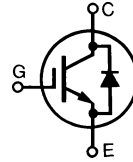


# High Speed IGBT with Diode

**IXSH 30N60BD1**  
**IXSK 30N60BD1**  
**IXST 30N60BD1**

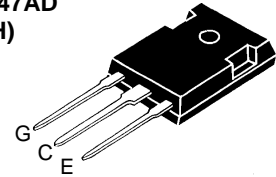
**V<sub>CES</sub> = 600 V**  
**I<sub>C25</sub> = 55 A**  
**V<sub>CE(sat)</sub> = 2.0 V**  
**t<sub>fi</sub> = 140 ns**

## Short Circuit SOA Capability

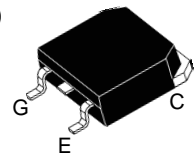


Symbol	Test Conditions	Maximum Ratings	
V <sub>CES</sub>	T <sub>J</sub> = 25°C to 150°C	600	V
V <sub>CGR</sub>	T <sub>J</sub> = 25°C to 150°C; R <sub>GE</sub> = 1 MΩ	600	V
V <sub>GES</sub>	Continuous	±20	V
V <sub>GEM</sub>	Transient	±30	V
I <sub>C25</sub>	T <sub>C</sub> = 25°C	55	A
I <sub>C90</sub>	T <sub>C</sub> = 90°C	30	A
I <sub>CM</sub>	T <sub>C</sub> = 25°C, 1 ms	110	A
<b>SSOA (RBSOA)</b>	V <sub>GE</sub> = 15 V, T <sub>J</sub> = 125°C, R <sub>G</sub> = 10 Ω Clamped inductive load, V <sub>CL</sub> = 0.8 V <sub>CES</sub>	I <sub>CM</sub> = 60	A
<b>t<sub>SC</sub> (SCSOA)</b>	V <sub>GE</sub> = 15 V, V <sub>CE</sub> = 360 V, T <sub>J</sub> = 125°C R <sub>G</sub> = 33 Ω, non repetitive	10	μs
P <sub>C</sub>	T <sub>C</sub> = 25°C	200	W
T <sub>J</sub>		-55 ... +150	°C
T <sub>JM</sub>		150	°C
T <sub>stg</sub>		-55 ... +150	°C
M <sub>d</sub>	Mounting torque	1.13/10	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	°C
<b>Weight</b>	TO-247/TO-268	6/4	g
	TO-264	10	g

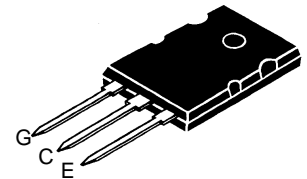
**TO-247AD (IXSH)**



**TO-268 (D3) (IXST)**



**TO-264 (IXSK)**



G = Gate                      C = Collector  
E = Emitter                    TAB = Collector

### Features

- International standard packages: JEDEC TO-247, TO-264 & TO-268
- Short Circuit SOA capability
- Medium frequency IGBT and anti-parallel FRED in one package
- New generation HDMOS™ process

### Applications

- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switch-mode and resonant-mode power supplies

### Advantages

- Space savings (two devices in one package)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Surface mountable, high power case style
- Reduces assembly time and cost
- High power density

Symbol	Test Conditions	Characteristic Values (T <sub>J</sub> = 25°C, unless otherwise specified)		
		min.	typ.	max.
BV <sub>CES</sub>	I <sub>C</sub> = 750 μA, V <sub>GE</sub> = 0 V	600		V
V <sub>GE(th)</sub>	I <sub>C</sub> = 2.5 mA, V <sub>CE</sub> = V <sub>GE</sub>	4		V
I <sub>CES</sub>	V <sub>CE</sub> = 0.8 • V <sub>CES</sub> V <sub>GE</sub> = 0 V	T <sub>J</sub> = 25°C		200 μA
		T <sub>J</sub> = 125°C		3 mA
I <sub>GES</sub>	V <sub>CE</sub> = 0 V, V <sub>GE</sub> = ±20 V			±100 nA
V <sub>CE(sat)</sub>	V <sub>GE</sub> = 15 V	I <sub>C</sub> = I <sub>C90</sub>		2.0 V
		I <sub>C</sub> = I <sub>C25</sub>		2.7 V

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$g_{fs}$	$I_C = I_{C90^\circ}; V_{CE} = 10\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $\leq 2\%$	10		S
$C_{ies}$ $C_{oes}$ $C_{res}$	$V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$		3100 240 30	pF pF pF
$Q_g$ $Q_{ge}$ $Q_{gc}$	$I_C = I_{C90^\circ}$ , $V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$		100 30 38	nC nC nC
$t_{d(on)}$ $t_{ri}$ $t_{d(off)}$ $t_{fi}$ $E_{off}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = I_{C90^\circ}$ ; $V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}$ ; $R_G = 4.7\ \Omega$ Note 1.		30 30 150 140 1.5	ns ns ns ns mJ
$t_{d(on)}$ $t_{ri}$ $E_{on}$ $t_{d(off)}$ $t_{fi}$ $E_{off}$	<b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b> $I_C = I_{C90^\circ}$ ; $V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}$ ; $R_G = 4.7\ \Omega$ Note 1		30 35 0.5 270 250 2.5	ns ns mJ ns ns mJ
$R_{thJC}$ $R_{thCK}$ $R_{thCK}$		TO-247 TO-264	0.25 0.15	K/W K/W K/W

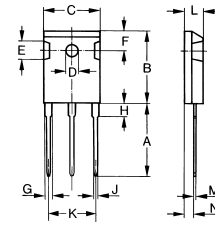
Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)			
		min.	typ.	max.	
$V_F$	$I_F = I_{C90^\circ}$ , $V_{GE} = 0\text{ V}$ Note 2	$T_J = 150^\circ\text{C}$ $T_J = 25^\circ\text{C}$		1.7 2.5	V V
$I_{RM}$	$I_F = 50\text{ A}$ ; $V_{GE} = 0\text{ V}$ ; $T_J = 100^\circ\text{C}$ $V_R = 100\text{ V}$ ; $-di_F/dt = 100\text{ A}/\mu\text{s}$		2	2.5	A
$t_{rr}$	$I_F = 1\text{ A}$ ; $-di/dt = 100\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		35	50	ns
$R_{thJC}$				.09	K/W

Notes: 1. Switching times may increase for  $V_{CE}$  (Clamp)  $> 0.8 \cdot V_{CES}$ , higher  $T_J$  or increased  $R_G$ .  
2. Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle  $d \leq 2\%$

**TO-268AA (IXST) (D<sup>3</sup> PAK)**

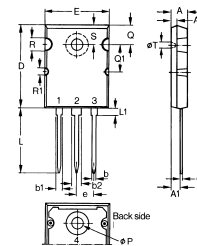
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.9	5.1	.193	.201
A <sub>1</sub>	2.7	2.9	.106	.114
A <sub>2</sub>	.02	.25	.001	.010
b	1.15	1.45	.045	.057
b <sub>2</sub>	1.9	2.1	.75	.83
C	.4	.65	.016	.026
D	13.80	14.00	.543	.551
E	15.85	16.05	.624	.632
E <sub>1</sub>	13.3	13.6	.524	.535
e	5.45 BSC		.215 BSC	
H	18.70	19.10	.736	.752
L	2.40	2.70	.094	.106
L1	1.20	1.40	.047	.055
L2	1.00	1.15	.039	.045
L3	0.25 BSC		.010 BSC	
L4	3.80	4.10	.150	.161

### TO-247 AD (IXSH) Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	19.81	20.32	0.780	0.800
B	20.80	21.46	0.819	0.845
C	15.75	16.26	0.610	0.640
D	3.55	3.65	0.140	0.144
E	4.32	5.49	0.170	0.216
F	5.4	6.2	0.212	0.244
G	1.65	2.13	0.065	0.084
H	-	4.5	-	0.177
J	1.0	1.4	0.040	0.055
K	10.8	11.0	0.426	0.433
L	4.7	5.3	0.185	0.209
M	0.4	0.8	0.016	0.031
N	1.5	2.49	0.087	0.102

### TO-264 AA (IXSK) Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A <sub>1</sub>	2.54	2.89	.100	.114
A <sub>2</sub>	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b <sub>1</sub>	2.39	2.69	.094	.106
b <sub>2</sub>	2.90	3.09	.114	.122
c	0.53	0.83	.021	.033
D	25.91	26.16	1.020	1.030
E	19.81	19.96	.780	.786
e	5.46 BSC		.215 BSC	
J	0.00	0.25	.000	.010
K	0.00	0.25	.000	.010
L	20.32	20.83	.800	.820
L <sub>1</sub>	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q <sub>1</sub>	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R <sub>1</sub>	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

### Min. Recommended Footprint

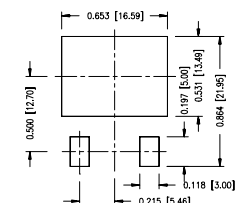


Fig.1 Saturation Characteristics

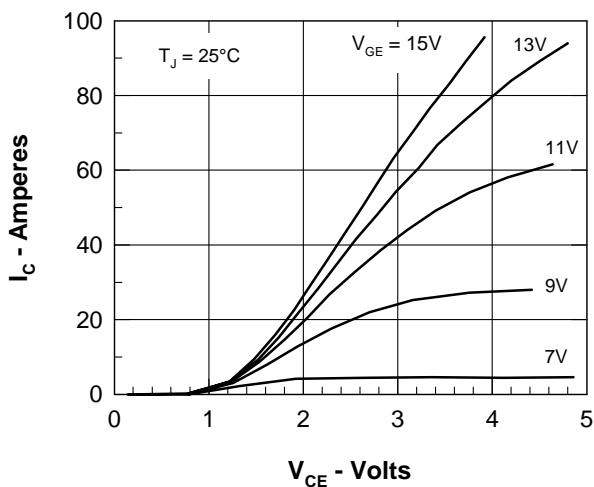


Fig.2 Output Characteristics

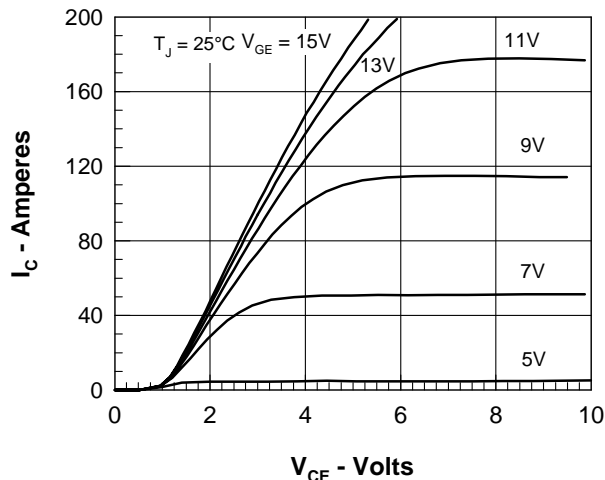


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

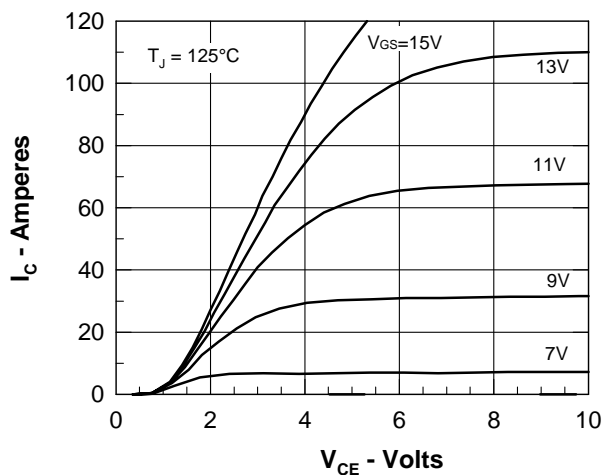


Fig.4 Temperature Dependence of Output Saturation Voltage

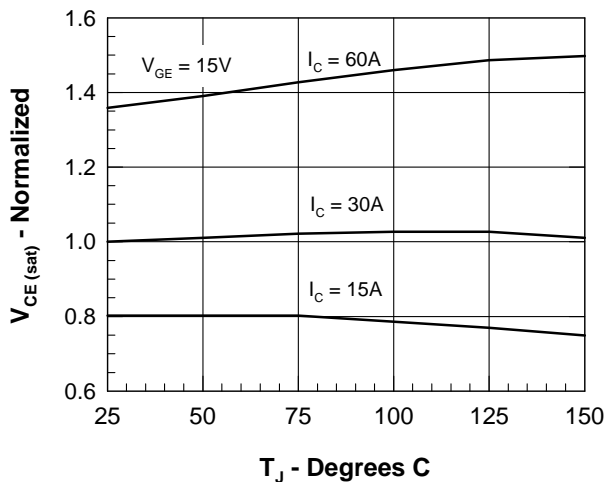


Fig.5 Input Admittance

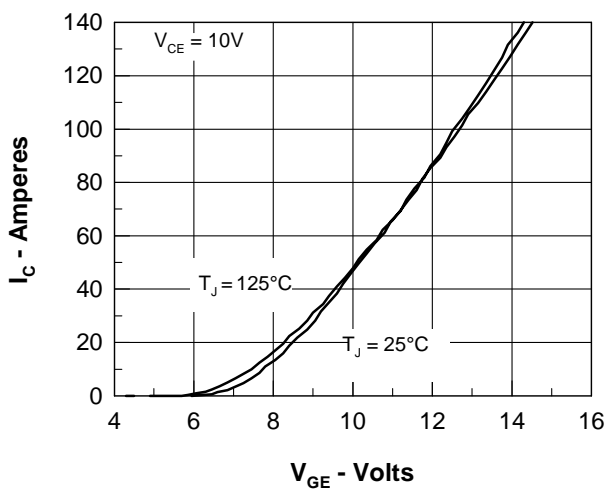


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

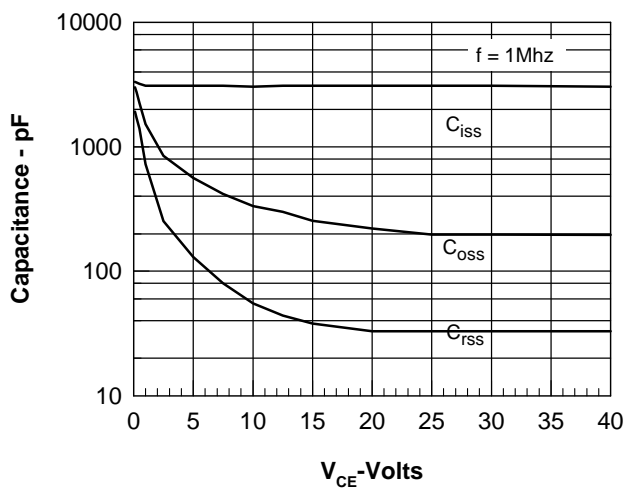


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

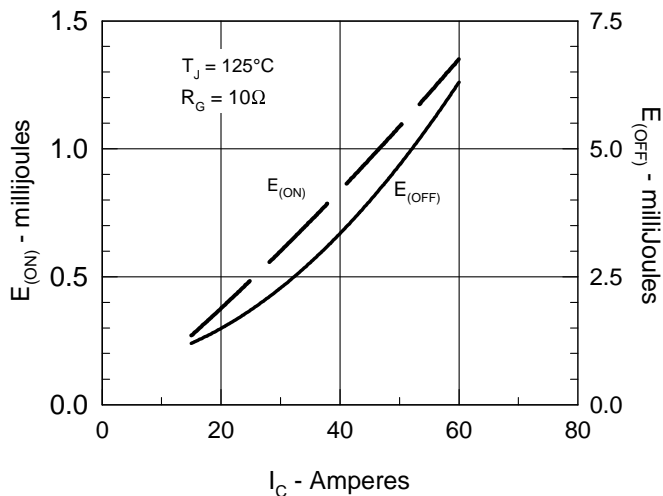
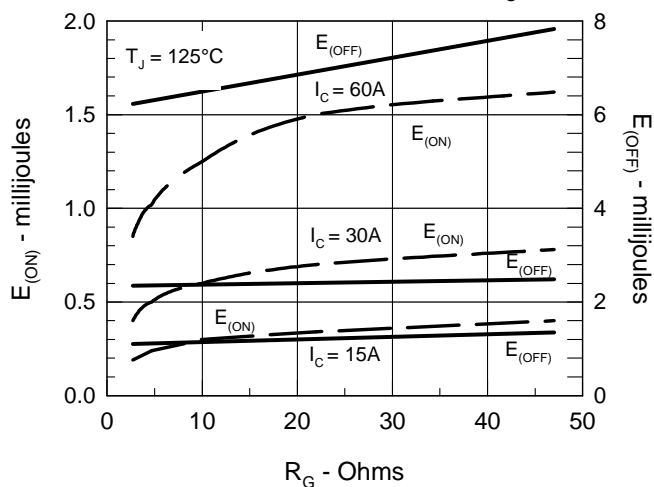

 Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on  $R_G$ 


Fig.9 Gate Charge Characteristic Curve

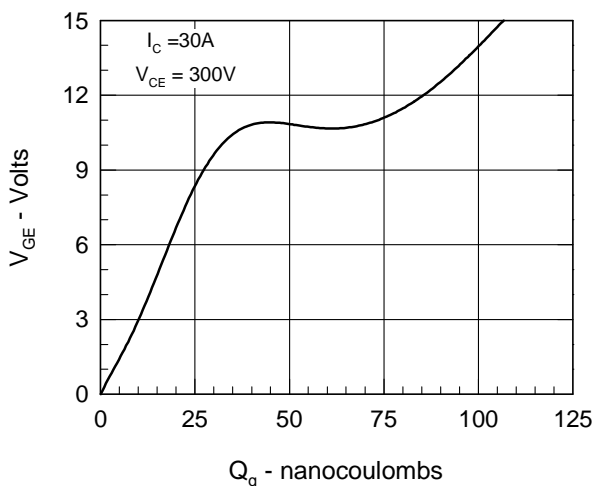


Fig.10 Turn-Off Safe Operating Area

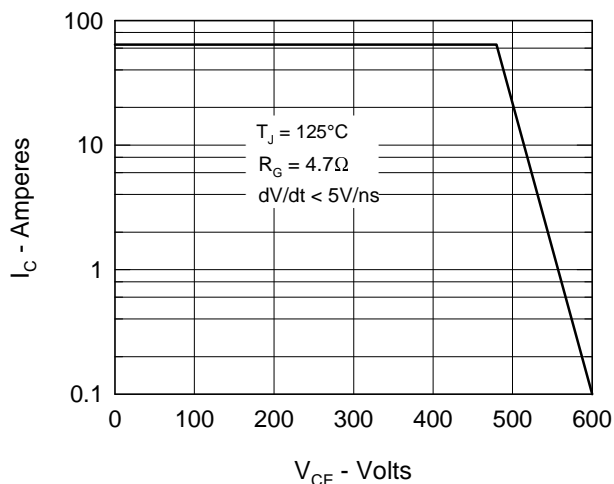
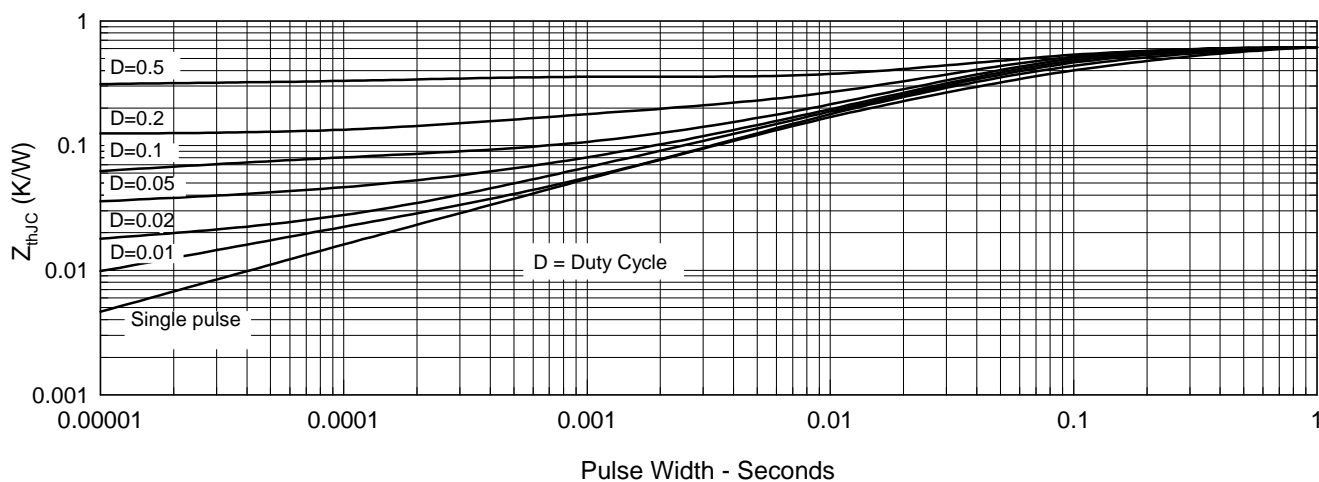


Fig.11 Transient Thermal Resistance



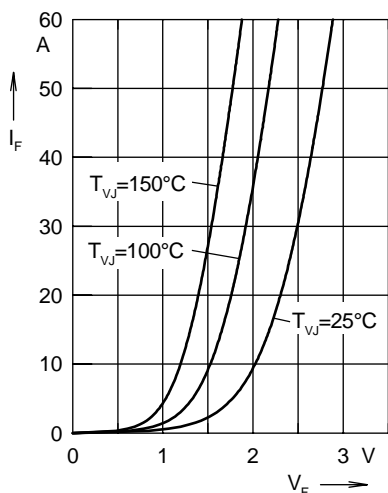
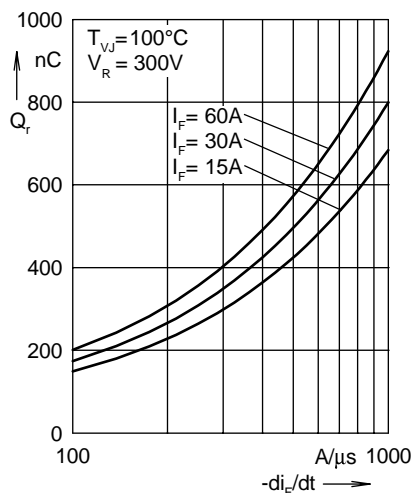
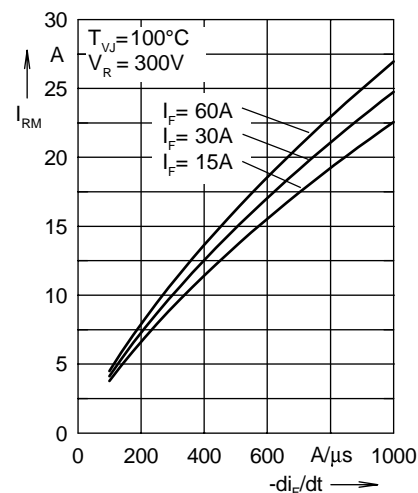
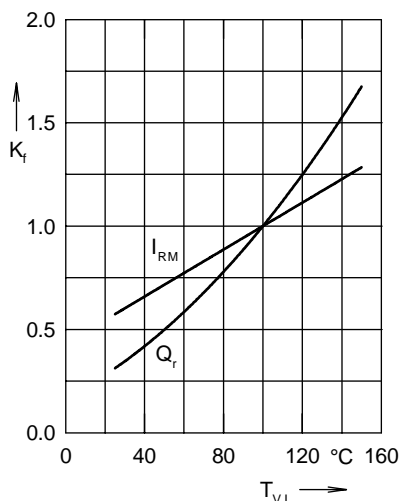
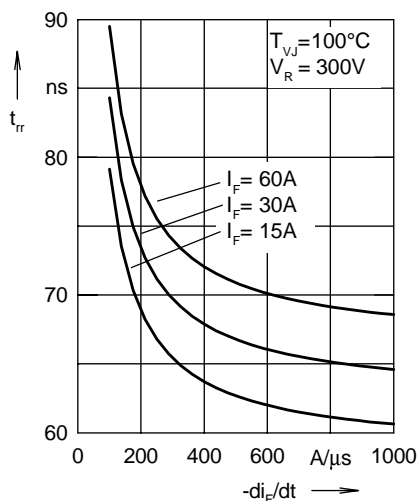
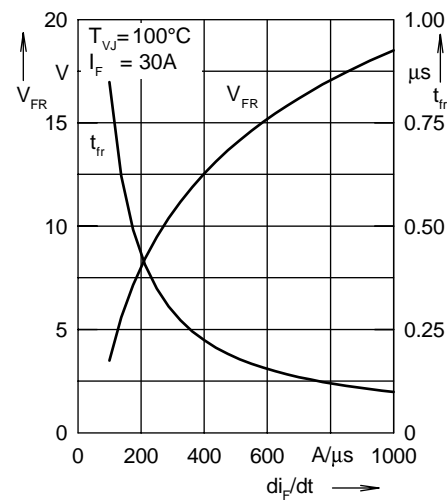
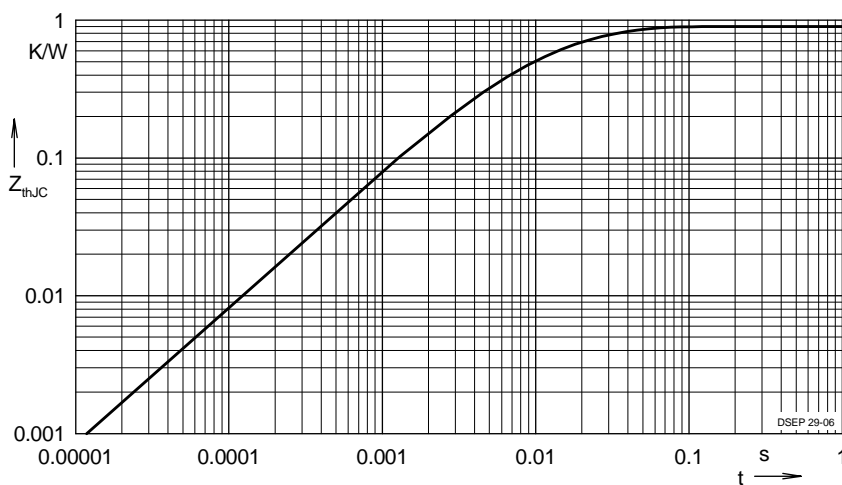

 Fig. 12 Forward current  $I_F$  versus  $V_F$ 

 Fig. 13 Reverse recovery charge  $Q_r$  versus  $-di_F/dt$ 

 Fig. 14 Peak reverse current  $I_{RM}$  versus  $-di_F/dt$ 

 Fig. 15 Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$ 

 Fig. 16 Recovery time  $t_{rr}$  versus  $-di_F/dt$ 

 Fig. 17 Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$ 


Fig. 18 Transient thermal resistance junction to case

 Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.502	0.0052
2	0.193	0.0003
3	0.205	0.0162