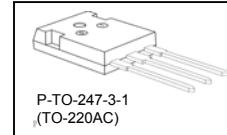
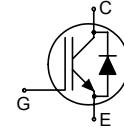


**Low Loss DuoPack : IGBT in Trench and Fieldstop technology
with soft, fast recovery anti-parallel EmCon HE diode**

- Very low $V_{CE(sat)}$ 1.5 V (typ.)
- Maximum Junction Temperature 175 °C
- Short circuit withstand time – 5μs
- Designed for :
 - Frequency Converters
 - Uninterrupted Power Supply
- Trench and Fieldstop technology for 600 V applications offers :
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
 - very high switching speed
 - low $V_{CE(sat)}$
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low Gate Charge
- Very soft, fast recovery anti-parallel EmCon HE diode
- Complete product spectrum and PSpice Models : <http://www.infineon.com/igbt/>



Type	V_{CE}	I_C	$V_{CE(sat)}, T_j=25^\circ\text{C}$	$T_{j,\text{max}}$	Marking Code	Package	Ordering Code
IKW50N60T	600V	50A	1.5V	175°C	K50T60	TO-247	Q67040S4718

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CE}	600	V
DC collector current, limited by $T_{j,\text{max}}$	I_C	80 ¹⁾	A
$T_C = 25^\circ\text{C}$		50	
$T_C = 100^\circ\text{C}$			
Pulsed collector current, t_p limited by $T_{j,\text{max}}$	$I_{C\text{puls}}$	150	
Turn off safe operating area ($V_{CE} \leq 600\text{V}$, $T_j \leq 175^\circ\text{C}$)	-	150	
Diode forward current, limited by $T_{j,\text{max}}$	I_F	100	
$T_C = 25^\circ\text{C}$		50	
$T_C = 100^\circ\text{C}$			
Diode pulsed current, t_p limited by $T_{j,\text{max}}$	$I_{F\text{puls}}$	150	
Gate-emitter voltage	V_{GE}	± 20	V
Short circuit withstand time ²⁾	t_{SC}	5	μs
$V_{GE} = 15\text{V}$, $V_{CC} \leq 400\text{V}$, $T_j \leq 150^\circ\text{C}$			
Power dissipation $T_C = 25^\circ\text{C}$	P_{tot}	333	W
Operating junction temperature	T_j	-40...+175	°C
Storage temperature	T_{stg}	-55...+175	
Soldering temperature, 1.6mm (0.063 in.) from case for 10s	-	260	

¹⁾ Value limited by bond wire

²⁾ Allowed number of short circuits: <1000; time between short circuits: >1s.

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value		Unit
Characteristic					
IGBT thermal resistance, junction – case	R_{thJC}	TO-247 AC	0.45		K/W
Diode thermal resistance, junction – case	R_{thJCD}	TO-247 AC	0.8		
Thermal resistance, junction – ambient	R_{thJA}	TO-247 AC	40		

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	$V_{(BR)CES}$	$V_{GE}=0\text{V}, I_C=0.2\text{mA}$	600	-	-	V
Collector-emitter saturation voltage	$V_{CE(\text{sat})}$	$V_{GE} = 15\text{V}, I_C=50\text{A}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	1.5	2	
Diode forward voltage	V_F	$V_{GE}=0\text{V}, I_F=50\text{A}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	1.65	2.05	
Gate-emitter threshold voltage	$V_{GE(\text{th})}$	$I_C=0.8\text{mA}, V_{CE}=V_{GE}$	4.1	4.9	5.7	
Zero gate voltage collector current	I_{CES}	$V_{CE}=600\text{V},$ $V_{GE}=0\text{V}$ $T_j=25^\circ\text{C}$ $T_j=175^\circ\text{C}$	-	-	40	μA
-			-	-	1000	
Gate-emitter leakage current	I_{GES}	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	-	-	100	nA
Transconductance	g_{fs}	$V_{CE}=20\text{V}, I_C=50\text{A}$	-	31	-	S
Integrated gate resistor	R_{Gint}			-		Ω

Dynamic Characteristic

Input capacitance	C_{iss}	$V_{CE}=25\text{V},$ $V_{GE}=0\text{V},$ $f=1\text{MHz}$	-	3140	-	pF
Output capacitance	C_{oss}		-	200	-	
Reverse transfer capacitance	C_{rss}		-	93	-	
Gate charge	Q_{Gate}	$V_{CC}=480\text{V}, I_C=50\text{A}$ $V_{GE}=15\text{V}$	-	310	-	nC
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E	TO-247-3-1	-	7	-	nH
Short circuit collector current ¹⁾	$I_{C(\text{SC})}$	$V_{GE}=15\text{V}, t_{SC}\leq 5\mu\text{s}$ $V_{CC} = 400\text{V},$ $T_j \leq 150^\circ\text{C}$	-	458.3	-	A

¹⁾ Allowed number of short circuits: <1000; time between short circuits: >1s.

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	$t_{d(on)}$	$T_j=25^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=50\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=7\ \Omega$, $L_\sigma^{(1)}=103\text{nH}$, $C_\sigma^{(1)}=39\text{pF}$ Energy losses include “tail” and diode reverse recovery.	-	26	-	ns
Rise time	t_r		-	29	-	
Turn-off delay time	$t_{d(off)}$		-	299	-	
Fall time	t_f		-	29	-	
Turn-on energy	E_{on}		-	1.2	-	mJ
Turn-off energy	E_{off}		-	1.4	-	
Total switching energy	E_{ts}		-	2.6	-	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=25^\circ\text{C}$, $V_R=400\text{V}$, $I_F=50\text{A}$, $di_F/dt=1280\text{A}/\mu\text{s}$	-	143	-	ns
Diode reverse recovery charge	Q_{rr}		-	1.8	-	μC
Diode peak reverse recovery current	I_{rrm}		-	27.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	671	-	$\text{A}/\mu\text{s}$

Switching Characteristic, Inductive Load, at $T_j=175^\circ\text{C}$

Parameter	Symbol	Conditions	Value			Unit
			min.	Typ.	max.	
IGBT Characteristic						
Turn-on delay time	$t_{d(on)}$	$T_j=175^\circ\text{C}$, $V_{CC}=400\text{V}$, $I_C=50\text{A}$, $V_{GE}=0/15\text{V}$, $R_G=7\ \Omega$, $L_\sigma^{(1)}=103\text{nH}$, $C_\sigma^{(1)}=39\text{pF}$ Energy losses include “tail” and diode reverse recovery.	-	27	-	ns
Rise time	t_r		-	33	-	
Turn-off delay time	$t_{d(off)}$		-	341	-	
Fall time	t_f		-	55	-	
Turn-on energy	E_{on}		-	1.8	-	mJ
Turn-off energy	E_{off}		-	1.8	-	
Total switching energy	E_{ts}		-	3.6	-	

Anti-Parallel Diode Characteristic

Diode reverse recovery time	t_{rr}	$T_j=175^\circ\text{C}$, $V_R=400\text{V}$, $I_F=50\text{A}$, $di_F/dt=1280\text{A}/\mu\text{s}$	-	205	-	ns
Diode reverse recovery charge	Q_{rr}		-	4.3	-	μC
Diode peak reverse recovery current	I_{rrm}		-	40.7	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	449	-	$\text{A}/\mu\text{s}$

¹⁾ Leakage inductance L_σ and Stray capacity C_σ due to dynamic test circuit in Figure E.

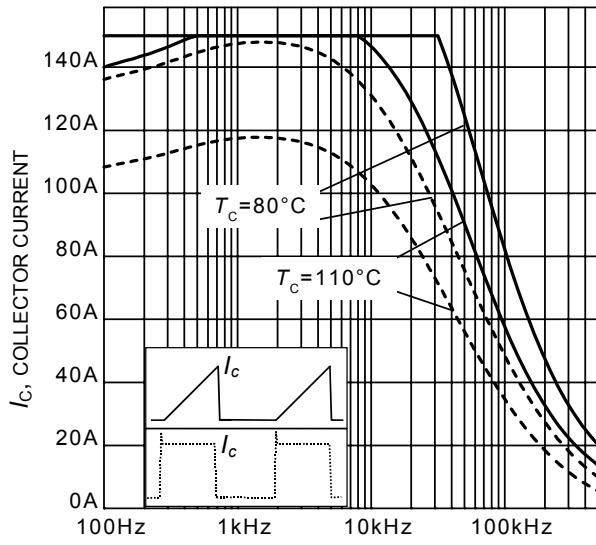

f, SWITCHING FREQUENCY

Figure 1. Collector current as a function of switching frequency

($T_j \leq 175^\circ\text{C}$, $D = 0.5$, $V_{\text{CE}} = 400\text{V}$,
 $V_{\text{GE}} = 0/+15\text{V}$, $R_{\text{G}} = 7\Omega$)

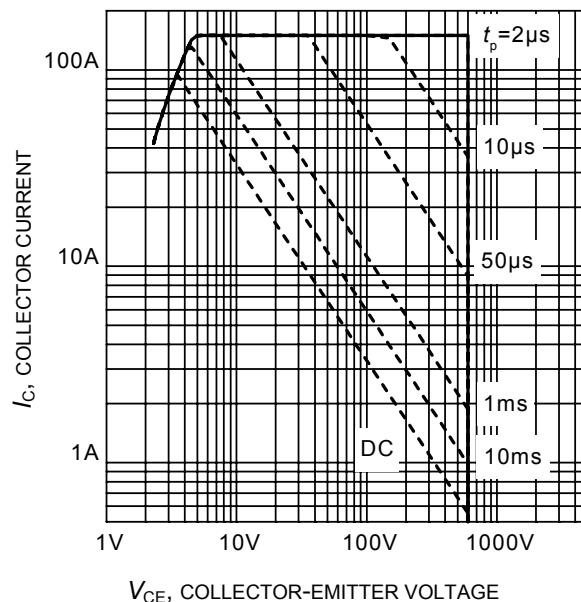

V_{CE}, COLLECTOR-EMITTER VOLTAGE

Figure 2. Safe operating area

($D = 0$, $T_c = 25^\circ\text{C}$, $T_j \leq 175^\circ\text{C}$;
 $V_{\text{GE}} = 15\text{V}$)

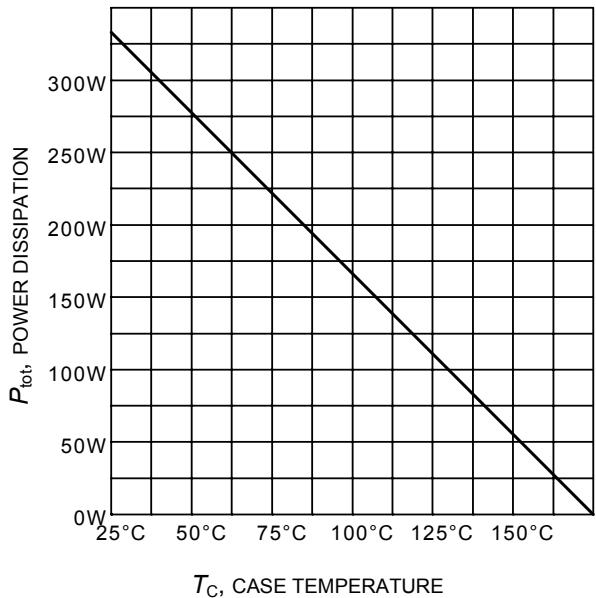

T_c, CASE TEMPERATURE

Figure 3. Power dissipation as a function of case temperature

($T_j \leq 175^\circ\text{C}$)

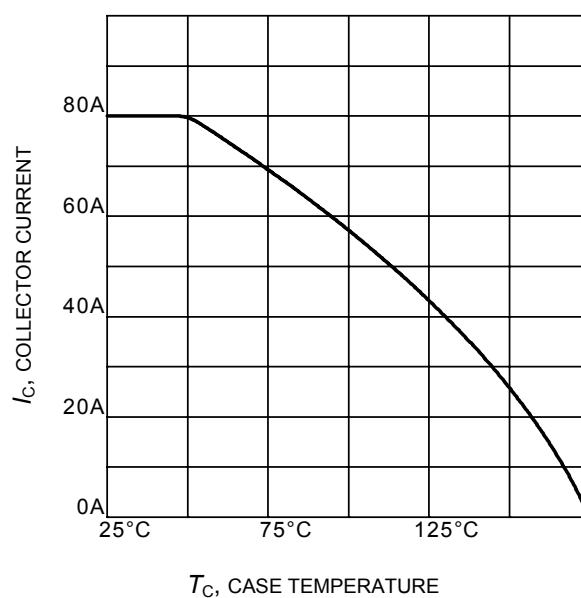

T_c, CASE TEMPERATURE

Figure 4. Collector current as a function of case temperature

($V_{\text{GE}} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

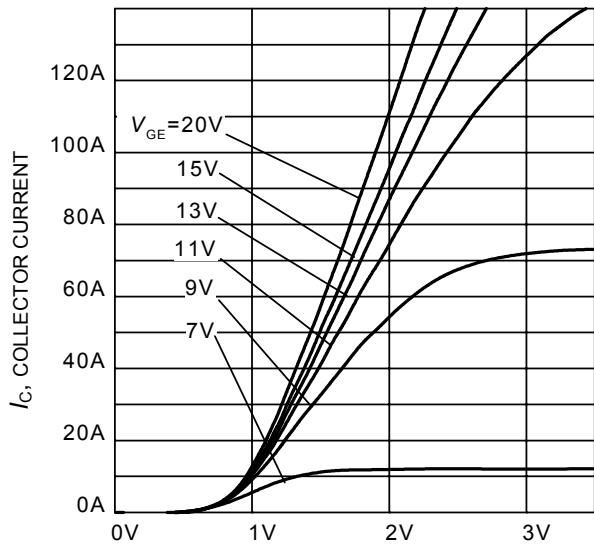
TrenchStop Series


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

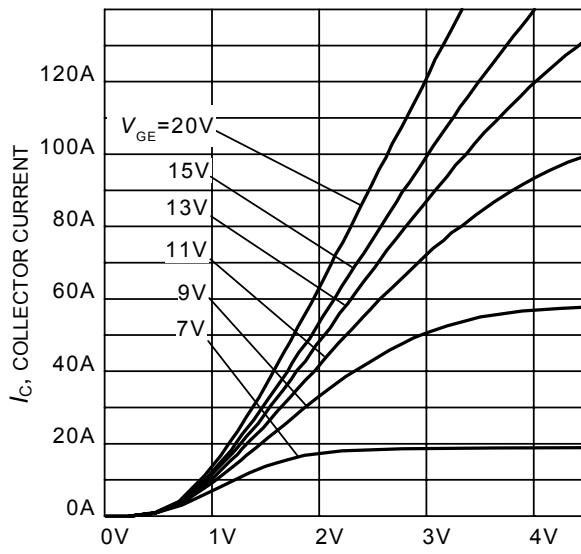


Figure 6. Typical output characteristic
($T_j = 175^\circ\text{C}$)

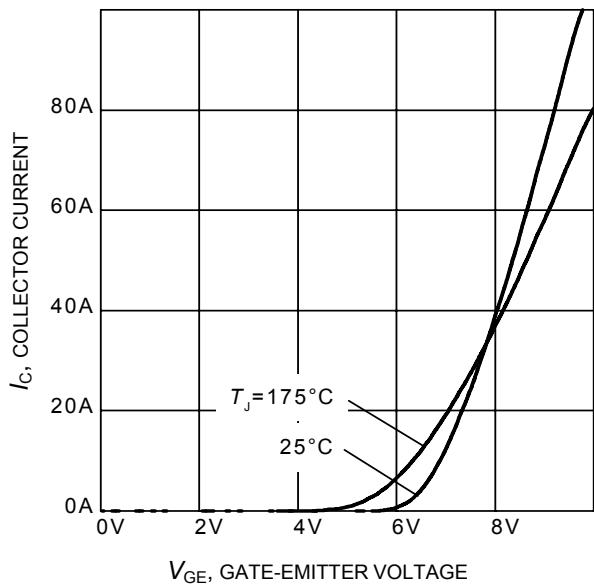


Figure 7. Typical transfer characteristic
($V_{CE} = 10\text{V}$)

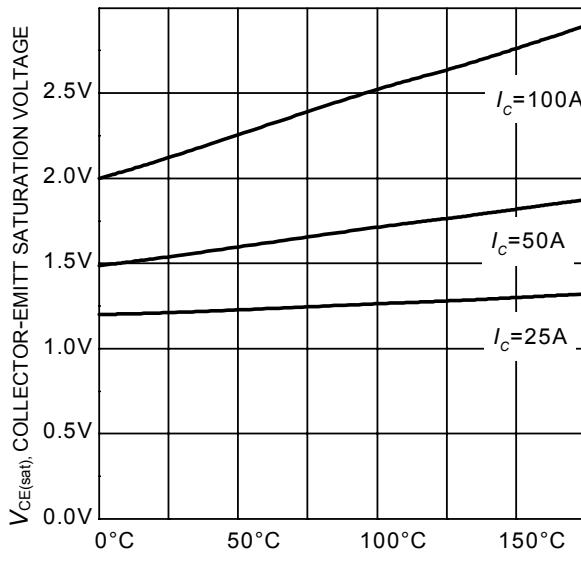
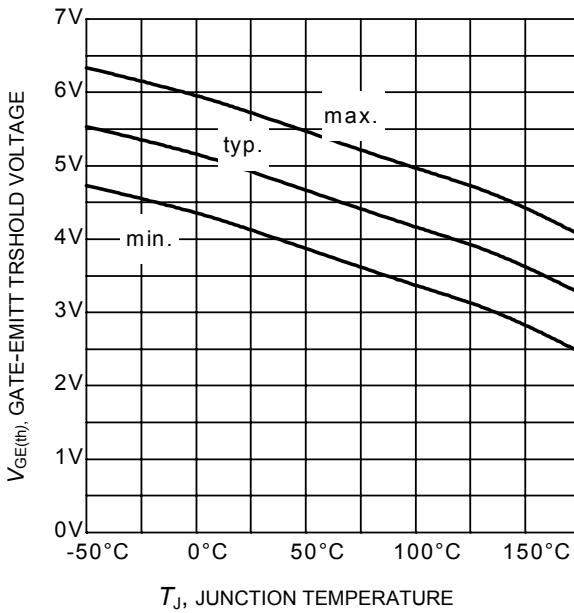
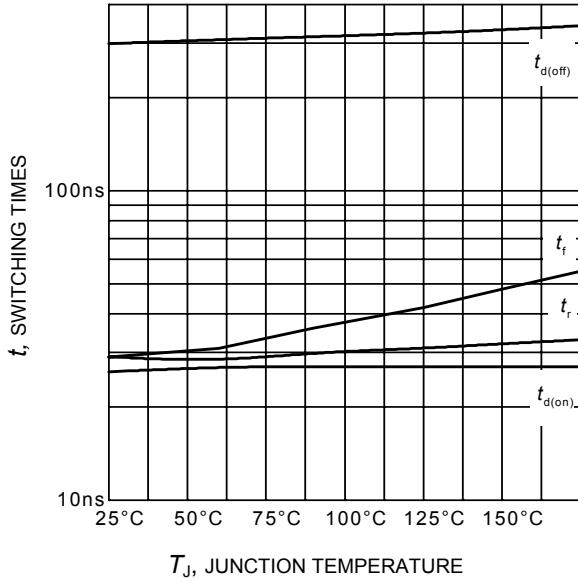
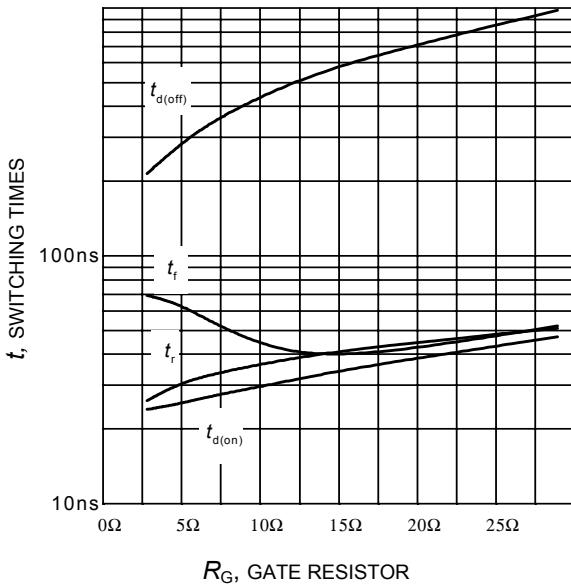
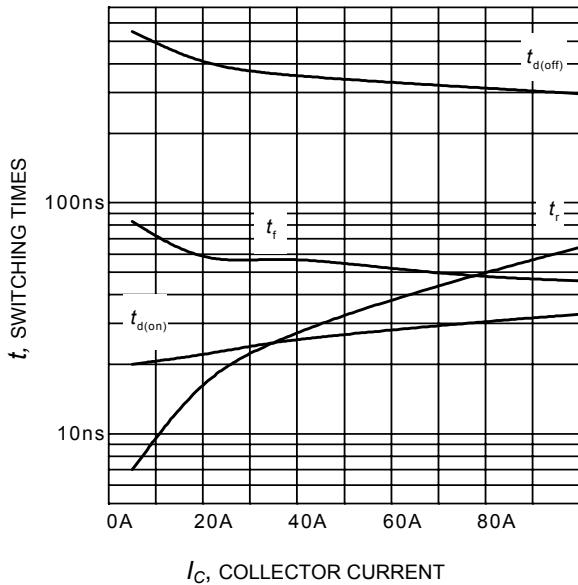


Figure 8. Typical collector-emitter saturation voltage as a function of junction temperature
($V_{GE} = 15\text{V}$)



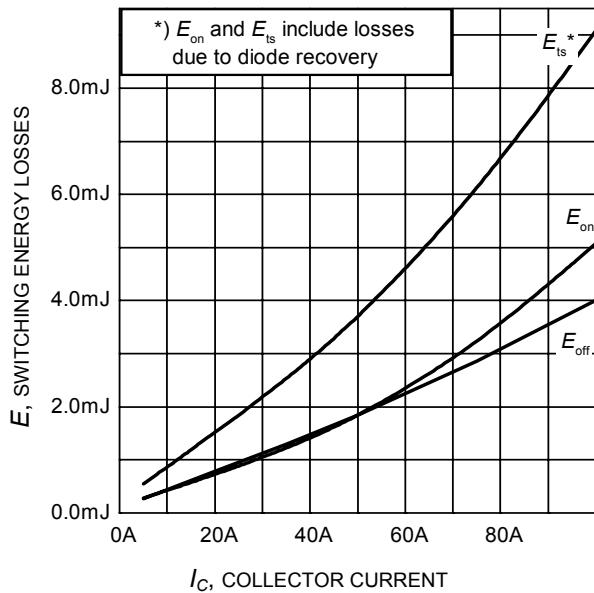


Figure 13. Typical switching energy losses as a function of collector current
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $R_G = 7\Omega$,
Dynamic test circuit in Figure E)

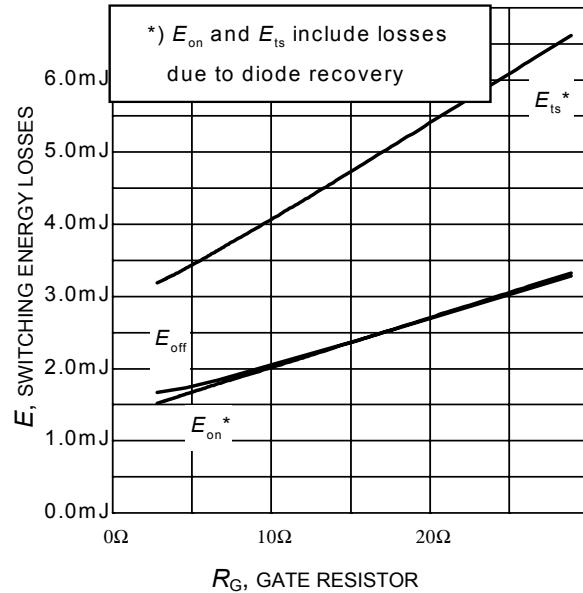


Figure 14. Typical switching energy losses as a function of gate resistor
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{CE} = 400\text{V}$, $V_{GE} = 0/15\text{V}$, $I_C = 50\text{A}$,
Dynamic test circuit in Figure E)

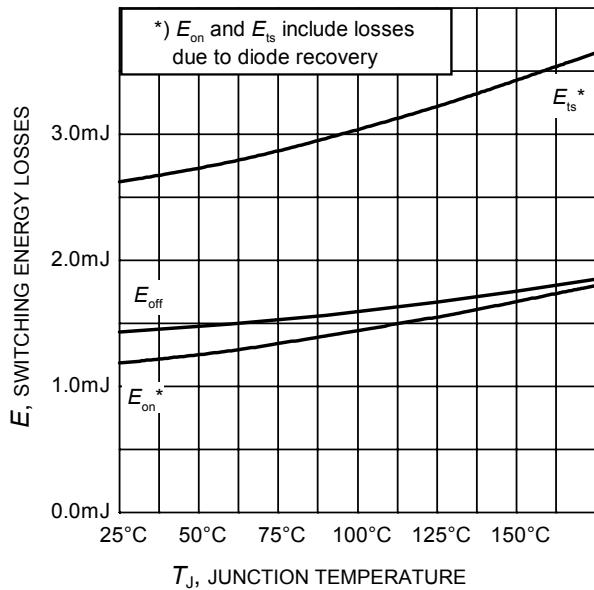


Figure 15. Typical switching energy losses as a function of junction temperature
(inductive load, $V_{CE} = 400\text{V}$,
 $V_{GE} = 0/15\text{V}$, $I_C = 50\text{A}$, $R_G = 7\Omega$,
Dynamic test circuit in Figure E)

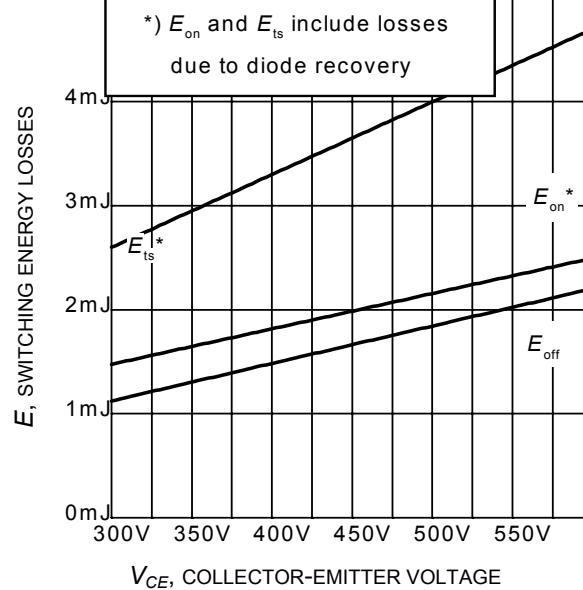


Figure 16. Typical switching energy losses as a function of collector-emitter voltage
(inductive load, $T_J = 175^\circ\text{C}$,
 $V_{GE} = 0/15\text{V}$, $I_C = 50\text{A}$, $R_G = 7\Omega$,
Dynamic test circuit in Figure E)

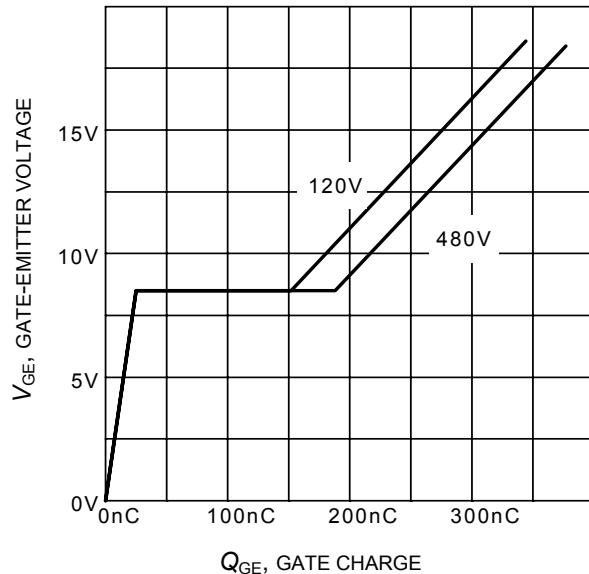


Figure 17. Typical gate charge
($I_C=50$ A)

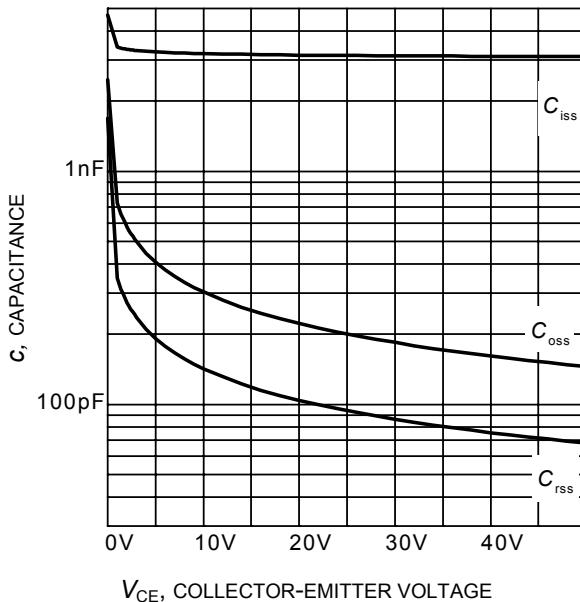


Figure 18. Typical capacitance as a function of collector-emitter voltage
($V_{GE}=0$ V, $f = 1$ MHz)

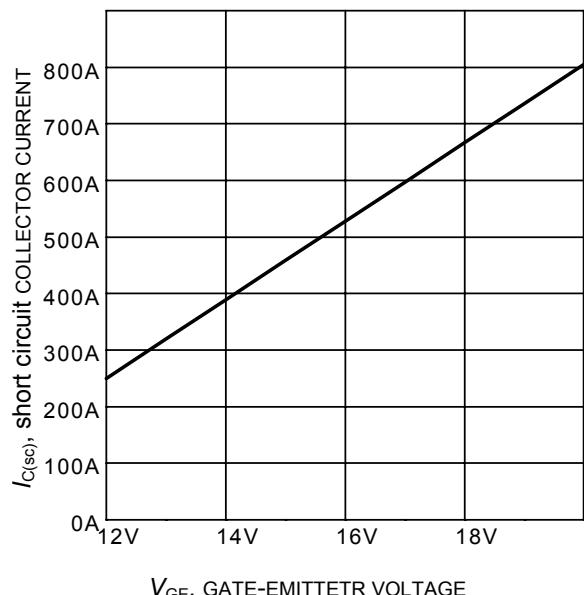


Figure 19. Typical short circuit collector current as a function of gate-emitter voltage
($V_{CE} \leq 400$ V, $T_j \leq 150^\circ$ C)

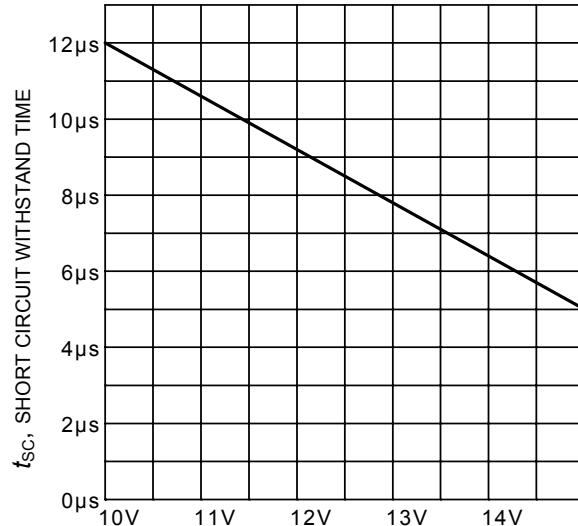


Figure 20. Short circuit withstand time as a function of gate-emitter voltage
($V_{CE}=600$ V, start at $T_j=25^\circ$ C,
 $T_{jmax}<150^\circ$ C)

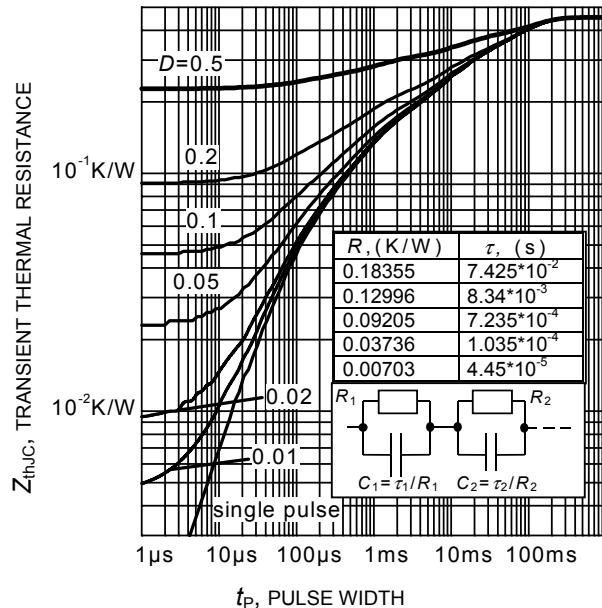


Figure 21. IGBT transient thermal resistance
($D = t_p / T$)

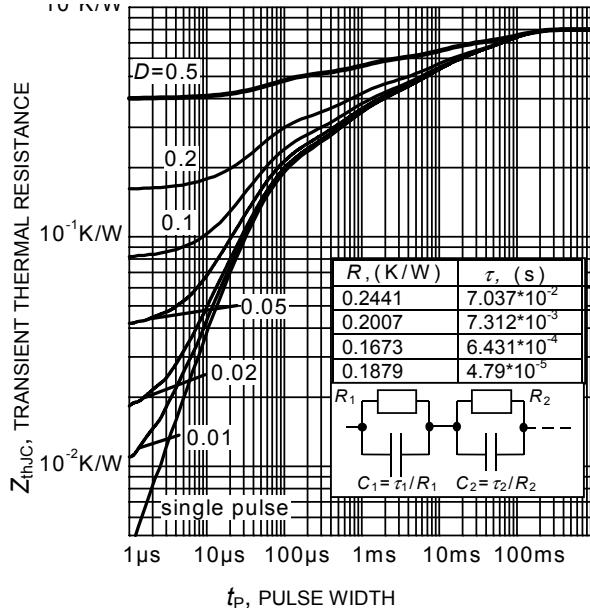


Figure 22. Diode transient thermal impedance as a function of pulse width
($D = t_p / T$)

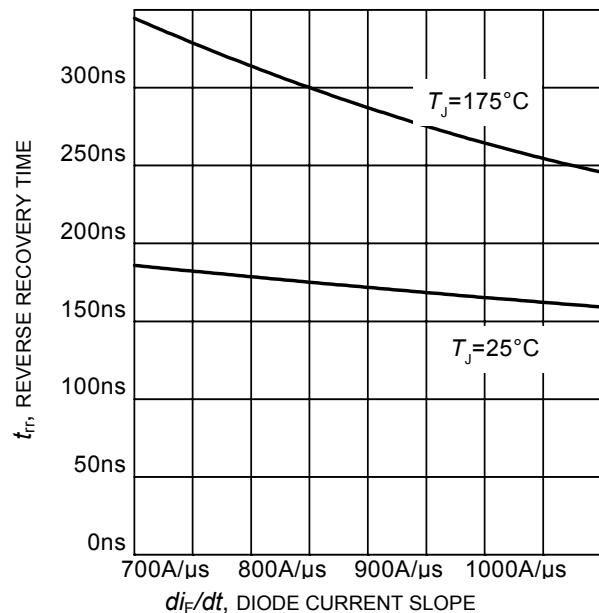


Figure 23. Typical reverse recovery time as a function of diode current slope
($V_R = 400V$, $I_F = 50A$,
Dynamic test circuit in Figure E)

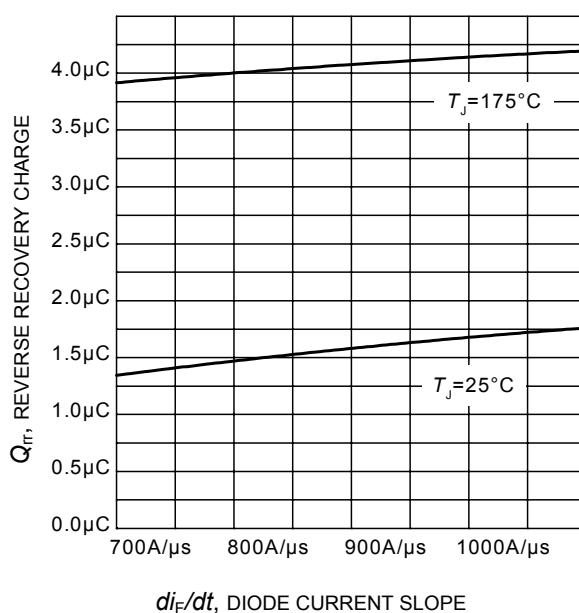


Figure 24. Typical reverse recovery charge as a function of diode current slope
($V_R = 400V$, $I_F = 50A$,
Dynamic test circuit in Figure E)

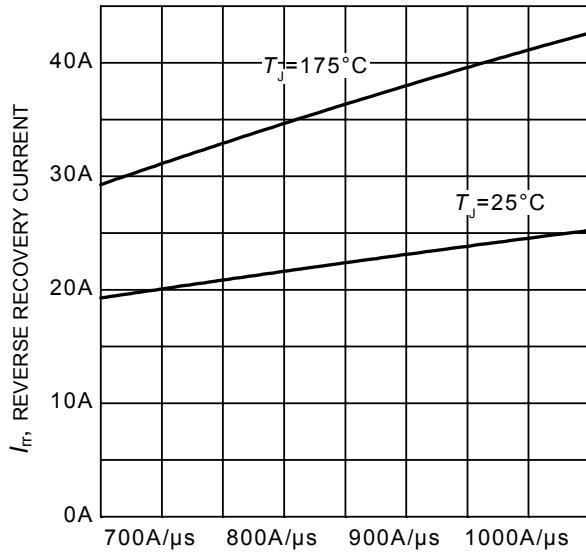


Figure 25. Typical reverse recovery current as a function of diode current slope
 $(V_R = 400\text{V}, I_F = 50\text{A}$,
Dynamic test circuit in Figure E)

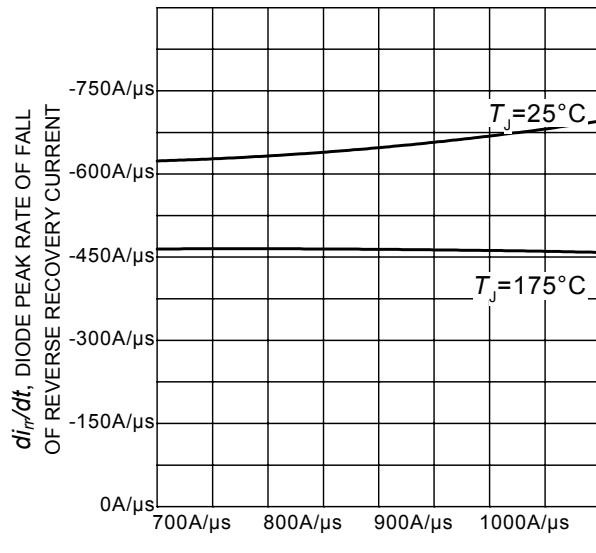


Figure 26. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope
 $(V_R = 400\text{V}, I_F = 50\text{A}$,
Dynamic test circuit in Figure E)

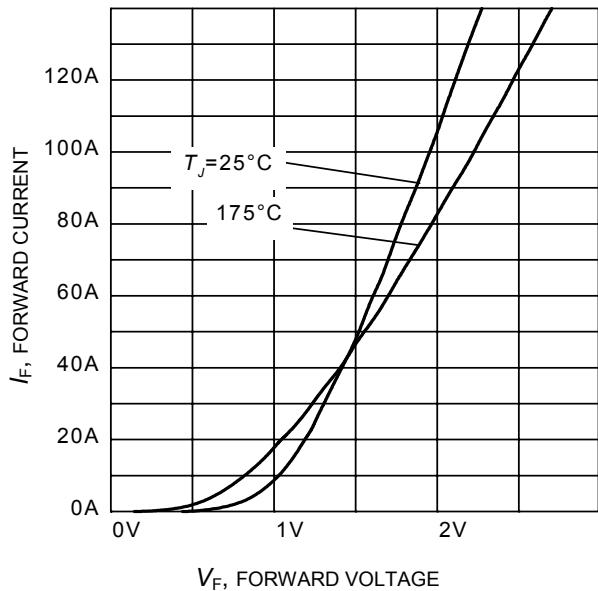


Figure 27. Typical diode forward current as a function of forward voltage

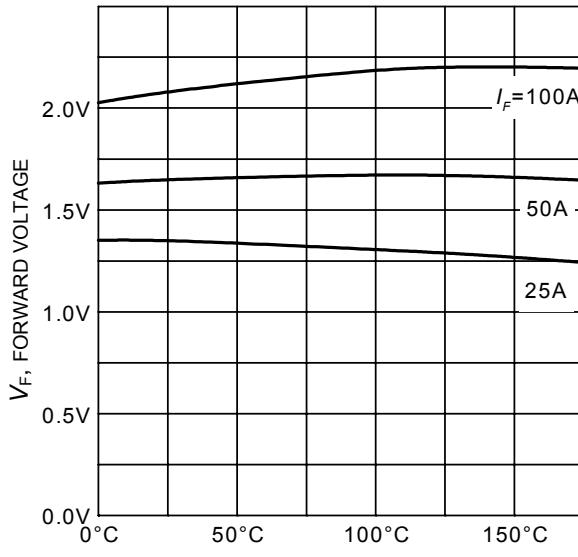
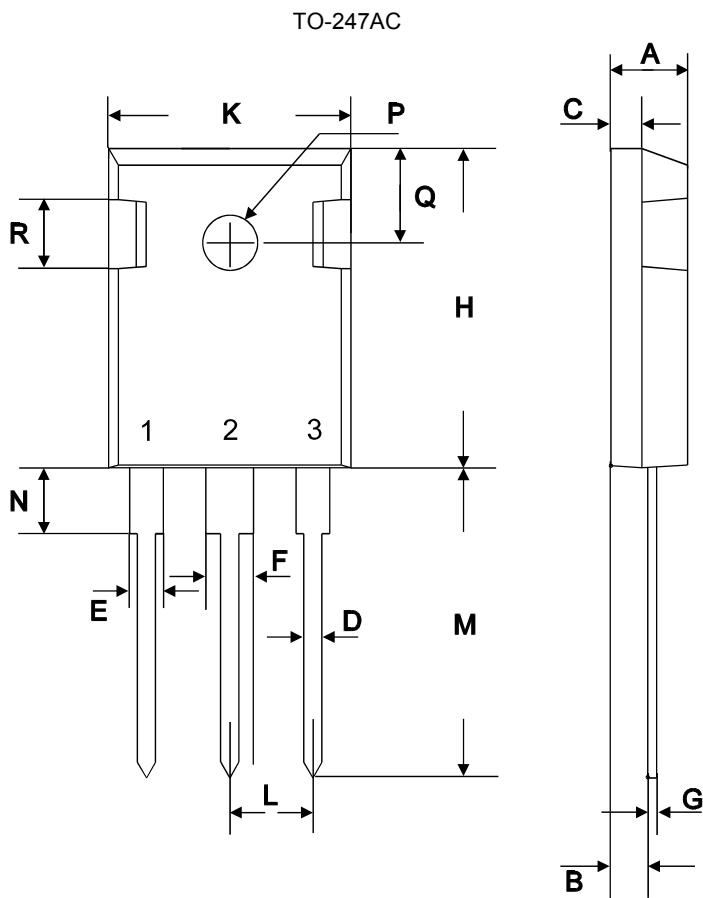


Figure 28. Typical diode forward voltage as a function of junction temperature



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	4.78	5.28	0.1882	0.2079
B	2.29	2.51	0.0902	0.0988
C	1.78	2.29	0.0701	0.0902
D	1.09	1.32	0.0429	0.0520
E	1.73	2.06	0.0681	0.0811
F	2.67	3.18	0.1051	0.1252
G	0.76 max		0.0299 max	
H	20.80	21.16	0.8189	0.8331
K	15.65	16.15	0.6161	0.6358
L	5.21	5.72	0.2051	0.2252
M	19.81	20.68	0.7799	0.8142
N	3.560	4.930	0.1402	0.1941
ØP	3.61		0.1421	
Q	6.12	6.22	0.2409	0.2449

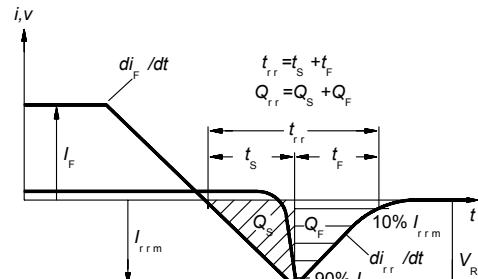
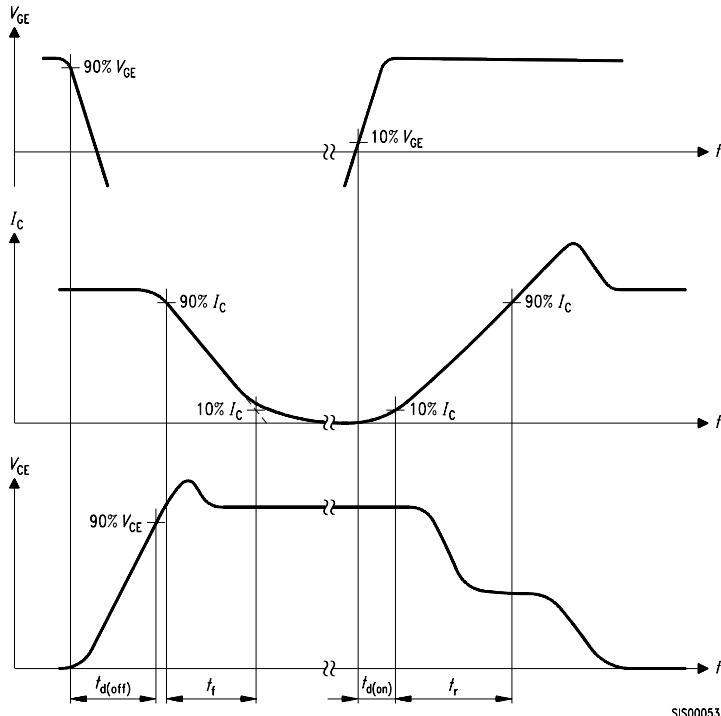
TrenchStop Series


Figure C. Definition of diodes switching characteristics

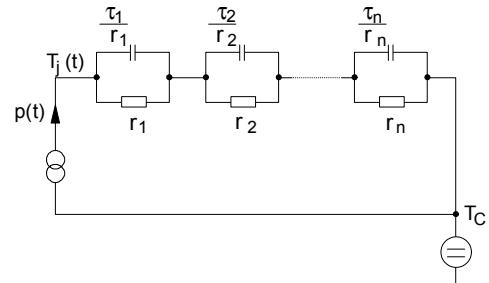


Figure D. Thermal equivalent circuit

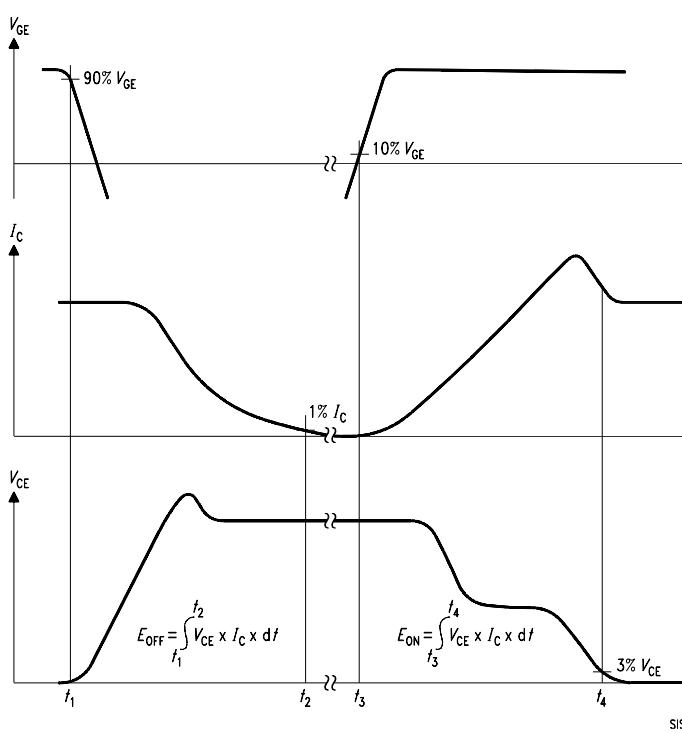


Figure B. Definition of switching losses

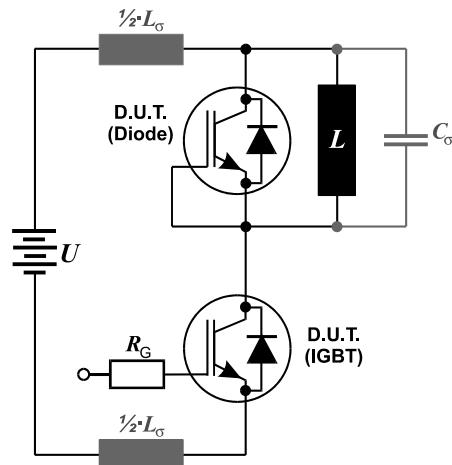


Figure E. Dynamic test circuit



IKW50N60T

TrenchStop Series

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