

## High speed IGBT in Trench and Fieldstop technology

#### **Features**

TRENCHSTOP™ 1200V technology offering

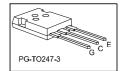
- very low V<sub>CEsat</sub>
- low EMI
- maximum junction temperature 175°C
- qualified according to JEDEC for target applications
- Pb-free lead plating; RoHS compliant
- complete product spectrum and PSpice Models:

http://www.infineon.com/igbt/



- uninterruptible power supplies
- welding converters
- · converters with high switching frequency





Туре	<b>V</b> CE	<i>l</i> c	V∕CEsat, Tvj=25°C	$\mathcal{T}_{vjmax}$	Marking	Package
IGW15N120H3	1200V	15A	2.05V	175°C	G15H1203	PG-TO247-3

#### **Maximum ratings**

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V <sub>CE</sub>	1200	V
DC collector current, limited by $T_{vjmax}$ $T_C = 25^{\circ}C$ $T_C = 100^{\circ}C$	lc	30.0 15.0	А
Pulsed collector current, $t_0$ limited by $T_{vjmax}$	Cpuls	60.0	Α
Turn off safe operating area $V_{CE} \le 1200V$ , $T_{vj} \le 175^{\circ}C$	-	60.0	Α
Gate-emitter voltage	V <sub>GE</sub>	±20	V
Short circuit withstand time $V_{\text{GE}} = 15.0 \text{V}, \ V_{\text{CC}} \le 600 \text{V}, \ T_{\text{vj}} \le 175^{\circ}\text{C}$ Allowed number of short circuits < 1000 Time between short circuits: $\ge 1.0 \text{s}$	<i>t</i> sc	10	μs
Power dissipation $T_C = 25^{\circ}C$ Power dissipation $T_C = 100^{\circ}C$	Ptot	217.0 105.0	W
Operating junction temperature	T <sub>vj</sub>	-40+175	°C
Storage temperature	$\mathcal{T}_{stg}$	-55+150	°C
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s		260	°C
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm



#### **Thermal Resistance**

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j^-c)}$		0.70	K/W
Thermal resistance junction - ambient	$R_{th(j^{-a)}}$		40	K/W

### Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified

Doromotor	Cumbal	Conditions	Value			11
Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Static Characteristic						•
Collector-emitter breakdown voltage	V(BR)CES	V <sub>GE</sub> = 0V, / <sub>C</sub> = 0.50mA	1200	-	-	V
Collector-emitter saturation voltage	<b>V</b> CEsat	$V_{GE} = 15.0V$ , $f_{C} = 15.0A$ $T_{Vj} = 25^{\circ}C$ $T_{Vj} = 125^{\circ}C$ $T_{Vj} = 175^{\circ}C$	- - -	2.05 2.50 2.70	2.40 - -	٧
Gate-emitter threshold voltage	VGE(th)	$I_C = 0.50$ mA, $V_{CE} = V_{GE}$	5.0	5.8	6.5	V
Zero gate voltage collector current	/ces	$V_{CE} = 1200V, V_{GE} = 0V$ $T_{vj} = 25^{\circ}C$ $T_{vj} = 175^{\circ}C$		- -	250.0 2500.0	μA
Gate-emitter leakage current	/GES	V <sub>CE</sub> = 0V, V <sub>GE</sub> = 20V	-	-	600	nA
Transconductance	<i>g</i> fs	V <sub>CE</sub> = 20V, I <sub>C</sub> = 15.0A	-	7.5	-	S

### Electrical Characteristic, at $T_{vj}$ = 25°C, unless otherwise specified

Devementer	Combal	mbal Canditions		Value		
Parameter	Symbol Conditions		min.	typ.	max.	Unit
Dynamic Characteristic	•					
Input capacitance	Cies		-	875	-	
Output capacitance	$V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 0\text{V}, f = 1\text{MHz}$		-	60	-	pF
Reverse transfer capacitance	Cres		-	45	-	1
Gate charge	<i>Q</i> <sub>G</sub>	$V_{CC} = 960V$ , $I_{C} = 15.0A$ , $V_{GE} = 15V$	-	75.0	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from cas	e <sup>L</sup> E		-	13.0	-	nH
Short circuit collector current Max. 1000 short circuits Time between short circuits: ≥ 1.0s	/c(sc)	$V_{GE} = 15.0V, V_{CC} \le 600V, \ T_{vj} \le 175^{\circ}C, t_{SC} \le 10\mu s$	-	52	-	Α

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### Switching Characteristic, Inductive Load, at $T_{vj}$ = 25°C

Davamatan	C: mah al	Conditions	Value			11
Parameter	Symbol Conditions		min.	typ.	max.	Unit
IGBT Characteristic						•
Turn-on delay time	<i>t</i> <sub>d(on)</sub>	$T_{\rm vj}$ = 25°C,	-	21	-	ns
Rise time	<b>t</b> r	$V_{CC}$ = 600V, $I_{C}$ = 15.0A, $V_{GE}$ = 0.0/15.0V, $I_{G}$ = 35.0Ω, $I_{G}$ = 95nH, $I_{G}$ = 67pF $I_{G}$ , $I_{G}$ from Fig. E Energy losses include "tail" and	-	34	-	ns
Turn-off delay time	<i>t</i> d(off)		-	260	-	ns
Fall time	<i>t</i> f		-	14	-	ns
Turn-on energy	<i>E</i> <sub>on</sub>		-	1.10	-	mJ
Turn-off energy	E <sub>off</sub>	diode (IKW15N120H3) reverse recovery.	-	0.45	-	mJ
Total switching energy	<i>E</i> ts		-	1.55	-	mJ

# Switching Characteristic, Inductive Load, at $T_{vj}$ = 175°C

Danamatan	O b l	O andition a	Value			11:4
Parameter	Symbol	Conditions	min.	typ.	max.	Unit
IGBT Characteristic	,				•	
Turn-on delay time	<i>t</i> d(on)	$T_{Vj} = 175^{\circ}\text{C},$ $V_{CC} = 600\text{V}, I_{C} = 15.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $I_{C} = 35.0\Omega, I_{C} = 95\text{nH},$ $I_{C} = 67\text{pF}$	-	19	-	ns
Rise time	<i>t</i> r		-	30	-	ns
Turn-off delay time	t <sub>d(off)</sub>		-	327	-	ns
Fall time	<i>t</i> f		-	43	-	ns
Turn-on energy	<i>E</i> on		-	1.60	-	mJ
Turn-off energy	E <sub>off</sub>	diode (IKW15N120H3) reverse recovery.	-	0.90	-	mJ
Total switching energy	Ets	,	-	2.50	-	mJ

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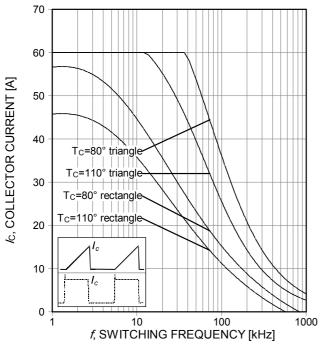


Figure 1. Collector current as a function of switching frequency ( $T_{\rm j} \le 175^{\circ}{\rm C}$ , D=0.5,  $V_{\rm CE}=600{\rm V}$ ,  $V_{\rm GE}=15/0{\rm V}$ ,  $R_{\rm G}=35\Omega$ )

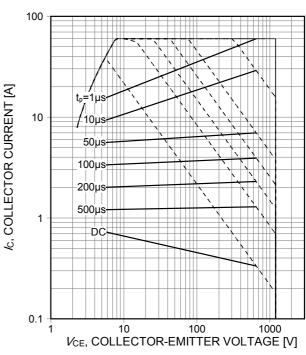


Figure 2. Forward bias safe operating area (D=0,  $T_C$ =25°C,  $T_j$ ≤175°C;  $V_{GE}$ =15V)

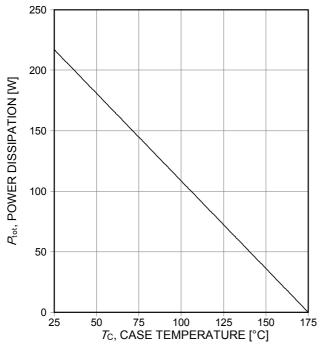


Figure 3. Power dissipation as a function of case temperature (T≤175°C)

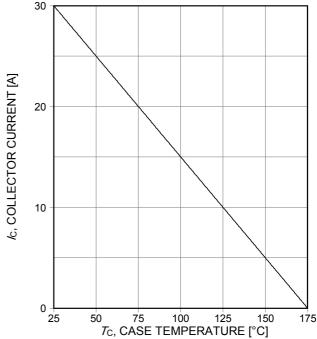


Figure 4. Collector current as a function of case temperature ( V<sub>GE</sub>≥15V, T<sub>j</sub>≤175°C)



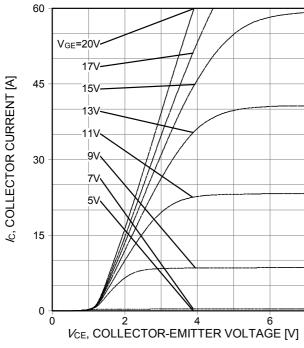


Figure 5. Typical output characteristic  $(T_i=25^{\circ}C)$ 

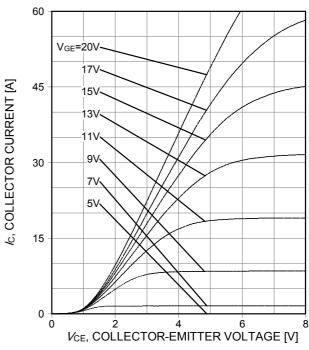


Figure 6. Typical output characteristic  $(T_i=175^{\circ}\text{C})$ 

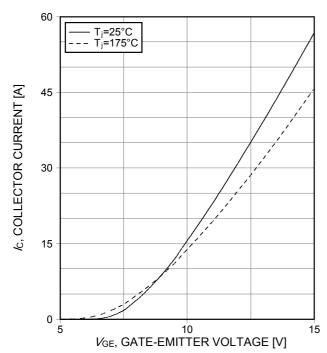


Figure 7. Typical transfer characteristic  $(V_{CE}=20V)$ 

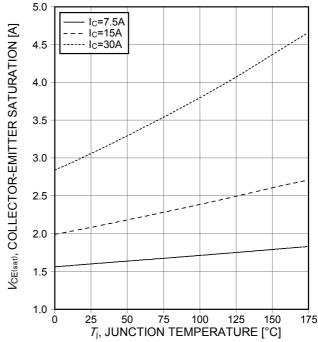


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature (  $V_{\rm GE}$ =15V)



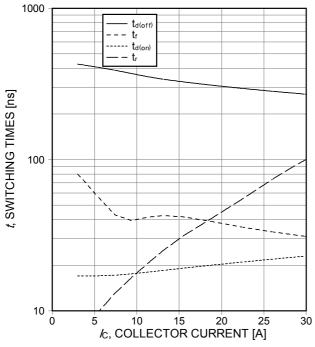


Figure 9. Typical switching times as a function of collector current (ind. load. T=175°C Mor=600V

(ind. load,  $T_j$ =175°C,  $V_{CE}$ =600V,  $V_{GE}$ =15/0V,  $R_{G}$ =35 $\Omega$ , test circuit in Fig. E)

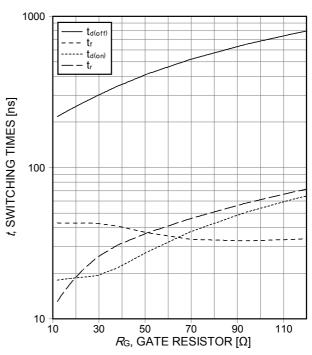


Figure 10. Typical switching times as a function of gate resistor (ind. load. Ti=175°C. Vc==600V.

(ind. load,  $T_j$ =175°C,  $V_{CE}$ =600V,  $V_{GE}$ =15/0V,  $V_{CE}$ =15A, test circuit in Fig. E)

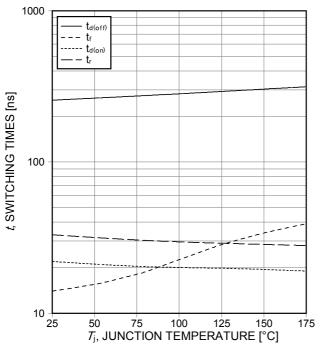


Figure 11. Typical switching times as a function of junction temperature (ind. load, V<sub>CE</sub>=600V, V<sub>GE</sub>=15/0V, /<sub>C</sub>=15A, R<sub>G</sub>=35Ω, test circuit in Fig. E)

typ. VGE(tm), GATE-EMITTER THRESHOLD VOLTAGE [V] min. max 6 5 4 3 2 50 100 25 75 125 150 175 T<sub>i</sub>, JUNCTION TEMPERATURE [°C]

Figure 12. Gate-emitter threshold voltage as a function of junction temperature (/c=0.5mA)



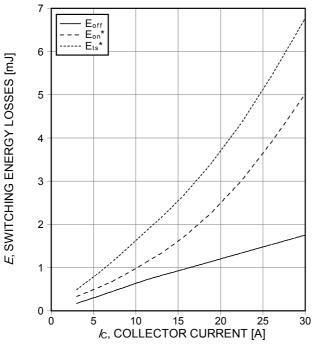


Figure 13. Typical switching energy losses as a function of collector current (ind. load,  $T_j$ =175°C,  $V_{CE}$ =600V,  $V_{GE}$ =15/0V,  $R_{G}$ =35 $\Omega$ , test circuit in Fig. E)

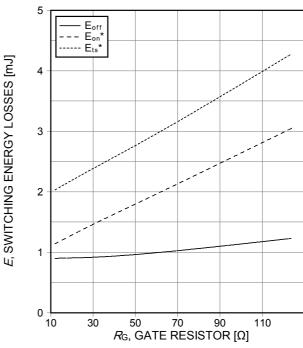


Figure 14. Typical switching energy losses as a function of gate resistor (ind. load, Tj=175°C, VcE=600V, VGE=15/0V, Ic=15A, test circuit in Fig. E)

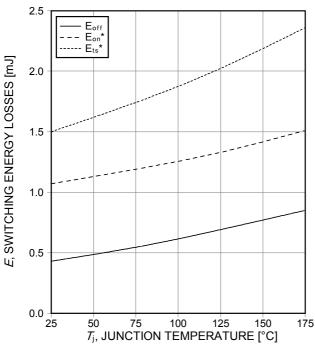


Figure 15. Typical switching energy losses as a function of junction temperature (ind load,  $V_{\text{CE}}$ =600V,  $V_{\text{GE}}$ =15/0V,  $I_{\text{C}}$ =15A,  $I_{\text{CE}}$ =35 $\Omega$ , test circuit in Fig. E)

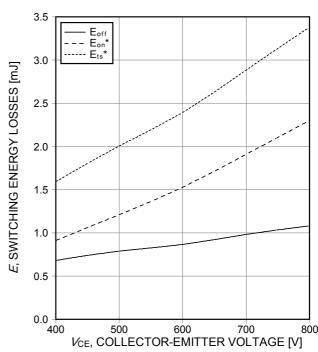


Figure 16. Typical switching energy losses as a function of collector emitter voltage (ind. load,  $T_j$ =175°C,  $V_{GE}$ =15/0V,  $I_{C}$ =15A,  $R_{G}$ =35 $\Omega$ , test circuit in Fig. E)



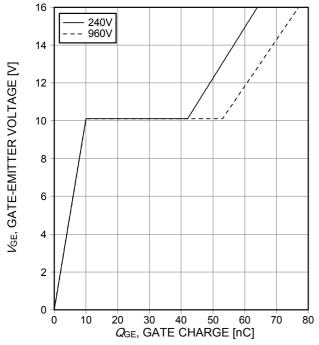


Figure 17. Typical gate charge (/c=15A)

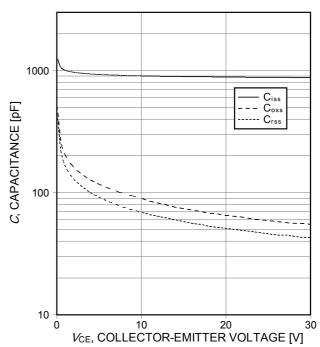


Figure 18. Typical capacitance as a function of collector-emitter voltage (V<sub>GE</sub>=0V, f=1MHz)

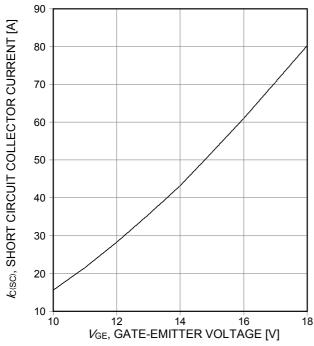


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage ( V<sub>CE</sub>≤600V, start at T<sub>j</sub>=25°C)

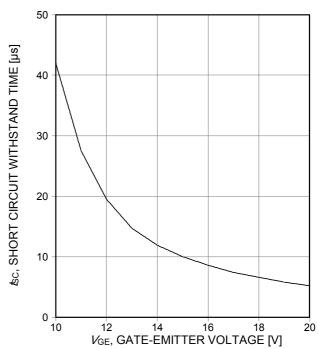


Figure 20. Short circuit withstand time as a function of gate-emitter voltage ( $V_{CE} \le 600 \text{V}$ , start at  $T_j \le 150 ^{\circ}\text{C}$ )



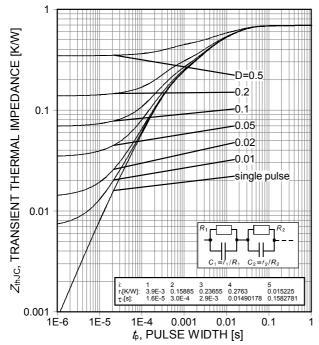
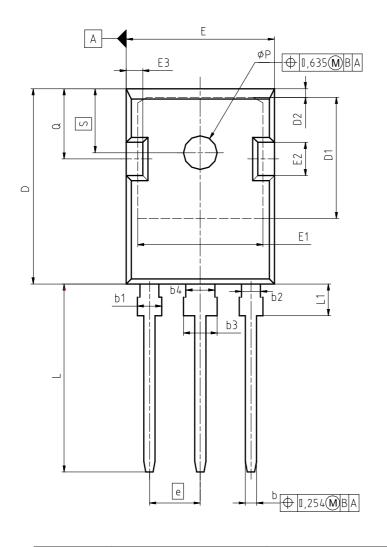


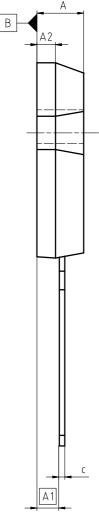
Figure 21. IGBT transient thermal impedance  $(D=t_r/T)$ 

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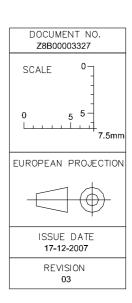


# PG-TO247-3

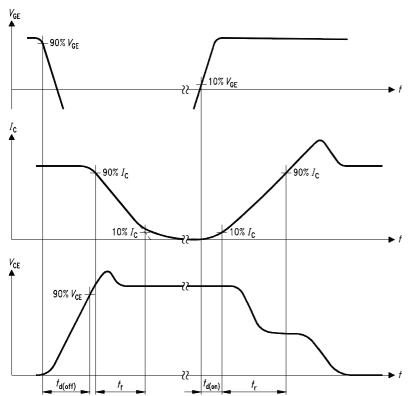




DIM	MILLIM	ETERS	INCH	HES	
DIIVI	MIN	MAX	MIN	MAX	
Α	4.90	5.16	0.193	0.203	
A1	2.27	2.53	0.089	0.099	
A2	1.85	2.11	0.073	0.083	
b	1.07	1.33	0.042	0.052	
b1	1.90	2.41	0.075	0.095	
b2	1.90	2.16	0.075	0.085	
b3	2.87	3.38	0.113	0.133	
b4	2.87	3.13	0.113	0.123	
С	0.55	0.68	0.022	0.027	
D	20.82	21.10	0.820	0.831	
D1	16.25	17.65	0.640	0.695	
D2	1.05	1.35	0.041	0.053	
E	15.70	16.03	0.618	0.631	
E1	13.10	14.15	0.516	0.557	
E2	3.68	5.10	0.145	0.201	
E3	1.68	2.60	0.066	0.102	
е	5	44	0.2	14	
N	;	3	3		
L	19.80	20.31	0.780	0.799	
L1	4.17	4.47	0.164	0.176	
øΡ	3.50	3.70	0.138	0.146	
Q	5.49	6.00	0.216	0.236	
S	6.04	6.30	0.238	0.248	







 $di_{F}/dt \qquad t_{rr} = t_{S} + t_{F}$   $Q_{rr} = Q_{S} + Q_{F}$   $t_{rr} \qquad t_{F}$   $Q_{S} = Q_{S} + Q_{F}$   $di_{rr}/dt \qquad V_{R}$ 

Figure C. Definition of diodes switching characteristics

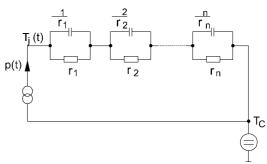


Figure A. Definition of switching times

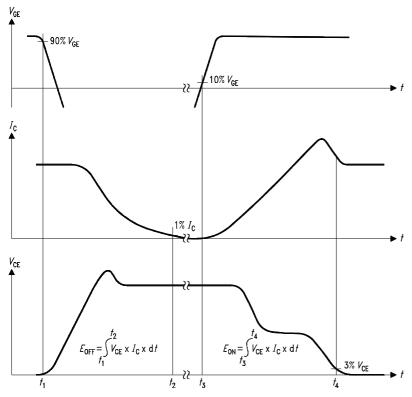


Figure D. Thermal equivalent circuit

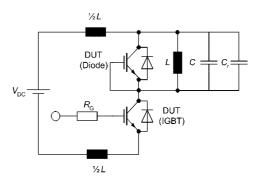


Figure E. Dynamic test circuit Leakage inductance L= 180nH, Stray capacitor  $C_{\sigma}$  = 40pF, Relief capacitor  $C_{r}$  = 1nF (only for ZVT switching)

Figure B. Definition of switching losses





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