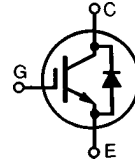
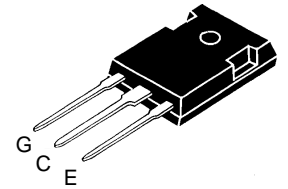


# Low $V_{CE(sat)}$ IGBT with Diode High speed IGBT with Diode Combi Packs

	$V_{CES}$	$I_{C25}$	$V_{CE(sat)}$
<b>IXGH10N60U1</b>	600 V	20 A	2.5 V
<b>IXGH10N60AU1</b>	600 V	20 A	3.0 V



TO-247 AD



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

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
$I_{C25}$	$T_C = 25^\circ\text{C}$	20	A
$I_{C90}$	$T_C = 90^\circ\text{C}$	10	A
$I_{CM}$	$T_C = 25^\circ\text{C}$ , 1 ms	40	A
<b>SSOA (RBSOA)</b>	$V_{GE} = 15\text{ V}$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 150\ \Omega$ Clamped inductive load, $L = 300\ \mu\text{H}$	$I_{CM} = 20$ @ $0.8\ V_{CES}$	A
$P_C$	$T_C = 25^\circ\text{C}$	100	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 (M3)	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	$^\circ\text{C}$

## Features

- International standard package JEDEC TO-247 AD
- IGBT and anti-parallel FRED in one package
- 2nd generation HDMOS™ process
- Low  $V_{CE(sat)}$ 
  - for low on-state conduction losses
- MOS Gate turn-on
  - drive simplicity
- Fast Recovery Epitaxial Diode (FRED)
  - soft recovery with low  $I_{RM}$

## Applications

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

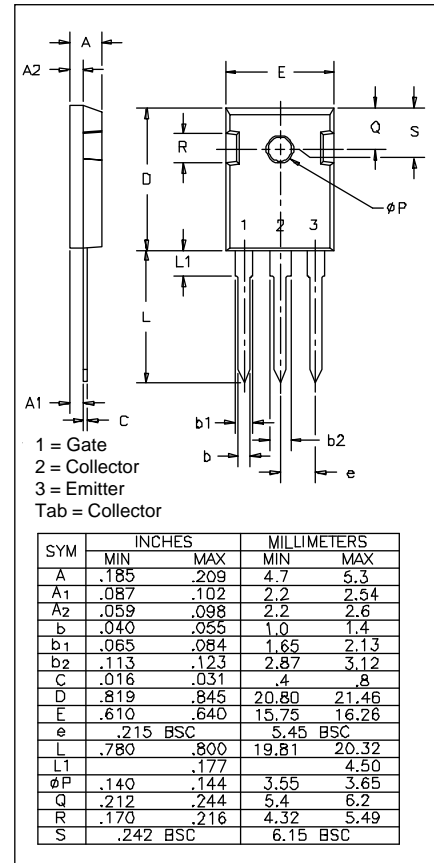
## Advantages

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

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$BV_{CES}$	$I_C = 750\ \mu\text{A}$ , $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 500\ \mu\text{A}$ , $V_{CE} = V_{GE}$	2.5		5.5 V
$I_{CES}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			$T_J = 25^\circ\text{C}$ : 260 $\mu\text{A}$ $T_J = 125^\circ\text{C}$ : 2.5 mA
$I_{GES}$	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$			10N60U1: 2.5 V 10N60AU1: 3.0 V

Symbol	Test Conditions	Characteristic Values		
		(T <sub>J</sub> = 25°C, unless otherwise specified)		
		min.	typ.	max.
<b>g<sub>fs</sub></b>	I <sub>C</sub> = I <sub>C90</sub> ; V <sub>CE</sub> = 10 V, Pulse test, t ≤ 300 μs, duty cycle ≤ 2 %	4	8	S
<b>C<sub>ies</sub></b> <b>C<sub>oes</sub></b> <b>C<sub>res</sub></b>	V <sub>CE</sub> = 25 V, V <sub>GE</sub> = 0 V, f = 1 MHz		750	pF
			125	pF
			30	pF
<b>Q<sub>g</sub></b> <b>Q<sub>ge</sub></b> <b>Q<sub>gc</sub></b>	I <sub>C</sub> = I <sub>C90</sub> , V <sub>GE</sub> = 15 V, V <sub>CE</sub> = 0.5 V <sub>CES</sub>		50	70 nC
			15	25 nC
			25	45 nC
<b>t<sub>d(on)</sub></b> <b>t<sub>ri</sub></b> <b>E<sub>on</sub></b> <b>t<sub>d(off)</sub></b> <b>t<sub>fi</sub></b> <b>E<sub>off</sub></b>	<b>Inductive load, T<sub>J</sub> = 25°C</b> I <sub>C</sub> = I <sub>C90</sub> , V <sub>GE</sub> = 15 V, L = 100 μH V <sub>CE</sub> = 0.8 V <sub>CES</sub> , R <sub>G</sub> = R <sub>off</sub> = 150 Ω Switching times may increase for V <sub>CE</sub> (Clamp) > 0.8 • V <sub>CES</sub> , higher T <sub>J</sub> or increased R <sub>G</sub>		100	ns
			200	ns
			0.4	mJ
			600	ns
			300	ns
			0.6	mJ
<b>t<sub>d(on)</sub></b> <b>t<sub>ri</sub></b> <b>E<sub>on</sub></b> <b>t<sub>d(off)</sub></b> <b>t<sub>fi</sub></b> <b>E<sub>off</sub></b>	<b>Inductive load, T<sub>J</sub> = 125°C</b> I <sub>C</sub> = I <sub>C90</sub> , V <sub>GE</sub> = 15 V, L = 100 μH V <sub>CE</sub> = 0.8 V <sub>CES</sub> , R <sub>G</sub> = R <sub>off</sub> = 150 Ω Switching times may increase for V <sub>CE</sub> (Clamp) > 0.8 • V <sub>CES</sub> , higher T <sub>J</sub> or increased R <sub>G</sub>		100	ns
			200	ns
			1	mJ
			900	1500 ns
			570	2000 ns
			1.2	mJ
<b>R<sub>thJC</sub></b> <b>R<sub>thCK</sub></b>				1.25 K/W K/W

### TO-247 AD Outline



### Reverse Diode (FRED)

Symbol	Test Conditions	Characteristic Values		
		(T <sub>J</sub> = 25°C, unless otherwise specified)		
		min.	typ.	max.
<b>V<sub>F</sub></b>	I <sub>F</sub> = I <sub>C90</sub> , V <sub>GE</sub> = 0 V, Pulse test, t ≤ 300 μs, duty cycle d ≤ 2 %			1.75 V
<b>I<sub>RM</sub></b> <b>t<sub>tr</sub></b>	I <sub>F</sub> = I <sub>C90</sub> , V <sub>GE</sub> = 0 V, -di <sub>F</sub> /dt = 64 A/μs V <sub>R</sub> = 360 V T <sub>J</sub> = 100°C I <sub>F</sub> = 1 A; -di <sub>F</sub> /dt = 50 A/μs; V <sub>R</sub> = 30 V T <sub>J</sub> = 25°C		2.5	A
				165
			35	50 ns
<b>R<sub>thJC</sub></b>				2.5 K/W

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IXYS MOSFETS and IGBTs are covered by one or more of the following U.S. patents: 4,835,592 4,881,106 5,017,508 5,049,961 5,187,117 5,486,715  
4,850,072 4,931,844 5,034,796 5,063,307 5,237,481 5,381,025

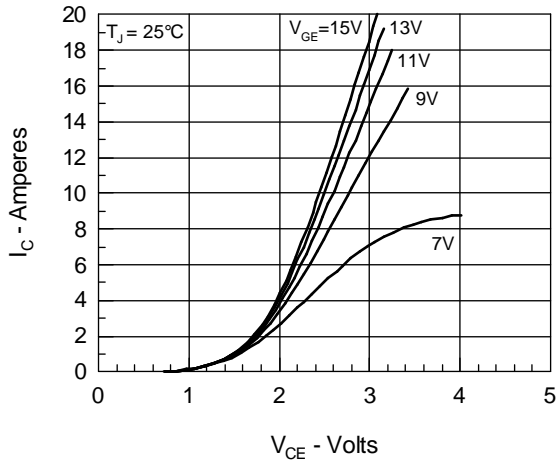
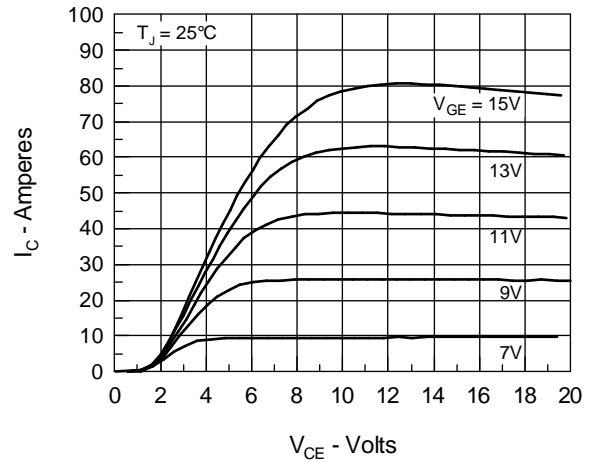
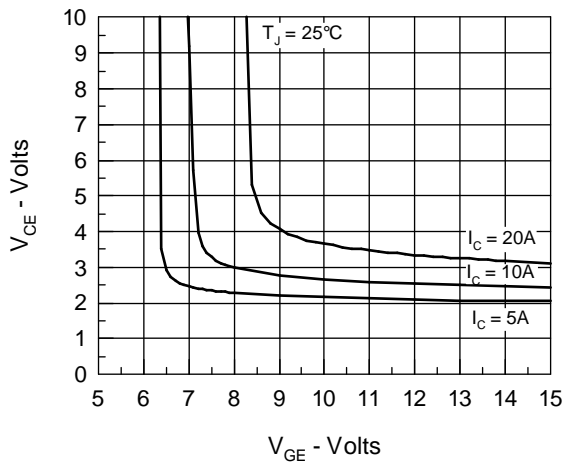
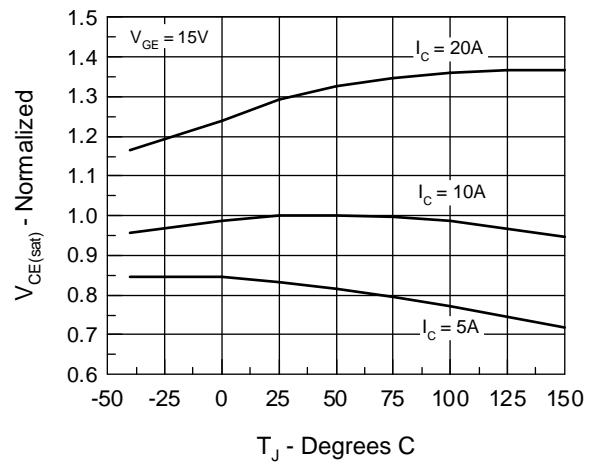
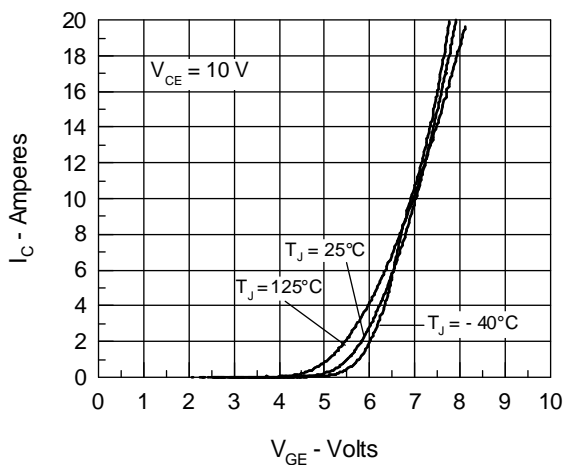
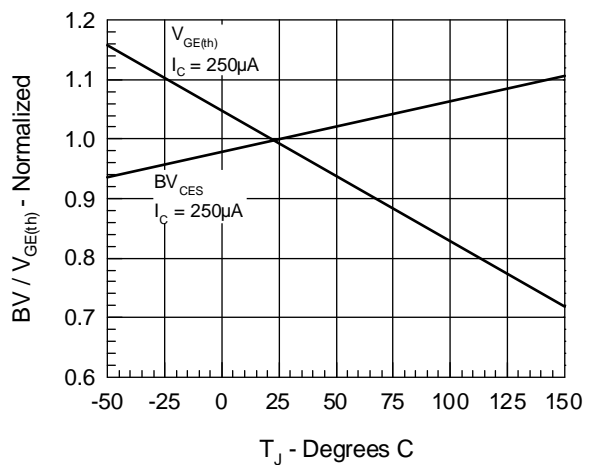
**Fig. 1 Saturation Characteristics**

**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 Gate Charge

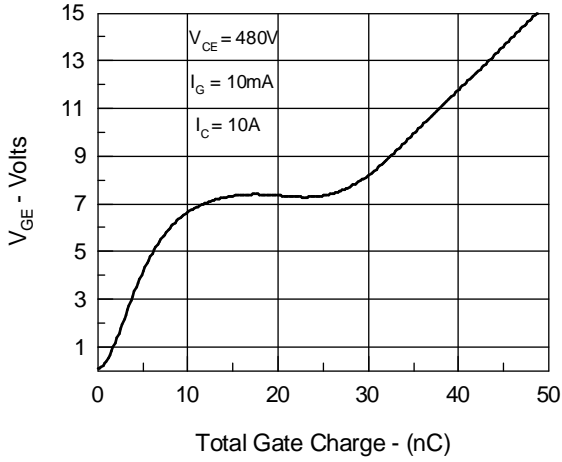


Fig.8 Turn-Off Safe Operating Area

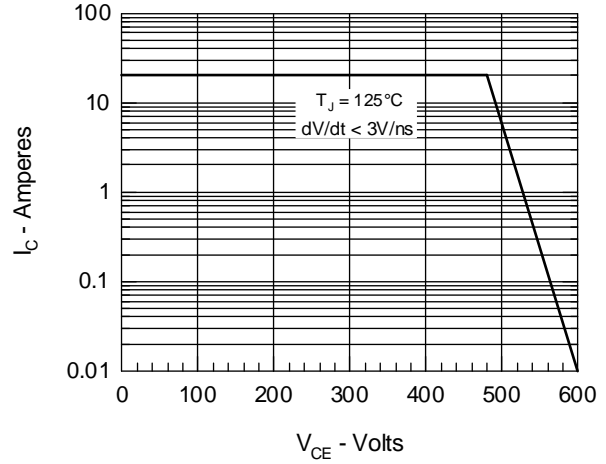


Fig.9 Capacitance Curves

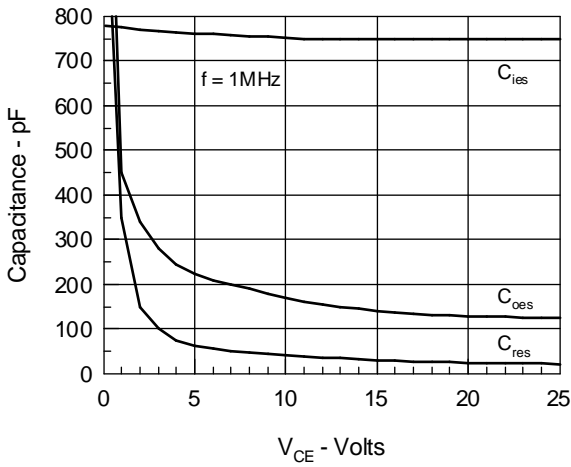
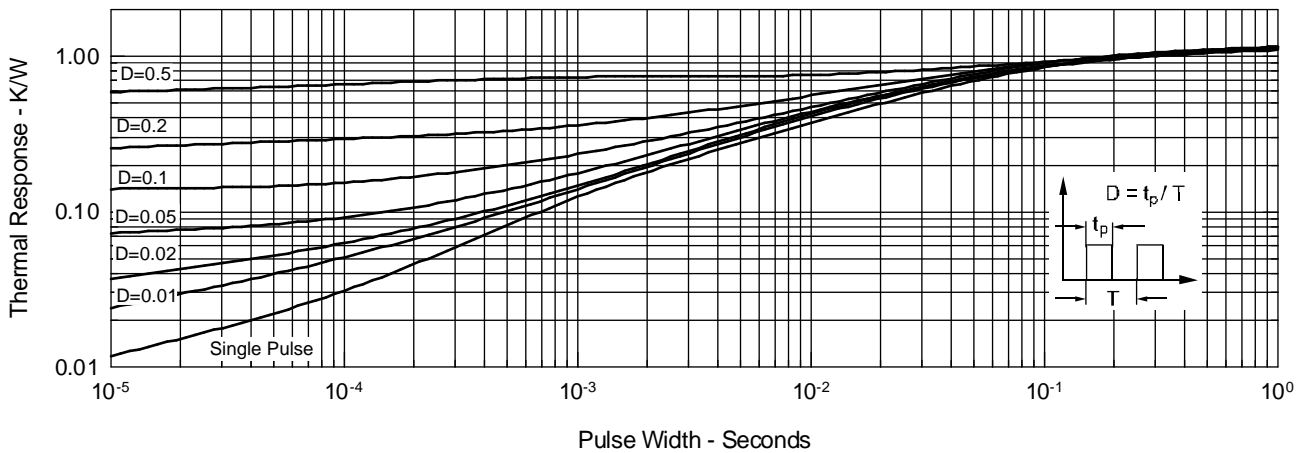


Fig.10 Transient Thermal Impedance



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4,850,072 4,931,844 5,034,796 5,063,307 5,237,481 5,381,025

Fig.11 Maximum Forward Voltage Drop

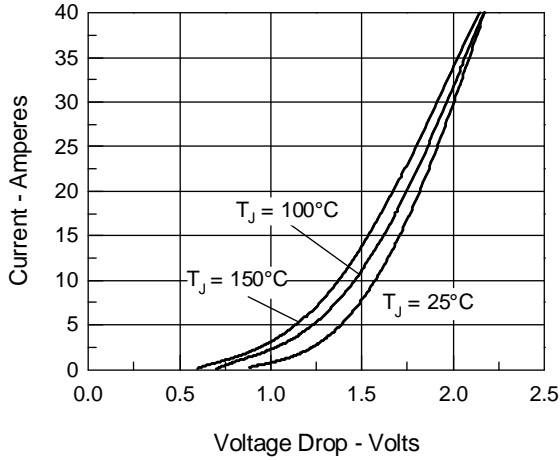


Fig.12 Peak Forward Voltage  $V_{FR}$  and Forward Recovery Time  $t_{FR}$

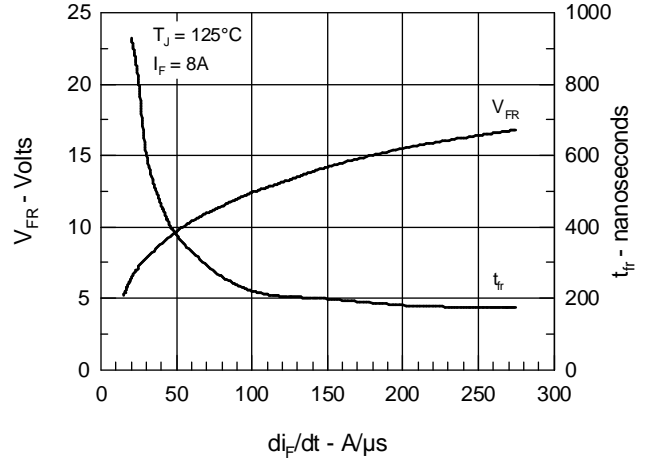


Fig.13 Junction Temperature Dependence off  $I_{RM}$  and  $Q_r$

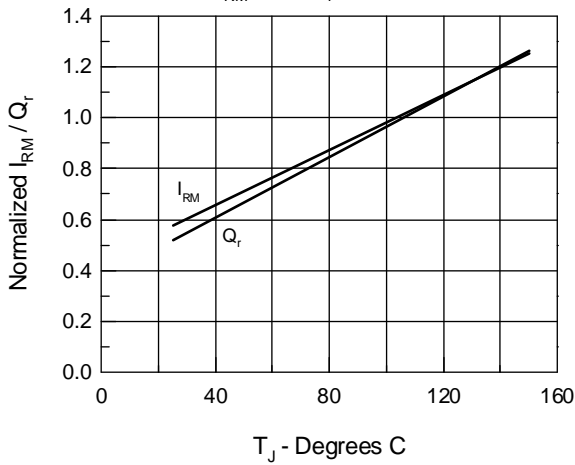


Fig.14 Reverse Recovery Charge

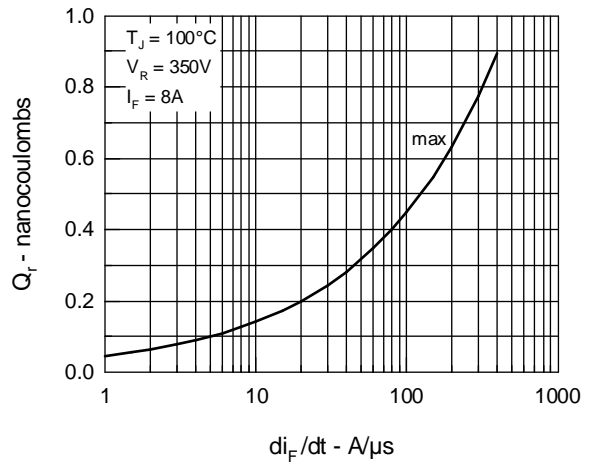


Fig.15 Peak Reverse Recovery Current

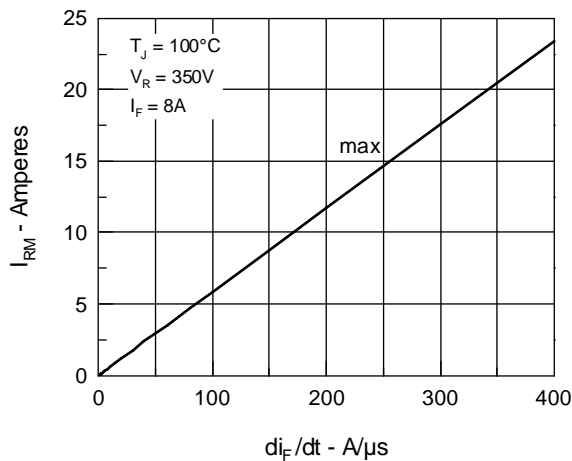


Fig.16 Reverse Recovery Time

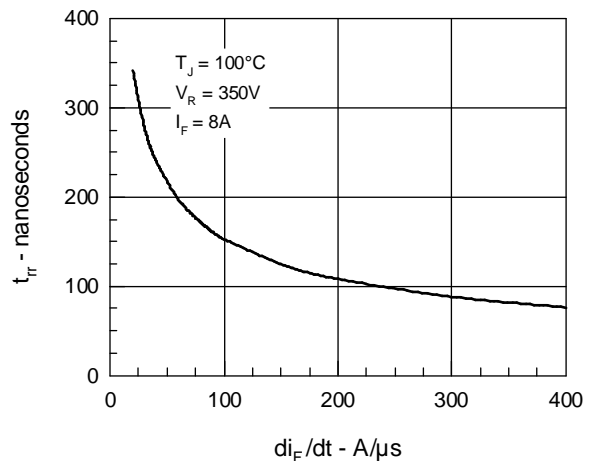
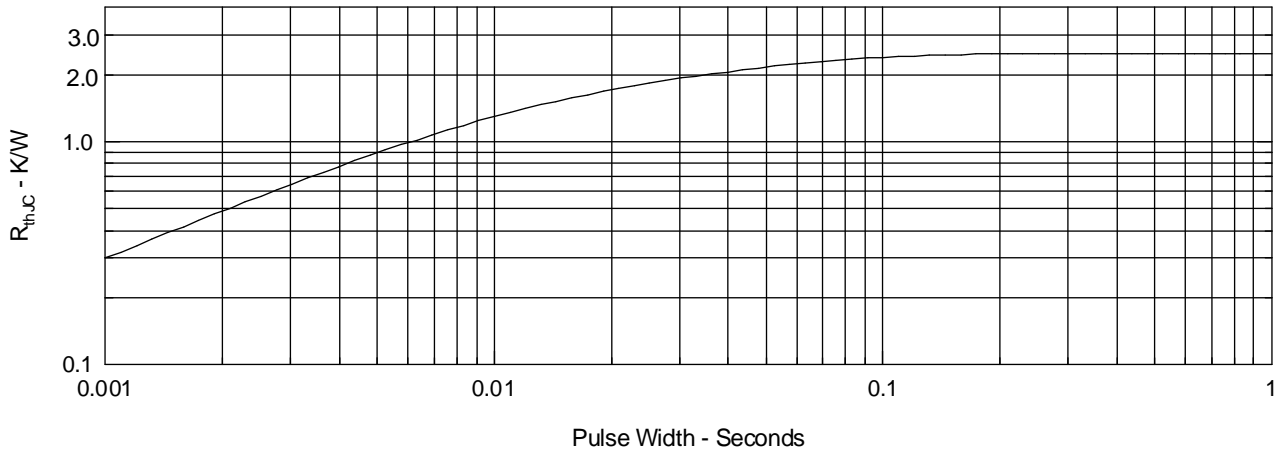


Fig.17 Diode Transient Thermal resistance junction to case



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