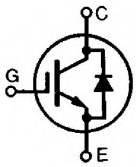
IXYS

HiPerFAST™ IGBT with Diode

	V_{CES}	I_{C25}	$V_{CE(sat)}$
IXSH 24N60U1 / IXSH 24N60U1S	**600 V**	**48 A**	**2.2 V**
IXSH 24N60AU1 / IXSH 24N60AU1S	**600 V**	**48 A**	**2.7 V**

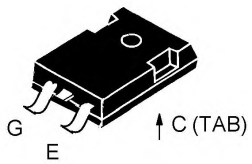
Short Circuit SOA Capability



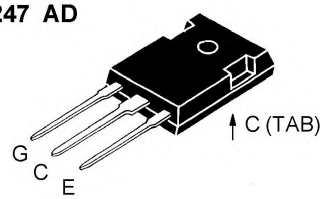
Symbol	Test Conditions		Maximum Ratings	
V_{CES}	T_J = 25°C to 150°C		600	V
V_{CGR}	T_J = 25°C to 150°C; R_{GE} = 1 MΩ		600	V
V_{GES}	Continuous		±20	V
V_{GEM}	Transient		±30	V
I_{C25}	T_C = 25°C		48	A
I_{C90}	T_C = 90°C		24	A
I_{CM}	T_C = 25°C, 1 ms		96	A
SSOA (RBSOA)	V_{GE} = 15 V, T_{VJ} = 125°C, R_G = 10 Ω Clamped inductive load, L = 100 µH		I_{CM} = 48 @ 0.8 V_{CES}	A
t_{SC} **(SCSOA)**	V_{GE} = 15 V, V_{CE} = 360 V, T_J = 125°C, R_G = 82 Ω, non-repetitive		10	µs
P_C	T_C = 25°C		150	W
T_J			-55 ... +150	°C
T_{JM}			150	°C
T_{stg}			-55 ... +150	°C
Maximum Lead and Tab temperature for soldering 1.6 mm (0.062 in.) from case for 10 s			300	°C
M_d	Mounting torque, TO-247		1.13/10	Nm/lb.in.
Weight		TO-247 SMD	4	g
		TO-247 AD	6	g

Symbol	Test Conditions		Characteristic Values (T_J = 25°C, unless otherwise specified) min.	typ.	max.	
BV_{CES}	I_C = 750 µA, V_{GE} = 0 V		600			V
$V_{GE(th)}$	I_C = 1.5 mA, V_{CE} = V_{GE}		3.5		6.5	V
I_{CES}	V_{CE} = 0.8 • V_{CES}	T_J = 25°C			500	µA
	V_{GE} = 0 V	T_J = 125°C			8	mA
I_{GES}	V_{CE} = 0 V, V_{GE} = ±20 V				±100	nA
$V_{CE(sat)}$	I_C = I_{C90}, V_{GE} = 15 V	IXSH 24N60U1			2.2	V
		IXSH 24N60AU1			2.7	V

TO-247 SMD
(...S)



TO-247 AD



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

Features

- International standard packages JEDEC TO-247 SMD surface mountable and JEDEC TO-247 AD
- High frequency IGBT and anti-parallel FRED in one package
- 2nd generation HDMOS™ process
- Low $V_{CE(sat)}$
  - for minimum 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

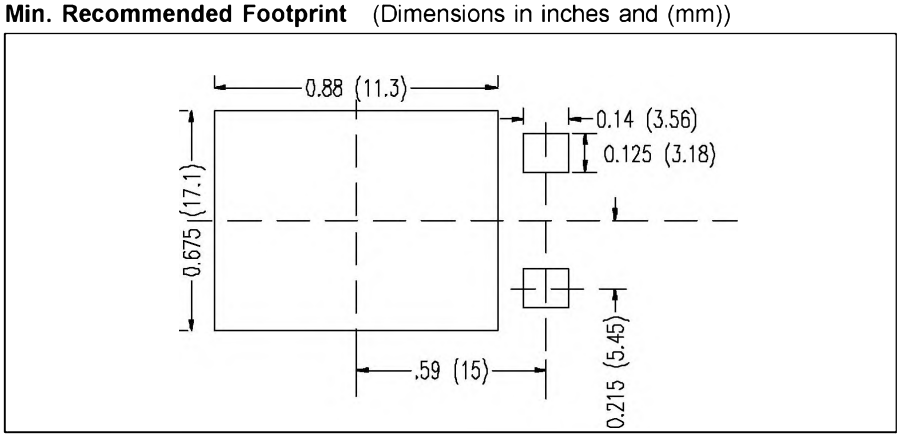
- Space savings (two devices in one package)
- Suitable for surface mounting
- Easy to mount with 1 screw, TO-247 (isolated mounting screw hole)
- Reduces assembly time and cost

Symbol	Test Conditions		Characteristic Values (T_J = 25°C, unless otherwise specified) min.	typ.	max.	
g_{fs}	$I_C = I_{C90}$; V_{CE} = 10 V, Pulse test, t ≤ 300 µs, duty cycle ≤ 2 %		9	13		S
$I_{C(on)}$	V_{GE} = 15 V, V_{CE} = 10 V			65		A
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz			1800		pF
C_{oes}				200		pF
C_{res}				45		pF
Q_g	$I_C = I_{C90}$, V_{GE} = 15 V, V_{CE} = 0.5 V_{CES}			75	90	nC
Q_{ge}				20	30	nC
Q_{gc}				35	50	nC
$t_{d(on)}$	**Inductive load, T_J = 25°C**			100		ns
t_{ri}	$I_C = I_{C90}$, V_{GE} = 15 V, L = 100 µH,			200		ns
$t_{d(off)}$	V_{CE} = 0.8 V_{CES}, $R_G = R_{off}$ = 10 Ω			450		ns
t_{fi}	Remarks: Switching times	24N60U1		500		ns
	may increase for	24N60AU1		275		ns
	V_{CE} (Clamp) > 0.8 • V_{CES},					
E_{off}	higher T_J or increased R_G	24N60AU1		2		mJ
$t_{d(on)}$	**Inductive load, T_J = 125°C**			100		ns
t_{ri}				200		ns
E_{on}	$I_C = I_{C90}$, V_{GE} = 15 V, L = 100 µH			1.8		mJ
$t_{d(off)}$	V_{CE} = 0.8 V_{CES}, $R_G = R_{off}$ = 10 Ω			475		ns
t_{fi}	Remarks: Switching times	24N60U1		600		ns
	may increase for	24N60AU1		450		ns
	V_{CE} (Clamp) > 0.8 • V_{CES},	24N60U1		4		mJ
E_{off}	higher T_J or increased R_G	24N60AU1		3		mJ
R_{thJC}					0.83	K/W
R_{thCK}				0.25		K/W

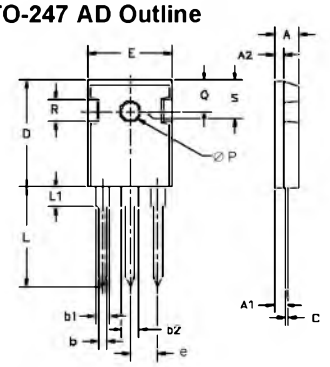
Reverse Diode (FRED) — Characteristic Values (T_J = 25°C, unless otherwise specified)

Symbol	Test Conditions		min.	typ.	max.	
V_F	$I_F = I_{C90}$, V_{GE} = 0 V, Pulse test, t ≤ 300 µs, duty cycle d ≤ 2 %				1.6	V
I_{RM}	$I_F = I_{C90}$, V_{GE} = 0 V, -di$_F$/dt = 240 A/µs			10	15	A
t_{rr}	V_R = 360 V	T_J = 125°C		150		ns
	I_F = 1 A; -di/dt = 100 A/µs; V_R = 30 V	T_J = 25°C		35	50	ns
R_{thJC}					1	K/W

Min. Recommended Footprint (Dimensions in inches and (mm))

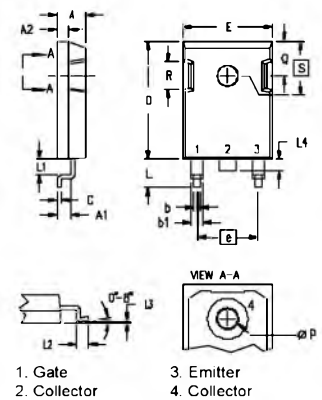


TO-247 AD Outline



Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.7	5.3	.185	.209
A_1	2.2	2.54	.087	.102
A_2	2.2	2.6	.059	.098
b	1.0	1.4	.040	.055
b_1	1.65	2.13	.065	.084
b_2	2.87	3.12	.113	.123
C	.4	.8	.016	.031
D	20.80	21.46	.819	.845
E	15.75	16.26	.610	.640
e	5.20	5.72	0.205	0.225
L	19.81	20.32	.780	.800
L1		4.50		.177
ØP	3.55	3.65	.140	.144
Q	5.89	6.40	0.232	0.252
R	4.32	5.49	.170	.216
S	6.15	BSC	242	BSC

TO-247 SMD Outline



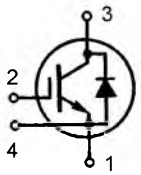
Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b1	1.91	2.13	.075	.084
C	0.61	0.80	.024	.031
D	20.80	21.34	.819	.840
E	15.75	16.13	.620	.635
e	5.45	BSC	.215	BSC
L	4.90	5.10	.193	.201
L1	2.70	2.90	.106	.114
L2	2.10	2.30	.083	.091
L3	0.00	0.10	.00	.004
L4	1.90	2.10	.075	.083
ØP	3.55	3.65	.140	.144
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190
S	6.15	BSC	.242	BSC

IXYS

High Voltage IGBT with Diode

IXSN 35N120AU1

V_{CES} = 1200 V
I_{C25} = 70 A
$V_{CE(sat)}$ = 4 V

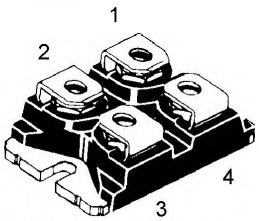


Symbol	Test Conditions		Maximum Ratings	
V_{CES}	T_J = 25°C to 150°C		1200	V
V_{CGR}	T_J = 25°C to 150°C; R_{GE} = 1 MΩ		1200	A
V_{GES}	Continuous		±20	V
V_{GEM}	Transient		±30	V
I_{C25}	T_C = 25°C		70	A
I_{C90}	T_C = 90°C		35	A
I_{CM}	T_C = 25°C, 1 ms		140	A
SSOA (RBSOA)	V_{GE} = 15 V, T_{VJ} = 125°C, R_G = 22 Ω Clamped inductive load, L = 30 µH		I_{CM} = 70 @ 0.8 V_{CES}	A
t_{SC} **(SCSOA)**	V_{GE} = 15 V, V_{CE} = 0.6 • V_{CES}, T_J = 125°C R_G = 22 Ω, non repetitive		10	µs
P_C	T_C = 25°C	IGBT	300	W
P_D		Diode	175	W
V_{ISOL}	50/60 Hz	t = 1 min	2500	V~
	I_{ISOL} ≤ 1 mA	t = 1 s	3000	V~
T_J			-55 ... +150	°C
T_{JM}			150	°C
T_{stg}			-55 ... +150	°C
M_d	Mounting torque		1.5/13	Nm/lb.in.
	Terminal connection torque (M4)		1.5/13	Nm/lb.in.
Weight			30	g

Symbol	Test Conditions		Characteristic Values (T_J = 25°C, unless otherwise specified) min.	typ.	max.	
BV_{CES}	I_C = 5 mA, V_{GE} = 0 V		1200			V
$V_{GE(th)}$	I_C = 4 mA, V_{CE} = V_{GE}		4		8	V
I_{CES} ①	V_{CE} = 0.8 • V_{CES}	T_J = 25°C			750	µA
	V_{GE} = 0 V	T_J = 125°C			15	mA
I_{GES}	V_{CE} = 0 V, V_{GE} = ±20 V				±100	nA
$V_{CE(sat)}$	I_C = I_{C90}, V_{GE} = 15 V				4	V

① Device must be heat sunk during high temperature leackage test to avoid thermal runaway.

miniBLOC, SOT-227 B



1 = Emitter ①, 3 = Collector
2 = Gate, 4 = Emitter ①

① Either Emitter terminal can be used as Main or Kelvin Emitter

Features

- International standard package miniBLOC (ISOTOP) compatible
- Aluminium-nitride isolation
  - high power dissipation
- Isolation voltage 3000 V~
- Low $V_{CE(sat)}$
  - for minimum on-state conduction losses
- Fast Recovery Epitaxial Diode
  - short t_{rr} and I_{RM}
- Low collector-to-case capacitance (< 50 pF)
  - reducesd RFI
- Low package inductance (< 10 nH)
  - easy to drive and to protect

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
- Easy to mount with 2 screws
- High power density

92519E (4/96)

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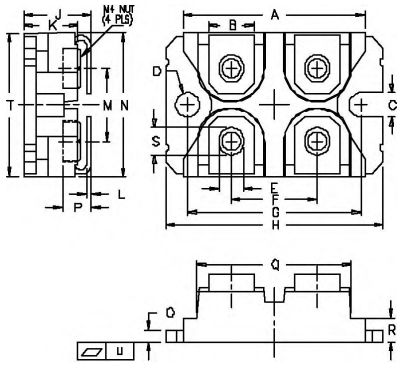
Symbol	Test Conditions (T$_J$ = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
g_{fs}	$I_C = I_{C90}$; V_{CE} = 10 V, Pulse test, t ≤ 300 µs, duty cycle d ≤ 2 %	20	26		S
$I_{C(on)}$	V_{CE} = 10 V, V_{GE} = 15 V		170		A
C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz		3900		pF
C_{oes}			295		pF
C_{res}			60		pF
Q_g	$I_C = I_{C90}$, V_{GE} = 15 V, V_{CE} = 0.5 V_{CES}		150	190	nC
Q_{ge}			40	60	nC
Q_{gc}			70	100	nC
$t_{d(on)}$	**Inductive load, T_J = 25°C**		80		ns
t_{ri}	$I_C = I_{C90}$, V_{GE} = 15 V,		150		ns
$t_{d(off)}$	V_{CE} = 0.8 • V_{CES}, R_G = 2.7 Ω		400	900	ns
t_{fi}	Remarks: Switching times may increase		500	700	ns
E_{off}	for V_{CE} (Clamp) > 0.8 • V_{CES}, higher T_J or increased R_G		10		mJ
$t_{d(on)}$	**Inductive load, T_J = 125°C**		80		ns
t_{ri}	$I_C = I_{C90}$, V_{GE} = 15 V,		150		ns
$t_{d(off)}$	V_{CE} = 0.8 • V_{CES}, R_G = 2.7 Ω		400		ns
t_{fi}	Remarks: Switching times may increase		700		ns
E_{on}	for V_{CE} (Clamp) > 0.8 • V_{CES}, higher T_J or		6		mJ
E_{off}	increased R_G		15		mJ
R_{thJC}				0.42	K/W
R_{thCK}			0.05		K/W

miniBLOC, SOT-227 B



M4 screws (4x) supplied

Dim.	Millimeter Min.	Max.	Inches Min.	Max.
A	31.50	31.88	1.240	1.255
B	7.80	8.20	0.307	0.323
C	4.09	4.29	0.161	0.169
D	4.09	4.29	0.161	0.169
E	4.09	4.29	0.161	0.169
F	14.91	15.11	0.587	0.595
G	30.12	30.30	1.186	1.193
H	38.00	38.23	1.496	1.505
J	11.68	12.22	0.460	0.481
K	8.92	9.60	0.351	0.378
L	0.76	0.84	0.030	0.033
M	12.60	12.85	0.496	0.506
N	25.15	25.42	0.990	1.001
O	1.98	2.13	0.078	0.084
P	4.95	5.97	0.195	0.235
Q	26.54	26.90	1.045	1.059
R	3.94	4.42	0.155	0.174
S	4.72	4.85	0.186	0.191
T	24.59	25.07	0.968	0.987
U	-0.05	0.1	-0.002	0.004

Reverse Diode (FRED)

Symbol	Test Conditions (T$_J$ = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
V_F	$I_F = I_{C90}$, V_{GE} = 0 V, Pulse test, t ≤ 300 µs, duty cycle d ≤ 2 %			2.35	V
I_{RM}	$I_F = I_{C90}$, V_{GE} = 0 V, -di$_F$/dt = 480 A/µs		32	35	A
t_{rr}	V_R = 540 V T_J = 100°C		225		ns
	I_F = 1 A; -di/dt = 200 A/µs; V_R = 30 V T_J = 25°C		40	60	ns
R_{thJC}				0.71	K/W

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Fig. 1 Saturation Characteristics

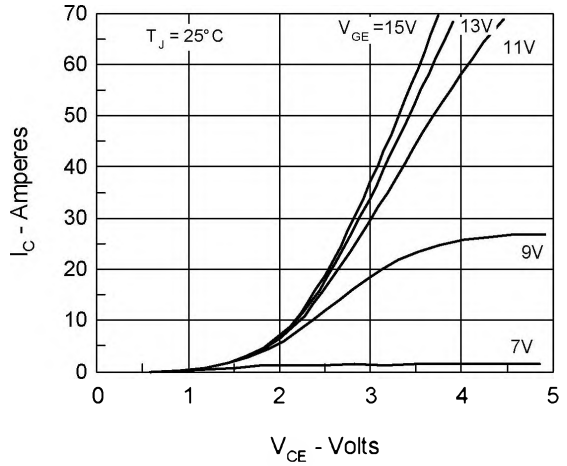

Fig. 2 Output Characterstics

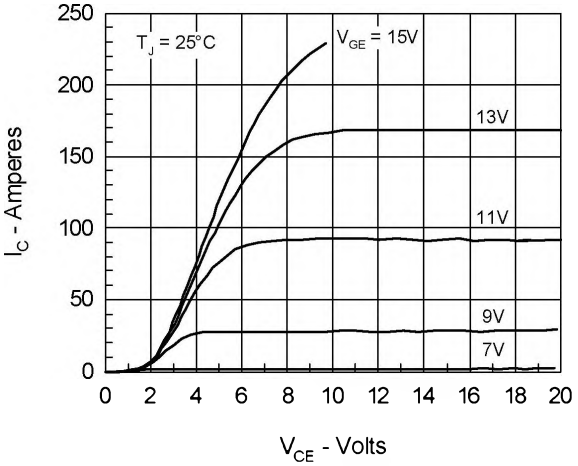

Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

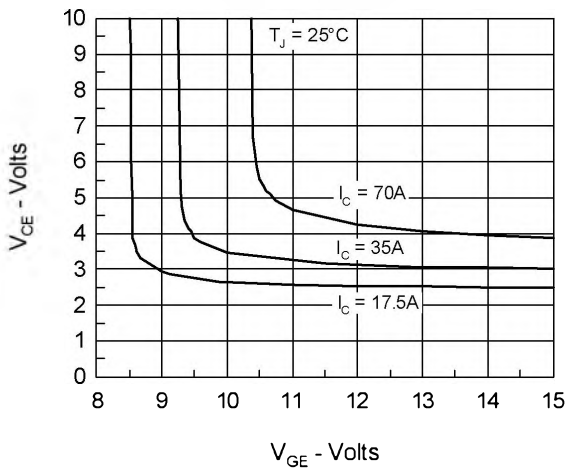

Fig. 4 Temperature Dependence of Output Saturation Voltage

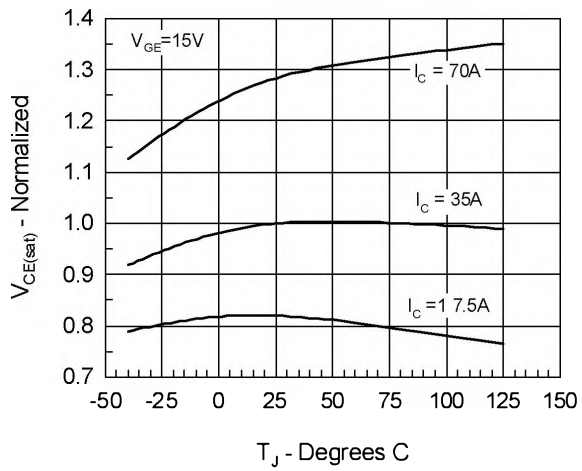

Fig. 5 Input Admittance

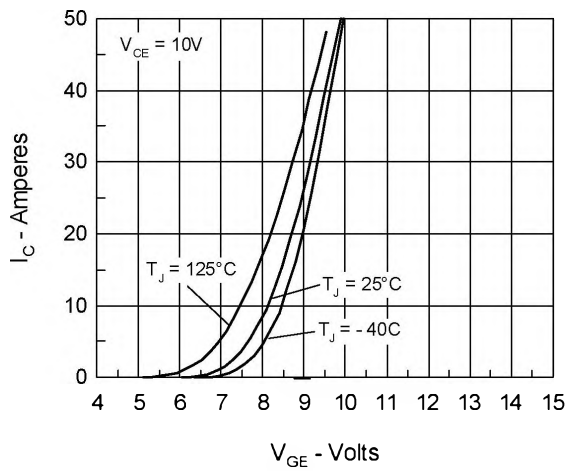

Fig. 6 Temperature Dependence of Breakdown and Threshold Voltage

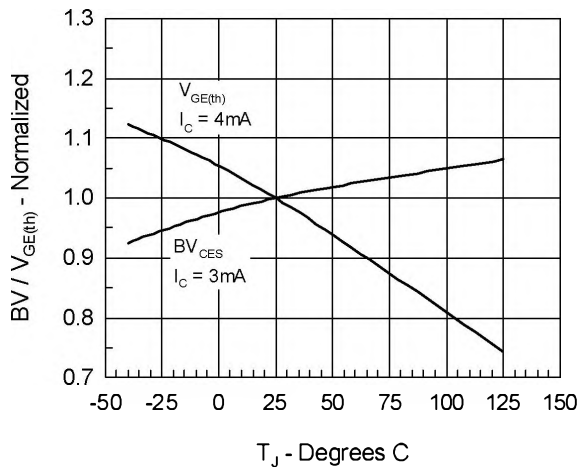

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Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

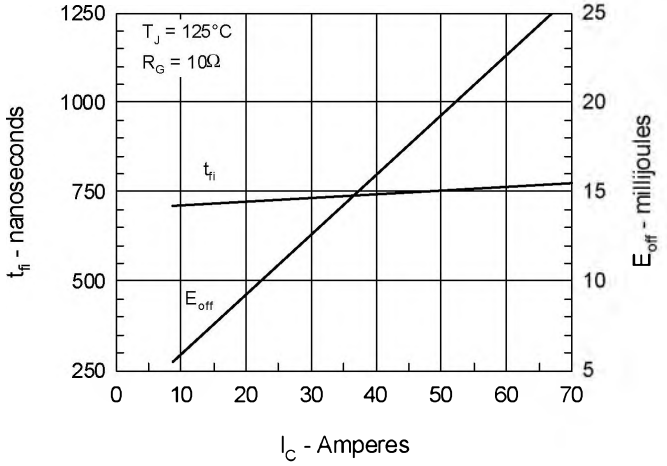


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

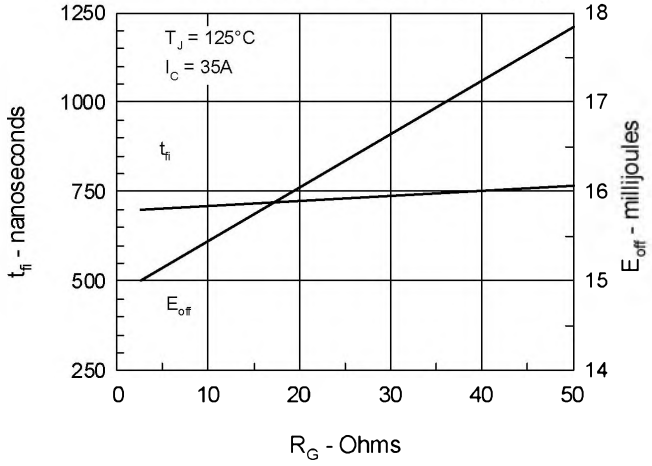


Fig.9 Gate Charge Characteristic Curve

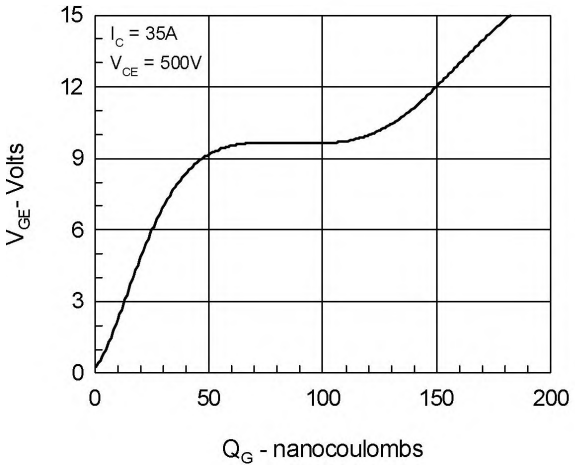


Fig.10 Turn-Off Safe Operating Area

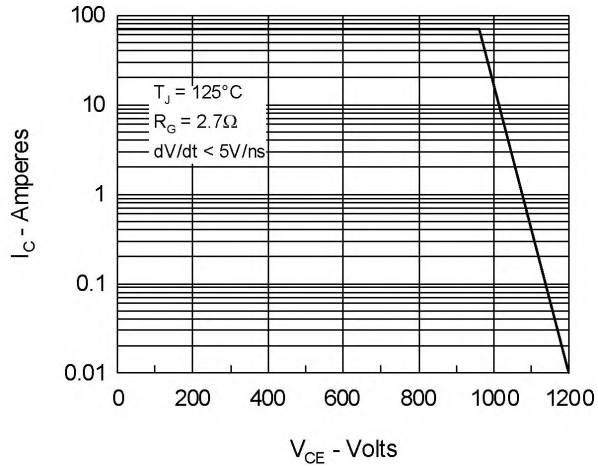
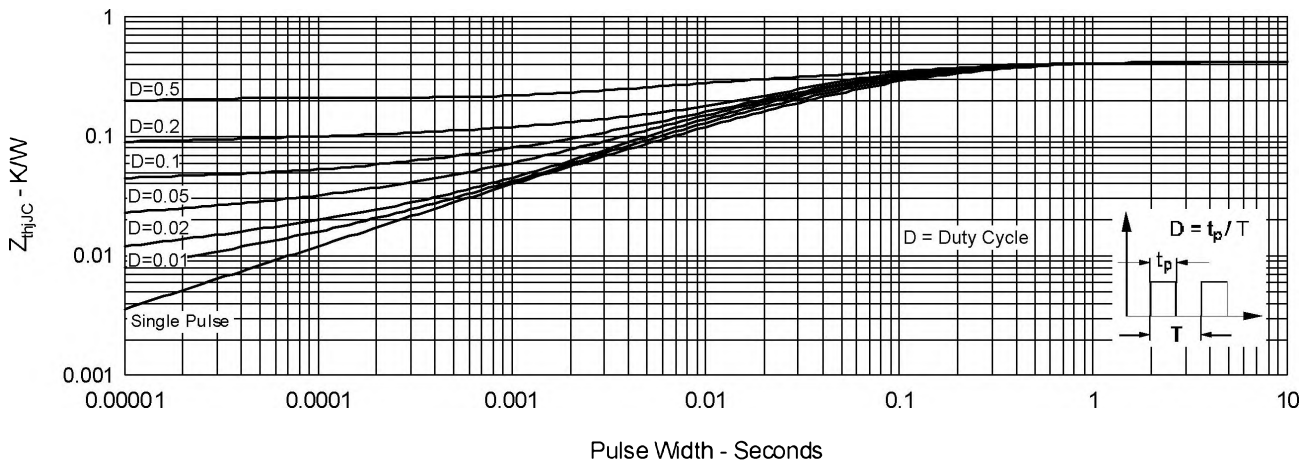


Fig.11 Transient Thermal Impedance



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