

1. General description

WG40N65HW5 uses advanced Fine Trench Field-stop IGBT technology in TO247 package to provide extremely low $V_{CE(sat)}$, and excellent switching performance. This device offers Best-in-Class efficiency in hard switching and resonant topology.



2. Features and benefits

- Maximum junction temperature 175 °C
- Positive Temperature efficient for easy paralleling
- High switching speed
- EMI Improved Design

3. Applications

- PFC
- Solar converters
- UPS
- Welding Converters
- Mid to high range switching frequency converters

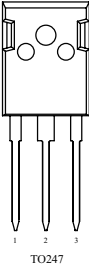
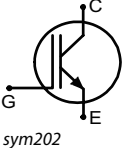
4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Notes	Value			Unit	
V_{CE}	Collector-emitter voltage, $T_j \geq 25\text{ °C}$		650			V	
I_C	DC collector current, limited by $T_{j(max)}$ $T_C = 100\text{ °C}$		40			A	
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}; I_C = 40\text{ A}; T_j = 25\text{ °C}$		-	1.45	1.85	V

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p style="text-align: center;">TO247</p>	 <p style="text-align: center;"><i>sym202</i></p>
2	C	collector		
3	E	emitter		
mb	C	mounting base; connected to collector		

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WG40N65HW5	TO247	WG40N65HW5Q	Tube	30	TO247P	09-Mar-2023

7. Marking

Table 4. Marking codes

Type number	Marking codes
WG40N65HW5	G40N65 HW5

8. Limiting values

Table 5. Limiting values

Symbol	Parameter	Notes	Value	Unit
V_{CE}	Collector-emitter voltage, $T_j \geq 25\text{ °C}$		650	V
I_C	DC collector current, limited by $T_{j(max)}$ $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$		80 40	A
$I_{C(puls)}$	Pulsed collector current, t_p limited by $T_{j(max)}$		120	A
-	Turn off safe operating area $V_{CE} \leq 650\text{ V}$, $T_j \leq 175\text{ °C}$, $t_p = 1\text{ }\mu\text{s}$		120	A
V_{GE}	Gate-emitter voltage		± 20	V
P_{tot}	Power dissipation $T_C = 25\text{ °C}$ Power dissipation $T_C = 100\text{ °C}$		312 156	W
T_{stg}	Storage temperature		-55 to +150	°C
T_{jmax}	Maximum operating junction temperature		175	°C
-	Peak soldering temperature		260	°C
M	Mounting Torque with washer		0.55	Nm

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-c)}$	IGBT thermal resistance from junction to case			-	0.48	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient			-	40	-	K/W

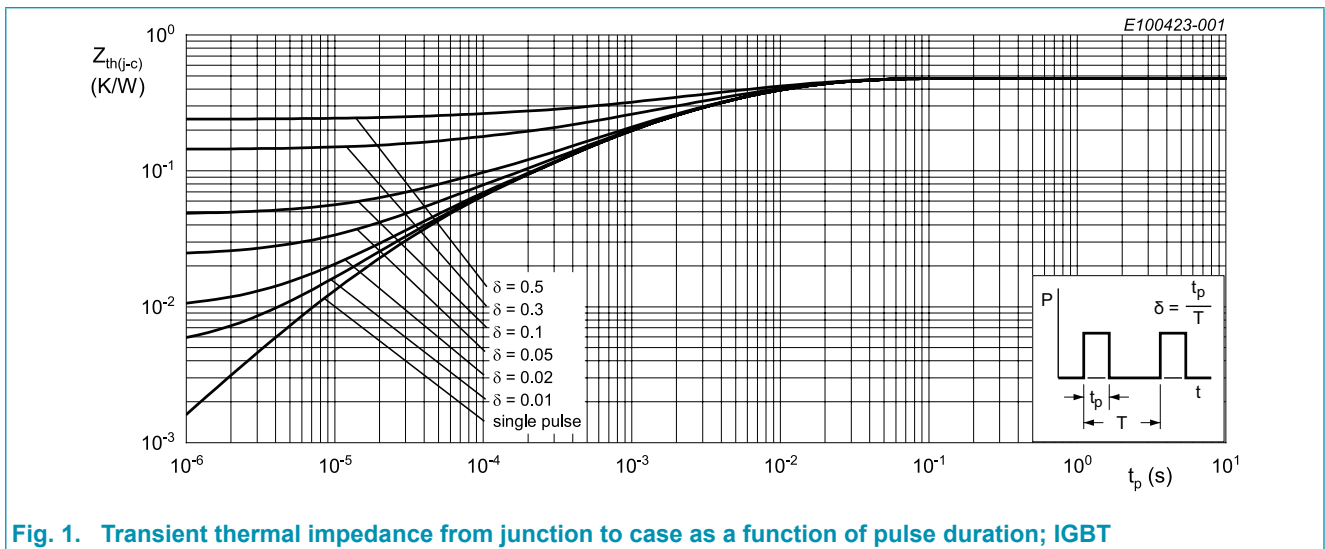


Fig. 1. Transient thermal impedance from junction to case as a function of pulse duration; IGBT

10. Characteristics

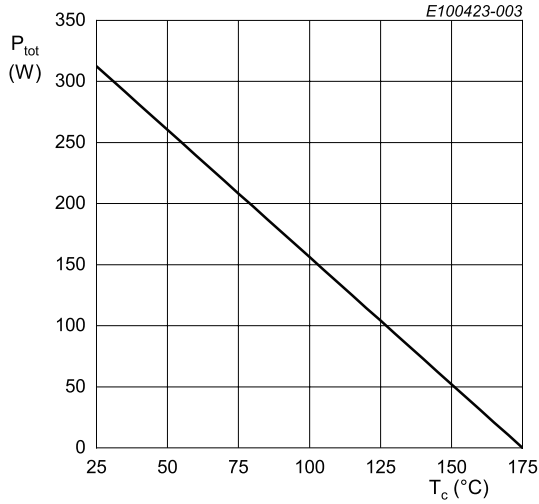
Table 7. Characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
Static characteristics							
BV_{CES}	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}; I_C = 1.0\text{ mA}$		650	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}; I_C = 40\text{ A}; T_j = 25\text{ °C}$		-	1.45	1.85	V
		$V_{GE} = 15\text{ V}; I_C = 40\text{ A}; T_j = 175\text{ °C}$		-	1.8	-	V
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C = 400\text{ }\mu\text{A}; V_{CE} = V_{GE}$		3.6	4.3	5.0	V
I_{CES}	Zero gate voltage collector current	$V_{CE} = 650\text{ V}; V_{GE} = 0\text{ V}; T_j = 25\text{ °C}$		-	-	100	μA
		$V_{CE} = 650\text{ V}; V_{GE} = 0\text{ V}; T_j = 175\text{ °C}$		-	-	1	mA
g_{fs}	Transconductance	$V_{CE} = 20\text{ V}; I_C = 40\text{ A}$		-	42	-	S
Dynamic characteristics							
C_{ies}	Input capacitance	$V_{CE} = 40\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C}$		-	3180	-	pF
C_{oes}	Output capacitance			-	39	-	pF
C_{res}	Reverse transfer capacitance			-	14	-	pF
Q_G	Gate charge	$V_{CC} = 520\text{ V}; I_C = 40\text{ A}; V_{GE} = 15\text{ V}; T_j = 25\text{ °C}$		-	124	-	nC

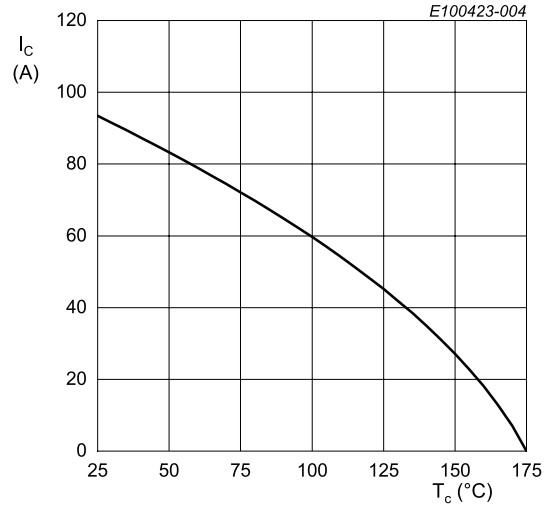
11. Switching Characteristics

Table 8. Switching Characteristics, Inductive Load

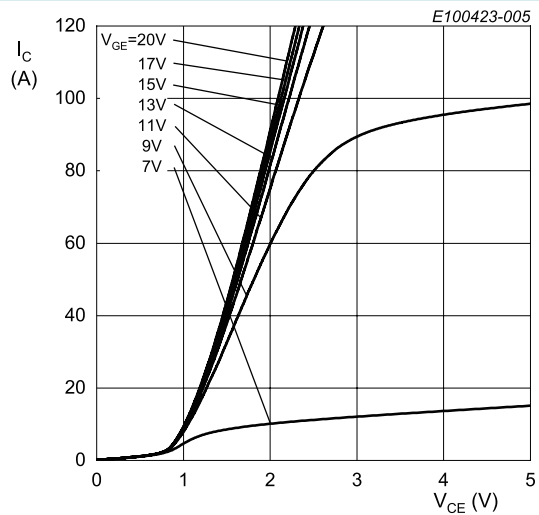
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
IGBT characteristics							
$t_{d(on)}$	Turn-on delay time	$T_J = 25\text{ °C};$ $V_{CC} = 400\text{ V}; I_C = 40\text{ A}; V_{GE} = 15\text{V} / 0\text{V};$ $R_G = 10\text{ }\Omega$		-	41	-	nS
t_r	Rise time			-	35	-	nS
$t_{d(off)}$	Turn-off delay time			-	173	-	nS
t_f	Fall time			-	27	-	nS
E_{on}	Turn-on energy			-	0.95	-	mJ
E_{off}	Turn-off energy			-	0.35	-	mJ
E_{ts}	Total switching energy			-	1.3	-	mJ
$t_{d(on)}$	Turn-on delay time	$T_J = 175\text{ °C};$ $V_{CC} = 400\text{ V}; I_C = 40\text{ A}; V_{GE} = 15\text{V} / 0\text{V};$ $R_G = 10\text{ }\Omega$		-	36	-	nS
t_r	Rise time			-	34	-	nS
$t_{d(off)}$	Turn-off delay time			-	201	-	nS
t_f	Fall time			-	37	-	nS
E_{on}	Turn-on energy			-	1.4	-	mJ
E_{off}	Turn-off energy			-	0.5	-	mJ
E_{ts}	Total switching energy			-	1.9	-	mJ



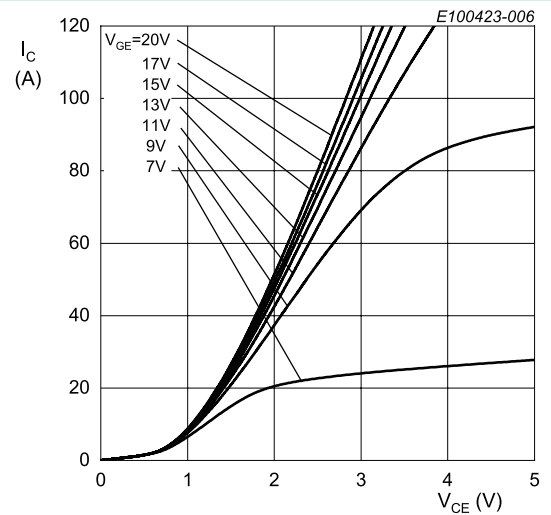
$T_j \leq 175 \text{ }^\circ\text{C}$
Fig. 2. Power dissipation as a function of case temperature



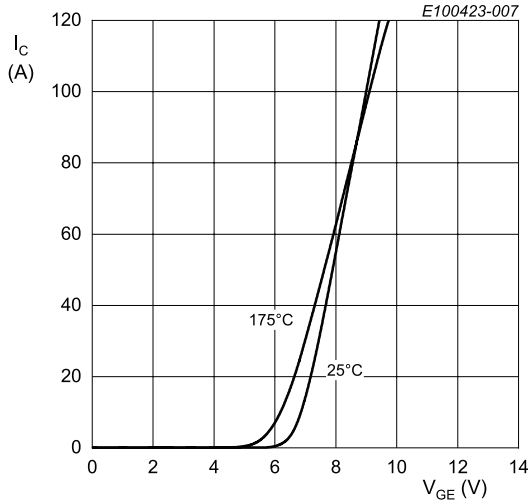
$V_{GE} \geq 15 \text{ V}; T_j \leq 175 \text{ }^\circ\text{C}$
Fig. 3. Collector current as a function of case temperature



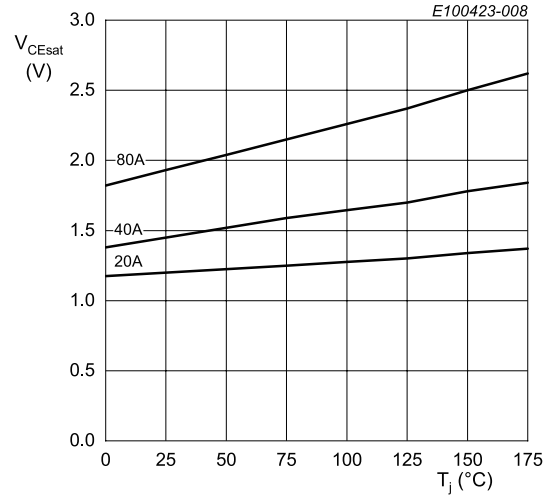
$T_j = 25 \text{ }^\circ\text{C}$
Fig. 4. Typical output characteristic



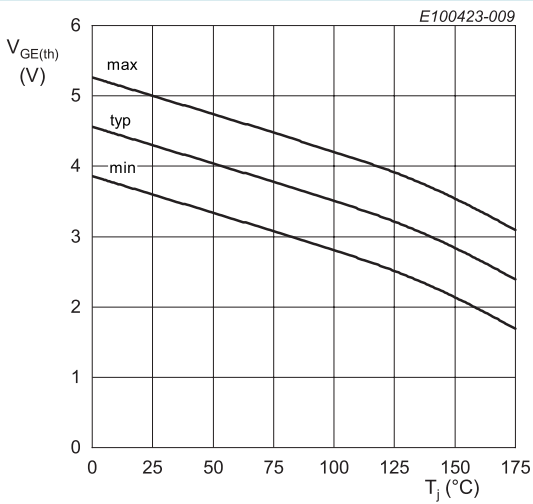
$T_j = 175 \text{ }^\circ\text{C}$
Fig. 5. Typical output characteristic



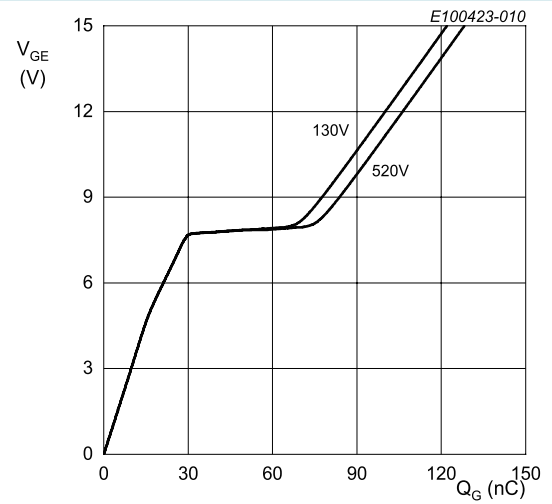
$V_{CE} = 20$ V
Fig. 6. Typical transfer characteristic



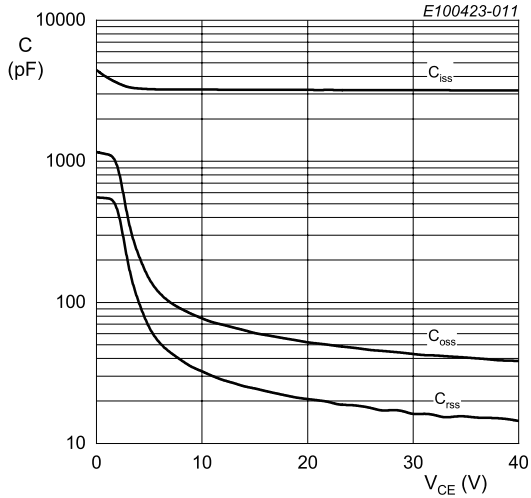
$V_{GE} = 15$ V
Fig. 7. Typical collector-emitter saturation voltage as a function of junction temperature



$I_C = 400$ µA
Fig. 8. Gate-emitter threshold voltage as a function of junction temperature

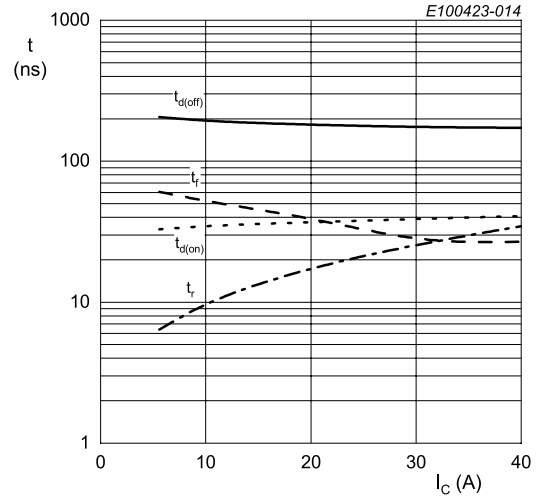


$I_C = 40$ A
Fig. 9. Typical gate charge



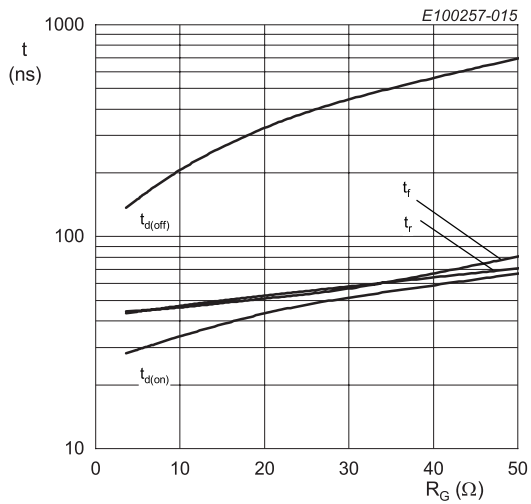
$V_{GE} = 0\text{ V}; f = 1\text{ MHz}$

Fig. 10. Typical capacitance as a function of collector-emitter voltage



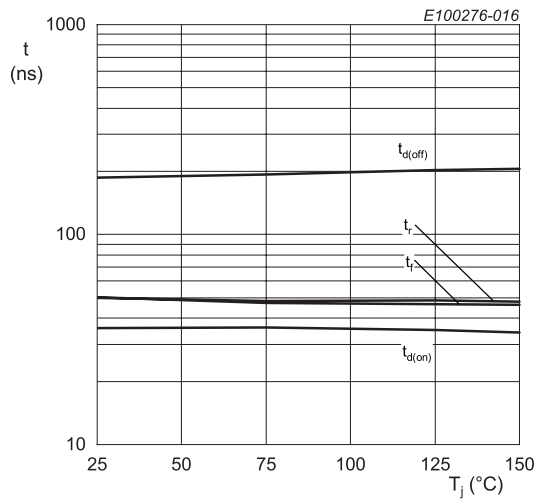
$R_g = 10\ \Omega; V_{GE} = 15\text{V}/0\text{V}; T_j = 175\text{ }^\circ\text{C};$
 $V_{CE} = 400\text{ V};$ inductive load

Fig. 11. Typical switching times as a function of collector current



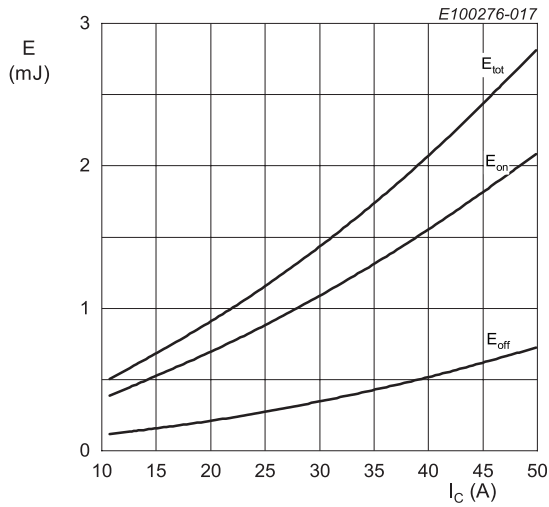
$I_C = 40\text{ A}; V_{GE} = 15\text{V}/0\text{V}; T_j = 175\text{ }^\circ\text{C};$
 $V_{CE} = 400\text{ V};$ inductive load

Fig. 12. Typical switching times as a function of gate resistance



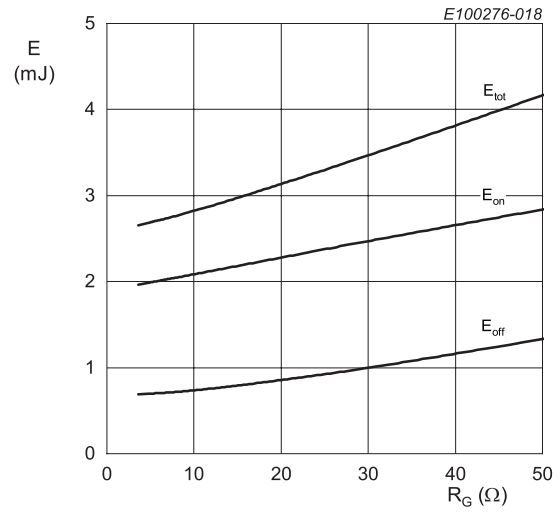
$I_C = 40\text{ A}; V_{GE} = 15\text{V}/0\text{V}; R_g = 10\ \Omega;$
 $V_{CE} = 400\text{ V};$ inductive load

Fig. 13. Typical switching times as a function of junction temperature



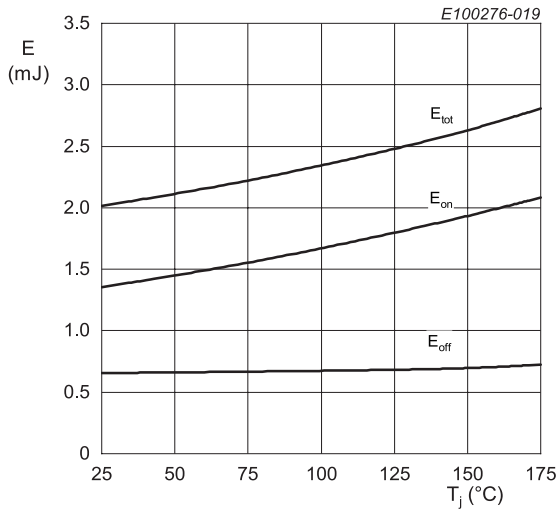
$R_g = 10 \Omega$; $V_{GE} = 15V/0V$; $T_j = 175 \text{ }^\circ\text{C}$;
 $V_{CE} = 400 \text{ V}$; inductive load

Fig. 14. Typical switching energy losses as a function of collector current



$I_C = 40 \text{ A}$; $V_{GE} = 15V/0V$; $T_j = 175 \text{ }^\circ\text{C}$;
 $V_{CE} = 400 \text{ V}$; inductive load

Fig. 15. Typical switching energy losses as a function of gate resistance



$I_C = 40 \text{ A}$; $V_{GE} = 15V/0V$; $R_g = 10 \Omega$;
 $V_{CE} = 400 \text{ V}$; inductive load

Fig. 16. Typical switching energy losses as a function of junction temperature

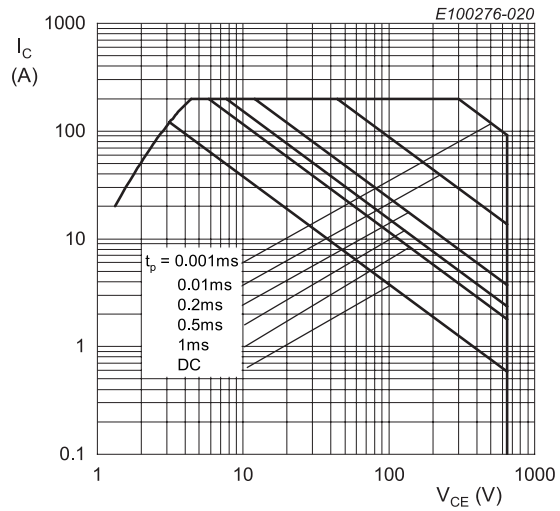
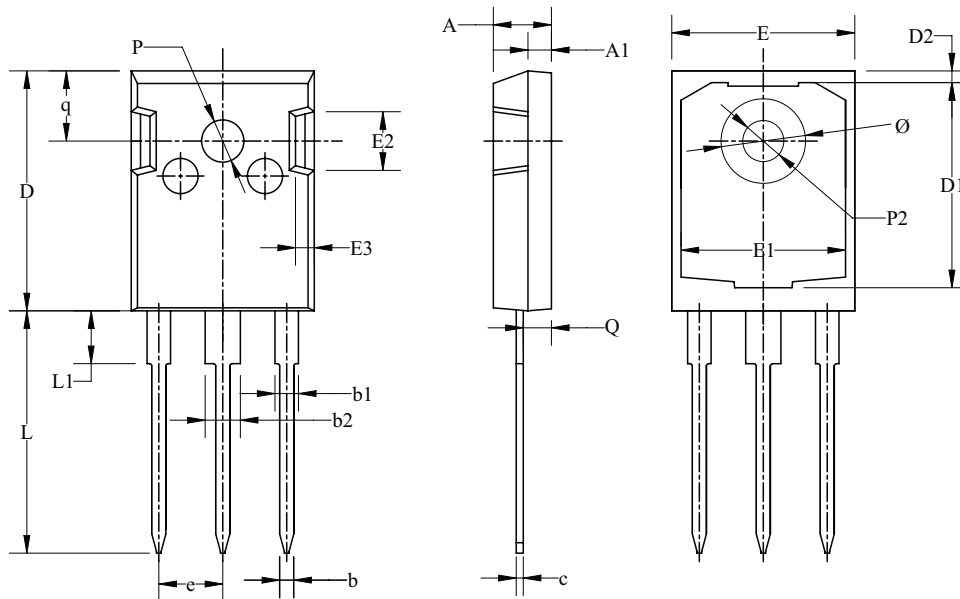


Fig. 17. Forward bias safe operating area

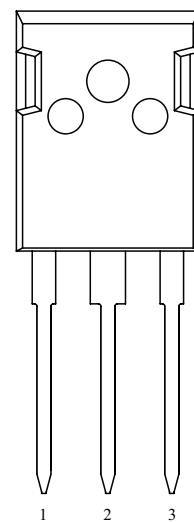
12. Package outline

Plastic single-ended through-hole pack age; headsink mounted; 1 mounting hole; 3 leads TO-247

TO247



Dim	All Dimensions in Millimeters		
	Min	Typ	Max
A	4.70	4.95	5.20
A1	1.90	2.00	2.10
b	1.00	1.20	1.40
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.50	0.60	0.70
D	20.30	20.45	20.60
D1	17.28	17.48	17.68
D2	0.80	1.00	1.20
E	15.45	15.60	15.75
E1	13.82	14.02	14.22
E2	4.80	5.00	5.20
E3	1.40	1.60	1.80
e	5.45 BSC		
L	20.40	20.65	20.90
L1	4.25	4.50	4.75
P2	3.40	3.50	3.60
P	3.50	3.60	3.70
Q	2.20	2.40	2.60
q	5.78	5.98	6.18
Ø	7.10	7.19	7.30



TO247

13. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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14. Contents

1. General description.....	1
2. Features and benefits	1
3. Applications	1
4. Quick reference data	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values	3
9. Thermal characteristics	4
10. Characteristics.....	5
11. Switching Characteristics.....	6
12. Package outline	11
13. Legal information	12
14. Contents	14

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