

Reverse-Conducting IGBT with monolithic body diode

Features

- $V_{CE} = 1400\text{ V}$
- $I_C = 40\text{ A}$
- Powerful monolithic body diode with low forward voltage designed for soft commutation only
- Very tight parameter distribution
- High ruggedness, temperature stable behavior
- Very low V_{CEsat}
- Easy paralleling capability due to positive temperature coefficient in V_{CEsat}
- Low EMI
- Qualified according to JESD-022 for target applications
- Pb-free lead plating; RoHS compliant
- Halogen free (according to IEC 61249-2-21)
- Complete product spectrum and PSpice Models: <http://www.infineon.com/igbt/>

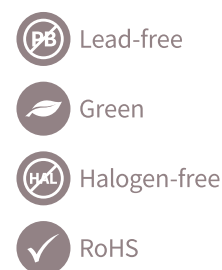
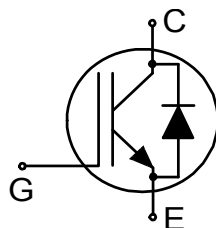
Potential applications

- Induction cooker
- Microwave ovens

Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description



Type	Package	Marking
IHW40N140R5L	PG-TO247-3-STD-NN2.5	H40QR5L

Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT	3
3	Diode	5
4	Characteristics diagrams	6
5	Package outlines	11
6	Testing conditions	12
	Revision history	13
	Disclaimer	14

1 Package

Table 1 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Internal emitter inductance measured 5 mm (0.197 in.) from case	L_E			13		nH
Storage temperature	T_{stg}		-55		150	°C
Soldering temperature	T_{sold}	wave soldering 1.6 mm (0.063 in.) from case for 10 s			260	°C
Mounting torque	M	M3 screw, Maximum of mounting processes: 3			0.6	Nm
Thermal resistance, junction-ambient	$R_{th(j-a)}$				40	K/W
IGBT thermal resistance, junction-case	$R_{th(j-c)}$				0.41	K/W
Diode thermal resistance, junction-case	$R_{th(j-c)}$				0.41	K/W

2 IGBT

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CE}	$T_{vj} \geq 25\text{ °C}$		1400	V
DC collector current, limited by T_{vjmax}	I_C	limited by bondwire	$T_c = 25\text{ °C}$	80	A
			$T_c = 100\text{ °C}$	72	
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpulse}			120	A
Non repetitive peak collector current ¹⁾	I_{CSM}			200	A
Turn-off safe operating area ²⁾		$V_{CE} \leq 1400\text{ V}, T_{vj} \leq 175\text{ °C}$		120	A
Gate-emitter voltage	V_{GE}			±20	V
Transient gate-emitter voltage	V_{GE}	$t_p \leq 10\text{ }\mu\text{s}, D < 0.01$		±25	V
Power dissipation	P_{tot}		$T_c = 25\text{ °C}$	366	W
			$T_c = 100\text{ °C}$	183	

1) capacitor charging saturation current limited by $T_{vjmax} < 175\text{ °C}$ and $t_p < 3\text{ }\mu\text{s}$

2) $dV/dt < 1\text{ kV}/\mu\text{s}$

Table 3 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter breakdown voltage	V_{BRCES}	$I_C = 0.5 \text{ mA}$, $V_{GE} = 0 \text{ V}$		1400			V
Collector-emitter saturation voltage	V_{CEsat}	$I_C = 40 \text{ A}$, $V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.65	1.95	V
			$T_{vj} = 125 \text{ °C}$		1.8		
			$T_{vj} = 175 \text{ °C}$		1.9		
Gate-emitter threshold voltage	V_{GEth}	$I_C = 0.63 \text{ mA}$, $V_{CE} = V_{GE}$		4	5.6	6.2	V
Zero gate-voltage collector current	I_{CES}	$V_{CE} = 1400 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$			100	μA
			$T_{vj} = 175 \text{ °C}$		920		
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = 20 \text{ V}$				100	nA
Transconductance	g_{fs}	$I_C = 40 \text{ A}$, $V_{CE} = 20 \text{ V}$			35.4		S
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			2020		pF
Output capacitance	C_{oes}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			57		pF
Reverse transfer capacitance	C_{res}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$			48		pF
Gate charge	Q_G	$V_{CC} = 1120 \text{ V}$, $I_C = 40 \text{ A}$, $V_{GE} = 15 \text{ V}$			260		nC
Turn-off delay time	$t_{d(off)}$	$V_{GE} = 0/15 \text{ V}$, $R_{G(off)} = 10 \text{ }\Omega$, $C_r = 270 \text{ nF}$, $L = 77 \text{ }\mu\text{H}$, $R = 2.2 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 40 \text{ A}$		225		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 40 \text{ A}$		235		
Fall time (inductive load)	t_f	$V_{GE} = 0/15 \text{ V}$, $R_{G(off)} = 10 \text{ }\Omega$, $C_r = 270 \text{ nF}$, $L = 77 \text{ }\mu\text{H}$, $R = 2.2 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 40 \text{ A}$		1005		ns
			$T_{vj} = 175 \text{ °C}$, $I_C = 40 \text{ A}$		1775		
Soft turn-off energy	E_{off}	$V_{GE} = 0/15 \text{ V}$, $R_{G(off)} = 10 \text{ }\Omega$, $C_r = 270 \text{ nF}$, $L = 77 \text{ }\mu\text{H}$, $R = 2.2 \text{ }\Omega$	$T_{vj} = 25 \text{ °C}$, $I_C = 40 \text{ A}$		0.24		mJ
			$T_{vj} = 175 \text{ °C}$, $I_C = 40 \text{ A}$		0.64		
Operating junction temperature	T_{vj}			-40		175	$^{\circ}\text{C}$

3 Diode

Table 4 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Diode forward current, limited by T_{vjmax}	I_F	limited by bondwire	$T_c = 25\text{ °C}$	80	A
			$T_c = 100\text{ °C}$	71	
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpulse}			120	A

Table 5 Characteristic values

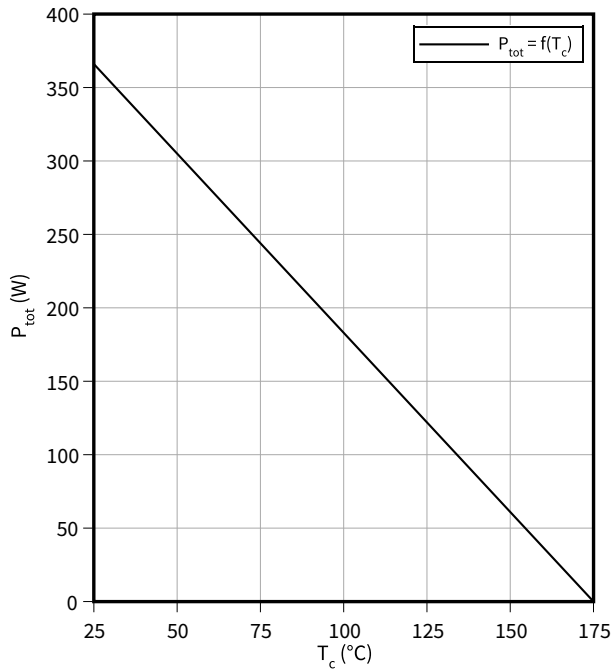
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Diode forward voltage	V_F	$I_F = 40\text{ A}$	$T_{vj} = 25\text{ °C}$		1.7	1.95	V
			$T_{vj} = 125\text{ °C}$		1.9		
			$T_{vj} = 175\text{ °C}$		2		
Operating junction temperature	T_{vj}			-40		175	°C

Note: For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.
Electrical Characteristic, at $T_{vj} = 25\text{ °C}$, unless otherwise specified.
Dynamic test circuit, energy losses include “tail” according to Figure B. (Test circuit Figure E).

4 Characteristics diagrams

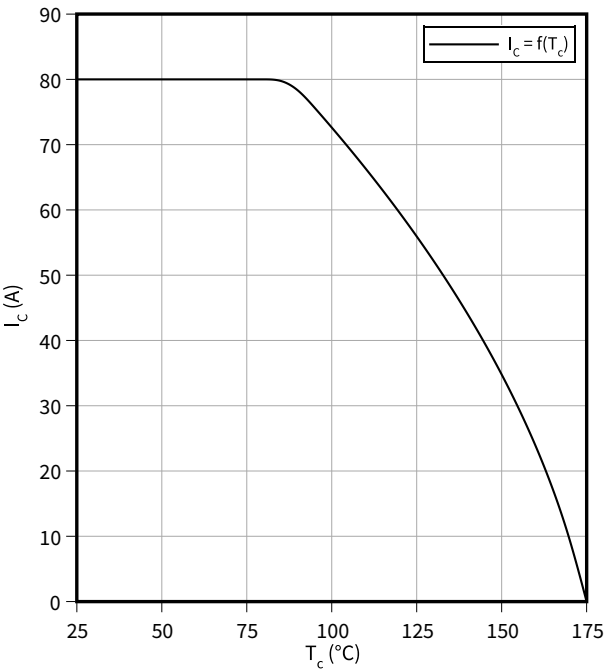
Power dissipation as a function of case temperature

$P_{\text{tot}} = f(T_c)$
 $T_{vj} \leq 175\text{ °C}$



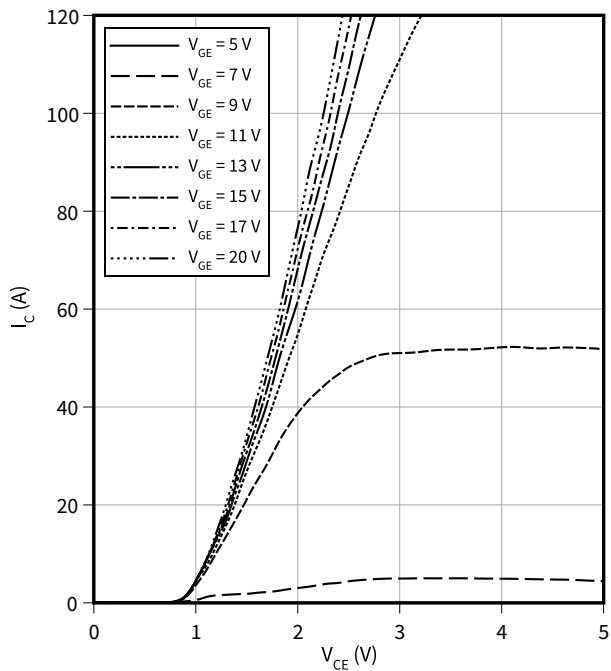
Collector current as a function of case temperature

$I_C = f(T_c)$
 $T_{vj} \leq 175\text{ °C}, V_{GE} \geq 15\text{ V}$



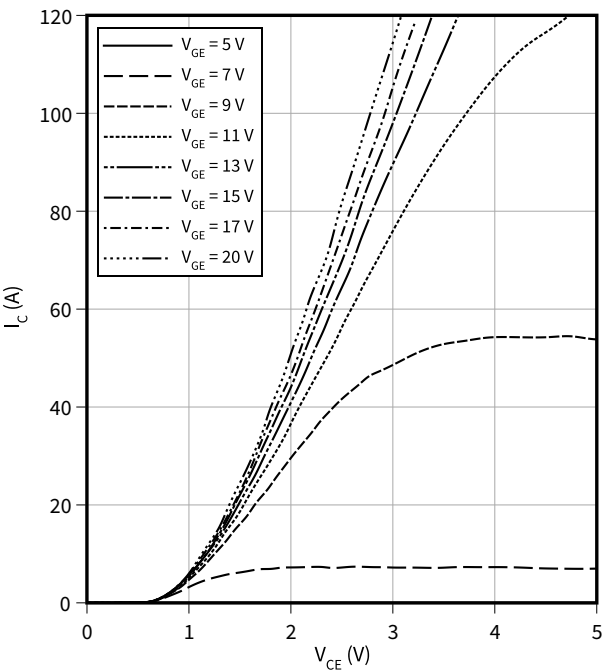
Typical output characteristic

$I_C = f(V_{CE})$
 $T_{vj} = 25\text{ °C}$



Typical output characteristic

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

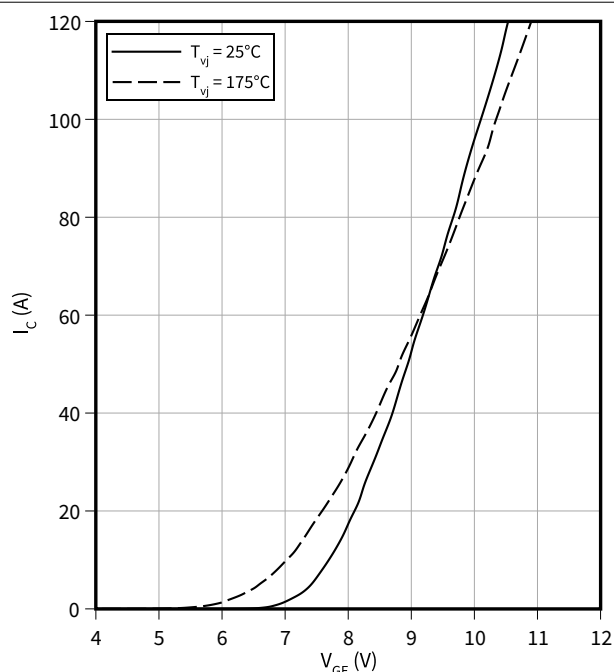


4 Characteristics diagrams

Typical transfer characteristic

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

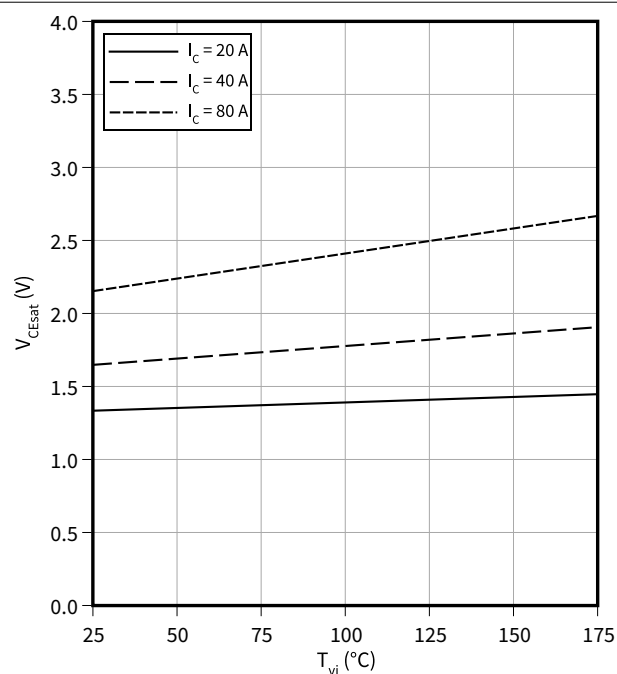
$$V_{CE} = 20 \text{ V}$$



Typical collector-emitter saturation voltage as a function of junction temperature

$$V_{CEsat} = f(T_{vj})$$

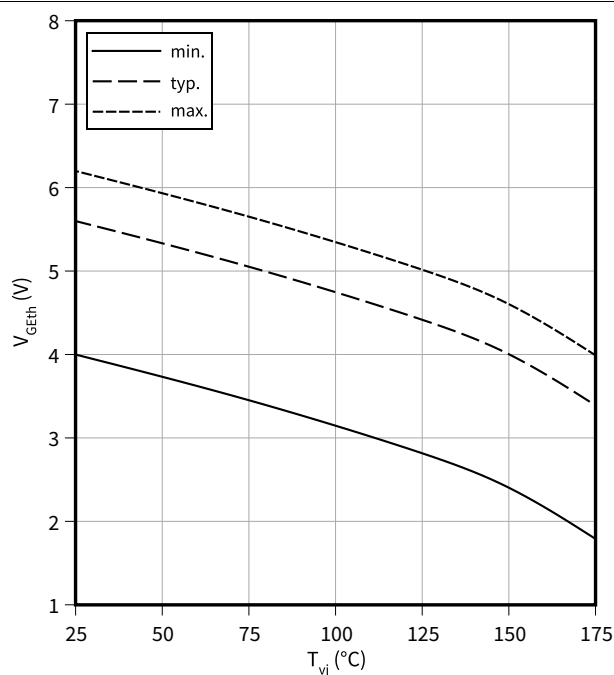
$$V_{GE} = 15 \text{ V}$$



Gate-emitter threshold voltage as a function of junction temperature

$$V_{GEth} = f(T_{vj})$$

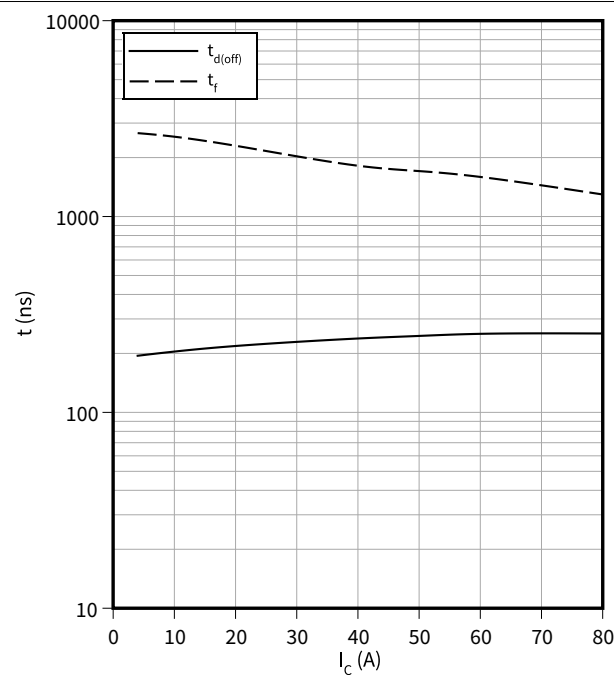
$$I_C = 0.63 \text{ mA}$$



Typical switching times as a function of collector current

$$t = f(I_C)$$

$$T_{vj} = 175^\circ\text{C}, V_{GE} = 0/15 \text{ V}, C_r = 270 \text{ nF}, R_G = 10 \Omega$$

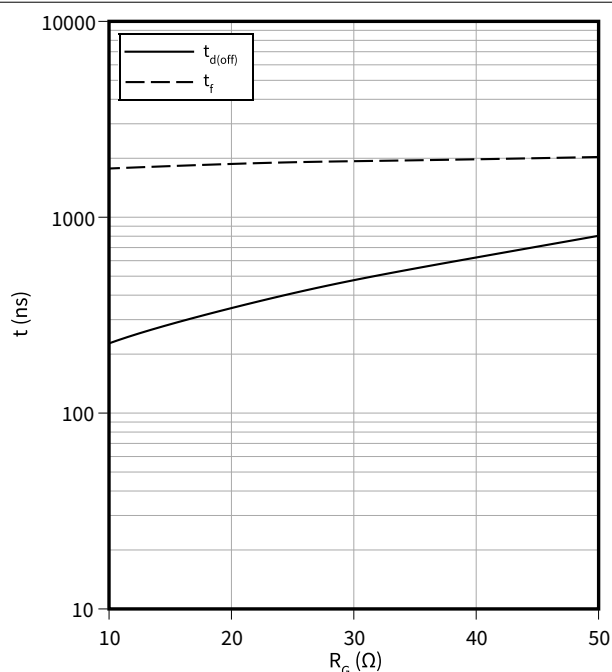


4 Characteristics diagrams

Typical switching times as a function of gate resistor

$$t = f(R_G)$$

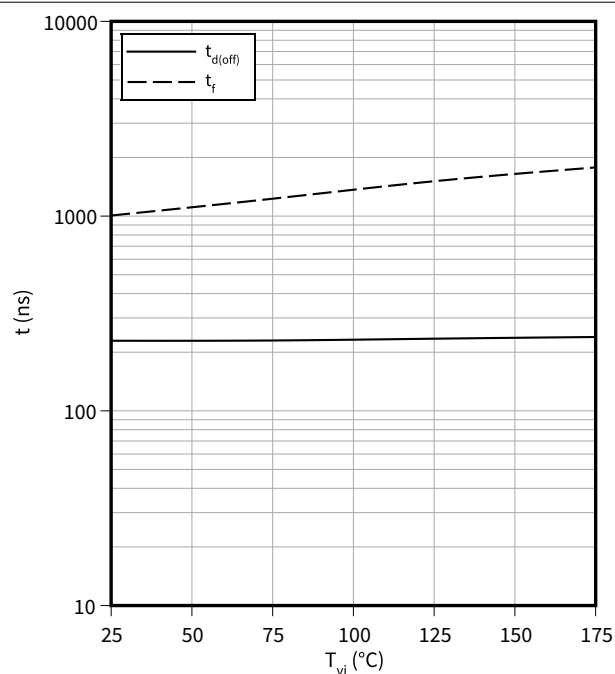
$I_C = 40\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$, $C_r = 270\text{ nF}$



Typical switching times as a function of junction temperature

$$t = f(T_{vj})$$

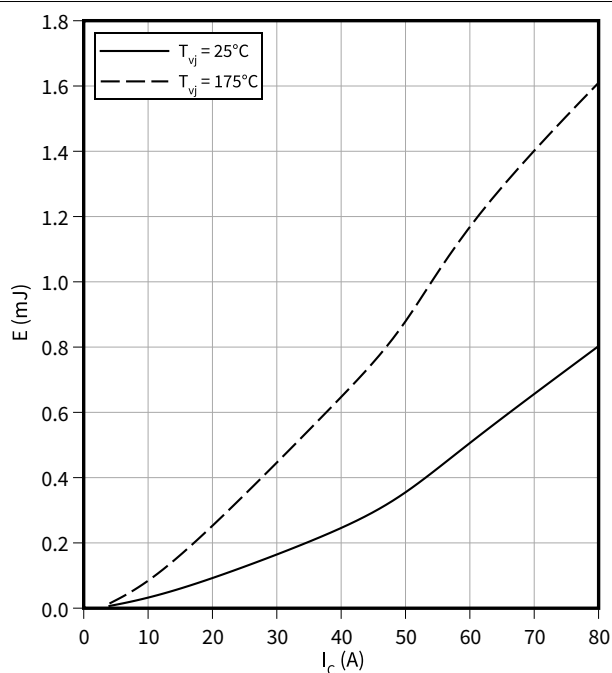
$I_C = 40\text{ A}$, $V_{GE} = 0/15\text{ V}$, $C_r = 270\text{ nF}$, $R_G = 10\text{ Ω}$



Typical switching energy losses as a function of collector current

$$E = f(I_C)$$

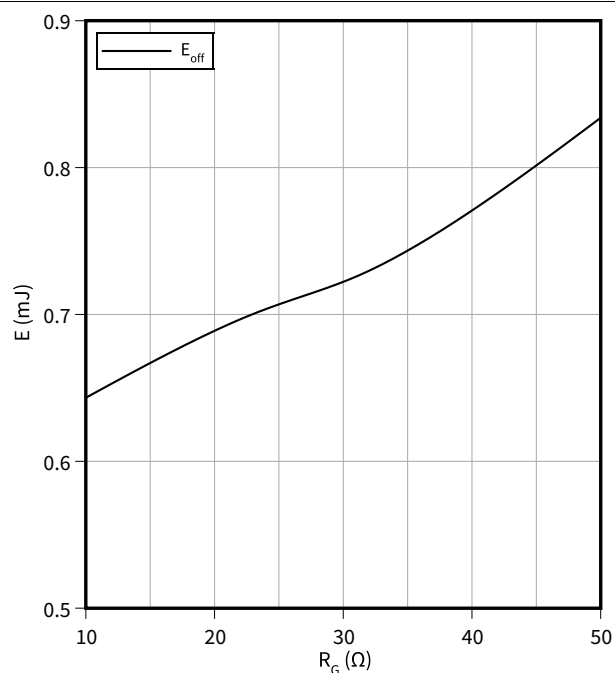
$V_{GE} = 0/15\text{ V}$, $C_r = 270\text{ nF}$, $R_G = 10\text{ Ω}$



Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$

$I_C = 40\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{GE} = 0/15\text{ V}$, $C_r = 270\text{ nF}$

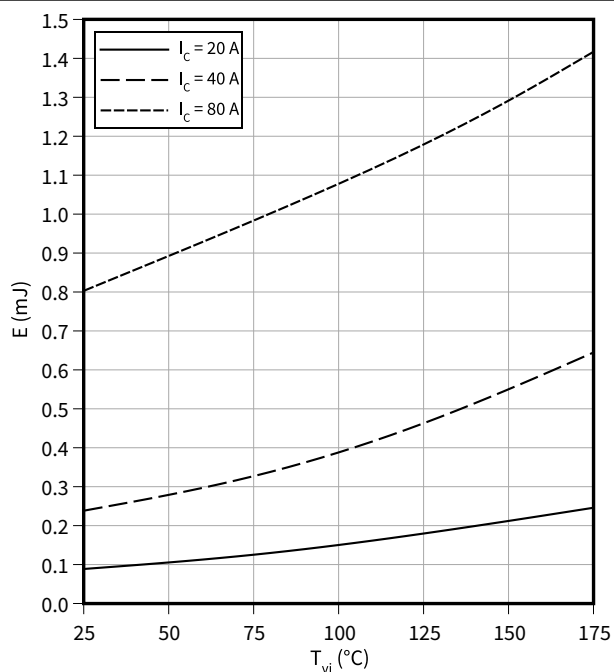


4 Characteristics diagrams

Typical switching energy losses as a function of junction temperature

$$E = f(T_{vj})$$

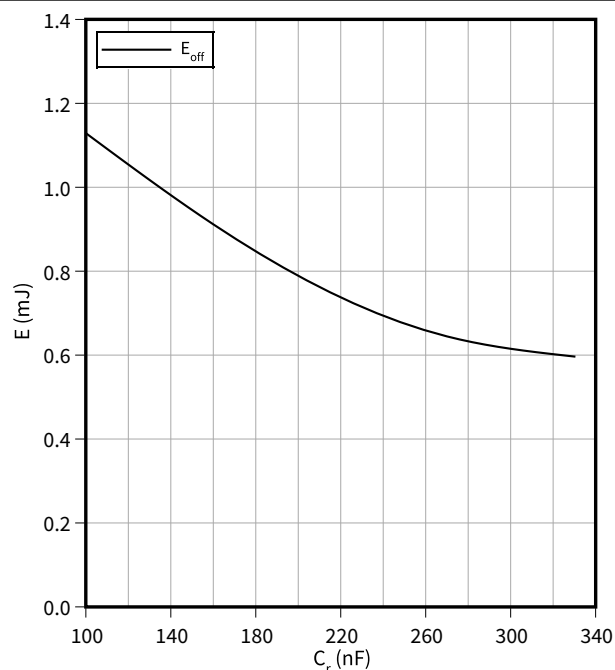
$V_{GE} = 0/15 \text{ V}$, $C_r = 270 \text{ nF}$, $R_G = 10 \Omega$



Typical switching energy losses as a function of resonant capacitance

$$E = f(C_r)$$

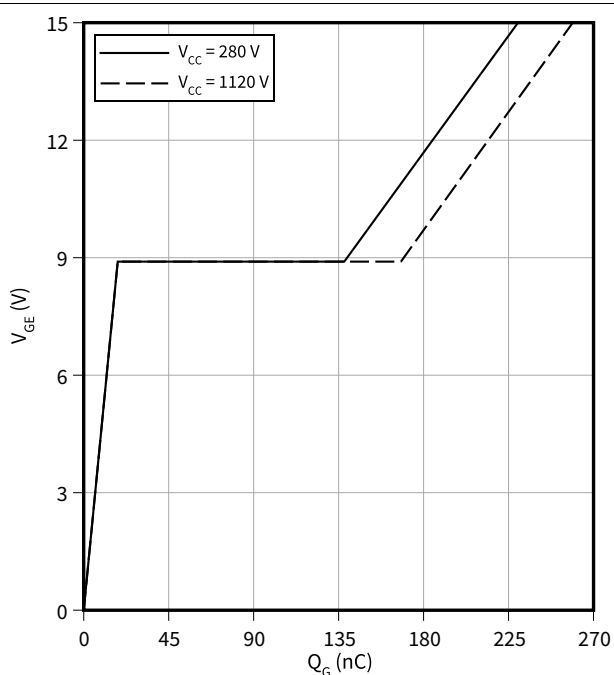
$I_C = 40 \text{ A}$, $T_{vj} = 175 \text{ °C}$, $V_{GE} = 0/15 \text{ V}$, $R_G = 10 \Omega$



Typical gate charge

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

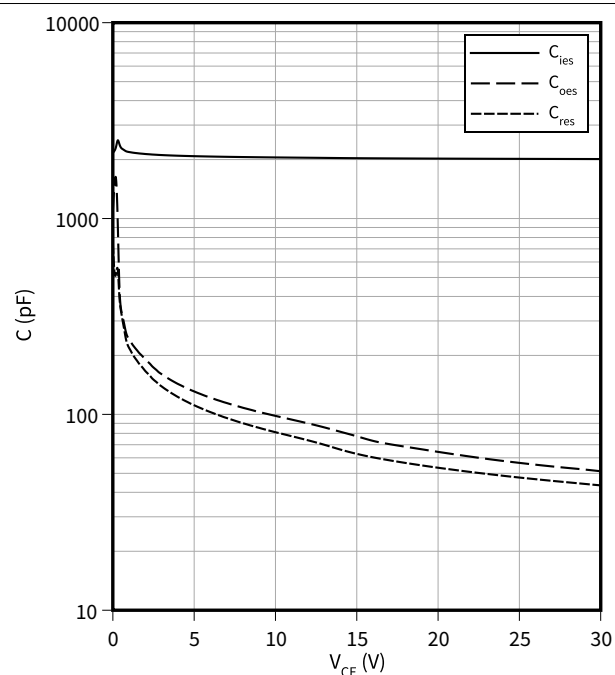
$I_C = 40 \text{ A}$



Typical capacitance as a function of collector-emitter voltage

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

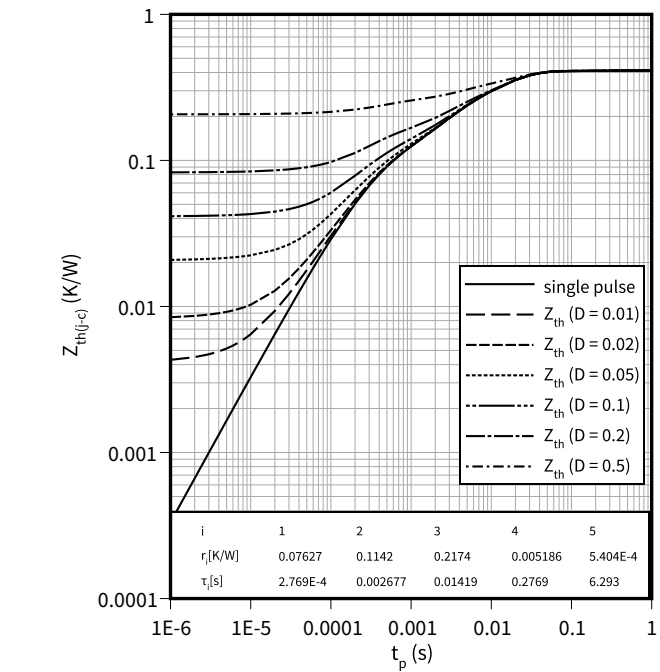
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$



4 Characteristics diagrams

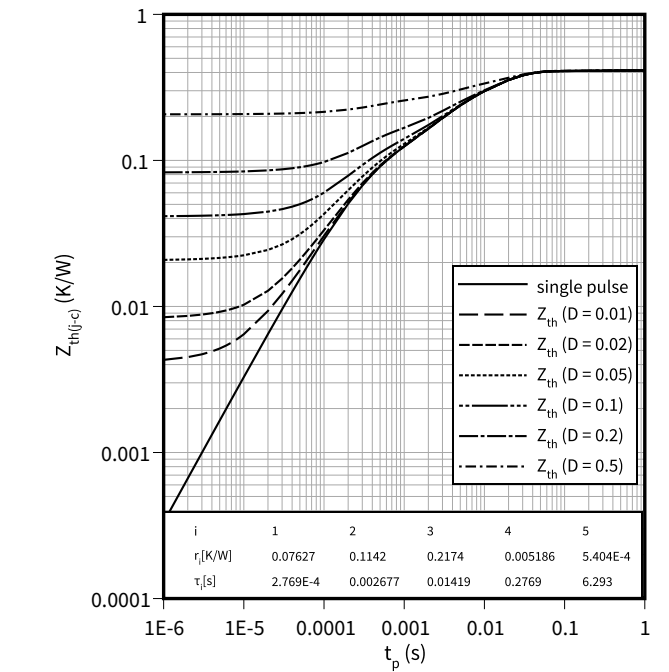
IGBT transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



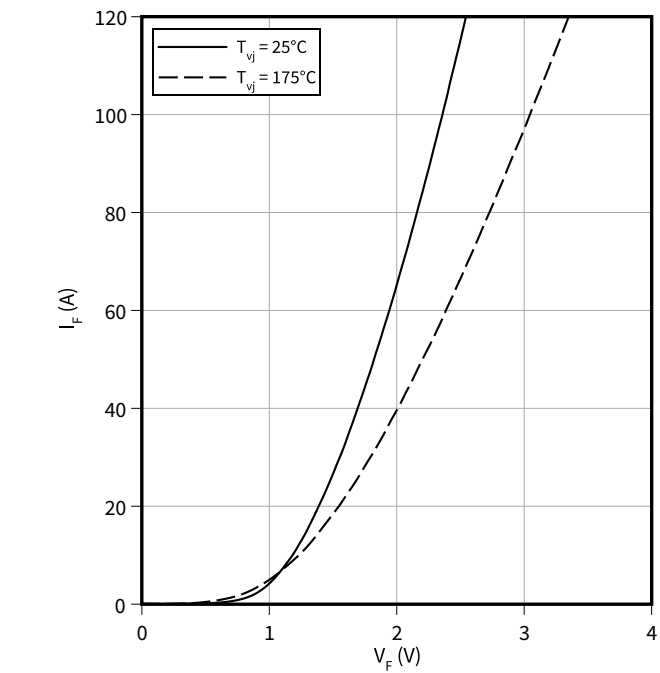
Diode transient thermal impedance as a function of pulse width

$Z_{th(j-c)} = f(t_p)$
 $D = t_p/T$



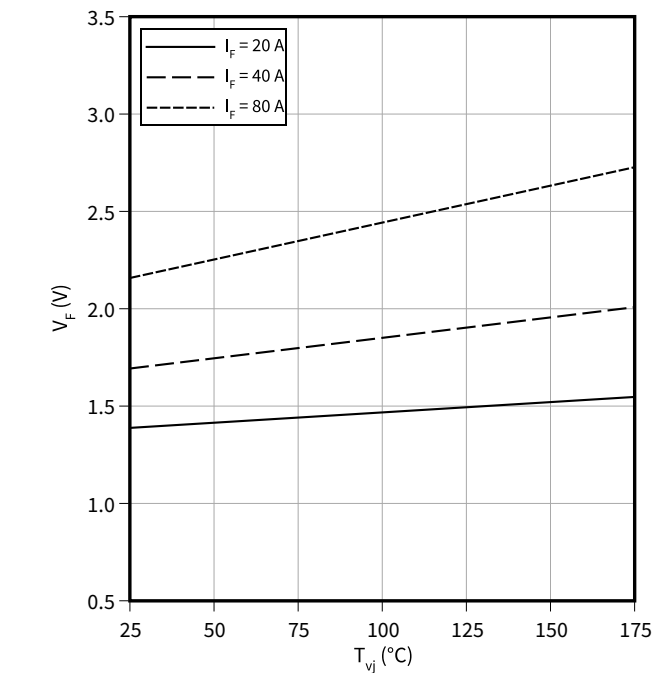
Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



Typical diode forward voltage as a function of junction temperature

$V_F = f(T_{vj})$



5 Package outlines

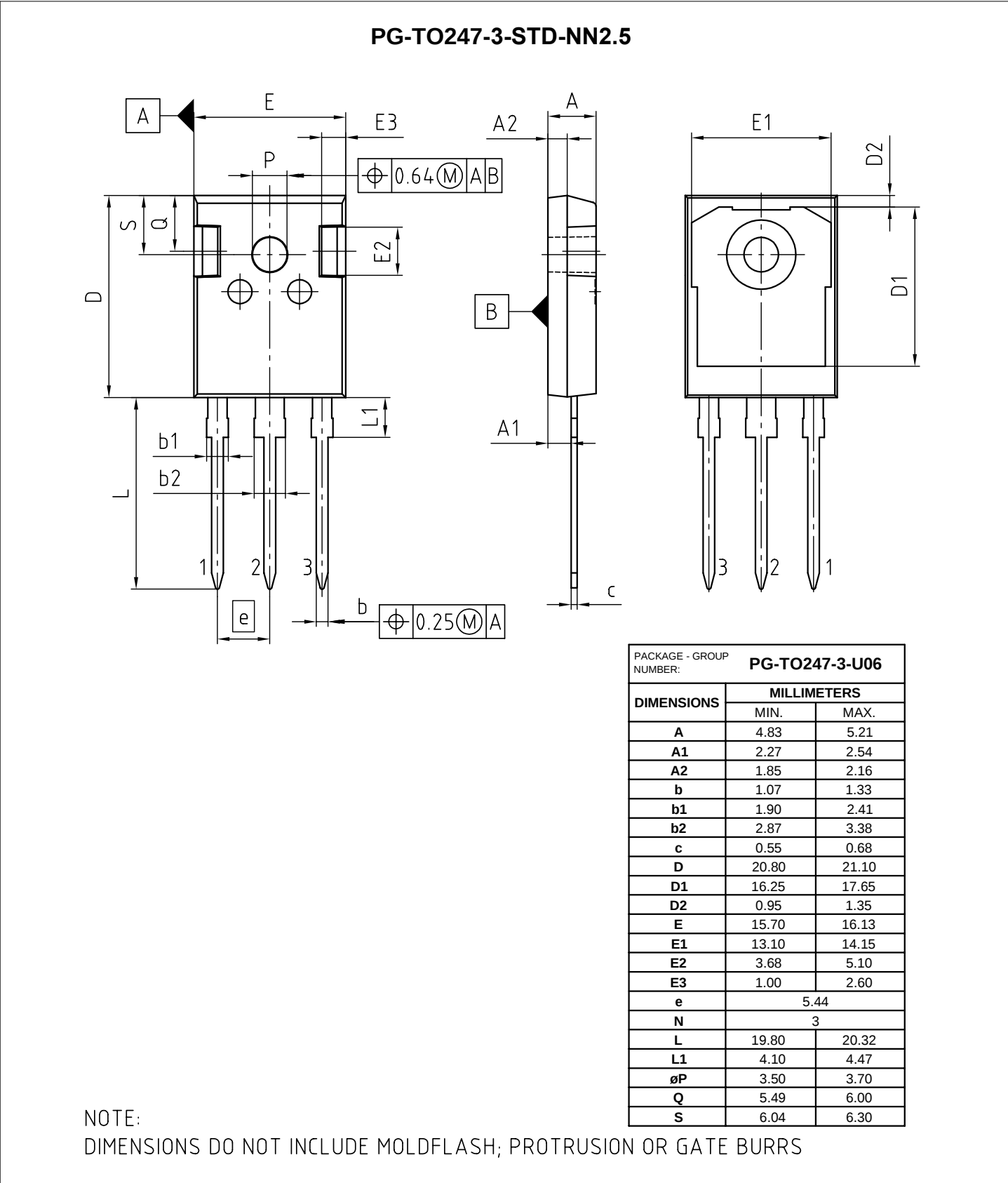


Figure 1

6 Testing conditions

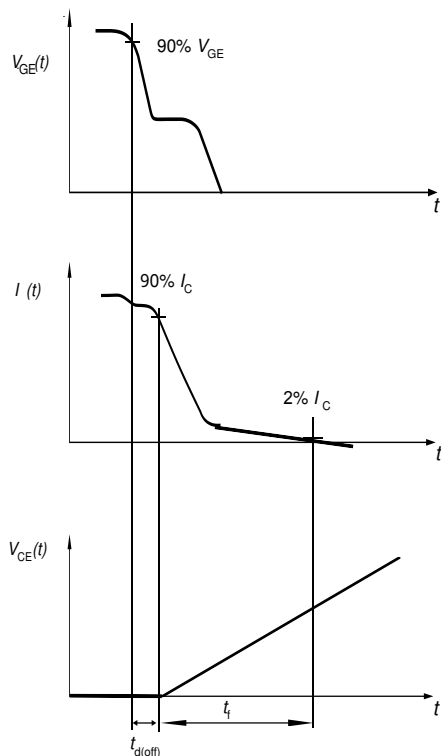


Figure A. Definition of switching times

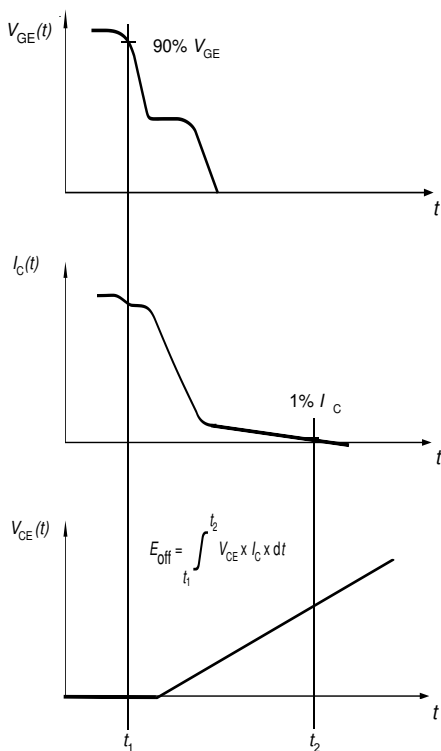


Figure B. Definition of switching losses

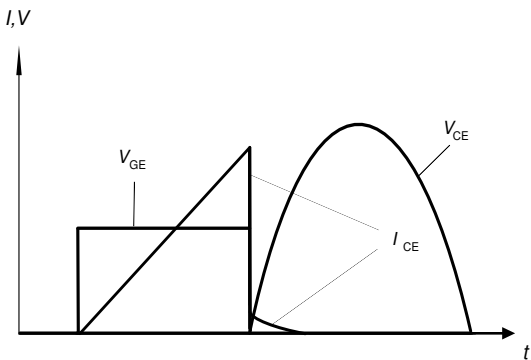


Figure C. Typical switching behavior in resonant applications

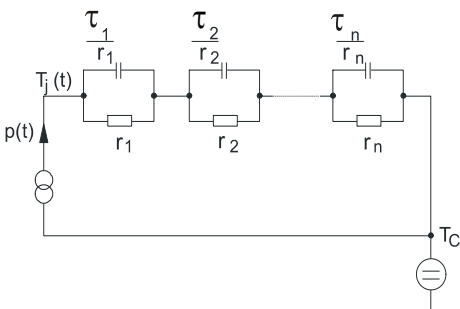


Figure D. Thermal equivalent circuit

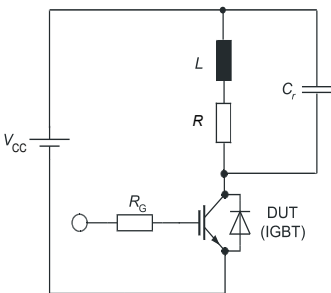


Figure E. Dynamic test circuit
Resonant capacitor, C_r
Damping resistor, R

Figure 2

Revision history

Document revision	Date of release	Description of changes
0.10	2022-11-25	Preliminary datasheet
1.00	2023-05-19	Final datasheet

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