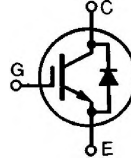


HiPerFAST™ IGBT with Diode

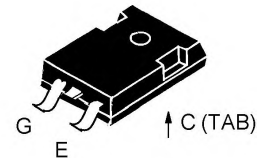
	V_{CES}	I_{C25}	$V_{CE(sat)}$
IXSH 24N60U1 / IXSH 24N60U1S	600 V	48 A	2.2 V
IXSH 24N60AU1 / IXSH 24N60AU1S	600 V	48 A	2.7 V

Short Circuit SOA Capability

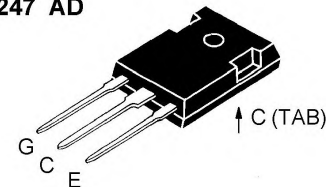


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1\text{ M}\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	48	A
I_{C90}	$T_C = 90^\circ\text{C}$	24	A
I_{CM}	$T_C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

TO-247 SMD (...S)



TO-247 AD



G = Gate,
E = Emitter,

C = Collector,
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 ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 750\ \mu\text{A}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 1.5\text{ mA}$, $V_{CE} = V_{GE}$	3.5		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			500 μA 8 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$ IXSH 24N60U1 IXSH 24N60AU1			2.2 V 2.7 V

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$, $V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$	9	13	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}			200	pF
C_{res}			45	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5\text{ V}_{CES}$		75	nC
Q_{ge}			20	nC
Q_{gc}			35	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = R_{off} = 10\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		100	ns
t_{ri}			200	ns
$t_{d(off)}$			450	ns
t_{fi}		24N60U1	500	ns
E_{off}		24N60AU1	275	ns
		24N60AU1	2	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = R_{off} = 10\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		100	ns
t_{ri}			200	ns
E_{on}			1.8	mJ
$t_{d(off)}$		24N60U1	475	ns
t_{fi}		24N60AU1	600	ns
		24N60AU1	450	ns
E_{off}		24N60U1	4	mJ
		24N60AU1	3	mJ
R_{thJC}				0.83 K/W
R_{thCK}			0.25	K/W

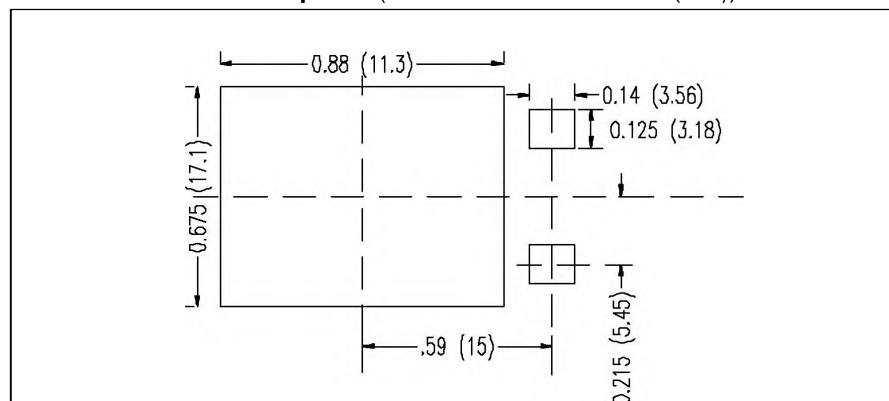
Reverse Diode (FRED)

Characteristic Values

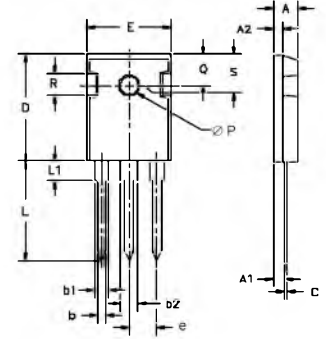
(T_J = 25°C, unless otherwise specified)

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

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

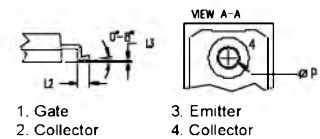
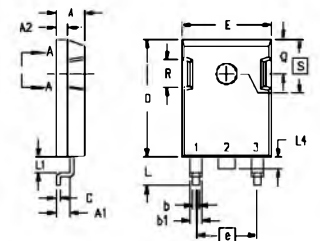


TO-247 AD Outline



Dim.	Millimeter	Min.	Max.	Inches	Min.	Max.
A	4.7	5.3		.185	.209	
A1	2.2	2.54		.087	.102	
A2	2.2	2.6		.059	.098	
b	1.0	1.4		.040	.055	
b1	1.65	2.13		.065	.084	
b2	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



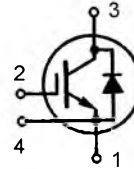
1. Gate
2. Collector
3. Emitter
4. Collector

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	

High Voltage IGBT with Diode

IXSN 35N120AU1

$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 70 \text{ A} \\ V_{CE(sat)} &= 4 \text{ V} \end{aligned}$$

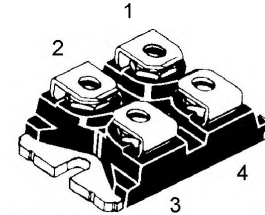


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	70	A
I_{C90}	$T_C = 90^\circ\text{C}$	35	A
I_{CM}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

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

① Device must be heat sunk during high temperature leakage 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

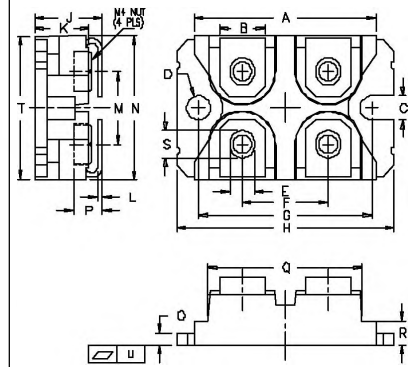
- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switch-mode and resonant-mode power supplies

Advantages

- Space savings
- Easy to mount with 2 screws
- High power density

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, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$	20	26	S
$I_{C(on)}$	$V_{CE} = 10\text{ V}$, $V_{GE} = 15\text{ V}$		170	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3900	pF
C_{oes}			295	pF
C_{res}			60	pF
Q_g	$I_C = I_{C90}, V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		150	nC
Q_{ge}			40	nC
Q_{gc}			70	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}$, $V_{CE} = 0.8 \cdot V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{rl}			150	ns
$t_{d(off)}$			400	900 ns
t_{fi}			500	700 ns
E_{off}			10	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}$, $V_{CE} = 0.8 \cdot V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{rl}			150	ns
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{on}			6	mJ
E_{off}			15	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.05	K/W

miniBLOC, SOT-227 B



M4 screws (4x) supplied

Dim.	Millimeter		Inches	
	Min.	Max.	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	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, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			2.35 V
I_{RM}	$I_F = I_{C90}, V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$, $T_J = 100^\circ\text{C}$ $I_F = 1\text{ A}$, $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$, $T_J = 25^\circ\text{C}$		32	35 A
t_{rr}			225	ns
t_{rr}			40	60 ns
R_{thJC}				0.71 K/W

IXYS MOSFETs and IGBTs are covered by one of the following U.S. patents: 4,835,592 4,881,108 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

IXYS reserves the right to change limits, test conditions, and dimensions.

IXYS Corporation
3540 Bassett Street, Santa Clara CA 95054

IXYS Semiconductor GmbH
Edisonstr. 15, D-68623 Lampertheim
Phone: +49-6206-503-0, Fax: +49-6206-503627

Fig. 1 Saturation Characteristics

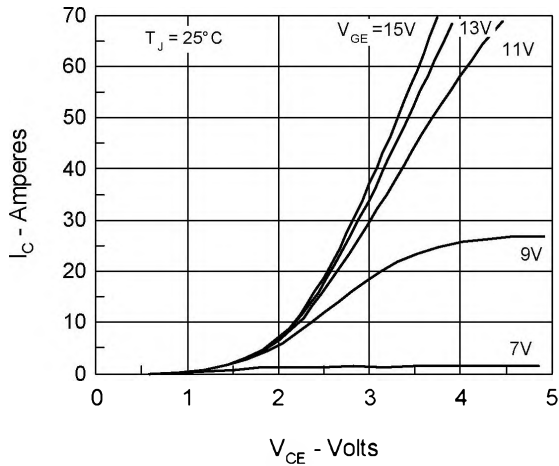


Fig. 2 Output Characteristics

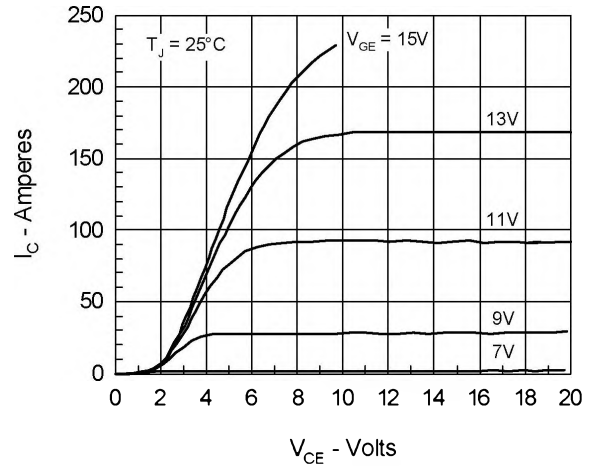


Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

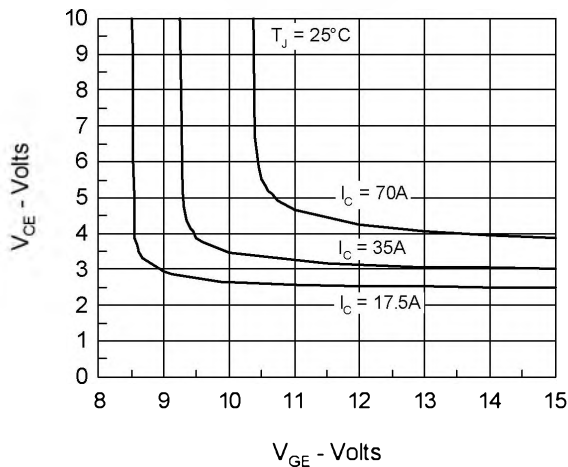


Fig. 4 Temperature Dependence of Output Saturation Voltage

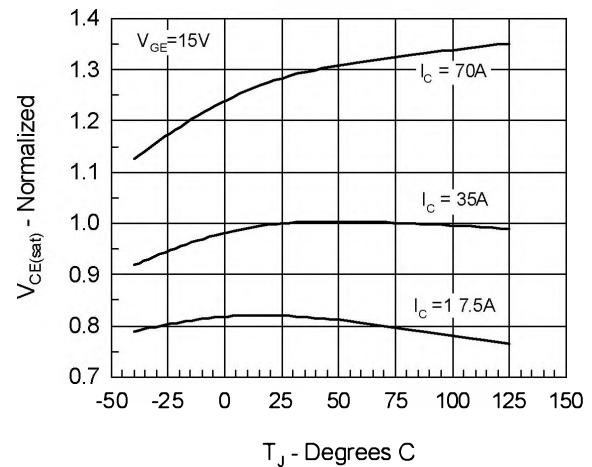


Fig. 5 Input Admittance

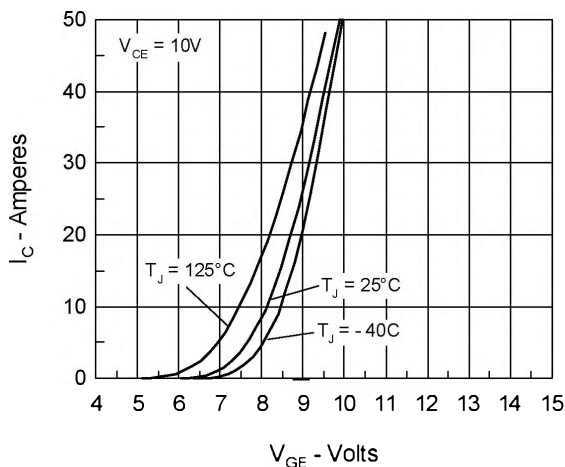


Fig. 6 Temperature Dependence of Breakdown and Threshold Voltage

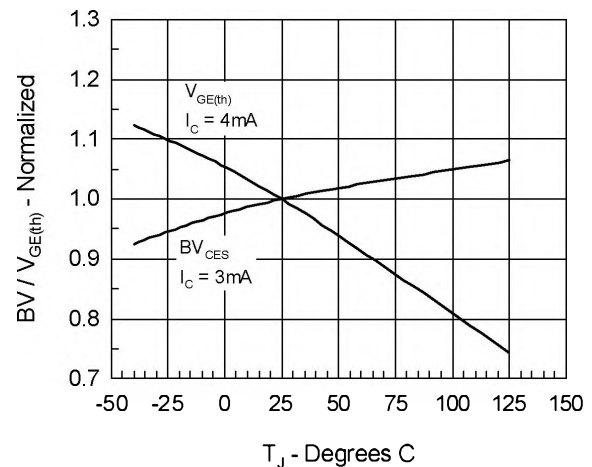
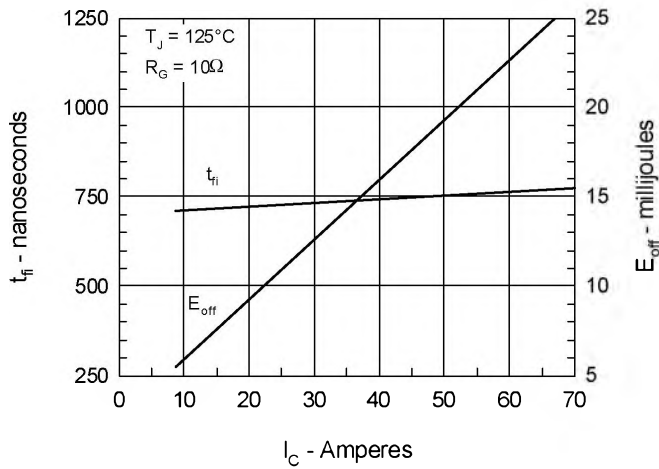
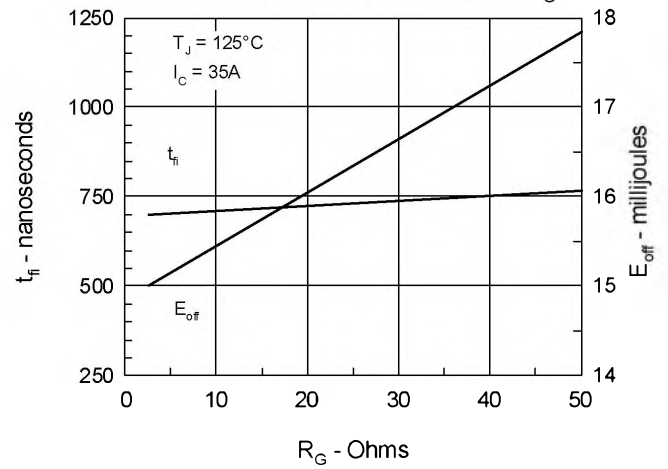
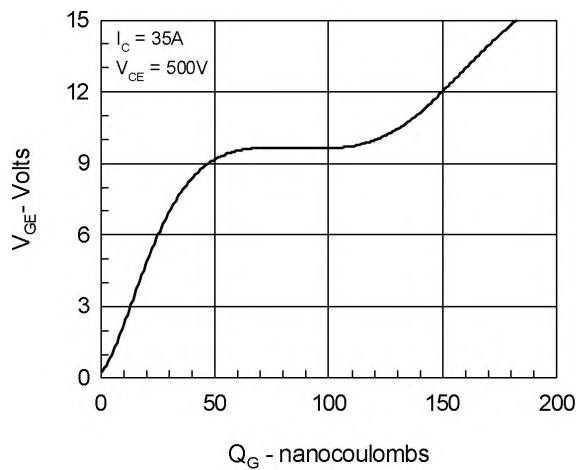
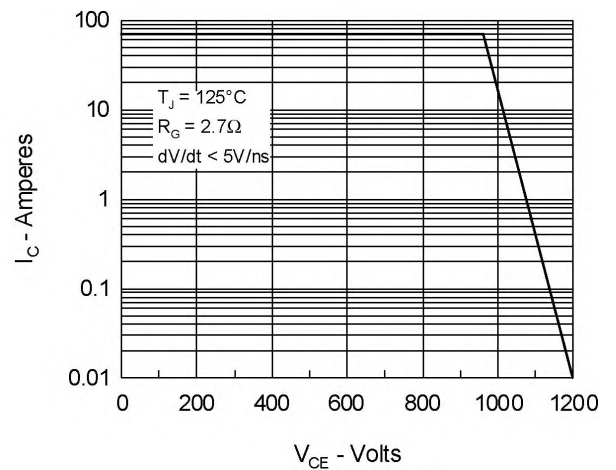
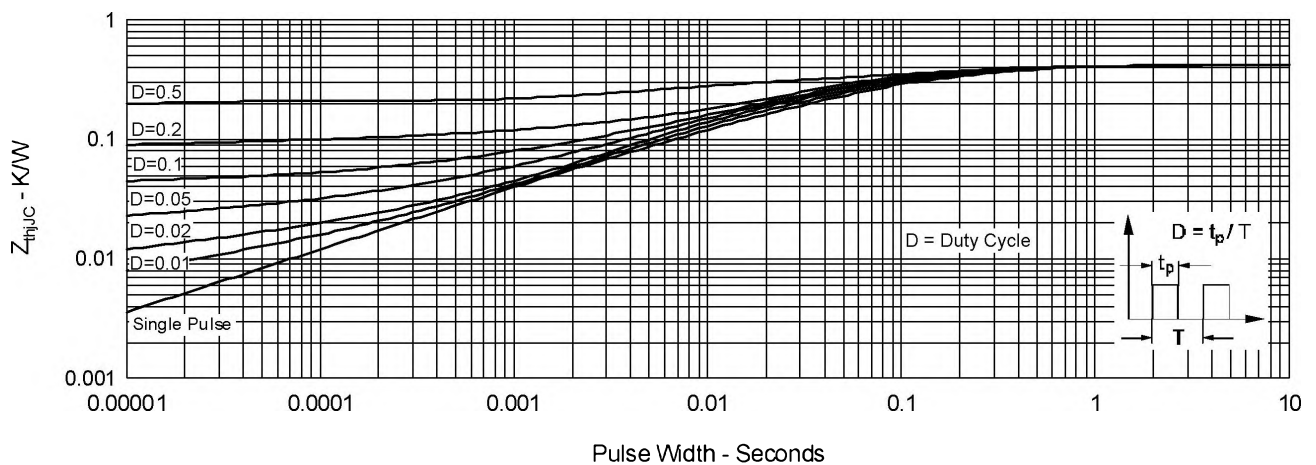


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

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 Impedance


IXYS reserves the right to change limits, test conditions, and dimensions.