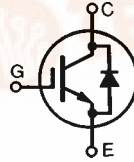


**Not for new designs**

Low  $V_{CE(sat)}$  IGBT with Diode  
High Speed IGBT with Diode

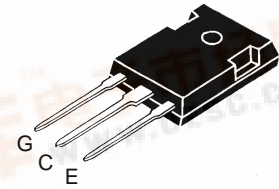
IXSH 20 N60U1  
IXSH 20 N60AU1

$V_{CES}$	$I_{C25}$	$V_{CE(sat)}$
600 V	40 A	2.5 V
600 V	40 A	3.0 V

**Combi Packs****Short Circuit SOA Capability**

Symbol	Test Conditions	Maximum Ratings	
$V_{CES}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$	600	V
$V_{CGR}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GE} = 1\text{ M}\Omega$	600	V
$V_{GES}$	Continuous	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ\text{C}$	40	A
$I_{C90}$	$T_C = 90^\circ\text{C}$	20	A
$I_{CM}$	$T_C = 25^\circ\text{C}$ , 1 ms	80	A
<b>SSOA</b> <b>(RBSOA)</b>	$V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ , $R_G = 82\ \Omega$ Clamped inductive load, $L = 100\ \mu\text{H}$	$I_{CM} = 40$ @ $0.8 V_{CES}$	A
$t_{SC}$ <b>(SCSOA)</b>	$V_{GE} = 15\text{ V}$ , $V_{CE} = 360\text{ V}$ , $T_J = 125^\circ\text{C}$ $R_G = 82\ \Omega$ , non repetitive	10	$\mu\text{s}$
$P_C$	$T_C = 25^\circ\text{C}$	150	W
$T_J$		-55 ... +150	$^\circ\text{C}$
$T_{JM}$		150	$^\circ\text{C}$
$T_{stg}$		-55 ... +150	$^\circ\text{C}$
$M_d$	Mounting torque	1.13/10	Nm/lb.in.
<b>Weight</b>		6	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

TO-247 AD



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

**Features**

- International standard package JEDEC TO-247 AD
- High frequency IGBT with guaranteed Short Circuit SOA capability
- IGBT and anti-parallel FRED in one package
- 2nd generation HD MOS™ process
- Low  $V_{CE(sat)}$ 
  - for low on-state conduction losses
- MOS Gate turn-on
  - drive simplicity

**Applications**

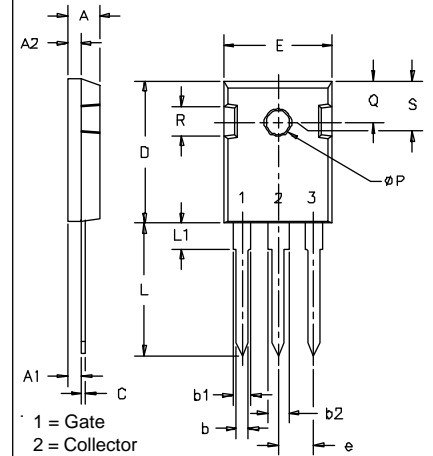
- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switch-mode and resonant-mode power supplies

**Advantages**

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

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$BV_{CES}$	$I_C = 1.75\text{ mA}$ , $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 1.5\text{ mA}$ , $V_{CE} = V_{GE}$	3.5		V
$I_{CES}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			$T_J = 25^\circ\text{C}$ 500 $\mu\text{A}$ $T_J = 125^\circ\text{C}$ 8 mA
$I_{GES}$	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$			20N60U1 2.5 V 20N60AU1 3.0 V

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$g_{fs}$	$I_C = I_{C90}$ ; $V_{CE} = 10\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $\leq 2\%$	6	7	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$ , $V_{CE} = 10\text{ V}$		65	A
$C_{ies}$	$V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$		1800	pF
$C_{oes}$			250	pF
$C_{res}$			45	pF
$Q_g$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$		90	120 nC
$Q_{ge}$			40	55 nC
$Q_{gc}$			65	80 nC
$t_{d(on)}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b> $I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$ , $V_{CE} = 0.8 V_{CES}$ , $R_G = 39\ \Omega$ Remarks: Switching times may increase for $V_{CE}$ (Clamp) > $0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$		100	ns
$t_{ri}$			200	ns
$t_{d(off)}$			450	ns
$t_{fi}$		20N60U1 20N60AU1	350	ns
$E_{off}$			2.5	mJ
$t_{d(on)}$	<b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b> $I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$ $V_{CE} = 0.8 V_{CES}$ , $R_G = 39\ \Omega$ Remarks: Switching times may increase for $V_{CE}$ (Clamp) > $0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$		100	ns
$t_{ri}$			200	ns
$E_{on}$			1	mJ
$t_{d(off)}$		20N60U1 20N60AU1	1000	ns
$t_{fi}$			1000	ns
$E_{off}$		20N60U1 20N60AU1	9 3	mJ 5 mJ
$R_{thJC}$			0.83	K/W
$R_{thCK}$		0.25		K/W

**TO-247 AD Outline**


1 = Gate  
2 = Collector  
3 = Emitter  
Tab = Collector

SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.185	.209	4.7	5.3
A1	.087	.102	2.2	2.54
A2	.059	.098	2.2	2.6
b	.040	.055	1.0	1.4
b1	.065	.084	1.65	2.13
b2	.113	.123	2.87	3.12
C	.016	.031	.4	.8
D	.819	.845	20.80	21.46
E	.610	.640	15.75	16.26
e	.215 BSC		5.45 BSC	
L	.780	.800	19.81	20.32
L1		.177		4.50
phi P	.140	.144	3.55	3.65
Q	.212	.244	5.4	6.2
R	.170	.216	4.32	5.49
S	.242 BSC		6.15 BSC	

**Reverse Diode (FRED)**

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = I_{C90}$ , $V_{GE} = 0\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $d \leq 2\%$			1.6 V
$I_{RM}$	$I_F = I_{C90}$ , $V_{GE} = 0\text{ V}$ , $-di_F/dt = 240\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ , $T_J = 125^\circ\text{C}$ $I_F = 1\text{ A}$ ; $-di/dt = 100\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ , $T_J = 25^\circ\text{C}$		10	A
$t_{tr}$			150	ns
			35	50 ns
$R_{thJC}$				1 K/W

Fig. 1 Saturation Characteristics

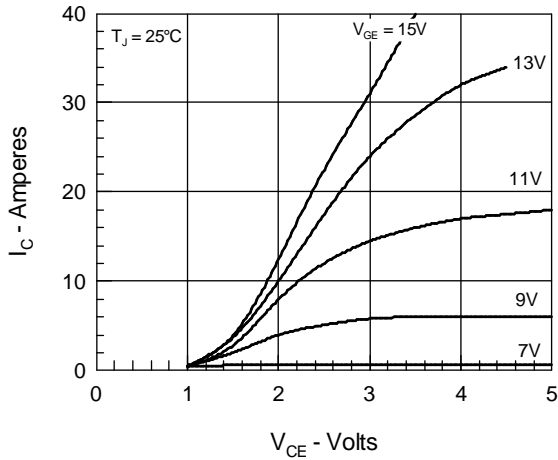


Fig. 2 Output Characteristics

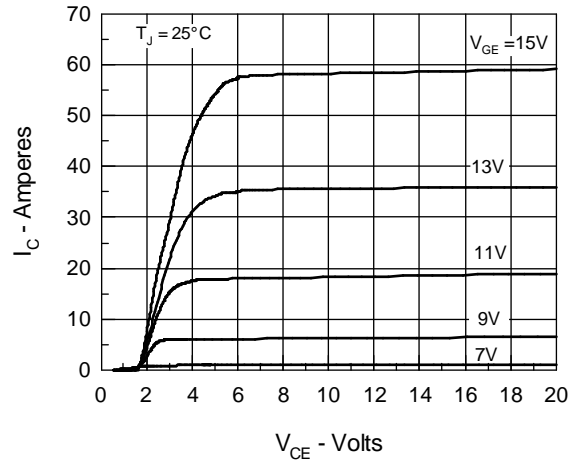


Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

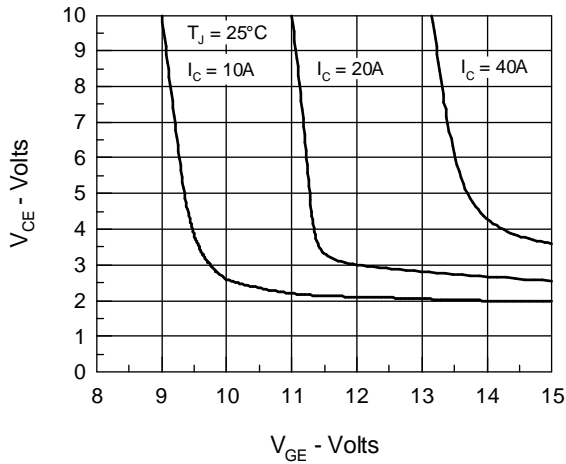


Fig. 4 Temperature Dependence of Output Saturation Voltage

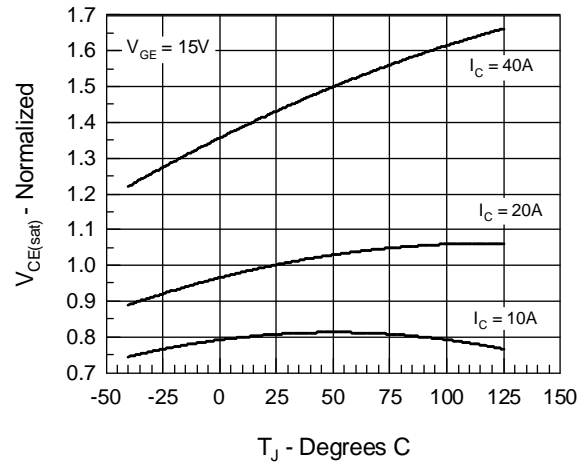


Fig. 5 Input Admittance

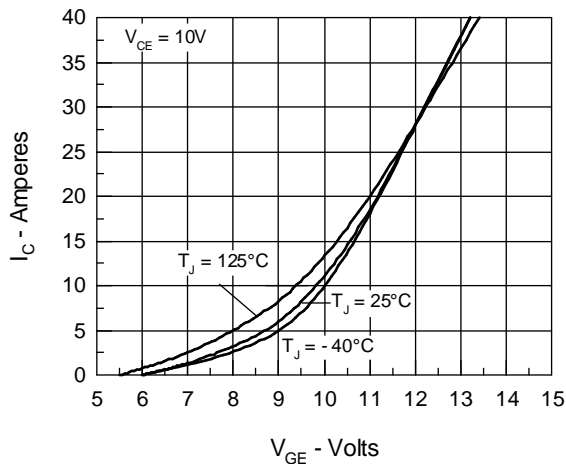


Fig. 6 Temperature Dependence of Breakdown and Threshold Volt.

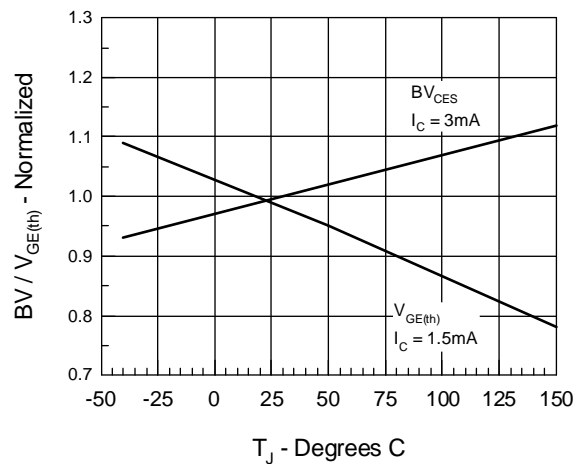


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

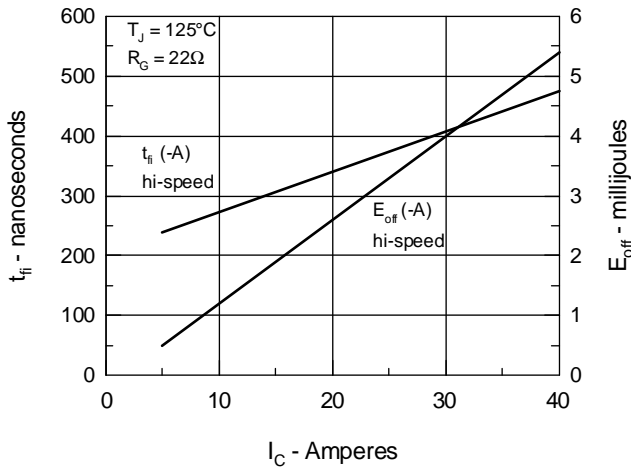


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on  $R_G$

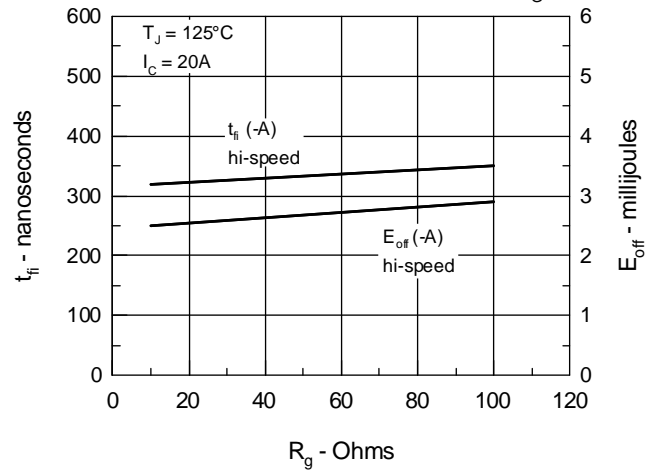


Fig.9 Gate Charge Characteristic Curve

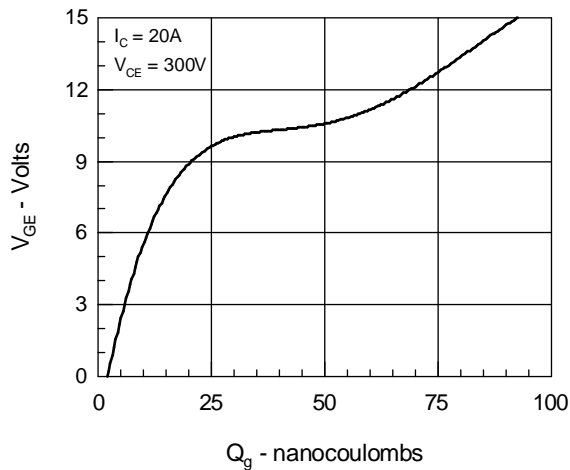


Fig.10 Turn-Off Safe Operating Area

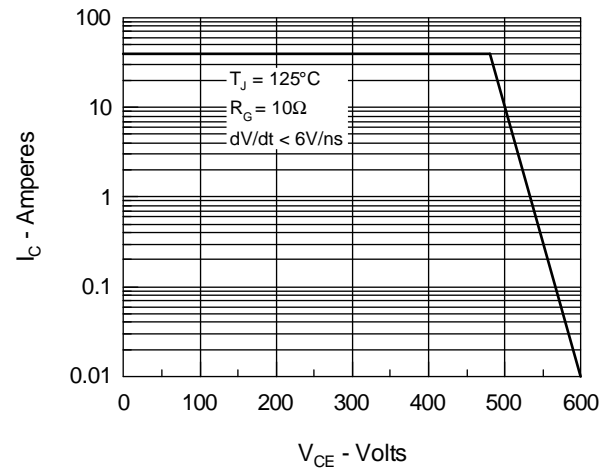


Fig.11 Transient Thermal Impedance

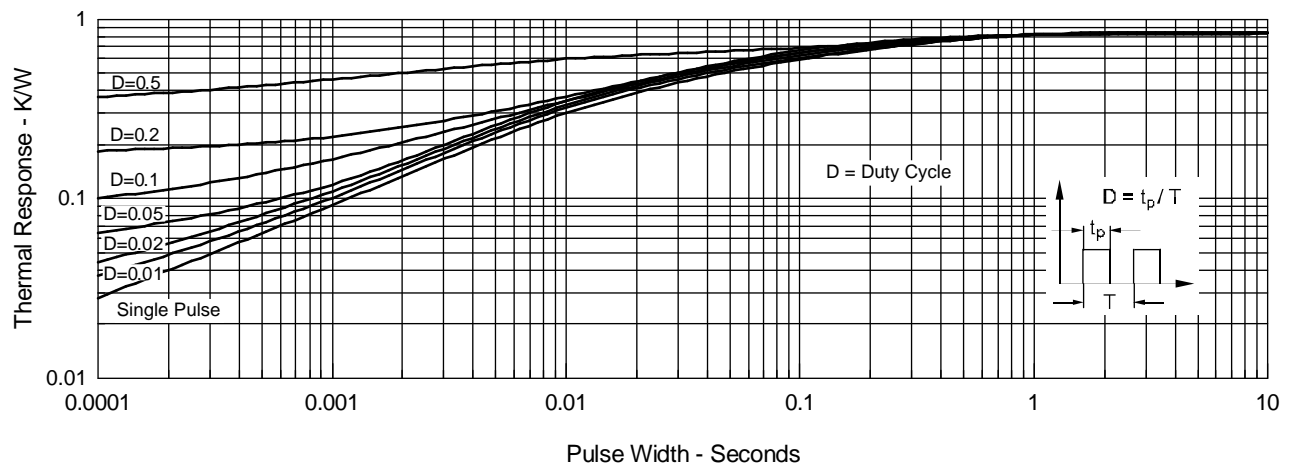


Fig.12 Maximum Forward Voltage Drop

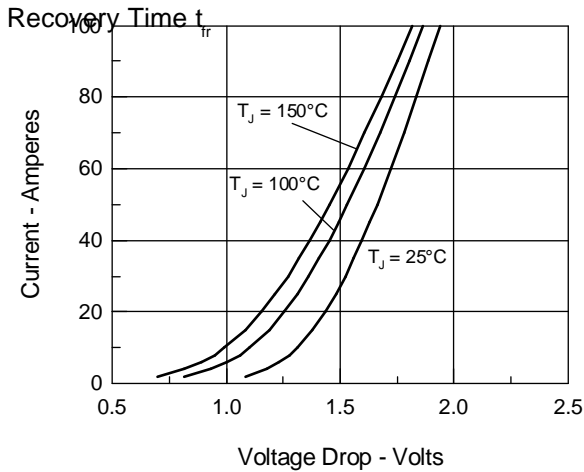


Fig.13 Peak Forward Voltage  $V_{FR}$  and Forward Recovery Time  $t_{fr}$

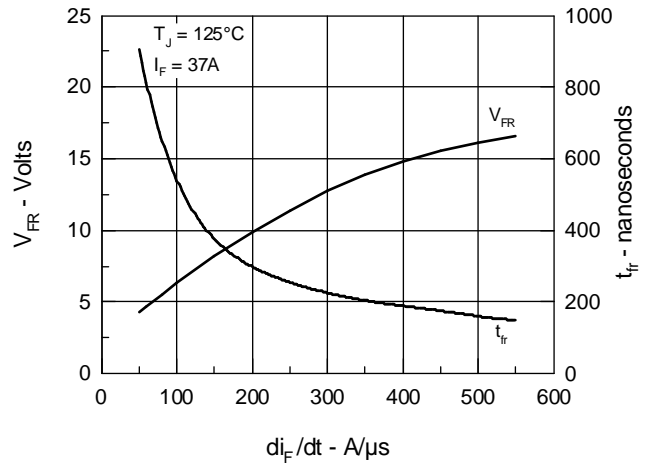


Fig.14 Junction Temperature Dependence of  $I_{RM}$  and  $Q_r$

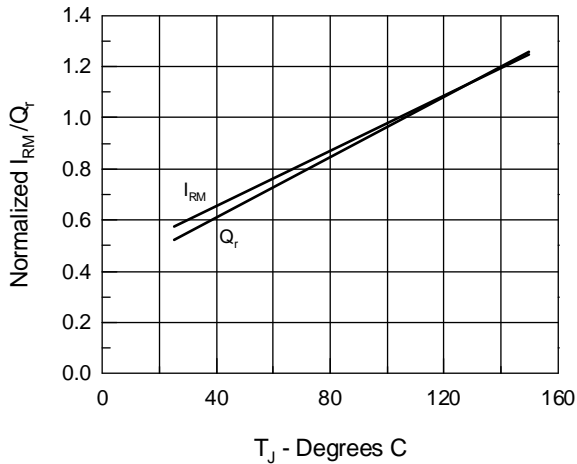


Fig.15 Reverse Recovery Charge

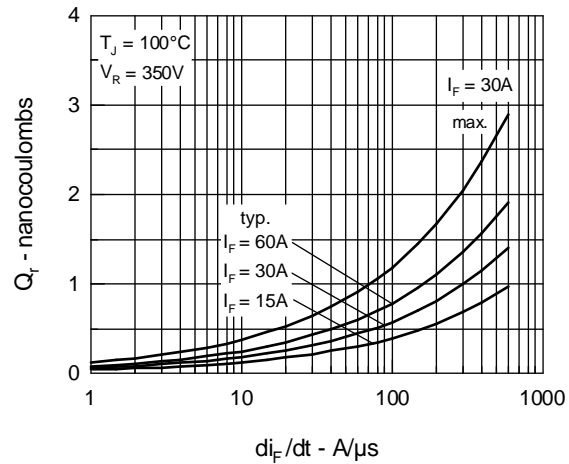


Fig.16 Peak Reverse Recovery Current

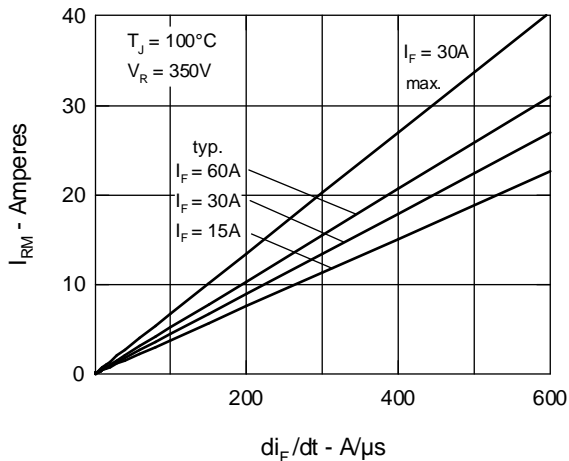


Fig.17 Reverse Recovery Time

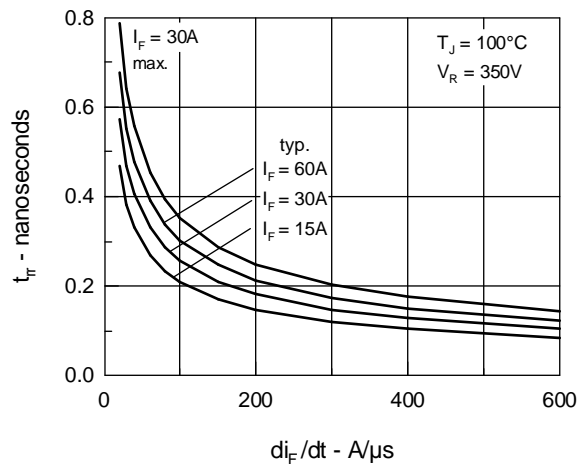


Fig.18 Diode Transient Thermal resistance junction to case

