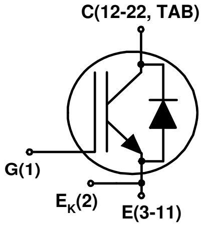
AIKDQ40N75CP2

EDT2™ Series

Low Loss DuoPack: EDT2™IGBT and EMCON3™ Diode

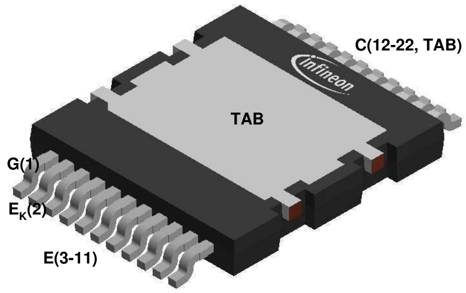
Features:



- 750V rated Device
- Very low $V_{CE(sat)}$, 1.30V (typ.)
- Smooth switching characteristics
- Maximun junction temperature of 175°C
- Square RBSOA and short circuit robust
- Copackage with soft fast recovery EMCON3™ diode
- Qualified according to AEC-Q101
- Top side cooling SMD package

Benefits:

- Increase over voltage margin
- High efficiency, lower cooling requirements
- Designed for hard switching applications
- Self limiting current under short circuit conditions
- High reliability and operating lifetime
- Simplify cooling and manufacturing assembly



Potential Applications:

Automotive HV Auxiliary Motors:

- Climate E-compressors
- Oil and water pumps
- Heater

Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
AIKDQ40N75CP2	750V	40A	1.3V	175°C	AKS4FCP	PG-HDSOP-22-2

Table of Contents

Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Parameter	Symbol	Value	Unit
Collector-emitter voltage, $T_{vj} \geq 25°C$	V_{CE}	750	V
DC collector current, limited by T_{vjmax} $T_c = 25°C$ value limited by bondwire $T_c = 100°C$	I_C	70.0 40.0	A
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	120.0	A
Turn off safe operating area $V_{CE} \leq 650V$, $T_{vj} \leq 175°C$, $t_p = 1µs$	-	120.0	A
Diode forward current, limited by T_{vjmax} $T_c = 25°C$ value limited by bondwire $T_c = 100°C$	I_F	70.0 40.0	A
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	120.0	A
Gate-emitter voltage	V_{GE}	±20	V
Short circuit withstand time$^{1)}$ $V_{GE} = 15.0V$, $V_{CC} \leq 400V$ Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s $T_{vj} = 150°C$	t_{SC}	4	µs
Power dissipation $T_c = 25°C$	P_{tot}	214.0	W
Operating junction temperature	T_{vj}	-40...+175	°C
Storage temperature	T_{stg}	-55...+150	°C
Soldering temperature, reflow soldering (MSL1 according to JEDEC J-STA-020)		260	°C

Thermal Resistance

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
R_{th} Characteristics						
IGBT thermal resistance,$^{2)}$ junction - case	$R_{th(j-c)}$		-	0.54	0.70	K/W
Diode thermal resistance,$^{2)}$ junction - case	$R_{th(j-c)}$		-	0.90	1.17	K/W
Thermal resistance, min. footprint junction - ambient	$R_{th(j-a)}$		-	-	62	K/W
Thermal resistance, 6cm² Cu on PCB junction - ambient	$R_{th(j-a)}$		-	-	55	K/W

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1) Not valid when Kelvin Emitter is used and not subject to production test.

2) Thermal resistance of thermal grease $R_{th(c-s)}$ (case to heat sink) of more than 0.1K/W not included.

Electrical Characteristic, at T_{vj} = 25°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 = 0.20mA	750	-	-	V
Collector-emitter saturation voltage	V_{CEsat}	V_{GE} = 15.0V, I_C = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.30 1.40	1.55 -	V
Diode forward voltage	V_F	V_{GE} = 0V, I_F = 40.0A T_{vj} = 25°C T_{vj} = 175°C	- -	1.70 1.60	1.95 -	V
Gate-emitter threshold voltage	$V_{GE(th)}$	I_C = 0.47mA, V_{CE} = V_{GE}	5.0	5.8	6.5	V
Zero gate voltage collector current	I_{CES}	V_{CE} = 750V, V_{GE} = 0V T_{vj} = 25°C T_{vj} = 175°C	- -	- 1000	20 -	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = 20V	-	-	100	nA
Transconductance	g_{fs}	V_{CE} = 20V, I_C = 40.0A	-	28.0	-	S

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

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
Dynamic Characteristic						
Input capacitance	C_{ies}	V_{CE} = 50V, V_{GE} = 0V f = 1000kHz	-	3290	-	pF
Output capacitance	C_{oes}		-	81	-	
Reverse transfer capacitance	C_{res}		-	13	-	
Gate charge	Q_G	V_{CC} = 400V, I_C = 40.0A, V_{GE} = 15V	-	150.0	-	nC
Short circuit collector current[1)] Max. 1000 short circuits Time between short circuits: ≥ 1.0s	$I_{C(SC)}$	V_{GE} = 15.0V, V_{CC} ≤ 400V, t_{SC} ≤ 4µs T_{vj} = 150°C	-	260	-	A

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 25°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 25°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 10.0Ω, $L\sigma$ = 50nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	17	-	ns
Turn-off delay time	$t_{d(off)}$		-	200	-	ns
Fall time	t_f		-	80	-	ns
Turn-on energy	E_{on}		-	0.60	-	mJ
Turn-off energy	E_{off}		-	1.10	-	mJ
Total switching energy	E_{ts}		-	1.70	-	mJ

[1)] Not valid when Kelvin Emitter is used and not subject to production test.

Diode Characteristic, at T_{vj} = 25°C

Diode reverse recovery time	t_{rr}	T_{vj} = 25°C, V_R = 400V, I_F = 40.0A, di_F/dt = 2410A/µs	-	44	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.80	-	µC
Diode peak reverse recovery current	I_{rrm}		-	38.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-1510	-	A/µs

Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Value			Unit
			min.	typ.	max.	
IGBT Characteristic, at T_{vj} = 175°C						
Turn-on delay time	$t_{d(on)}$	T_{vj} = 175°C, V_{CC} = 400V, I_C = 40.0A, V_{GE} = 0.0/15.0V, $R_{G(on)}$ = 10.0Ω, $R_{G(off)}$ = 10.0Ω, $L\sigma$ = 50nH, $C\sigma$ = 30pF $L\sigma$, $C\sigma$ from Fig. E Energy losses include “tail” and diode reverse recovery.	-	30	-	ns
Rise time	t_r		-	20	-	ns
Turn-off delay time	$t_{d(off)}$		-	250	-	ns
Fall time	t_f		-	150	-	ns
Turn-on energy	E_{on}		-	0.90	-	mJ
Turn-off energy	E_{off}		-	1.80	-	mJ
Total switching energy	E_{ts}		-	2.70	-	mJ

Diode Characteristic, at T_{vj} = 175°C

Diode reverse recovery time	t_{rr}	T_{vj} = 175°C, V_R = 400V, I_F = 40.0A, di_F/dt = 2090A/µs	-	90	-	ns
Diode reverse recovery charge	Q_{rr}		-	2.40	-	µC
Diode peak reverse recovery current	I_{rrm}		-	50.0	-	A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-725	-	A/µs

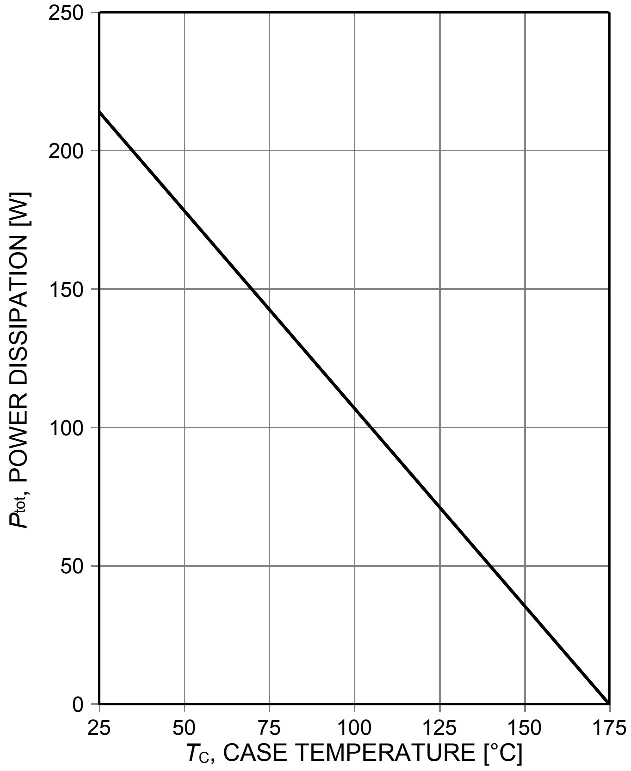


Figure 1. **Power dissipation as a function of case temperature**
(T_j≤175°C)

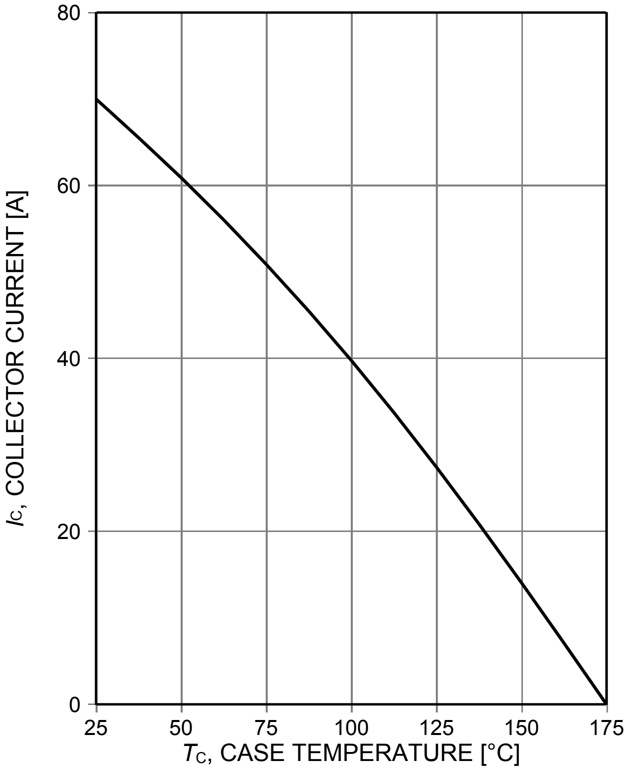


Figure 2. **Collector current as a function of case temperature**
(V_{GE}≥15V, T_j≤175°C)

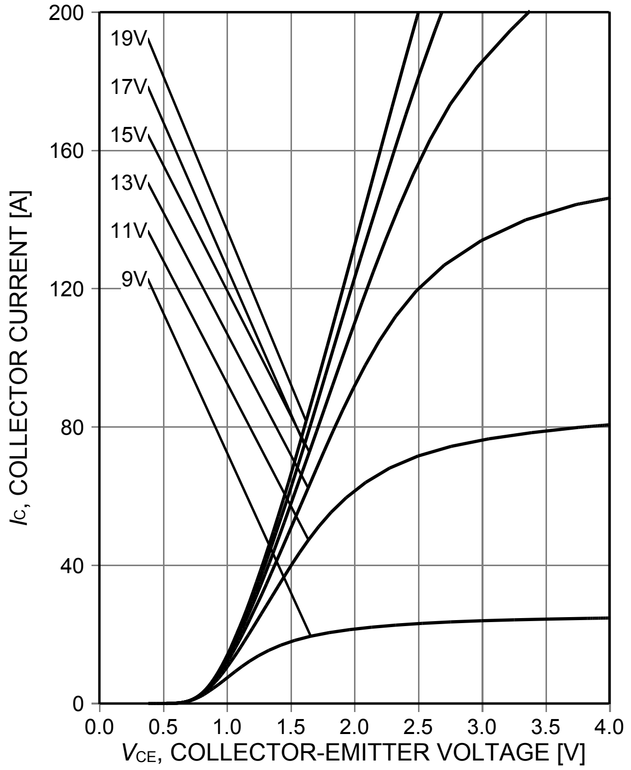


Figure 3. **Typical output characteristic**
(T_j=25°C)

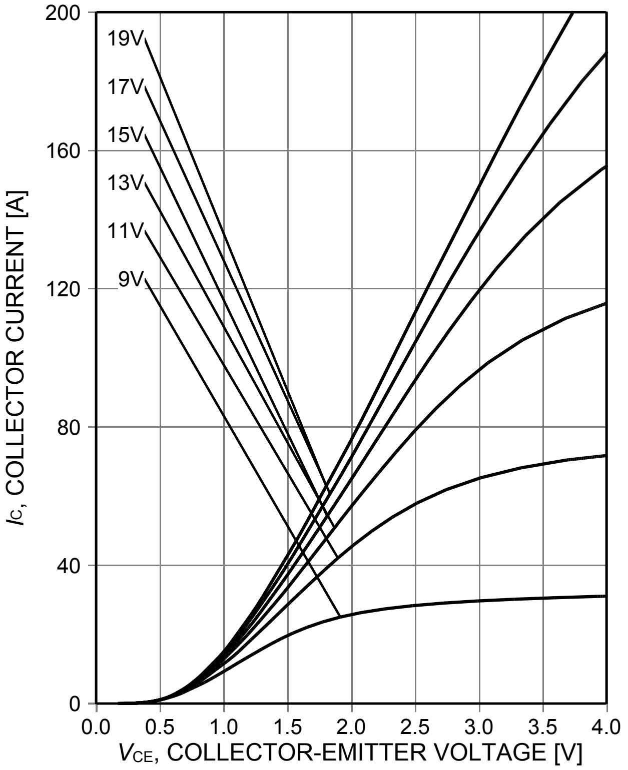


Figure 4. **Typical output characteristic**
(T_j=175°C)

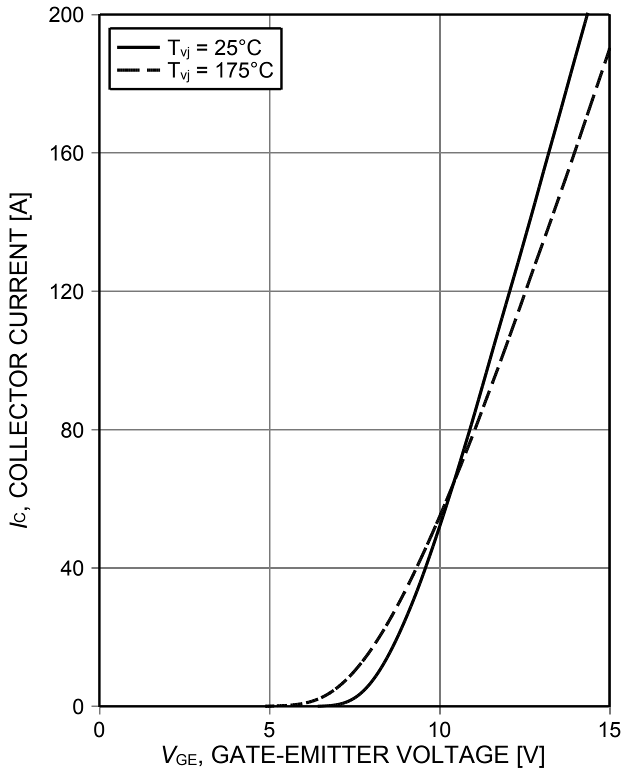


Figure 5. **Typical transfer characteristic**
(V_{CE}=20V)

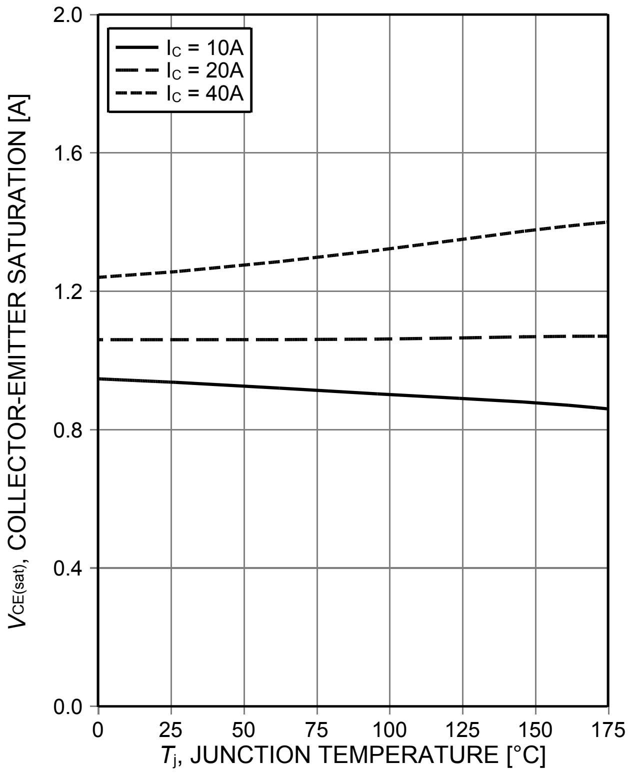


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
(V_{GE}=15V)

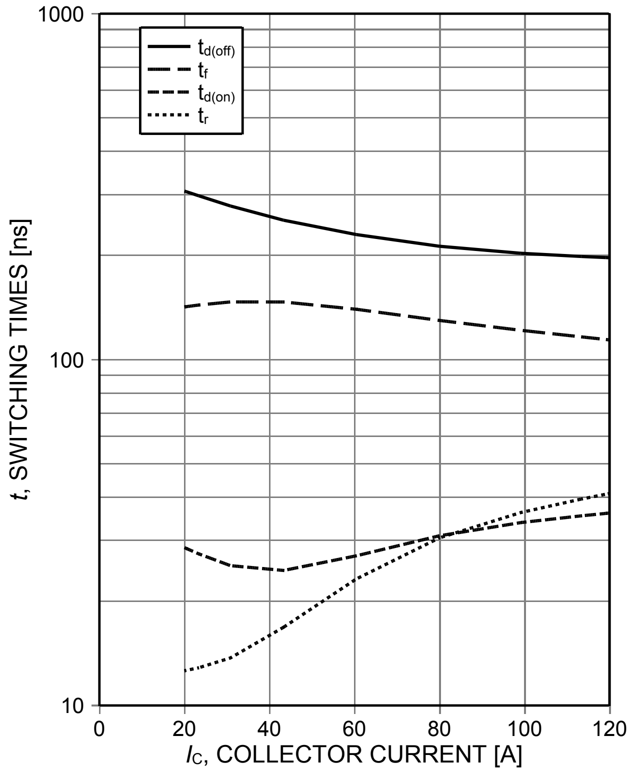


Figure 7. **Typical switching times as a function of collector current**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10Ω,Dynamic test circuit in Figure E)

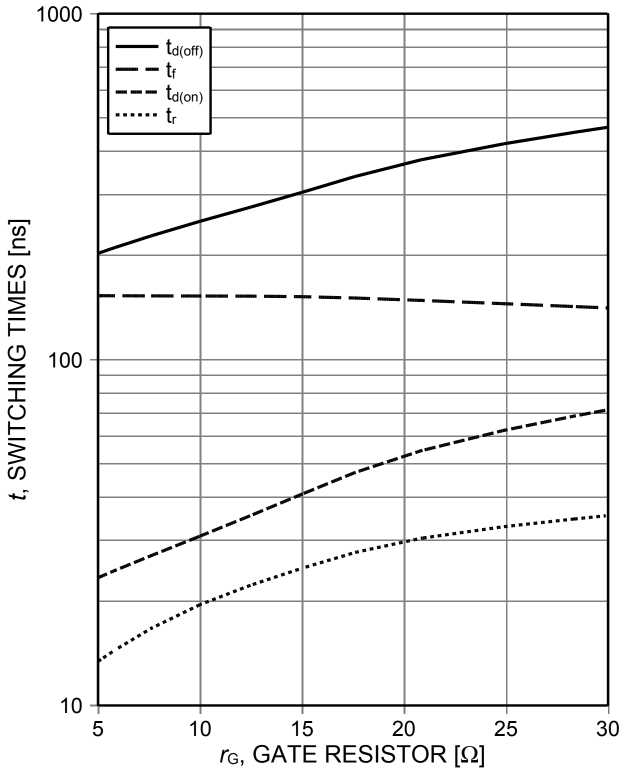


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A,Dynamic test circuit in Figure E)

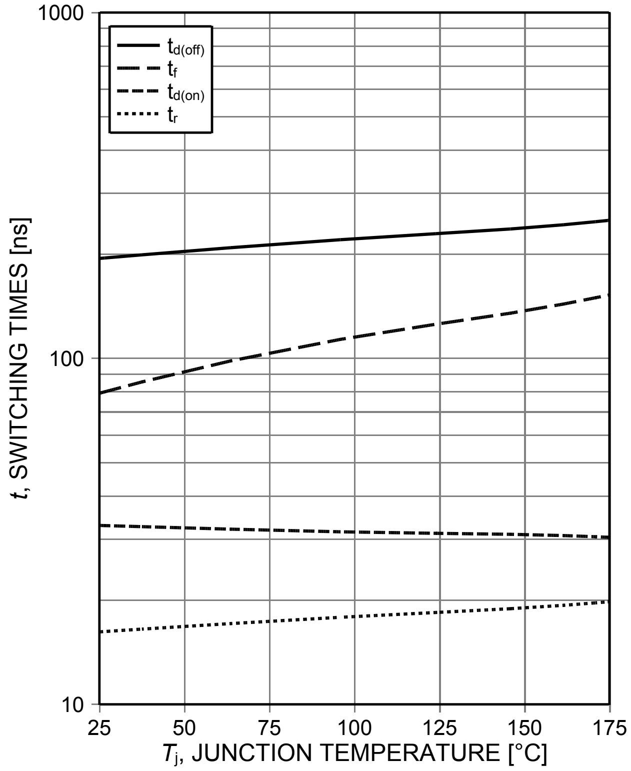


Figure 9. **Typical switching times as a function of junction temperature**
(inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=10Ω,Dynamic test circuit in Figure E)

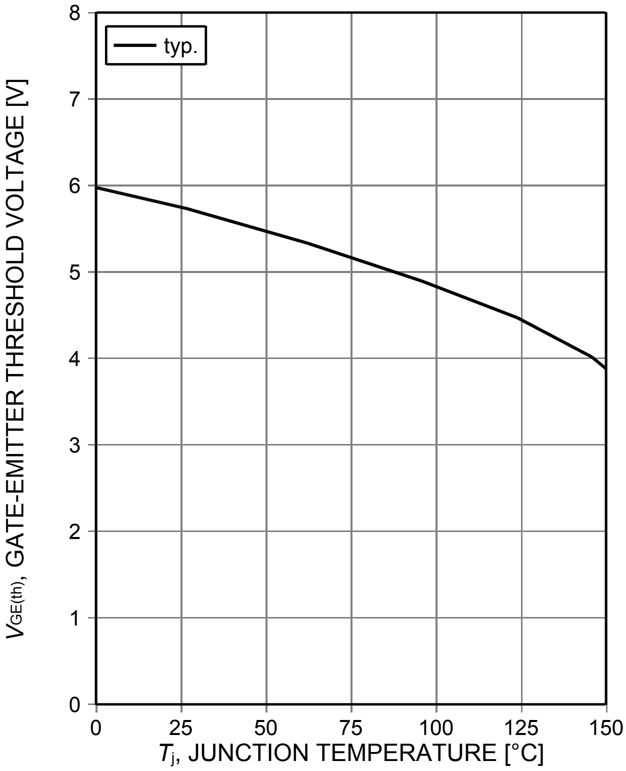


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
(I_C=0.47mA)

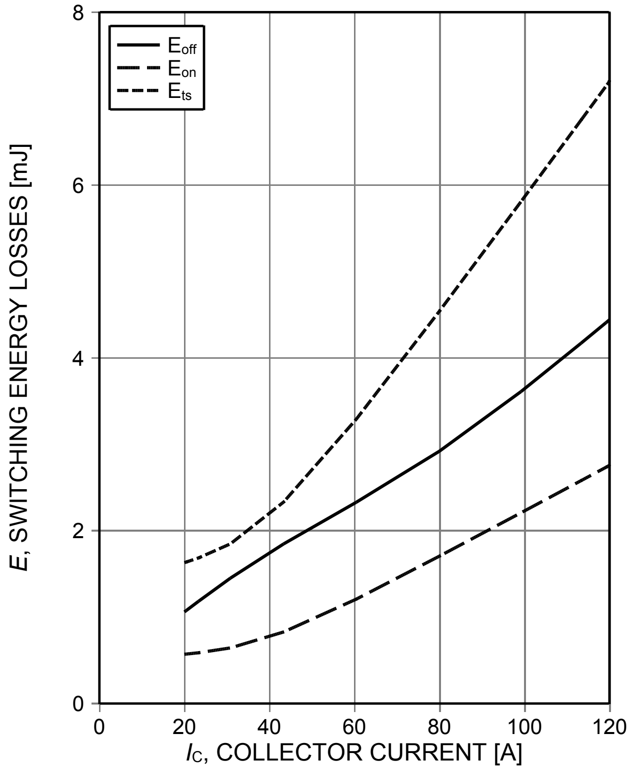


Figure 11. **Typical switching energy losses as a function of collector current**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, r_G=10Ω,Dynamic test circuit in Figure E)

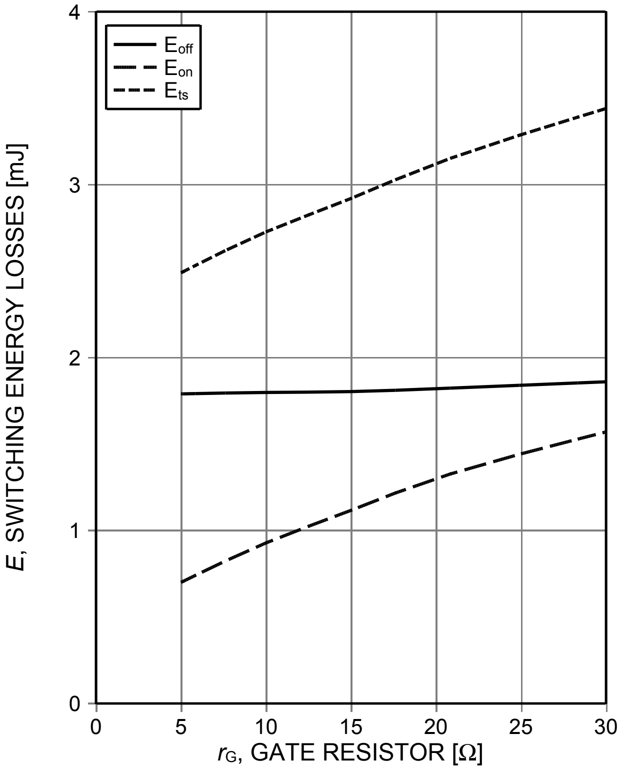


Figure 12. **Typical switching energy losses as a function of gate resistor**
(inductive load, T_j=175°C, V_{CE}=400V, V_{GE}=15/0V, I_C=40A,Dynamic test circuit in Figure E)

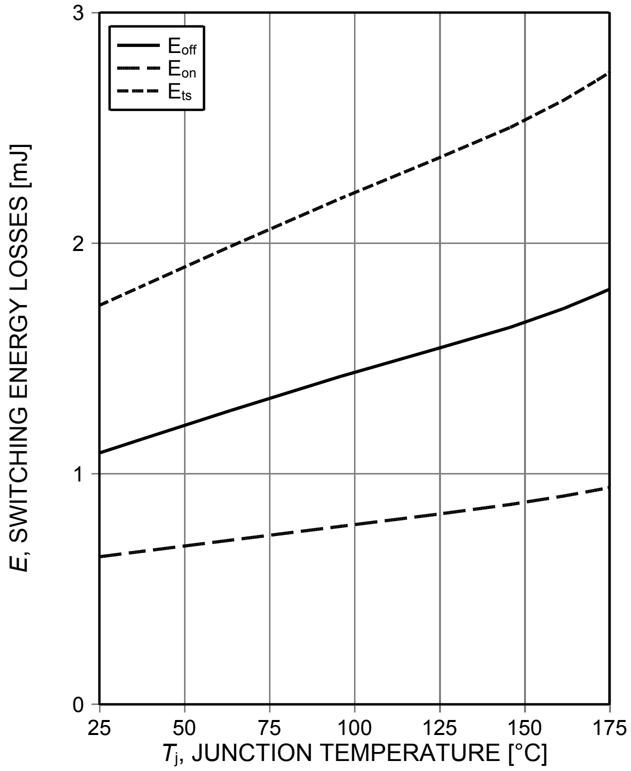


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, V_{CE}=400V, V_{GE}=15/0V, I_C=40A, r_G=10Ω,Dynamic test circuit in Figure E)

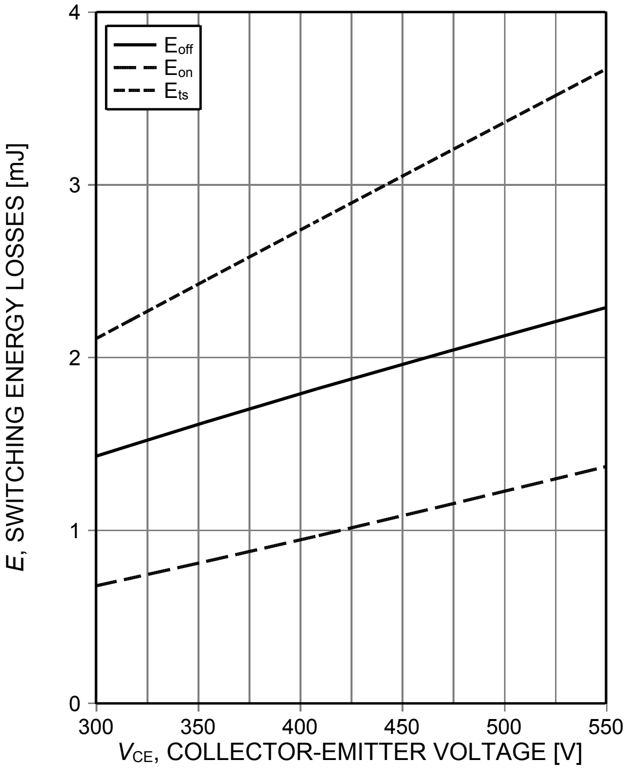


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, T_j=175°C, V_{GE}=15/0V, I_C=40A, R_G=10Ω, Dynamic test circuit in Figure E)

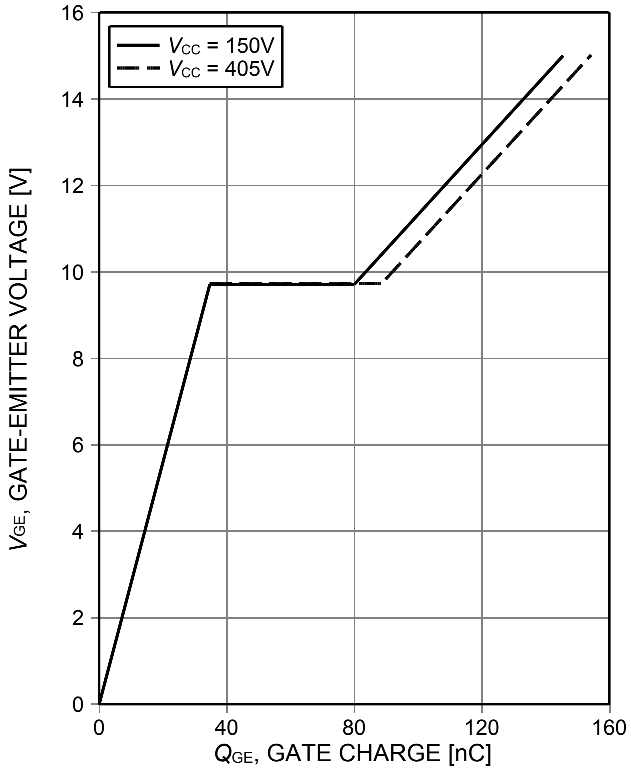


Figure 15. **Typical gate charge** (I_C=40A)

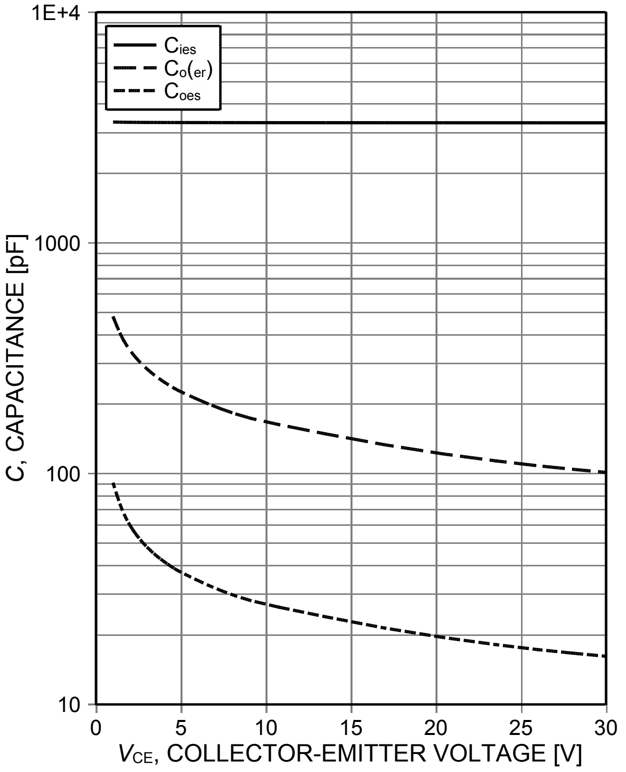


Figure 16. **Typical capacitance as a function of collector-emitter voltage** (V_{GE}=0V, f=1MHz)

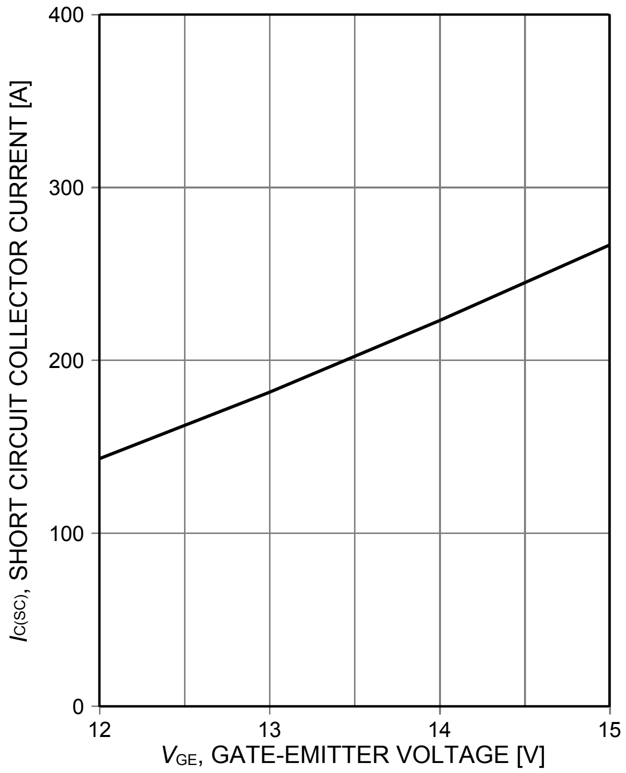


Figure 17. **Typical short circuit collector current as a function of gate-emitter voltage**
($V_{CE} \leq 400$V, start at $T_j \leq 150$°C)

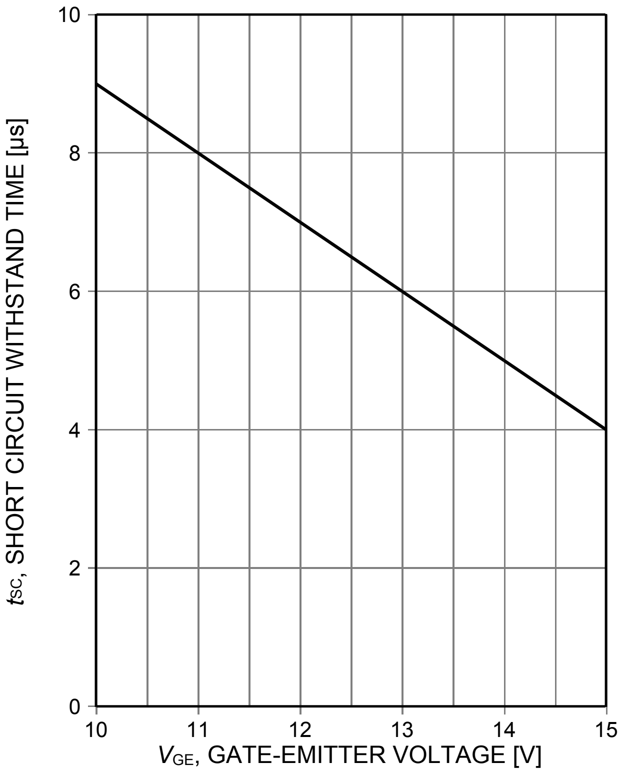
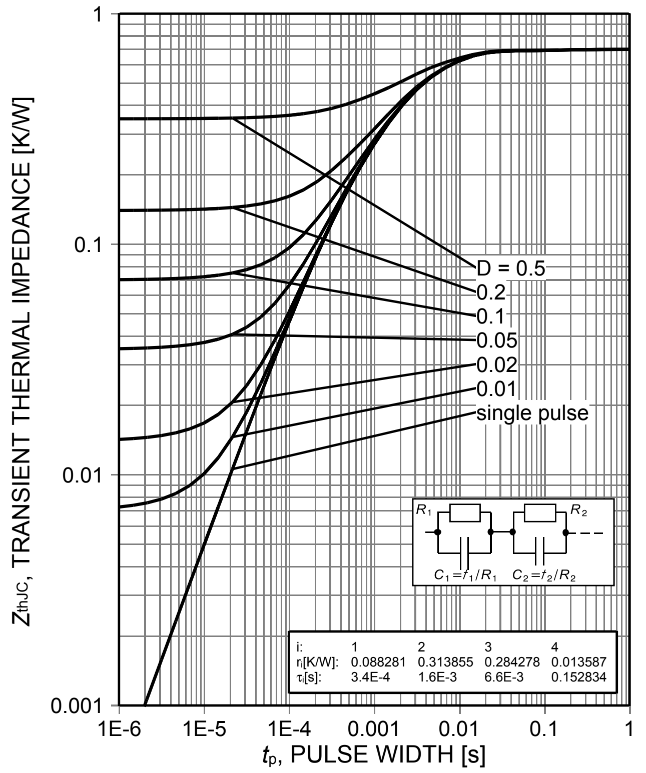
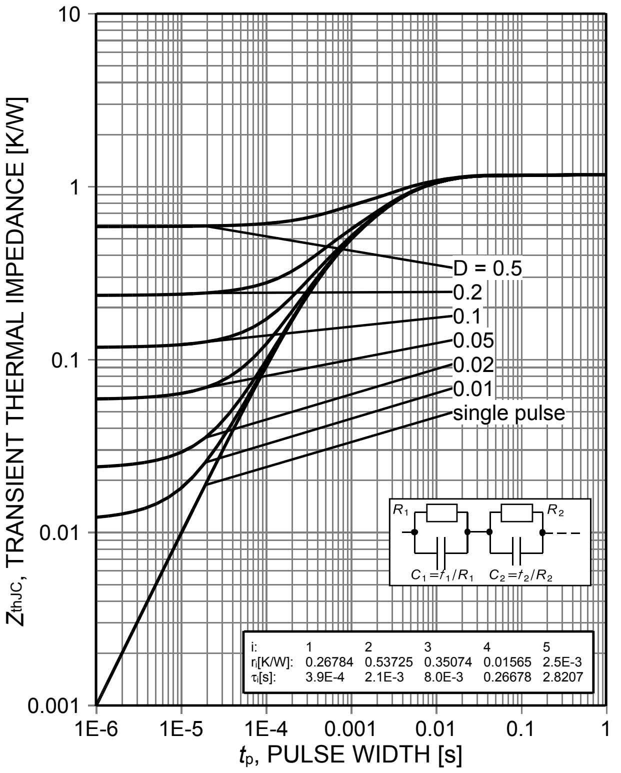


Figure 18. **Short circuit withstand time as a function of gate-emitter voltage**
($V_{CE}=400$V, start at $T_j=25$°C, $T_j$max≤150°C)



i:	1	2	3	4
r_i[K/W]:	0.088281	0.313855	0.284278	0.013587
τ_i[s]:	3.4E-4	1.6E-3	6.6E-3	0.152834

Figure 19. **IGBT transient thermal impedance as a function of pulse width for different duty cycles *D***
($D=t_p/T$)



i:	1	2	3	4	5
r_i[K/W]:	0.26784	0.53725	0.35074	0.01565	2.5E-3
τ_i[s]:	3.9E-4	2.1E-3	8.0E-3	0.26678	2.8207

Figure 20. **Diode transient thermal impedance as a function of pulse width for different duty cycles *D***
($D=t_p/T$)

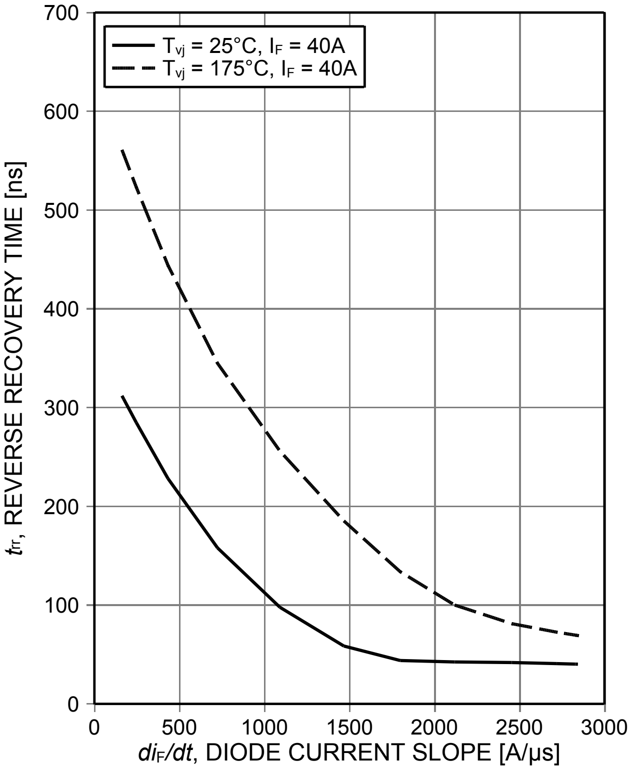


Figure 21. **Typical reverse recovery time as a function of diode current slope**
(V_R=400V,Dynamic test circuit in Figure E)

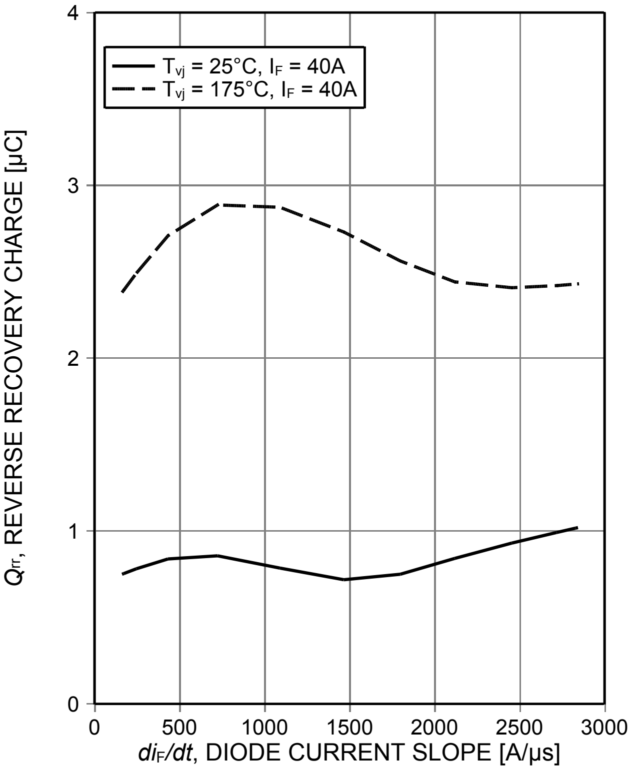


Figure 22. **Typical reverse recovery charge as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

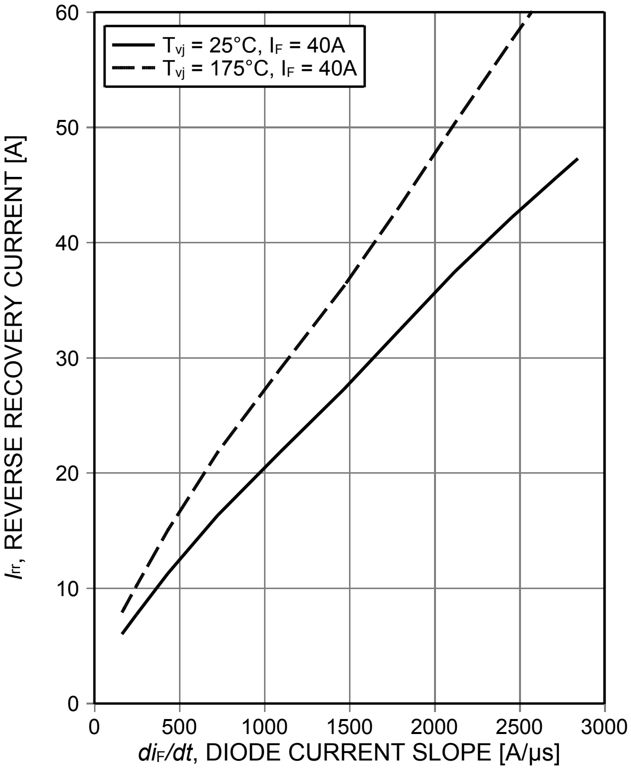


Figure 23. **Typical reverse recovery current as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

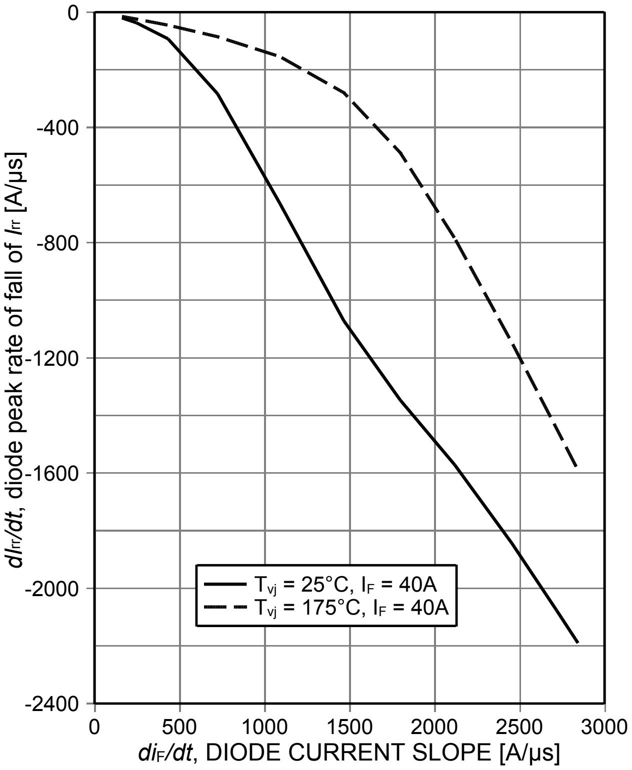


Figure 24. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**
(V_R=400V, Dynamic test circuit in Figure E)

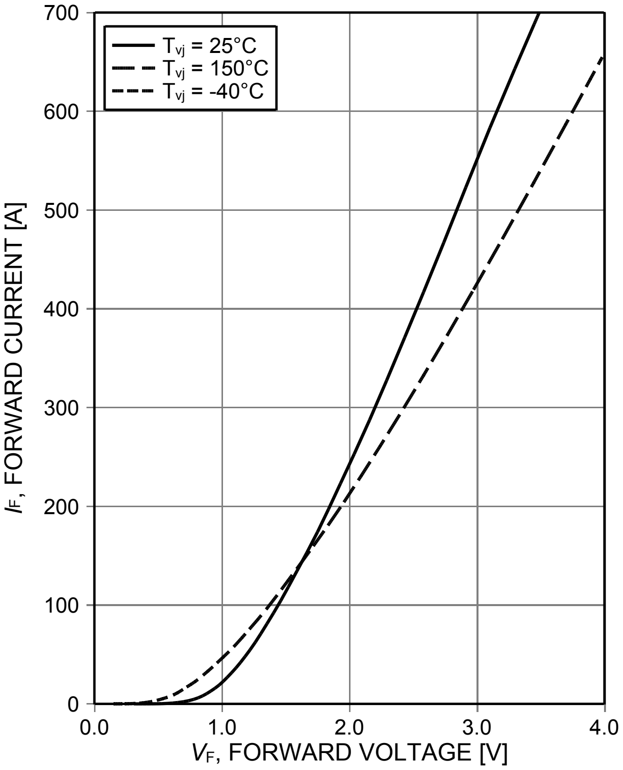


Figure 25. **Typical diode forward current as a function of forward voltage**

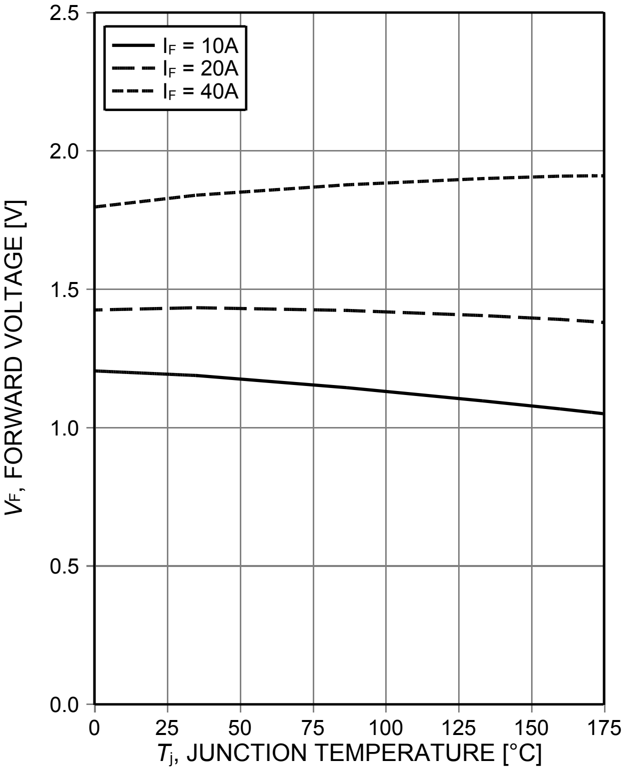
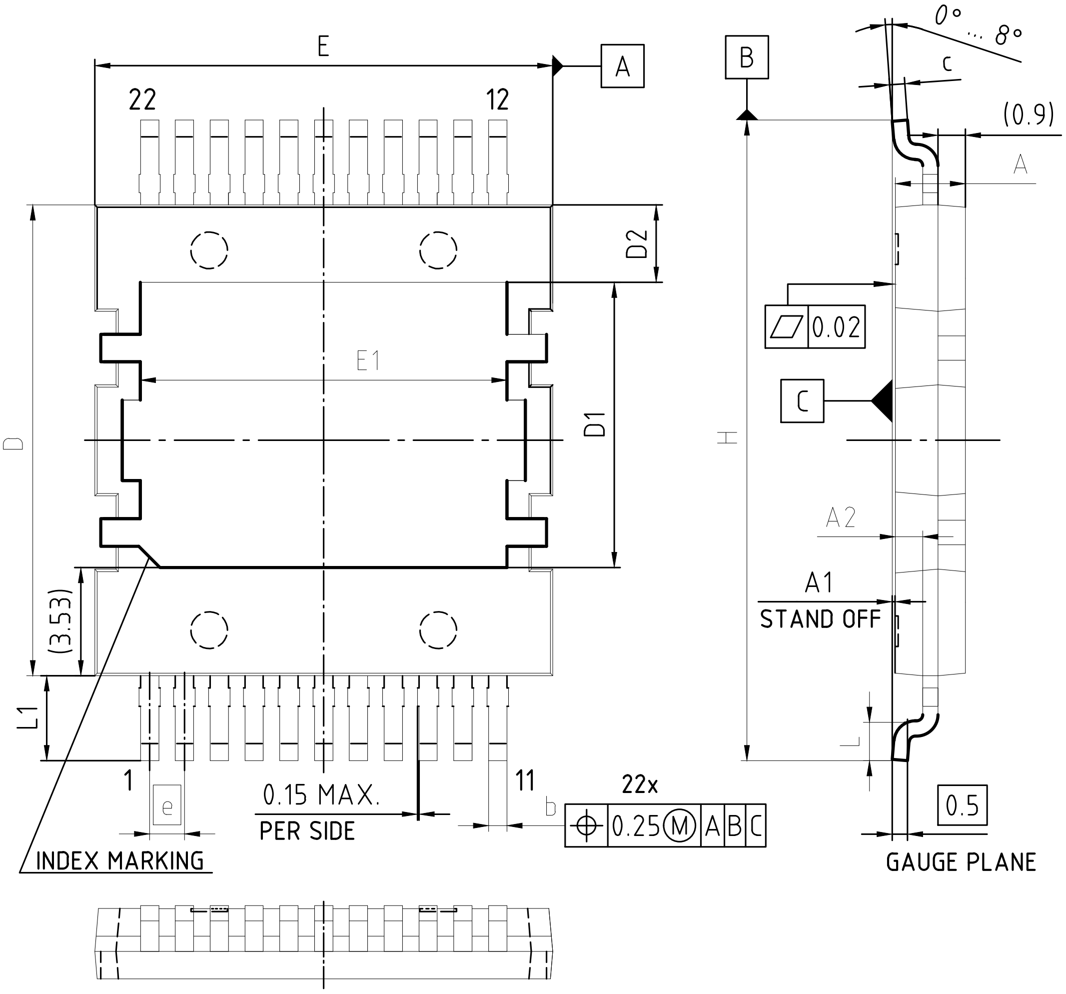


Figure 26. **Typical diode forward voltage as a function of junction temperature**

PG-HDSOP-22-2



NOTES:
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. ALL METAL SUFACES ARE TIN PLATED, EXCEPT AREA OF CUT.

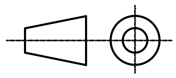
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	2.20	2.35
A1	0.00	0.15
A2	0.89	1.10
b	0.50	0.70
c	0.46	0.58
D	15.30	15.50
D1	9.23	9.43
D2	2.44	2.64
E	14.90	15.10
E1	11.91	12.11
e	1.14	
N	22	
H	20.86	21.06
L	1.20	1.40
L1	2.68	2.88

DOCUMENT NO.
Z8B00202783

REVISION
01

SCALE 5:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION



ISSUE DATE
17.04.2020

Testing Conditions

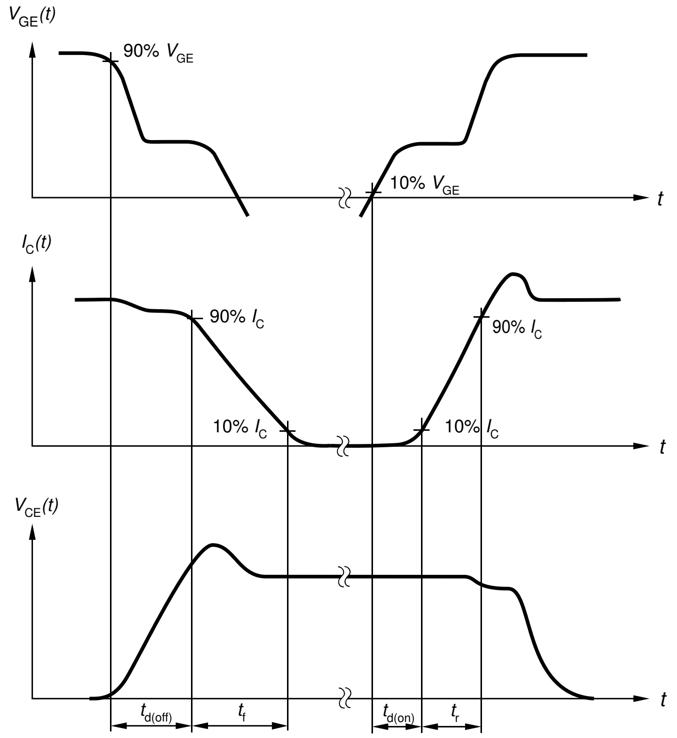


Figure A. **Definition of switching times**

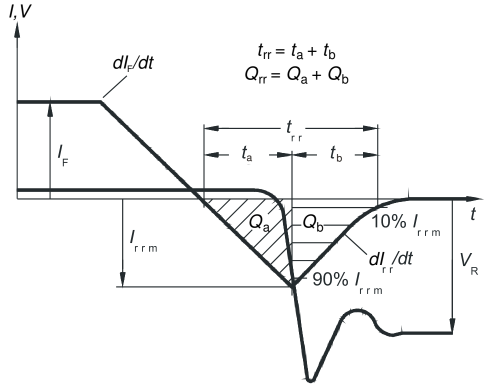


Figure C. **Definition of diode switching characteristics**

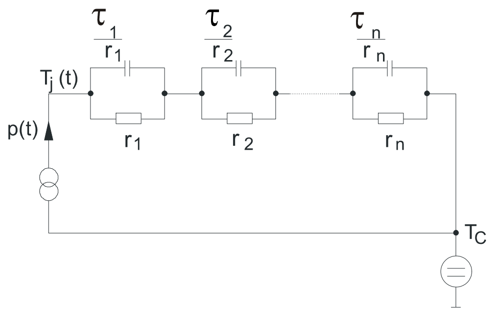


Figure D. **Thermal equivalent circuit**

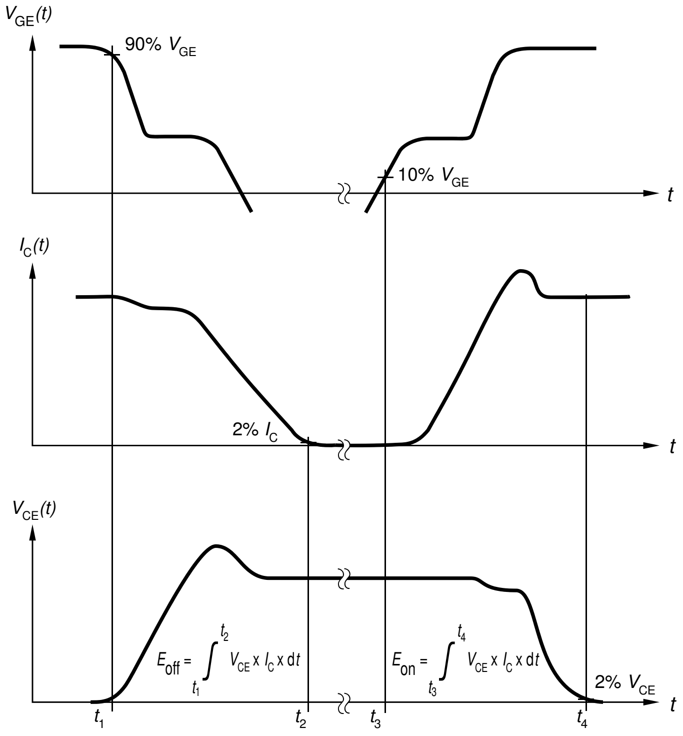


Figure B. **Definition of switching losses**

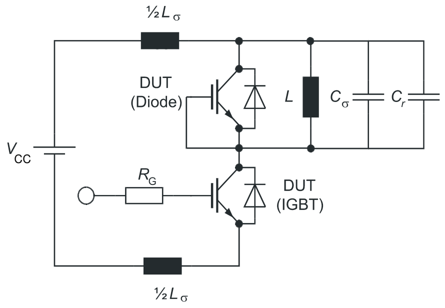


Figure E. **Dynamic test circuit**
Parasitic inductance L_σ,
parasitic capacitor C_σ,
relief capacitor C_r,
(only for ZVT switching)

Revision History

AIKDQ40N75CP2

Revision: 2020-10-22, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-10-22	Final

Trademarks

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