

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



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

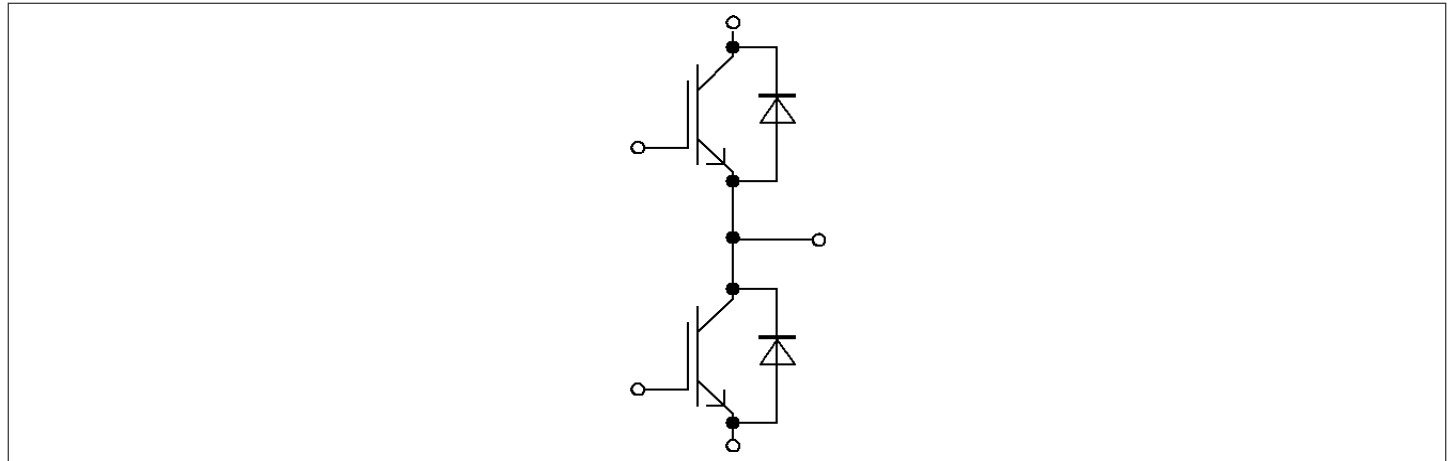


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1 Package

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)	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}	$T_{vj \max} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$	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}		± 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		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$		0.43		Ω
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		μs
			$T_{vj} = 125\ ^\circ C$	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		μs
			$T_{vj} = 125\ ^\circ C$	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		μs
			$T_{vj} = 125\ ^\circ C$	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		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	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	A^2s
			$T_{vj} = 175 \text{ }^\circ\text{C}$	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		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		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	$^\circ\text{C}$	

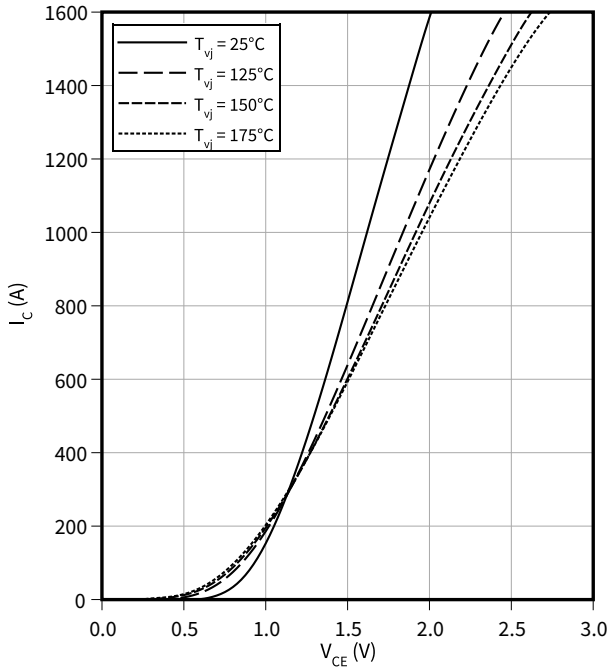
Note: $T_{vjop} > 150 \text{ }^\circ\text{C}$ is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

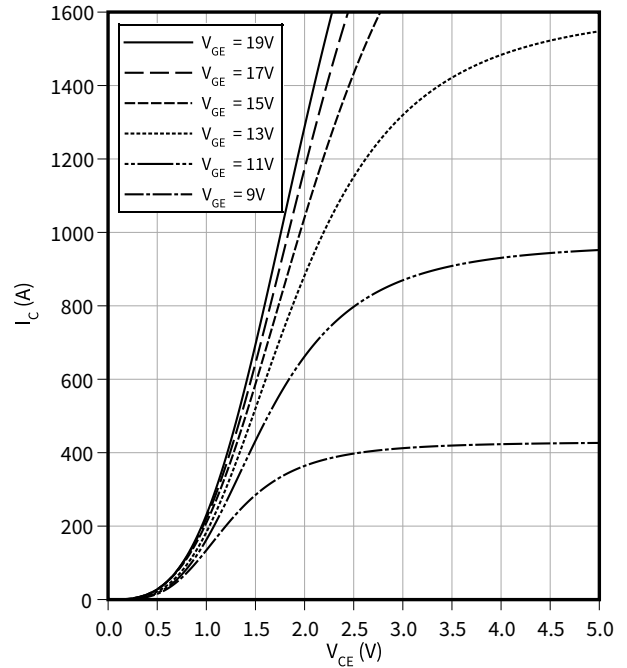
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

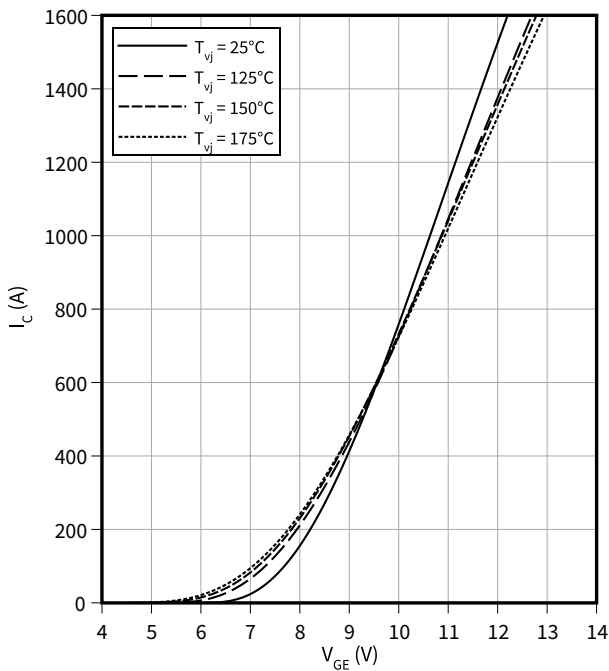
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

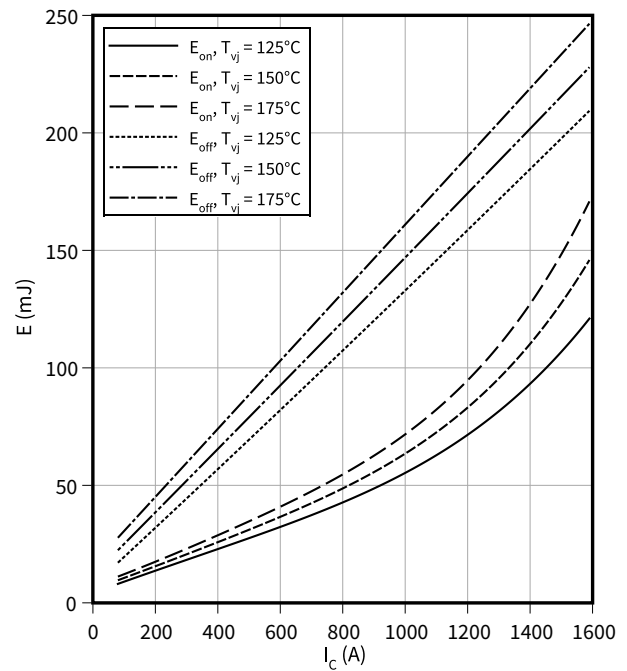
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

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

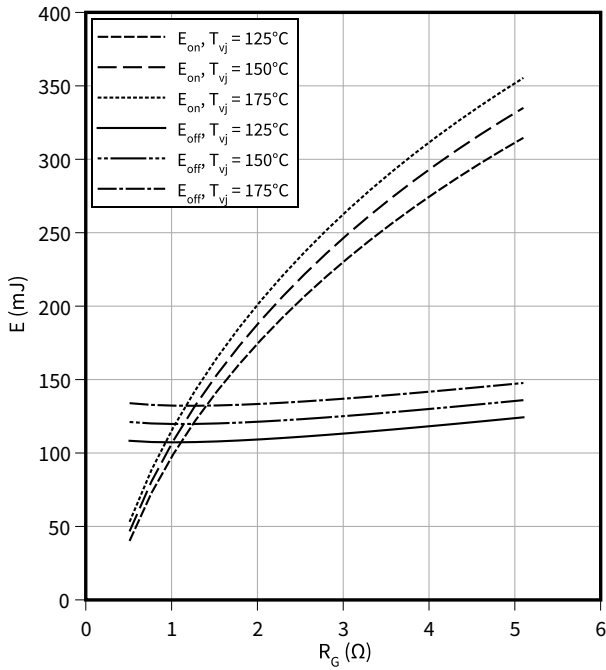


4 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

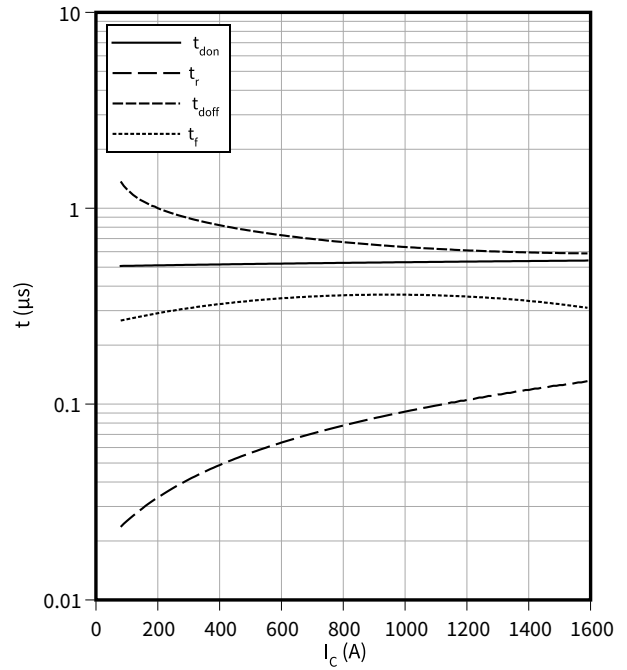
$I_C = 800 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

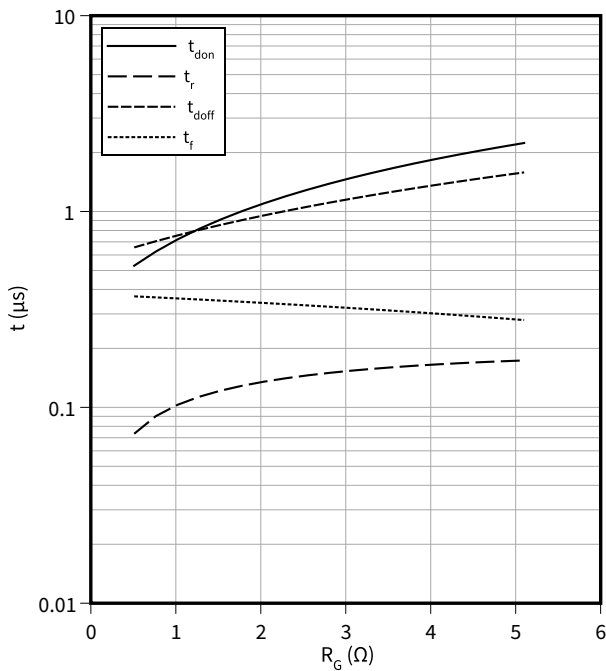
$R_{Goff} = 0.51 \Omega$, $R_{Gon} = 0.51 \Omega$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 175 \text{ °C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

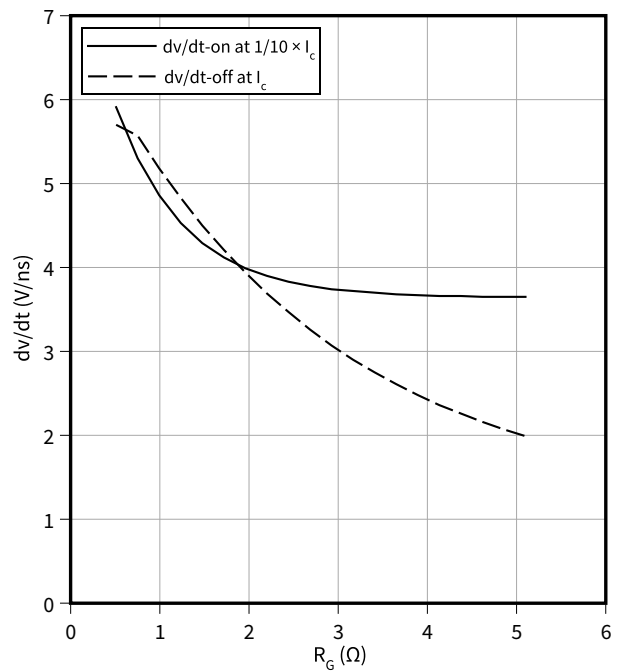
$I_C = 800 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 175 \text{ °C}$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

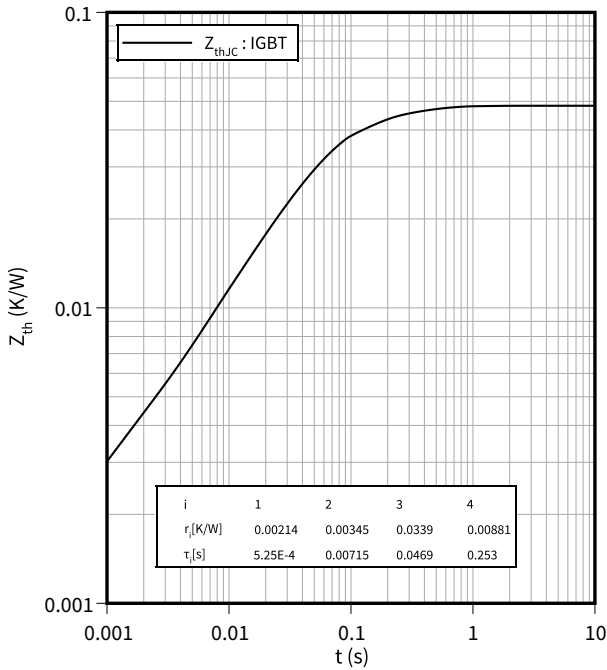
$I_C = 800 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 25 \text{ °C}$



4 Characteristics diagrams

Transient thermal impedance, IGBT, Inverter

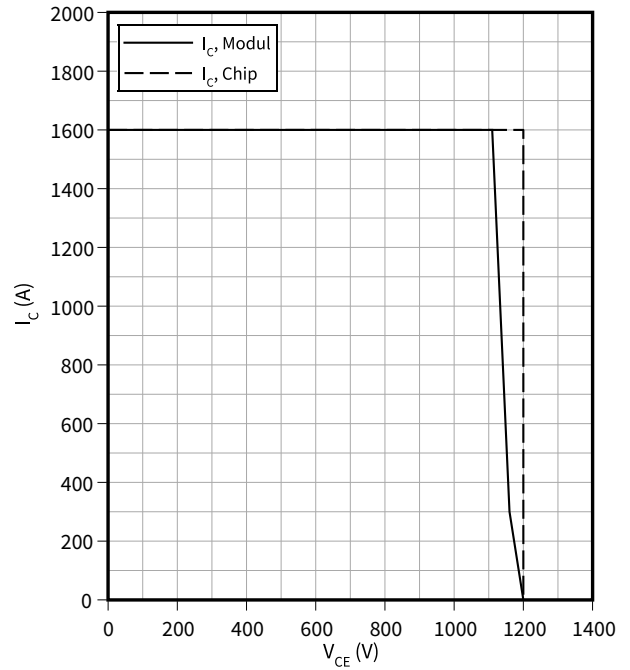
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

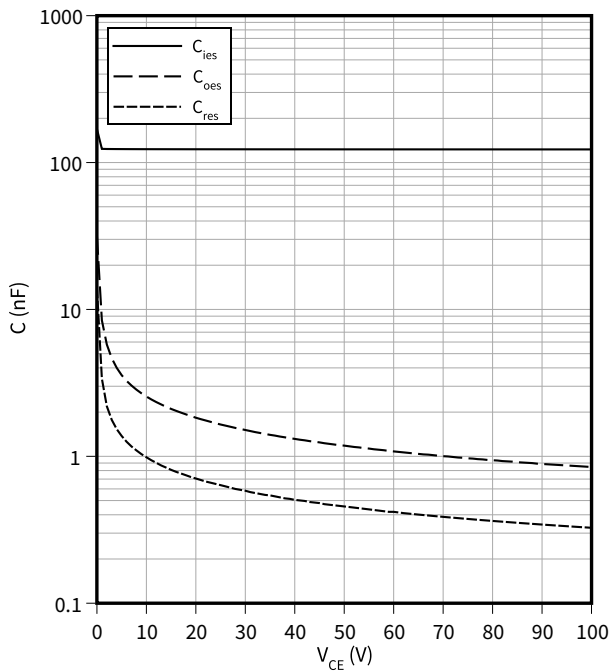
$R_{Goff} = 0.51 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

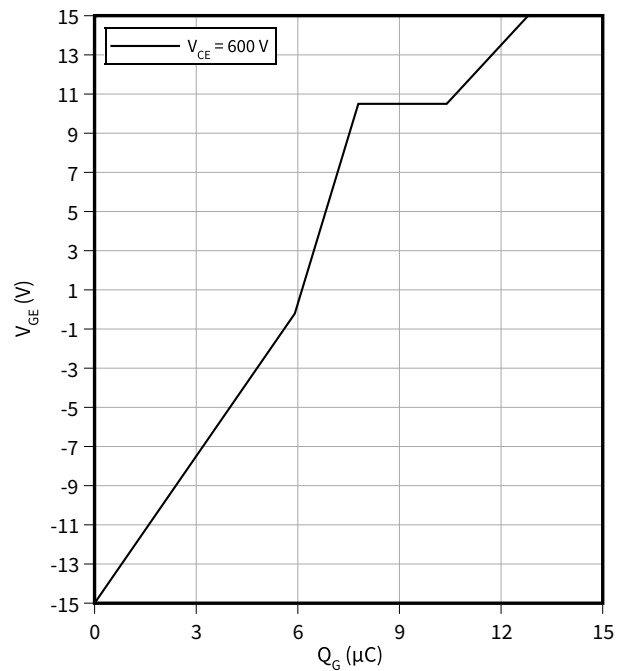
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

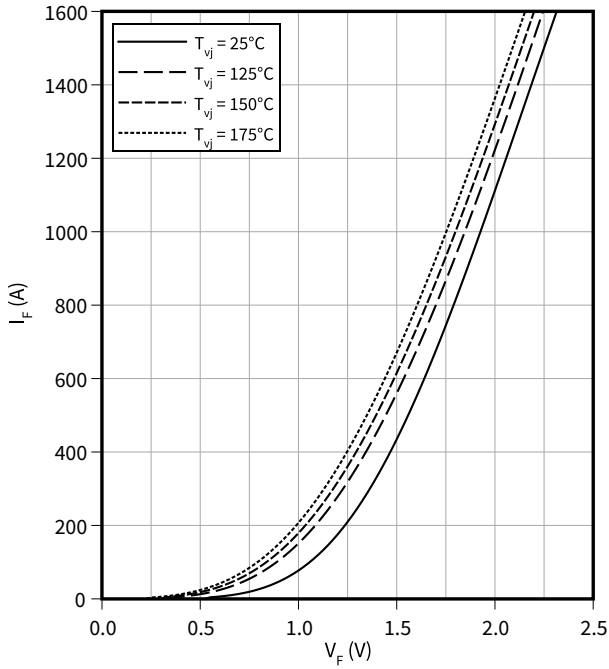
$I_C = 800 A, T_{vj} = 25 \text{ }^\circ\text{C}$



4 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

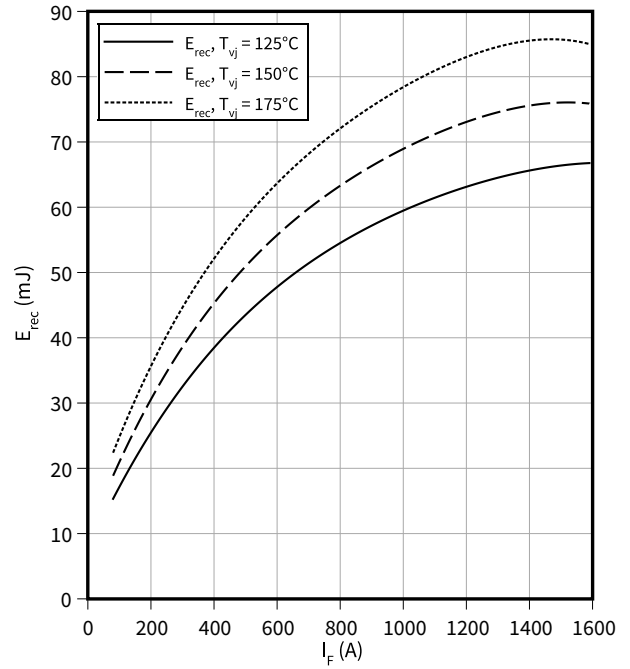
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

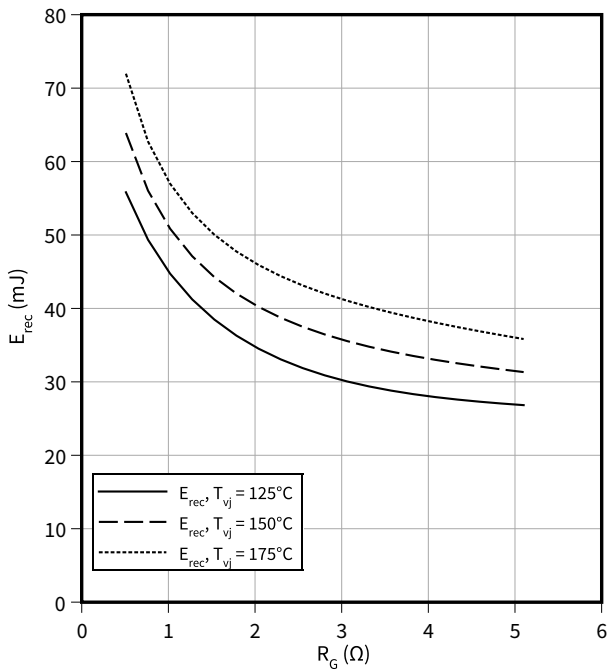
$R_{Gon} = 0.51 \Omega, V_{CE} = 600 V$



Switching losses (typical), Diode, Inverter

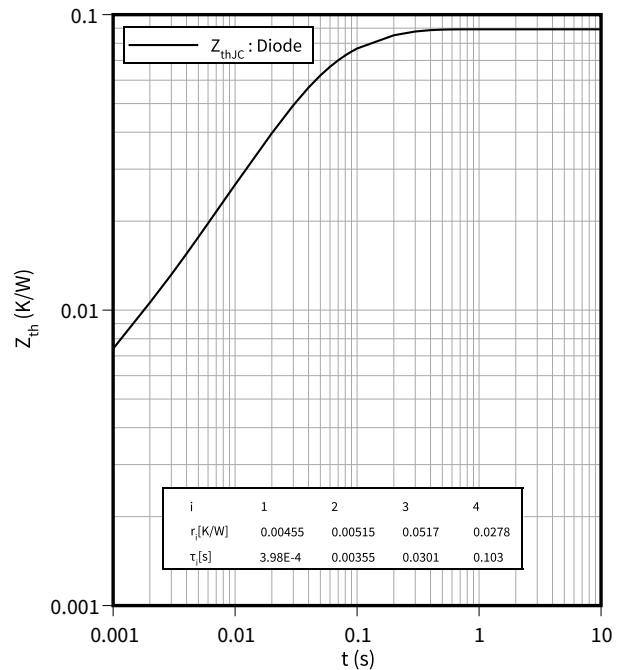
$E_{rec} = f(R_G)$

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



Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



5 Circuit diagram

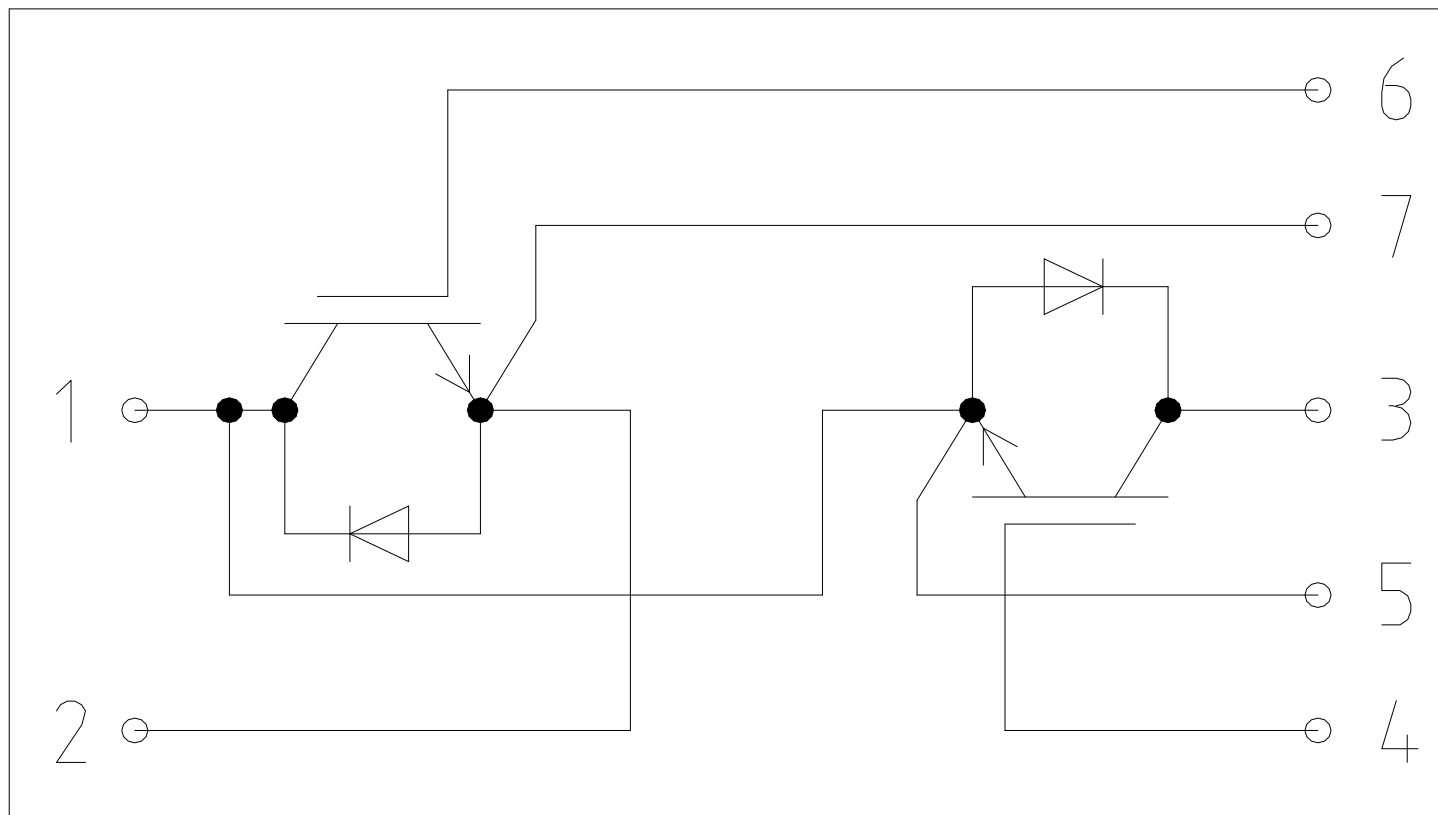


Figure 1

6 Package outlines

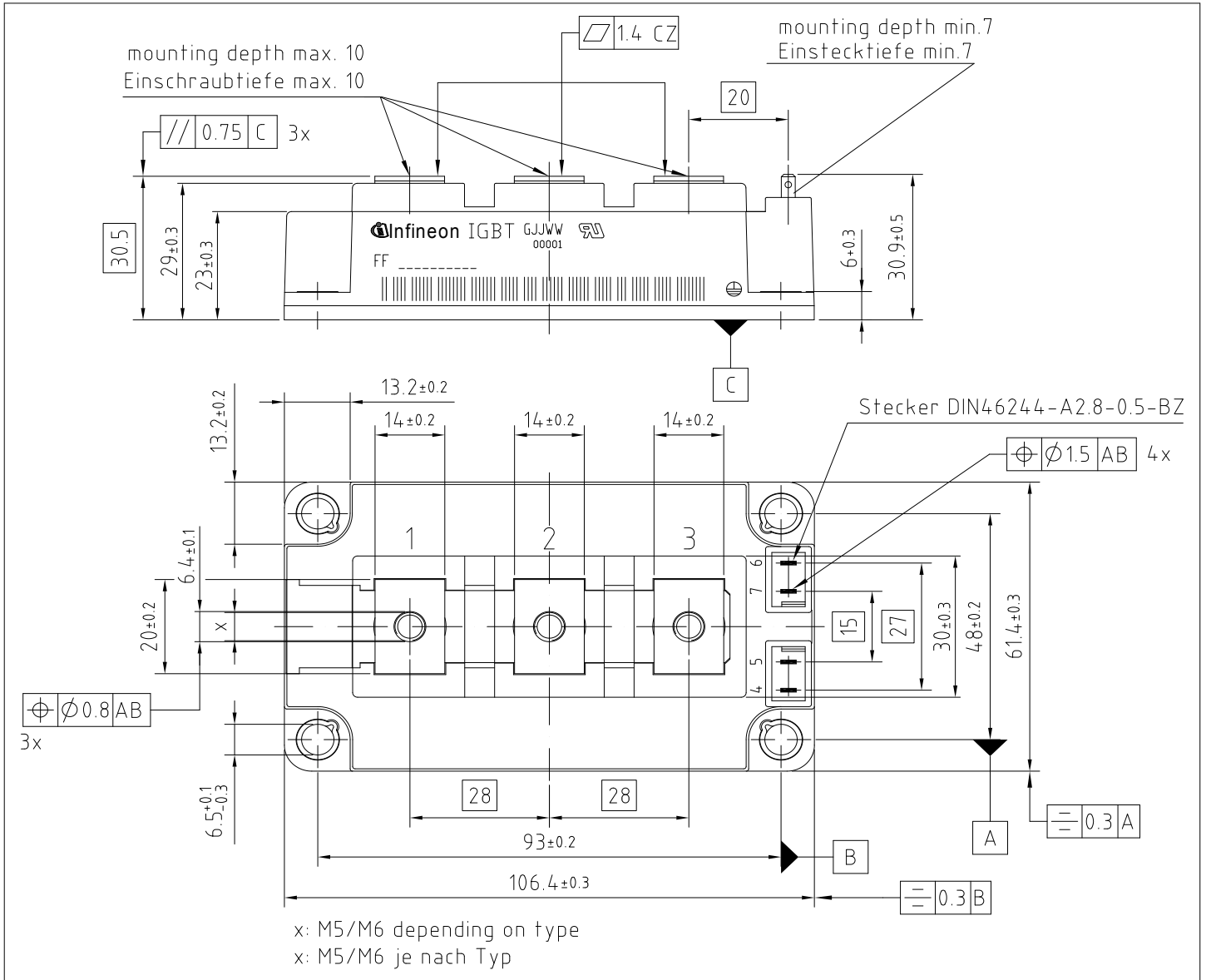


Figure 2

7 Module label code


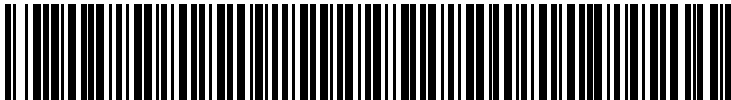
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production 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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