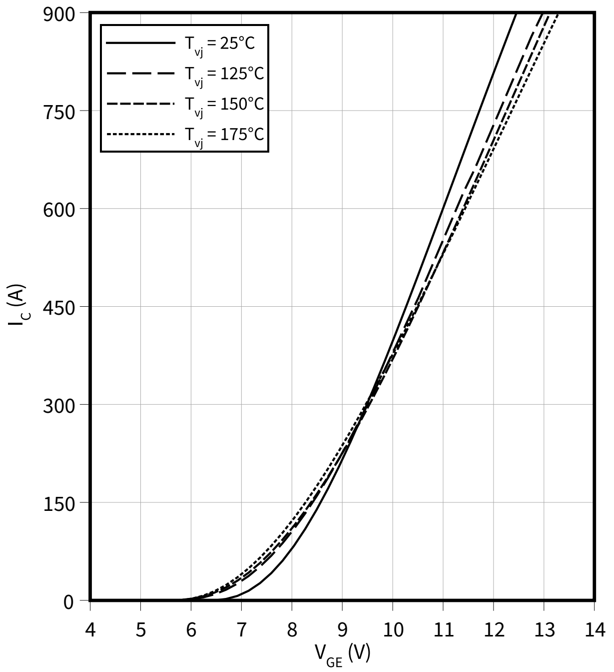
Output characteristic (typical), IGBT, T1 / T2
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



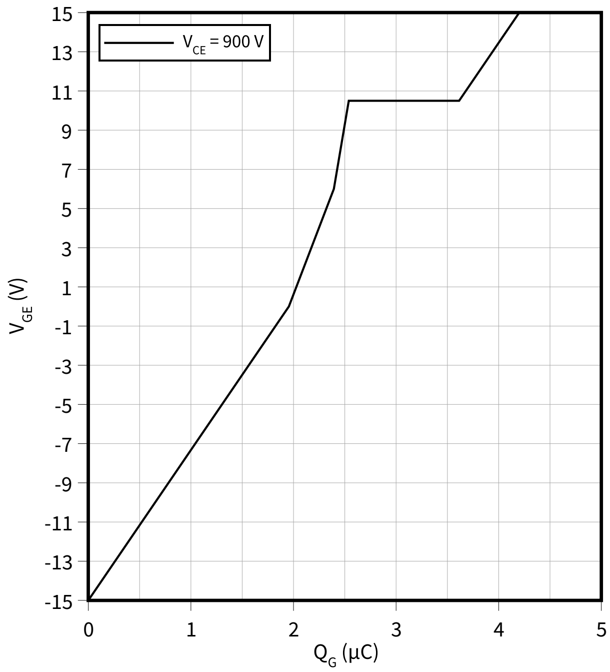
Output characteristic field (typical), IGBT, T1 / T2
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



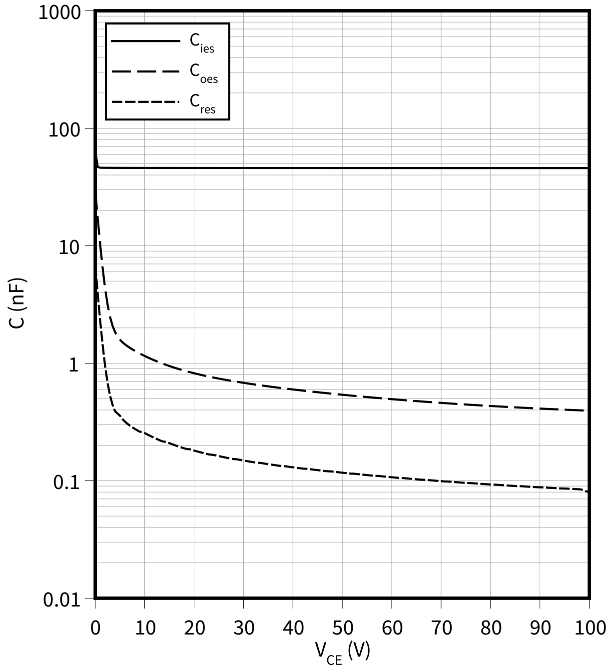
Transfer characteristic (typical), IGBT, T1 / T2
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



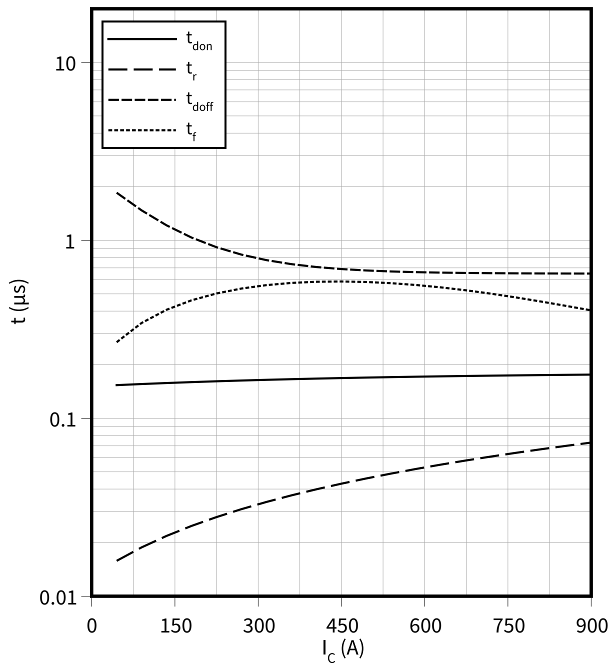
Gate charge characteristic (typical), IGBT, T1 / T2
$V_{GE} = f(Q_G)$
$I_C = 450$ A, $T_{vj} = 25$ °C



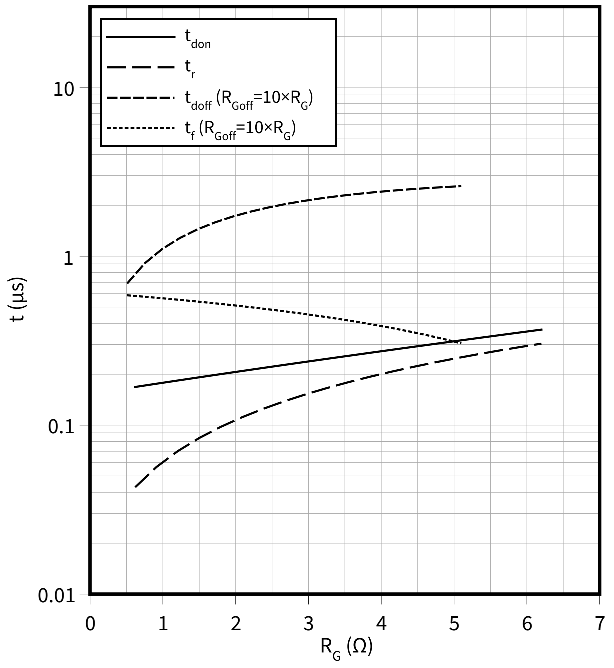
Capacity characteristic (typical), IGBT, T1 / T2
$C = f(V_{CE})$
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



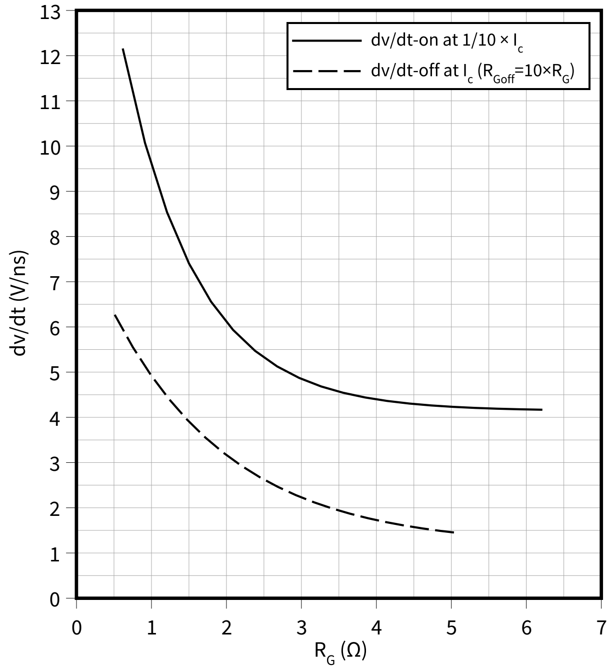
Switching times (typical), IGBT, T1 / T2
$t = f(I_C)$
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 0.62\ \Omega$, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $T_{vj} =$ 175 °C



Switching times (typical), IGBT, T1 / T2
$t = f(R_G)$
$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



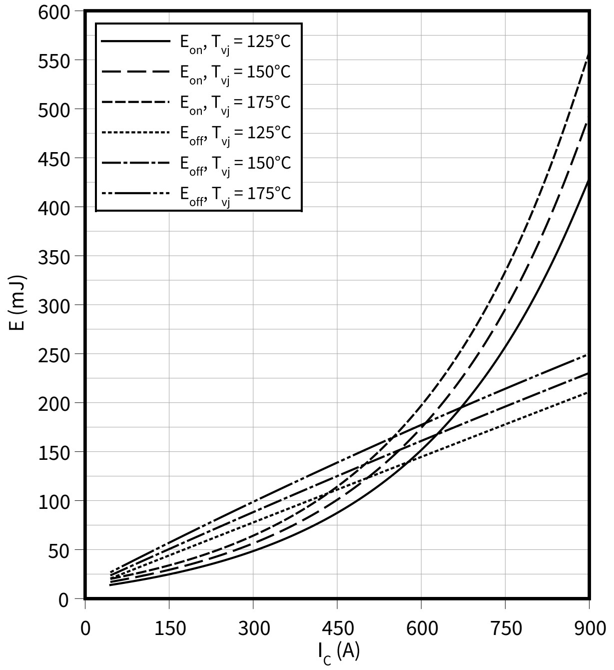
Voltage slope (typical), IGBT, T1 / T2
$dv/dt = f(R_G)$
$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 25$ °C



Switching losses (typical), IGBT, T1 / T2

$E = f(I_C)$

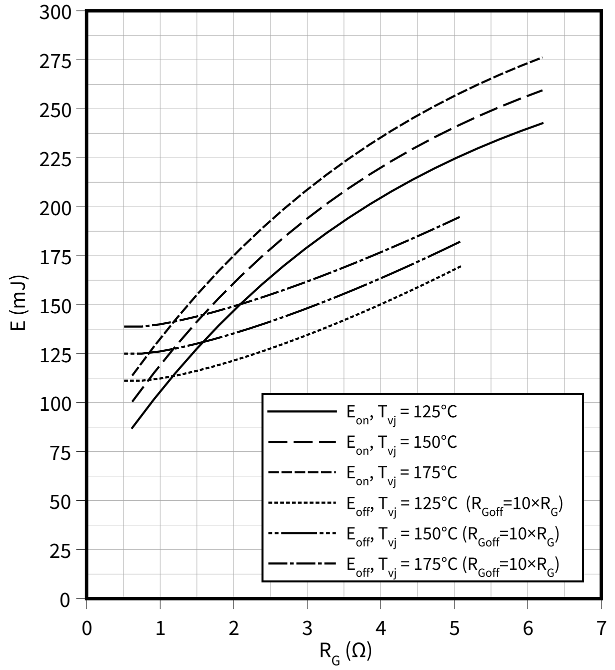
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 0.62\ \Omega$, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, T1 / T2

$E = f(R_G)$

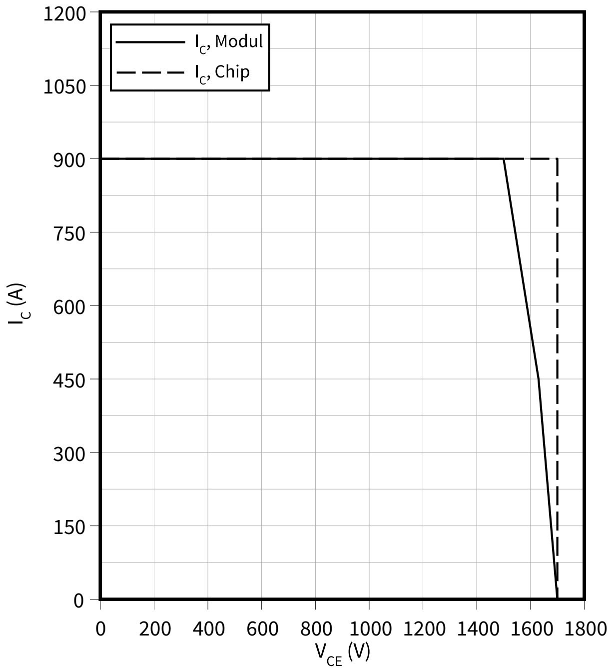
$I_C = 450$ A, $V_{CC} = 900$ V, $V_{GE} = \pm 15$ V



Reverse bias safe operating area (RBSOA), IGBT, T1 / T2

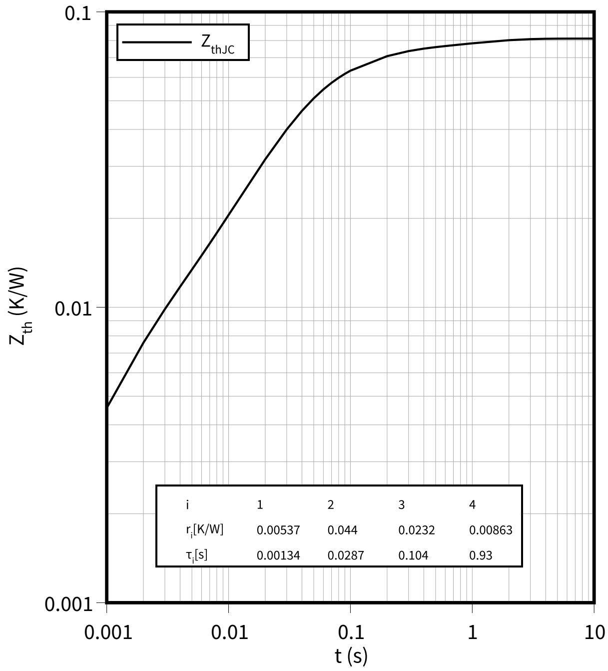
$I_C = f(V_{CE})$

$R_{Goff} = 5.1\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



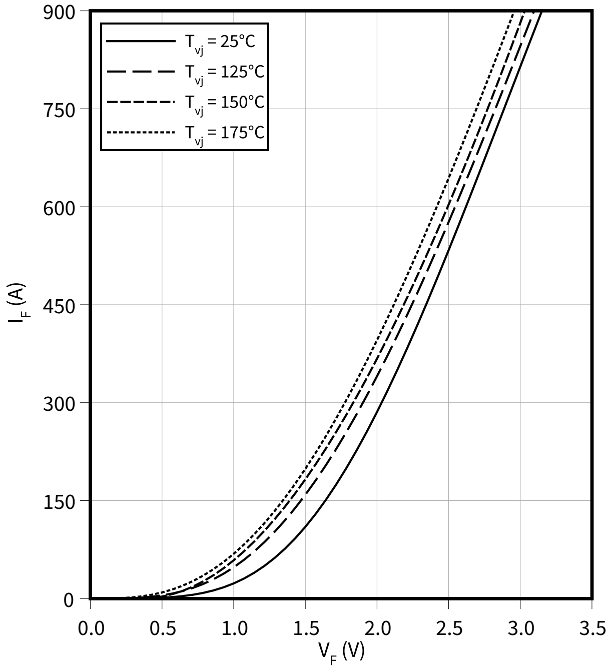
Transient thermal impedance, IGBT, T1 / T2

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D1 / D2

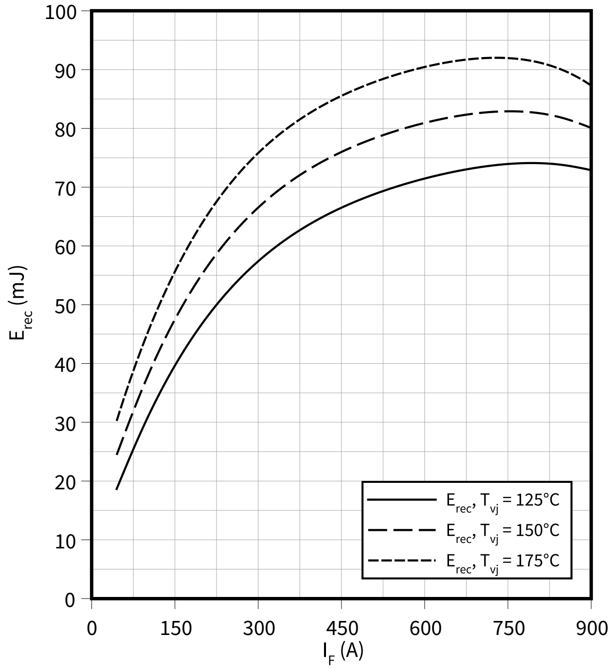
$I_F = f(V_F)$



Switching losses (typical), Diode, D1 / D2

$E_{rec} = f(I_F)$

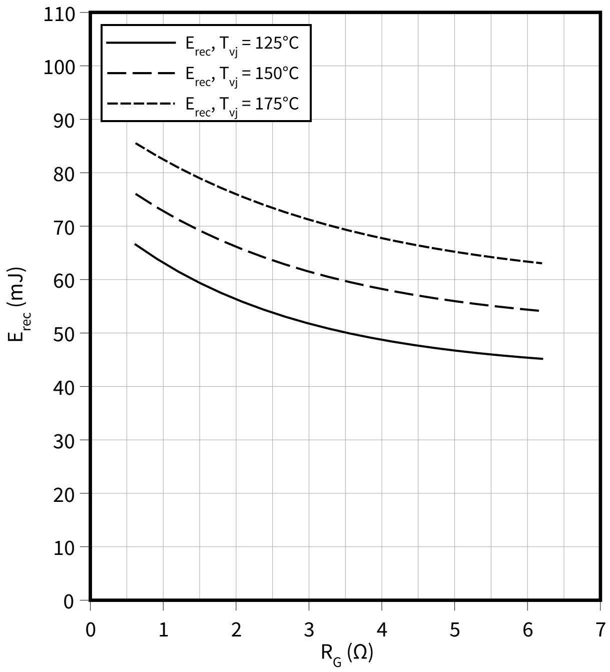
R_{Gon} = 0.62 Ω, V_{CC} = 900 V



Switching losses (typical), Diode, D1 / D2

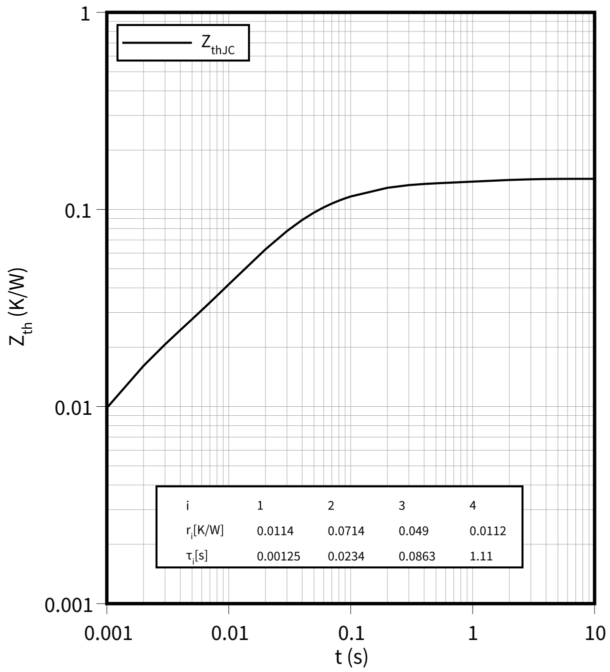
$E_{rec} = f(R_G)$

I_F = 450 A, V_{CC} = 900 V



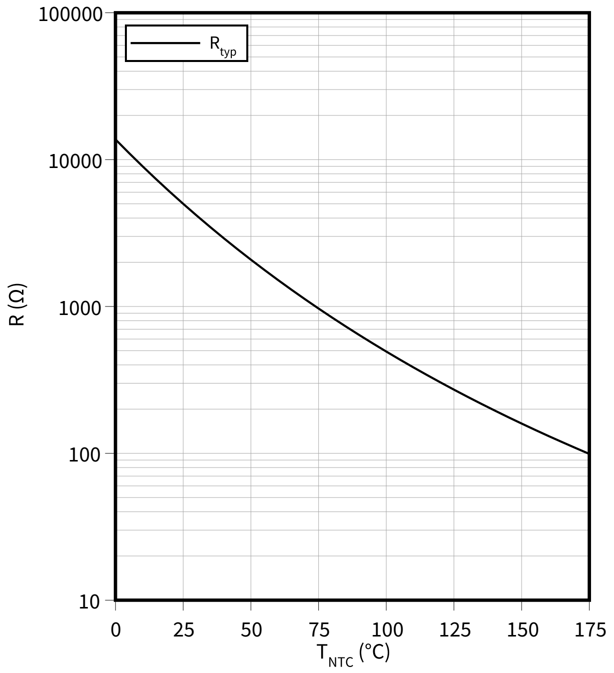
Transient thermal impedance, Diode, D1 / D2

$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.0114	0.0714	0.049	0.0112
τ_i[s]	0.00125	0.0234	0.0863	1.11

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



6 Circuit diagram

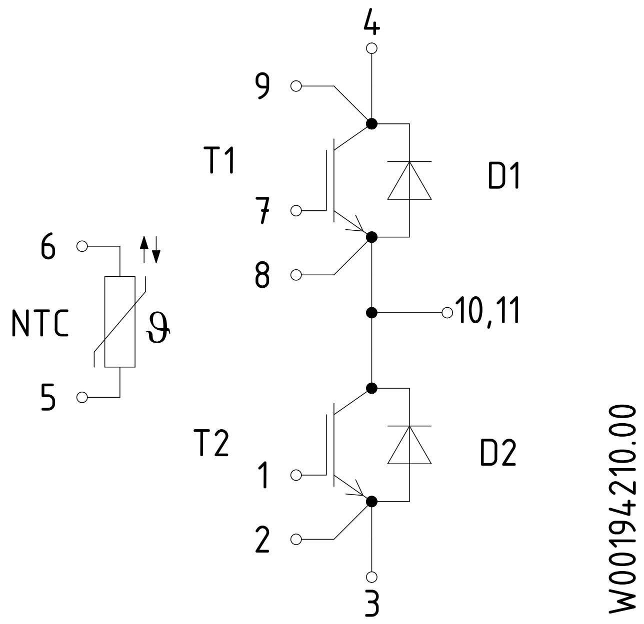


Figure 1

7 Package outlines

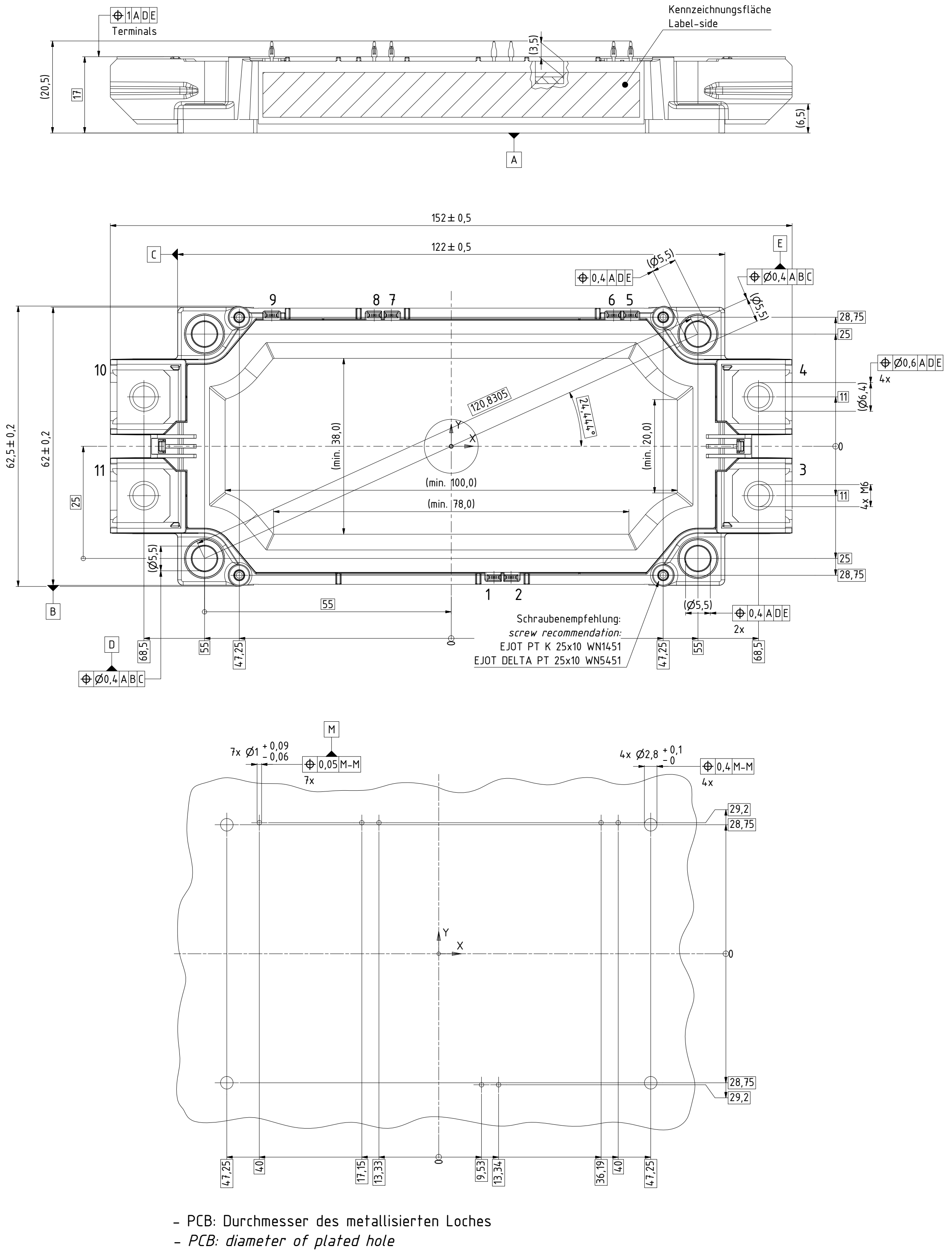


Figure 2

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

Revision history

Document revision	Date of release	Description of changes
0.10	2023-04-06	Initial version
1.00	2023-08-07	Final datasheet

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