Product data sheet

1. General description

WG40N120HFR1 uses advanced Fine Trench Field-stop IGBT technology with antiparallel diode in TO-247-4L package. This device is part of the H series of IGBTs, which represents an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converter.



2. Features and benefits

- Maximum junction temperature 175 °C
- · High speed switching series
- · Positive Temperature efficient for Easy Parallel Operating
- · Very soft, fast recovery anti-parallel diode
- · EMI Improved Design

3. Applications

- Solar inverter
- UPS
- · Welding converters
- PFC
- · Mid to high switching frequency applications

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Notes		Value		Unit	
V _{CE}	Collector-emitter voltage, T _j ≥			1200		V	
I _C	DC collector current, limited by T _C = 100 °C			40		А	
Symbol	Parameter	Notes	Min	Тур	Max	Unit	
Static cha	racteristics						
V _{CE(sat)}	Collector-emitter saturation voltage		-	2.2	2.8	V	

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	С	collector		.0
2	Е	emitter		r c
3	KE	kelvin emitter		(\
4	G	gate		G KE E
mb	С	mounting base; connected to collector	Ų ŲŲĮ	3,1120

6. Ordering information

Table 3. Ordering information

Type number	Package Name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WG40N120HFR1	TO247-4L	WG40N120HFR1Q	Tube	30	TO247N-4L	17-Dec-2021

7. Marking

Table 4. Marking codes

Type number	Marking codes
WG40N120HFR1	40N120HF

8. Limiting values

Table 5. Limiting values

Symbol	Parameter	Notes	Value	Unit
V _{CE}	Collector-emitter voltage, T _j ≥ 25 °C		1200	V
I _C	DC collector current, limited by $T_{j(max)}$ $T_c = 25 ^{\circ}C$ $T_c = 100 ^{\circ}C$		80 40	A
I _{C(puls)}	Pulsed collector current, t _p limited by T _{j(max)}		120	А
-	Turn off safe operating area $V_{CE} \le 1200 \text{ V}, T_j \le 175 ^{\circ}\text{C}, t_p = 1 \mu\text{s}$		120	А
I _F	Diode forward current, limited by $T_{j(max)}$ $T_c = 25 ^{\circ}C$ $T_c = 100 ^{\circ}C$		80 40	А
I _{Fpuls}	Diode pulsed current, t _p limited by T _{j(max)}		120	А
V_{GE}	Gate-emitter voltage		±20	V
P _{tot}	Power dissipation $T_C = 25 ^{\circ}\text{C}$ Power dissipation $T_C = 100 ^{\circ}\text{C}$		750 375	W
T _{stg}	Storage temperature		-55 to +150	°C
T _{jmax}	Operating junction temperature		175	°C
-	Peak soldering temperture		260	°C
M	Mounting Torque with washer		0.55	Nm

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Notes	Min	Тур	Max	Unit
R _{th(j-c)}	IGBT thermal resistance from junction to case			-	0.20	-	K/W
R _{th(j-c)}	Diode thermal resistance from junction to case			-	0.72	-	K/W
R _{th(j-a)}	thermal resistance from junction to ambient			-	40	-	K/W

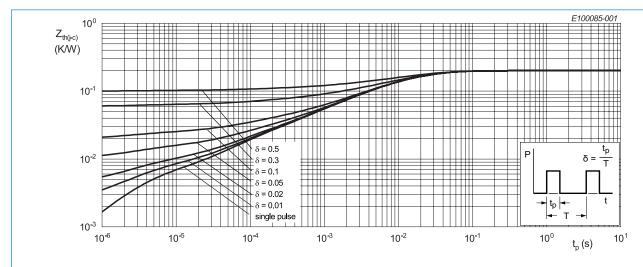


Fig. 1. Transient thermal impedance from junction to case as a function of pulse duration; IGBT

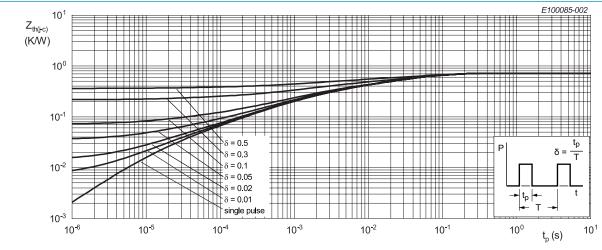


Fig. 2. Transient thermal impedance from junction to case as a function of pulse duration; Diode

10. Characteristics

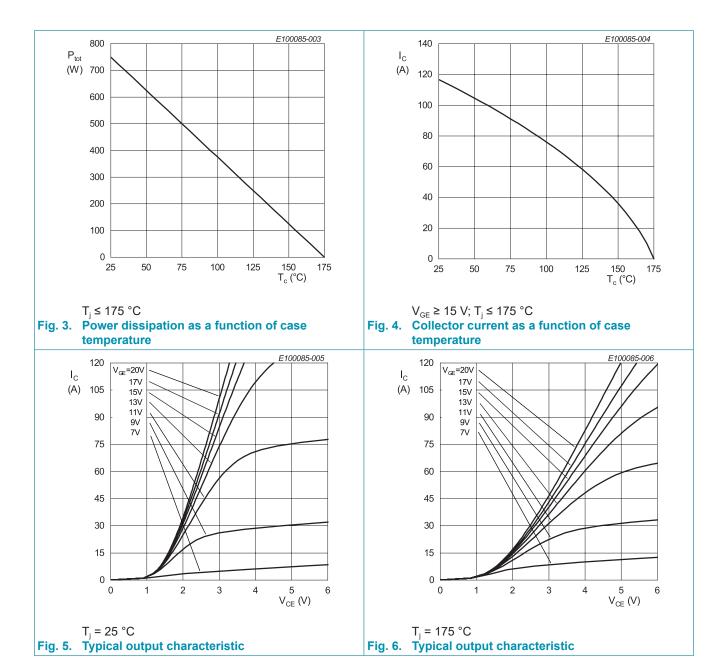
Table 7. Characteristics

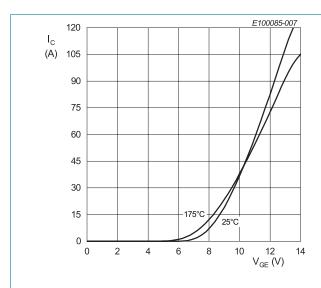
Symbol	Parameter	Conditions	Notes	Min	Тур	Max	Unit
Static cha	aracteristics						
BV_CES	Collector-emitter breakdown voltage	$V_{GE} = 0 \text{ V; } I_{C} = 1 \text{ mA}$		1200	-	-	V
$V_{\text{CE(sat)}}$	Collector-emitter saturation	$V_{GE} = 15 \text{ V}; I_{C} = 40 \text{ A}; T_{j} = 25 \text{ °C}$		-	2.2	2.8	V
	voltage	V_{GE} = 15 V; I_{C} = 40 A; T_{j} = 175 °C		-	3.1	-	V
V _F Diode forward voltage		$V_{GE} = 0 \text{ V}; I_F = 40 \text{ A}; T_j = 25 \text{ °C}$		-	2.3	-	V
		$V_{GE} = 0 \text{ V}; I_F = 40 \text{ A}; T_j = 175 \text{ °C}$		-	2.1	-	V
$V_{\text{GE(th)}}$	Gate-emitter threhold voltage	$I_{\rm C}$ = 0.5 mA; $V_{\rm CE}$ = $V_{\rm GE}$		4.2	5.3	6.4	V
I _{CES}	Zero gate voltage collector	V_{CE} = 1200 V; V_{GE} = 0 V; T_{j} = 25 °C		-	-	250	μA
	current	$V_{CE} = 1200V; V_{GE} = 0 V; T_j = 175 °C$		-	-	10	mA
g _{fs}	Transconductance	V _{CE} = 20 V; I _C = 40 A		-	21	-	S
Dynamic	characteristics						
C _{ies}	Input capacitance	$V_{CE} = 30 \text{ V}; V_{GE} = 0 \text{ V}; f = 1 \text{ MHz};$		-	6672	-	pF
C _{oes}	Output capacitance	T _j = 25 °C		-	137	-	pF
C _{res}	Reverse transfer capacitance			-	25	-	pF
Q_{G}	Gate charge	V_{CC} = 960 V; I_{C} = 40 A; V_{GE} = 15 V; T_{j} = 25 °C		-	200	-	nC

11. Switching Characteristics

Table 8. Switching Characteristics, Inductive Load

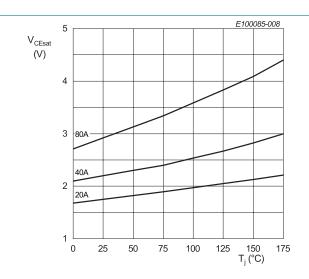
Symbol	Parameter	Conditions	Notes	Min	Тур	Max	Unit
IGBT cha	racteristics						
$t_{d(on)}$	Turn-on delay time	T _j = 25 °C;		-	37	-	nS
t _r	Rise time	$V_{CC} = 600 \text{ V}; I_C = 40 \text{ A}; V_{GE} = 15 \text{V} / 0 \text{V};$ $R_G = 3.6 \Omega$		-	13	-	nS
$t_{d(off)}$	Turn-off delay time			-	134	-	nS
t _f	Fall time			-	66	-	nS
E _{on}	Turn-on energy			-	1.2	-	mJ
E _{off}	Turn-off energy			-	0.9	-	mJ
E _{ts}	Total switching energy			-	2.1	-	mJ
t _{d(on)}	Turn-on delay time	T_{j} = 175 °C; V_{CC} = 600 V; I_{C} = 40 A; V_{GE} = 15V / 0V; R_{G} = 3.6 Ω		-	36	-	nS
t _r	Rise time			-	16	-	nS
$t_{d(off)}$	Turn-off delay time			-	159	-	nS
t _f	Fall time			-	110	-	nS
E _{on}	Turn-on energy			-	2.3	-	mJ
E _{off}	Turn-off energy			-	1.5	-	mJ
E _{ts}	Total switching energy			-	3.8	-	mJ
Diode cha	aracteristics		ı		'		
t _{rr}	Reverse recovery time	T _j = 25 °C;		-	200	-	nS
Q _r	Reverse recovery charge	$V_R = 600 \text{ V}; I_F = 40 \text{ A}; dI_F/dt = 500 \text{A/us}$		-	1660	-	nC
I _{RM}	Reverse recovery peak current			-	16	-	А
t _{rr}	Reverse recovery time	T _j = 175 °C;		-	453	-	nS
Q _r	Reverse recovery charge	$V_R = 600 \text{ V}; I_F = 40 \text{ A}; dI_F/dt = 500 \text{A/us}$		-	5566	-	nC
I _{RM}	Reverse recovery peak current			-	26	-	А





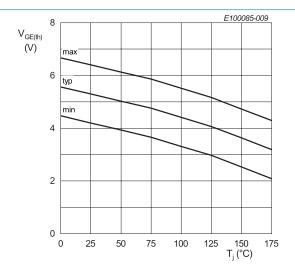
 $V_{CE} = 20 \text{ V}$

Fig. 7. Typical transfer characteristic



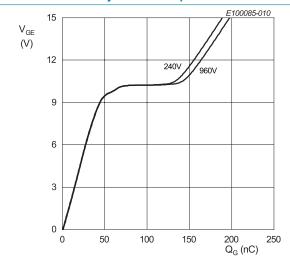
 $V_{GE} = 15 V$

Fig. 8. Typical collector-emitter saturation voltage as a function of junction temperature



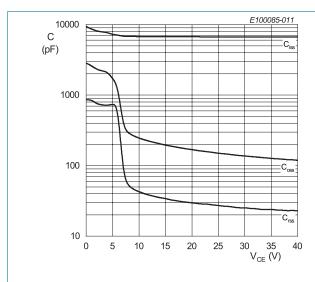
 $I_{c} = 500 \, \mu A$

Fig. 9. Gate-emitter threshold voltage as a function of junction temperature



 $I_{c} = 40 \text{ A}$

Fig. 10. Typical gate charge



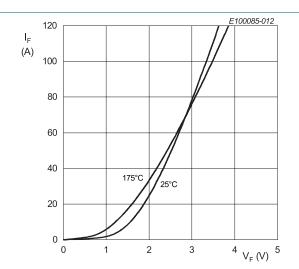
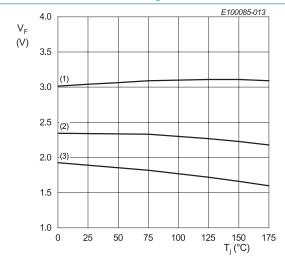
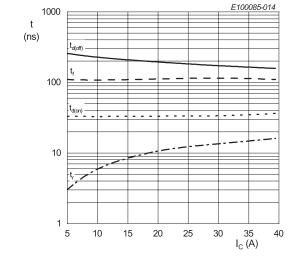


Fig. 12. Typical diode forward current as a function of forward voltage







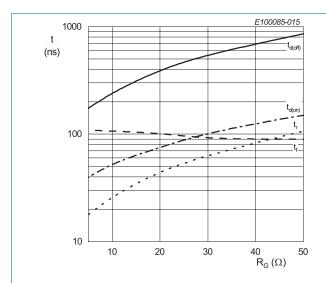
 $(1) I_F = 80 A$ (2) $I_F = 40 \text{ A}$

(3) $I_F = 20 A$

 $\rm R_g$ = 3.6 $\Omega;~\rm V_{GE}$ = 15V/0V; $\rm T_j$ = 175 °C; $\rm V_{CE}$ = 600 V; inductive load

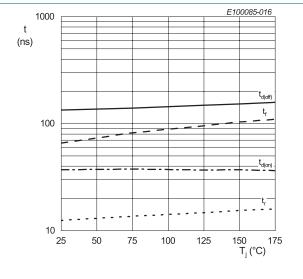
Fig. 13. Typical diode forward voltage as a function of junction temperature

Fig. 14. Typical switching times as a function of collector current



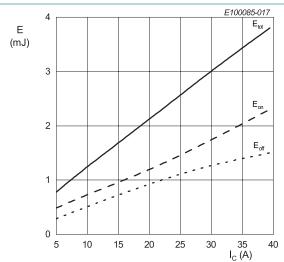
 $I_C = 40 \text{ A}; V_{GE} = 15 \text{V/0V}; T_i = 175 \,^{\circ}\text{C};$ V_{CE} = 600 V; inductive load

Fig. 15. Typical switching times as a function of gate resistance



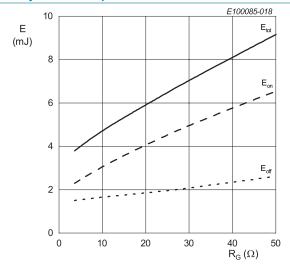
 $I_{c} = 40 \text{ A}; V_{ge} = 15 \text{V}/0 \text{V}; R_{g} = 3.6 \Omega;$ V_{CE} = 600 V; inductive load

Fig. 16. Typical switching times as a function of junction temperature



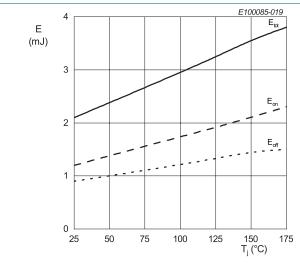
 R_g = 3.6 $\Omega;$ V_{GE} = 15V/0V; T_j = 175 °C; V_{CE} = 600 V; inductive load

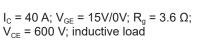
Fig. 17. Typical switching energy losses as a function of collector current



 I_{C} = 40 A; V_{GE} = 15V/0V; T_{j} = 175 °C; V_{CE} = 600 V; inductive load

Fig. 18. Typical switching energy losses as a function of gate resistance





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Fig. 20. Forward bias safe operating area



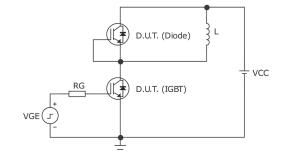


Fig. 21. Test circuit for inductive load switching

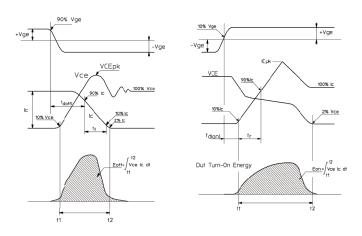
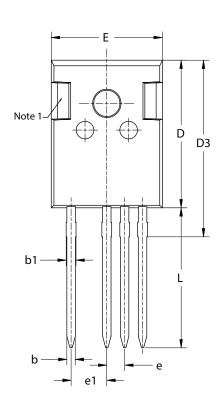


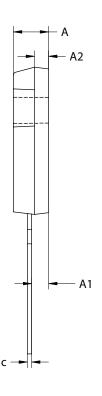
Fig. 22. Definition of switching times and losses

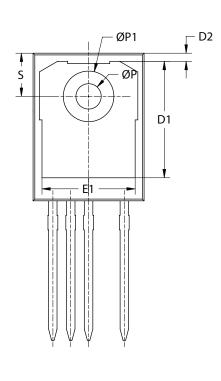
12. Package outline

Plastic single-ended through-hole package; heatsink mounted;1 mounting hole; 4 leads TO-247

TO247-4L



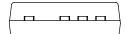




TOP VIEW

SIDE VIEW

BOTTOM VIEW



SIDE VIEW

UNIT	A	A 1	A2	b	b1	С	D	D1	D2	D3	E	E1	е	e1	L	P	P1	s
mm MAX	5.10	2.51	2.10	1.30	1.80	0.70	21.10	16.85	1.35	25.27	15.90	13.50	2.64 2.54		20.10	3.70		(6.15)
MIN	4.90	2.31	1.90	1.10	1.10	0.50	20.90	16.25	1.05	24.97	15.70	13.10			19.80	3.50		(0.10)

Note:

- Metal exposed with Sn plating.
 All dimensions do not include mold flash & gate remain

IGRT

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.

- Please consult the most recently issued document before initiating or completing a design.
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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	
9. Thermal characteristics	4
10. Characteristics	5
11. Switching Characteristics	
12. Package outline	
13. Legal information	
14. Contents	

For more information, please visit: http://www.ween-semi.com For sales office addresses, please send an email to: salesaddresses@ween-semi.com Date of release: 19 June 2024

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