

PrimePACK™3+ B-series module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{nom}} = 2400\text{ A} / I_{CRM} = 4800\text{ A}$
 - High current density
 - Low inductive design
 - Low $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - Overload operation up to 175°C
- Mechanical features
 - 4 kV AC 1 min insulation
 - High creepage and clearance distances
 - High power density



Potential applications

- Motor drives

Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description

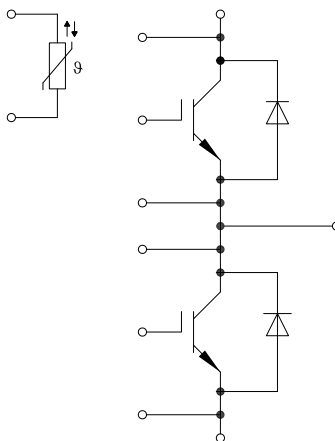


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1 Package

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	36.0	mm
Creepage distance	d_{Creep}	terminal to terminal	28.0	mm
Clearance	d_{Clear}	terminal to heatsink	21.0	mm
Clearance	d_{Clear}	terminal to terminal	19.0	mm
Comparative tracking index	CTI		> 400	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Stray inductance module	L_{SCE}			10		nH	
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25 \text{ }^\circ\text{C}$, per switch		0.1		mΩ	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25 \text{ }^\circ\text{C}$, per switch		0.135		mΩ	
Current slope at AC-terminals	$ di/dt_{AC} $	Valid if AC-terminals are permanently part of commutation path			100	A/μs	
Storage temperature	T_{stg}		-40		150	°C	
Maximum baseplate operation temperature	T_{BPmax}				150	°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	M4, Screw	1.8		2.1	Nm
			M8, Screw	8		10	
Weight	G			1400		g	

2 IGBT, Inverter

Table 3 Maximum rated values

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

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Implemented collector current	I_{CN}		2400	A
Continuous DC collector current	I_{CDC}	$T_{vj\ max} = 175\ ^\circ\text{C}$ $T_C = 95\ ^\circ\text{C}$	2400	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$	4800	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	$V_{CE\ sat}$	$I_C = 2400\ \text{A}, V_{GE} = 15\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$	1.27	1.79	V
			$T_{vj} = 125\ ^\circ\text{C}$	1.37	1.82	
			$T_{vj} = 175\ ^\circ\text{C}$	1.43	1.85	
Gate threshold voltage	V_{GEth}	$I_C = 48\ \text{mA}, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ\text{C}$	5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ \text{V}, V_{CC} = 600\ \text{V}$		38.1		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ\text{C}$		0.33		Ω
Input capacitance	C_{ies}	$f = 100\ \text{kHz}, T_{vj} = 25\ ^\circ\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$		325		nF
Reverse transfer capacitance	C_{res}	$f = 100\ \text{kHz}, T_{vj} = 25\ ^\circ\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$		1.92		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ \text{V}, V_{GE} = 0\ \text{V}$ $T_{vj} = 25\ ^\circ\text{C}$			5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ \text{V}, V_{GE} = 20\ \text{V}, T_{vj} = 25\ ^\circ\text{C}$			400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 2400\ \text{A}, V_{CC} = 600\ \text{V}, V_{GE} = \pm 15\ \text{V}, R_{Gon} = 0.2\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$	0.790		μs
			$T_{vj} = 125\ ^\circ\text{C}$	0.840		
			$T_{vj} = 175\ ^\circ\text{C}$	0.870		
Rise time (inductive load)	t_r	$I_C = 2400\ \text{A}, V_{CC} = 600\ \text{V}, V_{GE} = \pm 15\ \text{V}, R_{Gon} = 0.2\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$	0.120		μs
			$T_{vj} = 125\ ^\circ\text{C}$	0.140		
			$T_{vj} = 175\ ^\circ\text{C}$	0.150		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 2400\ \text{A}, V_{CC} = 600\ \text{V}, V_{GE} = \pm 15\ \text{V}, R_{Goff} = 0.4\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$	0.940		μs
			$T_{vj} = 125\ ^\circ\text{C}$	1.060		
			$T_{vj} = 175\ ^\circ\text{C}$	1.120		
Fall time (inductive load)	t_f	$I_C = 2400\ \text{A}, V_{CC} = 600\ \text{V}, V_{GE} = \pm 15\ \text{V}, R_{Goff} = 0.4\ \Omega$	$T_{vj} = 25\ ^\circ\text{C}$	0.230		μs
			$T_{vj} = 125\ ^\circ\text{C}$	0.430		
			$T_{vj} = 175\ ^\circ\text{C}$	0.530		

(table continues...)

Table 4 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	$I_C = 2400\text{ A}$, $V_{CC} = 600\text{ V}$, $L_\sigma = 20\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.2\ \Omega$, $di/dt =$ $15500\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	200		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	295		
			$T_{vj} = 175\text{ }^\circ\text{C}$	380		
Turn-off energy loss per pulse	E_{off}	$I_C = 2400\text{ A}$, $V_{CC} = 600\text{ V}$, $L_\sigma = 20\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 0.4\ \Omega$, $dv/dt =$ $2200\text{ V}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	355		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	510		
			$T_{vj} = 175\text{ }^\circ\text{C}$	570		
SC data	I_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$, $V_{CEmax} = V_{CES} - L_{SCE} * di/dt$	$t_p = 6\ \mu\text{s}$, $T_{vj} = 150\text{ }^\circ\text{C}$	8500		A
			$t_p = 6\ \mu\text{s}$, $T_{vj} = 175\text{ }^\circ\text{C}$	8000		
Thermal resistance, junction to case	R_{thJC}	per IGBT			17.9	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		12.9		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ\text{C}$

Note: Maximum RMS module DC-terminal current according to application note AN2009-08.
 $T_{vj\ op} > 150\text{ }^\circ\text{C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN2018-14.

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		2400	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	4800	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	455	kA ² s
			$T_{vj} = 175\text{ }^\circ\text{C}$	420	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 2400 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.70	2.03	V
			$T_{vj} = 125 \text{ °C}$		1.65	1.96	
			$T_{vj} = 175 \text{ °C}$		1.55	1.91	
Peak reverse recovery current	I_{RM}	$V_{CC} = 600 \text{ V}, I_F = 2400 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 15500 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		1410		A
			$T_{vj} = 125 \text{ °C}$		1720		
			$T_{vj} = 175 \text{ °C}$		1850		
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}, I_F = 2400 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 15500 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		265		μC
			$T_{vj} = 125 \text{ °C}$		455		
			$T_{vj} = 175 \text{ °C}$		585		
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}, I_F = 2400 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 15500 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		110		mJ
			$T_{vj} = 125 \text{ °C}$		200		
			$T_{vj} = 175 \text{ °C}$		250		
Thermal resistance, junction to case	R_{thJC}	per diode				34.1	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$			14.7		K/kW
Temperature under switching conditions	$T_{vj op}$		-40			175	°C

Note: $T_{vj op} > 150 \text{ °C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN2018-14.

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ }\Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

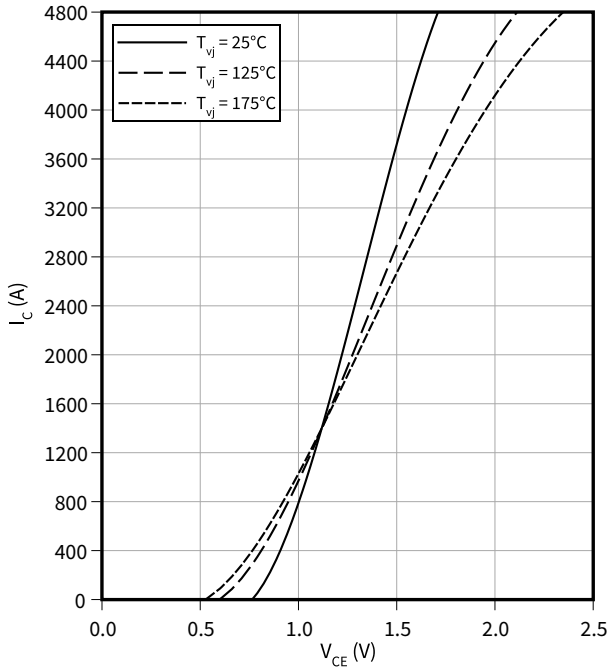
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

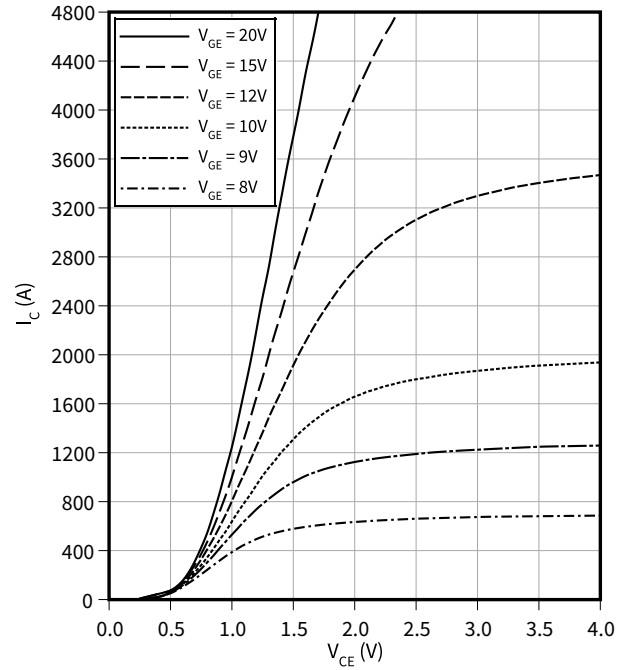
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

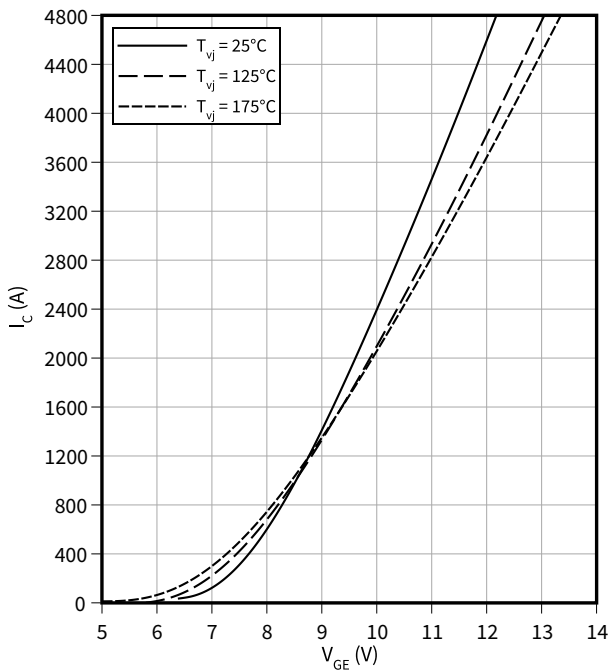
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

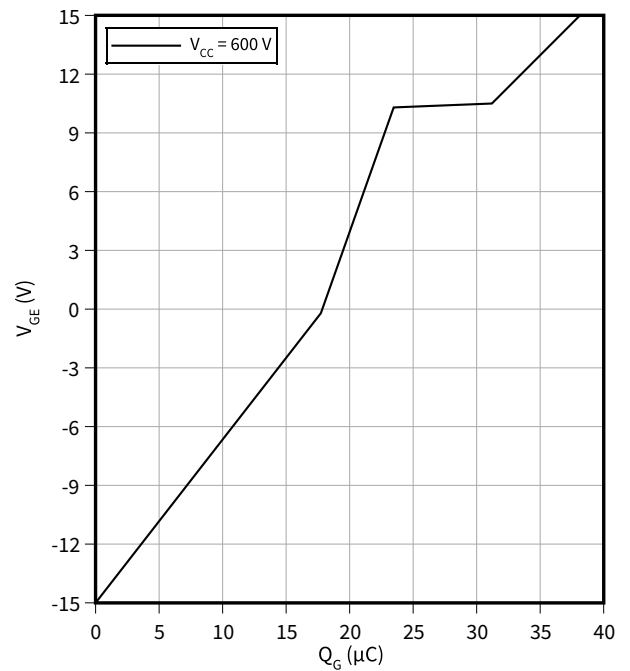
$$V_{CE} = 20 \text{ V}$$



Gate charge characteristic (typical), IGBT, Inverter

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

$$I_C = 2400 \text{ A}, T_{vj} = 25 \text{ °C}$$

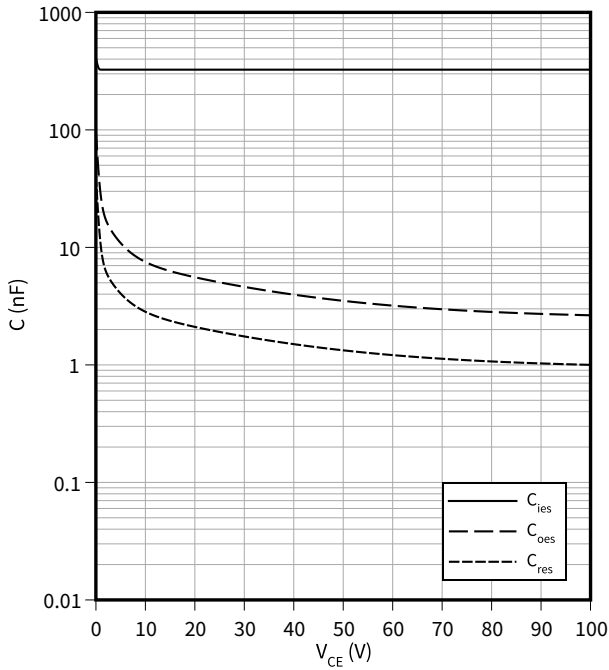


5 Characteristics diagrams

Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

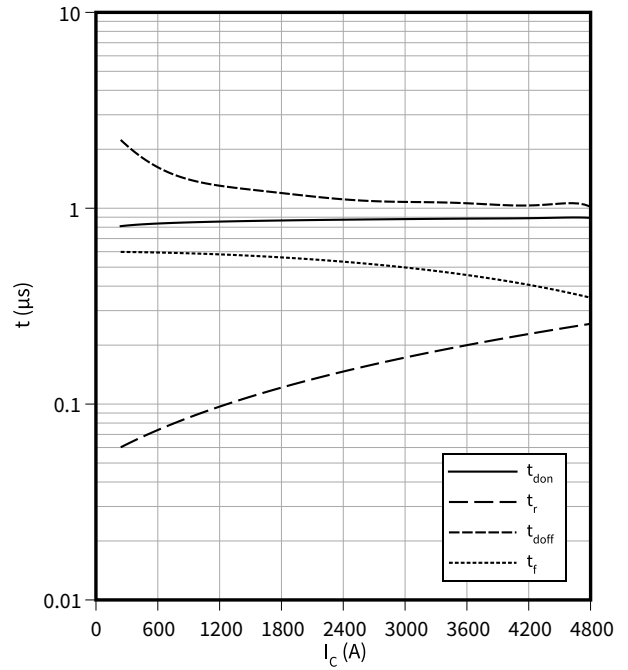
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

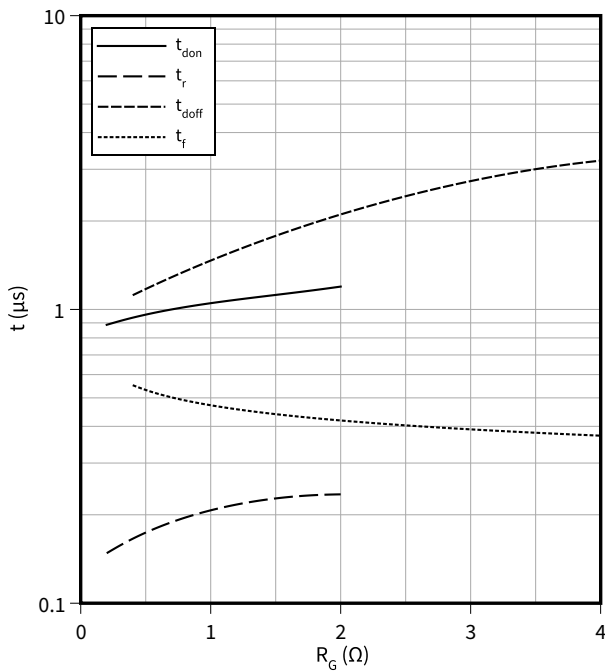
$R_{Goff} = 0.4 \text{ } \Omega, R_{Gon} = 0.2 \text{ } \Omega, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

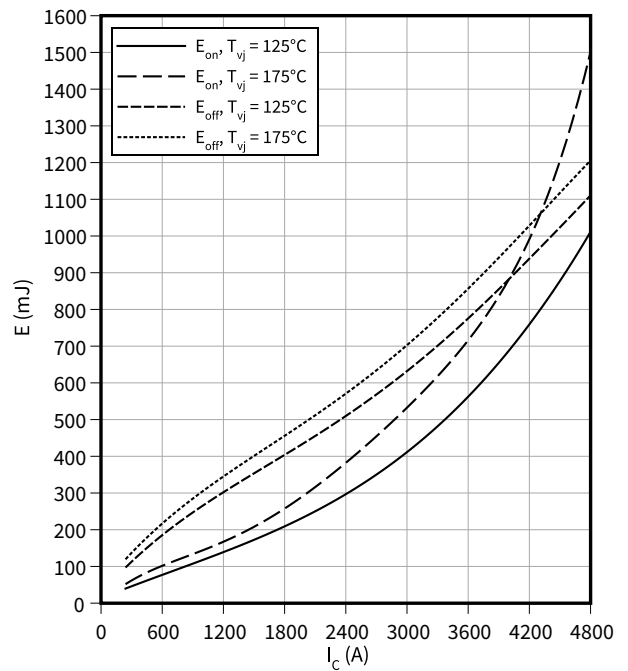
$I_C = 2400 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

$R_{Goff} = 0.4 \text{ } \Omega, R_{Gon} = 0.2 \text{ } \Omega, V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$

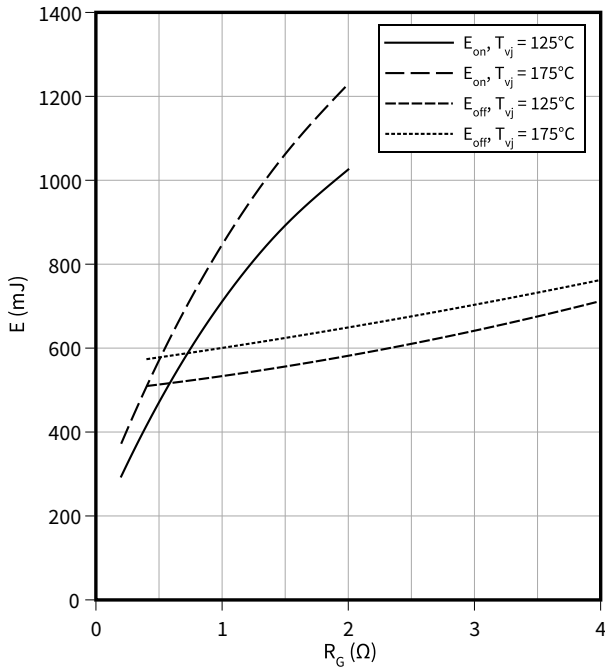


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

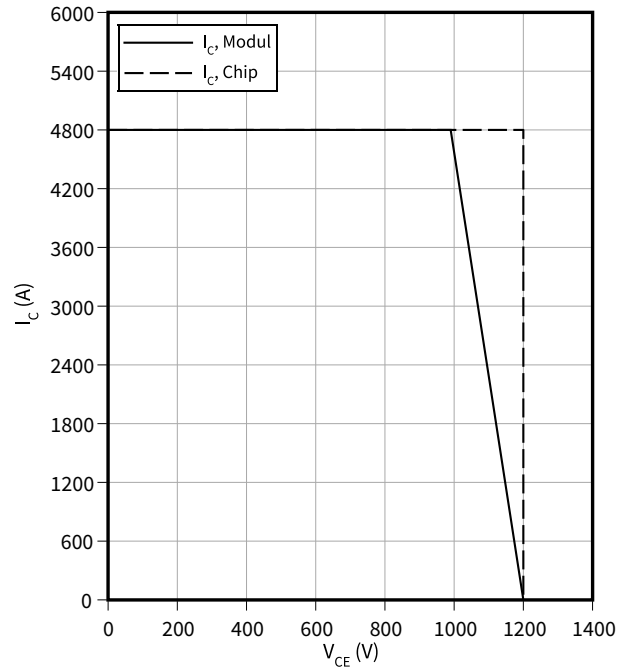
$I_C = 2400 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$



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

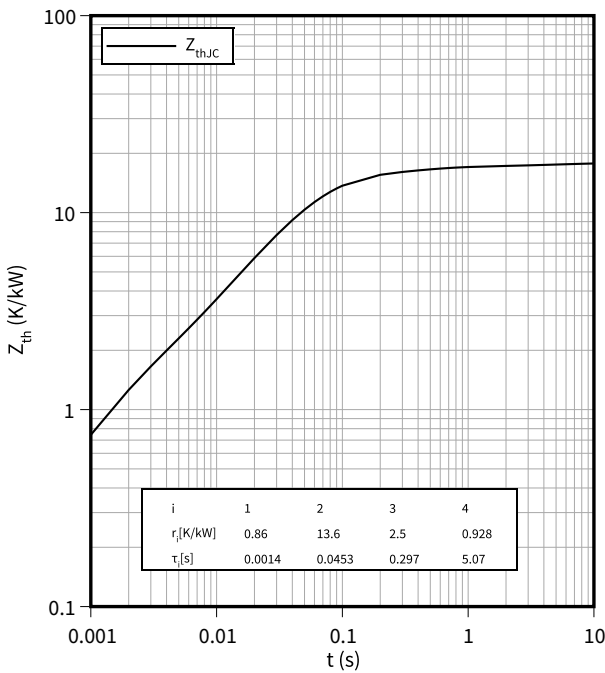
$I_C = f(V_{CE})$

$R_{Goff} = 0.4 \Omega$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 175 \text{ °C}$



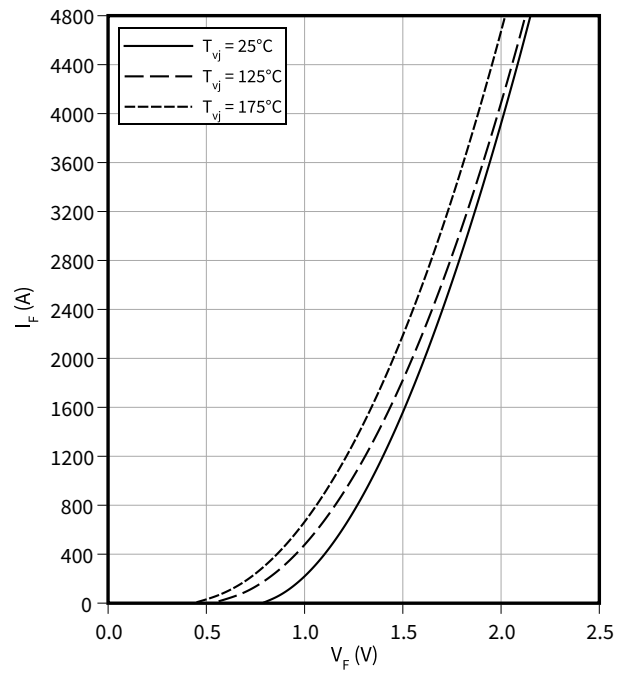
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

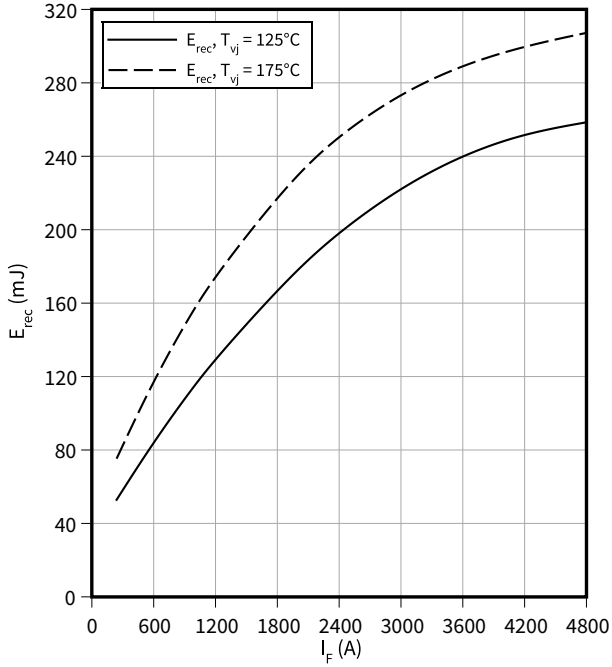
$I_F = f(V_F)$



5 Characteristics diagrams

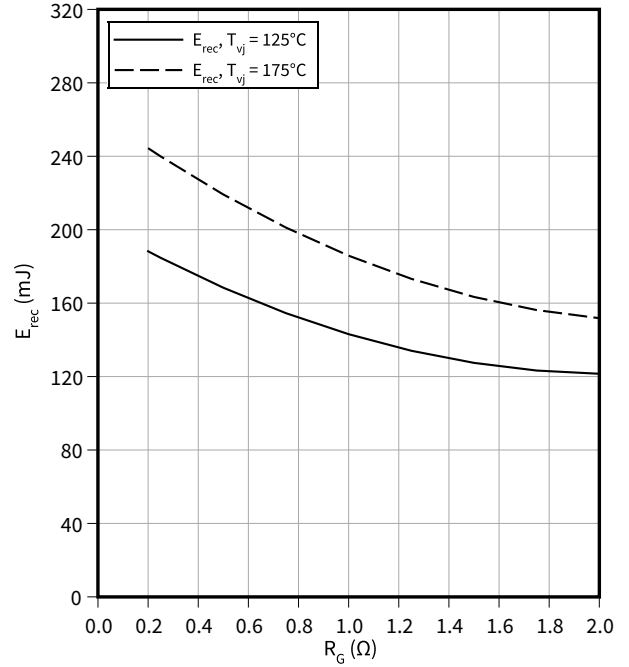
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $V_{CE} = 600\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



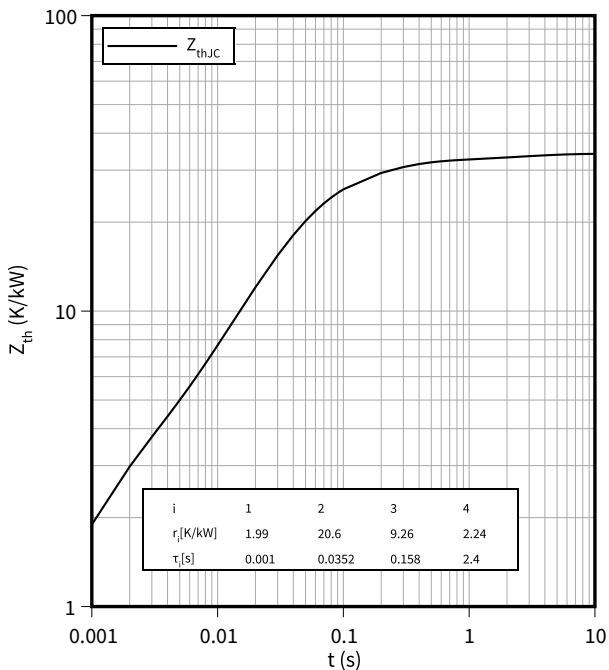
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $V_{CE} = 600\text{ V}, I_F = 2400\text{ A}$



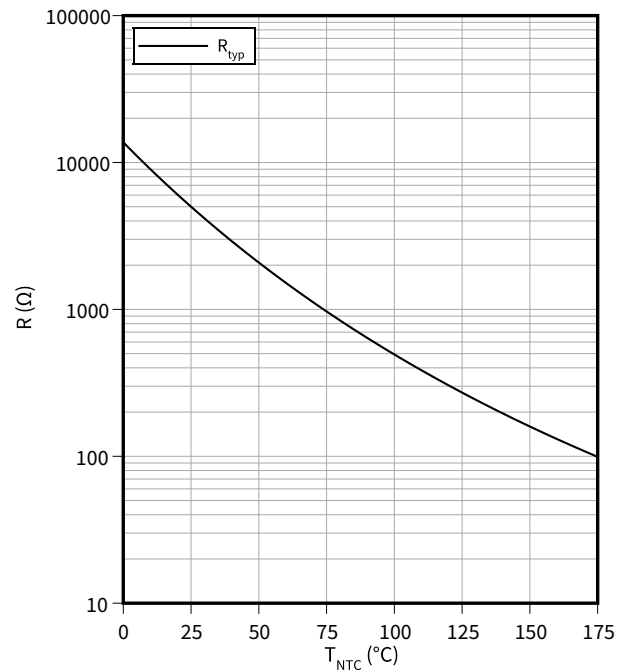
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

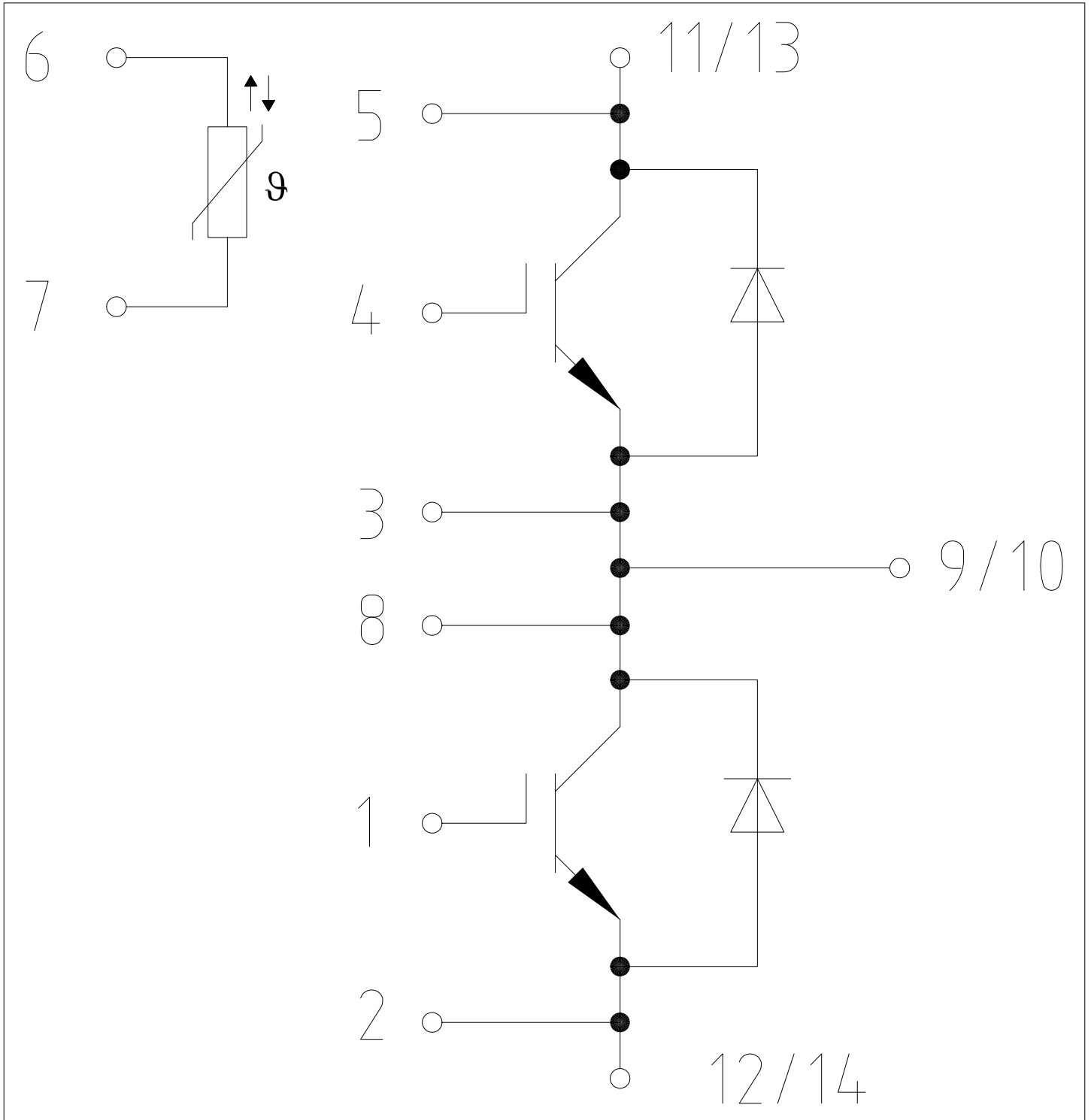


Figure 1

7 Package outlines

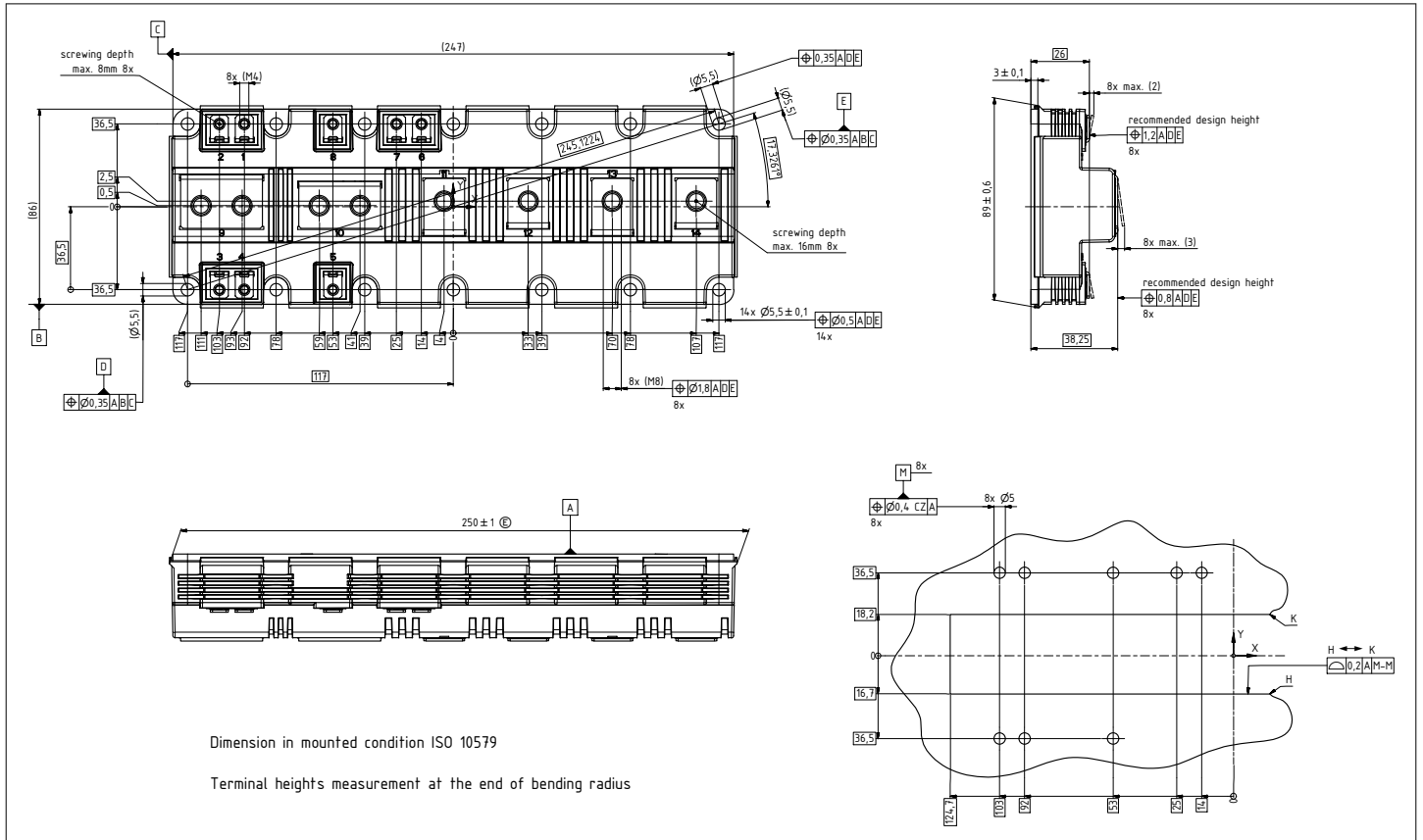


Figure 2

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	<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
0.10	2021-11-09	Initial version
0.20	2022-10-28	Target datasheet
1.00	2023-06-09	Final datasheet

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