

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
 - $V_{CE,sat}$ 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



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

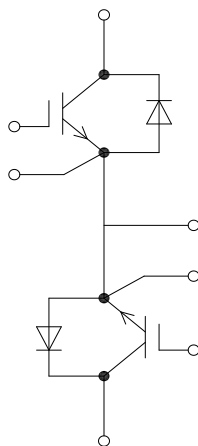


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1 Package

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	$R_{CC'+EE'}$	$T_H = 25\text{ }^{\circ}\text{C}$, per switch			0.5		mΩ
Storage temperature	T_{stg}			-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}					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

Note: Storage and shipment of modules with TIM => see AN2012-07

2 IGBT, T1 / T2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25 \text{ °C}$	1200	V

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC collector current	I_{CDC}	$T_{vj\ max} = 175\ ^\circ\text{C}$	$T_H = 50\ ^\circ\text{C}$	600	A
Maximum RMS module DC-terminal current	I_{tRMS}		$T_{\text{Terminal}} = 115\ ^\circ\text{C},$ $T_C = 90\ ^\circ\text{C}$	650	A
			$T_{\text{Terminal}} = 115\ ^\circ\text{C},$ $T_C = 115\ ^\circ\text{C}$	600	
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		1200	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	$V_{CE\ sat}$	$I_C = 600\ \text{A}, V_{GE} = 15\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$		1.50	1.75	V
			$T_{vj} = 125\ ^\circ\text{C}$		1.65		
			$T_{vj} = 150\ ^\circ\text{C}$		1.70		
			$T_{vj} = 175\ ^\circ\text{C}$		1.75		
Gate threshold voltage	V_{GEth}	$I_C = 12\ \text{mA}, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ\text{C}$		5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ \text{V}, V_{CC} = 600\ \text{V}$			9.66		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ\text{C}$			0.6		Ω
Input capacitance	C_{ies}	$f = 100\ \text{kHz}, T_{vj} = 25\ ^\circ\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$			92.3		nF
Reverse transfer capacitance	C_{res}	$f = 100\ \text{kHz}, T_{vj} = 25\ ^\circ\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$			0.462		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ \text{V}, V_{GE} = 0\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$			0.1	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ \text{V}, V_{GE} = 20\ \text{V}, T_{vj} = 25\ ^\circ\text{C}$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 600\ \text{A}, V_{CC} = 600\ \text{V},$ $V_{GE} = \pm 15\ \text{V}, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$		0.435		μs
			$T_{vj} = 125\ ^\circ\text{C}$		0.447		
			$T_{vj} = 150\ ^\circ\text{C}$		0.451		
			$T_{vj} = 175\ ^\circ\text{C}$		0.454		
Rise time (inductive load)	t_r	$I_C = 600\ \text{A}, V_{CC} = 600\ \text{V},$ $V_{GE} = \pm 15\ \text{V}, R_{Gon} = 0.51\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$		0.051		μs
			$T_{vj} = 125\ ^\circ\text{C}$		0.058		
			$T_{vj} = 150\ ^\circ\text{C}$		0.060		
			$T_{vj} = 175\ ^\circ\text{C}$		0.062		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time (inductive load)	t_{doff}	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V},$ $V_{GE} = \pm 15 \text{ V}, R_{\text{Goff}} = 0.51 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.490		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.558		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.578		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.597		
Fall time (inductive load)	t_f	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V},$ $V_{GE} = \pm 15 \text{ V}, R_{\text{Goff}} = 0.51 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.119		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	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}	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V},$ $L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V},$ $R_{\text{Gon}} = 0.51 \Omega, di/dt =$ $7700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$	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}	$I_C = 600 \text{ A}, V_{CC} = 600 \text{ V},$ $L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V},$ $R_{\text{Goff}} = 0.51 \Omega, dv/dt =$ $3150 \text{ V}/\mu\text{s} (T_{vj} = 175 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$	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}	$V_{GE} \leq 15 \text{ V}, V_{CC} = 800 \text{ V},$ $V_{CE\text{max}} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8 \mu\text{s},$ $T_{vj} = 150 \text{ }^\circ\text{C}$	2250		A
			$t_p \leq 6 \mu\text{s},$ $T_{vj} = 175 \text{ }^\circ\text{C}$	2000		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material			0.101	K/W
Temperature under switching conditions	$T_{vj\text{op}}$		-40		175	$^\circ\text{C}$

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

3 Diode, D1 / D2

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

(table continues...)

Table 5 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$	1200	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	A^2s
			$T_{vj} = 175 \text{ }^\circ\text{C}$	

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		μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$	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 heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			0.158	K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	$^\circ\text{C}$

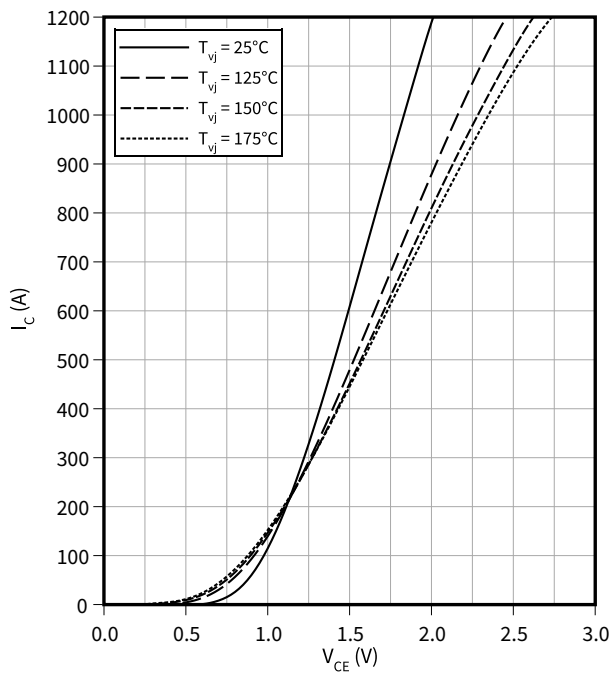
Note: $T_{vj\text{ op}} > 150 \text{ }^\circ\text{C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

4 Characteristics diagrams

Output characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{CE})$

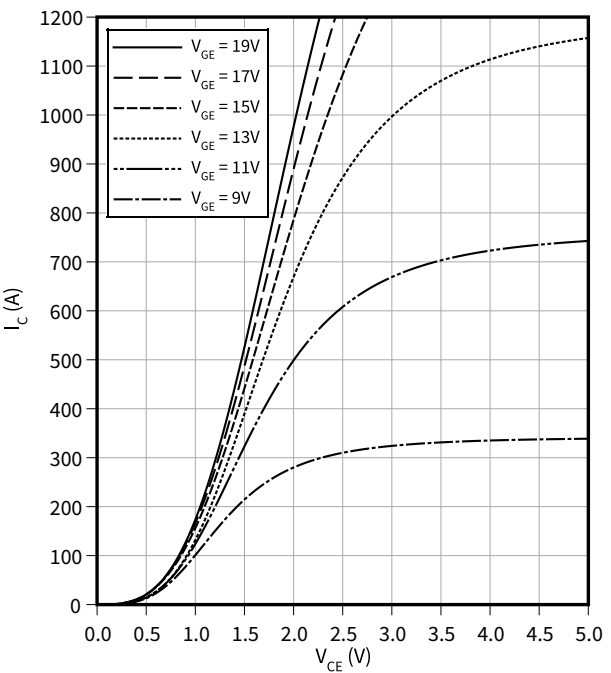
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, T1 / T2

$I_C = f(V_{CE})$

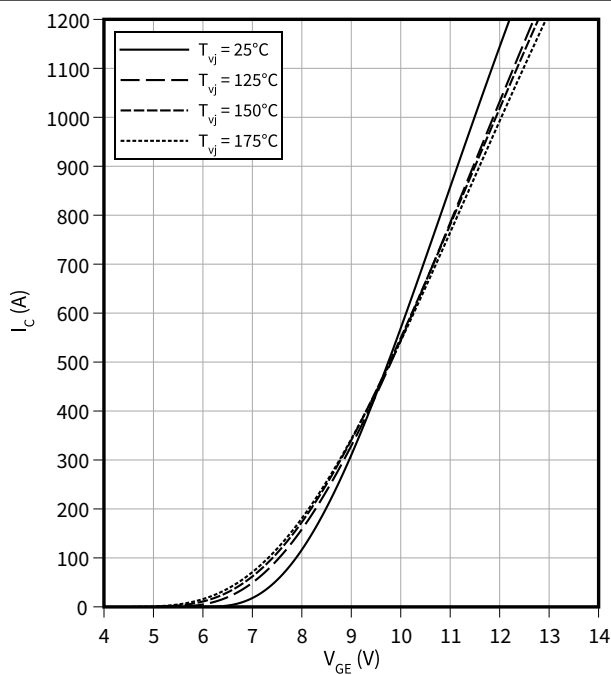
$T_{vj} = 175\text{ °C}$



Transfer characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{GE})$

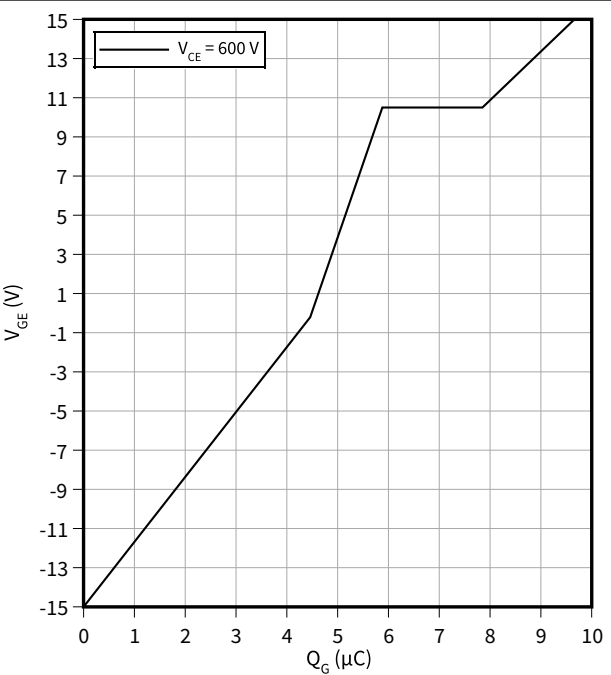
$V_{CE} = 20\text{ V}$



Gate charge characteristic (typical), IGBT, T1 / T2

$V_{GE} = f(Q_G)$

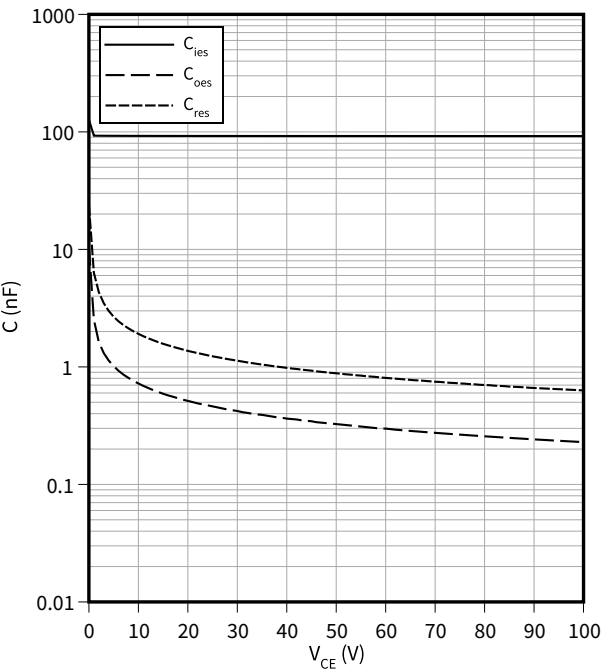
$I_C = 600\text{ A}, T_{vj} = 25\text{ °C}$



4 Characteristics diagrams

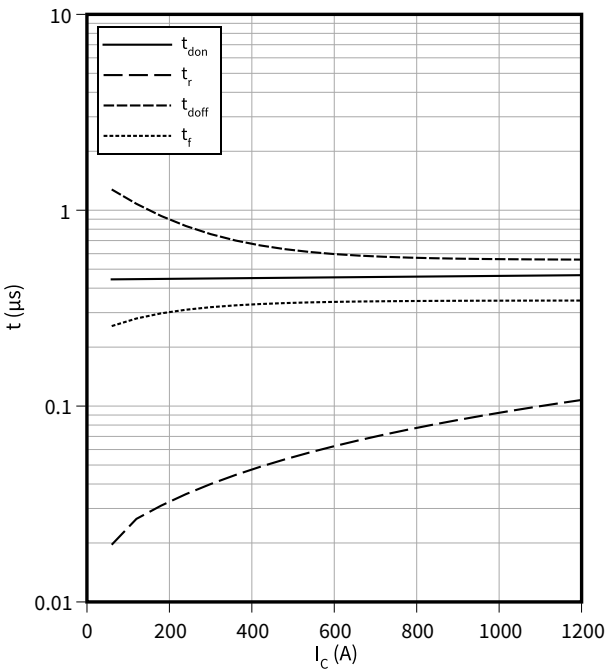
Capacity characteristic (typical), IGBT, T1 / T2

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



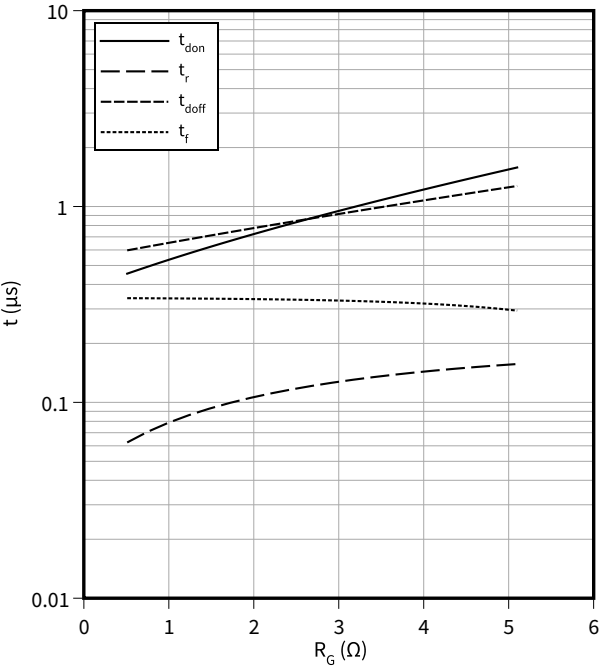
Switching times (typical), IGBT, T1 / T2

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



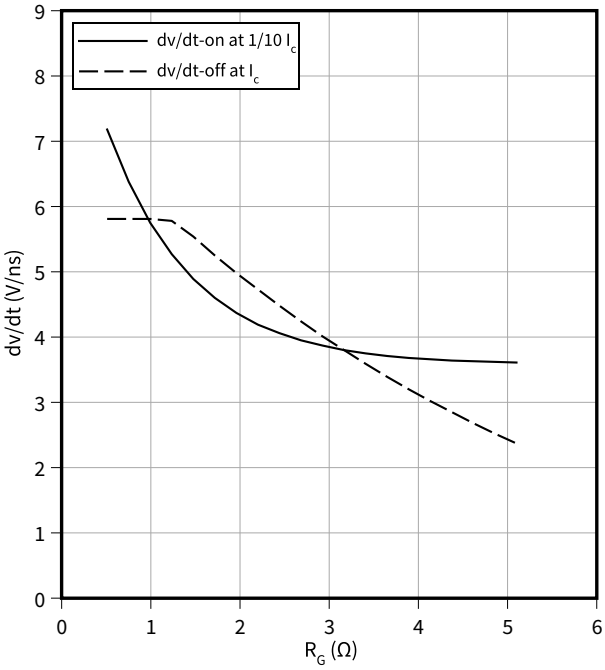
Switching times (typical), IGBT, T1 / T2

$t = f(R_G)$
 $I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$



Voltage slope (typical), IGBT, T1 / T2

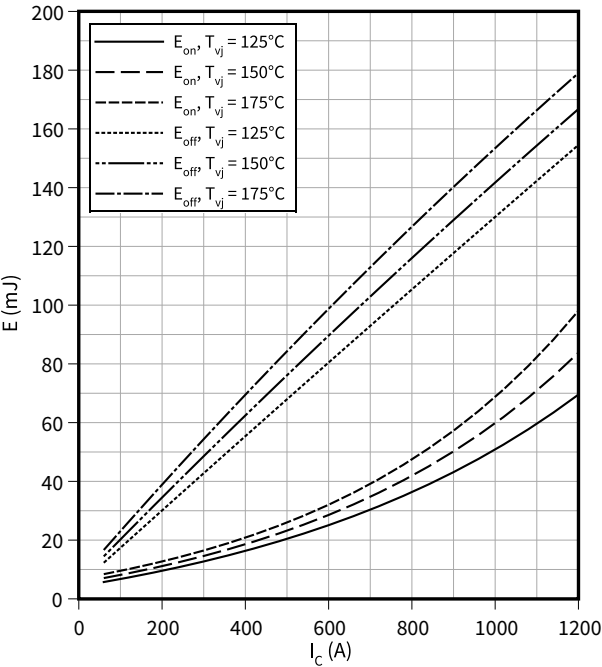
$dv/dt = f(R_G)$
 $I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 25\text{ }^{\circ}\text{C}$



4 Characteristics diagrams

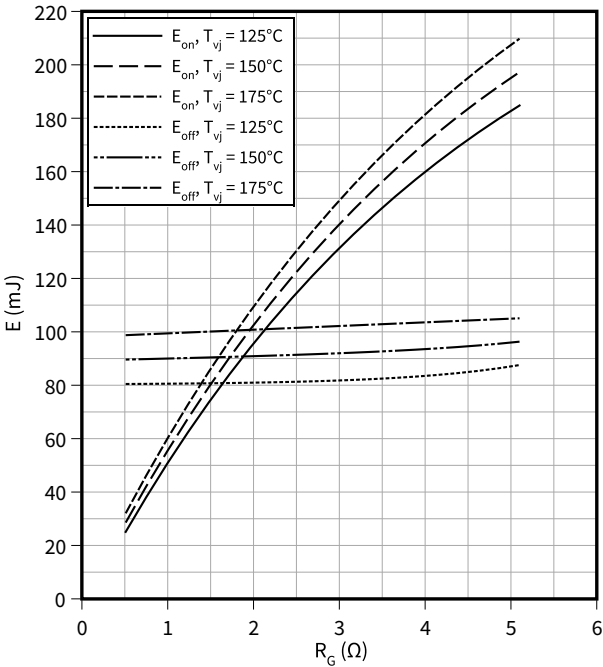
Switching losses (typical), IGBT, T1 / T2

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



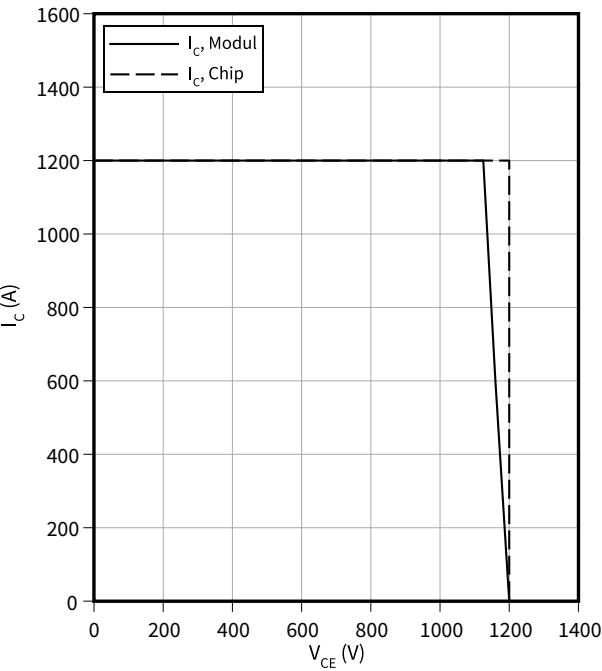
Switching losses (typical), IGBT, T1 / T2

$E = f(R_G)$
 $I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$



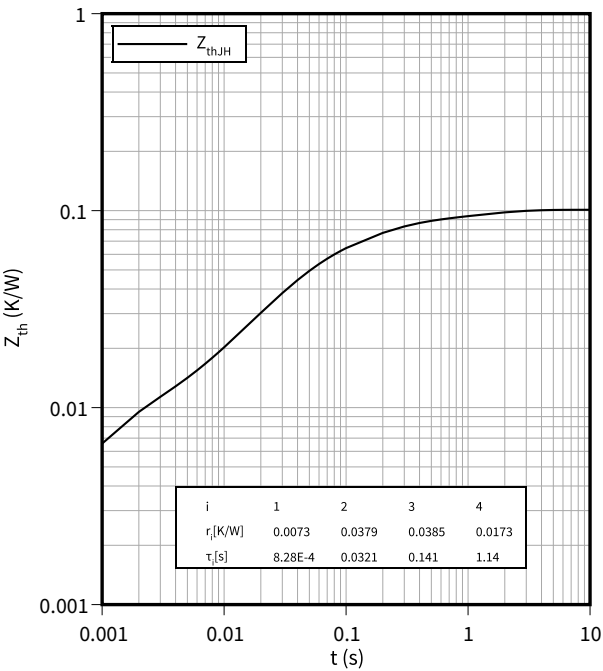
Reverse bias safe operating area (RBSOA), IGBT, T1 / T2

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



Transient thermal impedance, IGBT, T1 / T2

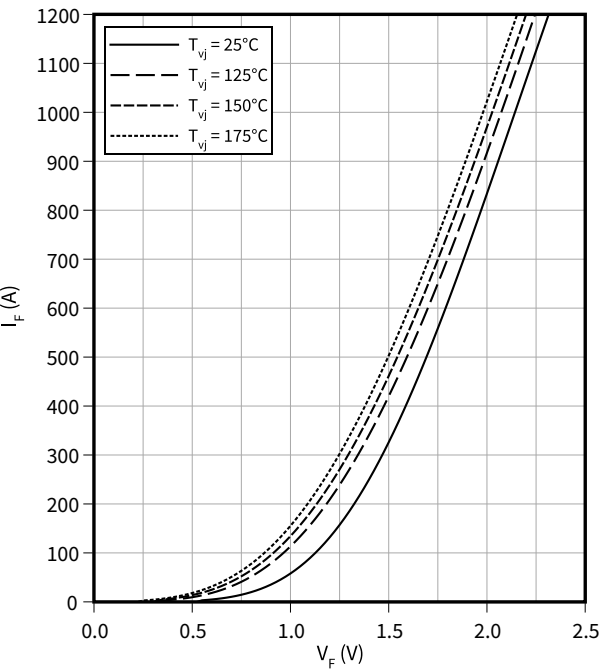
$Z_{th} = f(t)$



4 Characteristics diagrams

Forward characteristic (typical), Diode, D1 / D2

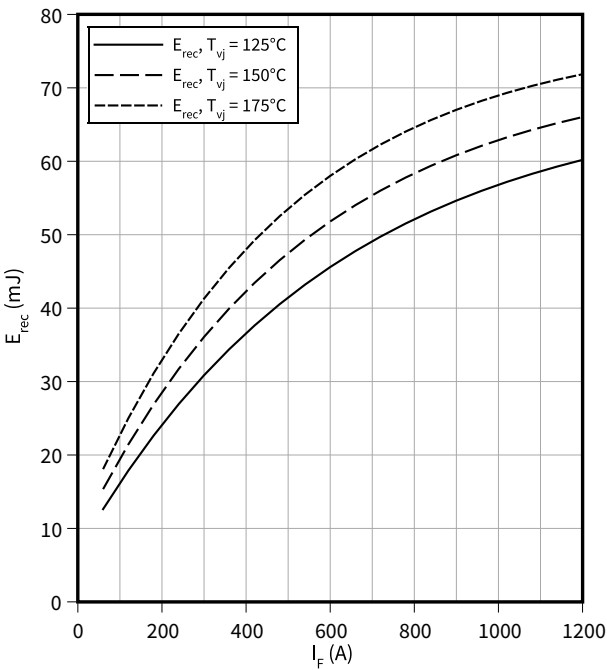
$I_F = f(V_F)$



Switching losses (typical), Diode, D1 / D2

$E_{rec} = f(I_F)$

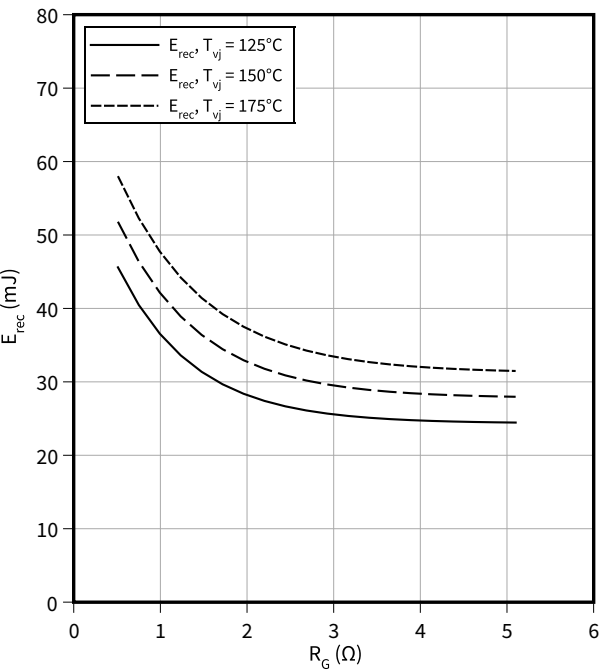
$R_{Gon} = 0.51 \, \Omega, V_{CC} = 600 \, \text{V}$



Switching losses (typical), Diode, D1 / D2

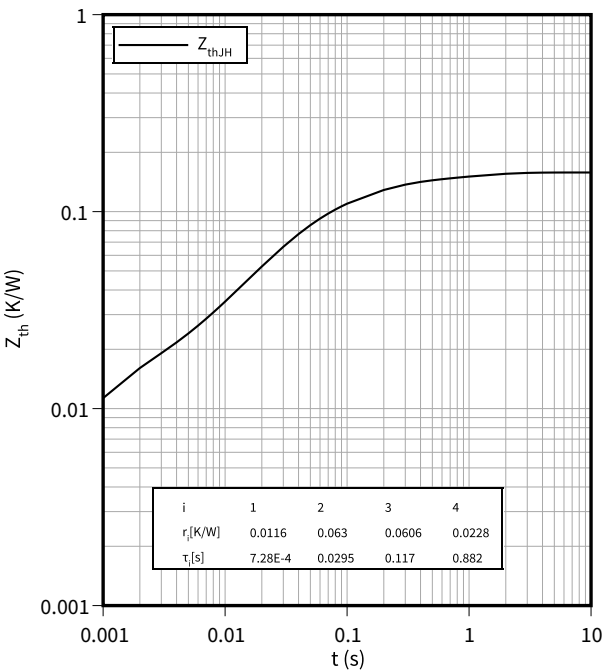
$E_{rec} = f(R_G)$

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



Transient thermal impedance, Diode, D1 / D2

$Z_{th} = f(t)$



5 **Circuit diagram**

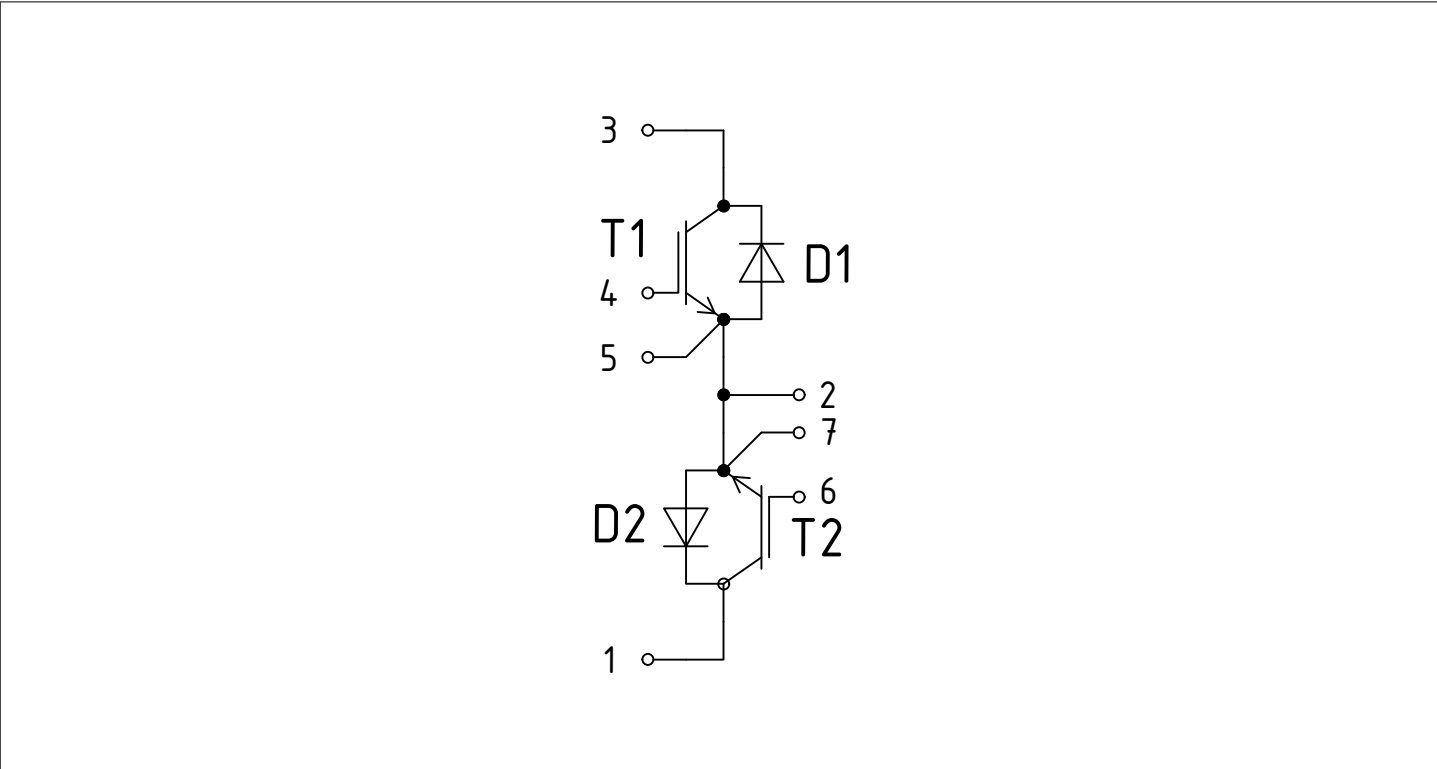


Figure 1

6 Package outlines

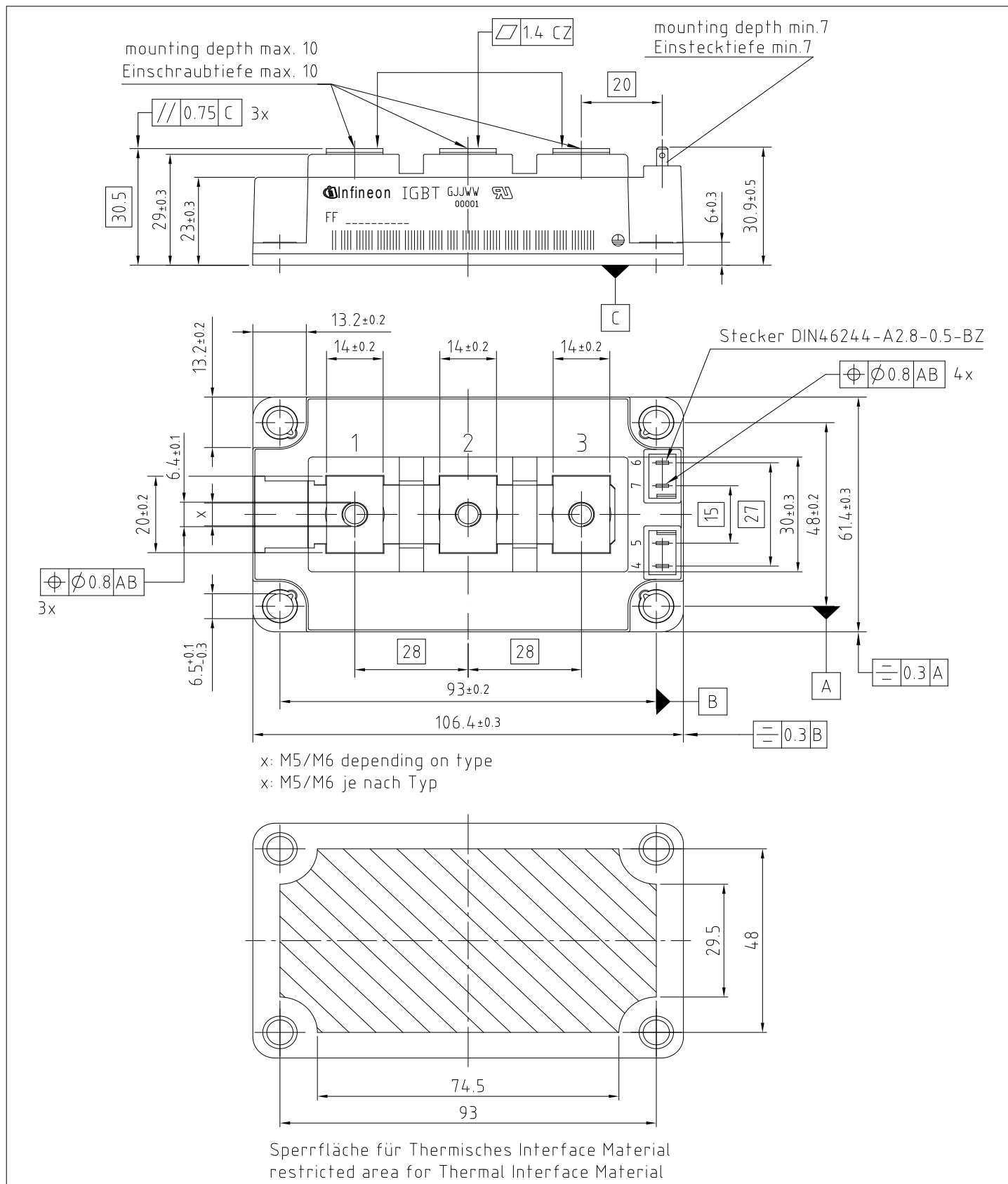


Figure 2

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
1.00	2023-05-31	Initial version

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