

## Preliminary datasheet

### 62 mm C-Series module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode

#### Features

- Electrical features
  - $V_{CES} = 1200\text{ V}$
  - $I_{C\text{ nom}} = 600\text{ A} / I_{CRM} = 1200\text{ A}$
  - TRENCHSTOP™ IGBT7
  - $V_{CE,\text{sat}}$  with positive temperature coefficient
- Mechanical features
  - 4 kV AC 1 min insulation
  - High creepage and clearance distances
  - High power density
  - Isolated base plate
  - Package with CTI > 400
  - Standard housing



Typical appearance

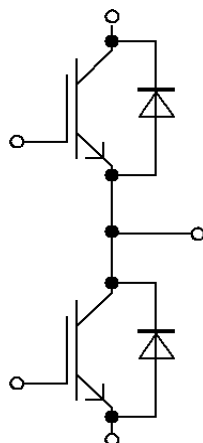
#### Potential applications

- Servo drives
- Solar applications
- UPS systems
- Motor drives
- High-power converters
- Commercial agriculture vehicles
- Three-level applications

#### 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, $f = 50 \text{ Hz}$ , $t = 60 \text{ s}$	4.0	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	$Al_2O_3$	
Creepage distance	$d_{Creep}$	terminal to heatsink	29.0	mm
Creepage distance	$d_{Creep}$	terminal to terminal	23.0	mm
Clearance	$d_{Clear}$	terminal to heatsink	23.0	mm
Clearance	$d_{Clear}$	terminal to terminal	11.0	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	$L_{sCE}$			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$ , per switch		0.5		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	2.5	5	Nm
Weight	$G$			340		g

## 2 IGBT, Inverter

**Table 3** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	$V_{CES}$	$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$	600	A
Maximum RMS module DC-terminal current	$I_{tRMS}$	$T_{Terminal} = 115^\circ\text{C}$ , $T_C = 90^\circ\text{C}$	650	A
		$T_{Terminal} = 115^\circ\text{C}$ , $T_C = 115^\circ\text{C}$	600	

(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 $T_{vj\ op}$	1200	A
Gate-emitter peak voltage	$V_{GES}$		$\pm 20$	V

**Table 4 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 600\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.50	1.75	V
			$T_{vj} = 125\ ^\circ C$	1.65		
			$T_{vj} = 150\ ^\circ C$	1.70		
			$T_{vj} = 175\ ^\circ C$	1.75		
Gate threshold voltage	$V_{GEth}$	$I_C = 12\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.15	5.80	6.45	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CC} = 600\ V$		9.66		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.6		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		92.3		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		0.462		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\ V, V_{GE} = 0\ V$			0.1	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)	$t_{don}$	$I_C = 600\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.435		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.447		
			$T_{vj} = 150\ ^\circ C$	0.451		
			$T_{vj} = 175\ ^\circ C$	0.454		
Rise time (inductive load)	$t_r$	$I_C = 600\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.051		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.058		
			$T_{vj} = 150\ ^\circ C$	0.060		
			$T_{vj} = 175\ ^\circ C$	0.062		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 600\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.490		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.558		
			$T_{vj} = 150\ ^\circ C$	0.578		
			$T_{vj} = 175\ ^\circ C$	0.597		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Fall time (inductive load)	$t_f$	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.51 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$		0.119		$\mu\text{s}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		0.249		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		0.295		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		0.340		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.51 \Omega, di/dt = 7700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		17		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		25.1		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		28.6		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		32		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.51 \Omega, dv/dt = 3150 \text{ V}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		53.2		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		80.5		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		89.7		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		98.9		
SC data	$I_{SC}$	$V_{GE} \leq 15 \text{ V}, V_{CC} = 800 \text{ V}$	$t_p \leq 8 \mu\text{s}, T_{vj} = 150 \text{ }^\circ\text{C}$		2250		A
			$t_p \leq 6 \mu\text{s}, T_{vj} = 175 \text{ }^\circ\text{C}$		2000		
Thermal resistance, junction to case	$R_{thJC}$	per IGBT				0.0668	K/W
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT			0.0336		K/W
Temperature under switching conditions	$T_{vj op}$			-40		175	$^\circ\text{C}$

Note:  $T_{vj op} > 150 \text{ }^\circ\text{C}$  is only 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	$I_F$		600	A
Repetitive peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$	1200	A

(table continues...)

**Table 5 (continued) Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	29900	$\text{A}^2\text{s}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$	23200	

**Table 6 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 600 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1.80	2.10	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.70		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.60		
Peak reverse recovery current	$I_{RM}$	$V_{CC} = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		448		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		583		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		616		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		648		
Recovered charge	$Q_r$	$V_{CC} = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		49.4		$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		85.7		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		100		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		115		
Reverse recovery energy	$E_{rec}$	$V_{CC} = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		27.9		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		45.6		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		51.8		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		58		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.110	K/W	
Thermal resistance, case to heat sink	$R_{thCH}$	per diode		0.0466		K/W	
Temperature under switching conditions	$T_{vjop}$		-40		175	$^\circ\text{C}$	

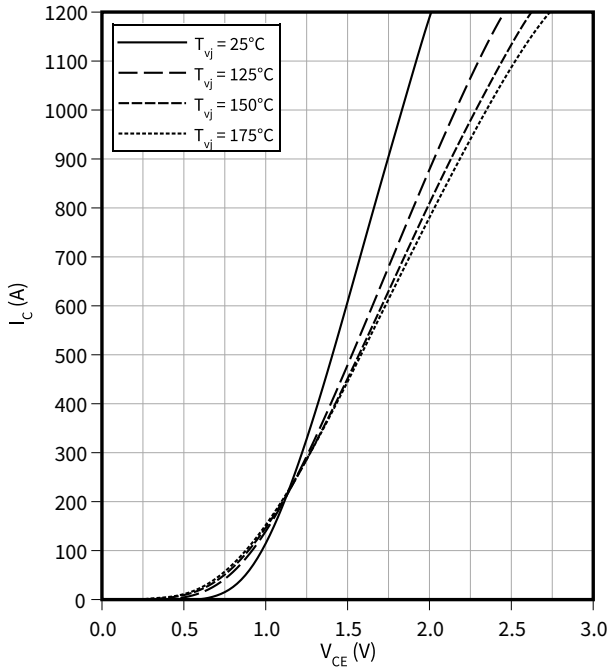
Note:  $T_{vjop} > 150 \text{ }^\circ\text{C}$  is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

## 4 Characteristics diagrams

**Output characteristic (typical), IGBT, Inverter**

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

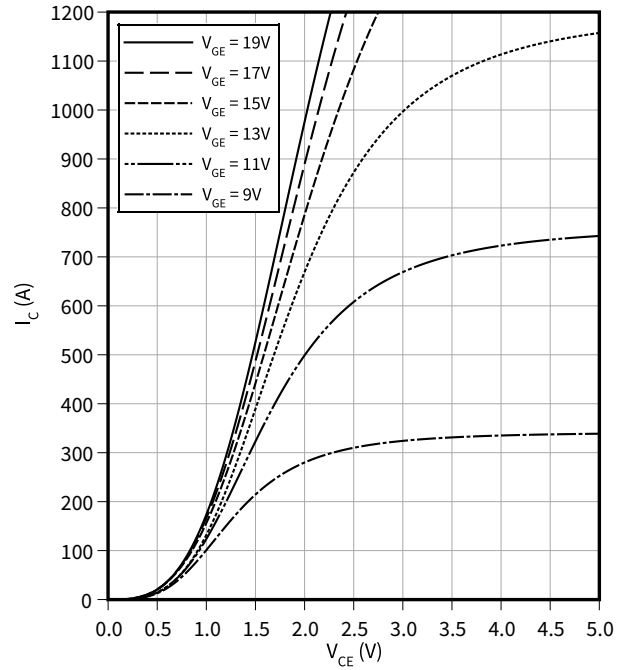
$$V_{GE} = 15 \text{ V}$$



**Output characteristic field (typical), IGBT, Inverter**

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

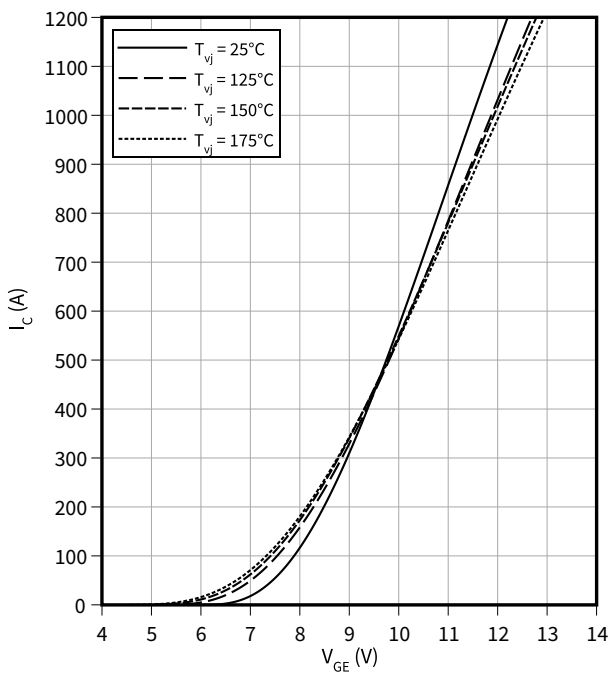
$$T_{vj} = 175 \text{ °C}$$



**Transfer characteristic (typical), IGBT, Inverter**

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

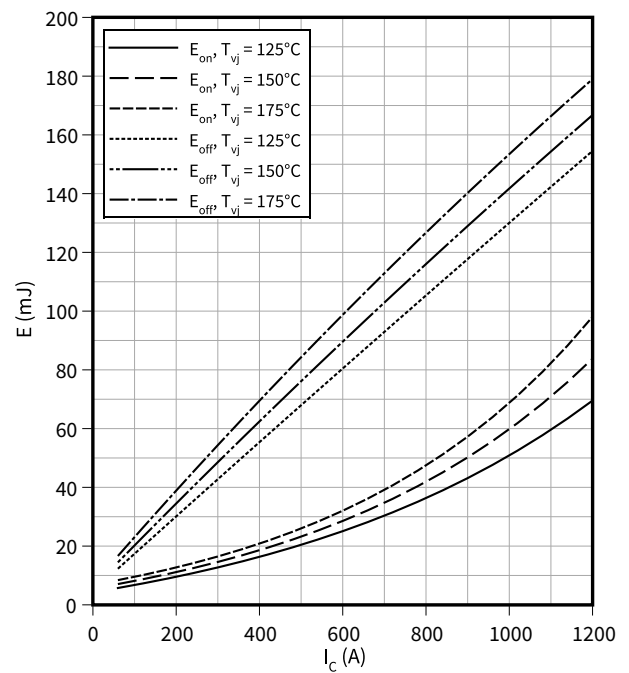
$$V_{CE} = 20 \text{ V}$$



**Switching losses (typical), IGBT, Inverter**

$$E = f(I_C)$$

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

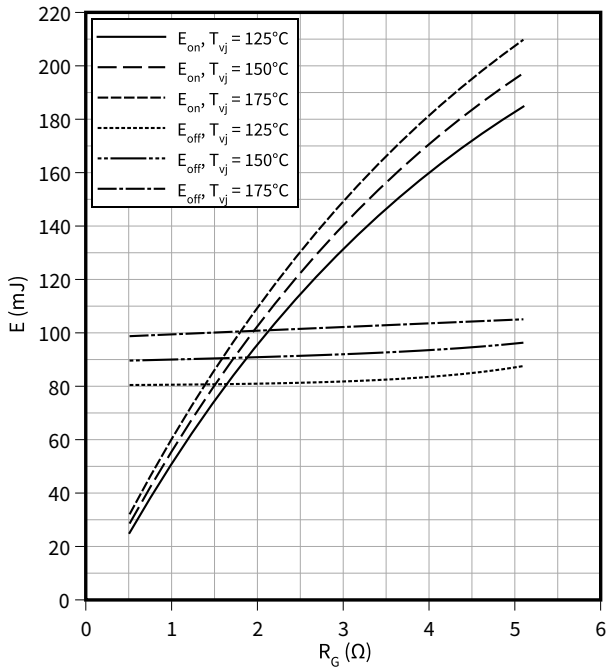


4 Characteristics diagrams

**Switching losses (typical), IGBT, Inverter**

$E = f(R_G)$

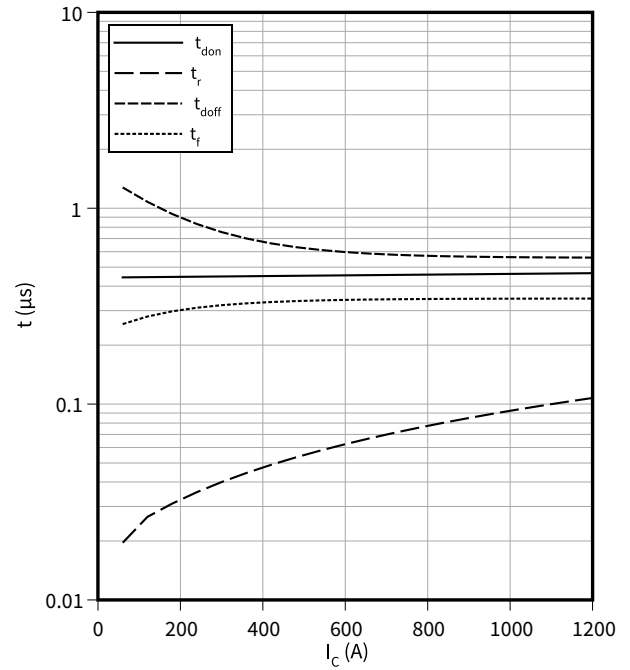
$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$



**Switching times (typical), IGBT, Inverter**

$t = f(I_C)$

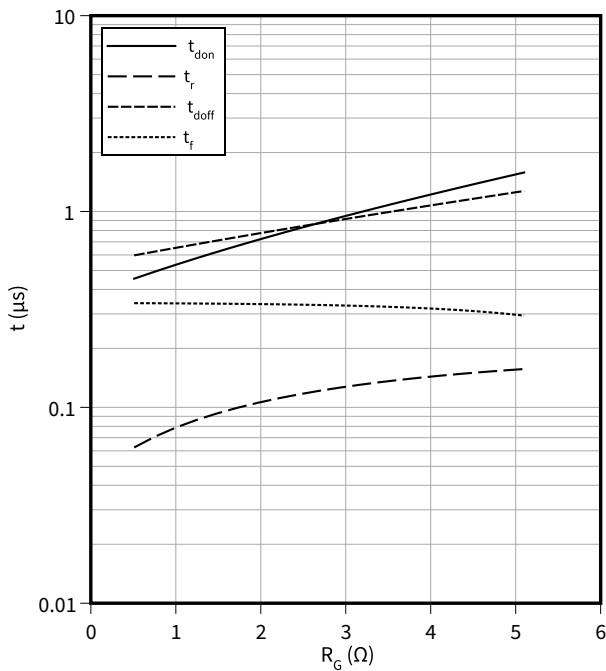
$R_{Goff} = 0.51 \Omega, R_{Gon} = 0.51 \Omega, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



**Switching times (typical), IGBT, Inverter**

$t = f(R_G)$

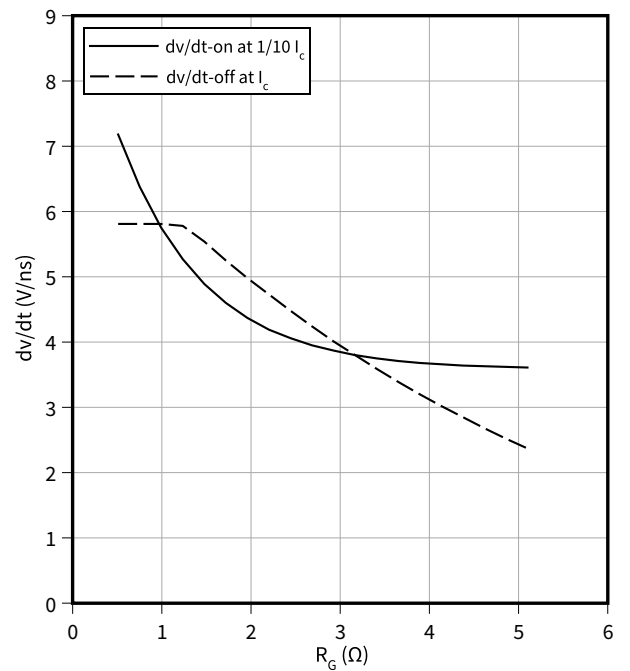
$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$



**Voltage slope (typical), IGBT, Inverter**

$dv/dt = f(R_G)$

$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25 \text{ °C}$

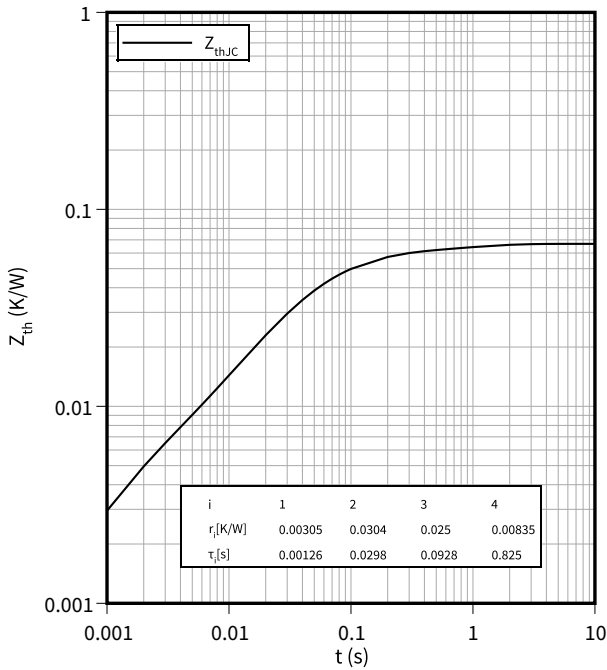




4 Characteristics diagrams

**Transient thermal impedance, IGBT, Inverter**

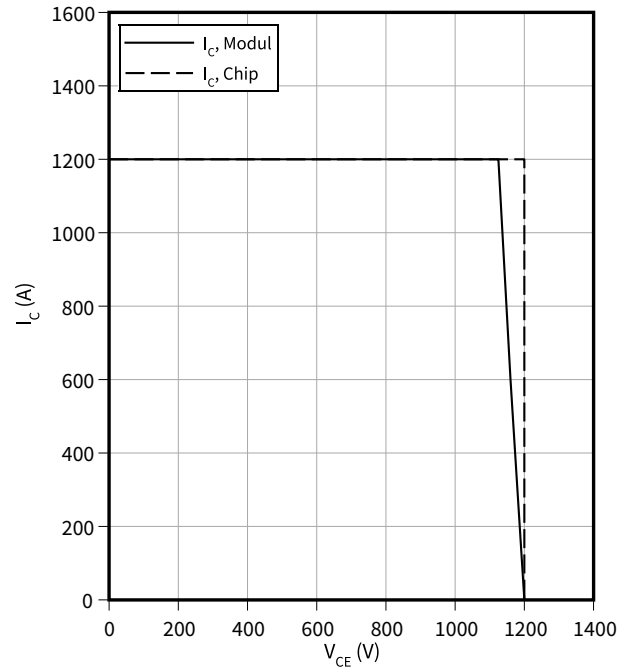
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

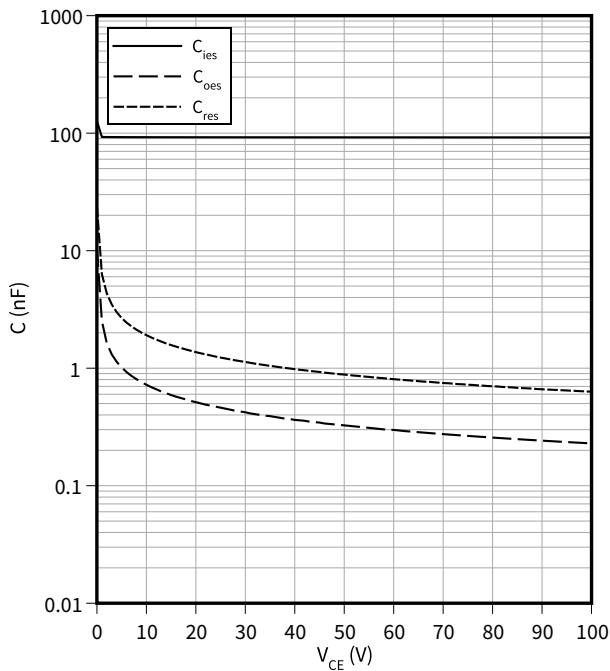
$R_{Goff} = 0.51 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



**Capacity characteristic (typical), IGBT, Inverter**

$C = f(V_{CE})$

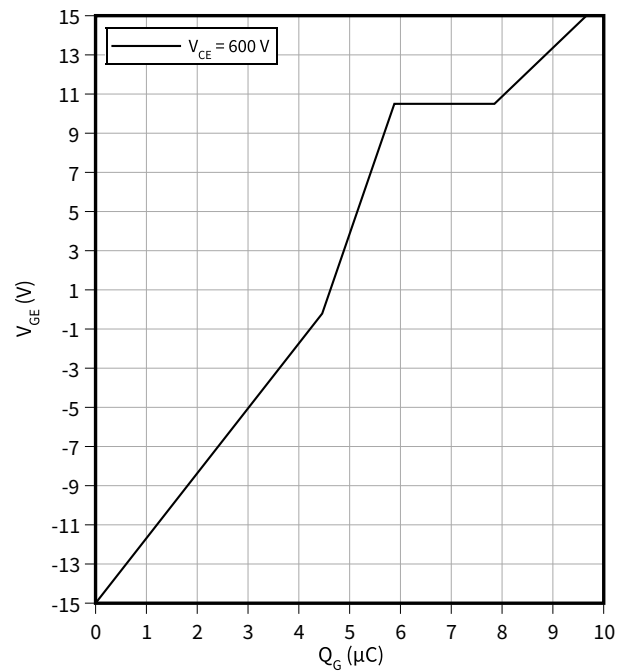
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



**Gate charge characteristic (typical), IGBT, Inverter**

$V_{GE} = f(Q_G)$

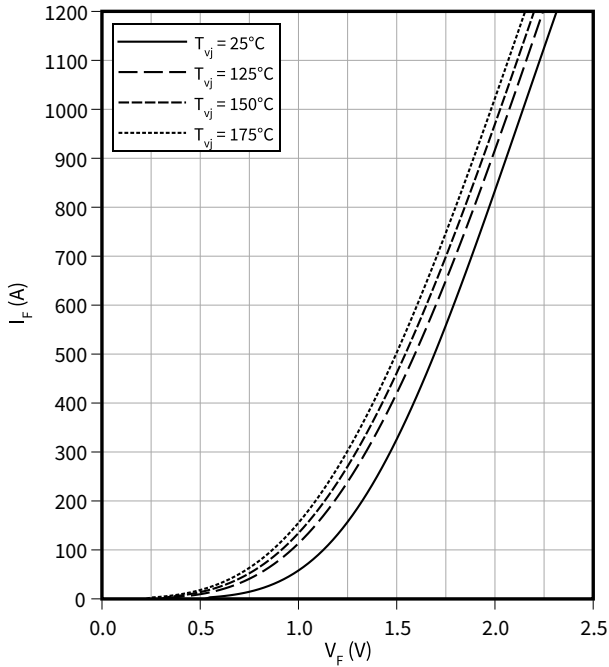
$I_C = 600 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



4 Characteristics diagrams

**Forward characteristic (typical), Diode, Inverter**

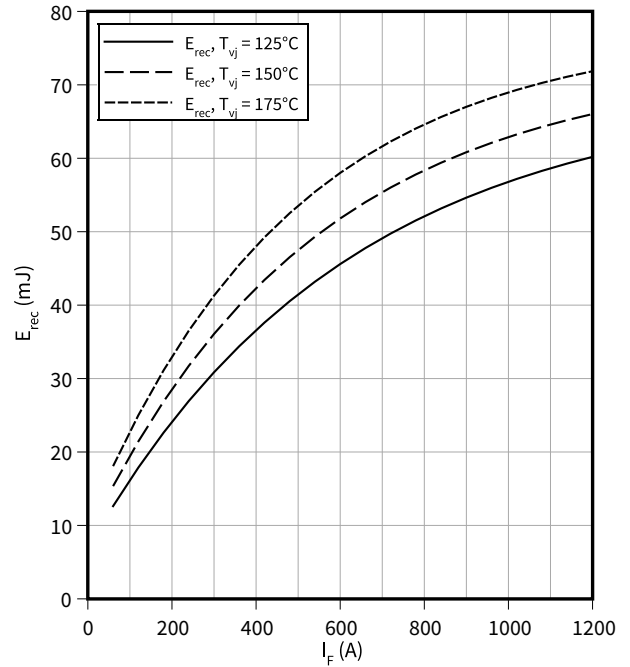
$I_F = f(V_F)$



**Switching losses (typical), Diode, Inverter**

$E_{rec} = f(I_F)$

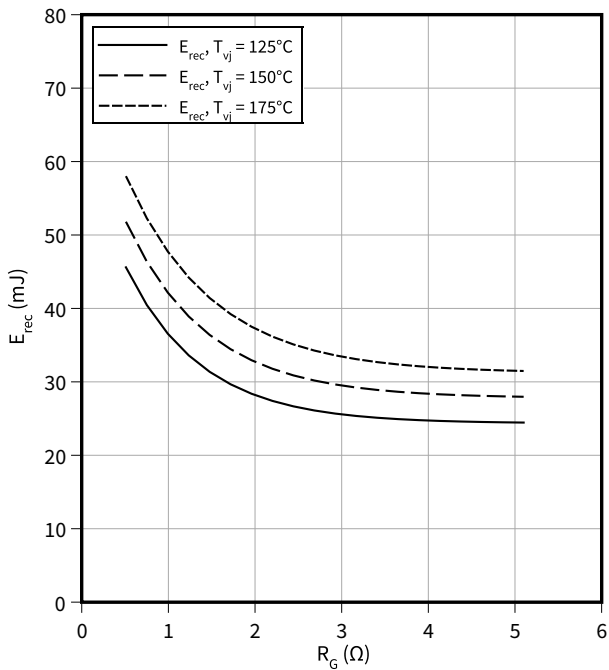
$R_{Gon} = 0.51 \Omega, V_{CC} = 600 V$



**Switching losses (typical), Diode, Inverter**

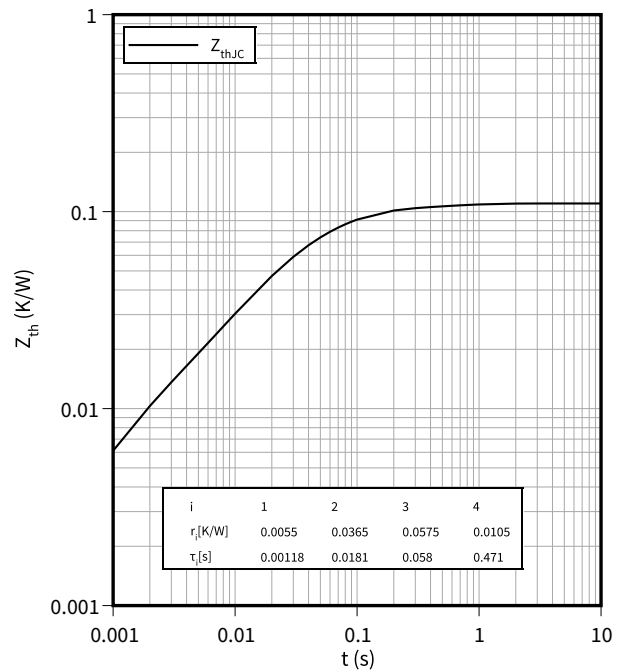
$E_{rec} = f(R_G)$

$I_F = 600 A, V_{CC} = 600 V$



**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$



## 5 Circuit diagram

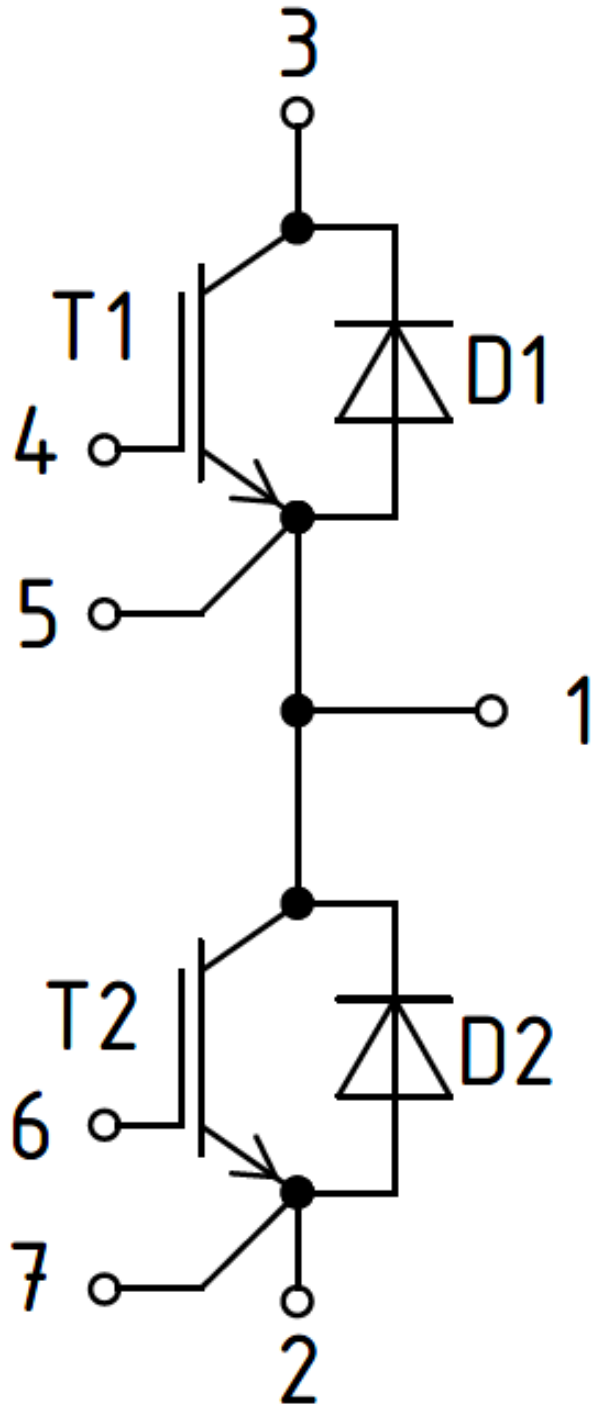
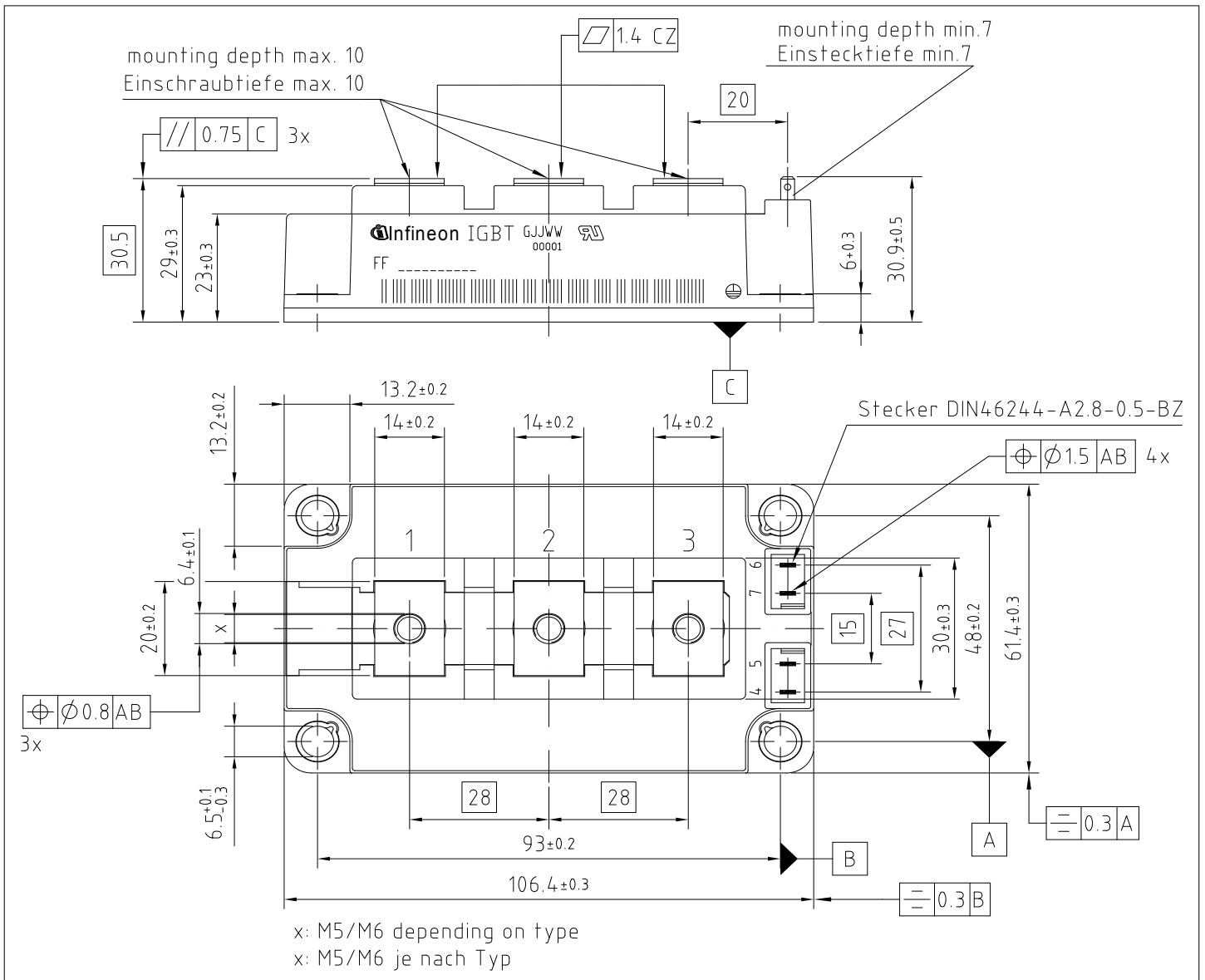


Figure 1

**6 Package outlines**



**Figure 2**

## 7 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	<i>Content</i> Module serial number Module material number Production order number Date code (production year) Date code (production week)	<i>Digit</i> 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	<i>Example</i> 71549 142846 55054991 15 30
Example	 		<p>71549142846550549911530</p> <p>71549142846550549911530</p>

**Figure 3**

## Revision history

Document revision	Date of release	Description of changes
0.10	2021-12-07	Initial version
0.20	2022-09-06	Preliminary datasheet