

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

### Features

- Electrical features
  - $V_{CES} = 1200\text{ V}$
  - $I_{C\text{nom}} = 800\text{ A} / I_{CRM} = 1600\text{ A}$
  - TRENCHSTOP™ IGBT7
  - $V_{CE,\text{sat}}$  with positive temperature coefficient
- Mechanical features
  - Standard housing
  - 4 kV AC 1 min insulation
  - High creepage and clearance distances
  - High power density
  - Isolated base plate
  - Package with CTI > 400



Typical appearance

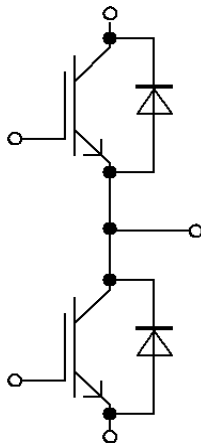
### Potential applications

- Three-level applications
- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- Solar applications
- 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, $f = 50 \text{ Hz}$ , $t = 60 \text{ s}$	4.0	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	$\text{Al}_2\text{O}_3$	
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	$I_{CDC}$	$T_{vj\max} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$	800	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 $T_{vj\ op}$	1600	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	$V_{CE\ sat}$	$I_C = 800\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	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	$V_{GEth}$	$I_C = 16\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.15	5.80	6.45	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CC} = 600\ V$		12.8		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.43		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		122		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		0.6		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)	$t_{don}$	$I_C = 800\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.500		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.517		
			$T_{vj} = 150\ ^\circ C$	0.522		
			$T_{vj} = 175\ ^\circ C$	0.527		
Rise time (inductive load)	$t_r$	$I_C = 800\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.065		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.073		
			$T_{vj} = 150\ ^\circ C$	0.075		
			$T_{vj} = 175\ ^\circ C$	0.077		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 800\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.544		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.628		
			$T_{vj} = 150\ ^\circ C$	0.652		
			$T_{vj} = 175\ ^\circ C$	0.675		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	$t_f$	$I_C = 800 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.51 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$		0.122	$\mu\text{s}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		0.260	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		0.310	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		0.360	
Turn-on energy loss per pulse	$E_{on}$	$I_C = 800 \text{ A}, V_{CC} = 600 \text{ V}, L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.51 \Omega, di/dt = 8700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		27.2	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		42.7	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		48.7	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		54.6	
Turn-off energy loss per pulse	$E_{off}$	$I_C = 800 \text{ A}, V_{CC} = 600 \text{ V}, L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.51 \Omega, dv/dt = 3400 \text{ V}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		69.7	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		108	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		120	
			$T_{vj} = 175 \text{ }^\circ\text{C}$		132	
SC data	$I_{SC}$	$V_{GE} \leq 15 \text{ V}, V_{CC} = 800 \text{ V}, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 8 \mu\text{s}, T_{vj} = 150 \text{ }^\circ\text{C}$		3000	A
			$t_p \leq 6 \mu\text{s}, T_{vj} = 175 \text{ }^\circ\text{C}$		2700	
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			0.0483	K/W
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT		0.0251		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	$I_F$		800	A
Repetitive peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$	1600	A

(table continues...)

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

Parameter	Symbol	Note or test condition	Values	Unit	
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	53000	$\text{A}^2\text{s}$
			$T_{vj} = 175 \text{ }^\circ\text{C}$	41000	

**Table 6 Characteristic values**

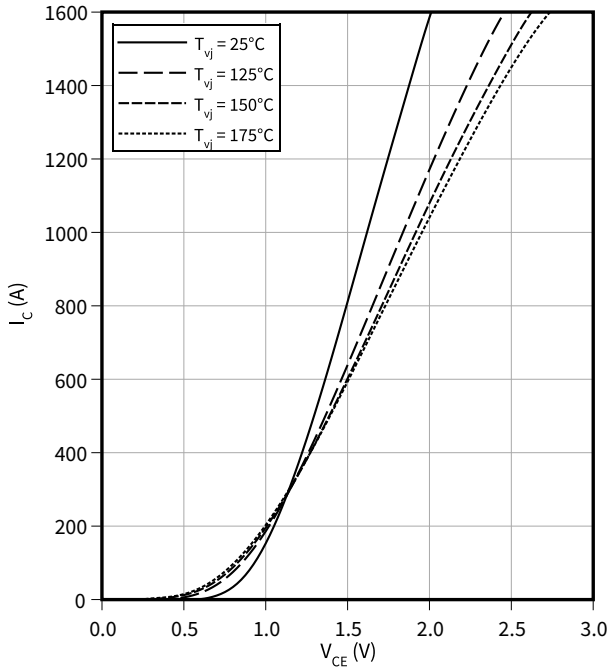
Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 800 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		1.80	2.10	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1.70		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		1.60		
Peak reverse recovery current	$I_{RM}$	$V_{CC} = 600 \text{ V}, I_F = 800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 8700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		540		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		720		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		765		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		810		
Recovered charge	$Q_r$	$V_{CC} = 600 \text{ V}, I_F = 800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 8700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		62		$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		117		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		137		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		156		
Reverse recovery energy	$E_{rec}$	$V_{CC} = 600 \text{ V}, I_F = 800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 8700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		27.9		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		54.5		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		63.3		
			$T_{vj} = 175 \text{ }^\circ\text{C}$		72.1		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.0892	K/W	
Thermal resistance, case to heat sink	$R_{thCH}$	per diode		0.0333		K/W	
Temperature under switching conditions	$T_{vjop}$		-40		175	$^\circ\text{C}$	

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

## 4 Characteristics diagrams

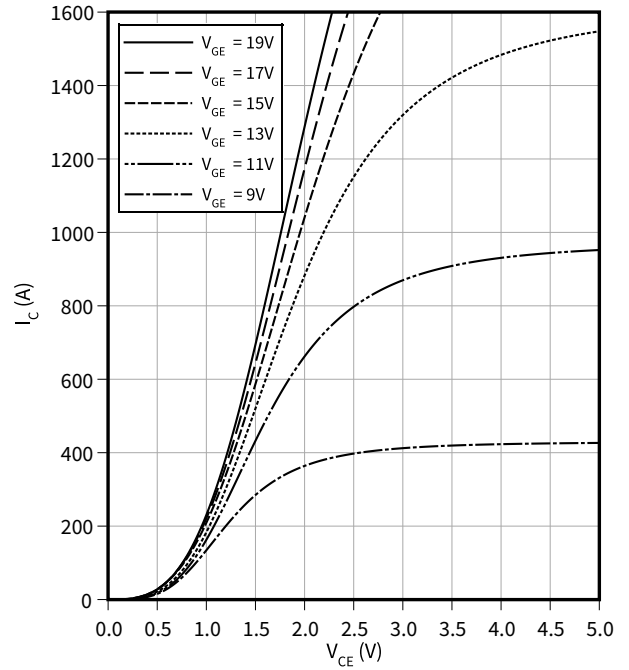
**Output characteristic (typical), IGBT, Inverter**

$I_C = f(V_{CE})$   
 $V_{GE} = 15 \text{ V}$



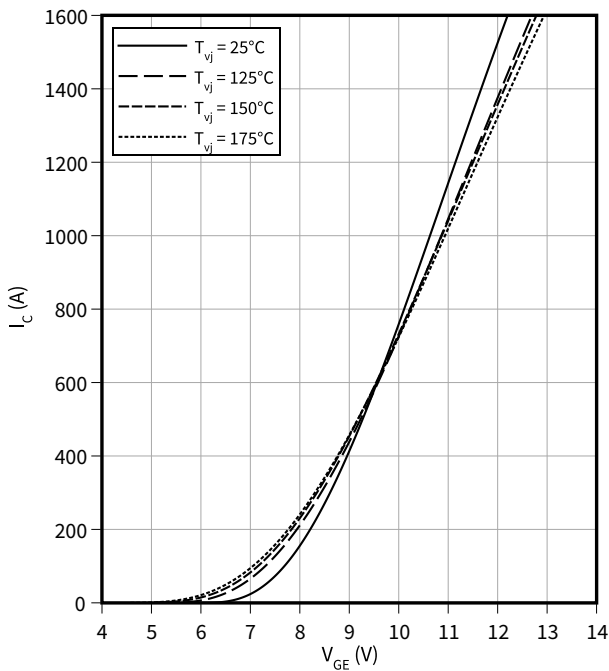
**Output characteristic field (typical), IGBT, Inverter**

$I_C = f(V_{CE})$   
 $T_{vj} = 175 \text{ °C}$



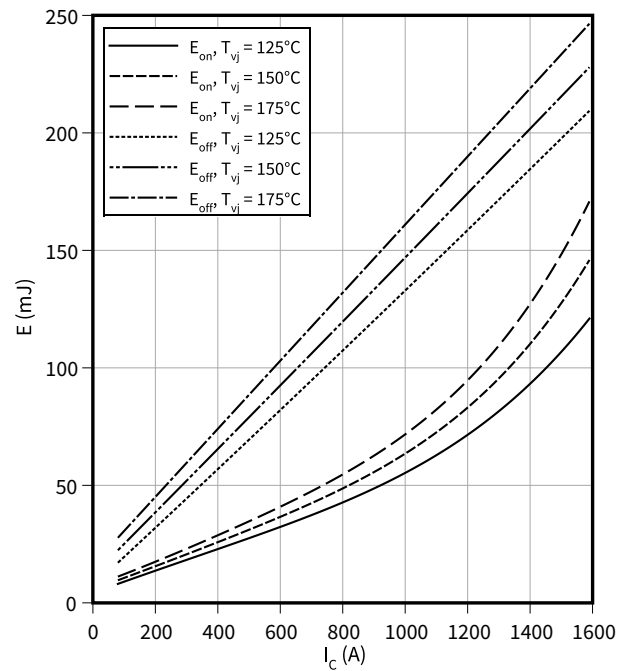
**Transfer characteristic (typical), IGBT, Inverter**

$I_C = f(V_{GE})$   
 $V_{CE} = 20 \text{ V}$



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

$E = f(I_C)$   
 $R_{Goff} = 0.51 \text{ } \Omega$ ,  $R_{Gon} = 0.51 \text{ } \Omega$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$

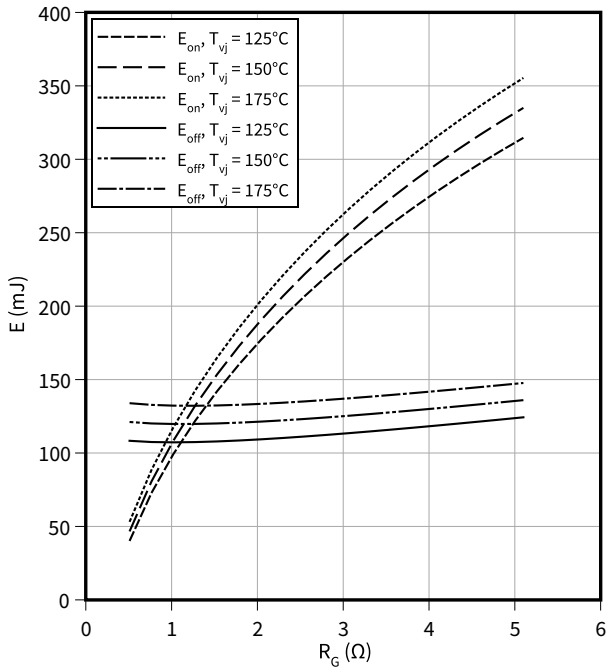


4 Characteristics diagrams

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

$E = f(R_G)$

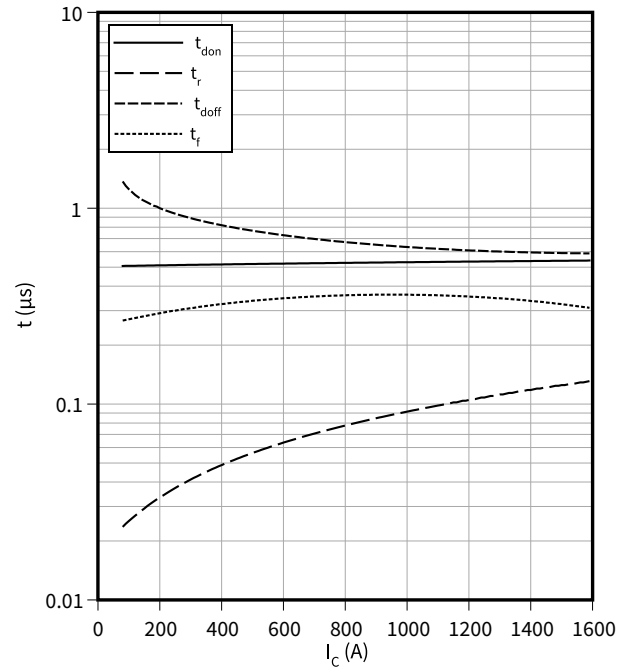
$I_C = 800 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$



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

$t = f(I_C)$

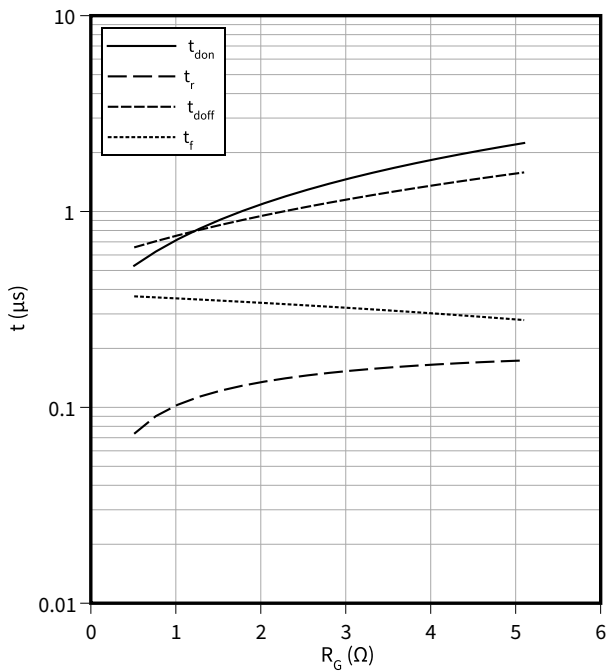
$R_{Goff} = 0.51 \Omega$ ,  $R_{Gon} = 0.51 \Omega$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 175 \text{ °C}$



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

$t = f(R_G)$

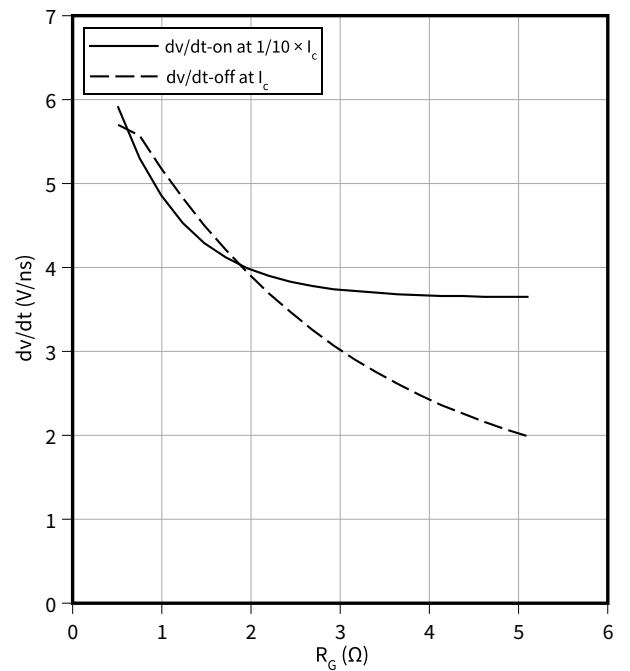
$I_C = 800 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 175 \text{ °C}$



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

$dv/dt = f(R_G)$

$I_C = 800 \text{ A}$ ,  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $T_{vj} = 25 \text{ °C}$

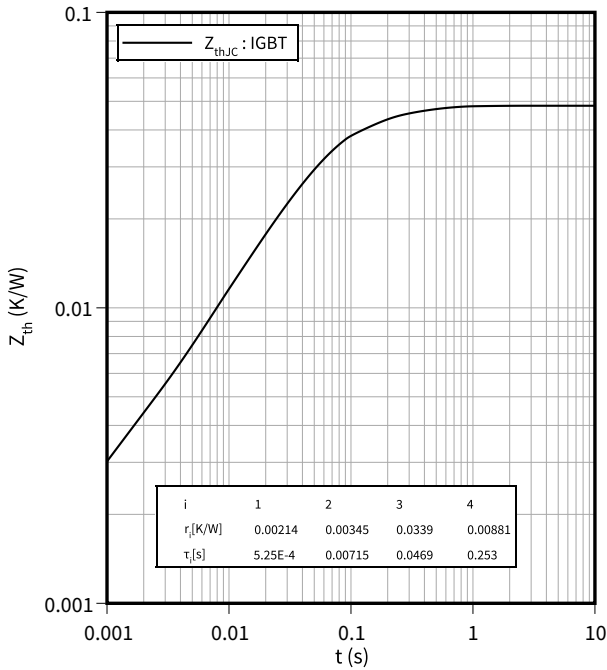




4 Characteristics diagrams

**Transient thermal impedance, IGBT, Inverter**

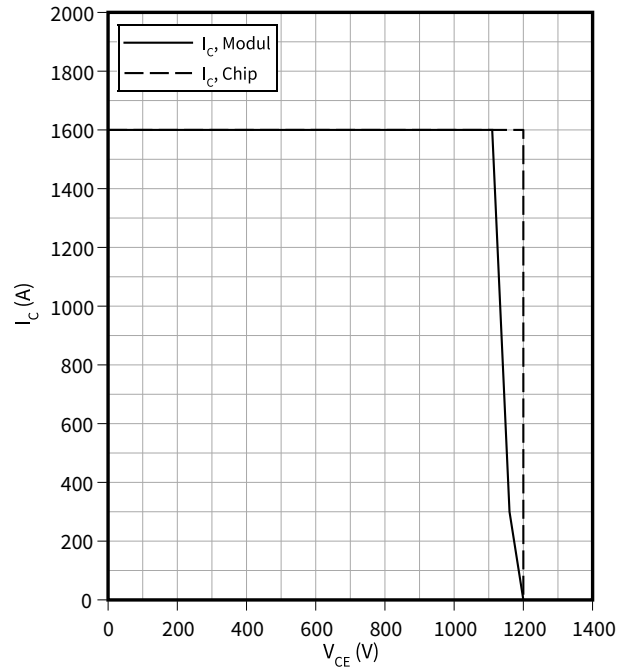
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

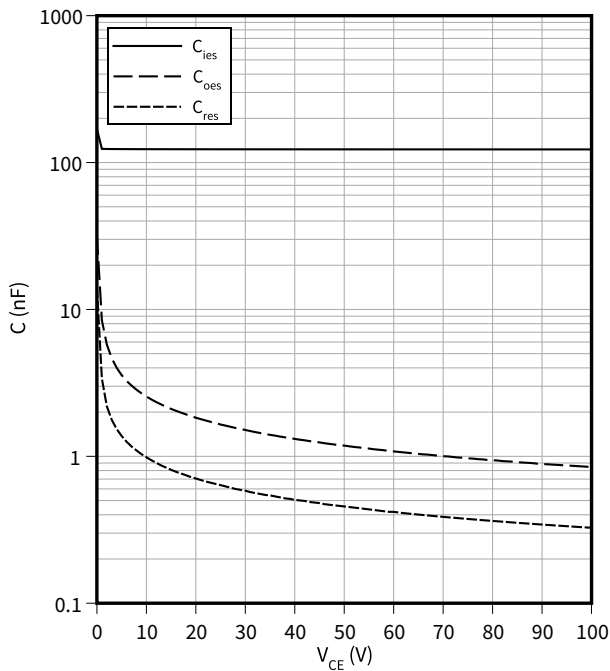
$R_{Goff} = 0.51 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



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

$C = f(V_{CE})$

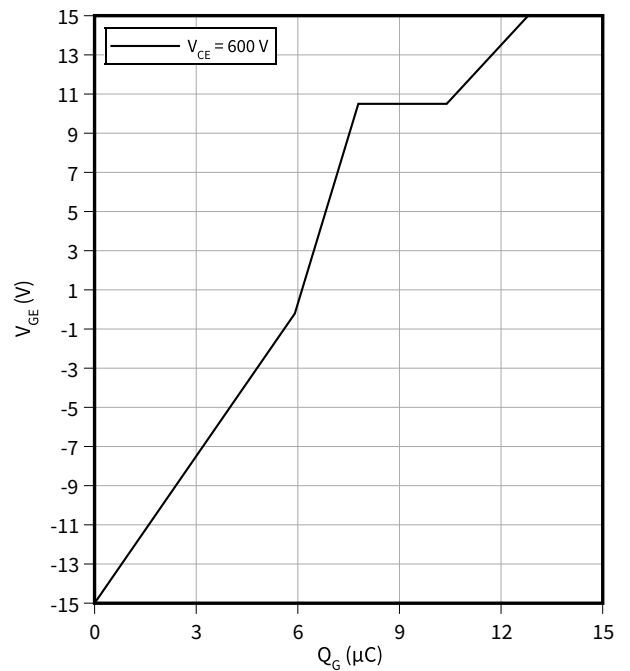
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



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

$V_{GE} = f(Q_G)$

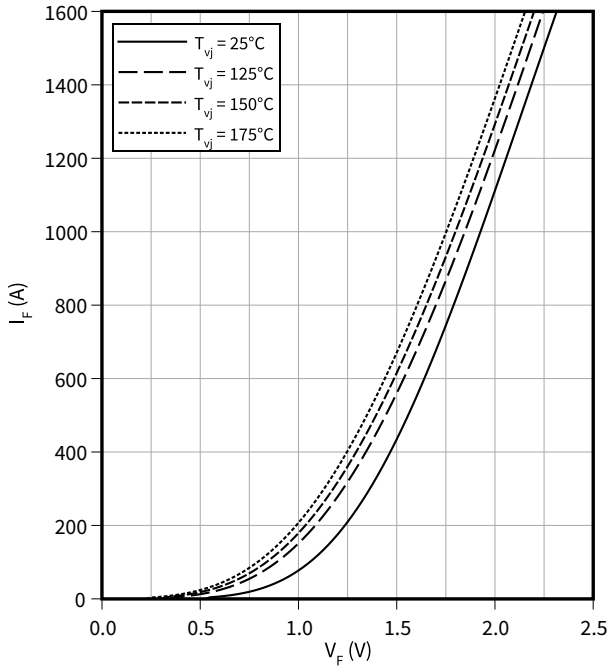
$I_C = 800 A, T_{vj} = 25 \text{ }^\circ\text{C}$



4 Characteristics diagrams

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

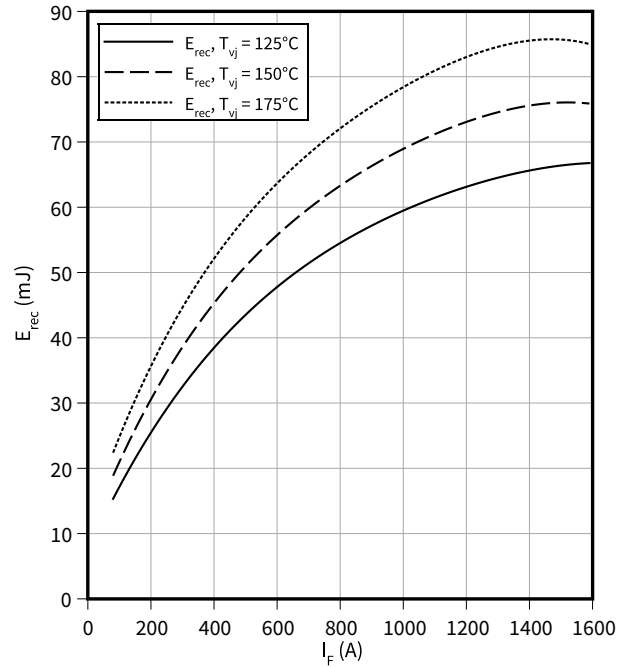
$I_F = f(V_F)$



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

$E_{rec} = f(I_F)$

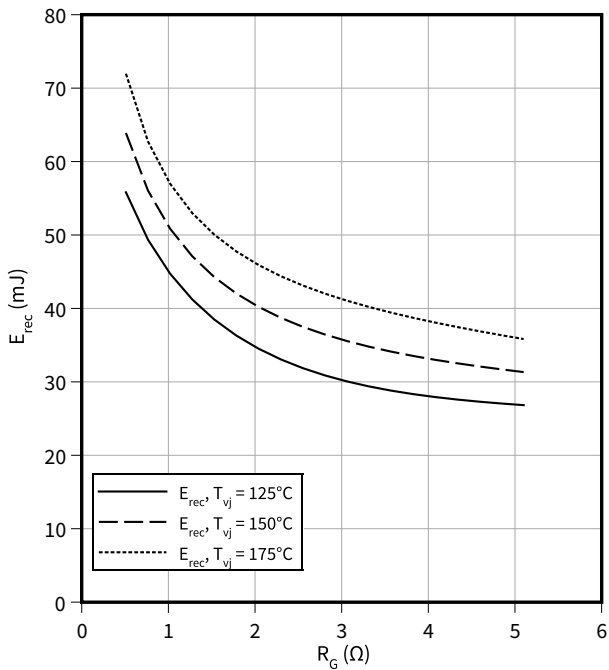
$R_{Gon} = 0.51 \Omega, V_{CE} = 600 V$



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

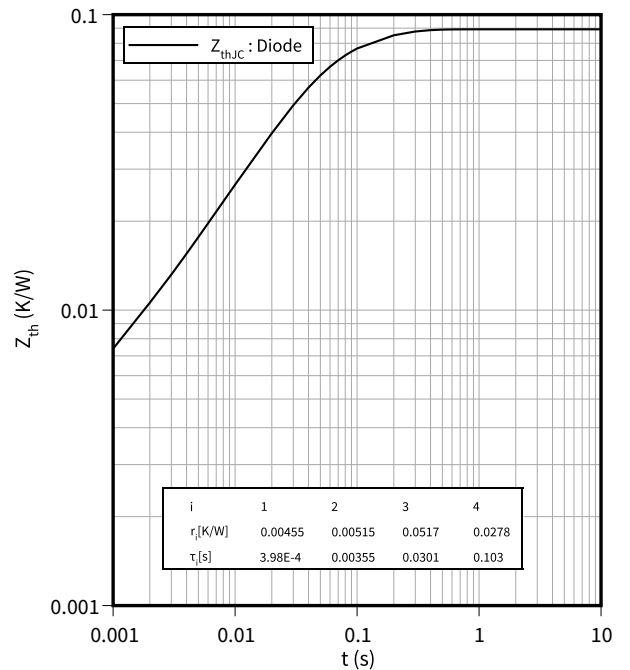
$E_{rec} = f(R_G)$

$V_{CE} = 600 V, I_F = 800 A$



**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$



## 5 Circuit diagram

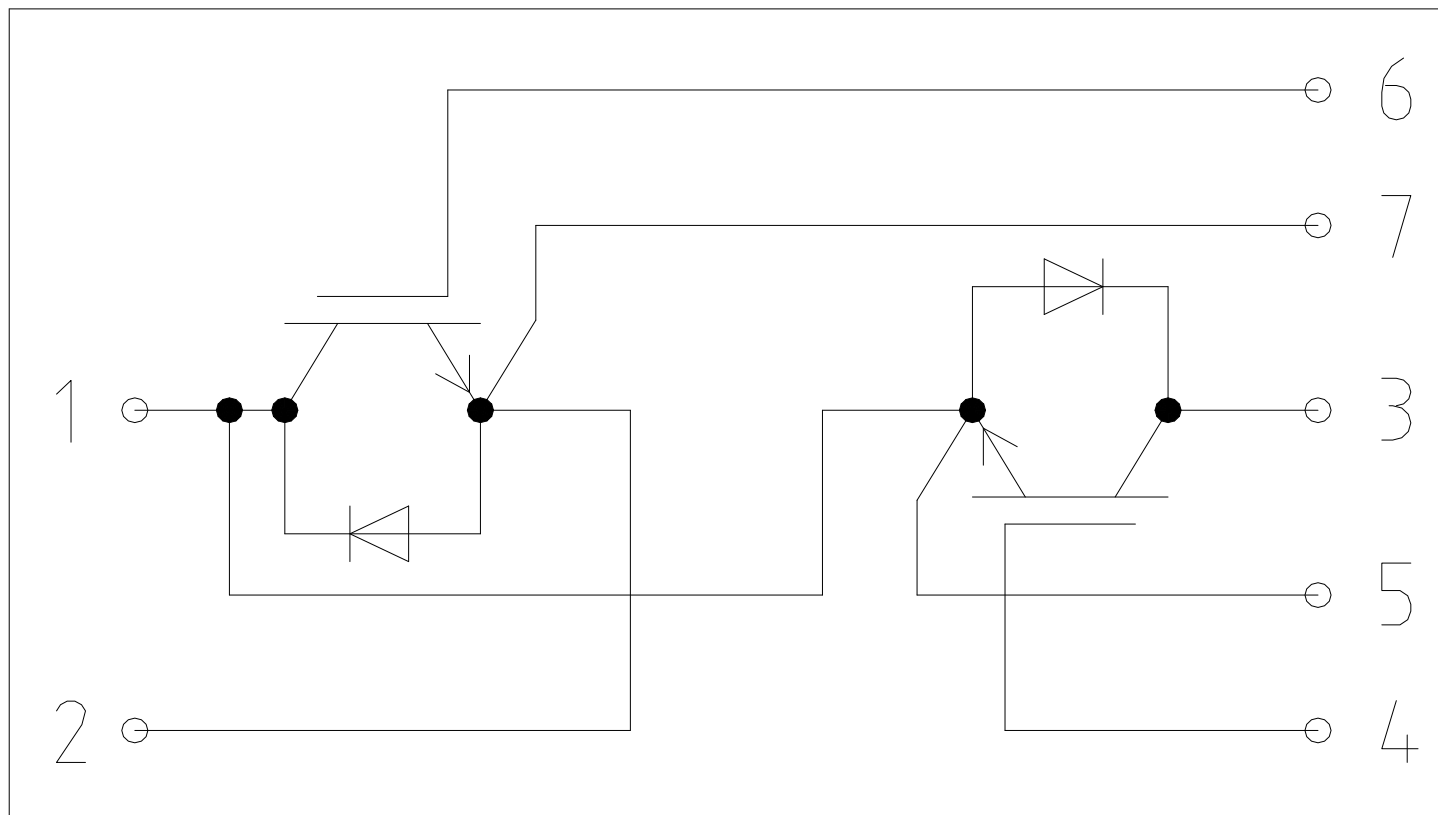
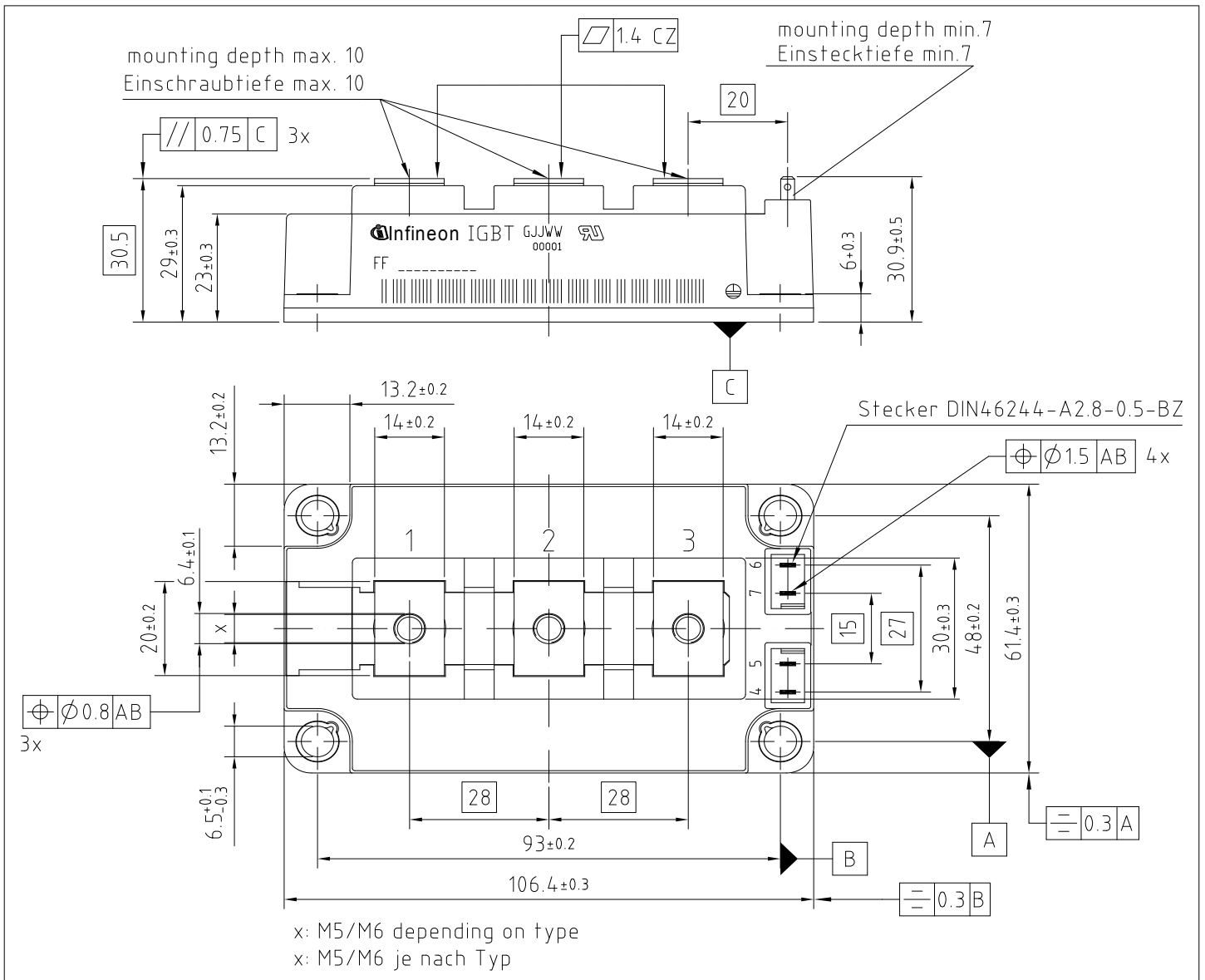



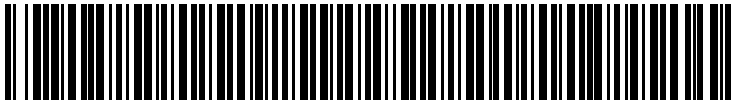
Figure 1

**6 Package outlines**



**Figure 2**

## 7 Module label code

<b>Module label code</b>			
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>	<i>Digit</i>	<i>Example</i>
	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
V1.0	2020-06-19	Target datasheet
V1.1	2020-08-21	Target datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
0.10	2021-09-02	Target datasheet
0.30	2021-11-15	Target datasheet
0.40	2021-12-17	Preliminary datasheet
1.00	2022-05-11	Final datasheet

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**Edition 2022-05-11**

**Published by**

**Infineon Technologies AG**

**81726 Munich, Germany**

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**IFX-AAJ653-006**

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