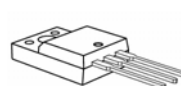
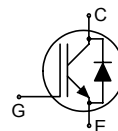
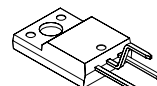


HighSpeed 2-Technology with soft, fast recovery anti-parallel EmCon HE diode

- **Designed for:**
 - TV – Horizontal Line Deflection
- **2nd generation HighSpeed-Technology for 1200V applications offers:**
 - loss reduction in resonant circuits
 - temperature stable behavior
 - parallel switching capability
 - tight parameter distribution
 - Integrated anti-parallel diode
 - E_{off} optimized for $I_C = 3A$



P-TO220-3-31
(FullIPAK)



P-TO220-3-34
(FullIPAK)

- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>

Type	V_{CE}	I_C	E_{off}	T_j	Marking	Package	Ordering Code
IKA03N120H2	1200V	3A	0.15mJ	150°C	K03H1202	P-TO-220-3-31	Q67040-S4649
IKA03N120H2	1200V	3A	0.15mJ	150°C	K03H1202	P-TO-220-3-34	Q67040-S4655

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	1200	V
Triangular collector peak current ($V_{GE} = 15V$) $T_C = 100^\circ C, f = 32kHz$	I_C	8.2	A
Pulsed collector current, t_p limited by T_{jmax}	I_{Cpuls}	9	
Turn off safe operating area $V_{CE} \leq 1200V, T_j \leq 150^\circ C$	-	9	
Diode forward current $T_C = 25^\circ C$ $T_C = 100^\circ C$	I_F	9.6 3.9	
Gate-emitter voltage	V_{GE}	± 20	
Power dissipation $T_C = 25^\circ C$	P_{tot}	29	W
Operating junction and storage temperature	T_j, T_{stg}	-40...+150	°C
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction – case	R_{thJC}		4.3	K/W
Diode thermal resistance, junction - case	R_{thJCD}		5.8	
Thermal resistance, junction – ambient	R_{thJA}	P-TO-220-3-31 P-TO-220-3-34	62	

Electrical Characteristic, at $T_j = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
Static Characteristic						
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=300\mu A$	1200	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C=3A$	-	2.2	2.8	
		$T_j=25^{\circ}C$	-	2.5	-	
		$T_j=150^{\circ}C$	-	2.4	-	
Diode forward voltage	V_F	$V_{GE} = 0, I_F=3A$	-	1.55	-	
		$T_j=25^{\circ}C$	-	1.6	-	
		$T_j=150^{\circ}C$	-	-	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C=90\mu A, V_{CE}=V_{GE}$	2.1	3	3.9	
Zero gate voltage collector current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$	-	-	20	μA
		$T_j=25^{\circ}C$	-	-	80	
		$T_j=150^{\circ}C$	-	-	-	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=20V$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20V, I_C=3A$	-	2	-	S
Dynamic Characteristic						
Input capacitance	C_{iss}	$V_{CE}=25V,$ $V_{GE}=0V,$ $f=1MHz$	-	205	-	pF
Output capacitance	C_{oss}		-	24	-	
Reverse transfer capacitance	C_{rss}		-	7	-	
Gate charge	Q_{Gate}	$V_{CC}=960V, I_C=3A$ $V_{GE}=15V$	-	8.6	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	P-TO-220-3-1	-	7	-	nH

Switching Characteristic, Inductive Load, at $T_j=25^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_J=25^{\circ}\text{C}$, $V_{CC}=800\text{V}$, $I_C=3\text{A}$, $V_{GE}=0\text{V}/15\text{V}$, $R_G=82\Omega$, $L_{\sigma}^{(2)}=180\text{nH}$, $C_{\sigma}^{(2)}=40\text{pF}$	-	9.2	-	ns
Rise time	t_r		-	5.2	-	
Turn-off delay time	$t_{d(off)}$		-	281	-	
Fall time	t_f		-	29	-	
Turn-on energy	E_{on}	Energy losses include “tail” and diode ²⁾ reverse recovery.	-	0.14	-	mJ
Turn-off energy	E_{off}		-	0.15	-	
Total switching energy	E_{ts}		-	0.29	-	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=25^\circ\text{C}$,	-	52	-	ns
Diode reverse recovery charge	Q_{rr}	$V_R=800\text{V}$, $I_F=3\text{A}$,	-	0.23	-	μC
Diode peak reverse recovery current	I_{rrm}	$R_G=82\Omega$	-	9.3	-	A
Diode current slope	di_F/dt		-	723	-	A/ μs

Switching Characteristic, Inductive Load, at $T_j=150^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_J=150^{\circ}\text{C}$	-	9.4	-	ns
Rise time	t_r	$V_{CC}=800\text{V}, I_C=3\text{A},$	-	6.7	-	
Turn-off delay time	$t_{d(off)}$	$V_{GE}=0\text{V}/15\text{V},$	-	340	-	
Fall time	t_f	$R_G=82\Omega,$	-	63	-	
Turn-on energy	E_{on}	$L_{\sigma}^{(2)}=180\text{nH},$	-	0.22	-	mJ
Turn-off energy	E_{off}	$C_{\sigma}^{(2)}=40\text{pF}$	-	0.26	-	
Total switching energy	E_{ts}	Energy losses include “tail” and diode ³⁾ reverse recovery.	-	0.48	-	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=150^\circ\text{C}$	-	112	-	ns
Diode reverse recovery charge	Q_{rr}	$V_R=800\text{V}$, $I_F=3\text{A}$,	-	0.52	-	μC
Diode peak reverse recovery current	I_{rrm}	$R_G=82\Omega$	-	11	-	A
Diode current slope	di_F/dt		-	661	-	A/ μs

²⁾ Leakage inductance L_{σ} and stray capacity C_{σ} due to dynamic test circuit in figure E

³⁾ Commutation diode from device IKP03N120H2

Switching Energy ZVT, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic						
Turn-off energy	E_{off}	$V_{CC}=800V, I_C=3A,$ $V_{GE}=0V/15V,$ $R_G=82\Omega, C_r^{2)}=4nF$ $T_j=25^{\circ}C$ $T_j=150^{\circ}C$	- -	0.05 0.09	- -	mJ

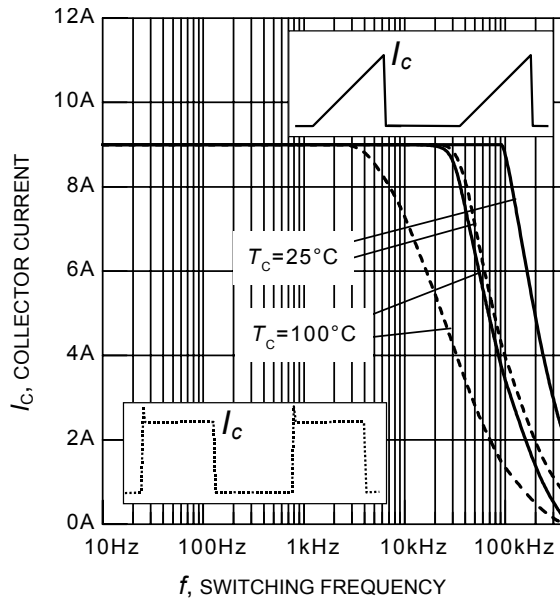


Figure 1. Collector current as a function of switching frequency

($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 800\text{V}$,
 $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 82\Omega$)

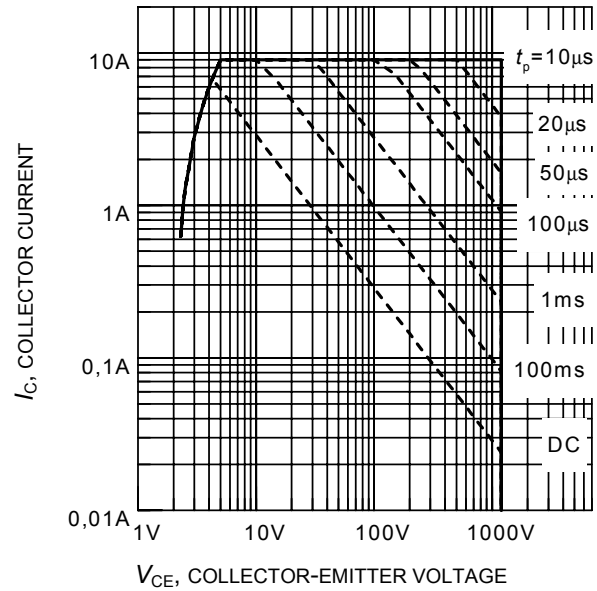


Figure 2. Safe operating area

($D = 0$, $T_C = 25^\circ\text{C}$, $T_j \leq 150^\circ\text{C}$)

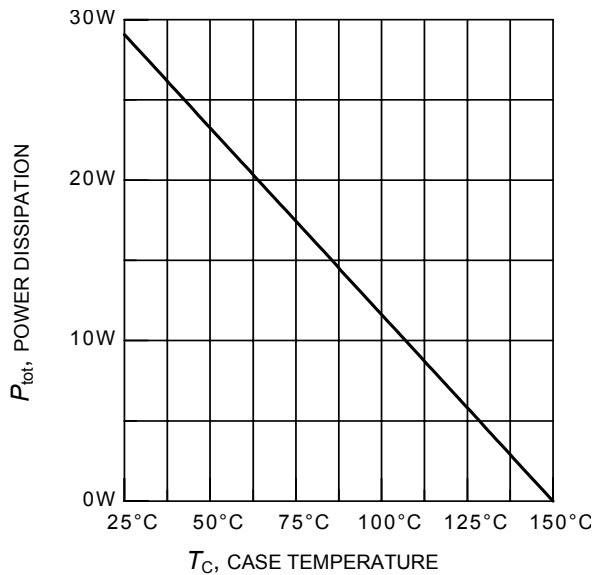


Figure 3. Power dissipation as a function of case temperature

($T_j \leq 150^\circ\text{C}$)

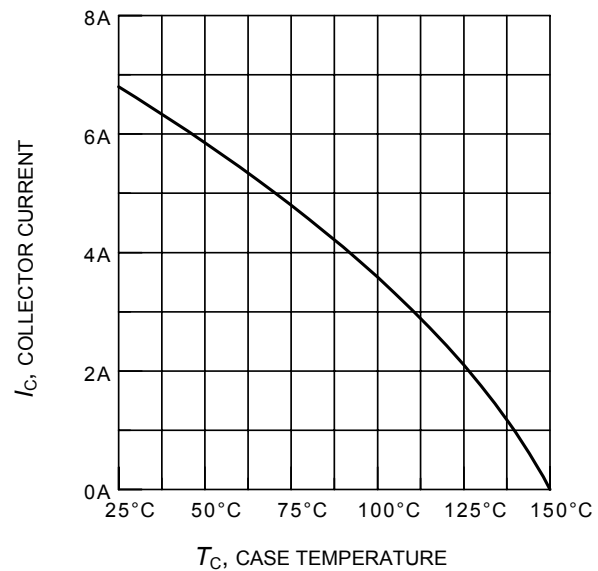


Figure 4. Collector current as a function of case temperature

($V_{GE} \leq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

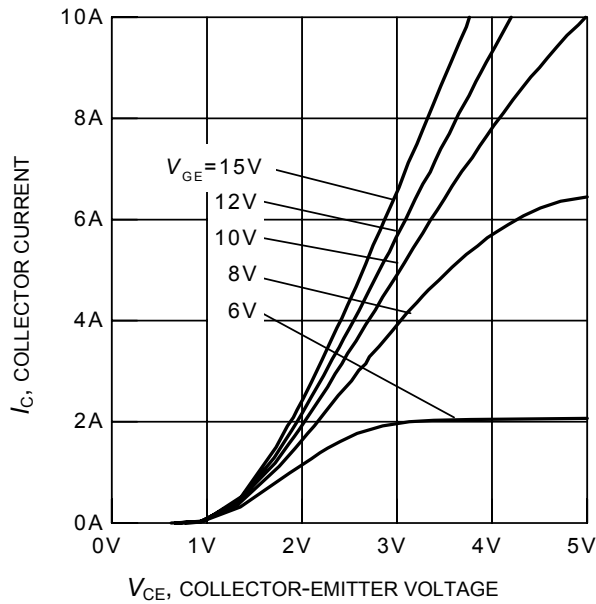


Figure 5. Typical output characteristics
($T_j = 25^\circ\text{C}$)

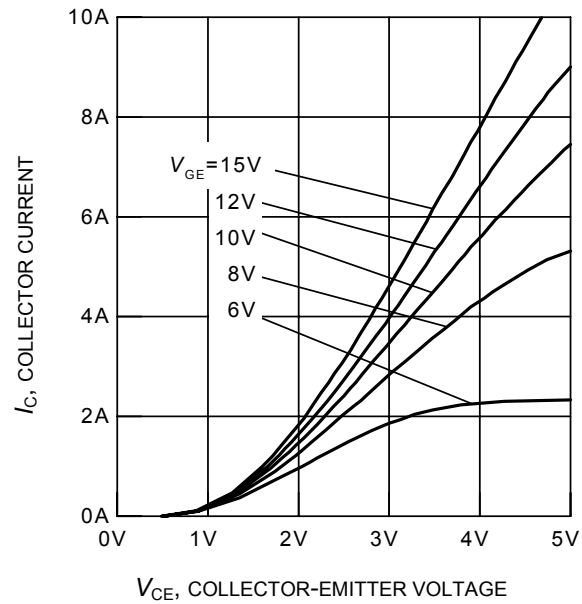


Figure 6. Typical output characteristics
($T_j = 150^\circ\text{C}$)

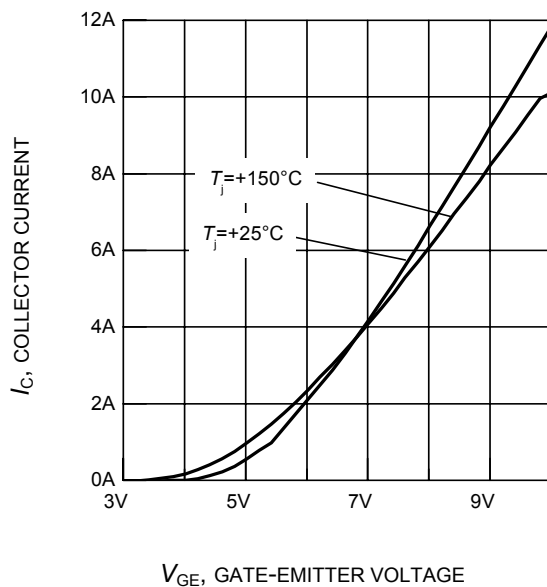


Figure 7. Typical transfer characteristics
($V_{CE} = 20V$)

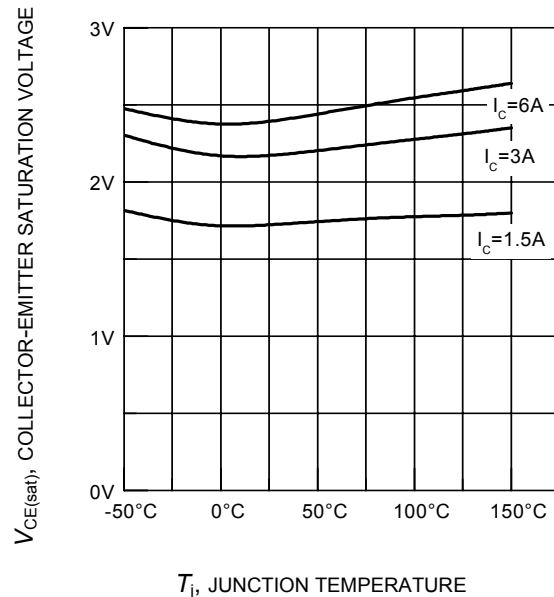
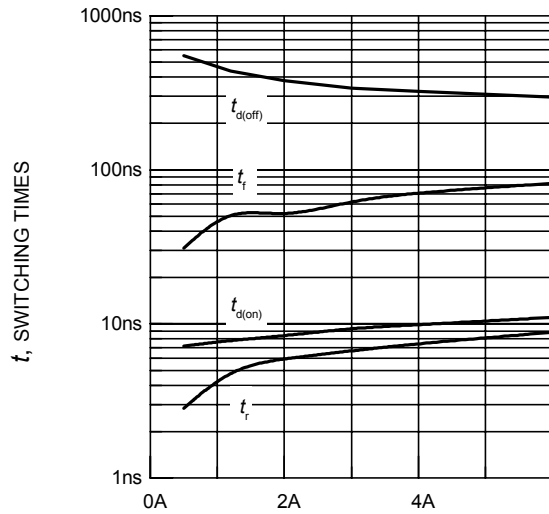


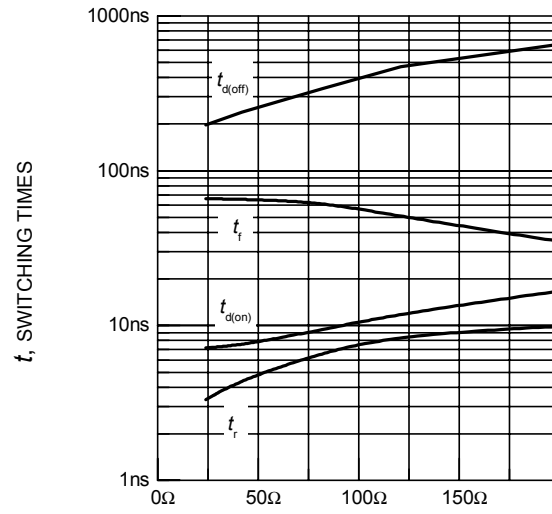
Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15V$)



I_C , COLLECTOR CURRENT

Figure 9. Typical switching times as a function of collector current

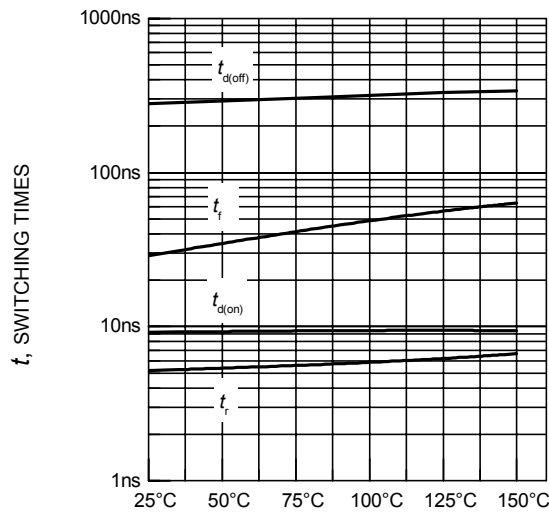
(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 82\Omega$, dynamic test circuit in Fig.E)



R_G , GATE RESISTOR

Figure 10. Typical switching times as a function of gate resistor

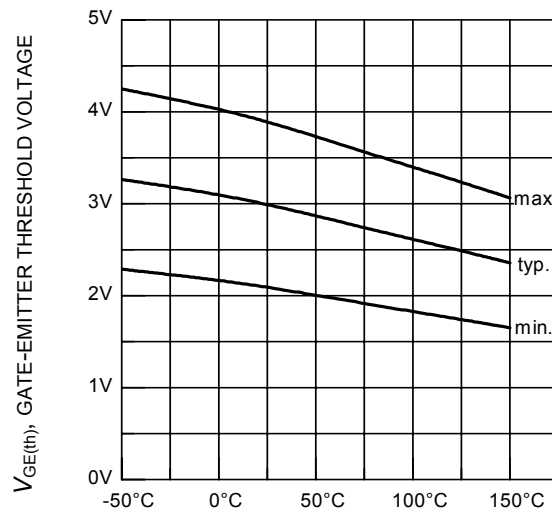
(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 3\text{A}$, dynamic test circuit in Fig.E)



T_j , JUNCTION TEMPERATURE

Figure 11. Typical switching times as a function of junction temperature

(inductive load, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 3\text{A}$, $R_G = 82\Omega$, dynamic test circuit in Fig.E)



T_j , JUNCTION TEMPERATURE

Figure 12. Gate-emitter threshold voltage as a function of junction temperature

($I_C = 0.09\text{mA}$)

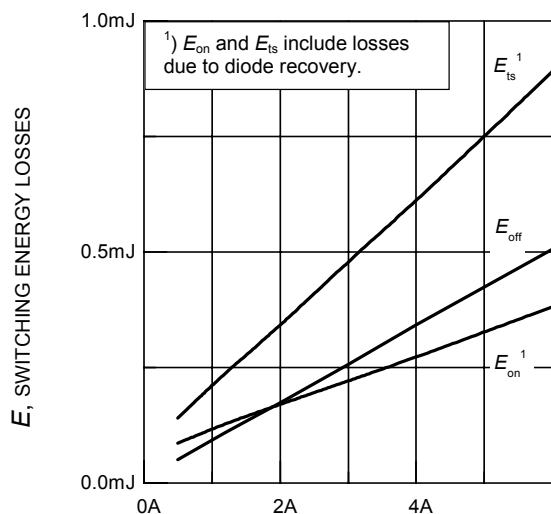

 I_C , COLLECTOR CURRENT

Figure 13. Typical switching energy losses as a function of collector current

(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = 82\Omega$, dynamic test circuit in Fig.E)

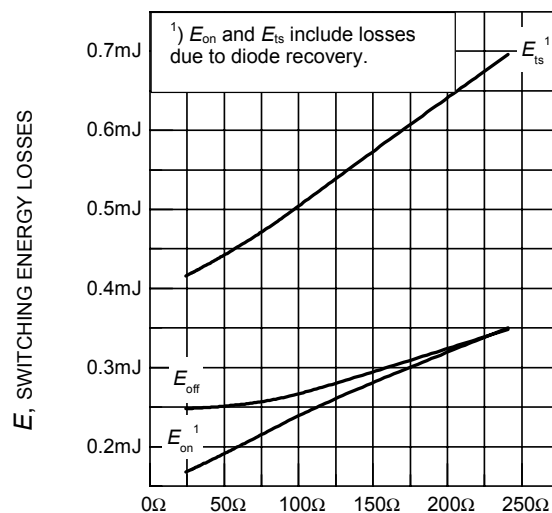

 R_G , GATE RESISTOR

Figure 14. Typical switching energy losses as a function of gate resistor

(inductive load, $T_j = 150^\circ\text{C}$, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 3\text{A}$, dynamic test circuit in Fig.E)

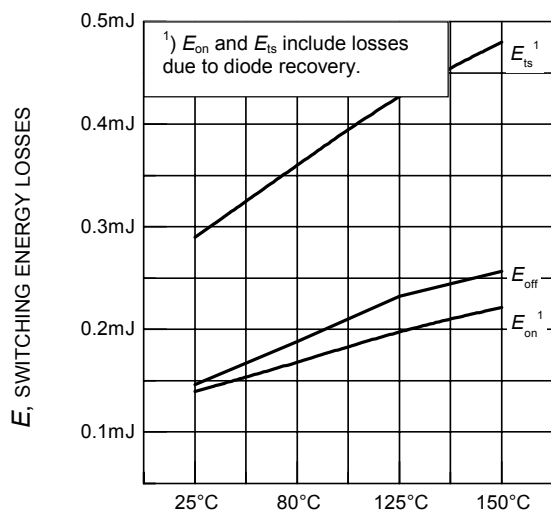

 T_j , JUNCTION TEMPERATURE

Figure 15. Typical switching energy losses as a function of junction temperature

(inductive load, $V_{CE} = 800\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $I_C = 3\text{A}$, $R_G = 82\Omega$, dynamic test circuit in Fig.E)

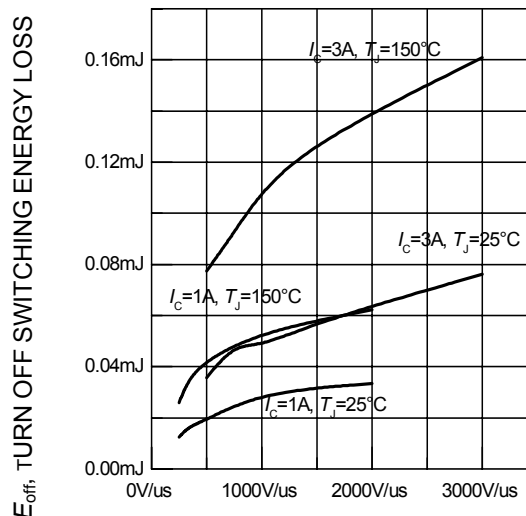

 dv/dt , VOLTAGE SLOPE

Figure 16. Typical turn off switching energy loss for soft switching

(dynamic test circuit in Fig. E)

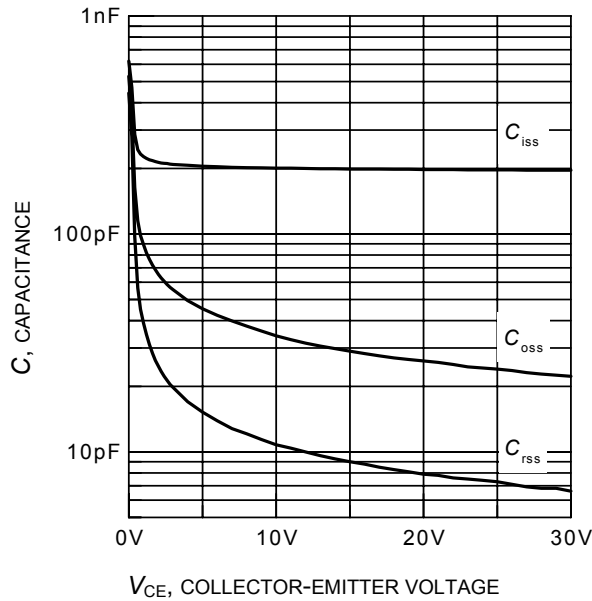


Figure 17. Typical capacitance as a function of collector-emitter voltage
($V_{GE} = 0V$, $f = 1MHz$)

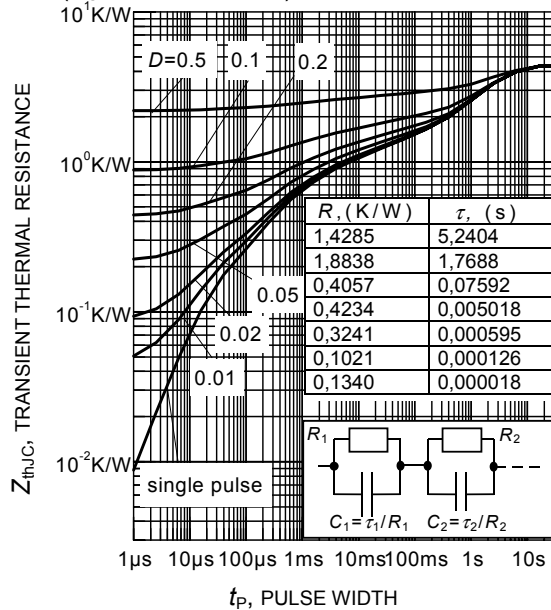


Figure 19. Typical IGBT transient thermal impedance as a function of pulse width
($D = t_p / T$)

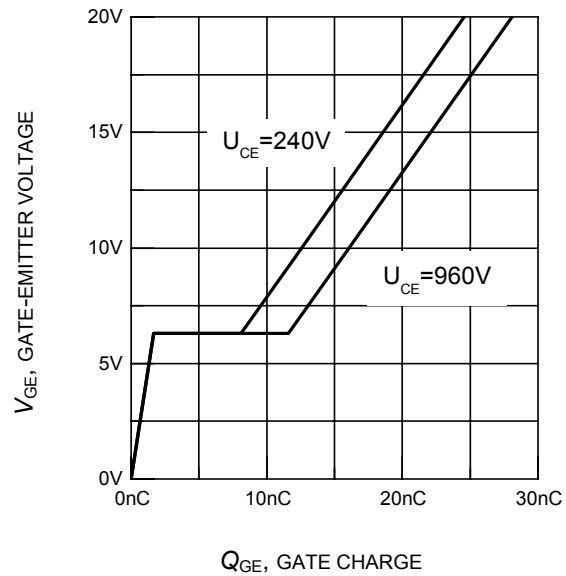


Figure 18. Typical gate charge
($I_C = 3A$)

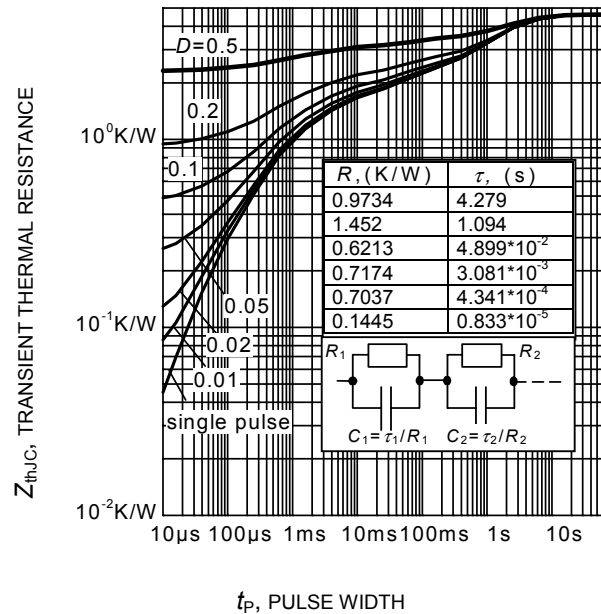
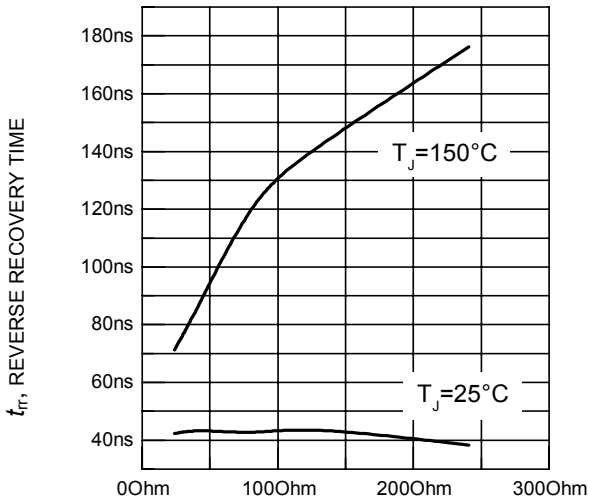
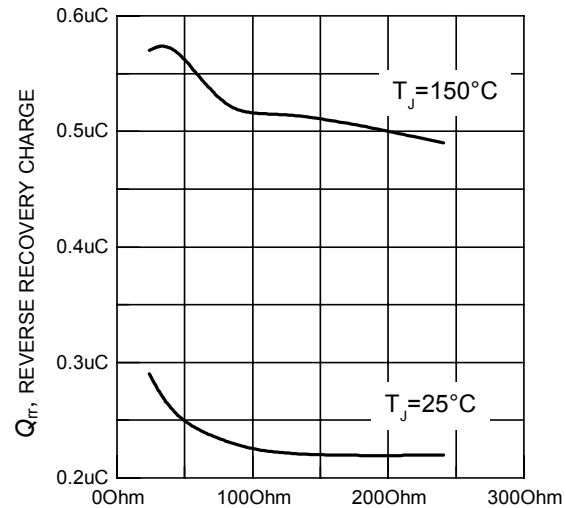


Figure 22. Typical Diode transient thermal impedance as a function of pulse width
($D = t_p / T$)



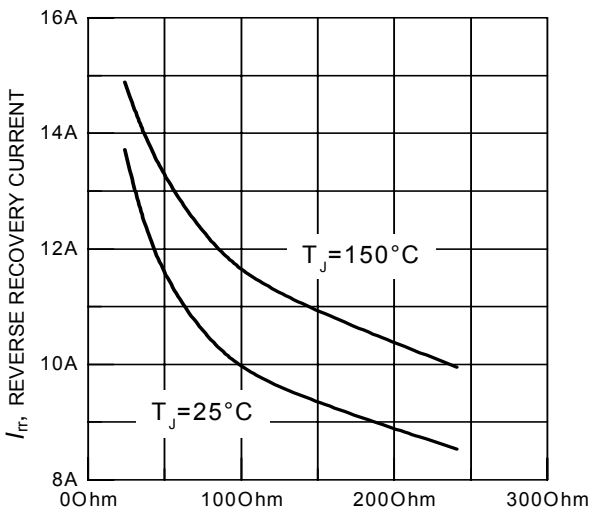
R_G , GATE RESISTANCE

Figure 23. Typical reverse recovery time as a function of diode current slope
 $V_R=800V$, $I_F=3A$,
 Dynamic test circuit in Figure E)



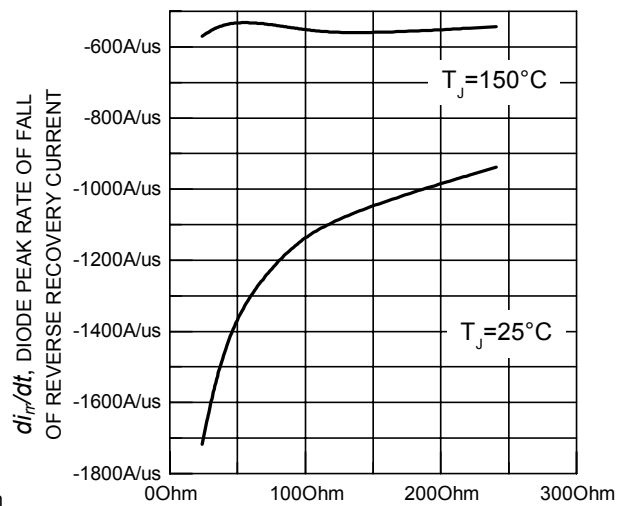
R_G , GATE RESISTANCE

Figure 24. Typical reverse recovery charge as a function of diode current slope
 $(V_R=800V, I_F=3A,$
 Dynamic test circuit in Figure E)



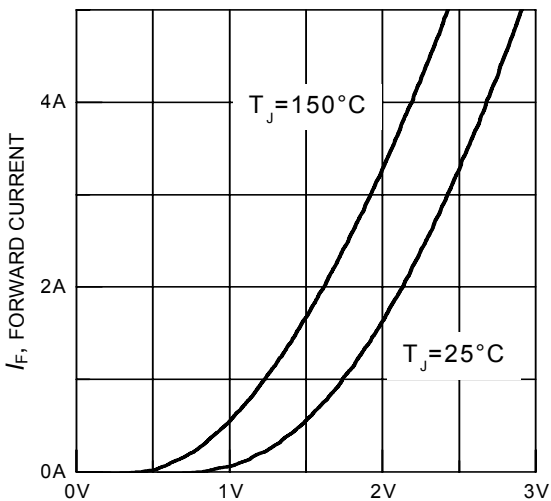
R_G , GATE RESISTANCE

Figure 25. Typical reverse recovery current as a function of diode current slope
 $(V_R=800V, I_F=3A,$
 Dynamic test circuit in Figure E)



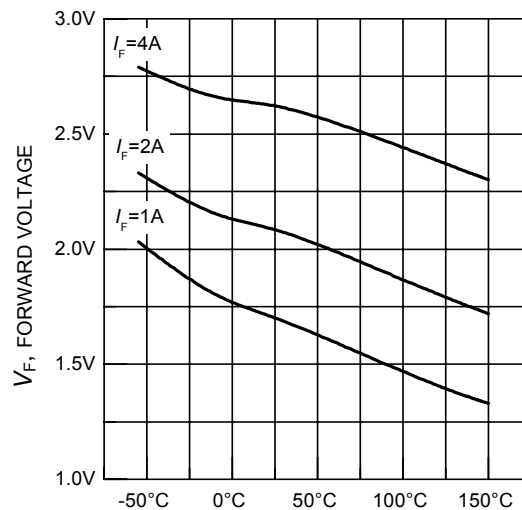
R_G , GATE RESISTANCE

Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 $(V_R=800V, I_F=3A,$
 Dynamic test circuit in Figure E)



V_F , FORWARD VOLTAGE

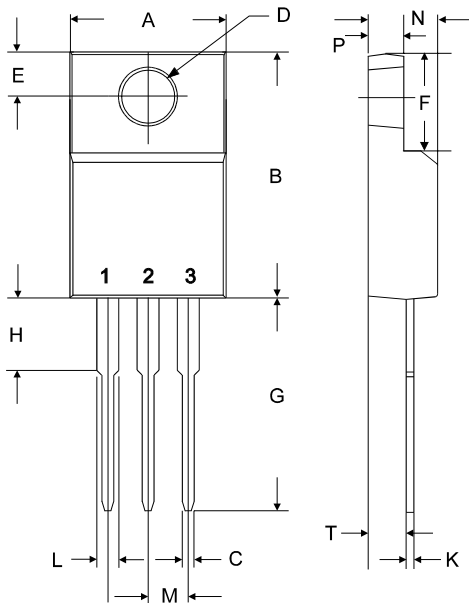
Figure 27. Typical diode forward current as a function of forward voltage



T_J , JUNCTION TEMPERATURE

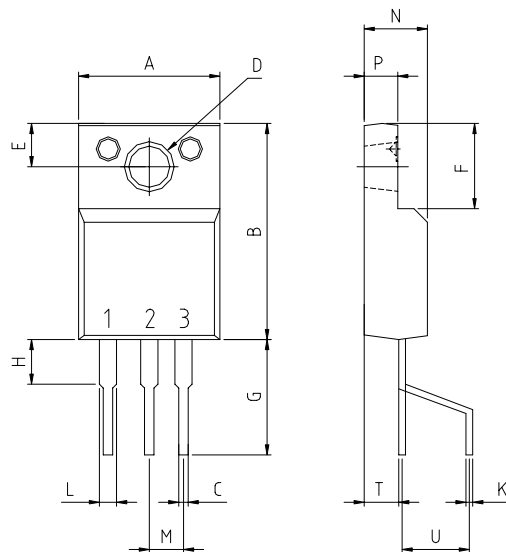
Figure 28. Typical diode forward voltage as a function of junction temperature

TO-220-3-31 (FullPAK)



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	10.37	10.63	0.4084	0.4184
B	15.86	16.12	0.6245	0.6345
C	0.65	0.78	0.0256	0.0306
D	2.95 typ.		0.1160 typ.	
E	3.15	3.25	0.124	0.128
F	6.05	6.56	0.2384	0.2584
G	13.47	13.73	0.5304	0.5404
H	3.18	3.43	0.125	0.135
K	0.45	0.63	0.0177	0.0247
L	1.23	1.36	0.0484	0.0534
M	2.54 typ.		0.100 typ.	
N	4.57	4.83	0.1800	0.1900
P	2.57	2.83	0.1013	0.1113
T	2.51	2.62	0.0990	0.1030

TO-220-3-34 (FullPAK)



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	10.37	10.63	0.4084	0.4184
B	15.86	16.12	0.6245	0.6345
C	0.65	0.78	0.0256	0.0306
D	2.95 typ.		0.1160 typ.	
E	3.15	3.25	0.124	0.128
F	6.05	6.56	0.2384	0.2584
G	8.28	8.79	0.326	0.346
H	3.18	3.43	0.125	0.135
K	0.45	0.63	0.0177	0.0247
L	1.23	1.36	0.0484	0.0534
M	2.54 typ.		0.100 typ.	
N	4.57	4.83	0.1800	0.1900
P	2.57	2.83	0.1013	0.1113
T	2.51	2.62	0.0990	0.1030
U	5.00 typ.		0.197 typ.	

- 1: Gate
- 2: Collector
- 3: Emitter

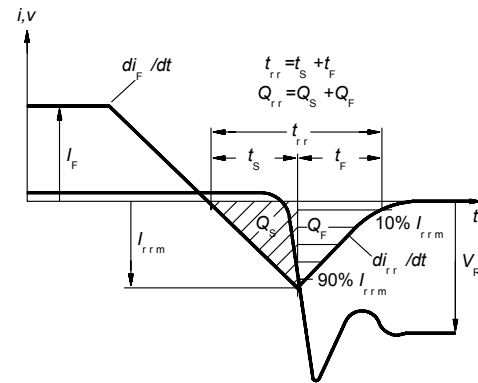
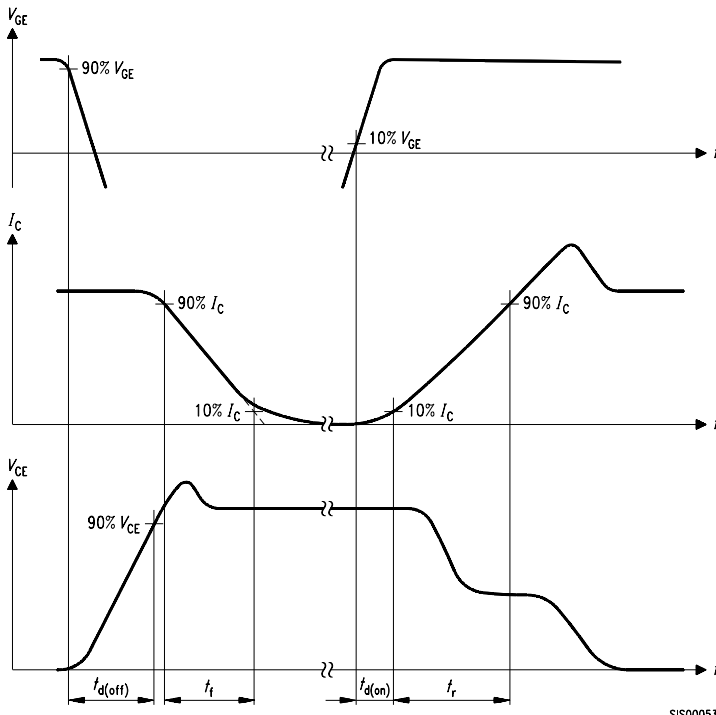


Figure C. Definition of diodes switching characteristics

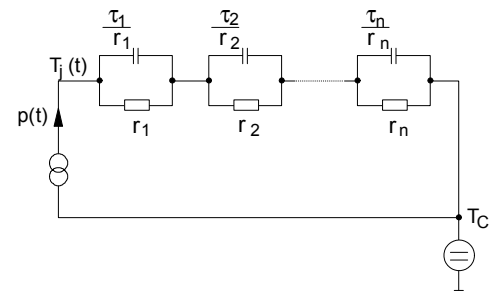


Figure D. Thermal equivalent circuit

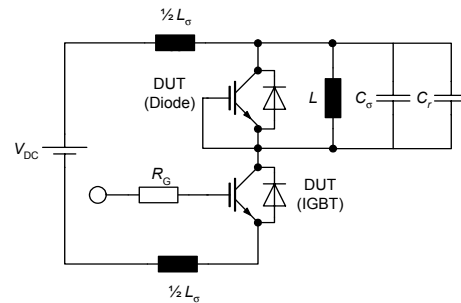
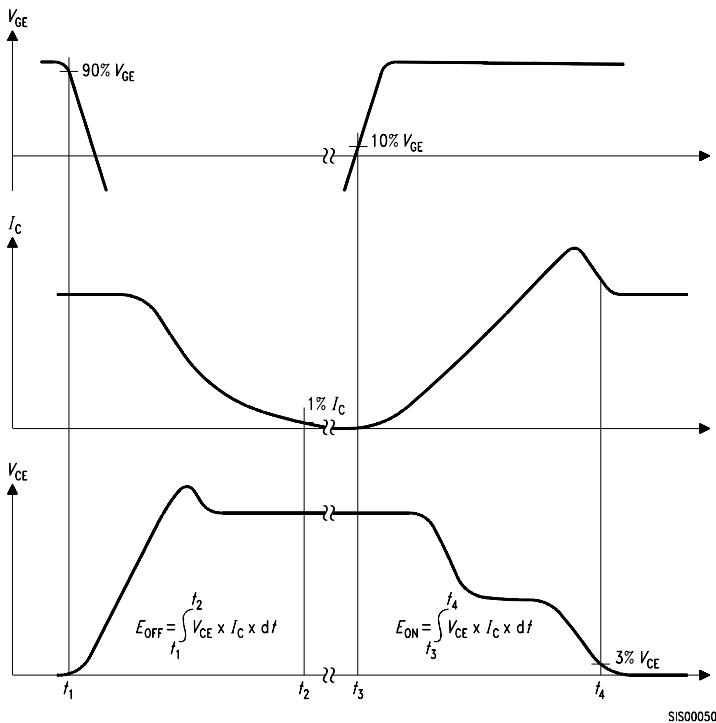


Figure E. Dynamic test circuit
Leakage inductance $L_\sigma = 180\text{nH}$,
Stray capacitor $C_\sigma = 40\text{pF}$,
Relief capacitor $C_r = 4\text{nF}$ (only for ZVT switching)

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