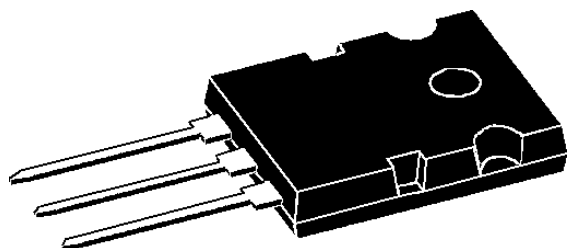
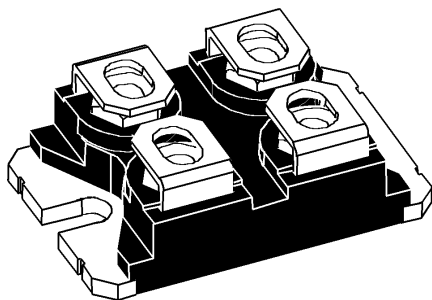
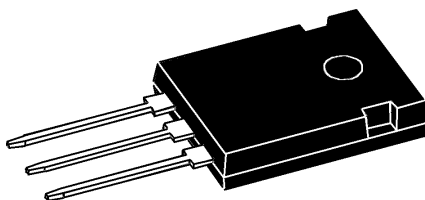
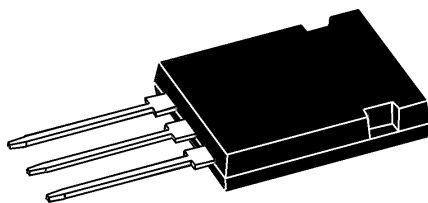
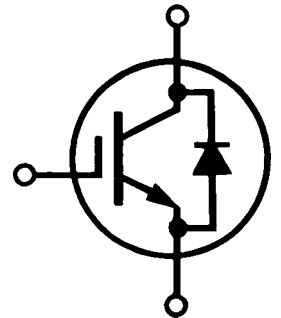
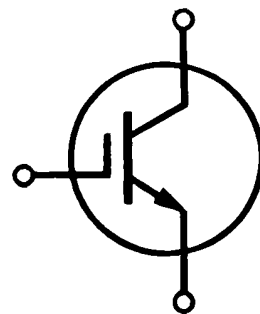


***Insulated Gate
Bipolar Transistors (IGBT)
IGBT with Fast Diode
Short Circuit Current Rated***



Contents



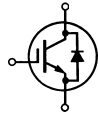
	$V_{CES\ max}$ V	I_C $T_c = 25\ ^\circ C$ A	$V_{CE(sat)\ max}$ $T_c = 25\ ^\circ C$ V	PLUS247 (IXSX)	TO-204 (IXSM)	TO-247 (IXSH)	TO-264 (IXSK)	TO-268 (IXST)	miniBLOC (IXSN)	Page
Low $V_{CE(sat)}$	600	48	2.2			IXSH 24N60				B1-6
	1000	75	2.7			IXSH 45N100	IXSM 45N100			B1-76
	1200	75 ①	3.0			IXSH 45N120				B1-105
High Speed	600	48	2.7			IXSH 24N60A				B1-6
		55	2.0			➤ IXSH 30N60B	IXST 30N60B			B1-10
		55	2.5			IXSH 30N60C	IXST 30N60C			B1-10
		75 ①	2.5			IXSH 40N60B	IXST 40N60B			B1-27
		75	2.5			➤ IXSH 50N60B				B1-37
		160	3.0						IXSN 80N60A	B1-64
		180	2.2	IXSX 80N60B			IXSK 80N60B			B1-66
	1000	70	3.5	IXSM 35N100A		IXSH 35N100A				B1-72
	1200	30	3.4			IXSH 15N120B	IXST 15N120B			B1-80
		50	4.0			IXSH 25N120A				B1-84
		70	3.6			IXSH 35N120A				B1-88
			3.6			IXSH 35N120B	IXST 35N120B			B1-92
		75	3.0			IXSH 45N120B	IXST 45N120B			B1-109
		110	4.0						IXSN 55N120A	B1-111
	1350	70	4.0			IXSH 35N135A				B1-115
	1400	70	4.0			IXSH 35N140A				B1-115

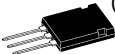
① limited by leads

➤ New Product

Contents

IGBT with Fast Diode



	$V_{CES\ max}$ V	I_C $T_c = 25\ ^\circ C$ A	$V_{CE(sat)\ max}$ $T_c = 25\ ^\circ C$ V	PLUS247 (IXSX) 	ISOPLUS 247 TM (IXSR) 	TO-247 (IXSH) 	TO-264 (IXSK) 	TO-268 (IXST) 	miniBLOC (IXSN) 	Page
Low $V_{CE(sat)}$	600	32	1.8			➤ IXSH 16N60U1				B1-4
		48	2.2			IXSH 24N60U1				B1-8
		50	2.5			IXSH 30N60U1				B1-14
		90	2.5						IXSN 62N60U1	B1-62
High Speed	600	48	2.7			IXSH 24N60AU1				B1-8
		50	3.0			IXSH 30N60AU1				B1-14
		55	2.0			➤ IXSH 30N60BD1	➤ IXST 30N60BD1 ➤ IXSK 30N60BD1			B1-20
			2.5			IXSH 30N60CD1	IXSK 30N60CD1 IXST 30N60CD1			B1-25
		62	2.5	IXSR 40N60CD1						B1-33
		70	2.2	IXSR 40N60BD1						B1-31
		75	2.5	IXSX 40N60CD1			IXSK 40N60CD1			B1-35
			2.2	IXSX 40N60BD1			➤ IXSK 40N60BD1			B1-29
			2.5	IXSX 50N60BD1			IXSK 50N60BD1			B1-41
			2.5	➤ IXSX 50N60BU1			➤ IXSK 50N60BU1			B1-51
			2.5						IXSN 50N60BD2 IXSN 50N60BD3	B1-46
		80	3.0						IXSN 52N60AU1	B1-57
		160							IXSN 80N60AU1	B1-68
	1200	30	3.4			IXSH 15N120BD1	IXST 15N120BD1			B1-82
		50	4.0			IXSH 25N120AU1				B1-86
		70	4.0				IXSK 35N120AU1			B1-98
			4.0	IXSX 35N120AU1						B1-100
			4.0						IXSN 35N120AU1	B1-94
		110	4.0						IXSN 55N120AU1	B1-113

*Special Product
IXSR = insulated package

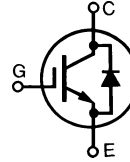
Low $V_{CE(sat)}$ IGBT with Diode

IXSH 16N60U1

$$\begin{aligned} V_{CES} &= 600V \\ I_{C25} &= 16A \\ V_{CE(sat)typ} &= 1.8V \end{aligned}$$

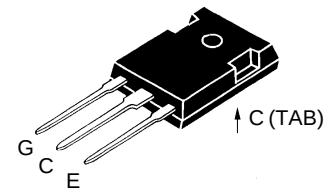
Short Circuit SOA Capability

Preliminary data



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}	$T_C = 25^\circ\text{C}$	32	A
I_{C90}	$T_C = 90^\circ\text{C}$	16	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	52	A
SSOA (RBSOA)	$V_{GE} = 15\text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 150\ \Omega$ Clamped inductive load, $L = 300\ \mu\text{H}$	$I_{CM} = 32$ @ $0.8 V_{CES}$	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	5	μs
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	$^\circ\text{C}$
Weight		2	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Maximum tab temperature for soldering for 10s		260	$^\circ\text{C}$

TO-247 AD



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

Features

- Latest generation HDMOS™ process
- International standard package
- Guaranteed Short Circuit SOA capability
- Low $V_{CE(sat)}$
 - for low on-state conduction losses
- High current handling capability
- MOS Gate turn-on
 - drive simplicity
- Fast fall time for switching speeds up to 20 kHz

Applications

- AC motor speed control
- Uninterruptible power supplies (UPS)
- Welding

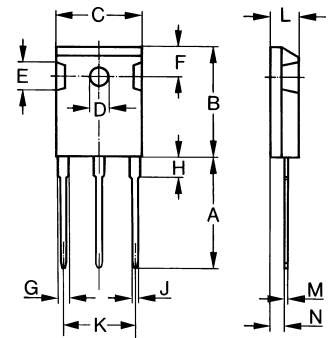
Advantages

- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 250\ \mu\text{A}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 750\ \mu\text{A}$, $V_{CE} = V_{GE}$	3.5		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			200 μA 1 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$	1.8	2.3	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 $\leq 2\%$	3.3	5.0	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		50	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		920	pF
C_{oes}			65	pF
C_{res}			14	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		40	nC
Q_{ge}			13	nC
Q_{gc}			18	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = 16\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 300\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 22\text{ }\Omega$ Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		30	ns
t_{ri}			30	ns
$t_{d(off)}$			100	420 ns
t_{fi}			310	470 ns
E_{off}			1.9	2.9 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = 16\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 300\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 22\text{ }\Omega$ Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		30	ns
t_{ri}			30	ns
E_{on}			0.12	mJ
$t_{d(off)}$			150	ns
t_{fi}			510	ns
E_{off}			3.0	mJ
R_{thJC}				1.25 K/W

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

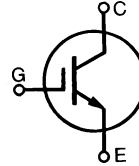
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.75 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 64\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 50\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		2.5	A
t_{rr}			165	ns
			35	50 ns
R_{thJC}				2.5 K/W

HiPerFAST™ IGBT

IXSH 24N60
IXSH 24N60A

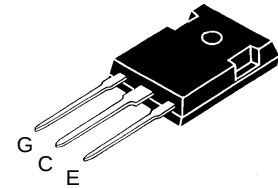
V_{CES}	I_{C25}	$V_{CE(sat)}$
600 V	48 A	2.2 V
600 V	48 A	2.7 V

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)	$V_{GE} = 15\text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 10\ \Omega$ 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	$^\circ\text{C}$
M_d	Mounting torque	1.13/10	Nm/lb.in.
Weight		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
- 2nd generation HDMOS™ 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

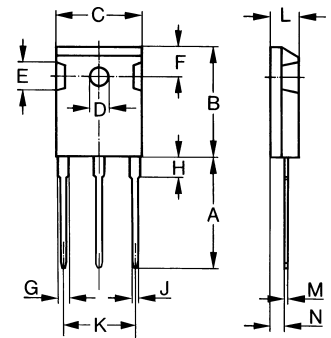
Advantages

- Easy to mount with 1 screw (isolated mounting screw hole)
- Switching speed for high frequency applications
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 250\ \mu\text{A}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 1.5\text{ mA}$, $V_{CE} = V_{GE}$	3.5		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			200 μA 1 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 24N60 IXSH 24N60A 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}			160	pF
C_{res}			45	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		75	nC
Q_{ge}			20	nC
Q_{gc}			35	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 10\text{ }\Omega$ 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}		24N60	500	ns
		24N60A	275	ns
E_{off}		24N60A	2.0	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 10\text{ }\Omega$ 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}			1.2	mJ
$t_{d(off)}$			475	ns
t_{fi}		24N60	600	ns
		24N60A	450	ns
E_{off}		24N60	4	mJ
		24N60A	3	mJ
R_{thJC}				0.83 K/W
R_{thCK}			0.25	K/W

TO-247 AD (IXSH) Outline

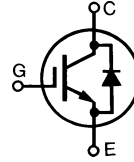


Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	19.81	20.32	0.780	0.800
B	20.80	21.46	0.819	0.845
C	15.75	16.26	0.610	0.640
D	3.55	3.65	0.140	0.144
E	4.32	5.49	0.170	0.216
F	5.4	6.2	0.212	0.244
G	1.65	2.13	0.065	0.084
H	-	4.5	-	0.177
J	1.0	1.4	0.040	0.055
K	10.8	11.0	0.426	0.433
L	4.7	5.3	0.185	0.209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

HiPerFAST™ IGBT with Diode

Short Circuit SOA Capability

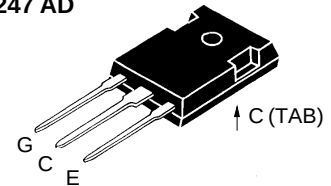
IXSH 24N60U1
IXSH24N60AU1



V_{CES}	I_{C25}	$V_{CE(sat)}$
600 V	48 A	2.2 V
600 V	48 A	2.7 V

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 temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Maximum Tab temperature for soldering SMD devices for 10 s		260	$^\circ\text{C}$
M_d	Mounting torque, TO-247	1.13/10	Nm/lb.in.
Weight	TO-247 AD	6	g

TO-247 AD



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

Features

- International standard package 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

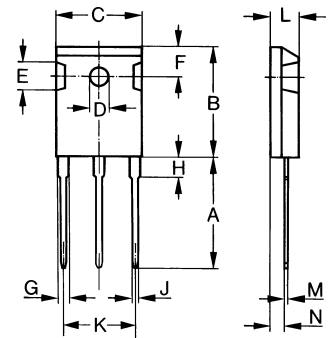
- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switch-mode and resonant-mode power supplies

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}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			500 μA 8 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$			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	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		75	nC
Q_{ge}			20	nC
Q_{gc}			35	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = R_{off} = 10\text{ }\Omega$ 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, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = R_{off} = 10\text{ }\Omega$ 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
$t_{d(off)}$			475	ns
t_{fi}		24N60U1	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

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

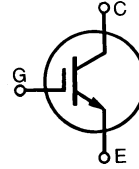
Reverse Diode (FRED)		Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
Symbol	Test Conditions	min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.6 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 240\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 100\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		10	15 A
t_{rr}			150	ns
			35	50 ns
R_{thJC}				1 K/W

High Speed IGBT

IXSH/IXST 30N60B
IXSH/IXST 30N60C

Short Circuit SOA Capability

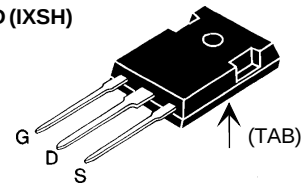
Preliminary Data



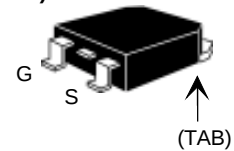
V_{CES}	I_{CES}	t_{fi}
600 V	2.0 V	140 ns
600 V	2.5 V	70 ns

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}	$T_C = 25^\circ\text{C}$	55	A
I_{C90}	$T_C = 90^\circ\text{C}$	30	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	110	A
SSOA (RBSOA)	$V_{GE} = 15\text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 2.7\ \Omega$ Clamped inductive load, $V_{CC} = 0.8 V_{CES}$	$I_{CM} = 60$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15\text{ V}$, $V_{CE} = 360\text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 33\ \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	200	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	(TO-247)	1.13/10 Nm/lb.in.
Weight		TO-247	6 g
		TO-268	4 g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

TO-247 AD (IXSH)



TO-268 (D3) (IXST)



G = Gate
S = Source

TAB = Drain

Features

- International standard packages
- Short Circuit SOA capability
- High frequency IGBT
- 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

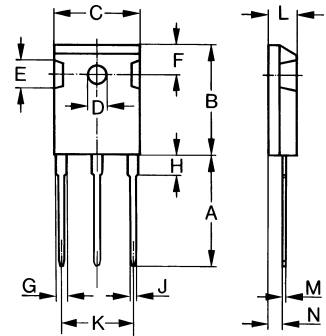
- Easy to mount with 1 screw (isolated mounting screw hole)
- Surface mountable, high power case style
- Reduce assembly time and cost
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 250\ \mu\text{A}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 2.5\text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ 100 μA 1 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$; $I_C = I_{C90}$			30N60B 30N60C 2.0 V 2.5 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 $\leq 2\%$	10		S	
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3100	pF	
C_{oes}			240	pF	
C_{res}			30	pF	
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		100	nC	
Q_{ge}			30	nC	
Q_{gc}			38	nC	
$t_{d(on)}$	Inductive load, $T_J = 25^{\circ}\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$ Note 1		30	ns	
t_{ri}			30	ns	
$t_{d(off)}$		30N60B	150	270	ns
		30N60C	90	150	ns
t_{fi}		30N60B	140	270	ns
		30N60C	70	120	ns
E_{off}		30N60B	1.5	2.5	mJ
		30N60C	0.7	1.2	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^{\circ}\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$ Note 1		35	ns	
t_{ri}			35	ns	
E_{on}			0.5	mJ	
$t_{d(off)}$		30N60B	270	ns	
		30N60C	150	ns	
t_{fi}		30N60B	250	ns	
		30N60C	140		
E_{off}		30N60B	2.5	mJ	
		30N60C	1.2	mJ	
R_{thJC}	(TO-247)			0.62 K/W	
R_{thCK}			0.25	K/W	

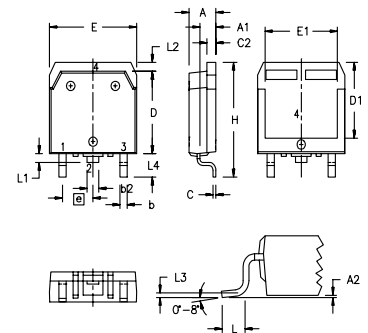
Notes: 1. Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_j or

TO-247 AD (IXSH) Outline



Dim.	Millimeter Min. Max.	Inches 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-268AA (D³ PAK)



Dim.	Millimeter Min. Max.	Inches Min. Max.
A	4.9 5.1	.193 .201
A ₁	2.7 2.9	.106 .114
A ₂	.02 .25	.001 .010
b	1.15 1.45	.045 .057
b ₂	1.9 2.1	.075 .083
C	.4 .65	.016 .026
D	13.80 14.00	.543 .551
E	15.85 16.05	.624 .632
E ₁	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
L ₁	1.20 1.40	.047 .055
L ₂	1.00 1.15	.039 .045
L ₃	0.25 BSC	.010 BSC
L ₄	3.80 4.10	.150 .161

Min. Recommended Footprint

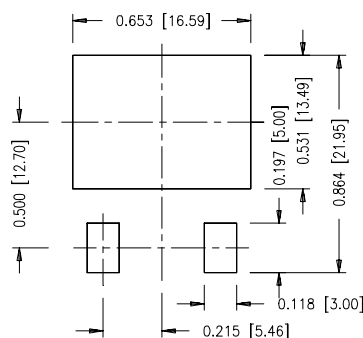


Fig.1 Saturation Characteristics

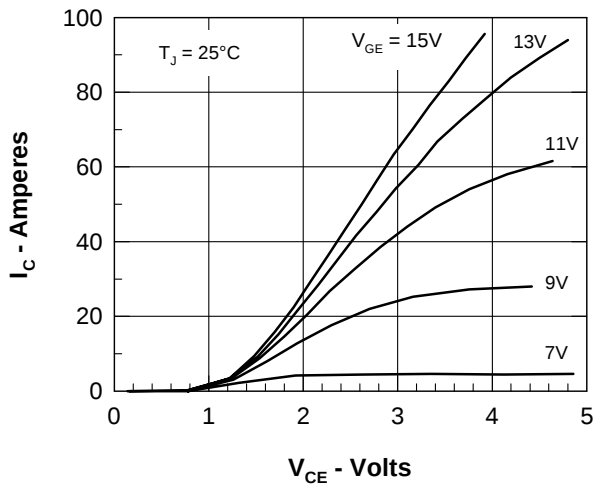


Fig.2 Output Characteristics

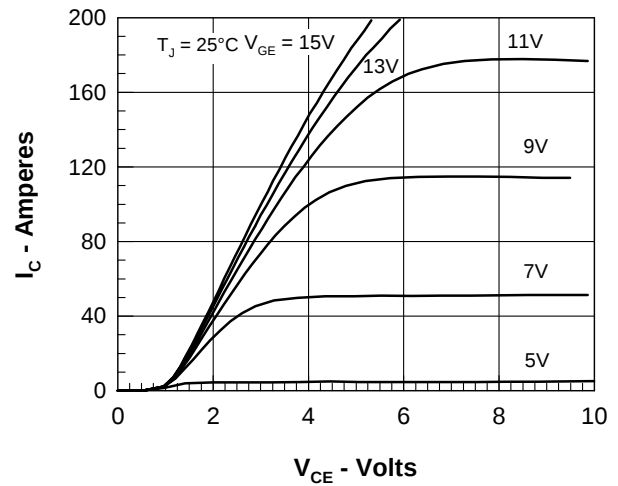


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

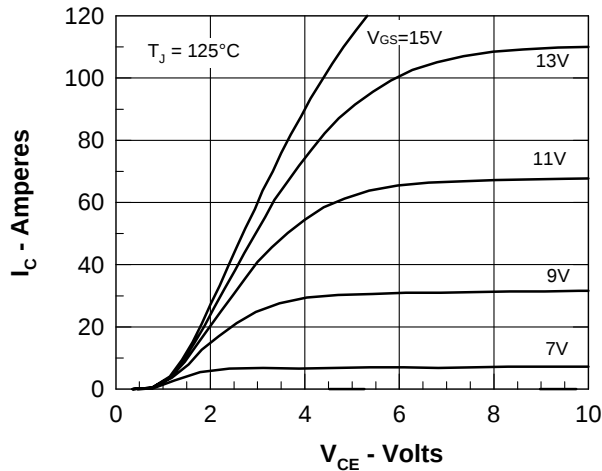


Fig.4 Temperature Dependence of Output Saturation Voltage

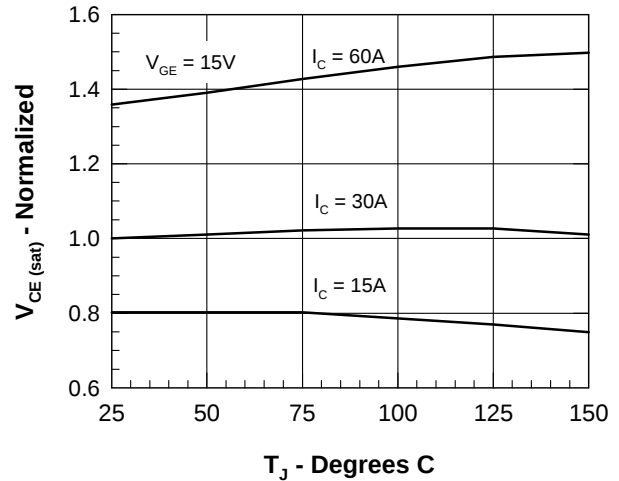


Fig.5 Input Admittance

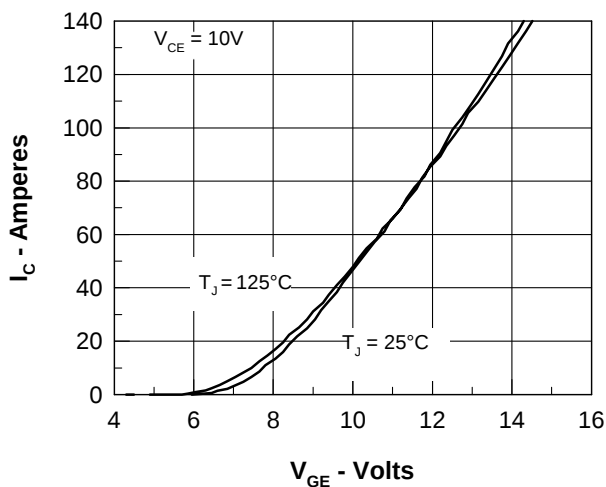


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

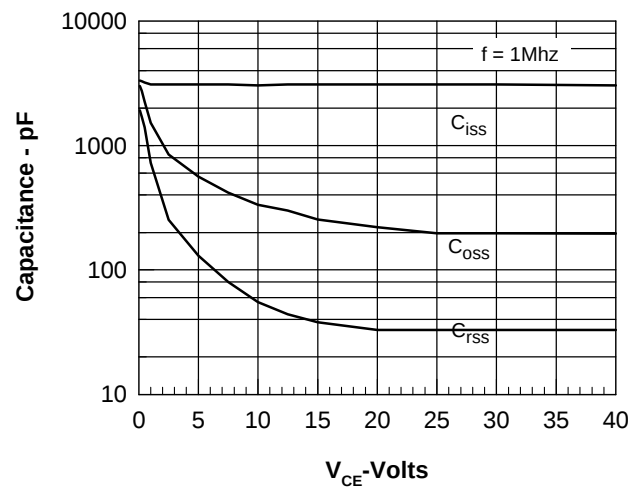


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

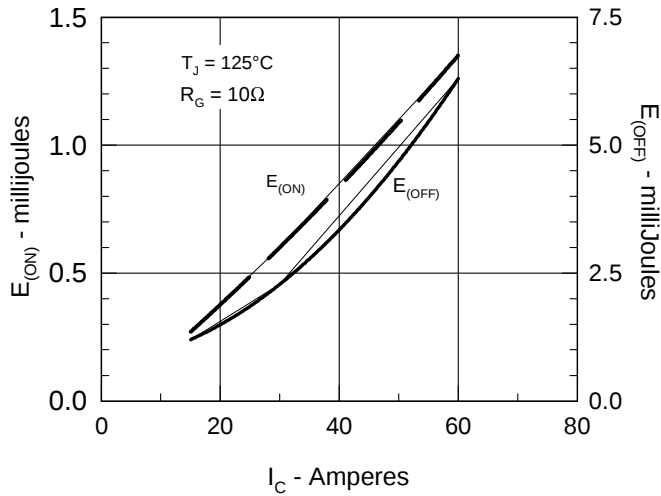


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

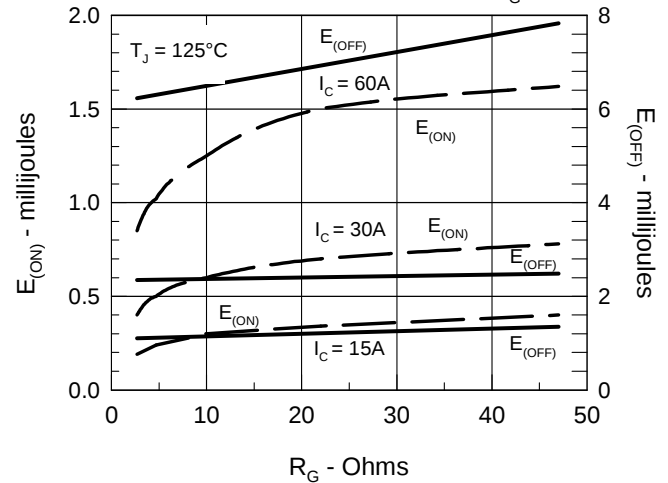


Fig.9 Gate Charge Characteristic Curve

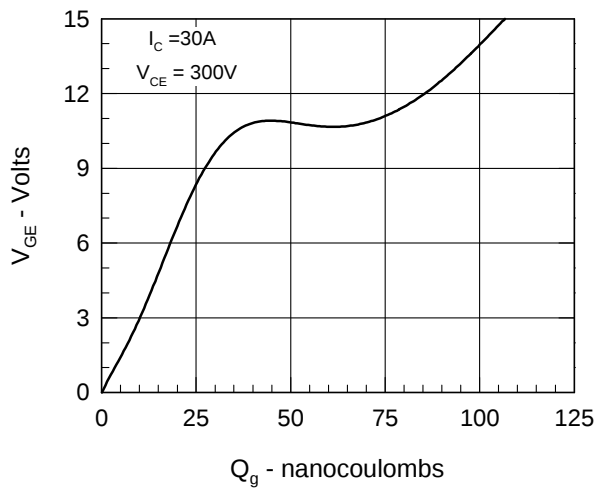


Fig.10 Turn-Off Safe Operating Area

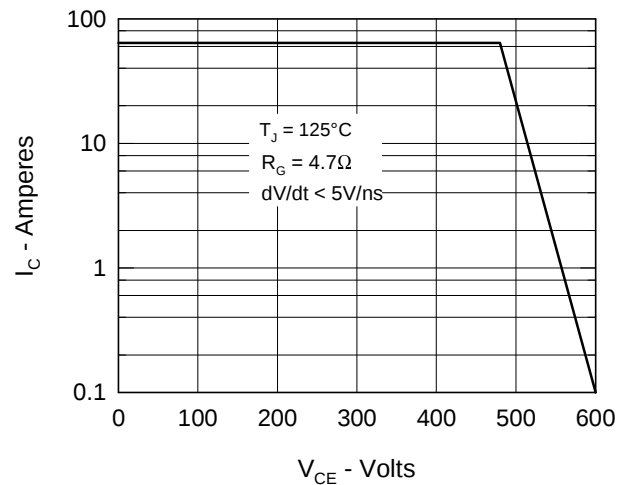
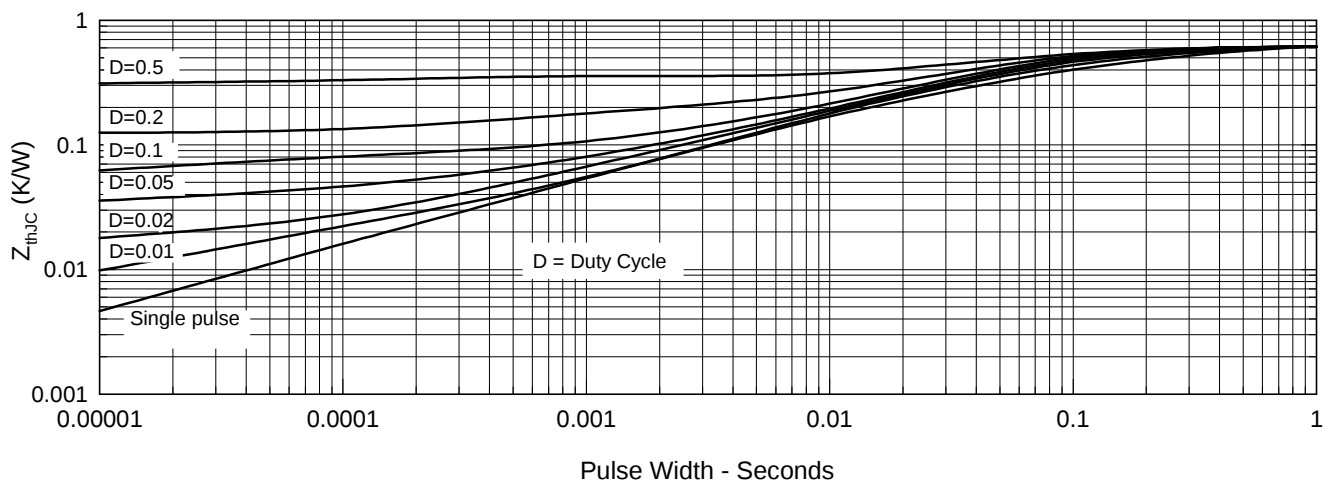


Fig.11 Transient Thermal Impedance



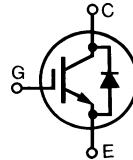
Low $V_{CE(sat)}$ IGBT with Diode
High Speed IGBT with Diode

IXSH30N60U1
IXSH30N60AU1

V_{CES}	I_{C25}	$V_{CE(sat)}$
600 V	50 A	2.5 V
600 V	50 A	3.0 V

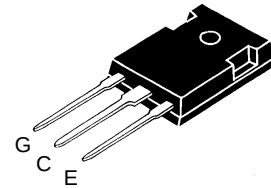
Combi Packs

Short Circuit SOA Capability



Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°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}	$T_C = 25^\circ\text{C}$	50	A
I_{C90}	$T_C = 90^\circ\text{C}$	30	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	100	A
SSOA (RBSOA)	$V_{GE} = 15\text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 33\ \Omega$ Clamped inductive load, $L = 100\ \mu\text{H}$	$I_{CM} = 60$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15\text{ V}$, $V_{CE} = 360\text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 33\ \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	200	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.
Weight		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 HDMOS™ 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

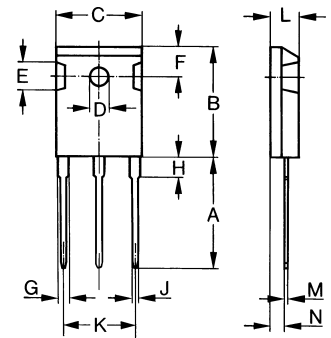
Advantages

- 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}	$I_C = 750\ \mu\text{A}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 2.5\text{ mA}$, $V_{CE} = V_{GE}$	5		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$			500 μA 8 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$			2.5 V 3.0 V
				30N60U1 30N60AU1

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 $\leq 2\%$	7	13	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		100	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		2760	pF
C_{oes}			240	pF
C_{res}			51	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		110	nC
Q_{ge}			34	nC
Q_{gc}			47	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		60	ns
t_{ri}			130	ns
$t_{d(off)}$			400	ns
t_{fi}		30N60U1	400	ns
		30N60AU1	200	ns
E_{off}		30N60AU1	2.5	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		60	ns
t_{ri}			130	ns
E_{on}			4.2	mJ
$t_{d(off)}$		30N60U1	540	1000 ns
		30N60AU1	340	525 ns
t_{fi}		30N60U1	600	1500 ns
		30N60AU1	340	700 ns
E_{off}		30N60U1	12	mJ
		30N60AU1	6	mJ
R_{thJC}				0.63 K/W
R_{thCK}			0.25	K/W

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

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 $d \leq 2\%$			1.6 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 240\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 100\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		10	15 A
t_{rr}			150	ns
			35	50 ns
R_{thJC}				1 K/W

Fig.1 Saturation Characteristics

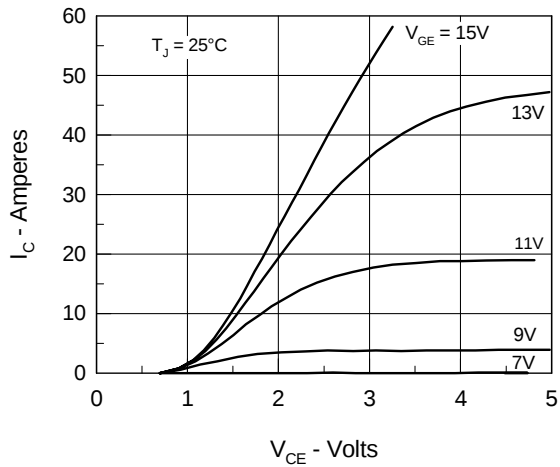


Fig.2 Output Characteristics

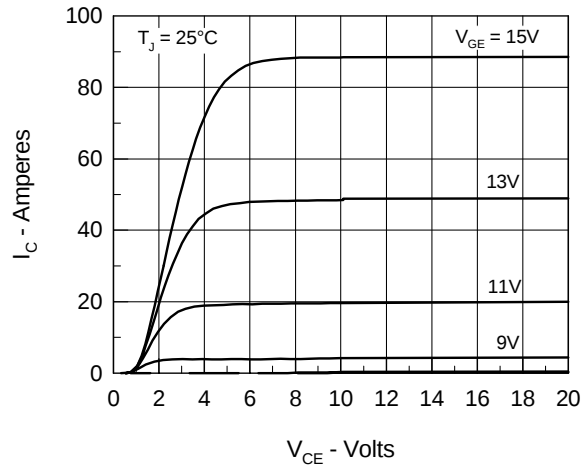


Fig.3 Collector-Emittor Voltage vs. Gate-Emittor Voltage

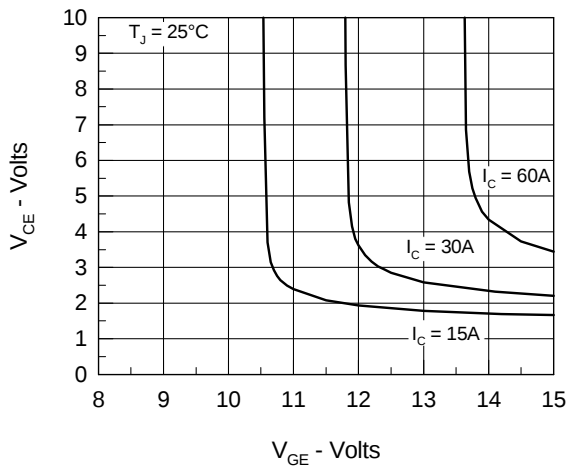


Fig.4 Temperature Dependence of Output Saturation Voltage

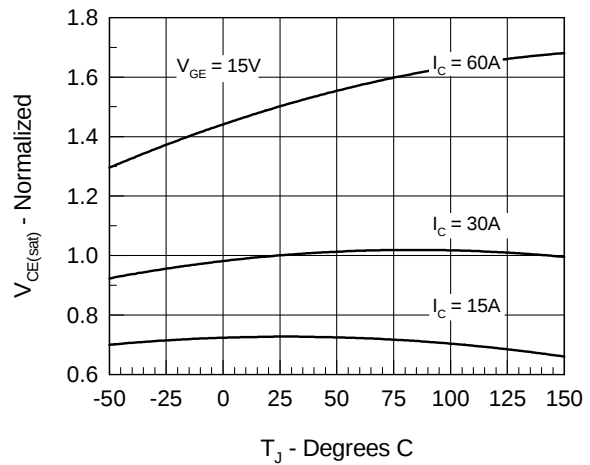


Fig.5 Input Admittance

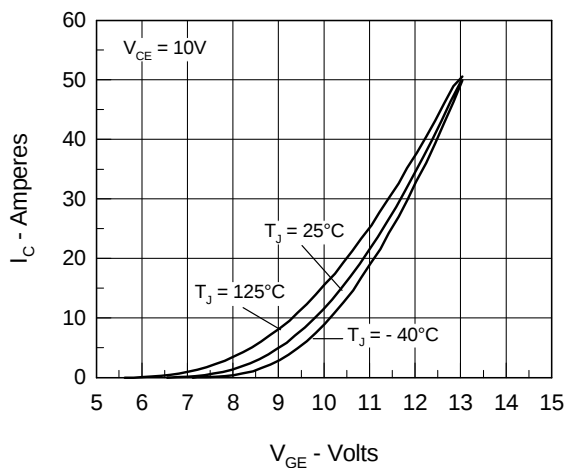


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

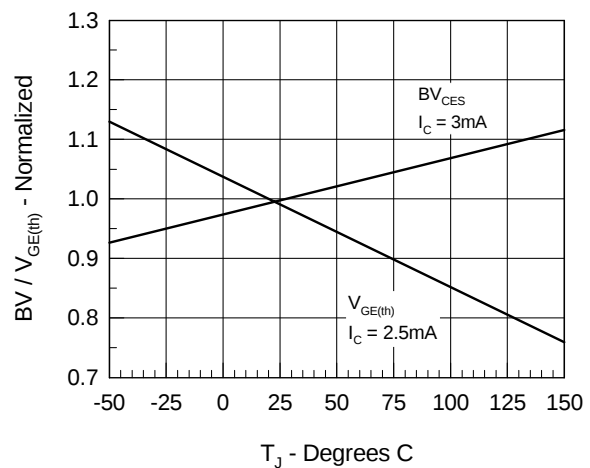


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

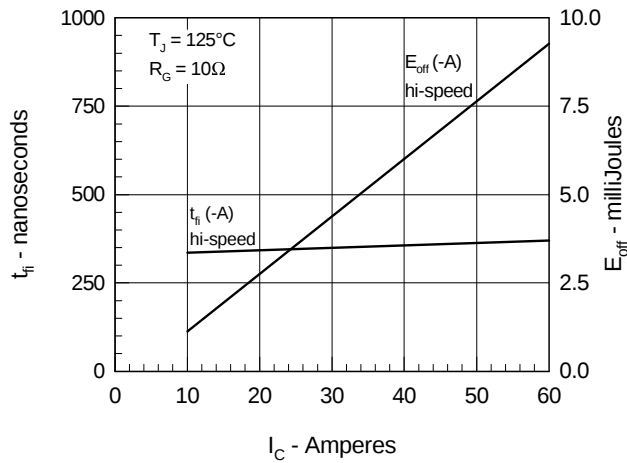


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

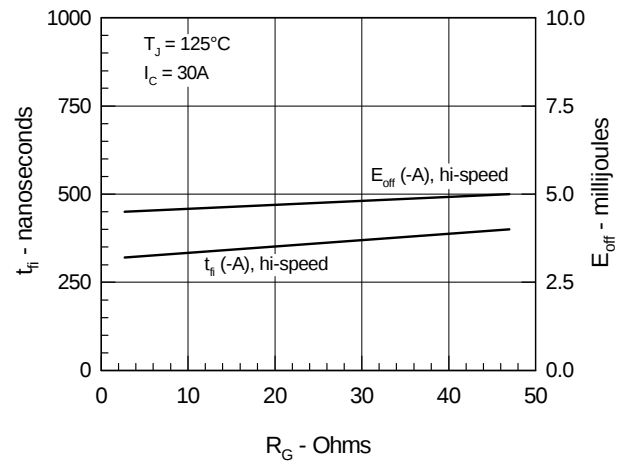


Fig.9 Gate Charge Characteristic Curve

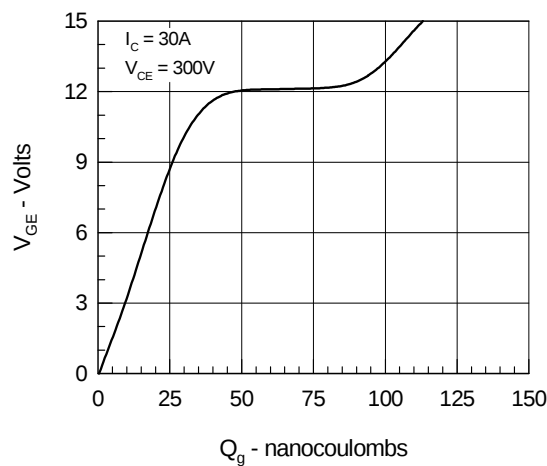


Fig.10 Turn-Off Safe Operating Area

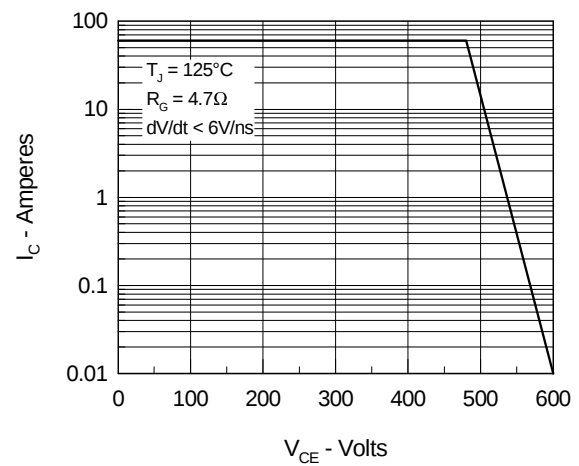


Fig.11 Transient Thermal Impedance

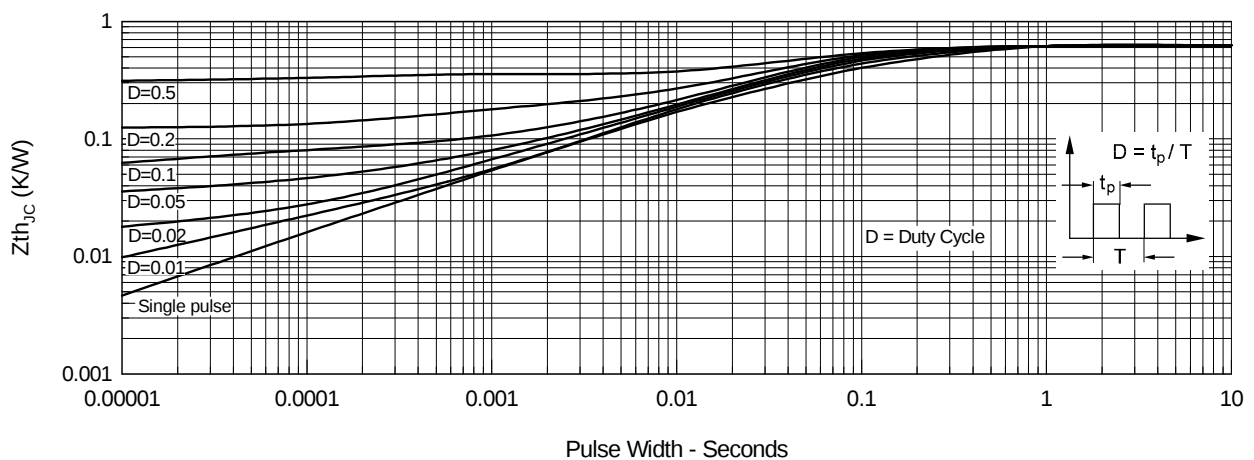


Fig.12 Maximum Forward Voltage Drop

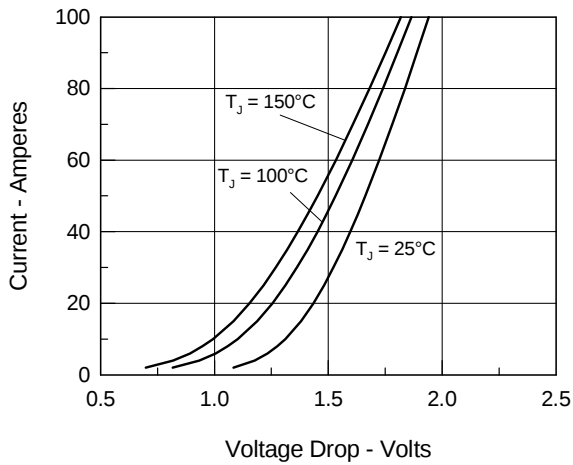


Fig.13 Peak Forward Voltage V_{FR} and Forward Recovery Time t_{fr}

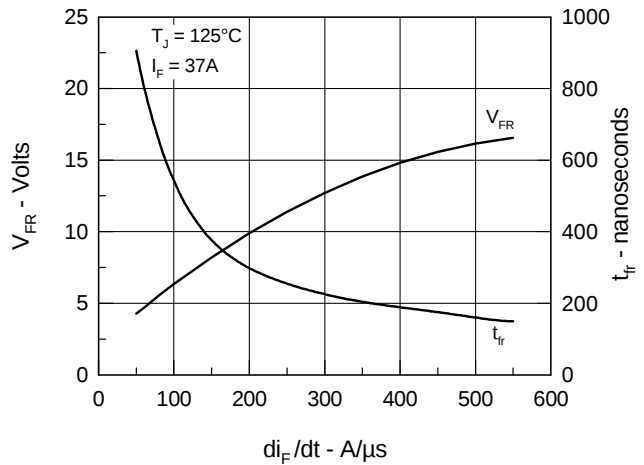


Fig.14 Junction Temperature Dependence of I_{RM} and Q_r

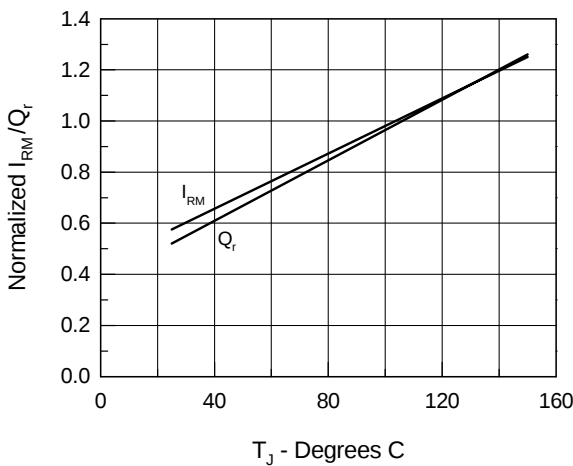


Fig.15 Reverse Recovery Charge

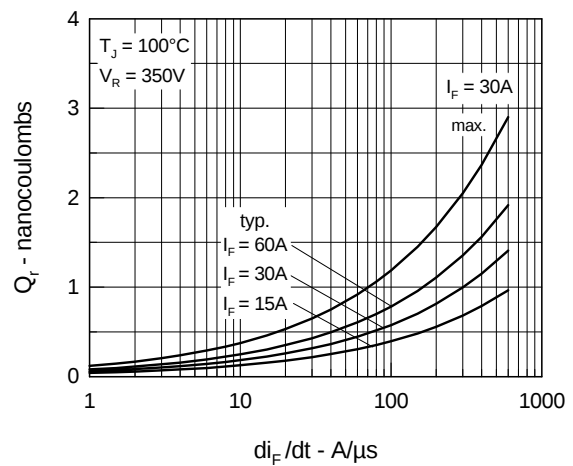


Fig.16 Peak Reverse Recovery Current

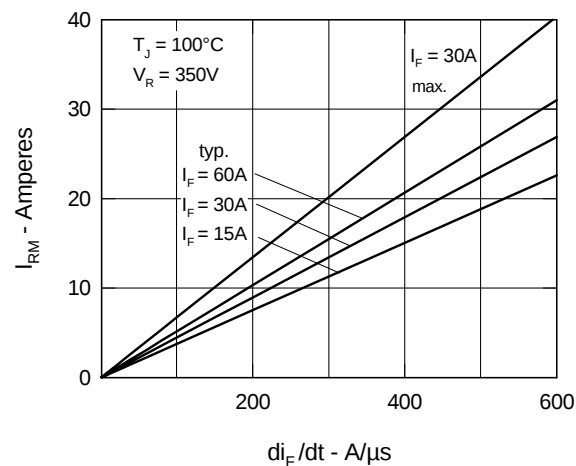


Fig.17 Reverse Recovery Time

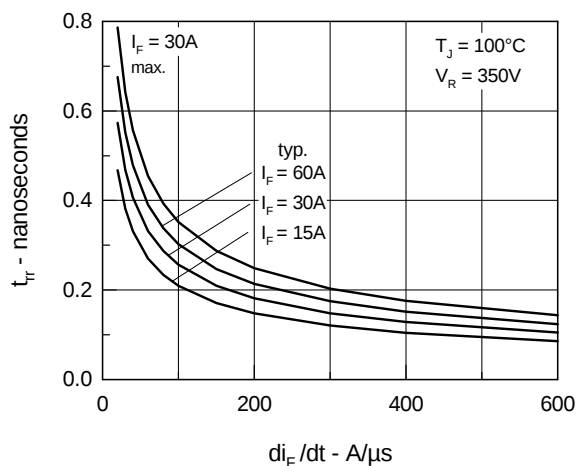
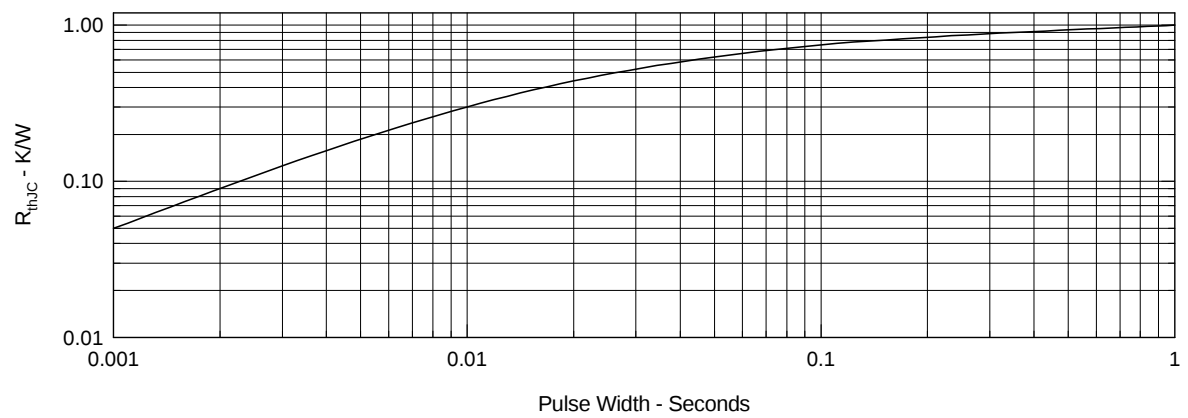


Fig.18 Diode Transient Thermal resistance junction to case

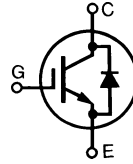


High Speed IGBT with Diode

Short Circuit SOA Capability

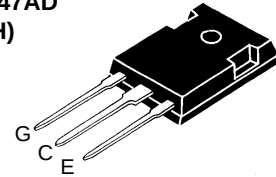
IXSH 30N60BD1
IXSK 30N60BD1
IXST 30N60BD1

$V_{CES} = 600 \text{ V}$
 $I_{C25} = 55 \text{ A}$
 $V_{CE(sat)} = 2.0 \text{ V}$
 $t_{fi} = 140 \text{ ns}$

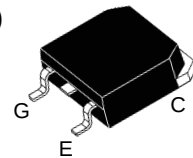


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	55	A
I_{C90}	$T_C = 90^\circ\text{C}$	30	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	110	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 10 \Omega$ Clamped inductive load, $V_{CL} = 0.8 V_{CES}$	$I_{CM} = 60$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 33 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	200	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.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	TO-247/TO-268	6/4	g
	TO-264	10	g

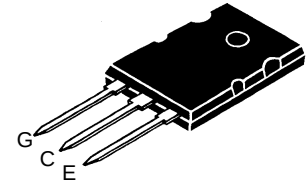
TO-247AD
(IXSH)



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 ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 750 \mu\text{A}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 2.5 \text{ mA}$, $V_{CE} = V_{GE}$	4		7 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			200 μA 3 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}$			2.0 V 2.7 V
				$I_C = I_{C90}$ $I_C = I_{C25}$

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 %	10		S
C_{ies} C_{oes} C_{res}	V _{CE} = 25 V, V _{GE} = 0 V, f = 1 MHz		3100 240 30	pF pF pF
Q_g Q_{ge} Q_{gc}	I _C = I _{C90} ; V _{GE} = 15 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}	Inductive load, T_j = 25°C I _C = I _{C90} ; V _{GE} = 15 V V _{CE} = 0.8 V _{CES} ; R _G = 4.7 Ω 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}	Inductive load, T_j = 125°C I _C = I _{C90} ; V _{GE} = 15 V V _{CE} = 0.8 V _{CES} ; R _G = 4.7 Ω 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	0.62 K/W K/W K/W

Reverse Diode (FRED)

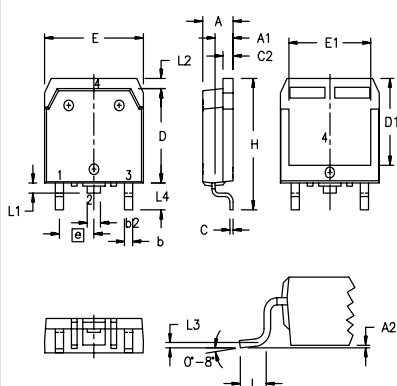
Characteristic Values

($T_1 = 25^\circ\text{C}$, unless otherwise specified)

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

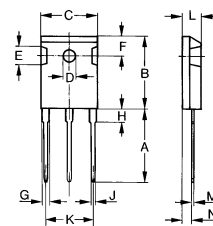
Notes: 1. Switching times may increase for $V_{CE} \text{ (Clamp)} > 0.8 \cdot V_{CES}$, higher T_J or increased R_{G_1} .
2. Pulse test. $t \leq 300 \mu s$, duty cycle $d \leq 2\%$

TO-268AA (IXST) (D³ PAK)



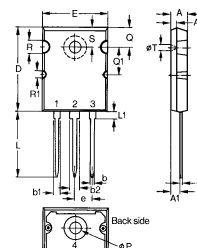
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.9	5.1	.193	.201
A ₁	2.7	2.9	.106	.114
A ₂	.02	.25	.001	.010
b	1.15	1.45	.045	.057
b ₂	1.9	2.1	.75	.83
C	.4	.65	.016	.026
D	13.80	14.00	.543	.551
E	15.85	16.05	.624	.632
E ₁	13.3	13.6	.524	.535
e	5.45 BSC		.215 BSC	
H	18.70	19.10	.736	.752
L	2.40	2.70	.094	.106
L1	1.20	1.40	.047	.055
L2	1.00	1.15	.039	.045
L3	.025 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
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

Min. Recommended Footprint

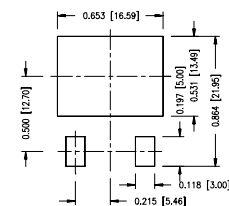


Fig.1 Saturation Characteristics

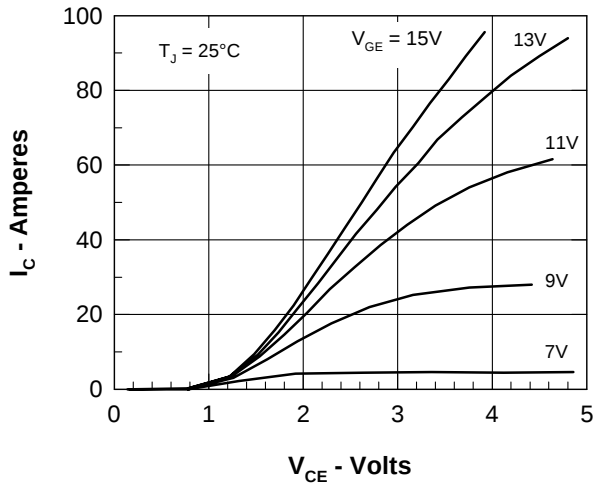


Fig.2 Output Characteristics

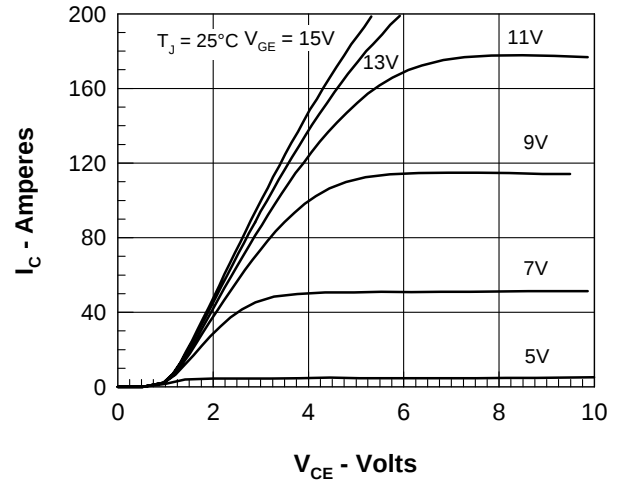


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

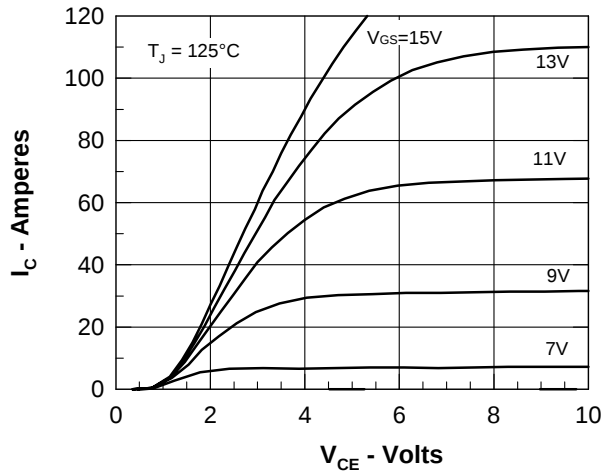


Fig.4 Temperature Dependence of Output Saturation Voltage

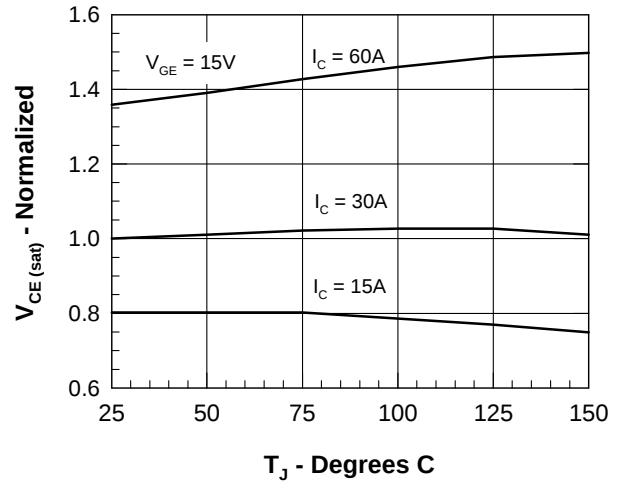


Fig.5 Input Admittance

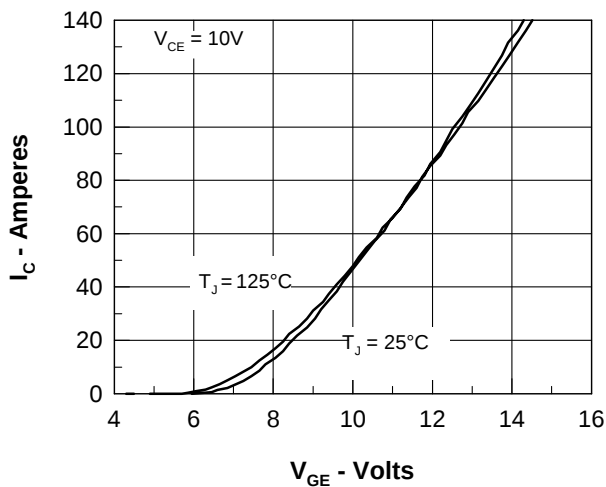


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

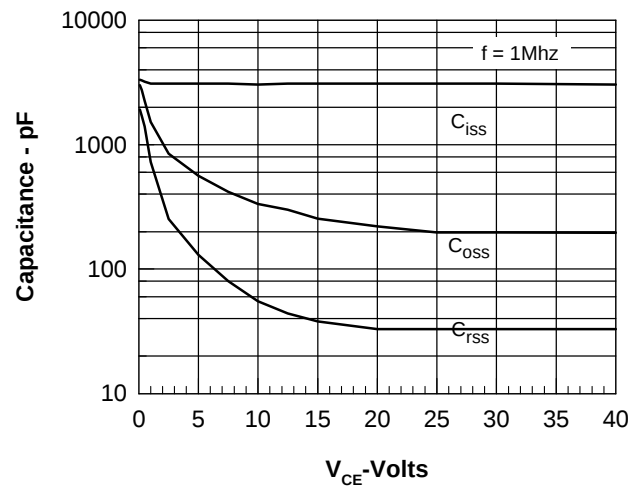


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

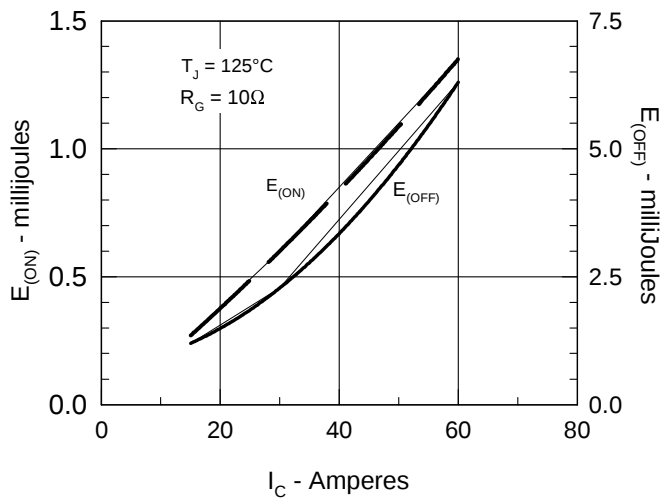
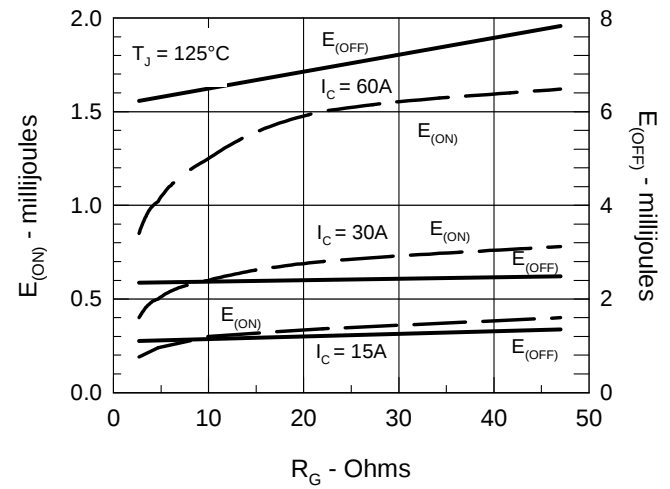

Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G


Fig.9 Gate Charge Characteristic Curve

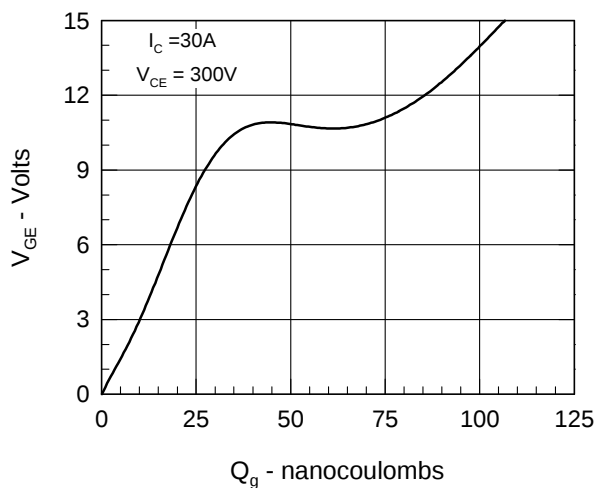


Fig.10 Turn-Off Safe Operating Area

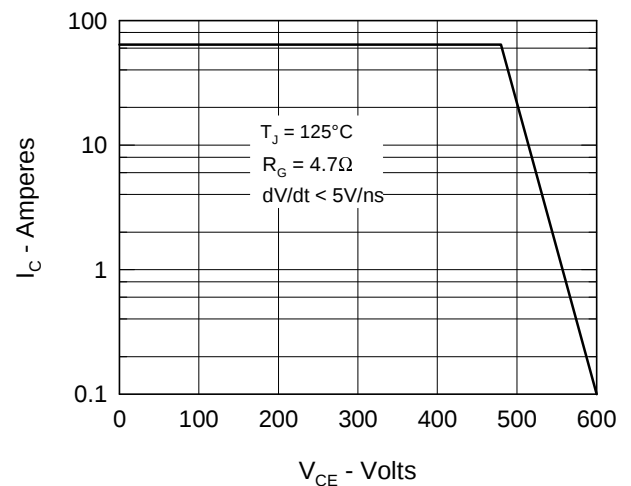
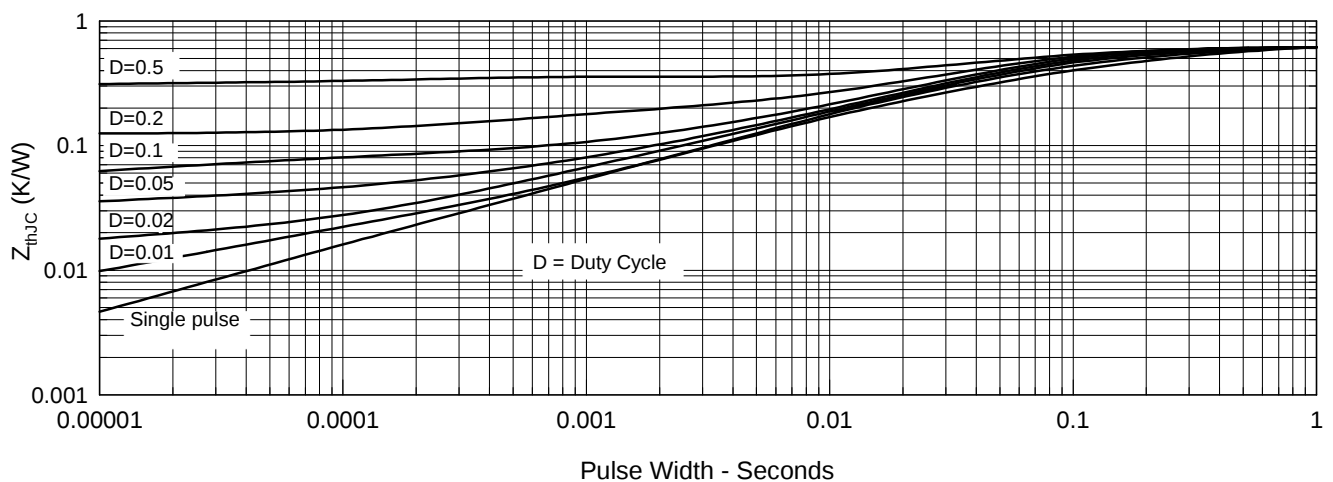


Fig.11 Transient Thermal Resistance



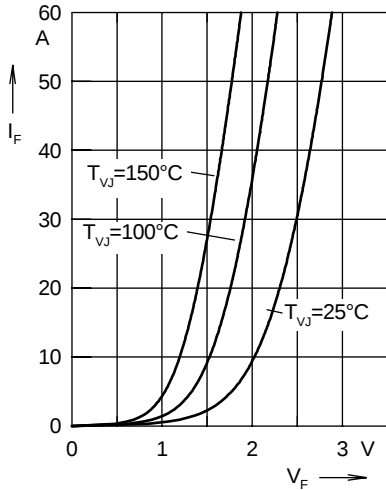


Fig. 12 Forward current I_F versus V_F

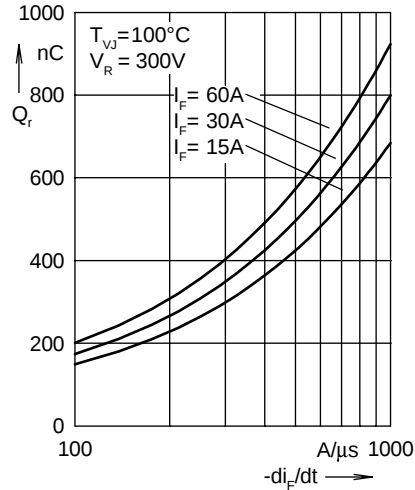


Fig. 13 Reverse recovery charge Q_r versus $-di_F/dt$

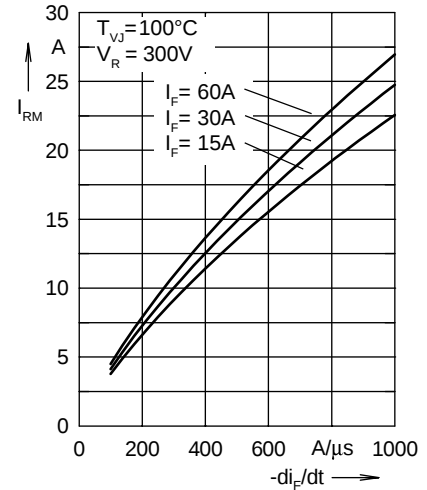


Fig. 14 Peak reverse current I_{RM} versus $-di_F/dt$

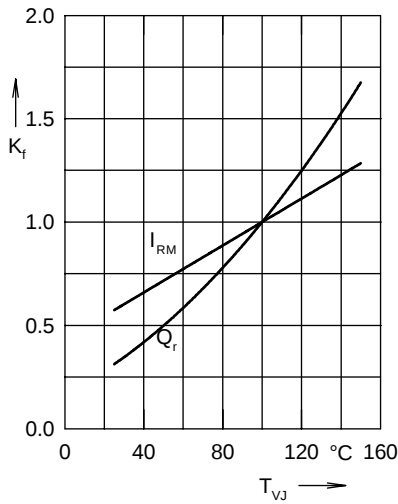


Fig. 15 Dynamic parameters Q_r , I_{RM} versus T_{VJ}

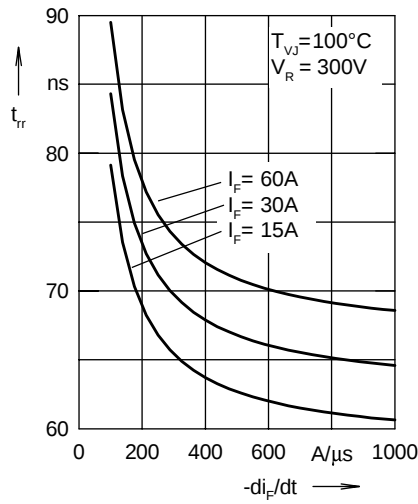


Fig. 16 Recovery time t_{rr} versus $-di_F/dt$

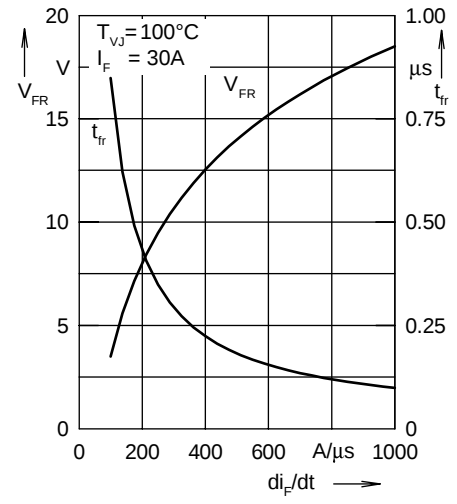


Fig. 17 Peak forward voltage V_{FR} and t_{fr} versus di_F/dt

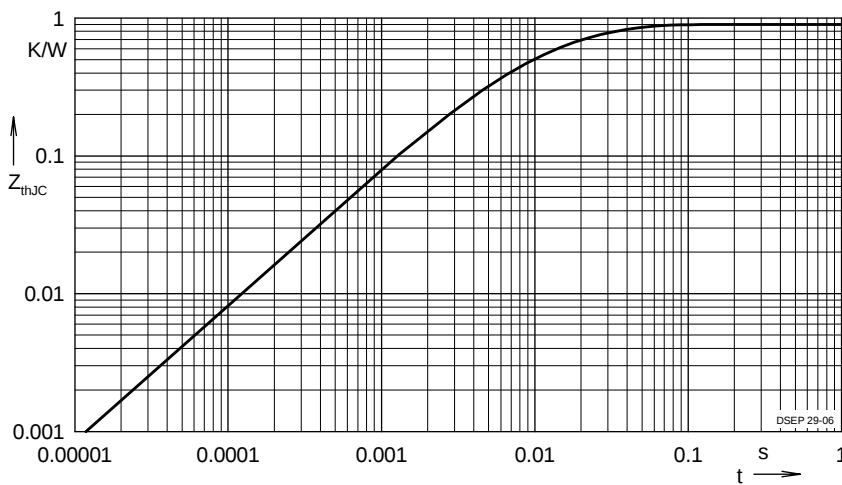


Fig. 18 Transient thermal resistance junction to case

Constants for Z_{thJC} calculation:

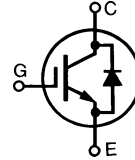
i	R_{thi} (K/W)	t_i (s)
1	0.502	0.0052
2	0.193	0.0003
3	0.205	0.0162

High Speed IGBT with Diode

IXSH 30 N60CD1
IXSK 30 N60CD1
IXST 30 N60CD1

Short Circuit SOA Capability

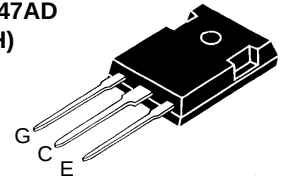
Preliminary data



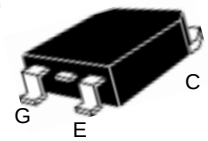
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 55 \text{ A} \\ V_{CE(sat)} &= 2.5 \text{ V} \\ t_{fi} &= 70 \text{ ns} \end{aligned}$$

Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
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P_C	$T_C = 25^\circ\text{C}$	200	W
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T_{stg}		-55 ... +150	$^\circ\text{C}$
M_d	Mounting torque	1.13/10	Nm/lb.in.
Weight		6	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

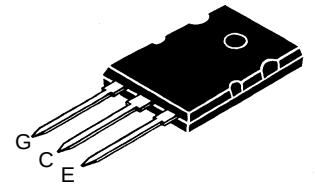
TO-247AD
(IXSH)



TO-268 (D3)
(IXST)



TO-264
(IXSK)



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- Easy to mount with 1 screw (isolated mounting screw hole)
- Surface mountable, high power case style
- Reduces assembly time and cost
- High power density

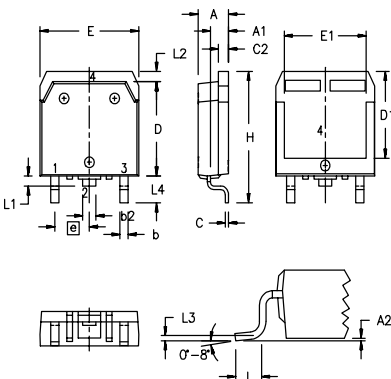
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 750 \mu\text{A}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 2.5 \text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			200 μA 3 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}$			2.5 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 $\leq 2\%$	10		S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3100	pF
C_{oes}			240	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		100	nC
Q_{ge}			30	nC
Q_{gc}			38	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		30	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		30	ns
$t_{d(off)}$	$V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$		90	ns
t_{fi}	Note 1.		70	ns
E_{off}			0.7	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		35	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		35	ns
E_{on}			0.5	mJ
$t_{d(off)}$	$V_{CE} = 0.8 V_{CES}$, $R_G = 4.7\text{ }\Omega$		150	ns
t_{fi}	Note 1		140	ns
E_{off}			1.2	mJ
R_{thJC}	TO-247 TO-264			0.62 K/W
R_{thCK}			0.25	K/W
R_{thCK}			0.15	K/W

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$ Note 2	$T_J = 150^\circ\text{C}$ $T_J = 150^\circ\text{C}$		1.7 V 2.5 V
I_{RM}	$I_F = 100\text{ A}$; $V_{GE} = 0\text{ V}$; $T_J = 100^\circ\text{C}$ $V_R = 100\text{ V}$; $-di_F/dt = 100\text{ A}/\mu\text{s}$		2	2.5 A
t_{rr}	$I_F = 1\text{ A}$; $-di_F/dt = 100\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		35	50 ns
R_{thJC}				1.0 K/W

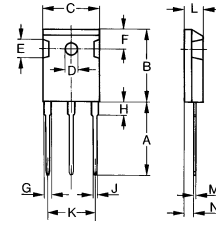
Notes: 1. Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G .
2. Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$

TO-268AA (IXST) (D³ PAK)



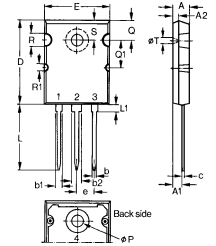
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.9	5.1	.193	.201
A ₁	2.7	2.9	.106	.114
A ₂	.02	.25	.001	.010
b	1.15	1.45	.045	.057
b ₂	1.9	2.1	.75	.83
C	.4	.65	.016	.026
D	13.80	14.00	.543	.551
E	15.85	16.05	.624	.632
E ₁	13.3	13.6	.524	.535
e	5.45 BSC		.215 BSC	
H	18.70	19.10	.736	.752
L	2.40	2.70	.094	.106
L ₁	1.20	1.40	.047	.055
L ₂	1.00	1.15	.039	.045
L ₃	0.25 BSC		.010 BSC	
L ₄	3.80	4.10	.150	.161

TO-247 AD (IXSH) Outline



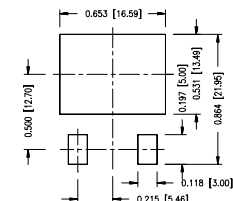
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	19.81	20.32	0.780	0.800
B	20.80	21.46	0.819	0.845
C	15.75	16.26	0.610	0.640
D	3.55	3.65	0.140	0.144
E	4.32	5.49	0.170	0.216
F	5.4	6.2	0.212	0.244
G	1.65	2.13	0.065	0.084
H	-	4.5	-	0.177
J	1.0	1.4	0.040	0.055
K	10.8	11.0	0.426	0.433
L	4.7	5.3	0.185	0.209
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 ₁	2.54	2.89	.100	.114
A ₂	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b ₁	2.39	2.69	.094	.106
b ₂	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 ₁	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q ₁	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R ₁	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

Min. Recommended Footprint



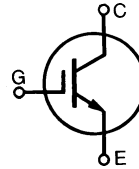
High Speed IGBT

IXSH 40N60B
IXST 40N60B

$$\begin{aligned} V_{CES} &= 600V \\ I_{C25} &= 75A \\ V_{CE(sat)} &= 2.2V \\ t_{fi\ typ} &= 100\ ns \end{aligned}$$

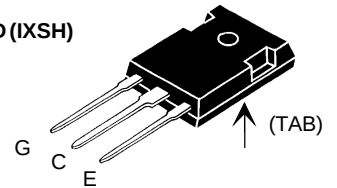
Short Circuit SOA Capability

Preliminary data

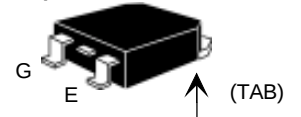


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1\ \text{M}\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	40	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	150	A
SSOA (RBSOA)	$V_{GE} = 15\ \text{V}$, $T_J = 125^\circ\text{C}$, $R_G = 2.7\ \Omega$ Clamped inductive load, $V_{CC} = 0.8\ V_{CES}$	$I_{CM} = 80$ @ $0.8\ V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15\ \text{V}$, $V_{CE} = 360\ \text{V}$, $T_J = 125^\circ\text{C}$ $R_G = 22\ \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	280	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.
Weight		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 (IXSH)



TO-268 (D3) (IXST)



G = Gate
E = Emitter

TAB = Collector

Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- Low $V_{CE(sat)}$
 - for low on-state conduction losses
- High current handling capability
- MOS Gate turn-on
 - drive simplicity
- Fast Fall Time for switching speeds up to 50 kHz

Applications

- AC and DC motor speed control
- Uninterruptible power supplies (UPS)
- Welding

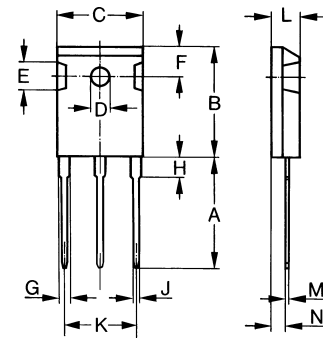
Advantages

- Easy to mount with 1 screw (TO-247) (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 250\ \mu\text{A}$, $V_{GE} = 0\ \text{V}$	600		V
$V_{GE(th)}$	$I_C = 4\ \text{mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\ \text{V}$			25 μA 1 mA
I_{GES}	$V_{CE} = 0\ \text{V}$, $V_{GE} = \pm 20\ \text{V}$			$\pm 100\ \text{nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15\ \text{V}$			2.2 V

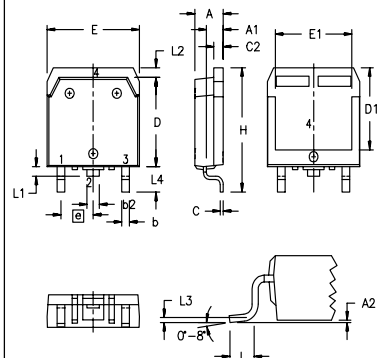
Symbol	Test Conditions	Characteristic Values ($T_j = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$	16	23	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3700	pF
C_{oes}			280	pF
C_{res}			80	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		190	nC
Q_{ge}			45	nC
Q_{gc}			90	nC
$t_{d(on)}$	Inductive load, $T_j = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$		50	ns
t_{ri}			50	ns
$t_{d(off)}$			110	200
t_{fi}			120	200
E_{off}			1.8	2.6
$t_{d(on)}$	Inductive load, $T_j = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$		55	ns
t_{ri}			170	ns
E_{on}			1.7	mJ
$t_{d(off)}$			190	ns
t_{fi}			180	ns
E_{off}			2.0	mJ
R_{thJC}	(IXSH40N60B)			0.45 K/W
R_{thCK}			0.25	K/W

TO-247 AD (IXSH) Outline



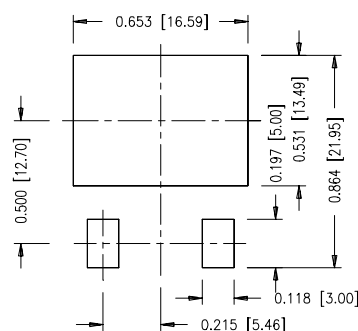
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	19.81	20.32	0.780	0.800
B	20.80	21.46	0.819	0.845
C	15.75	16.26	0.610	0.640
D	3.55	3.65	0.140	0.144
E	4.32	5.49	0.170	0.216
F	5.4	6.2	0.212	0.244
G	1.65	2.13	0.065	0.084
H	-	4.5	-	0.177
J	1.0	1.4	0.040	0.055
K	10.8	11.0	0.426	0.433
L	4.7	5.3	0.185	0.209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

TO-268AA (D³ PAK)



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.9	5.1	.193	.201
A ₁	2.7	2.9	.106	.114
A ₂	.02	.25	.001	.010
b	1.15	1.45	.045	.057
b ₂	1.9	2.1	.075	.083
C	.4	.65	.016	.026
D	13.80	14.00	.543	.551
E	15.85	16.05	.624	.632
E ₁	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
L ₁	1.20	1.40	.047	.055
L ₂	1.00	1.15	.039	.045
L ₃	0.25 BSC		.010 BSC	
L ₄	3.80	4.10	.150	.161

Min. Recommended Footprint

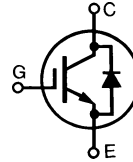


IGBT with Diode PLUS247™ package

IXSK 40N60BD1
IXSX 40N60BD1

Short Circuit SOA Capability

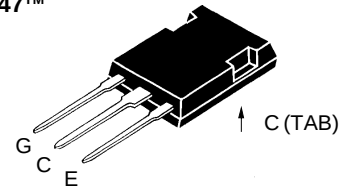
Preliminary data



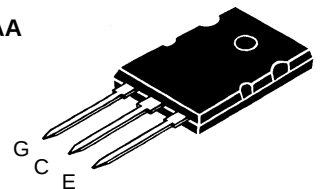
$V_{CES} = 600 \text{ V}$
 $I_{C25} = 75 \text{ A}$
 $V_{CE(sat)} = 2.2 \text{ V}$
 $t_{fi(typ)} = 120 \text{ ns}$

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	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	40	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	150	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 80$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	280	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 (TO-264)	0.9/6	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	TO-264	10	g
	PLUS247	5	g

**PLUS 247™
(IXSX)**



**TO-264 AA
(IXSK)**



G = Gate, C = Collector,
E = Emitter

Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- Medium frequency IGBT and anti-parallel FRED in one package
- Latest generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- MOS Gate turn-on
 - drive simplicity
- Fast Recovery, low leakage Epitaxial Diode
 - 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

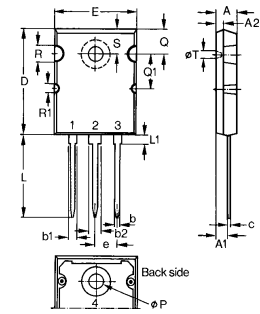
- PLUS 247™ package for clip or spring mounting
- Space savings (two devices in one package)
- Reduces assembly time and cost

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		7 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			650 μA 5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			2.2 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 $\leq 2\%$	16	23	S
C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$		3700	pF
C_{oss}			440	pF
C_{rss}			60	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		190	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		50	ns
t_{ri}			50	ns
$t_{d(off)}$			110	200 ns
t_{fi}			120	200 ns
E_{off}			1.8	2.6 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		50	ns
t_{ri}			50	ns
E_{on}			2.2	mJ
$t_{d(off)}$			190	ns
t_{fi}			180	ns
E_{off}			2.6	mJ
R_{thJC}				0.48 K/W
R_{thCK}			0.15	K/W

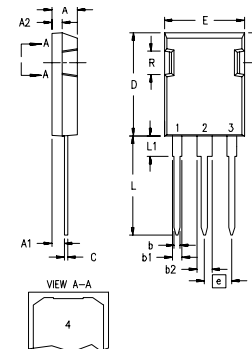
Reverse Diode (FRED)		Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
Symbol	Test Conditions	min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.8 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 100\text{ A}/\mu\text{s}$ $V_R = 100\text{ V}$ $I_F = 1\text{ A}$; $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		2	2.5 A
t_{rr}			35	ns
R_{thJC}				0.75 K/W

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

PLUS247™ (IXSX)



Dim.	Millimeter		Inches	
	Min.	Max.	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
b2	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

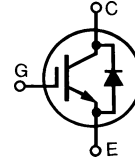
IGBT with Diode

IXSR 40N60BD1

ISOPLUS 247™

(Electrically Isolated Backside)

Short Circuit SOA Capability

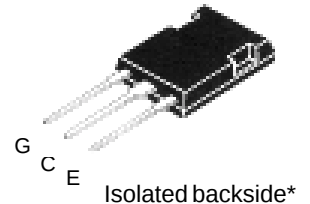


$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 70 \text{ A} \\ V_{CE(sat)} &= 2.2 \text{ V} \\ t_{fi(typ)} &= 120 \text{ ns} \end{aligned}$$

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}	$T_C = 25^\circ\text{C}$	70	A
I_{C90}	$T_C = 90^\circ\text{C}$	40	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	150	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 80$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	170	W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
V_{ISOL}	50/60 Hz, RMS $t = 1 \text{ min}$ leads-to housing	2500	V~
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight		5	g

ISOPLUS 247™

 E 153432



G = Gate, C = Collector,
E = Emitter

*Patent pending

Features

- DCB Isolated mounting tab
- Meets TO-247AD package Outline
- High current handling capability
- Latest generation HDMOS™ process
- MOS Gate turn-on - drive simplicity

Applications

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

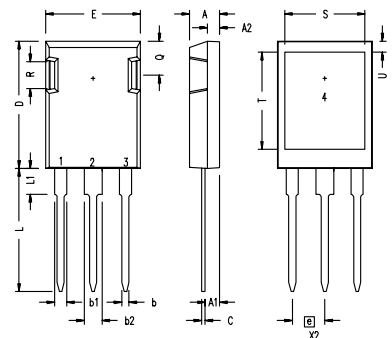
Advantages

- Easy assembly
- High power density
- Very fast switching speeds for high frequency applications

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		7 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			$T_J = 25^\circ\text{C}$ 650 μA $T_J = 150^\circ\text{C}$ 5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_T$, $V_{GE} = 15 \text{ V}$			2.2 V

Symbol	Test Conditions	Characteristic Values (T _J = 25°C, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	I _C = I _T ; V _{CE} = 10 V, Pulse test, t ≤ 300 μs, duty cycle ≤ 2 %	16	23	S
C_{iss}	} V _{GS} = 0 V, V _{DS} = 25 V, f = 1 MHz		3700	pF
C_{oss}			440	pF
C_{rss}			60	pF
Q_g	} I _C = I _T , V _{GE} = 15 V, V _{CE} = 0.5 V _{CES}		190	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
t_{d(on)}	} Inductive load, T_J = 25°C		50	ns
t_{ri}			50	ns
t_{d(off)}			110	200 ns
t_{fi}			120	200 ns
E_{off}			1.8	2.6 mJ
t_{d(on)}	} Inductive load, T_J = 125°C		50	ns
t_{ri}			50	ns
E_{on}			2.2	mJ
t_{d(off)}			190	ns
t_{fi}			180	ns
E_{off}			2.6	mJ
R_{thJC}				0.73 K/W
R_{thCK}			0.15	K/W

ISOPLUS 247 (IXSR) OUTLINE



1 Gate, 2 Drain (Collector)
3 Source (Emitter)
4 no connection

Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A ₁	2.29	2.54	.090	.100
A ₂	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b ₁	1.91	2.13	.075	.084
b ₂	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190
S	13.21	13.72	.520	.540
T	15.75	16.26	.620	.640
U	1.65	3.03	.065	.080

Reverse Diode (FRED)		Characteristic Values (T _J = 25°C, unless otherwise specified)		
Symbol	Test Conditions	min.	typ.	max.
V _F	I _F = I _T , V _{GE} = 0 V, Pulse test, t ≤ 300 μs, duty cycle d ≤ 2 %			1.8 V
I _{RM} t _{rr}	$\left. \begin{array}{l} I_F = I_T, V_{GE} = 0 \text{ V, } -di_F/dt = 100 \text{ A}/\mu\text{s} \\ V_R = 100 \text{ V} \\ I_F = 1 \text{ A; } -di/dt = 200 \text{ A}/\mu\text{s; } V_R = 30 \text{ V} \end{array} \right\}$		2 35	A ns
R _{thJC}				1.15 K/W

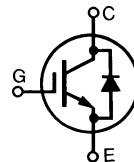
Note: 1. $I_T = 40A$

IGBT with Diode ISOPLUS247™

(Electrically Isolated Backside)

Short Circuit SOA Capability

Preliminary data



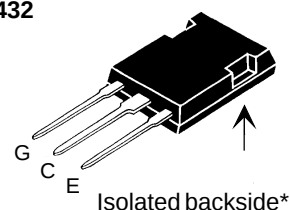
IXSR 40N60CD1

V_{CES}	= 600 V
I_{C25}	= 62 A
$V_{CE(SAT)}$	= 2.5 V
$t_{fi(typ)}$	= 70 ns

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}	$T_C = 25^\circ\text{C}$, limited by leads	62	A
I_{C90}	$T_C = 90^\circ\text{C}$	37	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	150	A
SSOA (RBSOA)	$V_{GE} = 15\text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22\ \Omega$ Clamped inductive load, $L = 30\ \mu\text{H}$	$I_{CM} = 80$ @ 0.8 V_{CES}	A
t_{SC} (SCSOA)	$V_{GE} = 15\text{ V}$, $V_{CE} = 360\text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22\ \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	210	W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
V_{ISOL}	50/60 Hz, RMS $t = 1\text{ min}$	2500	V~
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	PLUS247	5	g

ISOPLUS 247™ (IXSR)

 E 153432



G = Gate, C = Collector,
E = Emitter

* Patent pending

Features

- DCB Isolated mounting tab
- Meets TO-247AD package Outline
- High current handling capability
- Latest generation HDMOS™ process
- MOS Gate turn-on - drive simplicity

Applications

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

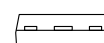
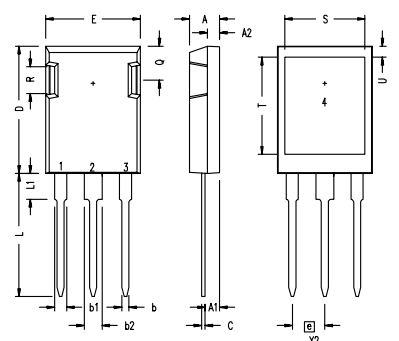
Advantages

- Easy assembly
- High power density
- Very fast switching speeds for high frequency applications

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1\text{ mA}$, $V_{GE} = 0\text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4\text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$ $T_J = 150^\circ\text{C}$			650 μA 5 mA
I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			$\pm 100\text{ nA}$
$V_{CE(sat)}$	$I_C = I_T$, $V_{GE} = 15\text{ V}$			2.5 V

Symbol	Test Conditions	Characteristic Values		
		(T _j = 25°C, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	I _C = I _T ; V _{CE} = 10 V, Pulse test, t ≤ 300 μs, duty cycle ≤ 2 %	16	23	S
C_{ies}	V _{GS} = 0 V, V _{DS} , 25 V, = f = 1 MHz		3700	pF
C_{oes}			440	pF
C_{res}			60	pF
Q_g	I _C = I _T , V _{GE} = 15 V, V _{CE} = 0.5 V _{CES}		190	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
t_{d(on)}	Inductive load, T _j = 25°C I _C = I _T , V _{GE} = 15 V, L = 100 μH, V _{CE} = 0.8 V _{CES} , R _G = R _{off} = 2.7 Ω Remarks: Switching times may increase for V _{CE} (Clamp) > 0.8 • V _{CES} , higher T _j or increased R _G		50	ns
t_{ri}			50	ns
t_{d(off)}			70	140 ns
t_{fi}			70	120 ns
E_{off}			1.0	1.7 mJ
t_{d(on)}	Inductive load, T _j = 125°C I _C = I _T , V _{GE} = 15 V, L = 100 μH V _{CE} = 0.8 V _{CES} , R _G = R _{off} = 2.7 Ω Remarks: Switching times may increase for V _{CE} (Clamp) > 0.8 • V _{CES} , higher T _j or increased R _G		50	ns
t_{ri}			50	ns
E_{on}			2.2	mJ
t_{d(off)}			140	ns
t_{fi}			140	ns
E_{off}			1.7	mJ
R_{thJC}				0.6 K/W
R_{thCK}			0.15	K/W

ISOPLUS 247 (IXSR) OUTLINE



- 1 Gate, 2 Drain (Collector)
3 Source (Emitter)
4 no connection

Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A ₁	2.29	2.54	.090	.100
A ₂	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b ₁	1.91	2.13	.075	.084
b ₂	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190
S	13.21	13.72	.520	.540
T	15.75	16.26	.620	.640
U	1.65	3.03	.065	.080

Reverse Diode (FRED)

Symbol	Test Conditions	Characteristic Values		
		(T _j = 25°C, unless otherwise specified)		
		min.	typ.	max.
V_F	I _F = I _T , V _{GE} = 0 V, Pulse test ≤ 300 μs, duty cycle d ≤ 2 %			1.8 V
I_{RM}	I _F = I _T , V _{GE} = 0 V, -di _F /dt = 100 A/μs V _R = 100 V I _F = 1 A; -di/dt = 200 A/μs; V _R = 30 V		2	2.5 A
t_{rr}			35	ns
R_{thJC}				1.15 K/W

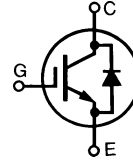
Note: 1. I_T = 40A

IGBT with Diode PLUS247™ package

IXSK 40N60CD1
IXSX 40N60CD1

Short Circuit SOA Capability

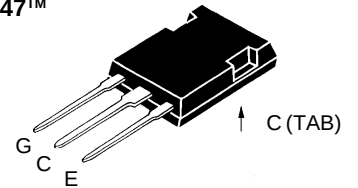
Preliminary data



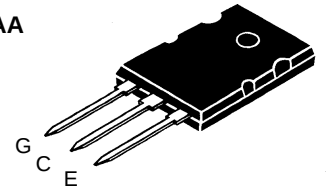
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 75 \text{ A} \\ V_{CE(sat)} &= 2.5 \text{ V} \\ t_{fi(typ)} &= 70 \text{ ns} \end{aligned}$$

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}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	40	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	150	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 80$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	280	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 (TO-264)	0.9/6	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	TO-264	10	g
	PLUS247	6	g

PLUS 247™
(IXSX)



TO-264 AA
(IXSK)



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

Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- High frequency IGBT and anti-parallel FRED in one package
- Latest generation HDMOS™ process
- MOS Gate turn-on
 - drive simplicity
- Fast Recovery, low leakage Epitaxial Diode
 - 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

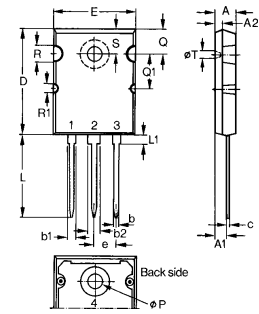
- PLUS 247™ package for clip or spring mounting
- Space savings (two devices in one package)
- Reduces assembly time and cost

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		7 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$ $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$			650 μA 5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			2.5 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 $\leq 2\%$	16	23	S
C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$		3700	pF
C_{oss}			440	pF
C_{rss}			60	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		190	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_j = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_j or increased R_G		50	ns
t_{ri}			50	ns
$t_{d(off)}$			70	140 ns
t_{fi}			70	120 ns
E_{off}			1.0	1.7 mJ
$t_{d(on)}$	Inductive load, $T_j = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_j or increased R_G		50	ns
t_{ri}			50	ns
E_{on}			2.2	mJ
$t_{d(off)}$			140	ns
t_{fi}			140	ns
E_{off}			1.7	mJ
R_{thJC}				0.48 K/W
R_{thCK}			0.15	K/W

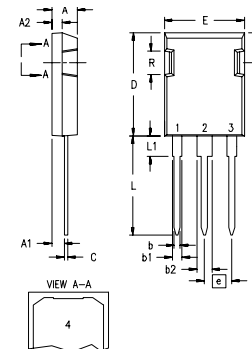
Reverse Diode (FRED)		Characteristic Values ($T_j = 25^\circ\text{C}$, unless otherwise specified)		
Symbol	Test Conditions	min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.8 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 100\text{ A}/\mu\text{s}$ $V_R = 100\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		2	2.5 A
t_{rr}			35	ns
R_{thJC}				0.75 K/W

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

PLUS247™ (IXSX)



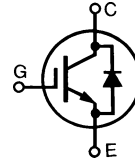
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b1	1.91	2.13	.075	.084
b2	2.92	3.12	.115	.123
C	0.61	0.80	.024	.031
D	20.80	21.34	.819	.840
E	15.75	16.13	.620	.635
e	5.45 BSC		.215 BSC	
L	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

IGBT High Speed

IXSH 50N60B

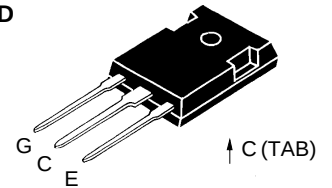
Short Circuit SOA Capability

$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 75 \text{ A} \\ V_{CE(sat)} &= 2.5 \text{ V} \end{aligned}$$



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}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	50	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	200	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 100$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	250	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.
Weight		TO-247	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 for surface mount
- Guaranteed Short Circuit SOA capability
- High frequency IGBT
- Latest generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum 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

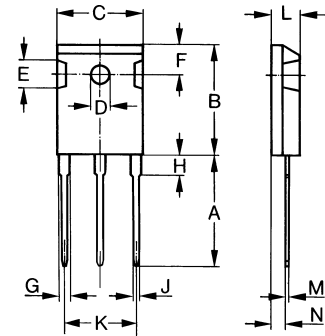
Advantages

- 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}	$I_C = 250 \mu\text{A}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			200 μA 1 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$	2.2	2.5	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 $\leq 2\%$	16	23	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		160	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3850	pF
C_{oes}			440	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		167	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
$t_{d(off)}$			150	300 ns
t_{fi}			150	300 ns
E_{off}			3.3	6.0 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
E_{on}			0.6	mJ
$t_{d(off)}$			230	ns
t_{fi}			230	ns
E_{off}			4.8	mJ
R_{thJC}				0.5 K/W
R_{thCK}			0.25	K/W

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

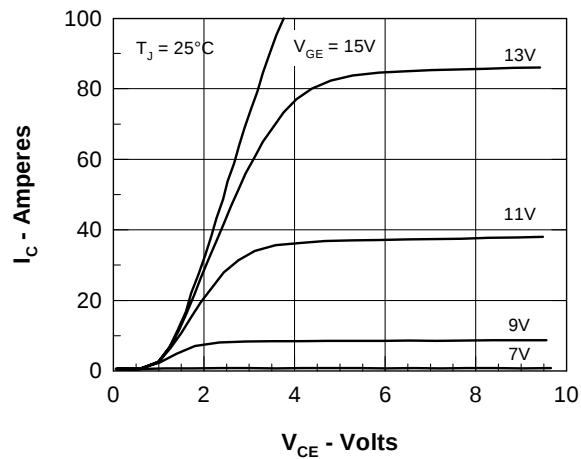


Figure 1. Saturation Voltage Characteristics

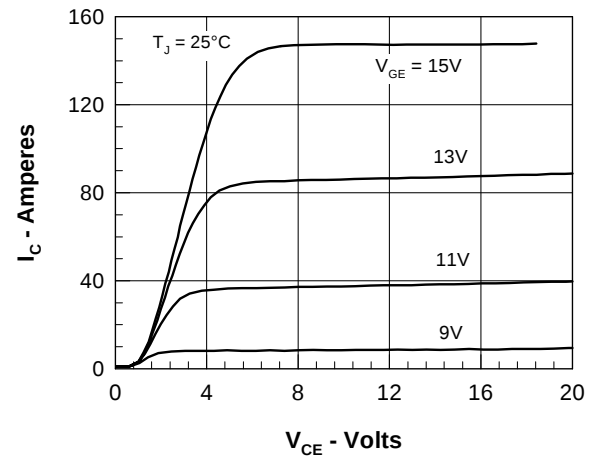


Figure 2. Extended Output Characteristics

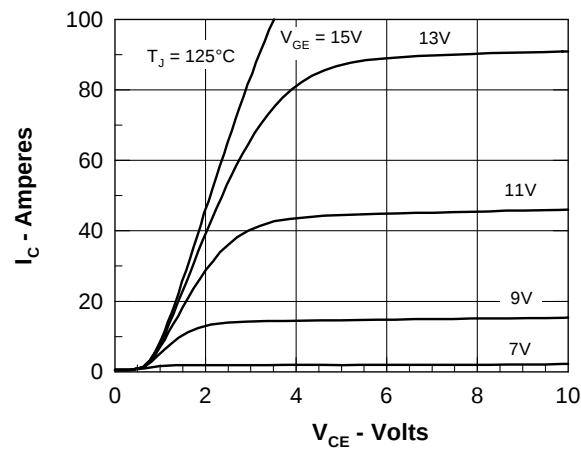


Figure 3. Saturation Voltage Characteristics

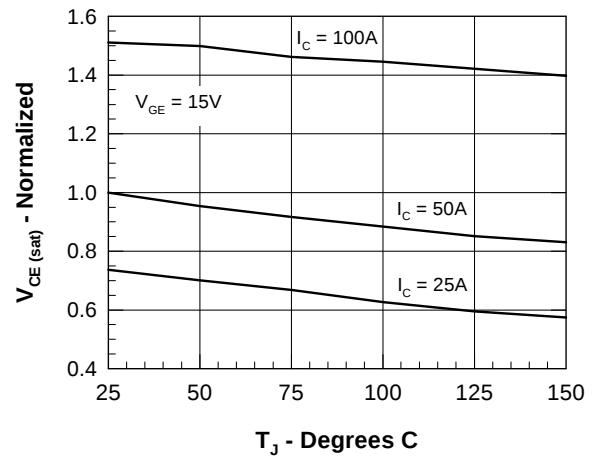


Figure 4. Temperature Dependence of $V_{CE(sat)}$

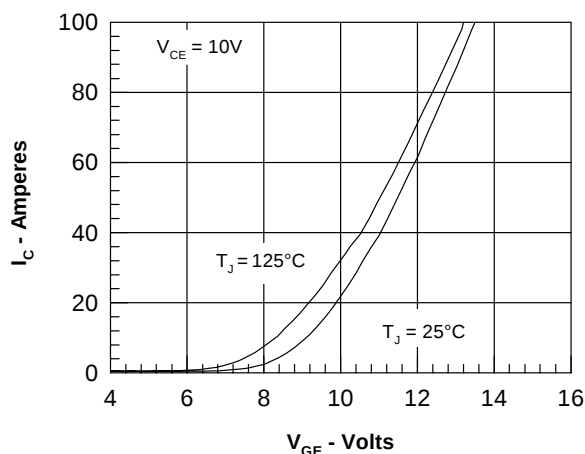


Figure 5. Admittance Curves

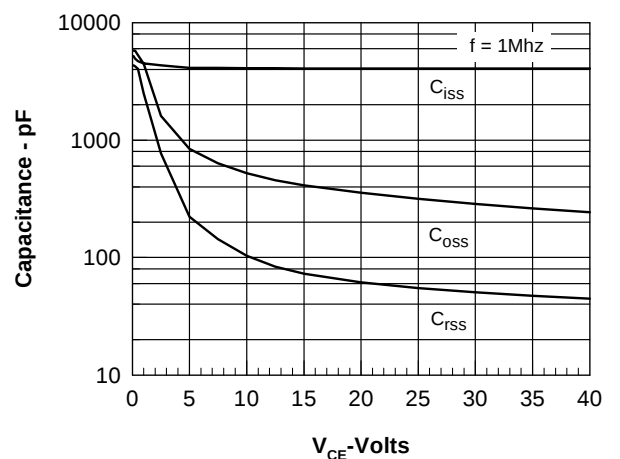


Figure 6. Capacitance Curves

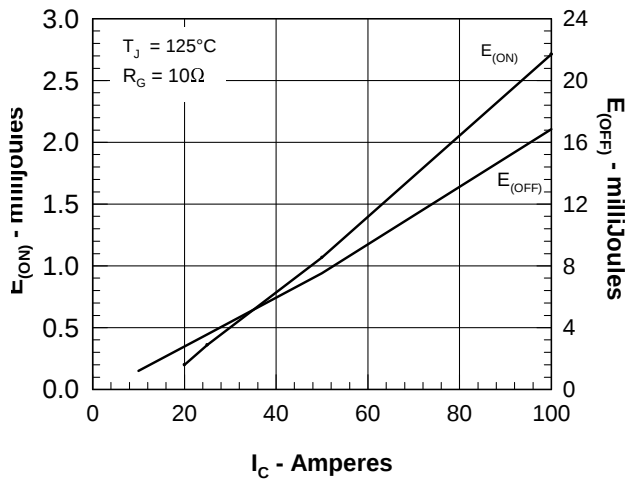


Figure 7. Dependence of E_{ON} and E_{OFF} on I_C .

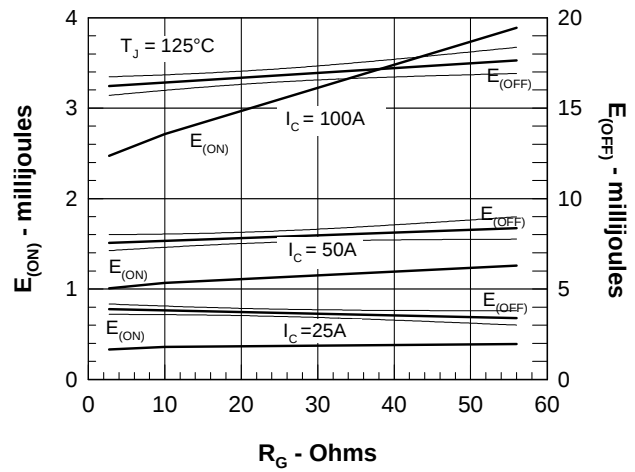


Figure 8. Dependence of E_{ON} and E_{OFF} on R_G .

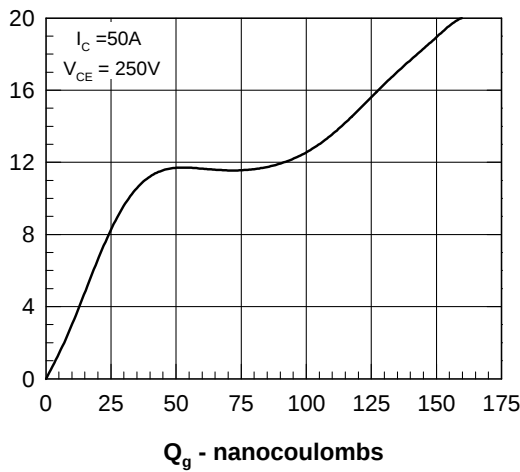


Figure 9. Gate Charge

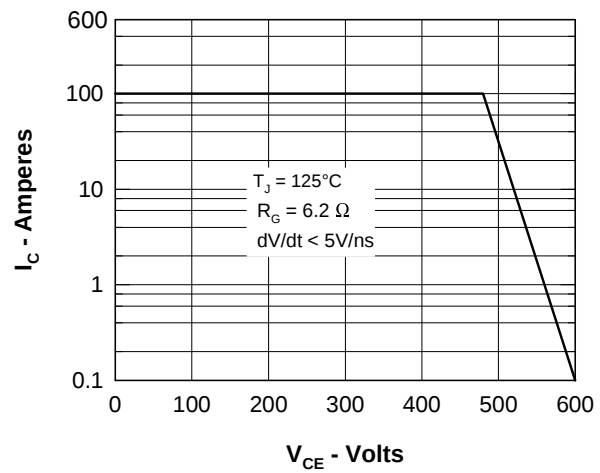


Figure 10. Turn-off Safe Operating Area

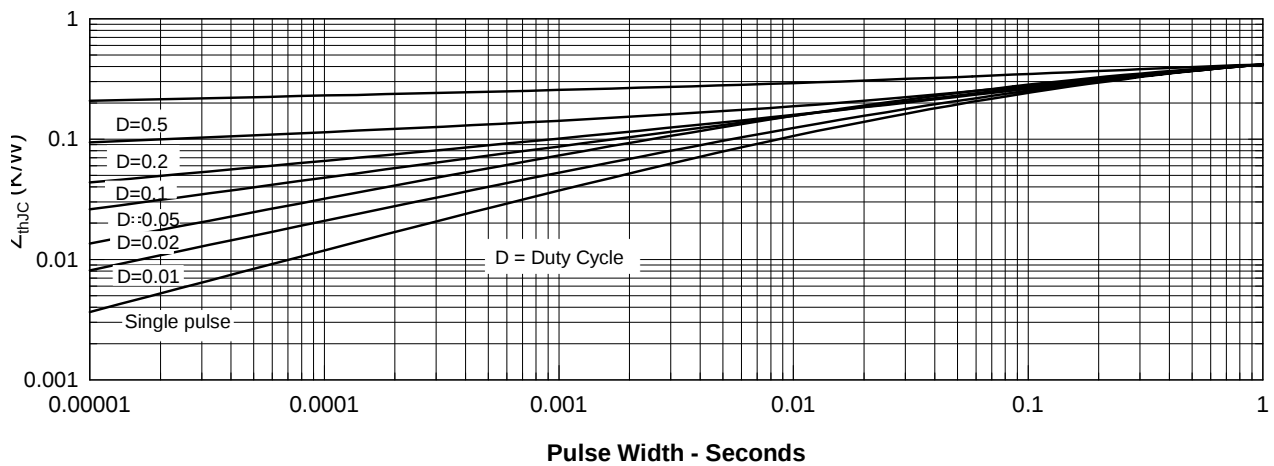


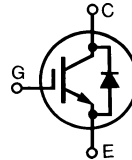
Figure 11. Transient Thermal Resistance

IGBT with Diode

IXSK 50N60BD1
IXSX 50N60BD1

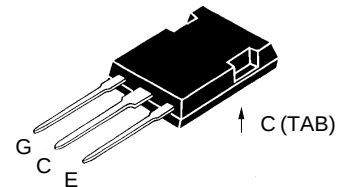
$V_{CES} = 600 \text{ V}$
 $I_{C25} = 75 \text{ A}$
 $V_{CE(sat)} = 2.5 \text{ V}$

Short Circuit SOA Capability

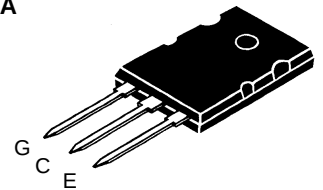


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	600	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	50	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	200	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 100$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	300	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	0.9/6	Nm/lb.in.
Weight		10	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

PLUS247 (IXSX)



TO-264 AA (IXSK)



G = Gate,
E = Emitter,

C = Collector,
TAB = Collector

Features

- International standard package JEDEC TO-264 AA, and hole-less TO-247 package for clip mounting
- Guaranteed Short Circuit SOA capability
- High frequency IGBT and anti-parallel FRED in one package
- Latest 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

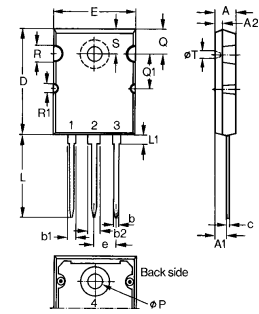
- Space savings (two devices in one package)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Reduces assembly time and cost

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			350 μA 5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$	2.2	2.5	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 $\leq 2\%$	16	23	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		160	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3850	pF
C_{oes}			440	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5\text{ V}_{CES}$		167	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
$t_{d(off)}$		150	300	ns
t_{fi}		150	300	ns
E_{off}		3.3	6.0	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
E_{on}		2.5		mJ
$t_{d(off)}$		230		ns
t_{fi}		230		ns
E_{off}		4.8		mJ
R_{thJC}				0.42 K/W
R_{thCK}		0.15		K/W

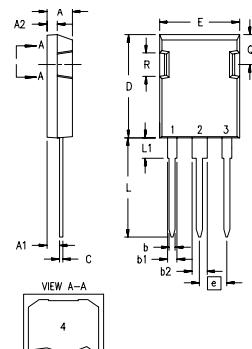
Reverse Diode (FRED)		Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
Symbol	Test Conditions	min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			2.5 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 100\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		2	2.5 A
t_{rr}			35	ns
R_{thJC}				0.75 K/W

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

PLUS247™ (IXSX)



Dim.	Millimeter		Inches	
	Min.	Max.	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
b2	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

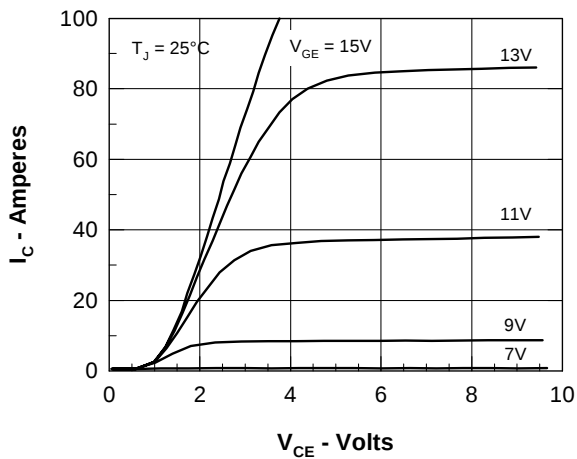


Figure 1. Saturation Voltage Characteristics

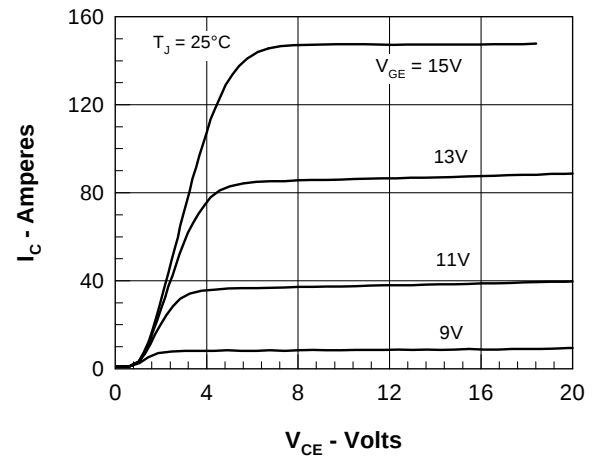


Figure 2. Extended Output Characteristics

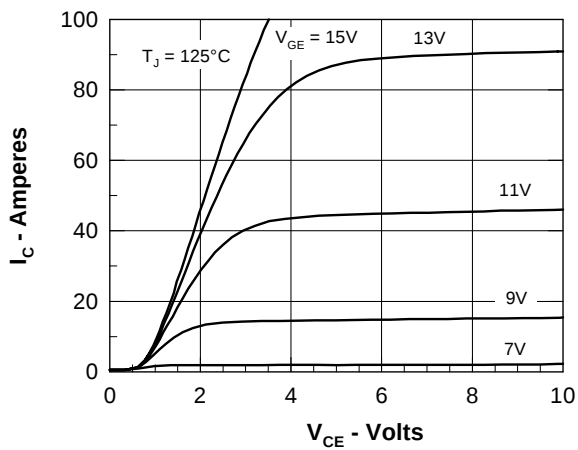


Figure 3. Saturation Voltage Characteristics

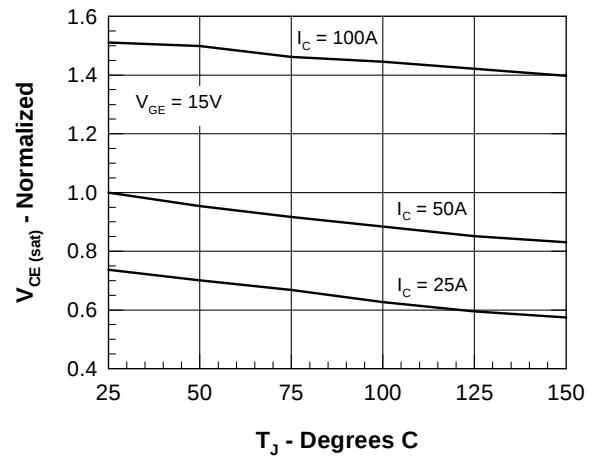


Figure 4. Temperature Dependence of $V_{CE(sat)}$

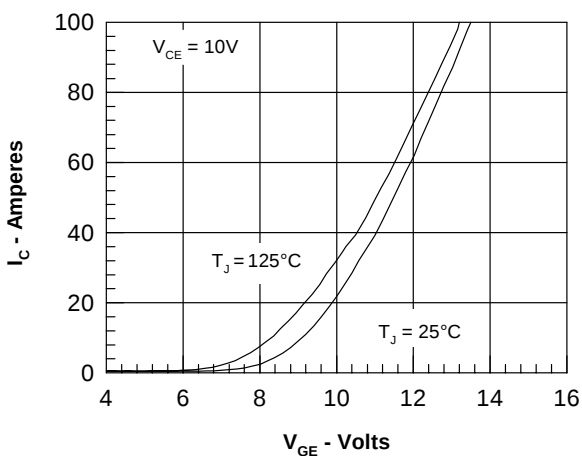


Figure 5. Admittance Curves

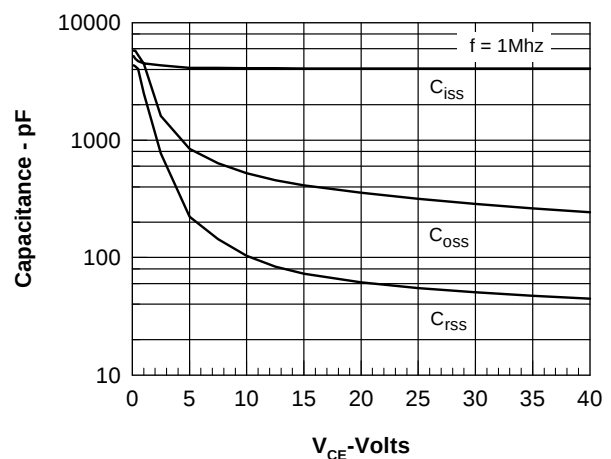


Figure 6. Capacitance Curves

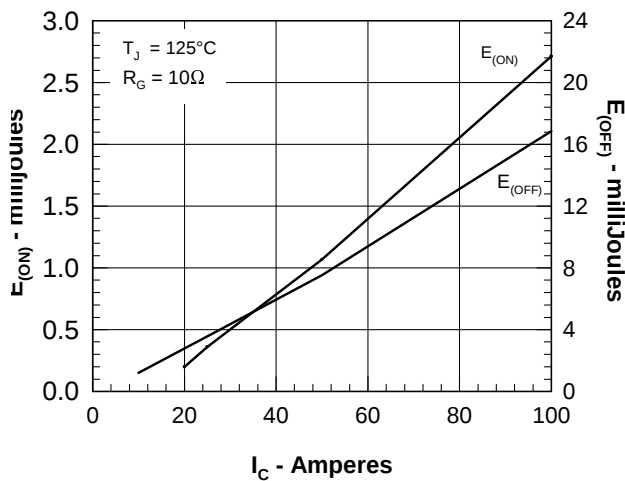


Figure 7. Dependence of E_{ON} and E_{OFF} on I_C .

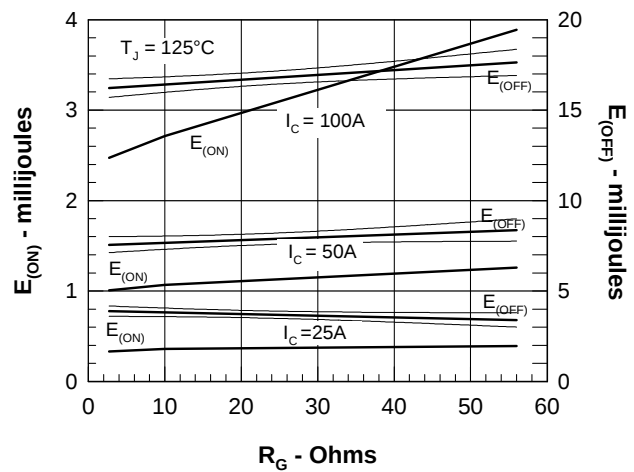


Figure 8. Dependence of E_{ON} and E_{OFF} on R_G .

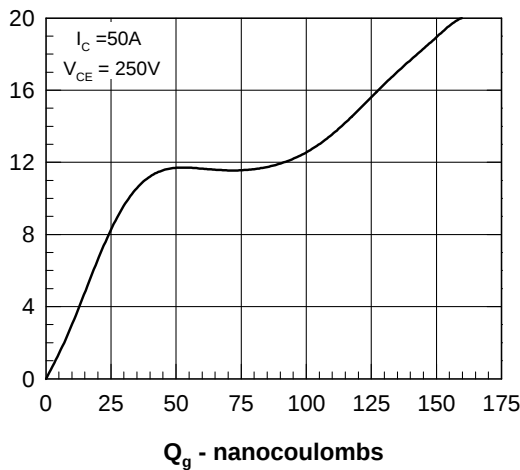


Figure 9. Gate Charge

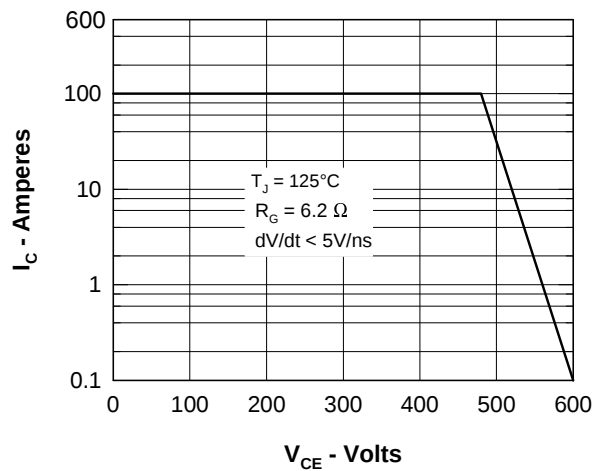


Figure 10. Turn-off Safe Operating Area

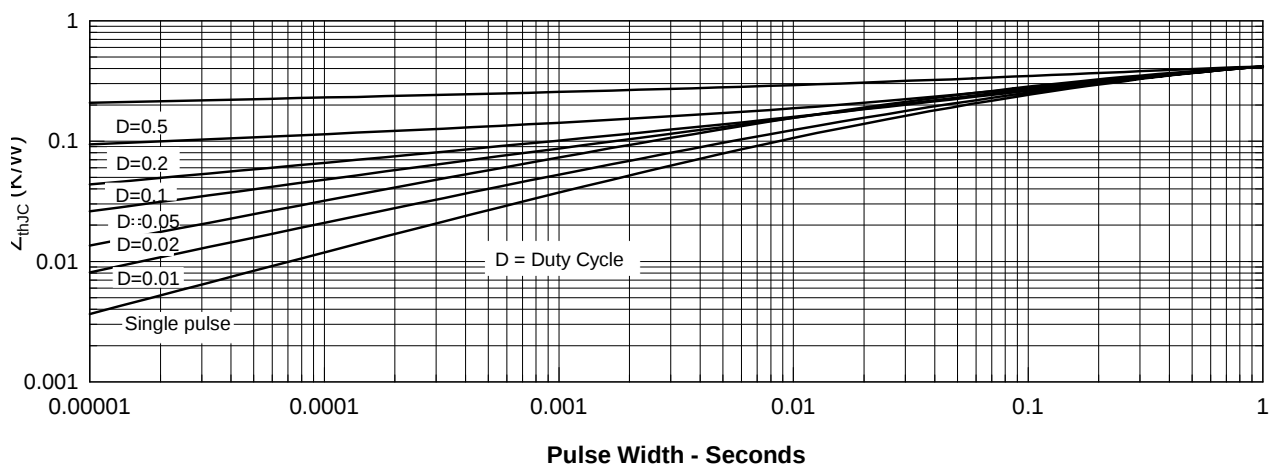


Figure 11. Transient Thermal Resistance

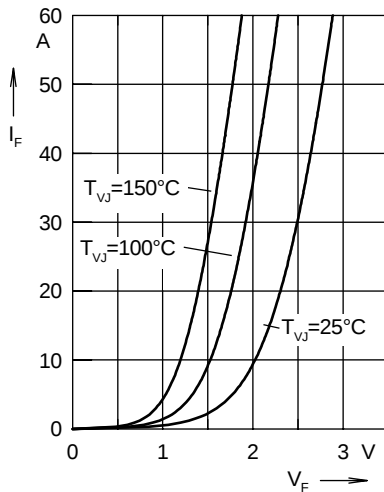


Fig. 12 Forward current I_F versus V_F

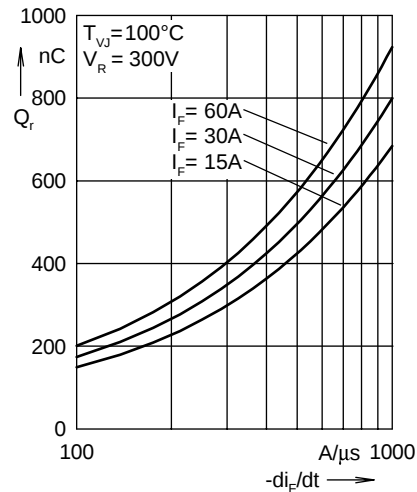


Fig. 13 Reverse recovery charge Q_r versus $-di_F/dt$

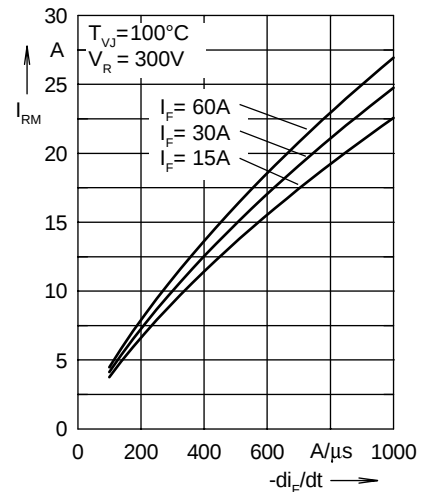


Fig. 14 Peak reverse current I_{RM} versus $-di_F/dt$

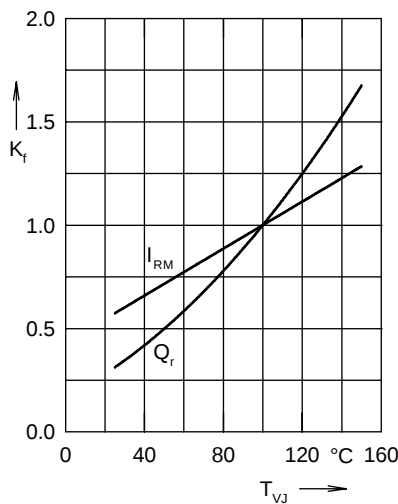


Fig. 15 Dynamic parameters Q_r , I_{RM} versus T_{VJ}

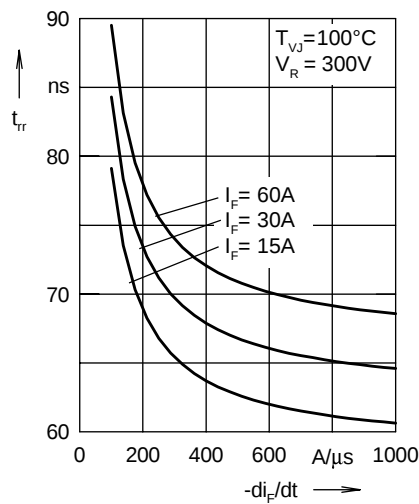


Fig. 16 Recovery time t_{rr} versus $-di_F/dt$

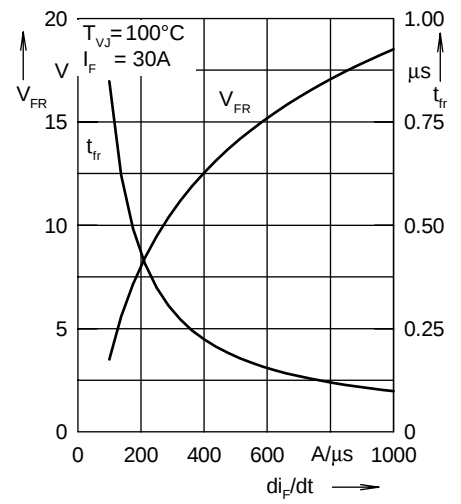


Fig. 17 Peak forward voltage V_{FR} and t_{fr} versus di_F/dt

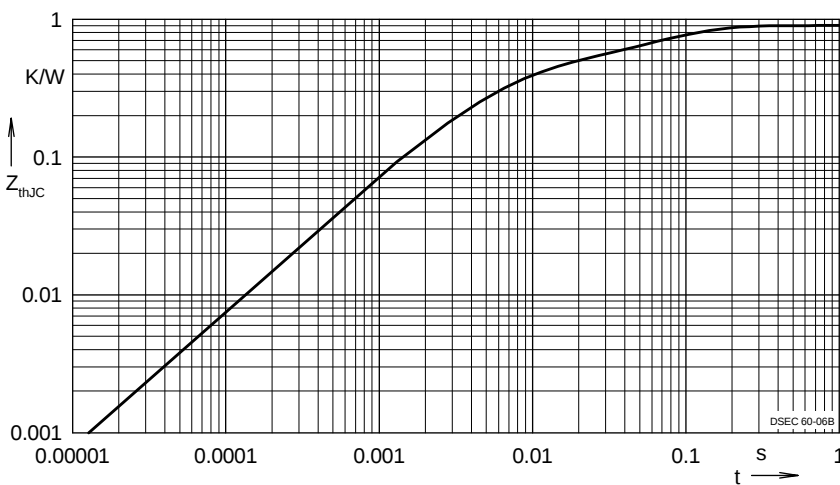


Fig. 18 Transient thermal resistance junction to case

Constants for Z_{thJC} calculation:

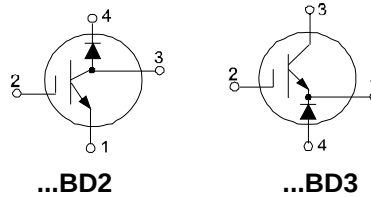
i	R_{thi} (K/W)	t_i (s)
1	0.465	0.0052
2	0.179	0.0003
3	0.256	0.0396

HIGH Speed IGBT with HiPerFRED

Short Circuit SOA Capability
Buck & boost configurations

Preliminary data

IXSN 50N60BD2 IXSN 50N60BD3

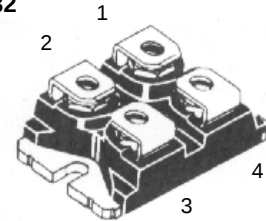


$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 75 \text{ A} \\ V_{CESat} &= 2.5 \text{ V} \\ t_{fi} &= 150 \text{ ns} \end{aligned}$$

	Symbol	Test Conditions	Maximum Ratings	
IGBT	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}	$T_C = 25^\circ\text{C}$	75	A
	I_{C90}	$T_C = 90^\circ\text{C}$	50	A
	I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	200	A
	SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 100$ @ $0.8 V_{CES}$	A
	t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
Diode	P_C	$T_C = 25^\circ\text{C}$	250	W
	V_{RRM}		600	V
	I_{FAVM}	$T_C = 70^\circ\text{C}$; rectangular, $d = 50\%$	60	A
	I_{FRM}	$t_p < 10 \text{ ms}$; pulse width limited by T_J	600	A
Case	P_D	$T_C = 25^\circ\text{C}$	150	W
	T_J		-40 ... +150	$^\circ\text{C}$
	T_{JM}		150	$^\circ\text{C}$
	T_{stg}		-40 ... +150	$^\circ\text{C}$
	M_d	Mounting torque	1.5/13	Nm/lb.in.
		Terminal connection torque (M4)	1.5/13	Nm/lb.in.
	Weight		30	g
	Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

SOT-227B, miniBLOC

E 153432



IXSN50N60BD2

1 = Emitter; 2 = Gate
3 = Collector; 4 = Diode cathode

IXSN50N60BD3

1 = Emitter/Diode Cathode; 2 = Gate
3 = Collector; 4 = Diode anode

Features

- International standard package miniBLOC
- Aluminium nitride isolation
 - high power dissipation
- Isolation voltage 3000 V~
- Very high current, fast switching IGBT & FRED diode
- MOS Gate turn-on
 - drive simplicity
- Low collector-to-case capacitance
- Low package inductance ($< 10 \text{ nH}$)
 - easy to drive and to protect

Applications

- AC motor speed control
- DC servo and robot drives
- DC choppers
- Buck converters

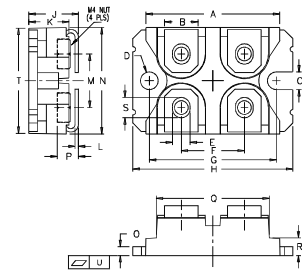
Advantages

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

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			350 μA 5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$	2.2	2.5	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 $\leq 2\%$	16	27	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3850	pF
C_{oes}			440	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		167	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = R_{off} = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
$t_{d(off)}$			150	300 ns
t_{fi}			150	300 ns
E_{off}			3.3	6.0 mJ
$t_{d(on)}$			70	ns
t_{ri}	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = R_{off} = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
E_{on}			2.5	mJ
$t_{d(off)}$			230	ns
t_{fi}			230	ns
E_{off}			4.8	mJ
R_{thJC}				0.50 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)

Characteristic Values
($T_J = 25^\circ\text{C}$, unless otherwise specified)

Symbol	Test Conditions	typ.	max.
I_R	$T_{VJ} = 25^\circ\text{C}$ $V_R = V_{RRM}$ $T_{VJ} = 150^\circ\text{C}$		650 μA 2.5 mA
V_F	$I_F = 60\text{ A}$ Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$		1.75 V 2.40 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 100\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$, $T_J = 100^\circ\text{C}$		8.0 A
t_{rr}	$I_F = 1\text{ A}$, $-di_F/dt = 50\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$	35	ns
R_{thJC}			0.85 K/W

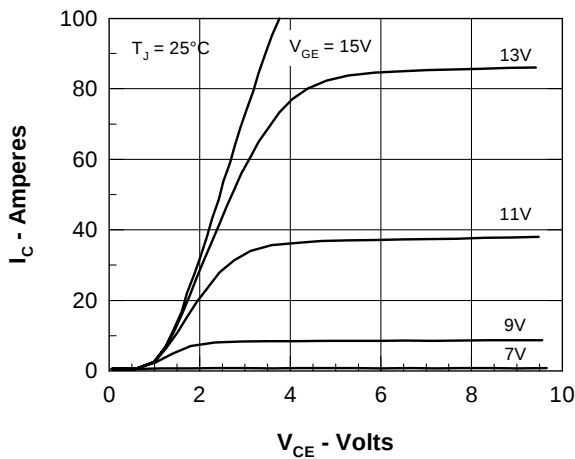


Figure 1. Saturation Voltage Characteristics

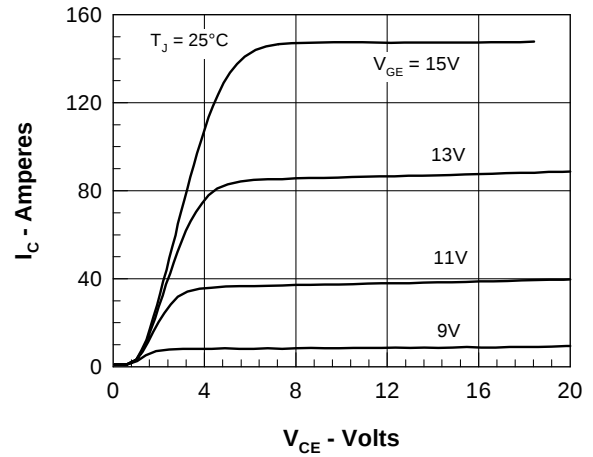


Figure 2. Extended Output Characteristics

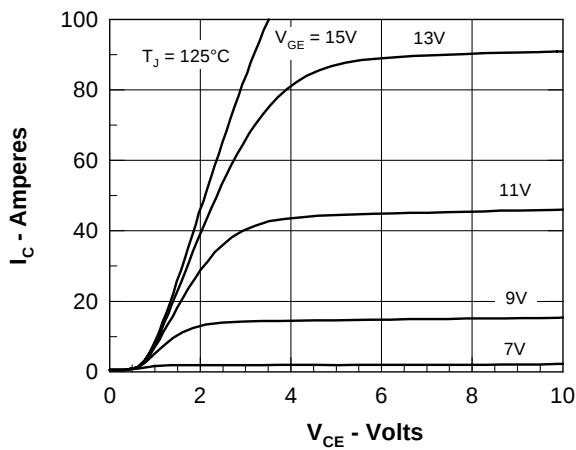


Figure 3. Saturation Voltage Characteristics

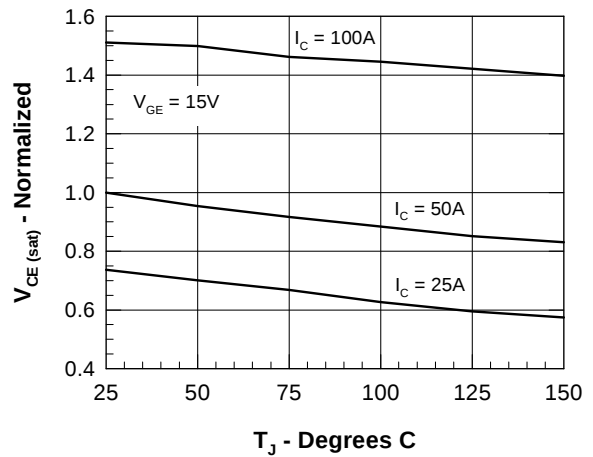


Figure 4. Temperature Dependence of $V_{CE(sat)}$

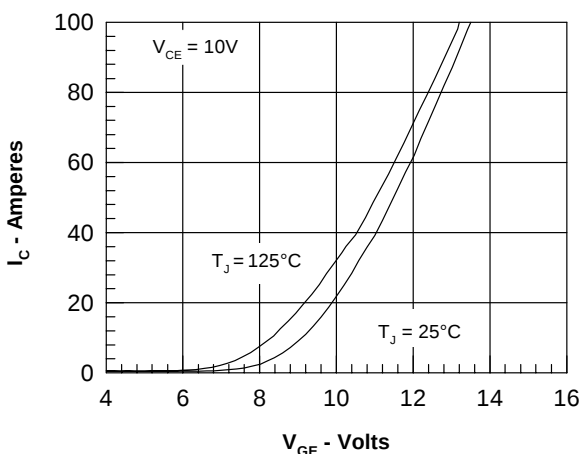


Figure 5. Admittance Curves

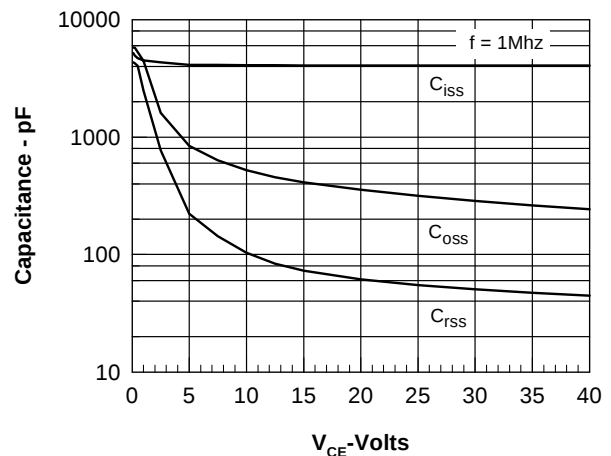


Figure 6. Capacitance Curves

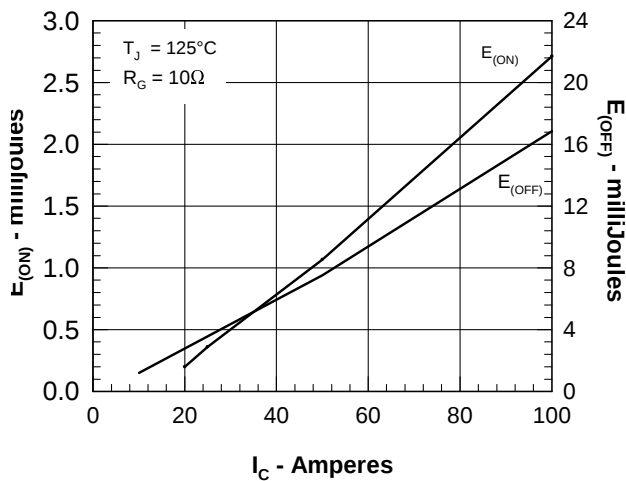


Figure 7. Dependence of E_{ON} and E_{OFF} on I_C .

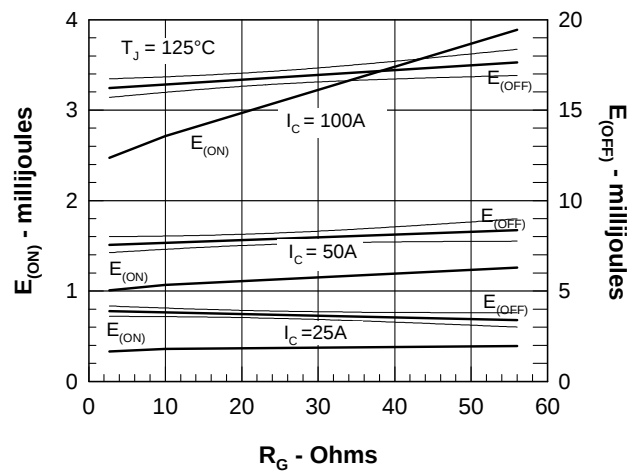


Figure 8. Dependence of E_{ON} and E_{OFF} on R_G .

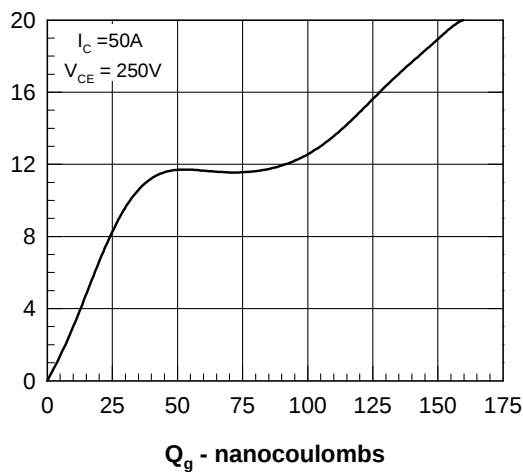


Figure 9. Gate Charge

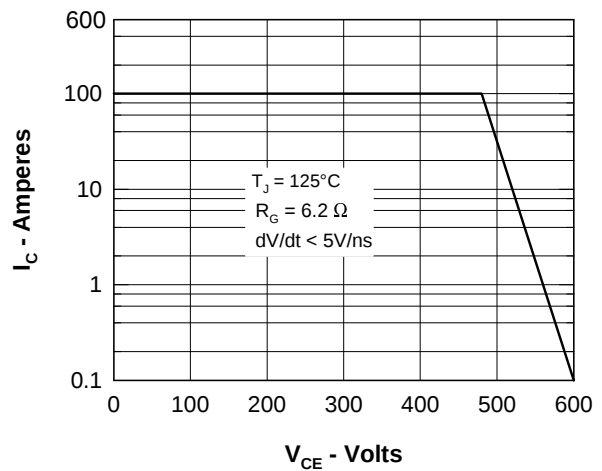


Figure 10. Turn-off Safe Operating Area

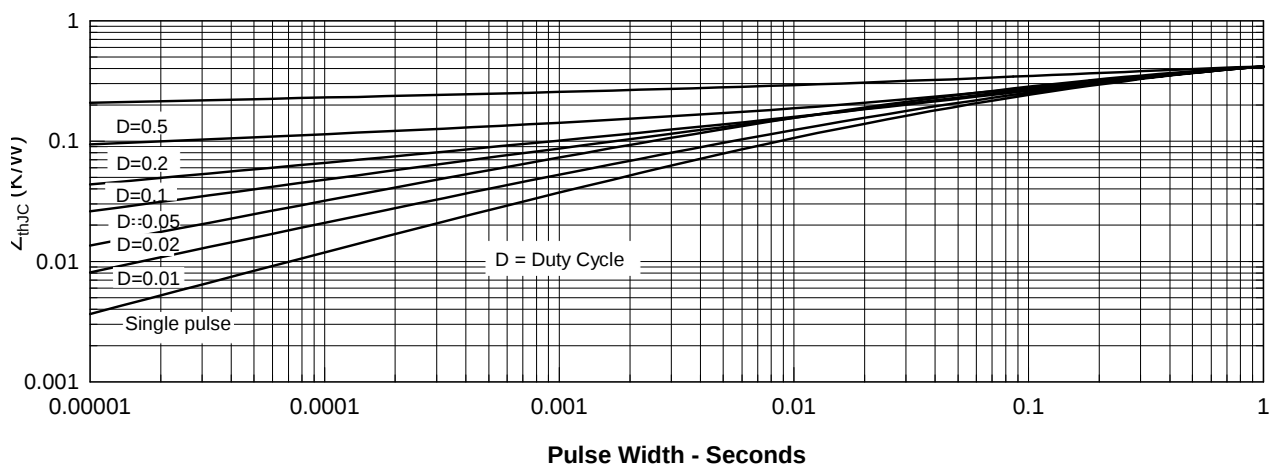


Figure 11. Transient Thermal Resistance

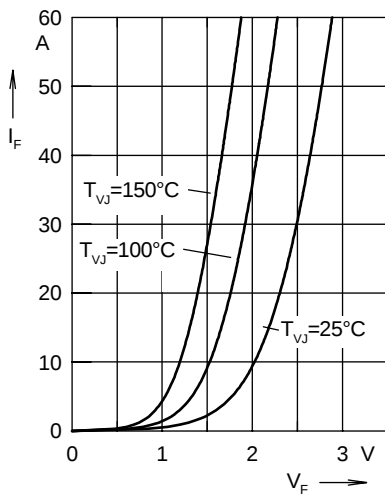


Fig. 12 Forward current I_F versus V_F

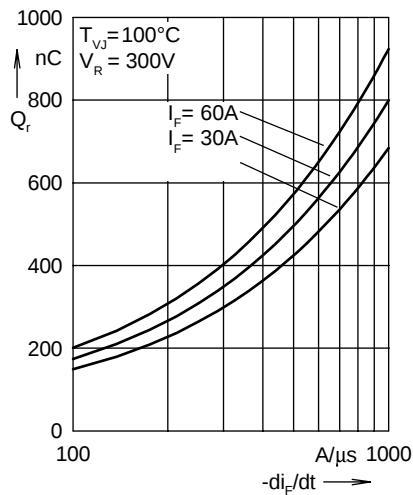


Fig. 13 Reverse recovery charge Q_r versus $-di_F/dt$

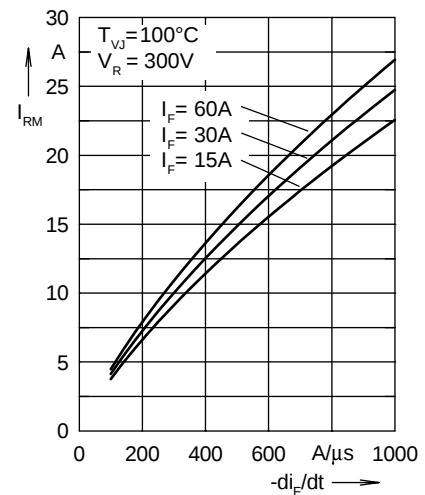


Fig. 14 Peak reverse current I_{RM} versus $-di_F/dt$

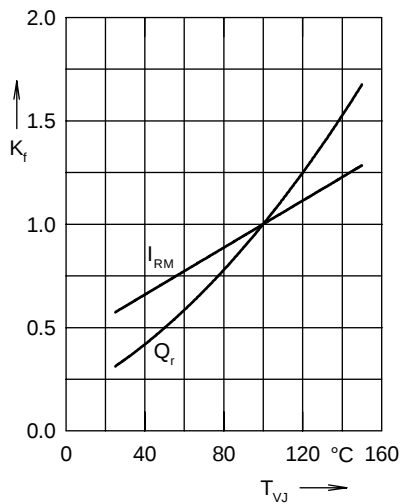


Fig. 15 Dynamic parameters Q_r , I_{RM} versus T_{VJ}

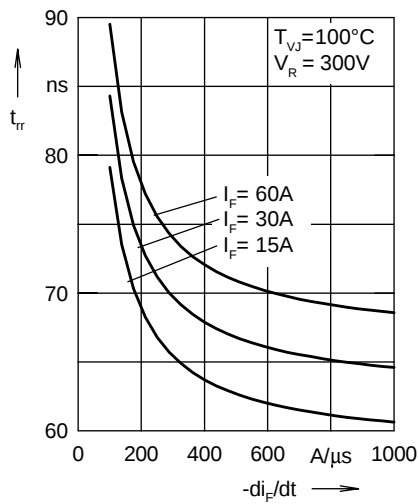


Fig. 16 Recovery time t_{rr} versus $-di_F/dt$

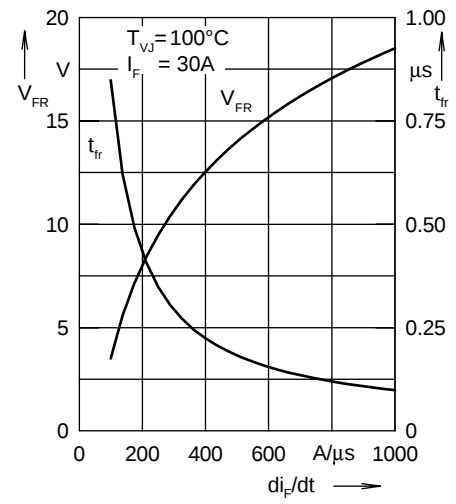
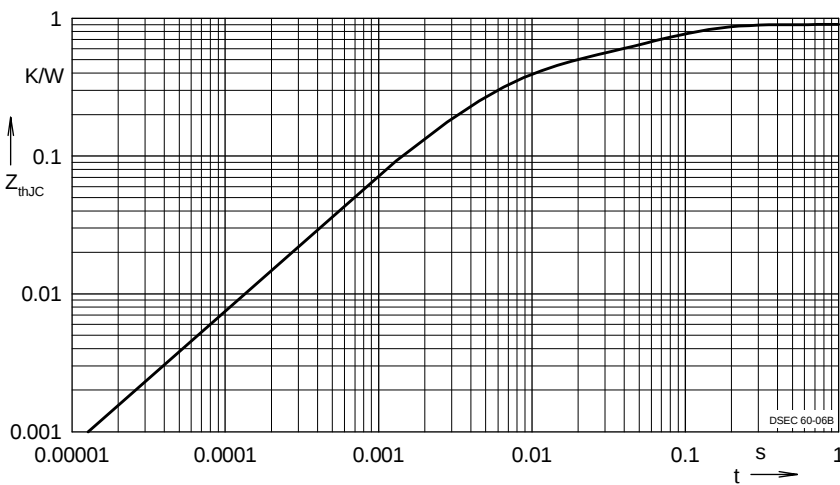


Fig. 17 Peak forward voltage V_{FR} and t_{fr} versus di_F/dt



Constants for Z_{thJC} calculation:

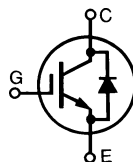
i	R_{thi} (K/W)	t_i (s)
1	0.465	0.0052
2	0.179	0.0003
3	0.256	0.0396

IGBT with Diode

IXSK 50N60BU1
IXSX 50N60BU1

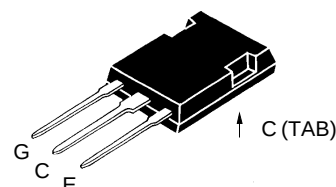
$V_{CES} = 600 \text{ V}$
 $I_{C25} = 75 \text{ A}$
 $V_{CE(sat)} = 2.5 \text{ V}$

Short Circuit SOA Capability

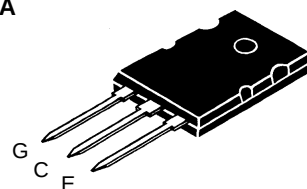


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	600	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	600	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	50	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	200	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 100$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	300	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	0.9/6	Nm/lb.in.
Weight		10	g
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$

PLUS247 (IXSX)



TO-264 AA (IXSK)



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

Features

- International standard package JEDEC TO-264 AA, and hole-less TO-247 package for clip mounting
- Guaranteed Short Circuit SOA capability
- High frequency IGBT and anti-parallel FRED in one package
- Latest 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)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Reduces assembly time and cost

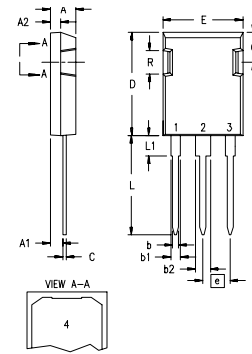
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			325 μA 17 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$	2.2	2.5	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 $\leq 2\%$	20	23	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		160	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3850	pF
C_{oes}			440	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		167	nC
Q_{ge}			45	nC
Q_{gc}			88	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			70	ns
$t_{d(off)}$		150	300	ns
t_{fi}		150	300	ns
E_{off}		3.3	6.0	mJ
$t_{d(on)}$			70	ns
t_{ri}	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
E_{on}		2.5	mJ	
$t_{d(off)}$		230	ns	
t_{fi}		230	ns	
E_{off}		4.8	mJ	
R_{thJC}			0.15	0.42 K/W
R_{thCK}				K/W

Reverse Diode (FRED)

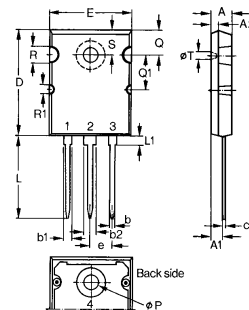
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.8 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $T_J = 125^\circ\text{C}$ $I_F = 1\text{ A}$; $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		19	33 A
t_{rr}			175	ns
R_{thJC}			35	50 ns
R_{thJC}				0.75 K/W

PLUS247™ (IXSX)



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A ₁	2.29	2.54	.090	.100
A ₂	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b ₁	1.91	2.13	.075	.084
b ₂	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A ₁	2.54	2.89	.100	.114
A ₂	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b ₁	2.39	2.69	.094	.106
b ₂	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

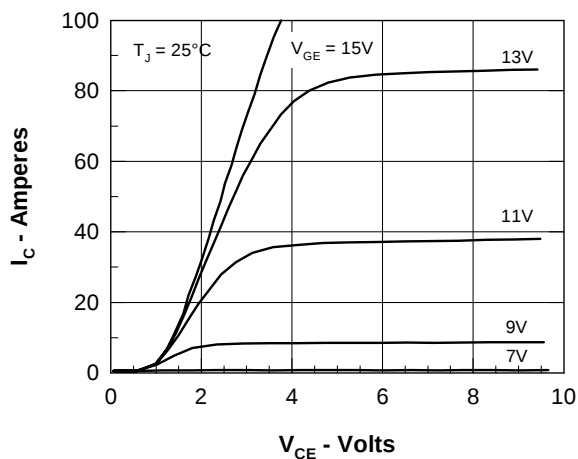


Figure 1. Saturation Voltage Characteristics

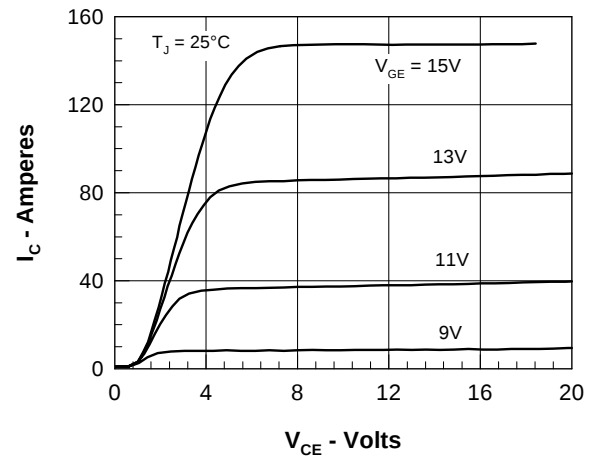


Figure 2. Extended Output Characteristics

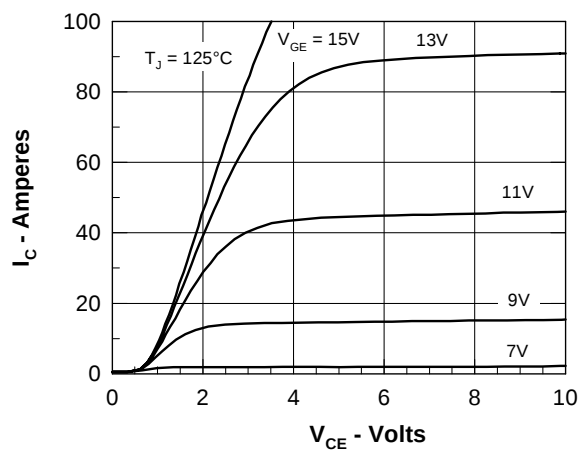


Figure 3. Saturation Voltage Characteristics

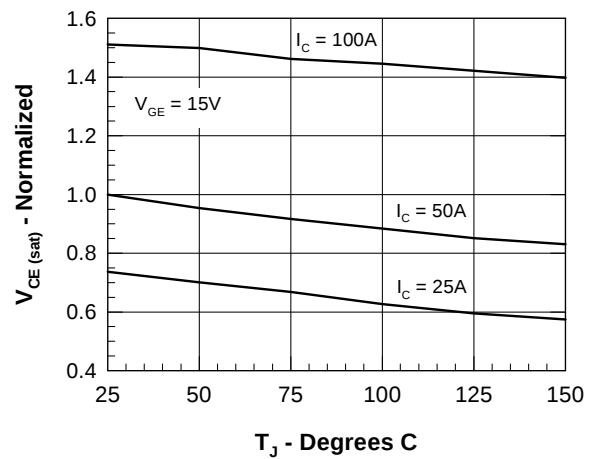


Figure 4. Temperature Dependence of $V_{CE(sat)}$

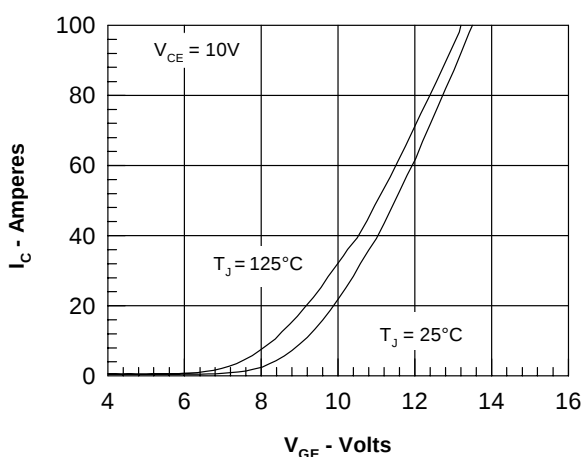


Figure 5. Admittance Curves

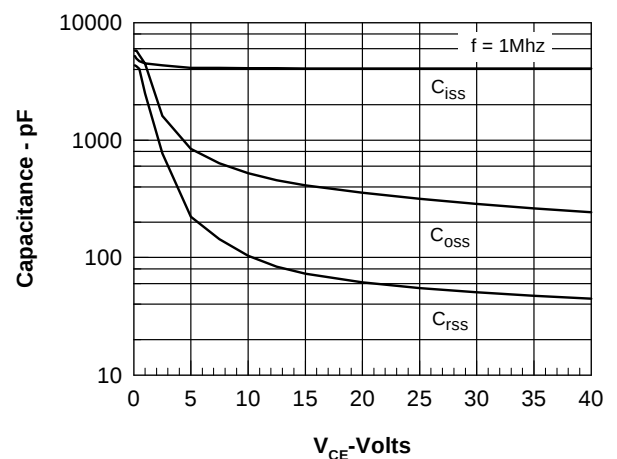


Figure 6. Capacitance Curves

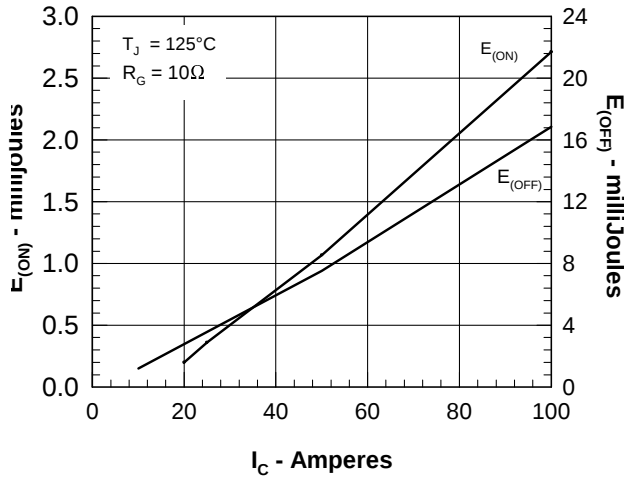


Figure 7. Dependence of E_{ON} and E_{OFF} on I_C .

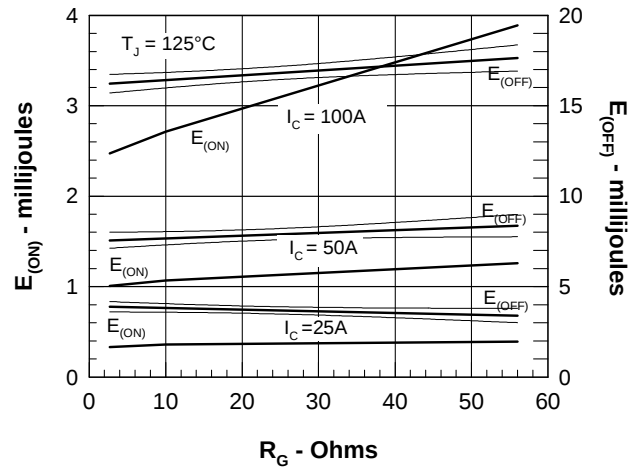


Figure 8. Dependence of E_{ON} and E_{OFF} on R_G .

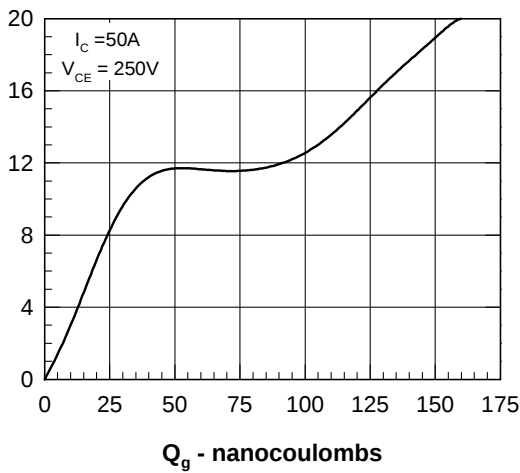


Figure 9. Gate Charge

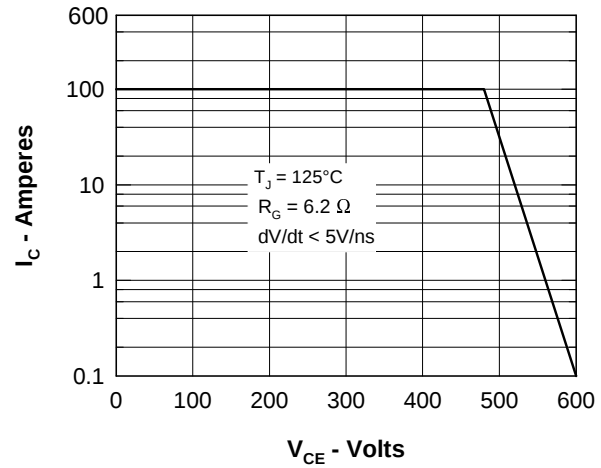


Figure 10. Turn-off Safe Operating Area

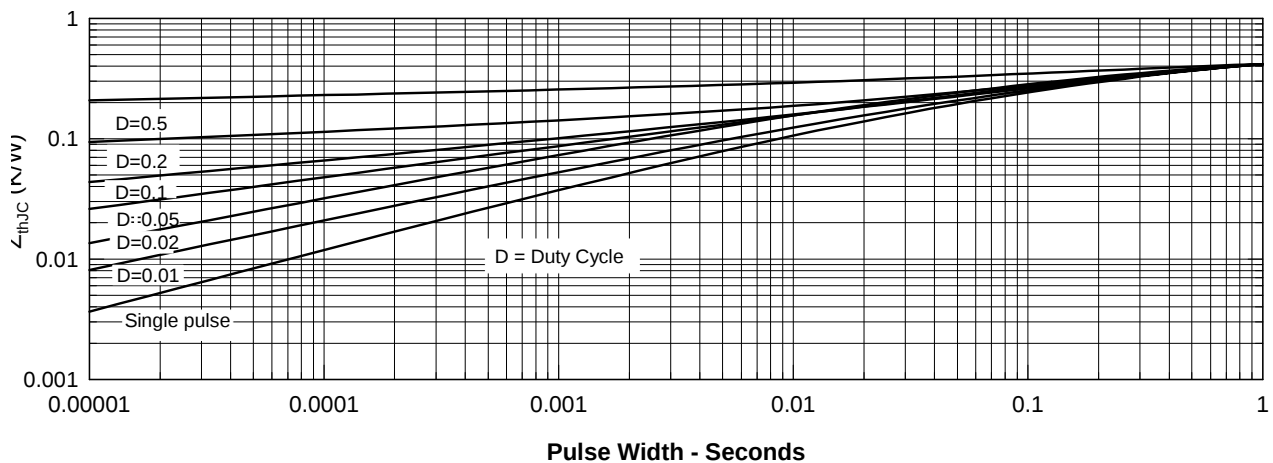


Figure 11. Transient Thermal Resistance

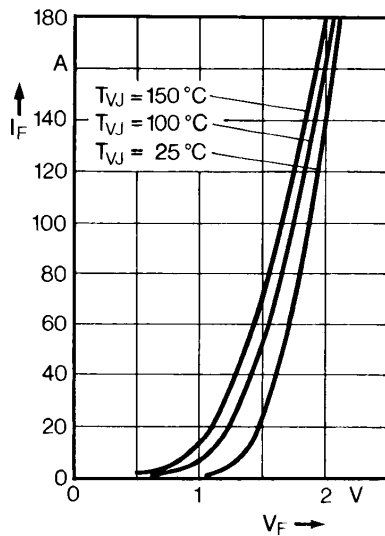


Fig. 12 Forward current versus voltage drop.

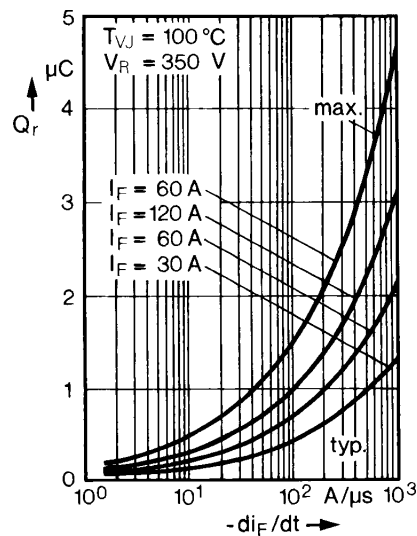


Fig. 13 Recovery charge versus $-di_F/dt$.

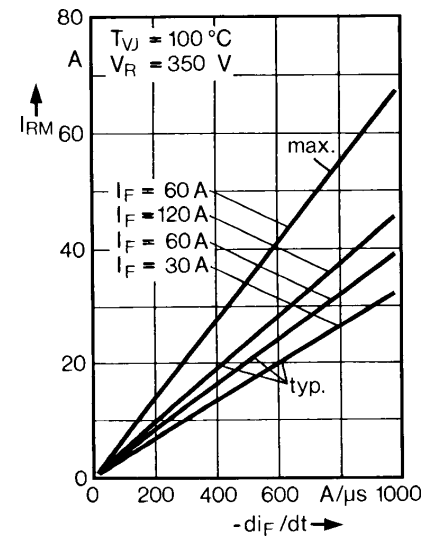


Fig. 14 Peak reverse current versus $-di_F/dt$.

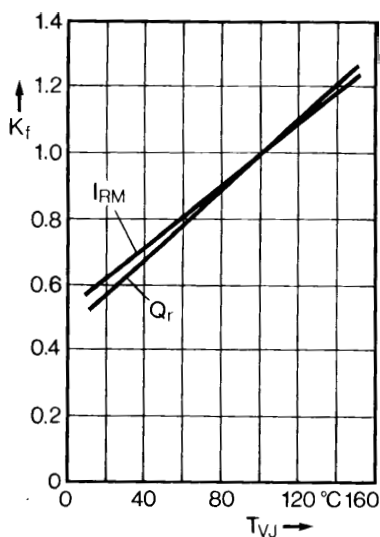


Fig. 15. Dynamic parameters versus junction temperature.

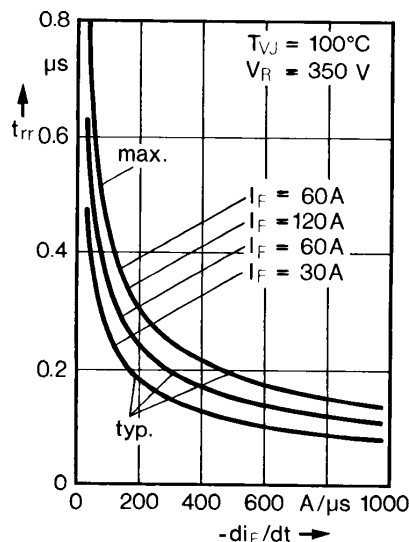


Fig. 16 Recovery time versus $-di_F/dt$.

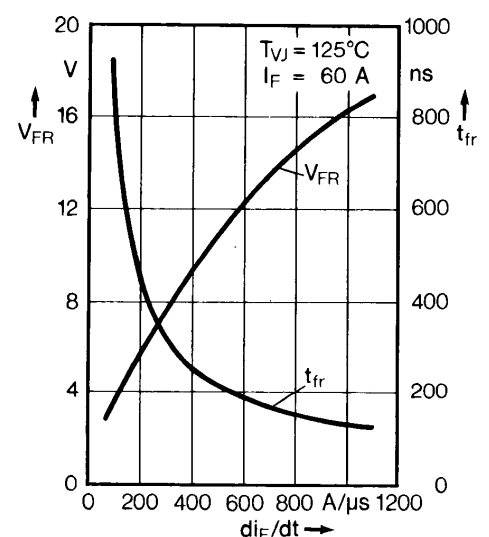


Fig. 17 Peak forward voltage vs. di_F/dt .

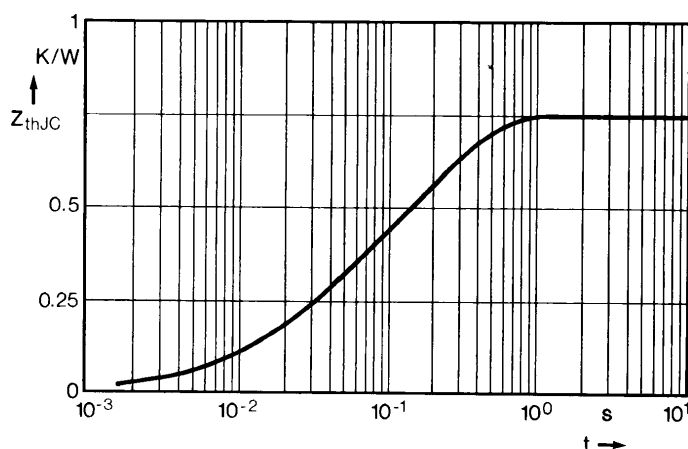


Fig. 18 Transient thermal impedance junction to case.

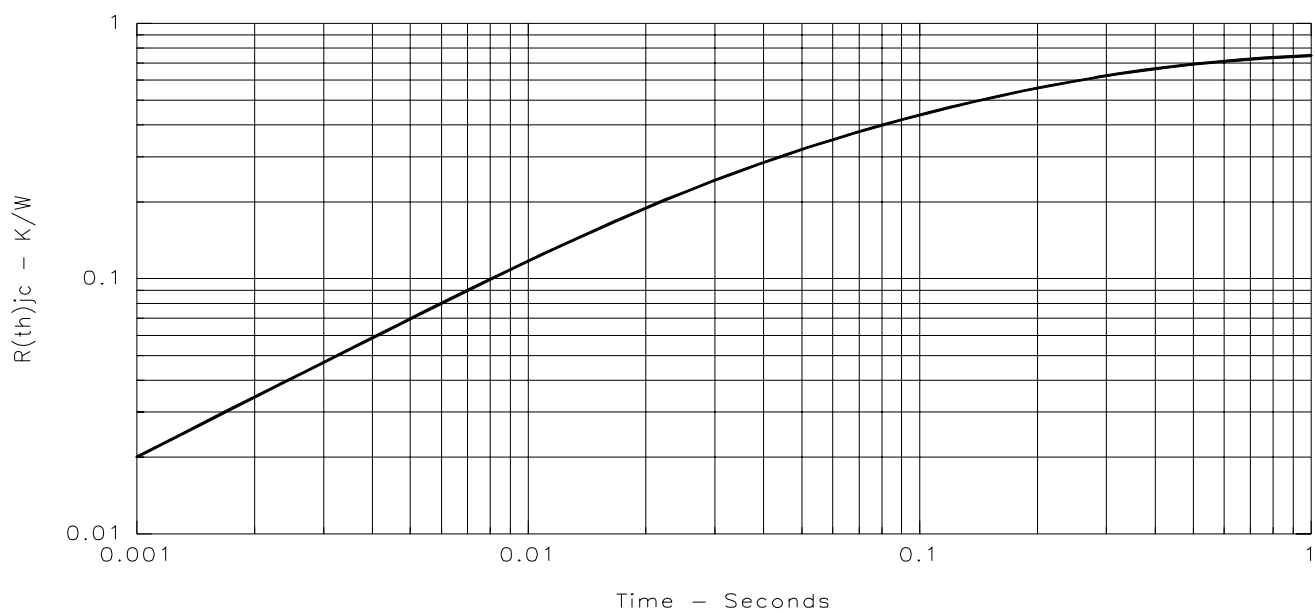


Fig. 18. Diode transient thermal resistance junction-to-case.

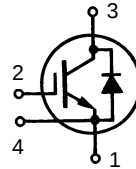
IGBT with Diode

IXSN 52N60AU1

Combi Pack

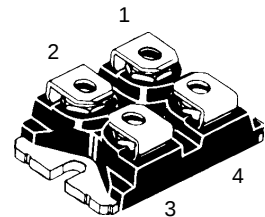
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 80 \text{ A} \\ V_{CE(sat)} &= 3 \text{ V} \end{aligned}$$

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	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	80	A
I_{C90}	$T_C = 90^\circ\text{C}$	40	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	160	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 80$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}, V_{CE} = 360 \text{ V}, T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	250	W
V_{ISOL}	50/60 Hz	$t = 1 \text{ min}$	2500 V~
	$I_{ISOL} \leq 1 \text{ mA}$	$t = 1 \text{ s}$	3000 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	1.5/13	Nm/lb.in.
	Terminal connection torque (M4)	1.5/13	Nm/lb.in.
Weight		30	g

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
- 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

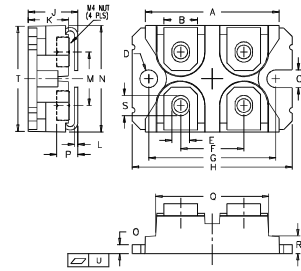
Advantages

- 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.
BV_{CES}	$I_C = 3 \text{ mA}, V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}, V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$		750 μA
				15 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			3 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 $d \leq 2\%$	20	23	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		4500	pF
C_{oes}			400	pF
C_{res}			90	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		190	250 nC
Q_{ge}			45	60 nC
Q_{gc}			88	120 nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			220	ns
$t_{d(off)}$			200	ns
t_{fi}			200	ns
E_{off}			3.5	mJ
$t_{d(on)}$			70	ns
t_{ri}	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		220	ns
E_{on}			4.7	mJ
$t_{d(off)}$			450	ns
t_{fi}			340	600 ns
E_{off}			6	mJ
R_{thJC}				0.50 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)		Characteristic Values ($T_J = 25^\circ\text{C}$, 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 $d \leq 2\%$			1.8 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $T_J = 125^\circ\text{C}$ $I_F = 1\text{ A}$; $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		19	A
t_{rr}			175	ns
			35	50 ns
R_{thJC}				0.80 K/W

Fig.1 Saturation Characteristics

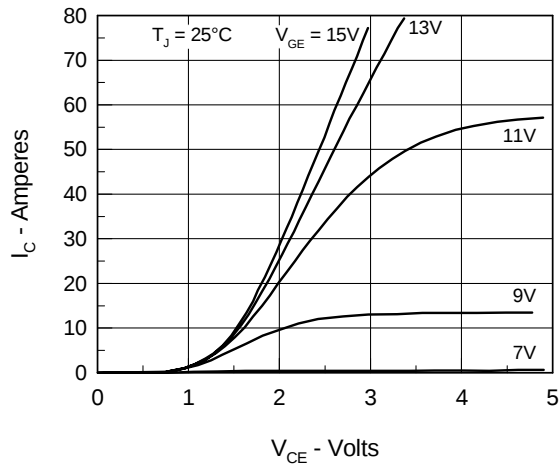


Fig.2 Output Characteristics

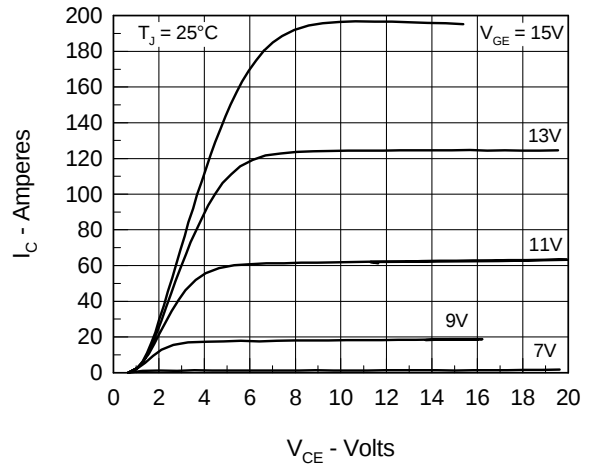


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

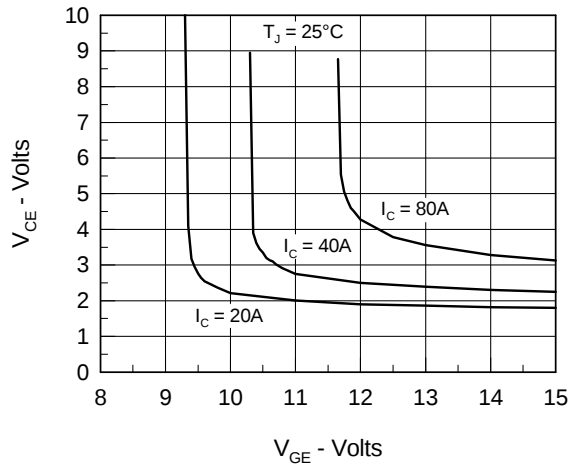


Fig.4 Temperature Dependence of Output Saturation Voltage

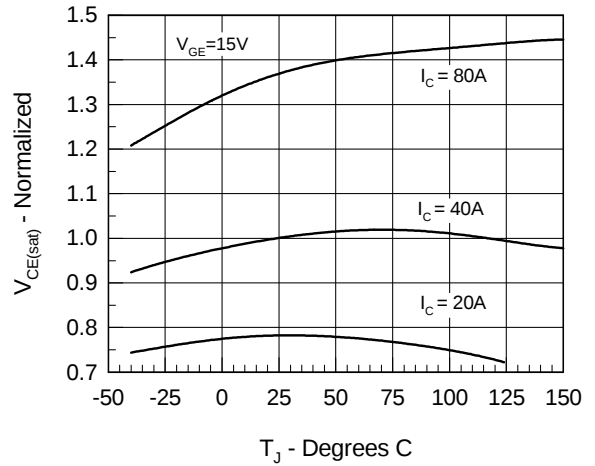


Fig.5 Input Admittance

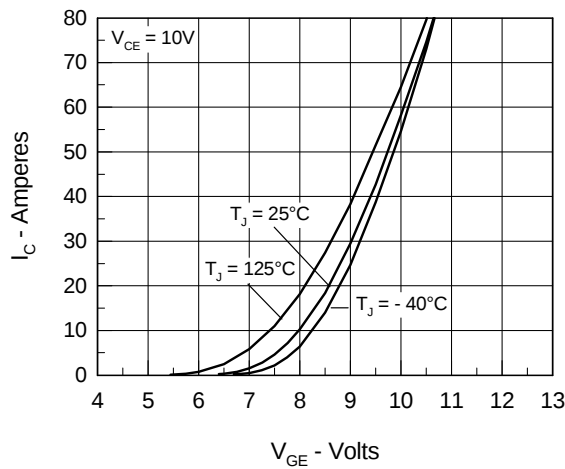


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

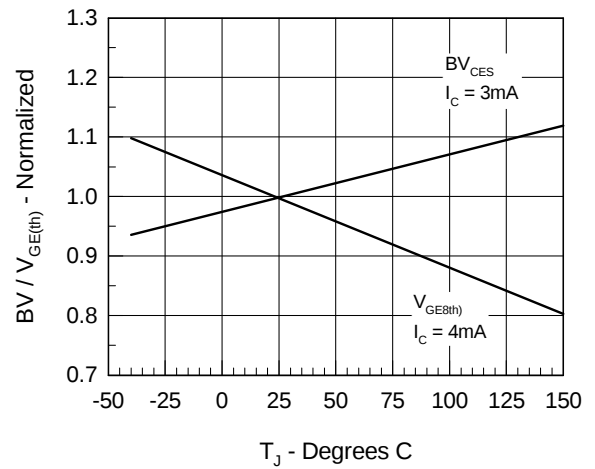


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

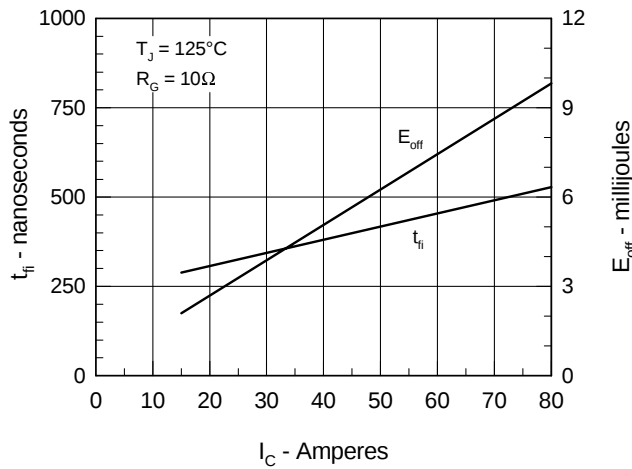


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

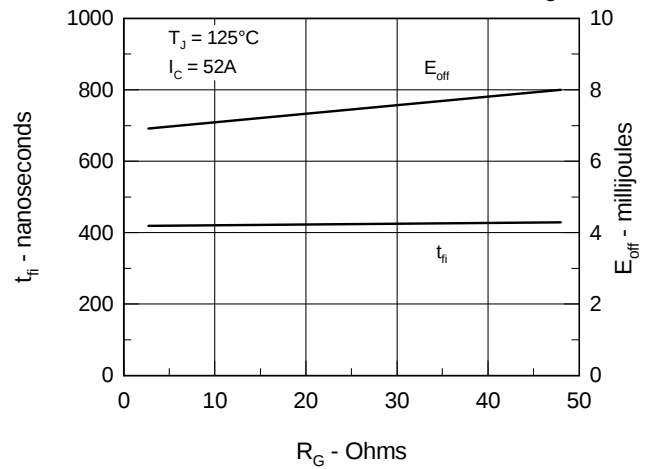


Fig.9 Gate Charge Characteristic Curve

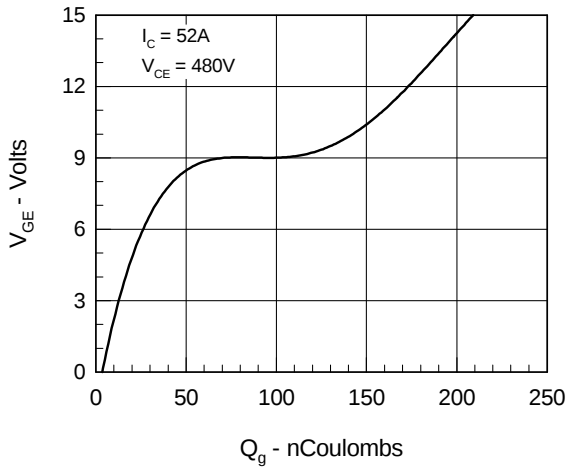


Fig.10 Turn-Off Safe Operating Area

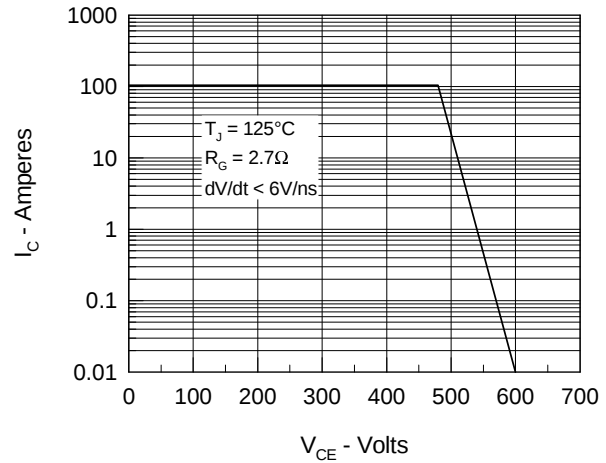
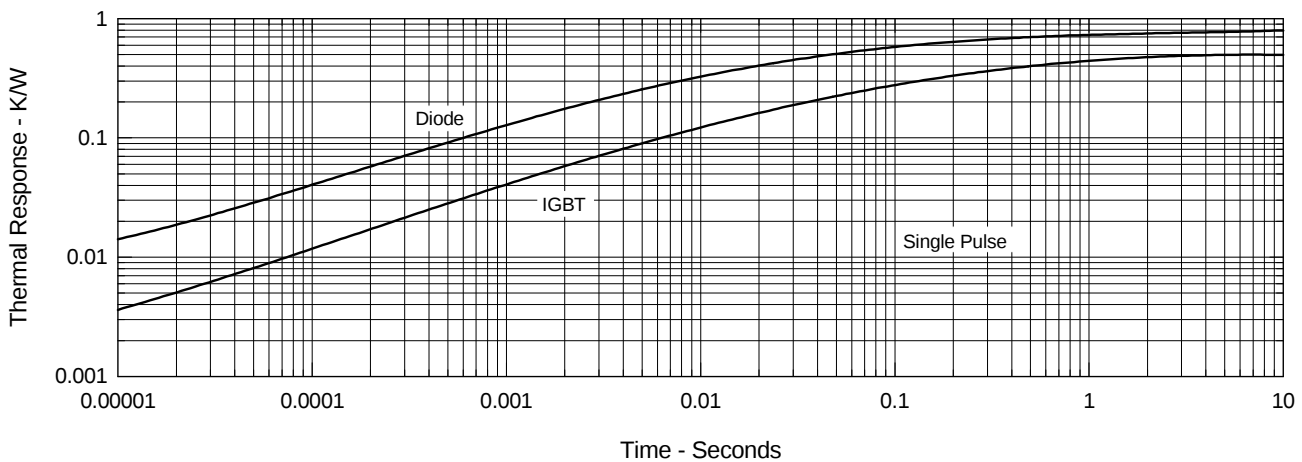


Fig.11 Transient Thermal Impedance



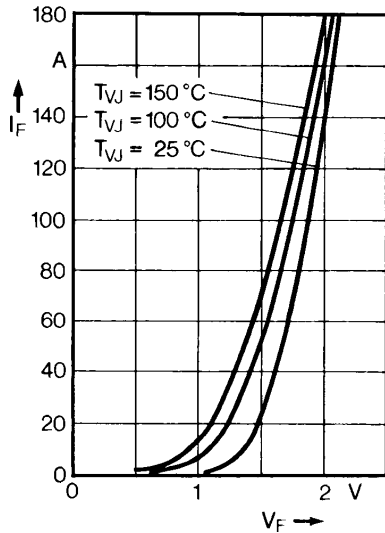


Fig. 12 Forward current versus voltage drop.

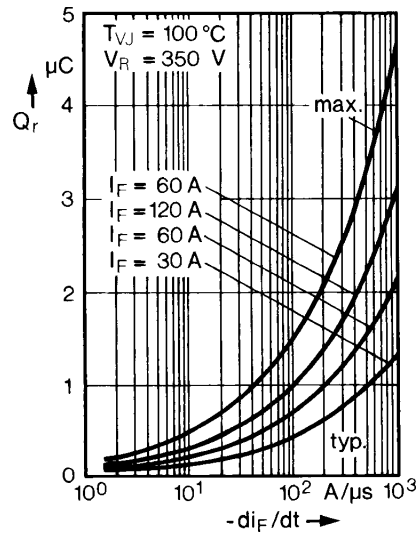


Fig. 13 Recovery charge versus $-di_F/dt$.

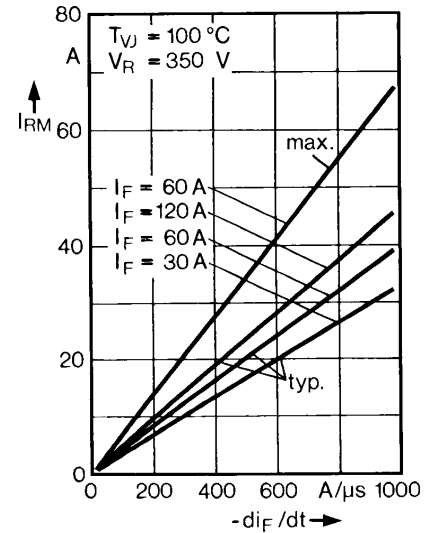


Fig. 14 Peak reverse current versus $-di_F/dt$.

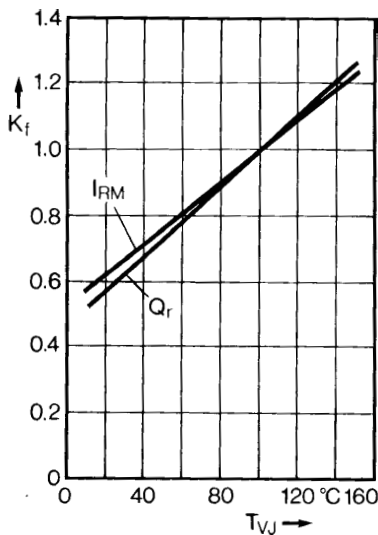


Fig. 15 Dynamic parameters versus junction temperature.

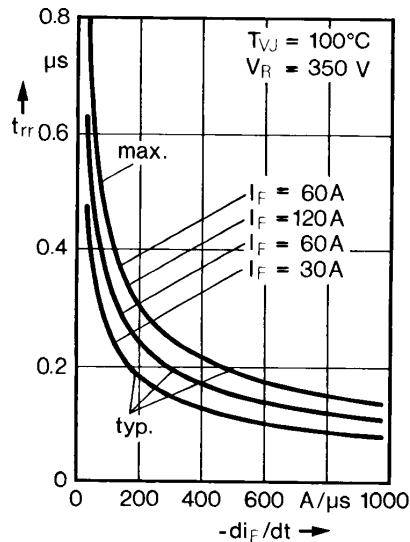


Fig. 16 Recovery time versus $-di_F/dt$.

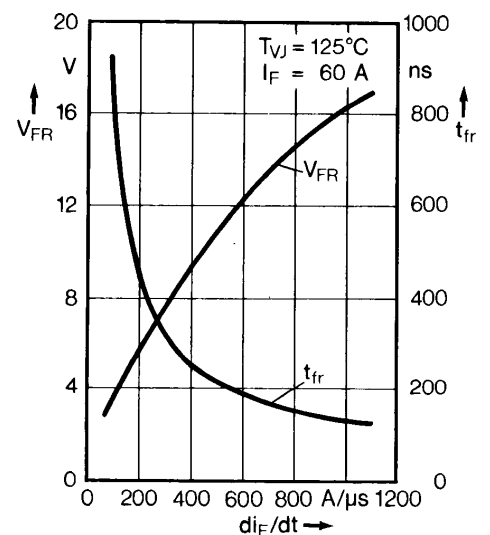


Fig. 17 Peak forward voltage vs. di_F/dt .

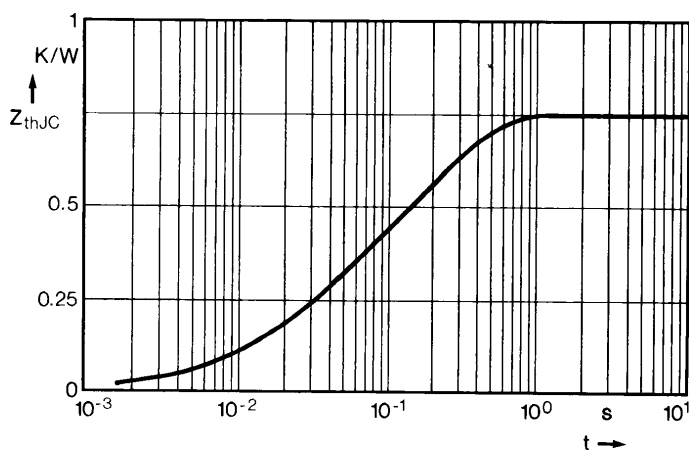


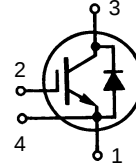
Fig. 18 Transient thermal impedance junction to case.

IGBT with Diode

IXSN 62N60U1

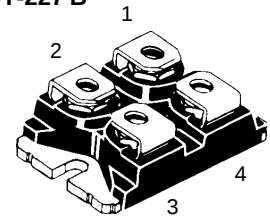
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 90 \text{ A} \\ V_{CE(sat)} &= 2.5 \text{ V} \end{aligned}$$

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	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	90	A
I_{C90}	$T_C = 90^\circ\text{C}$	50	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	180	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 100$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 360 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_c	$T_C = 25^\circ\text{C}$	250	W
V_{ISOL}	50/60 Hz	$t = 1 \text{ min}$	2500 V~
	$I_{ISOL} \leq 1 \text{ mA}$	$t = 1 \text{ s}$	3000 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	1.5/13	Nm/lb.in.
	Terminal connection torque (M4)	1.5/13	Nm/lb.in.
Weight		30	g

miniBLOC, SOT-227 B



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

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)
 - reduces 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

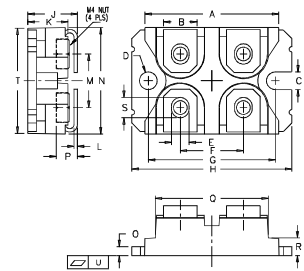
Advantages

- 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.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$	$T_J = 25^\circ\text{C}$		750 μA
	$V_{GE} = 0 \text{ V}$	$T_J = 125^\circ\text{C}$		15 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			2.5 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 $d \leq 2\%$	20	23	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		4500	pF
C_{oes}			400	pF
C_{res}			90	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		190	250 nC
Q_{ge}			45	60 nC
Q_{gc}			88	120 nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		70	ns
t_{ri}			220	ns
$t_{d(off)}$			300	650 ns
t_{fi}			400	700 ns
E_{off}			7	11 mJ
$t_{d(on)}$			70	ns
t_{ri}	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		220	ns
E_{on}			4	mJ
$t_{d(off)}$			650	ns
t_{fi}			600	1000 ns
E_{off}			9	mJ
R_{thJC}				0.50 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

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 $d \leq 2\%$			1.8 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $I_F = 1\text{ A}$; $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		19	A
t_{rr}			175	ns
t_{rr}			35	50 ns
R_{thJC}				0.80 K/W

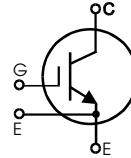
High Current IGBT

IXSN80N60A

$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 160 \text{ A} \\ V_{CE(sat)} &= 3 \text{ V} \end{aligned}$$

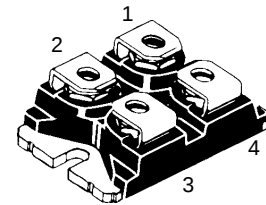
Short Circuit SOA Capability

Preliminary Data



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	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	160	A
I_{C90}	$T_C = 90^\circ\text{C}$	80	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	320	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 160$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 0.6 V_{CES}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non-repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	500	W
V_{ISOL}	50/60 Hz	2500	V~
	$I_{ISOL} \leq 1 \text{ mA}$	3000	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	1.5/13	Nm/lb.in.
	Terminal connection torque (M4)	1.5/13	Nm/lb.in.
Weight		30	g

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
- Aluminium-nitride isolation
 - high power dissipation
- Isolation voltage 3000 V~
- UL registered E 153432
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- Low collector-to-case capacitance (< 100 pF)
 - reduces 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

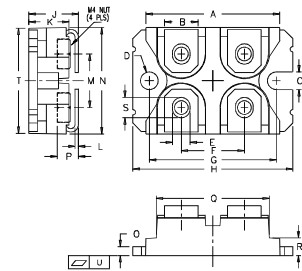
Advantages

- 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.
BV_{CES}	$I_C = 500 \mu\text{A}$, $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 8 \text{ mA}$, $V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 V_{CES}$			400 μA
	$V_{GE} = 0 \text{ V}$			2 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			3 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 $d \leq 2\%$		46	S
C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		8500	pF
C_{oes}			650	pF
C_{res}			120	pF
Q_g	$I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.5 V_{CES}$		335	nC
Q_{ge}			88	nC
Q_{gc}			158	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, L = 100\text{ }\mu\text{H},$ $V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) > $0.8 V_{CES}$, higher T_J or increased R_G		140	ns
t_{ri}			220	ns
$t_{d(off)}$			300	600 ns
t_{fi}			450	600 ns
E_{off}			10	mJ
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, L = 100\text{ }\mu\text{H},$ $V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) > $0.8 V_{CES}$, higher T_J or increased R_G		140	ns
t_{ri}			250	ns
$E_{(on)}$			8	mJ
$t_{d(off)}$			520	ns
t_{fi}			550	ns
E_{off}			13	mJ
R_{thJC}				0.25 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

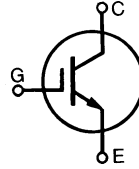
High Current IGBT

Short Circuit SOA Capability

IXSK 80N60B
IXSX 80N60B

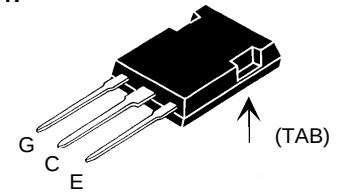
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 180 \text{ A} \\ V_{CE(sat)} &= 2.2 \text{ V} \end{aligned}$$

Preliminary data

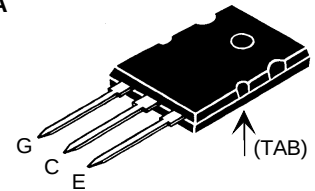


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	600	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GS} = 1 \text{ M}\Omega$	600	V
V_{CES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	160	A
I_{C90}	$T_C = 90^\circ\text{C}$	80	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	300	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 2.5 \Omega$ Clamped inductive load	$I_{CM} = 160$ @ $0.8 V_{CES}$	A
tsc SCSOA	$V_{GE} = 15 \text{ V}, V_{CE} = 0.6 V_{CES}, T_J = 125^\circ\text{C}$ $R_G = 5 \Omega$, non-repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	500	W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
T_L	1.6 mm (0.063 in.) from case for 10 s	300	$^\circ\text{C}$
M_d	Mounting torque	TO-264	0.4/6 Nm/lb.in.
Weight		PLUS 247	6 g
		TO-264	10 g

PLUS 247™
(IXSX)



TO-264 AA
(IXSK)



G = Gate
C = Collector

E = Emitter
TAB = Collector

Features

- International standard packages
- Very high current, fast switching IGBT
- Low $V_{CE(sat)}$
 - for minimum 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

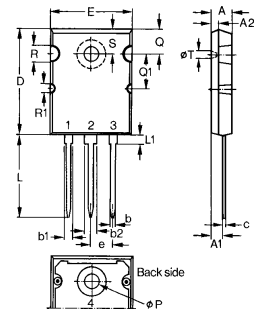
Advantages

- PLUS 247™ package for clip or spring mounting
- Space savings
- High power density

Symbol	Test Conditions	Characteristic Values		
		$(T_J = 25^\circ\text{C}, \text{ unless otherwise specified})$		
		min.	typ.	max.
BV_{CES}	$I_C = 500 \mu\text{A}, V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 8 \text{ mA}, V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$			$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ 200 μA 2 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 500 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			2.2 V

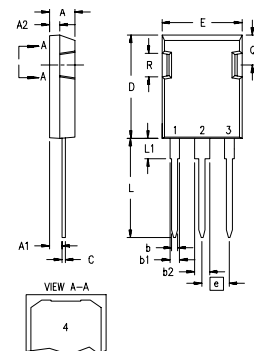
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = 60\text{ A}; V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$	40	52	S
C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		6600	pF
C_{oes}			660	pF
C_{res}			196	pF
Q_g	$I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.5 V_{CES}$		240	nC
Q_{ge}			85	nC
Q_{gc}			90	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}, R_G = R_{off} = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		60	ns
t_{ri}			45	ns
$t_{d(off)}$			140	280 ns
t_{fi}			180	280 ns
E_{off}			4.2	7.0 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}$ $V_{CE} = 0.8 V_{CES}, R_G = R_{off} = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		60	ns
t_{ri}			60	ns
E_{on}			4.8	mJ
$t_{d(off)}$			190	ns
t_{fi}			260	ns
E_{off}			6.7	mJ
R_{thJC}				0.26 K/W
R_{thCK}		0.15		K/W

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

PLUS247™ (IXSX)



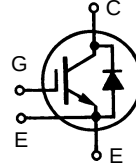
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b1	1.91	2.13	.075	.084
b2	2.92	3.12	.115	.123
C	0.61	0.80	.024	.031
D	20.80	21.34	.819	.840
E	15.75	16.13	.620	.635
e	5.45 BSC		.215 BSC	
L	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

IGBT with Diode

IXSN 80N60AU1

$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 160 \text{ A} \\ V_{CE(sat)} &= 3 \text{ V} \end{aligned}$$

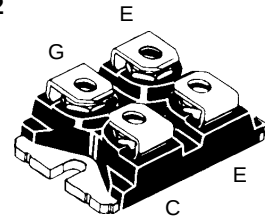
Short Circuit SOA Capability



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	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	160	A
I_{C90}	$T_C = 90^\circ\text{C}$	80	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	320	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 160$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}, V_{CE} = 360 \text{ V}, T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	500	W
V_{ISOL}	50/60 Hz	$t = 1 \text{ min}$	2500 V~
	$I_{ISOL} \leq 1 \text{ mA}$	$t = 1 \text{ s}$	3000 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	1.5/13	Nm/lb.in.
	Terminal connection torque (M4)	1.5/13	Nm/lb.in.
Weight		30	g

miniBLOC, SOT-227 B

 E153432



E = Emitter ①, C = Collector
G = Gate, E = Emitter ①

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

Features

- International standard package miniBLOC
- Aluminium-nitride isolation
 - high power dissipation
- Isolation voltage 3000 V~
- UL registered E 153432
- 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 ($< 60 \text{ pF}$)
 - reduced RFI
- Low package inductance ($< 10 \text{ nH}$)
 - 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

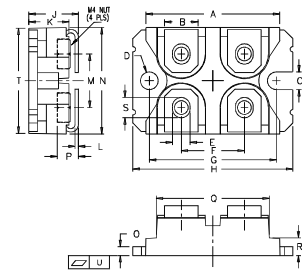
Advantages

- 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.
BV_{CES}	$I_C = 3 \text{ mA}, V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 8 \text{ mA}, V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$	$T_J = 25^\circ\text{C}$		1 mA
	$V_{GE} = 0 \text{ V}$	$T_J = 125^\circ\text{C}$		15 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ ns}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			3 V

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = 60\text{ A}$; $V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$		46	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		8500	pF
C_{oes}			650	pF
C_{res}			120	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		335	nC
Q_{ge}			88	nC
Q_{gc}			158	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		140	ns
t_{ri}			220	ns
$t_{d(off)}$			300	600 ns
t_{fi}			450	600 ns
E_{off}			10	mJ
$t_{d(on)}$			140	ns
t_{ri}	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G		220	ns
E_{on}			8	mJ
$t_{d(off)}$			520	ns
t_{fi}			550	ns
E_{off}			13	mJ
R_{thJC}				0.25 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

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = 50\text{ A}$, $V_{GE} = 0\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$			1.8 V
I_{RM}	$I_F = 50\text{ A}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ $I_F = 1\text{ A}$; $-di_F/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		19	A
t_{rr}			175	ns
t_{rr}			35	50 ns
R_{thJC}				0.80 K/W

Fig.1 Saturation Characteristics

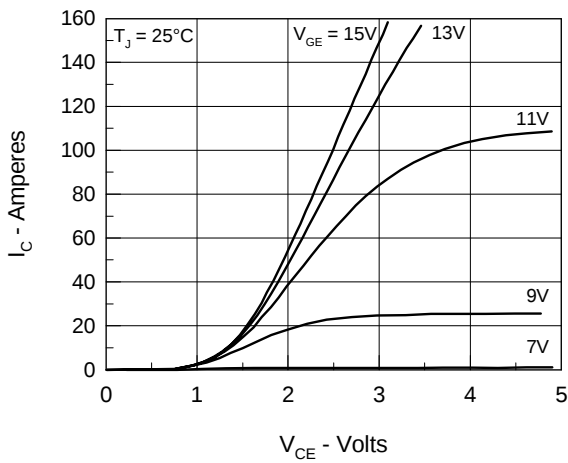


Fig.2 Output Characteristics

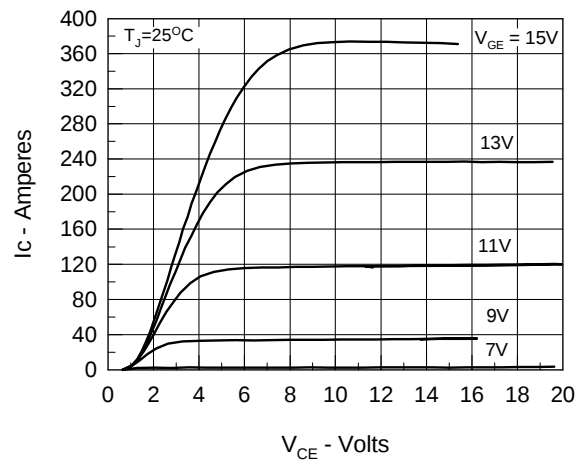


Fig.3 Collector-Emittor Voltage vs. Gate-Emittor Voltage

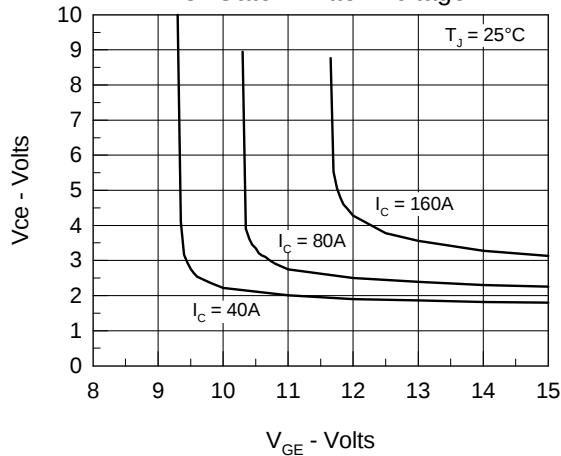


Fig.4 Temperature Dependence of Output Saturation Voltage

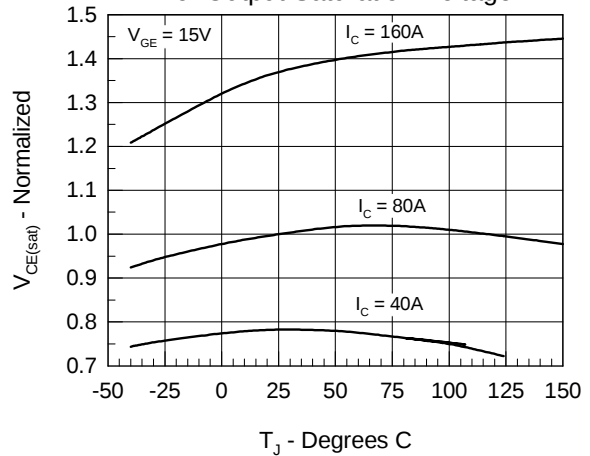


Fig.5 Input Admittance

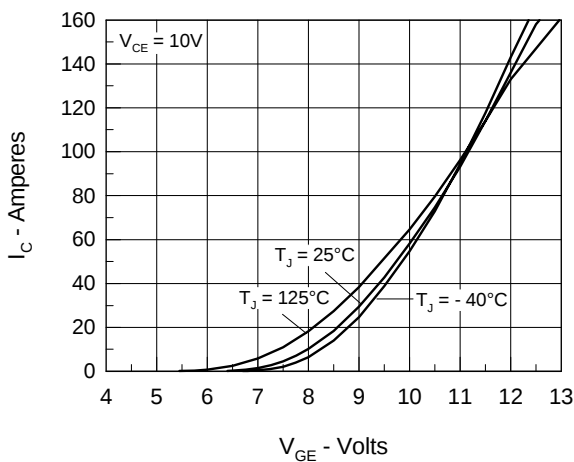


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

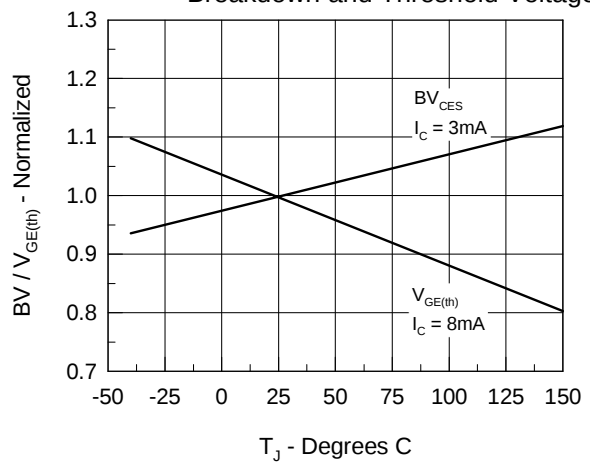


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

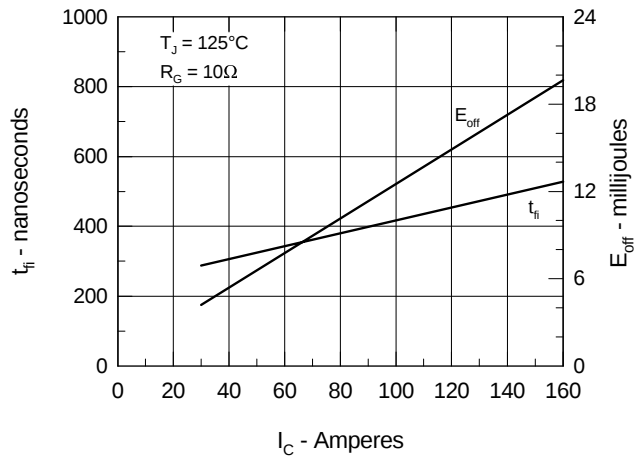


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

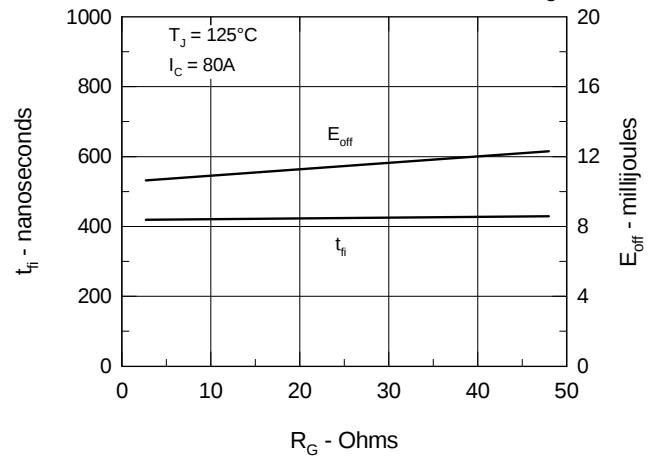


Fig.9 Gate Charge Characteristic Curve

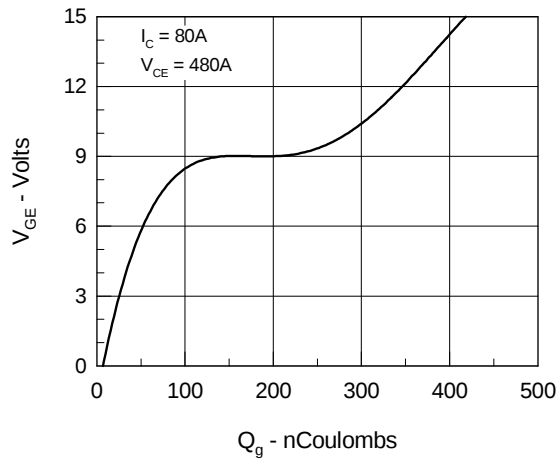


Fig.10 Turn-Off Safe Operating Area

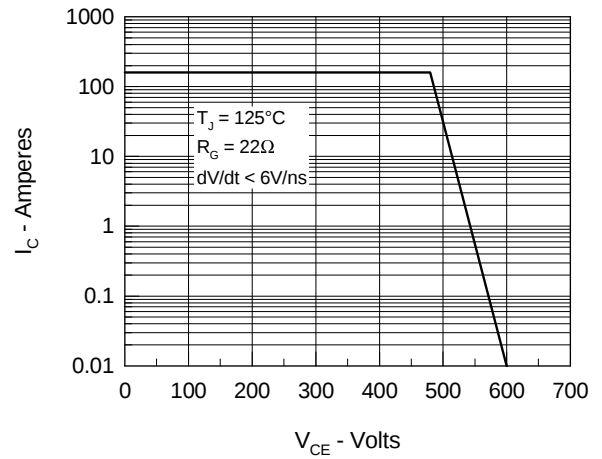
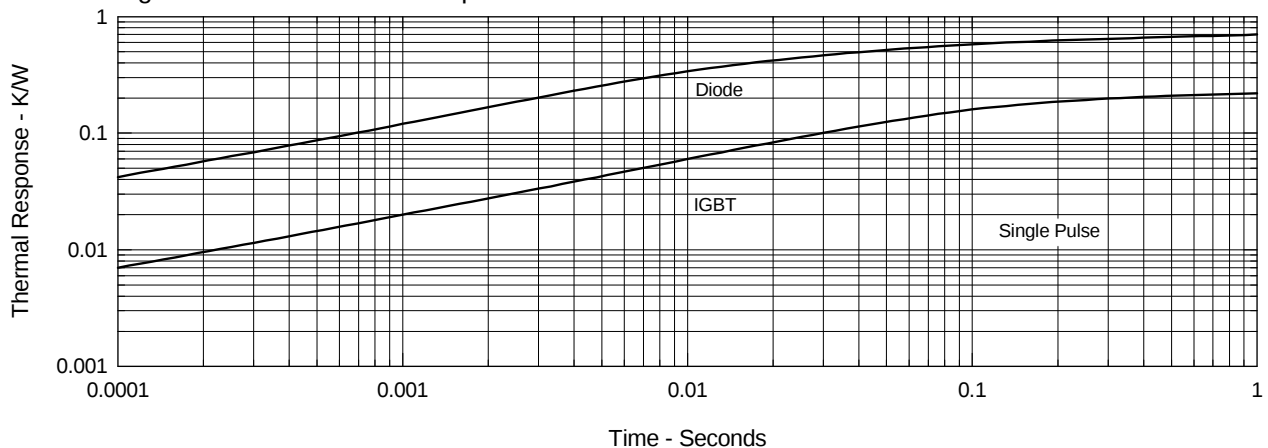


Fig.11 Transient Thermal Impedance

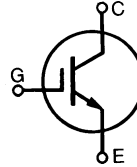


High speed IGBT

IXSH 35N100A
IXSM 35N100A

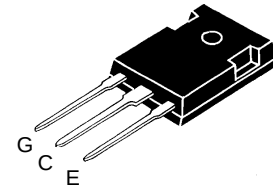
$$\begin{aligned} V_{CES} &= 1000 \text{ V} \\ I_{C25} &= 70 \text{ A} \\ V_{CE(sat)} &= 3.5 \text{ V} \end{aligned}$$

Short Circuit SOA Capability

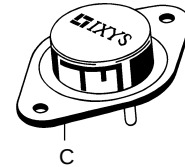


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1000	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1000	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	70	A
I_{C90}	$T_C = 90^\circ\text{C}$	35	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	140	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 2.7 \Omega$ 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	$T_C = 25^\circ\text{C}$	300	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.
Weight		TO-204 = 18 g, TO-247 = 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 (IXSH)



TO-204 AE (IXSM)



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

Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- Low $V_{CE(sat)}$
 - for low on-state conduction losses
- High current handling capability
- MOS Gate turn-on
 - drive simplicity
- Fast Fall Time for switching speeds up to 20 kHz

Applications

- AC motor speed control
- Uninterruptible power supplies (UPS)
- Welding

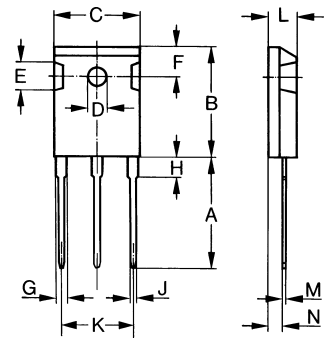
Advantages

- Easy to mount with 1 screw (TO-247) (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1000		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	5		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$, $T_J = 25^\circ\text{C}$ $V_{GE} = 0 \text{ V}$, $T_J = 125^\circ\text{C}$			250 μA 1 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			3.5 V

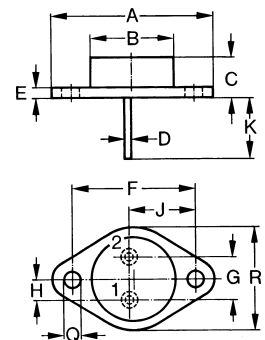
Symbol	Test Conditions	Characteristic Values ($T_j = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}, V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$	20	25	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}, V_{CE} = 10\text{ V}$		240	A
C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		4400	pF
C_{oes}			325	pF
C_{res}			85	pF
Q_g	$I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.5 V_{CES}$		180	nC
Q_{ge}			45	nC
Q_{gc}			120	nC
$t_{d(on)}$	Inductive load, $T_j = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_j or increased R_G		80	ns
t_{ri}			150	ns
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}			10	mJ
$t_{d(on)}$	Inductive load, $T_j = 125^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_j or increased R_G		100	ns
t_{ri}			200	ns
E_{on}			4.2	mJ
$t_{d(off)}$			400	ns
t_{fi}			1300	ns
E_{off}			15	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.25	K/W

TO-247 AD (IXSH) Outline



Dim.	Millimeter Min. Max.	Inches 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-204 AE (IXSM) Outline



Dim.	Millimeter Min. Max.	Inches Min. Max.
A	38.61 39.12	1.520 1.540
B	- 22.22	- 0.875
C	6.40 11.40	0.252 0.449
D	1.45 1.60	0.057 0.063
E	1.52 3.43	0.060 0.135
F	30.15 BSC	1.187 BSC
G	10.67 11.17	0.420 0.440
H	5.21 5.71	0.205 0.225
J	16.64 17.14	0.655 0.675
K	11.18 12.19	0.440 0.480
Q	3.84 4.19	0.151 0.165
R	25.16 26.66	0.991 1.050

Fig.1 Saturation Characteristics

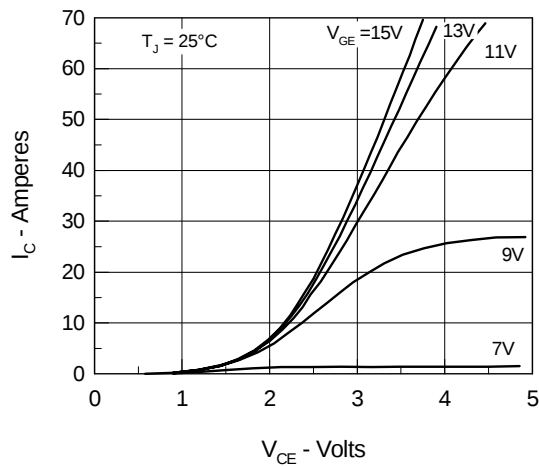


Fig.2 Output Characteristics

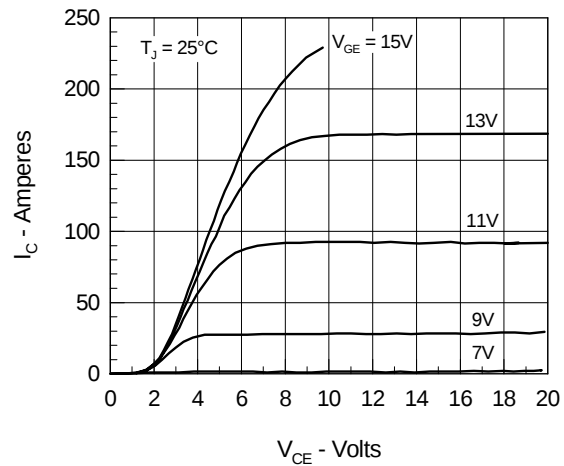


Fig.3 Collector-Emittor Voltage vs. Gate-Emittor Voltage

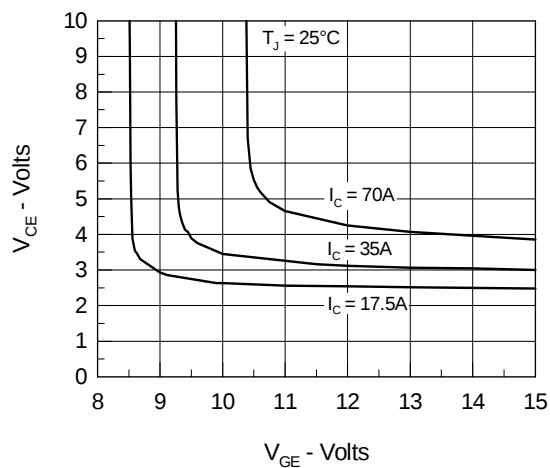


Fig.4 Temperature Dependence of Output Saturation Voltage

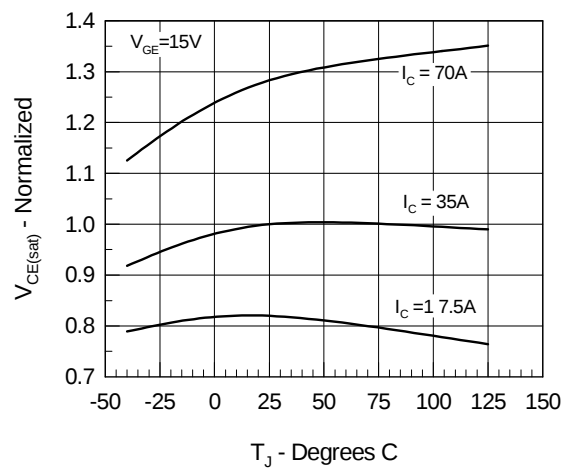


Fig.5 Input Admittance

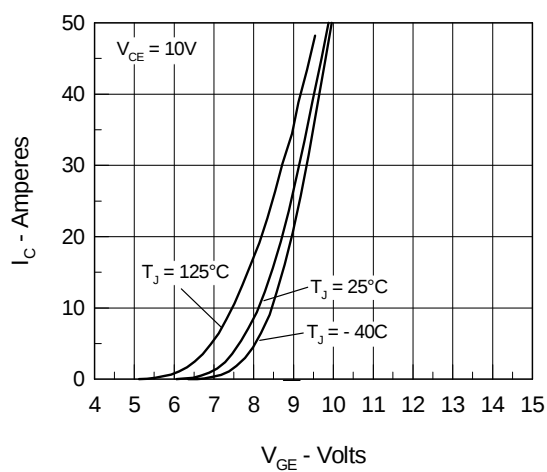


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

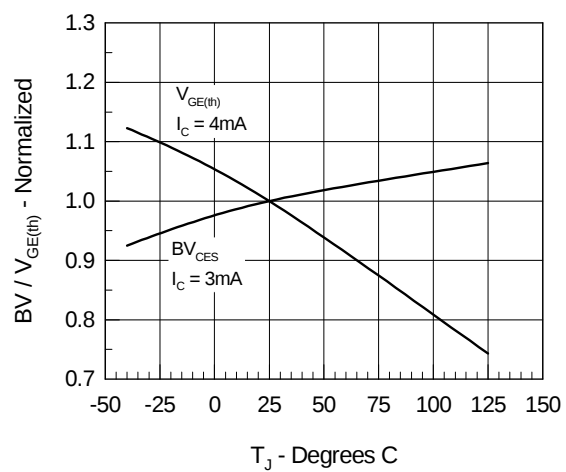


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

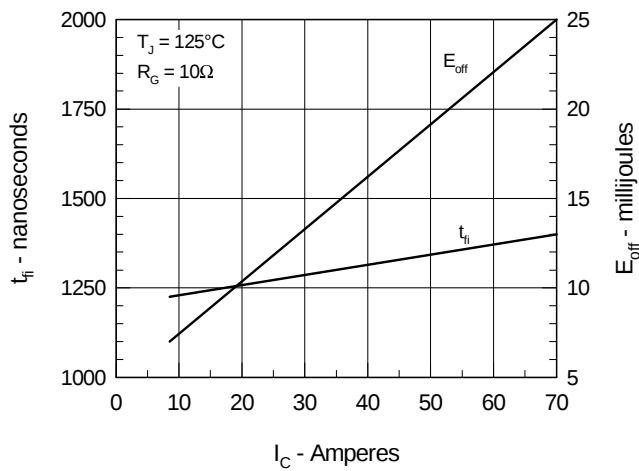


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

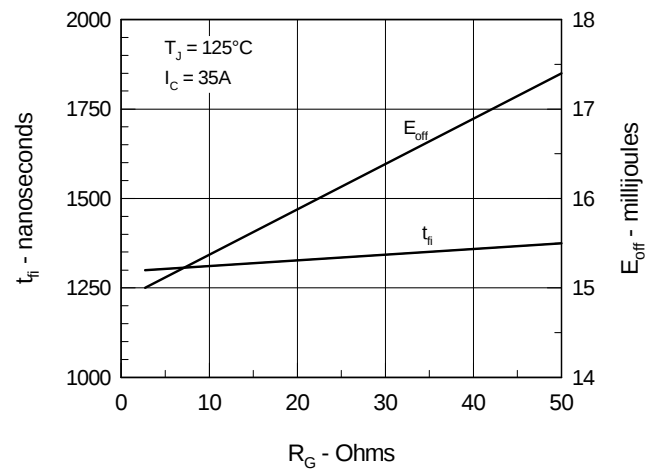


Fig.9 Gate Charge Characteristic Curve

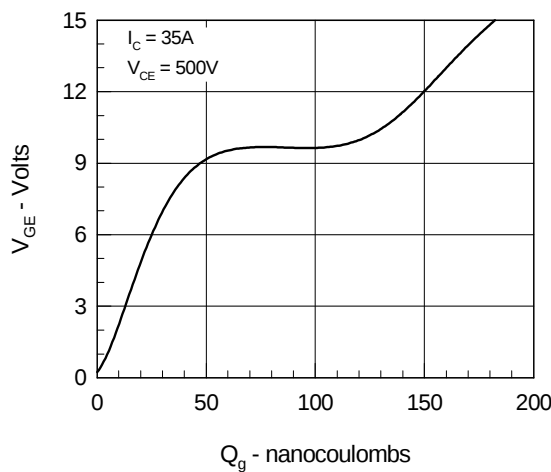


Fig.10 Turn-Off Safe Operating Area

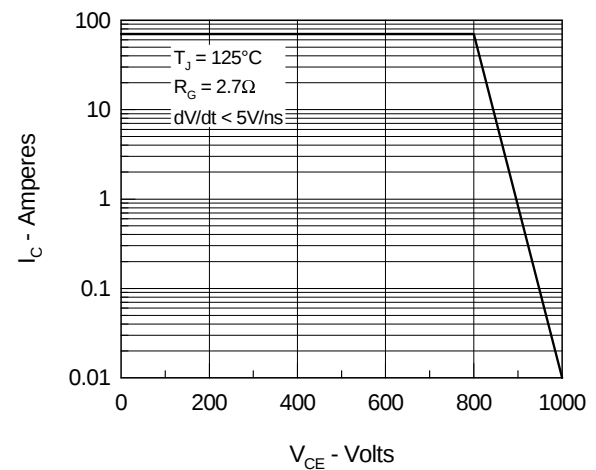
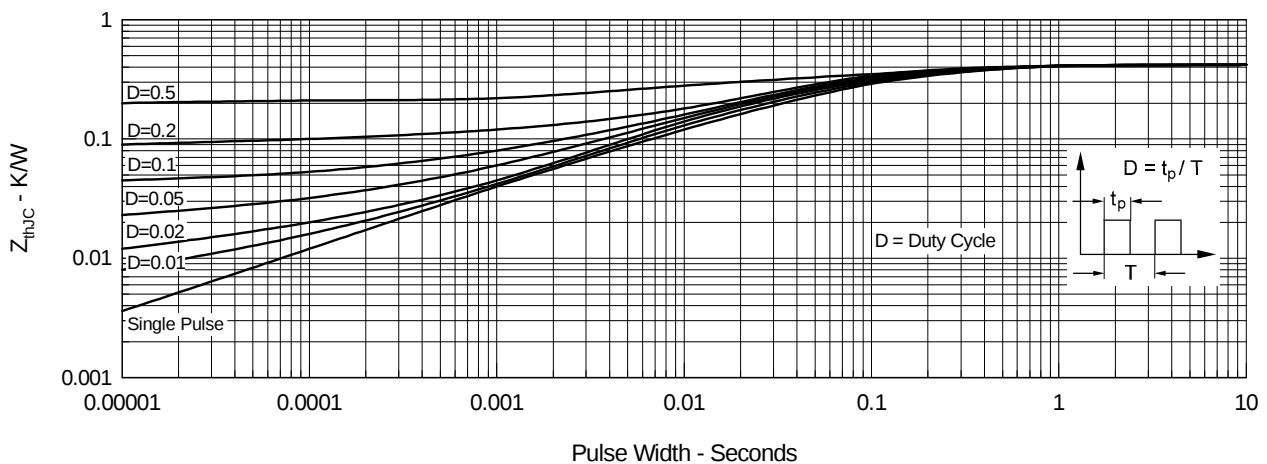


Fig.11 Transient Thermal Impedance

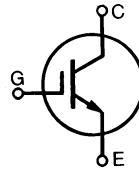


Low $V_{CE(sat)}$ IGBT

IXSH 45N100
IXSM 45N100

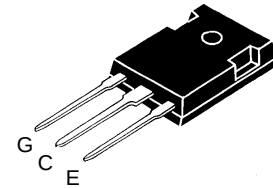
$V_{CES} = 1000 \text{ V}$
 $I_{C25} = 75 \text{ A}$
 $V_{CE(sat)} = 2.7 \text{ V}$

Short Circuit SOA Capability

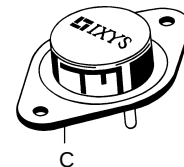


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1000	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1000	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	45	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	180	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 2.7 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 90$ @ $0.8 V_{CES}$	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	$T_C = 25^\circ\text{C}$	300	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.
Weight		TO-204 = 18 g, TO-247 = 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 (IXSH)



TO-204 AE (IXSM)



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

Features

- International standard packages
- Guaranteed Short Circuit SOA capability
- Low $V_{CE(sat)}$
 - for low on-state conduction losses
- High current handling capability
- MOS Gate turn-on
 - drive simplicity

Applications

- AC motor speed control
- Uninterruptible power supplies (UPS)
- Welding

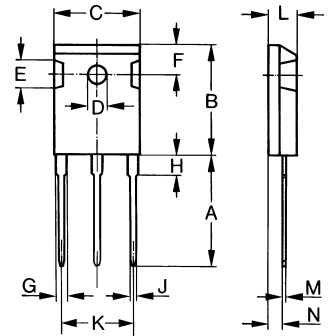
Advantages

- Easy to mount with 1 screw (TO-247) (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1000		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	5		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			$T_J = 25^\circ\text{C}$ 250 μA $T_J = 125^\circ\text{C}$ 1 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			2.7 V

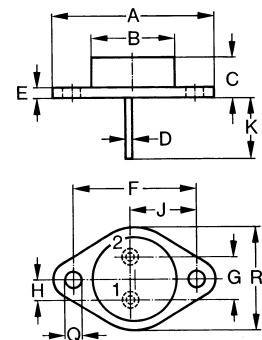
Symbol	Test Conditions	Characteristic Values ($T_j = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $d \leq 2\%$	20	25	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		195	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		4150	pF
C_{oes}			300	pF
C_{res}			60	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		165	260 nC
Q_{ge}			40	60 nC
Q_{gc}			80	200 nC
$t_{d(on)}$	Inductive load, $T_j = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ 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_{ri}			150	ns
$t_{d(off)}$			400	ns
t_{fi}			1000	1500 ns
E_{off}			15	mJ
$t_{d(on)}$	Inductive load, $T_j = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_j or increased R_G		100	ns
t_{ri}			300	ns
E_{on}			5.4	mJ
$t_{d(off)}$			550	900 ns
t_{fi}			2200	2900 ns
E_{off}			25	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.25	K/W

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-204 AE (IXSM) Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	38.61	39.12	1.520	1.540
B	-	22.22	-	0.875
C	6.40	11.40	0.252	0.449
D	1.45	1.60	0.057	0.063
E	1.52	3.43	0.060	0.135
F	30.15	BSC	1.187	BSC
G	10.67	11.17	0.420	0.440
H	5.21	5.71	0.205	0.225
J	16.64	17.14	0.655	0.675
K	11.18	12.19	0.440	0.480
Q	3.84	4.19	0.151	0.165
R	25.16	26.66	0.991	1.050

Fig.1 Saturation Characteristics

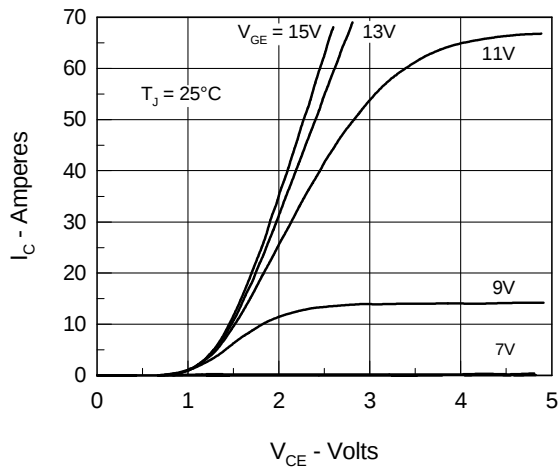


Fig.2 Output Characteristics

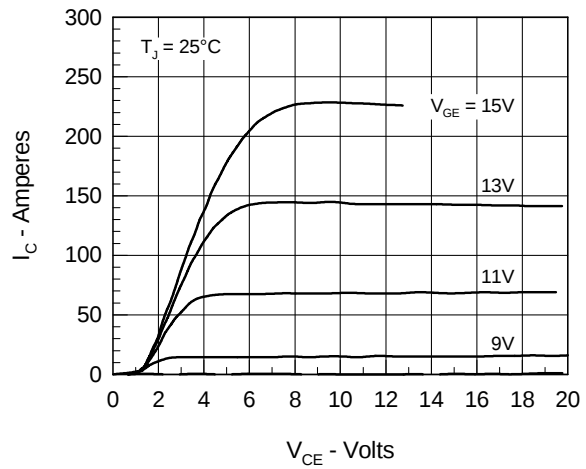


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

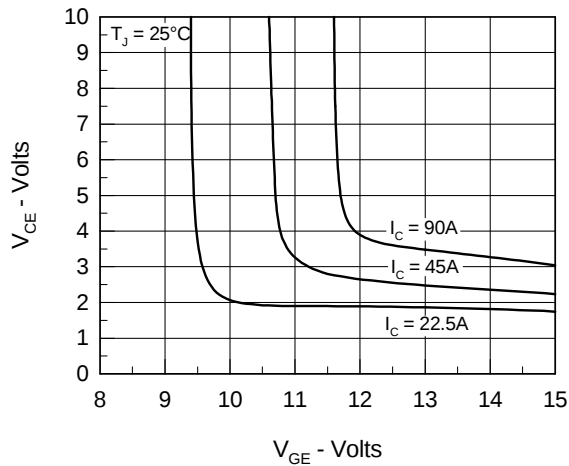


Fig.4 Temperature Dependence of Output Saturation Voltage

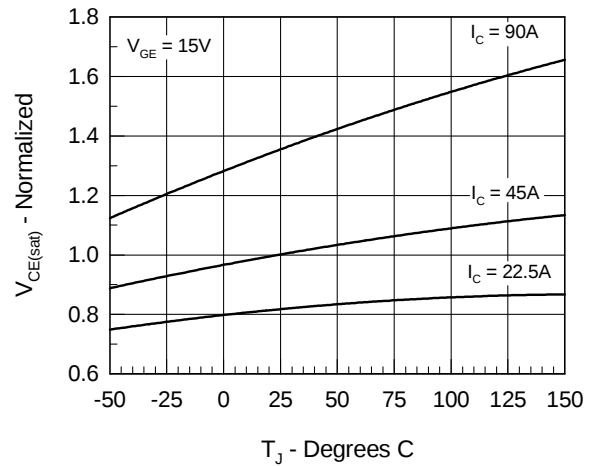


Fig.5 Input Admittance

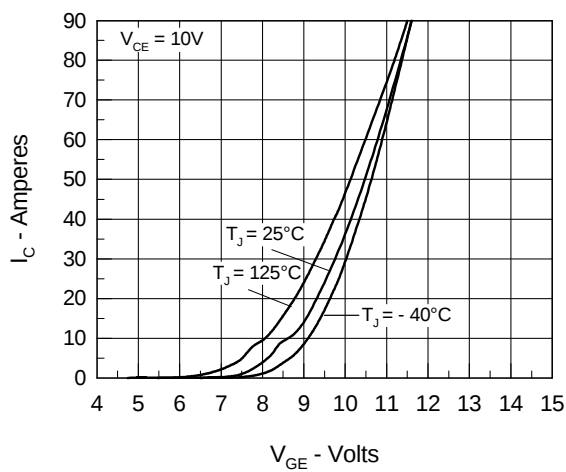


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

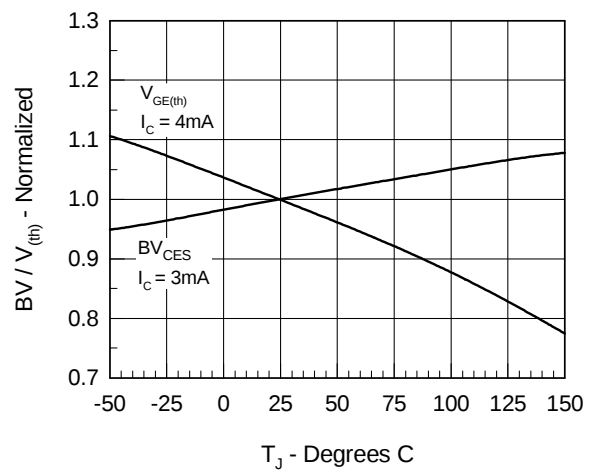


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

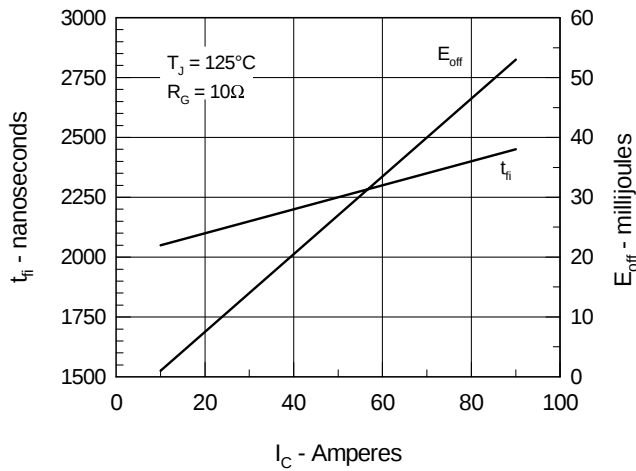


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

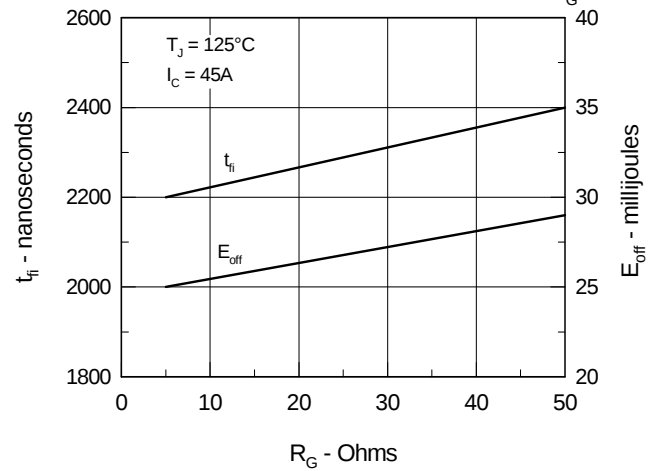


Fig.9 Gate Charge Characteristic Curve

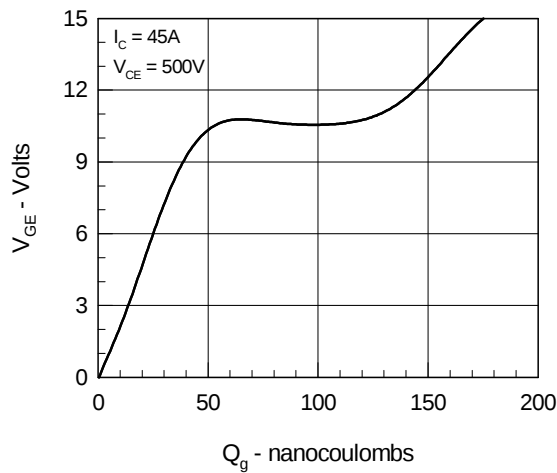


Fig.10 Turn-Off Safe Operating Area

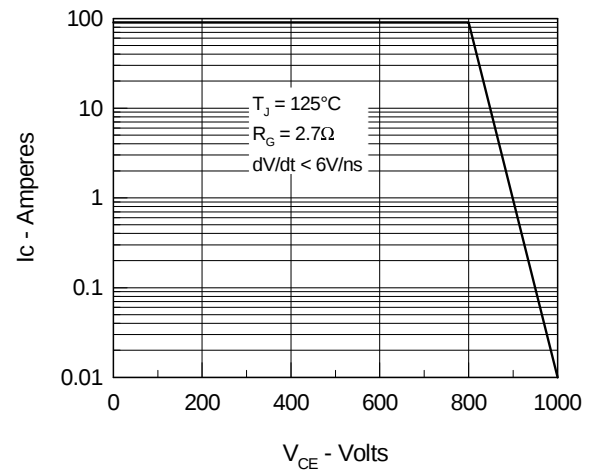
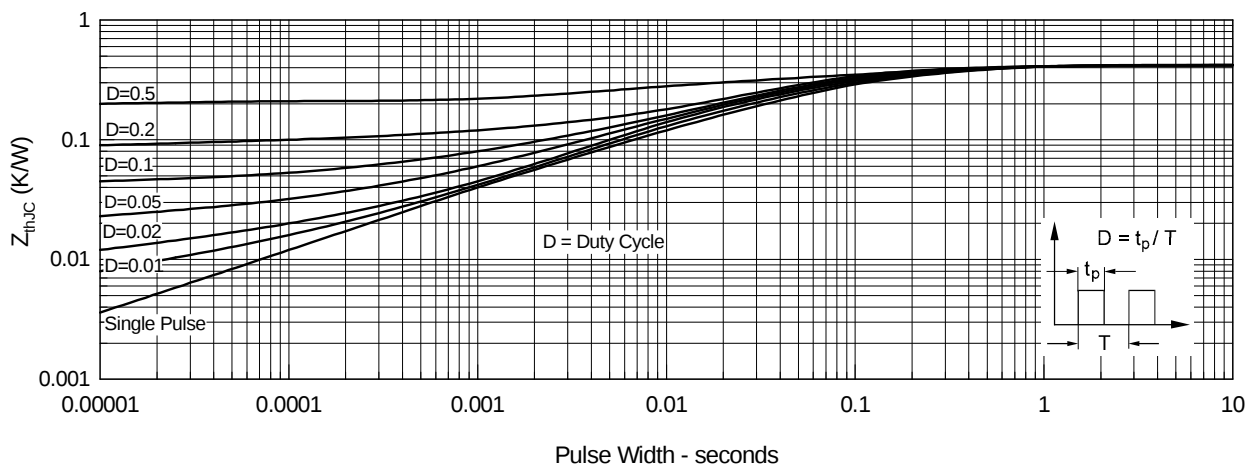


Fig.11 Transient Thermal Impedance



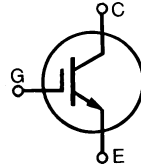
HIGH Voltage IGBT

IXSH 15N120B
IXST 15N120B

"S" Series - Improved SCSOA Capability

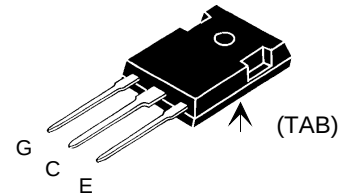
$$\begin{aligned} I_{C25} &= 30 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 3.4 \text{ V} \end{aligned}$$

Preliminary data

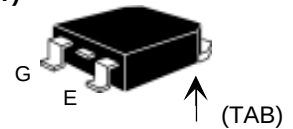


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	30	A
I_{C90}	$T_C = 90^\circ\text{C}$	15	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	60	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 10 \Omega$ Clamped inductive load	$I_{CM} = 40$ @ $0.8 V_{CES}$	A
t_{SC}	$T_J = 125^\circ\text{C}$, $V_{GE} = 720 \text{ V}$; $V_{GE} = 15 \text{ V}$, $R_G = 10 \Omega$ 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	$^\circ\text{C}$
M_d	Mounting torque (TO-247)	1.13/10	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Maximum tab temperature for soldering (TO-268)		260	$^\circ\text{C}$
Weight	TO-247 TO-268	6 4	g g

TO-247 AD (IXSH)



TO-268 (IXST)



Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1.0 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 250 \mu\text{A}$, $V_{CE} = V_{GE}$	3		6 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ Note 1 $T_J = 125^\circ\text{C}$			50 μA 2.5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$ Note 2 $T_J = 125^\circ\text{C}$	3.0 2.8	3.4	V V

Features

- High Blocking Voltage
- Epitaxial Silicon drift region
 - fast switching
 - small tail current
 - low switching losses
- MOS gate turn-on for drive simplicity
- Molding epoxies meet UL 94 V-0 flammability classification

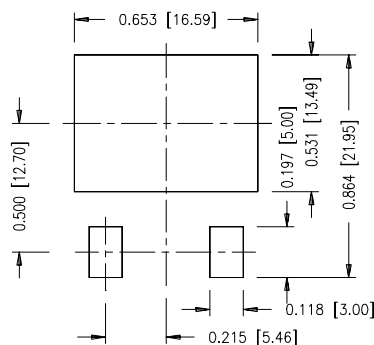
Applications

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

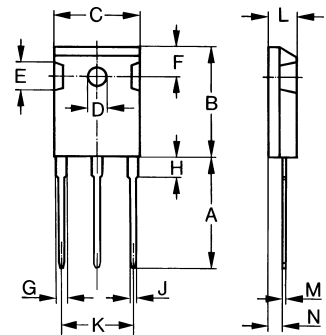
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Note 2	7	9.5	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		1400	pF
C_{oes}			98	pF
C_{res}			37	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		57	nC
Q_{ge}			14	nC
Q_{gc}			25	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		30	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		25	ns
$t_{d(off)}$	$R_G = 10\ \Omega$		148	300 ns
t_{fi}	$V_{CE} = 0.8 V_{CES}$ Note 3		126	250 ns
E_{off}			1.5	2.9 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		30	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		25	ns
E_{on}	$R_G = 10\ \Omega$, $V_{CE} = 0.8 V_{CES}$ Note 3		1.1	mJ
$t_{d(off)}$			265	ns
t_{fi}			298	ns
E_{off}			3.1	mJ
R_{thJC}				0.83 K/W
R_{thCK}	(TO-247)		0.25	K/W

- Notes: 1. Device must be heatsunk for high temperature leakage current measurements to avoid thermal runaway.
2. Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$
3. Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G .

Min. Recommended Footprint

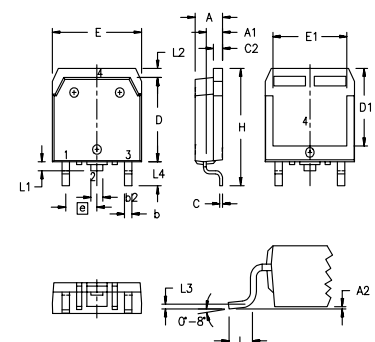


TO-247 AD (IXSH) Outline



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-268AA (D³ PAK)



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.9	5.1	.193	.201
A ₁	2.7	2.9	.106	.114
A ₂	.02	.25	.001	.010
b	1.15	1.45	.045	.057
b ₂	1.9	2.1	.075	.083
C	.4	.65	.016	.026
D	13.80	14.00	.543	.551
E	15.85	16.05	.624	.632
E ₁	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
L ₁	1.20	1.40	.047	.055
L ₂	1.00	1.15	.039	.045
L ₃	0.25 BSC		.010 BSC	
L ₄	3.80	4.10	.150	.161

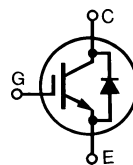
HIGH Voltage IGBT with Diode

IXSH 15N120BD1
IXST 15N120BD1

"S" Series - Improved SCSOA Capability

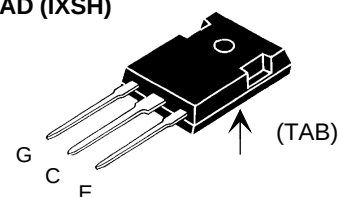
$$\begin{aligned} I_{C25} &= 30 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 3.4 \text{ V} \end{aligned}$$

Preliminary data

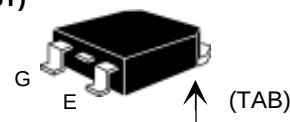


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	30	A
I_{C90}	$T_C = 90^\circ\text{C}$	15	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	60	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 10 \Omega$ Clamped inductive load	$I_{CM} = 40$ @ $0.8 V_{CES}$	A
t_{SC}	$T_J = 125^\circ\text{C}$, $V_{GE} = 720 \text{ V}$; $V_{GE} = 15 \text{ V}$, $R_G = 10 \Omega$ 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	$^\circ\text{C}$
M_d	Mounting torque (TO-247)	1.13/10	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Maximum tab temperature for soldering (TO-268)		260	$^\circ\text{C}$
Weight	TO-247	6	g
	TO-268	4	g

TO-247 AD (IXSH)



TO-268 (IXST)



Features

- High Blocking Voltage
- Epitaxial Silicon drift region
 - fast switching
 - small tail current
 - low switching losses
- MOS gate turn-on for drive simplicity
- Molding epoxies meet UL 94 V-0 flammability classification

Applications

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

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1.0 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 250 \mu\text{A}$, $V_{CE} = V_{GE}$	3		6 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ Note 1 $T_J = 125^\circ\text{C}$			50 μA 2.5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$ Note 2 $T_J = 125^\circ\text{C}$	3.0 2.8		3.4 V V

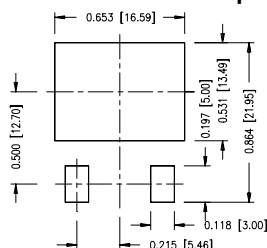
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Note 2	7	9.5	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		1400	pF
C_{oes}			120	pF
C_{res}			37	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		57	nC
Q_{ge}			14	nC
Q_{gc}			25	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		30	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		25	ns
$t_{d(off)}$	$R_G = 10\ \Omega$		148	300 ns
t_{fi}	$V_{CE} = 0.8 V_{CES}$		126	250 ns
E_{off}	Note 3		1.5	2.9 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		30	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		25	ns
E_{on}	$R_G = 10\ \Omega$, $V_{CE} = 0.8 V_{CES}$		2.6	mJ
$t_{d(off)}$	Note 3		265	ns
t_{fi}			298	ns
E_{off}			3.1	mJ
R_{thJC}				0.83 K/W
R_{thCK}	(TO-247)		0.25	K/W

Reverse Diode (FRED)

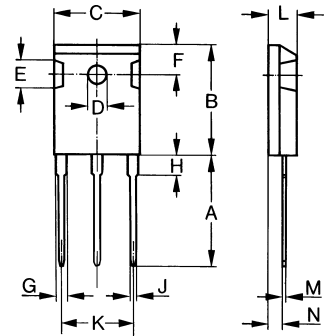
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, Note 2			1.7 V 2.5 V
I_{RM}	$I_F = 30\text{ A}$; $V_{GE} = 0\text{ V}$; $T_J = 100^\circ\text{C}$ $V_R = 100\text{ V}$; $-di_F/dt = 100\text{ A}/\mu\text{s}$		5.5	A
t_{rr}	$I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		30	ns
R_{thJC}				0.9 K/W

- Notes: 1. Device must be heatsunk for high temperature leakage current measurements to avoid thermal runaway.
2. Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$
3. Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G .

Min. Recommended Footprint

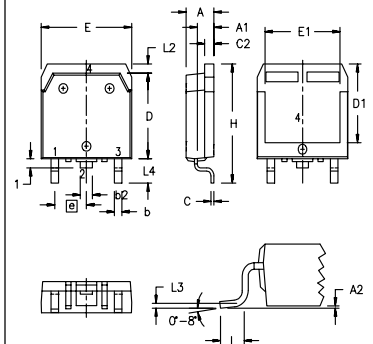


TO-247 AD (IXSH) Outline



Dim.	Millimeter Min. Max.	Inches 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-268AA (D³ PAK)



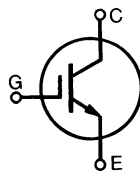
Dim.	Millimeter Min. Max.	Inches Min. Max.
A	4.9 5.1	.193 .201
A ₁	2.7 2.9	.106 .114
A ₂	.02 .25	.001 .010
b	1.15 1.45	.045 .057
b ₂	1.9 2.1	.75 .83
C	.4 .65	.016 .026
D	13.80 14.00	.543 .551
E	15.85 16.05	.624 .632
E ₁	13.3 13.6	.524 .535
e	5.45 BSC	.215 BSC
H	18.70 19.10	.736 .752
L	2.40 2.70	.094 .106
L ₁	1.20 1.40	.047 .055
L ₂	1.00 1.15	.039 .045
L ₃	0.25 BSC	.010 BSC
L ₄	3.80 4.10	.150 .161

IGBT

Improved SCSOA Capability

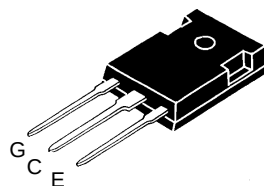
IXSH25N120A

$$\begin{aligned} I_{C25} &= 50 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 4.0 \text{ V} \end{aligned}$$



Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	1200	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	50	A
I_{C90}	$T_C = 90^\circ\text{C}$	25	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	80	A
SSOA	$V_{GE} = 15 \text{ V}, T_J = 125^\circ\text{C}, R_G = 33 \Omega$	$I_{CM} = 50$	A
(RBSOA)	Clamped inductive load, $L = 100 \mu\text{H}$	@ $0.8 V_{CES}$	
t_{sc}	$T_J = 125^\circ\text{C}, V_{CE} = 720 \text{ V}; V_{GE} = 15 \text{ V}, R_G = 33 \Omega$	10	μs
P_C	$T_C = 25^\circ\text{C}$	200	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	1.15/10	Nm/lb-in.
Weight		6	g
Max. Lead Temperature for Soldering (1.6mm from case for 10s)		300	$^\circ\text{C}$

TO-247AD



Features

- Second generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- MOS Gate turn-on
 - drive simplicity

Applications

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

Advantages

- Easy to mount (isolated mounting hole)
- Reduces assembly time and cost

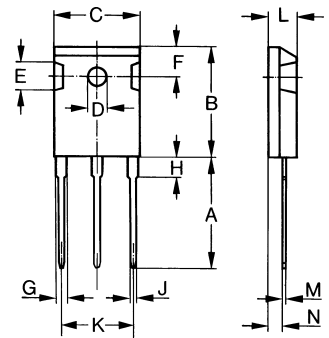
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$ unless otherwise specified)		
		Min.	Typ.	Max.
BV_{CES}	$I_C = 3 \text{ mA}, V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 2.5 \text{ mA}, V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 V_{CES}, V_{GE} = 0 \text{ V}$ Note 2			200 μA 1 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			4.0 V

Symbol	Test Conditions ($T_J = 25^\circ\text{C}$ unless otherwise specified)	Characteristic Values		
		Min.	Typ.	Max.
g_{fs}	$I_C = I_{C90^\circ}$, $V_{CE} = 10\text{ V}$, Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$	10	17	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		140	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		2850	pF
C_{oes}			210	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90^\circ}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		120	nC
Q_{ge}			30	nC
Q_{gc}			50	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		100	ns
t_{ri}	$I_C = I_{C90^\circ}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$		200	ns
$t_{d(off)}$	$R_G = 18\text{ }\Omega$, $V_{CLAMP} = 0.8 V_{CES}$		450	ns
t_{fi}	Note 1		650	ns
E_{off}			9.6	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		100	ns
t_{ri}	$I_C = I_{C90^\circ}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$		200	ns
$E_{(on)}$	$R_G = 18\text{ }\Omega$		1.8	mJ
$t_{d(off)}$	$V_{CLAMP} = 0.8 V_{CES}$		450	ns
t_{fi}	Note 1		900	ns
E_{off}			17	mJ
R_{thJC}			0.25	0.63 K/W
R_{thCK}				K/W

Notes:

- 1) Switching times may increase for V_{CE} (Clamp) $> 0.8 V_{CES}$, higher T_J or R_G values.
- 2) Device must be heatsunk for high temperature measurements to avoid thermal runaway.

TO-247 AD (IXSH) Outline

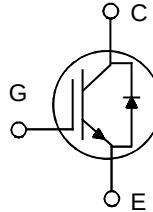


Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	19.81	20.32	0.780	0.800
B	20.80	21.46	0.819	0.845
C	15.75	16.26	0.610	0.640
D	3.55	3.65	0.140	0.144
E	4.32	5.49	0.170	0.216
F	5.4	6.2	0.212	0.244
G	1.65	2.13	0.065	0.084
H	-	4.5	-	0.177
J	1.0	1.4	0.040	0.055
K	10.8	11.0	0.426	0.433
L	4.7	5.3	0.185	0.209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

IGBT with Diode IXSH25N120AU1

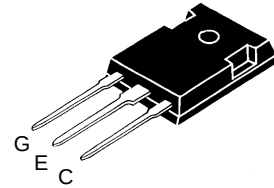
"S" Series - Improved SCSOA Capability

$$\begin{aligned} I_{C25} &= 50 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 4.0 \text{ V} \end{aligned}$$



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	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	50	A
I_{C90}	$T_C = 90^\circ\text{C}$	25	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	80	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 33 \Omega$ Clamped inductive load, $L = 100 \mu\text{H}$	$I_{CM} = 50$ @ $0.8 V_{CES}$	A
t_{sc}	$T_J = 125^\circ\text{C}$, $V_{CE} = 720 \text{ V}$; $V_{GE} = 15 \text{ V}$, $R_G = 33 \Omega$	10	μs
P_C	$T_C = 25^\circ\text{C}$	200	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	1.15/10	Nm/lb-in.
Weight		6	g
Max. Lead Temperature for Soldering (1.6mm from case for 10s)		300	$^\circ\text{C}$

TO-247 AD



Features

- High frequency IGBT with guaranteed short circuit SOA capability.
- IGBT with anti-parallel diode in one package
- 2nd generation HDMOS™ process
Low $V_{CE(sat)}$
- for minimum on-state conduction losses
- MOS Gate turn-on
- drive simplicity

Applications

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

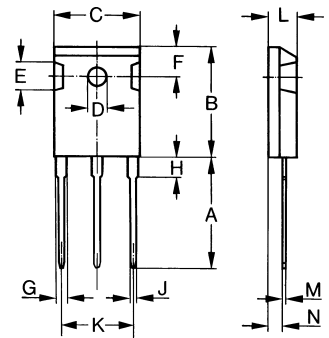
Advantages

- Saves space (two devices in one package)
- Easy to mount (isolated mounting hole)
- Reduces assembly time and cost
- Operates cooler
- Easier to assemble

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$ unless otherwise specified)		
		Min.	Typ.	Max.
BV_{CES}	$I_C = 4 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 2.5 \text{ mA}$, $V_{CE} = V_{GE}$	4		8 V
I_{CES}	$V_{CE} = 0.8 V_{CES}$, $V_{GE} = 0 \text{ V}$ Note 2			500 μA 8 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			4.0 V

Symbol	Test Conditions ($T_J = 25^\circ\text{C}$ unless otherwise specified)	Characteristic Values		
		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 $\leq 2\%$	10	17	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		140	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		2850	pF
C_{oes}			210	pF
C_{res}			50	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		120	nC
Q_{ge}			30	nC
Q_{gc}			50	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		100	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$		200	ns
$t_{d(off)}$	$R_G = 18\text{ }\Omega$, $V_{CLAMP} = 0.8 V_{CES}$		450	ns
t_{fi}	Note 1		650	ns
t_c			800	ns
E_{off}			9.6	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		100	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$		200	ns
$E_{(on)}$	$R_G = 18\text{ }\Omega$		1.8	mJ
$t_{d(off)}$	$V_{CLAMP} = 0.8 V_{CES}$		450	ns
t_{fi}	Note 1		900	ns
t_c			1200	ns
E_{off}			17	mJ
R_{thJC}				0.63 K/W
R_{thCK}			0.25	K/W

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

Reverse Diode (FRED)

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 $< 2\%$			2.5 V
	$T_J = 125^\circ\text{C}$			2.2 V
t_{rr}	$I_F = 1\text{ A}$; $di/dt = -100\text{ }\mu\text{s}$; $V_R = 30\text{ V}$; $T_J = 25^\circ\text{C}$		40	60 ns
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 240\text{ A}/\mu\text{s}$		16	A
t_{rr}	$T_J = 100^\circ\text{C}$, $V_R = 540\text{ V}$		300	ns
R_{thJC}				1.0 K/W

Notes:

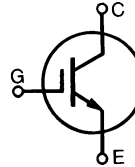
- 1) Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 V_{CES}$, higher T_J or R_G values.
- 2) Device must be heatsunk for high temperature measurements to avoid thermal runaway.

High Voltage, High speed IGBT

IXSH 35N120A

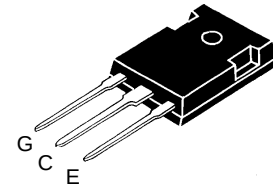
$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 70 \text{ A} \\ V_{CE(sat)} &= 4 \text{ V} \end{aligned}$$

Short Circuit SOA Capability



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	V
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)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 22 \Omega$ 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	$T_C = 25^\circ\text{C}$	300	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.
Weight		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
- High frequency IGBT with guaranteed Short Circuit SOA capability
- Fast Fall Time for switching speeds up to 20 kHz
- 2nd generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- MOS Gate turn-on
 - drive simplicity

Applications

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

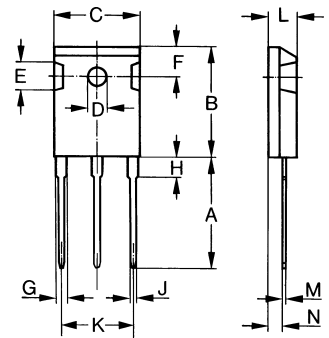
Advantages

- Easy to mount with 1 screw (TO-247) (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4	6	8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			400 μA 1.2 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			4 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 $d \leq 2\%$	20	26	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		170	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3750	pF
C_{oes}			235	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, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ 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_{ri}			150	ns
$t_{d(off)}$			400	900 ns
t_{fi}			500	700 ns
E_{off}			10	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ 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_{ri}			150	ns
E_{on}			2.5	mJ
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}			15	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.25	K/W

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

Fig.1 Saturation Characteristics

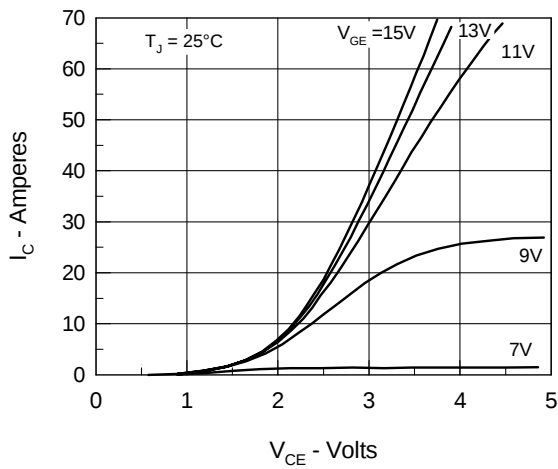


Fig.2 Output Characteristics

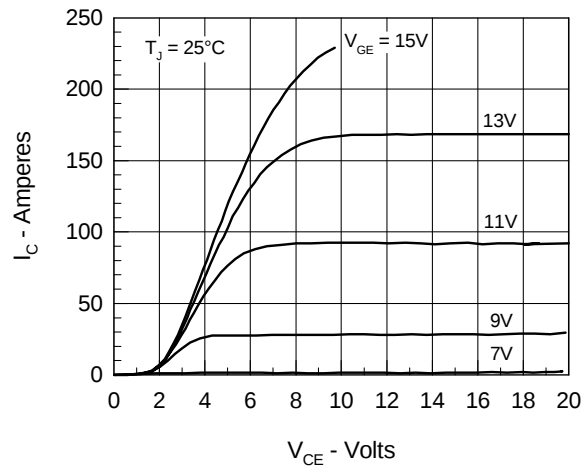


Fig.3 Collector-Emittter Voltage vs. Gate-Emittter Voltage

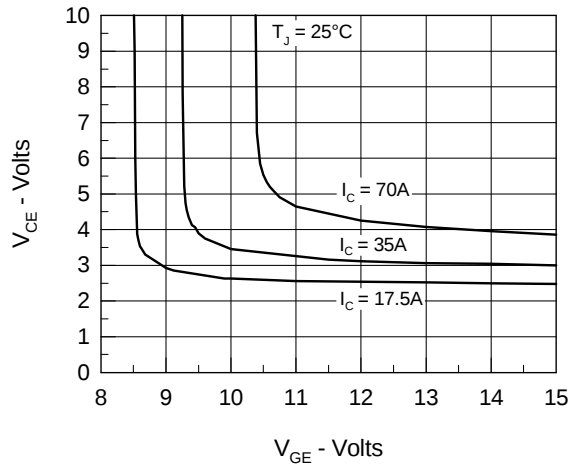


Fig.4 Temperature Dependence of Output Saturation Voltage

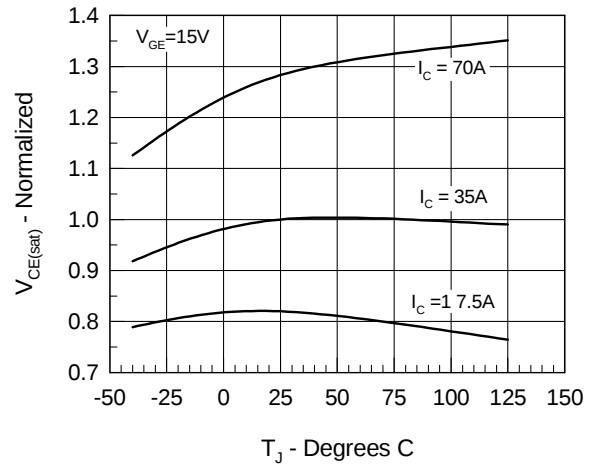


Fig.5 Input Admittance

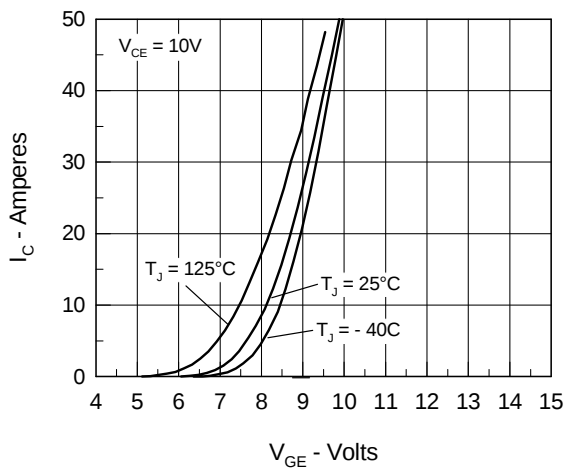


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

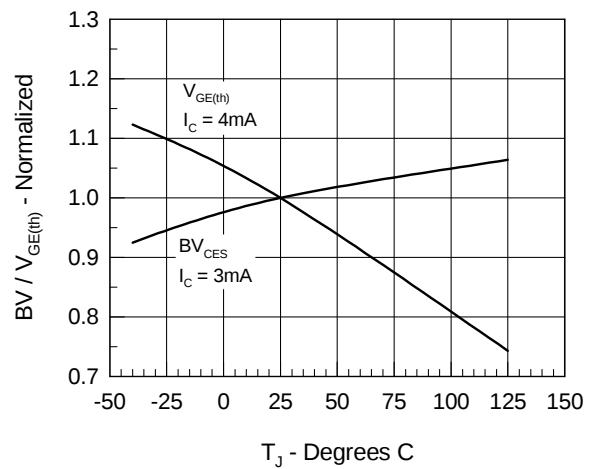


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

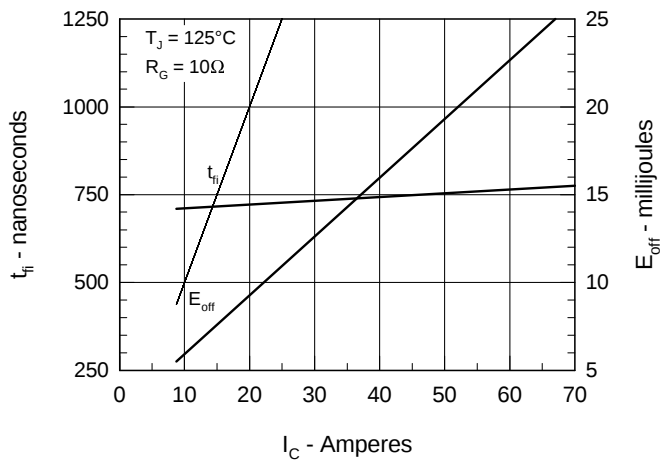


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

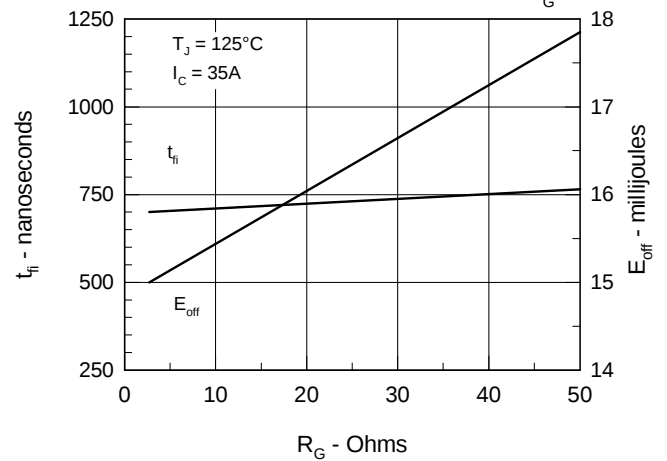


Fig.9 Gate Charge Characteristic Curve

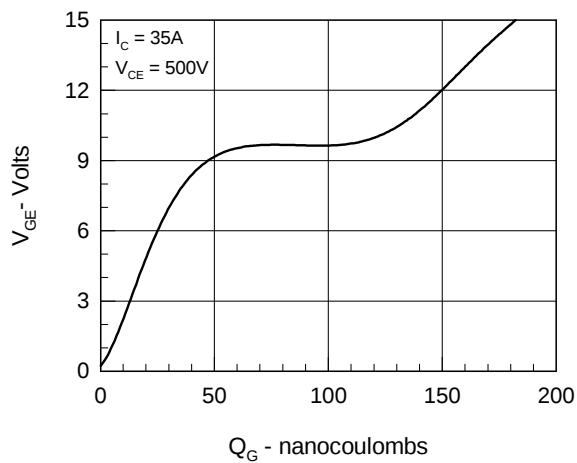


Fig.10 Turn-Off Safe Operating Area

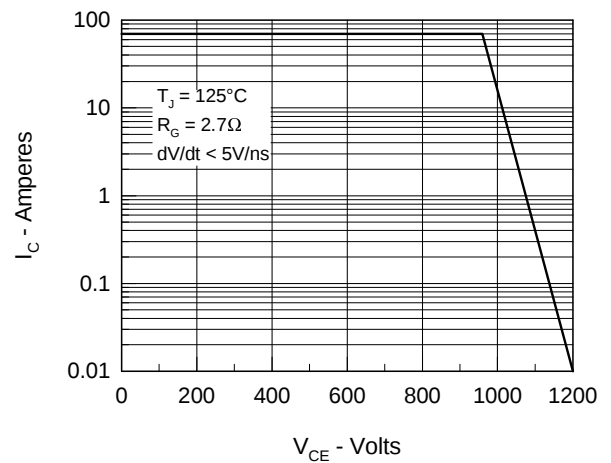
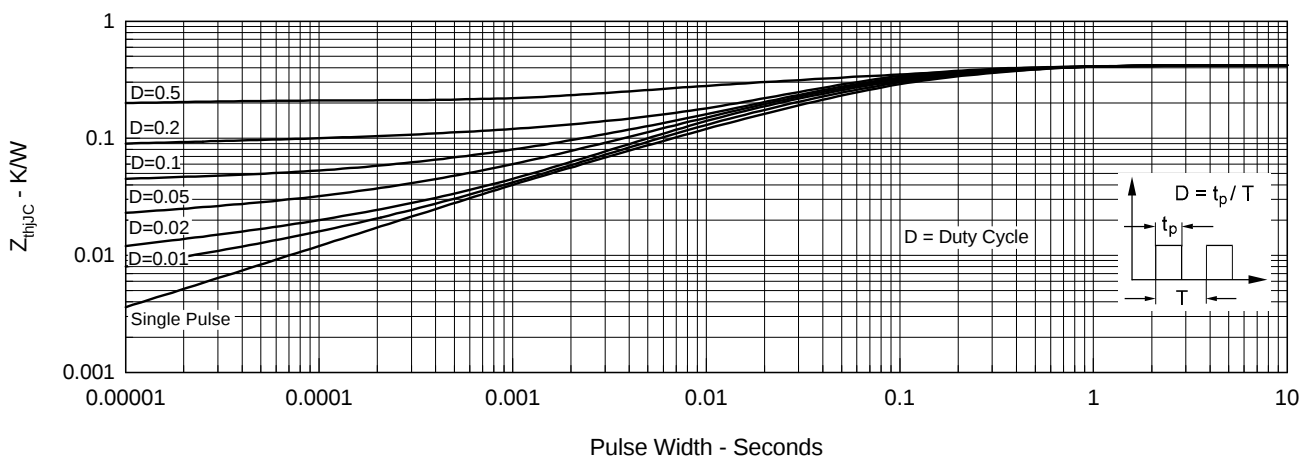


Fig.11 Transient Thermal Impedance



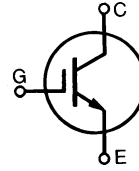
IGBT

IXSH 35N120B
IXST 35N120B

"S" Series - Improved SCSOA Capability

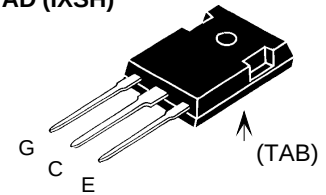
$$\begin{aligned} I_{C25} &= 70 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 3.6 \text{ V} \end{aligned}$$

Preliminary data

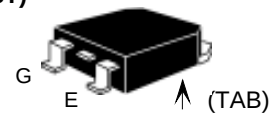


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	70	A
I_{C90}	$T_C = 90^\circ\text{C}$	35	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	140	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 5 \Omega$ Clamped inductive load	$I_{CM} = 90$ @ $0.8 V_{CES}$	A
t_{SC}	$T_J = 125^\circ\text{C}$, $V_{GE} = 720 \text{ V}$; $V_{GE} = 15 \text{ V}$, $R_G = 5 \Omega$	10	μs
P_C	$T_C = 25^\circ\text{C}$	300	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 (TO-247)	1.13/10	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	TO-247	6	g
	TO-268	4	g

TO-247 AD (IXSH)



TO-268 (IXST)



G = Gate
S = Emitter

TAB = Collector

Features

- Epitaxial Silicon drift region
 - fast switching
 - small tail current
- MOS gate turn-on for drive simplicity

Applications

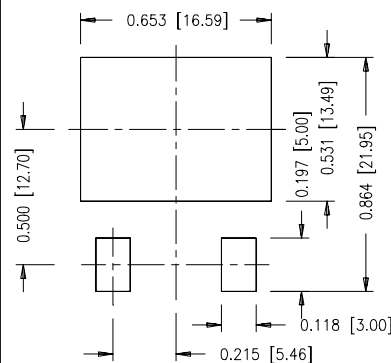
- AC motor speed control
- DC servo and robot drives
- Uninterruptible power supplies (UPS)
- Switched-mode and resonant-mode power supplies
- DC choppers

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1.0 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 250 \mu\text{A}$, $V_{CE} = V_{GE}$	3		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ Note 1			$50 \mu\text{A}$ 2.5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$ Note 2		2.9	3.6 V V

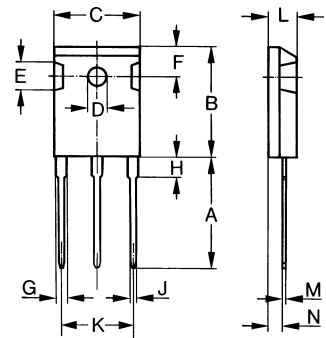
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Note 2	16	23	S
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		3600	pF
C_{oes}			260	pF
C_{res}			75	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		120	nC
Q_{ge}			33	nC
Q_{gc}			49	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$ $R_G = 5\ \Omega$		36	ns
t_{ri}			27	ns
$t_{d(off)}$			160	ns
t_{fi}	$V_{CE} = 0.8 V_{CES}$ Note 3		180	ns
E_{off}			5	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$ $R_G = 5\ \Omega$, $V_{CE} = 0.8 V_{CES}$ Note 3		38	ns
t_{ri}			29	ns
E_{on}			2.5	mJ
$t_{d(off)}$			240	ns
t_{fi}			340	ns
E_{off}			9	mJ
R_{thJC}				0.42 K/W
R_{thCK}	(TO-247)		0.25	K/W

- Notes: 1. Device must be heatsunk for high temperature leakage current measurements to avoid thermal runaway.
2. Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$
3. Switching times may increase for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$, higher T_J or increased R_G .

Min. Recommended Footprint

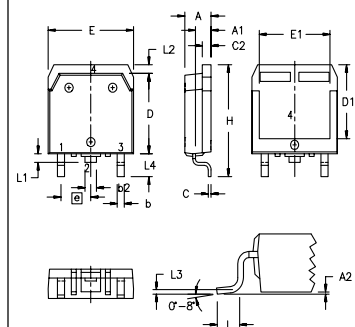


TO-247 AD (IXSH) Outline



Dim.	Millimeter Min. Max.	Inches 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-268AA (D³ PAK)

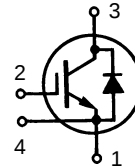


Dim.	Millimeter Min. Max.	Inches Min. Max.
A	4.9 5.1	.193 .201
A ₁	2.7 2.9	.106 .114
A ₂	.02 .25	.001 .010
b	1.15 1.45	.045 .057
b ₂	1.9 2.1	.75 .83
C	.4 .65	.016 .026
D	13.80 14.00	.543 .551
E	15.85 16.05	.624 .632
E ₁	13.3 13.6	.524 .535
e	5.45 BSC	.215 BSC
H	18.70 19.10	.736 .752
L	2.40 2.70	.094 .106
L ₁	1.20 1.40	.047 .055
L ₂	1.00 1.15	.039 .045
L ₃	0.25 BSC	.010 BSC
L ₄	3.80 4.10	.150 .161

High Voltage IGBT with Diode

IXSN 35N120AU1

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

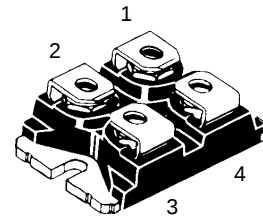


Symbol	Test Conditions	Maximum Ratings
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200 V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200 A
V_{GES}	Continuous	± 20 V
V_{GEM}	Transient	± 30 V
I_{C25}	$T_C = 25^\circ\text{C}$	70 A
I_{C90}	$T_C = 90^\circ\text{C}$	35 A
I_{CM}	$T_C = 25^\circ\text{C}$, 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 300 W Diode 175 W
V_{ISOL}	50/60 Hz $I_{ISOL} \leq 1 \text{ mA}$	$t = 1 \text{ min}$ 2500 V~ $t = 1 \text{ s}$ 3000 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 Nm/lb.in. 1.5/13 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 8 V
$I_{CES}^{(1)}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$ 750 μA $T_J = 125^\circ\text{C}$ 15 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

② 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)
 - reduces RFI
- Low package inductance (< 10 nH)
 - easy to drive and to protect

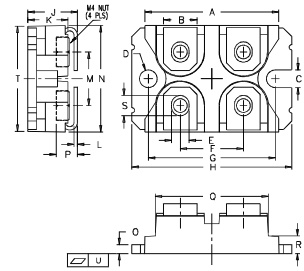
Applications

- 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	190 nC
Q_{ge}			40	60 nC
Q_{gc}			70	100 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_{ri}			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_{ri}			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

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}	$I_F = I_{C90}, V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$ $T_J = 100^\circ\text{C}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$		32	35 A
t_{rr}			225	ns
			40	60 ns
R_{thJC}				0.71 K/W

Fig. 1 Saturation Characteristics

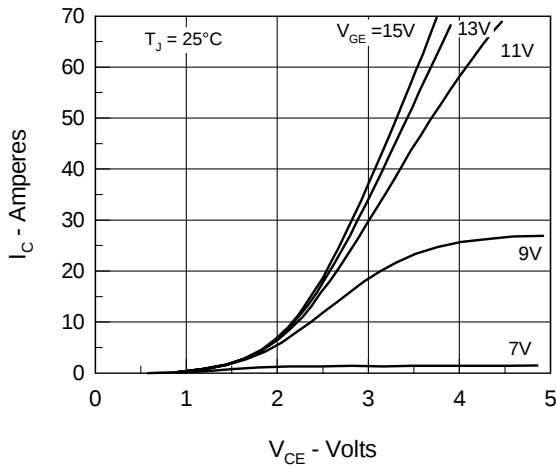


Fig. 2 Output Characteristics

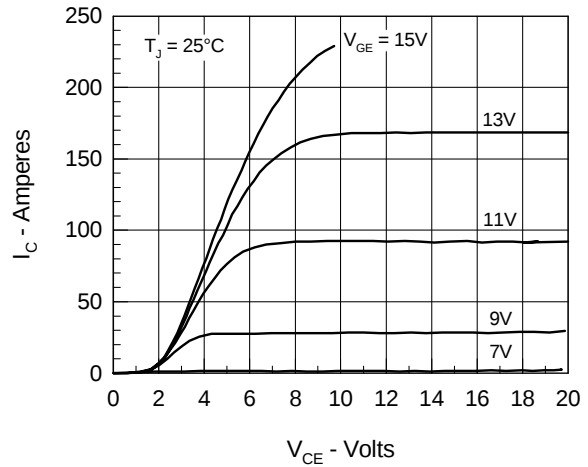


Fig. 3 Collector-Emittor Voltage vs. Gate-Emittor Voltage

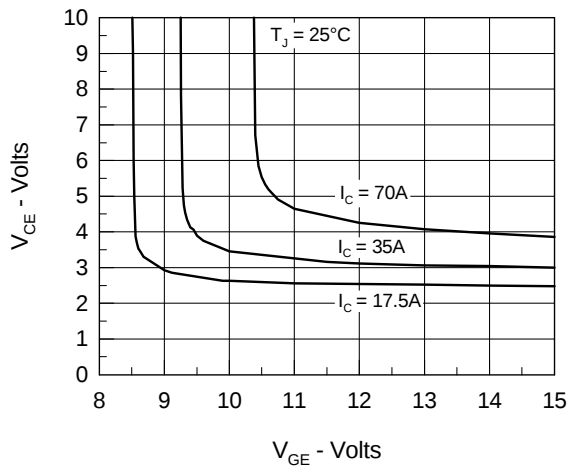


Fig. 4 Temperature Dependence of Output Saturation Voltage

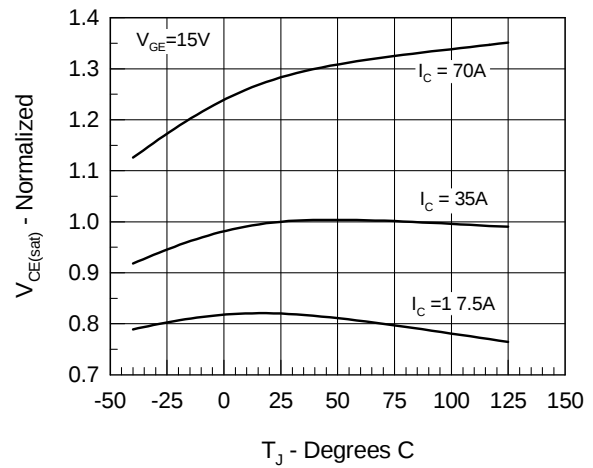


Fig. 5 Input Admittance

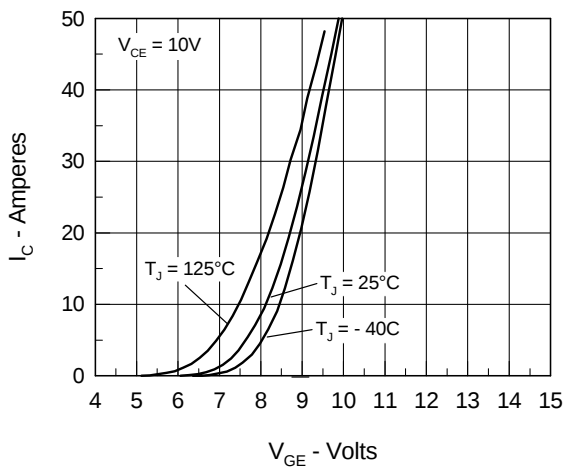


Fig. 6 Temperature Dependence of Breakdown and Threshold Voltage

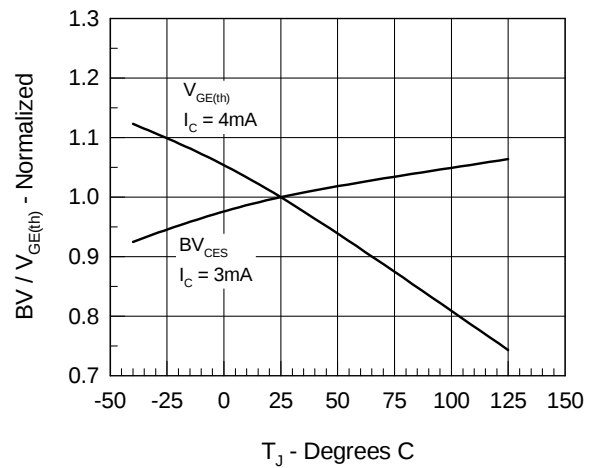


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

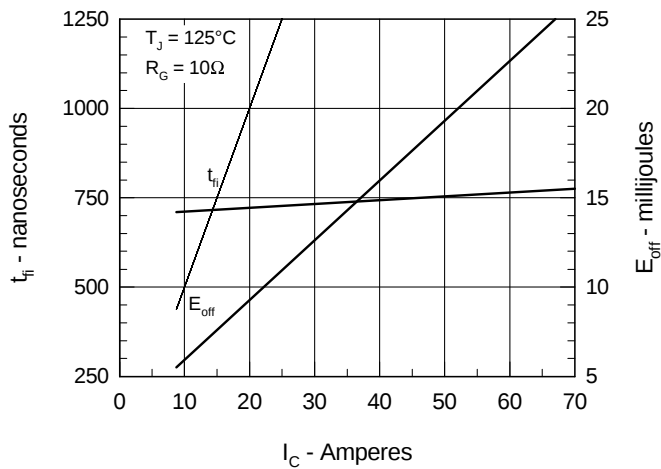


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

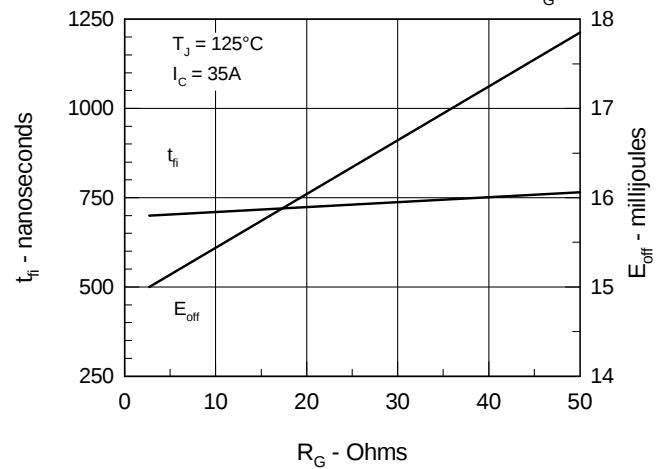


Fig.9 Gate Charge Characteristic Curve

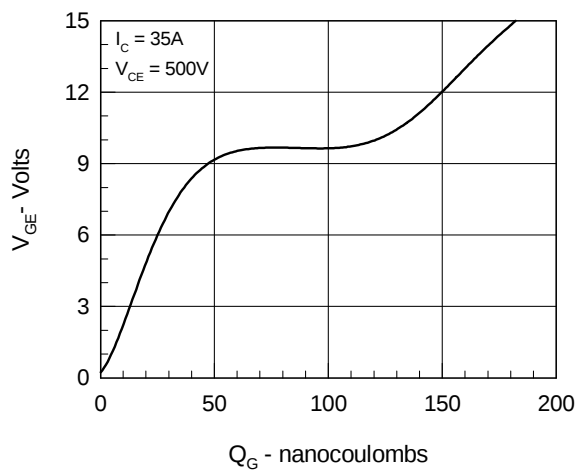


Fig.10 Turn-Off Safe Operating Area

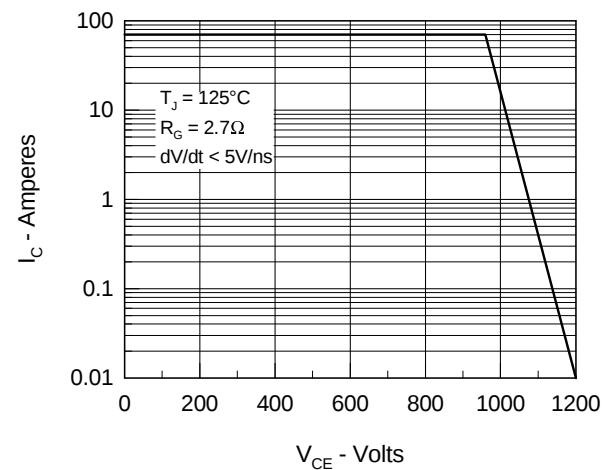
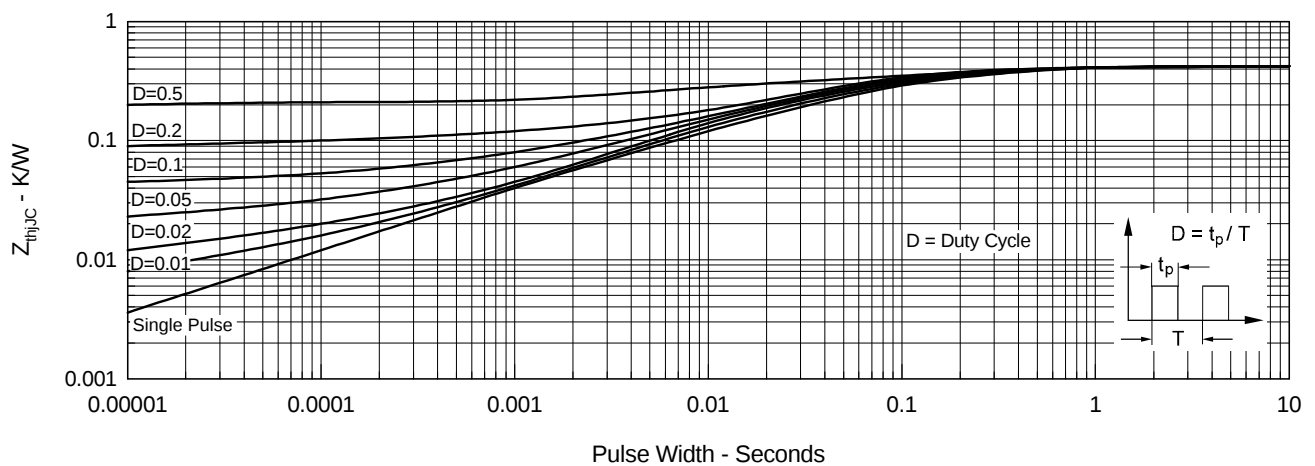


Fig.11 Transient Thermal Impedance



High Voltage IGBT with Diode

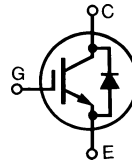
Combi Pack
Short Circuit SOA Capability

IXSK35N120AU1

$$V_{CES} = 1200 \text{ V}$$

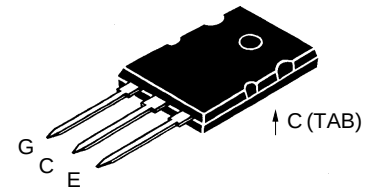
$$I_{C25} = 70 \text{ A}$$

$$V_{CE(sat)} = 4 \text{ V}$$



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	V
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)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 70$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}$, $V_{CE} = 720 \text{ V}$, $T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_c	$T_C = 25^\circ\text{C}$	IGBT 300 Diode 190	W W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
T_L	1.6 mm (0.063 in) from case for 10 s	300	$^\circ\text{C}$
M_d	Mounting torque	1.15/13	Nm/lb.in.
Weight		10	g

TO-264 AA



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

Features

- International standard package JEDEC TO-264 AA
- 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

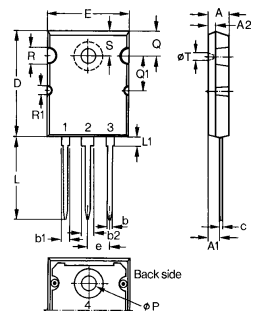
Advantages

- Space savings (two devices in one package)
- Easy to mount with one screw (isolated mounting screw hole)
- High power density

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}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			$T_J = 25^\circ\text{C}$ 750 μA $T_J = 125^\circ\text{C}$ 15 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			4 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 $\leq 2\%$	20	26	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		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	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5\text{ V}_{CES}$		150	nC
Q_{ge}			40	nC
Q_{gc}			70	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$		80	ns
t_{ri}			150	ns
$t_{d(off)}$			400	ns
t_{fi}			500	ns
E_{off}		Note 1	10	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$		80	ns
t_{ri}			150	ns
E_{on}			8	mJ
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}		Note 1	15	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.15	K/W

TO-264 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.82	5.13	.190	.202
A1	2.54	2.89	.100	.114
A2	2.00	2.10	.079	.083
b	1.12	1.42	.044	.056
b1	2.39	2.69	.094	.106
b2	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
L1	2.29	2.59	.090	.102
P	3.17	3.66	.125	.144
Q	6.07	6.27	.239	.247
Q1	8.38	8.69	.330	.342
R	3.81	4.32	.150	.170
R1	1.78	2.29	.070	.090
S	6.04	6.30	.238	.248
T	1.57	1.83	.062	.072

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 $d \leq 2\%$, $T_J = 125^\circ\text{C}$			2.35 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		32	36 A
t_{rr}			225	ns
			40	ns
R_{thJC}				0.65 K/W

IXSK 35N120AU1 characteristic curves are located in the IXSH 35N120A data sheet, Publication No. D96001DE, pages 66 - 67.

High Voltage IGBT with Diode

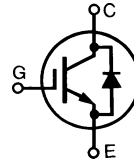
Combi Pack
Short Circuit SOA Capability

IXSX 35N120AU1

$$V_{CES} = 1200 \text{ V}$$

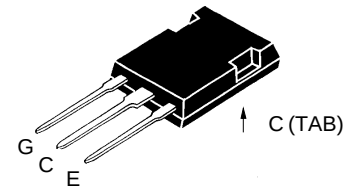
$$I_{C25} = 70 \text{ A}$$

$$V_{CE(sat)} = 4 \text{ V}$$



Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	1200	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	1200	V
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}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	140	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_J = 125^\circ\text{C}, R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 70$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}, V_{CE} = 720 \text{ V}, T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$	300 190	W W
T_J		-55 ... +150	$^\circ\text{C}$
T_{JM}		150	$^\circ\text{C}$
T_{stg}		-55 ... +150	$^\circ\text{C}$
T_L	1.6 mm (0.063 in) from case for 10 s	300	$^\circ\text{C}$
Weight	TO-247 HL	6	g

**PLUS TO-247™
(IXSX35N120AU1)**



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

Features

- Hole-less TO-247 package for clip mounting
- High frequency IGBT and anti-parallel FRED in one package
- 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

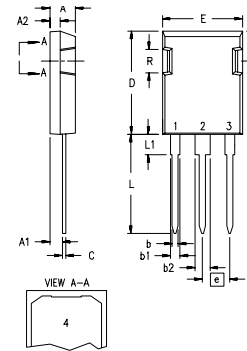
Advantages

- Space savings (two devices in one package)
- 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}	$I_C = 5 \text{ mA}, V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}, V_{CE} = V_{GE}$	4		8 V
$I_{CES} \text{ ①}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			750 μA 15 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			4 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 $\leq 2\%$	20	26	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		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, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{ri}			150	ns
$t_{d(off)}$			400	900 ns
t_{fi}			500	700 ns
E_{off}			10	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$, $V_{CE} = 0.8 V_{CES}$, $R_G = 2.7\text{ }\Omega$ Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{ri}			150	ns
E_{on}			8	mJ
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}			15	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.15	K/W

PLUS247™ (IXSX)



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	.190	.205
A ₁	2.29	2.54	.090	.100
A ₂	1.91	2.16	.075	.085
b	1.14	1.40	.045	.055
b ₁	1.91	2.13	.075	.084
b ₂	2.92	3.12	.115	.123
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	19.81	20.32	.780	.800
L1	3.81	4.32	.150	.170
Q	5.59	6.20	.220	.244
R	4.32	4.83	.170	.190

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 $d \leq 2\%$, $T_J = 125^\circ\text{C}$			2.35 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		32	36 A
t_{rr}			225	ns
t_{rr}			40	60 ns
R_{thJC}				0.65 K/W

Fig.1 Saturation Characteristics

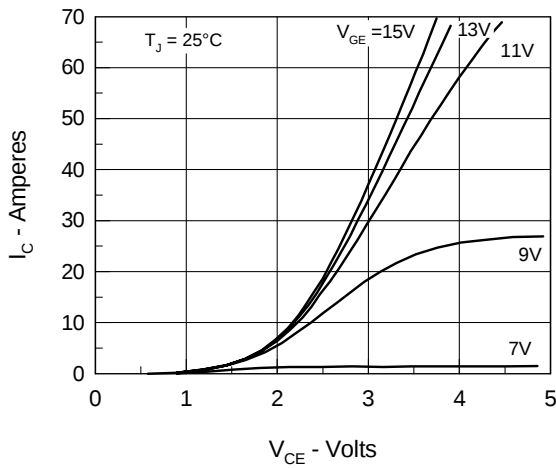


Fig.2 Output Characteristics

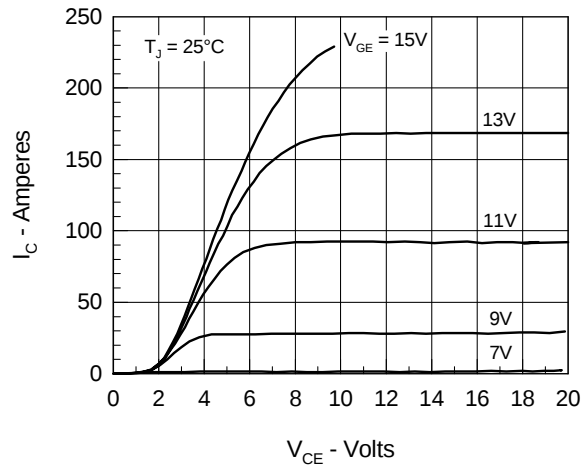


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

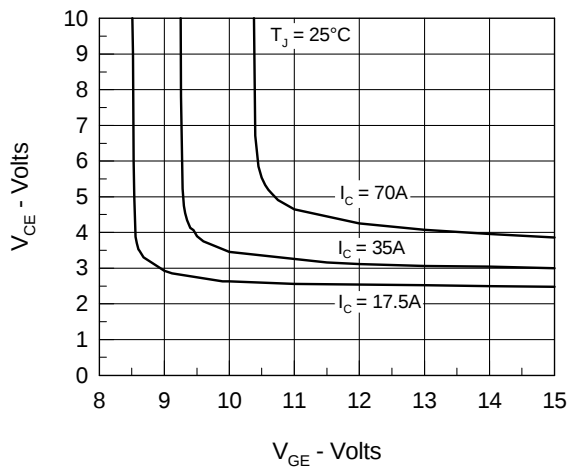


Fig.4 Temperature Dependence of Output Saturation Voltage

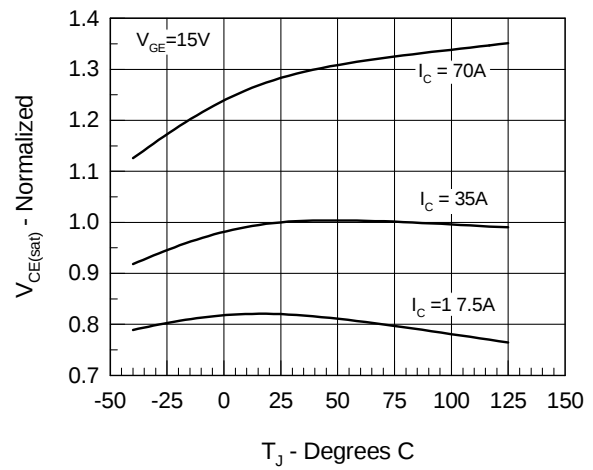


Fig.5 Input Admittance

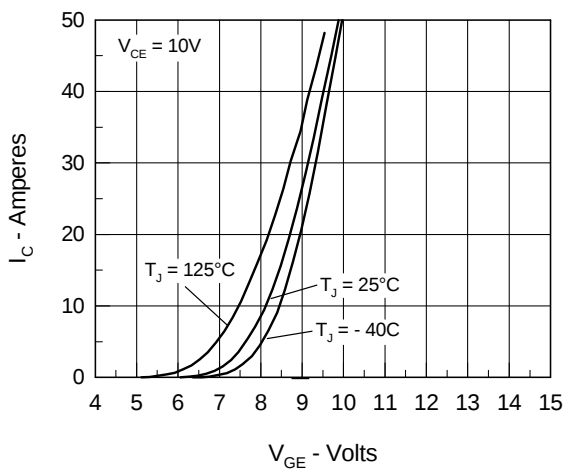


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

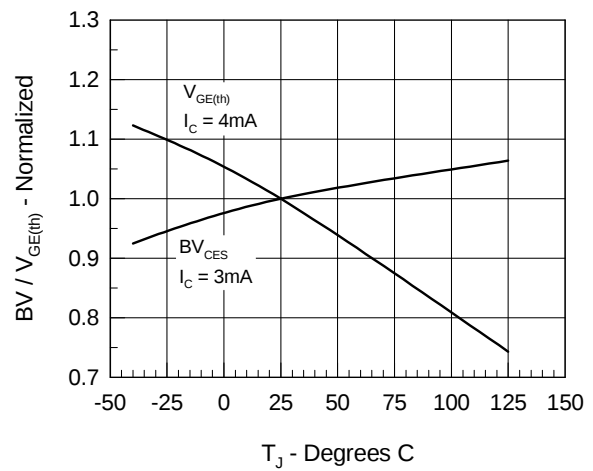


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

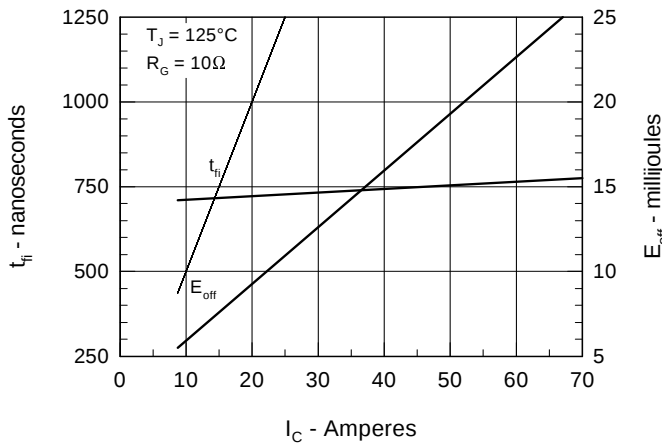


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

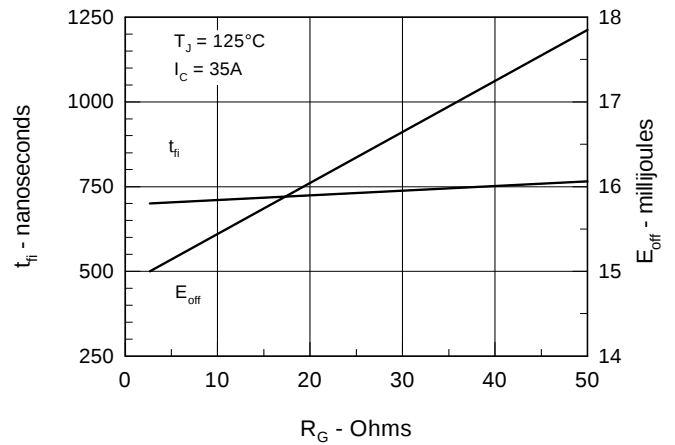


Fig.9 Gate Charge Characteristic Curve

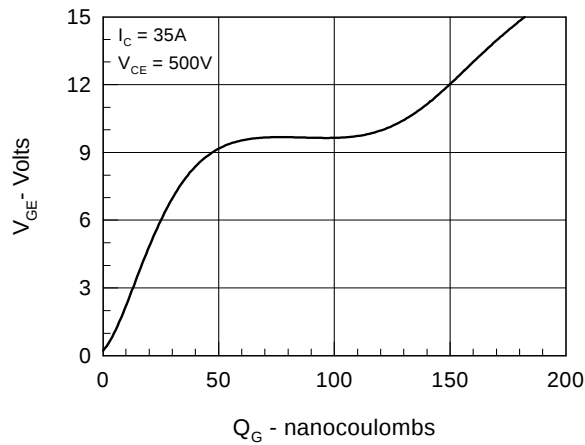


Fig.10 Turn-Off Safe Operating Area

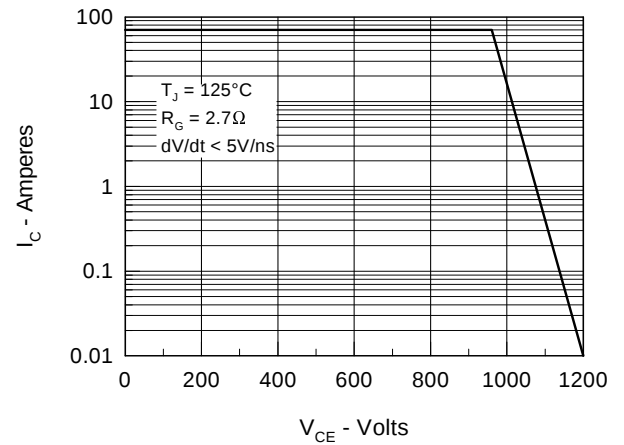


Fig.11 Transient Thermal Impedance

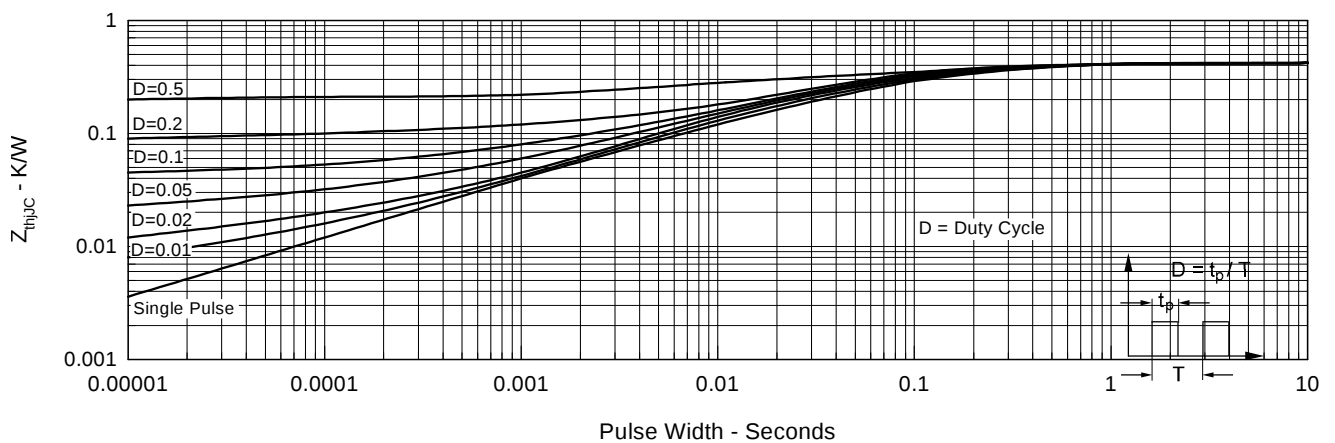


Fig.12 Maximum Forward Voltage Drop

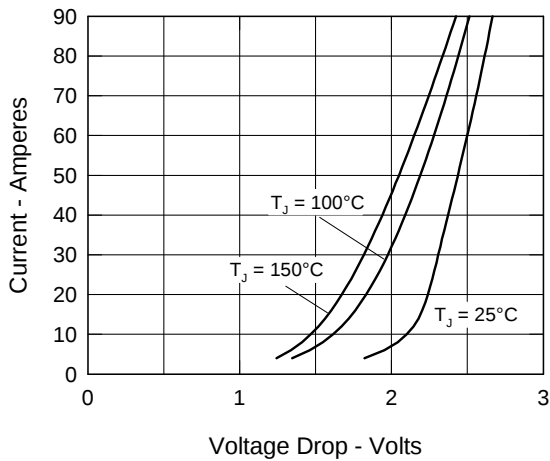


Fig.13 Peak Forward Voltage V_{FR} and Forward Recovery Time t_{FR}

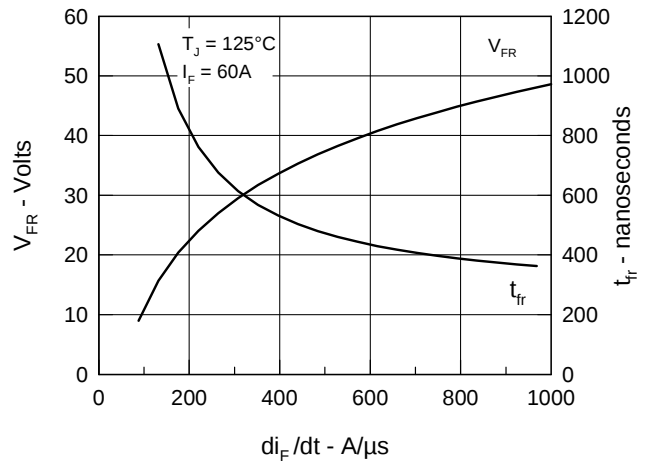


Fig.14 Junction Temperature Dependence of I_{RM} and Q_r

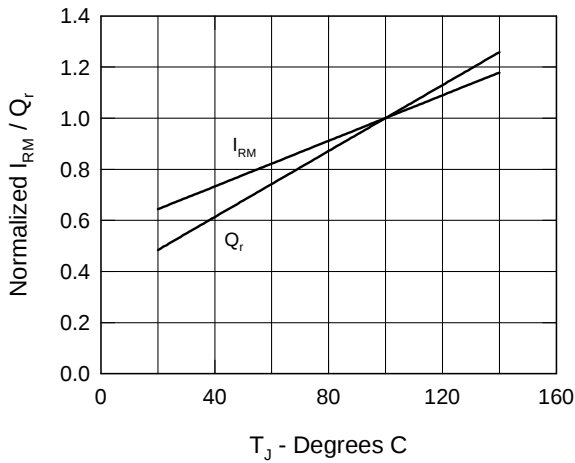


Fig.15 Reverse Recovery Charge

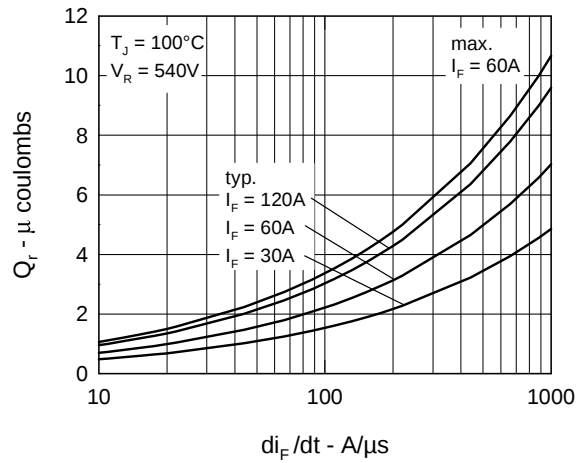


Fig.16 Peak Reverse Recovery Current

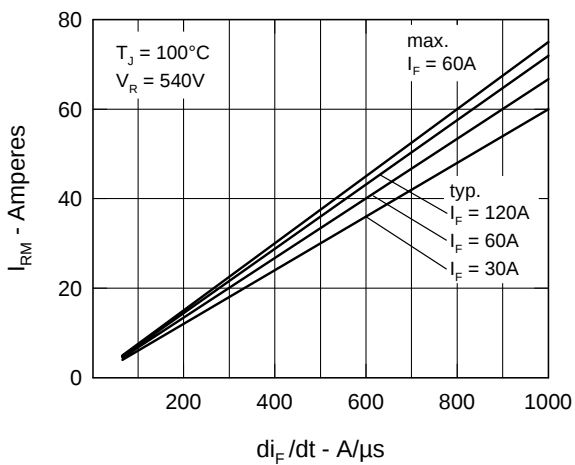
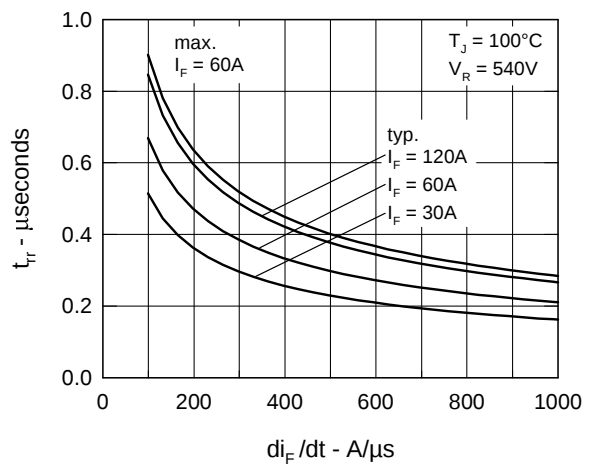


Fig.17 Reverse Recovery Time

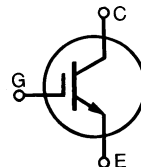


High Voltage, Low $V_{CE(sat)}$ IGBT

IXSH 45N120

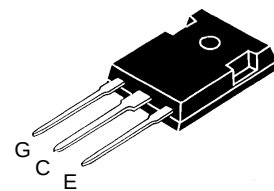
$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 75 \text{ A} \\ V_{CE(sat)} &= 3 \text{ V} \end{aligned}$$

Short Circuit SOA Capability



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	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$, limited by leads	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	45	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	180	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 2.7 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 90$ @ $0.8 V_{CES}$	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	$T_C = 25^\circ\text{C}$	300	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.
Weight		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
- High frequency IGBT with guaranteed Short Circuit SOA capability
- Fast Fall Time for switching speeds up to 20 kHz
- 2nd generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- MOS Gate turn-on
 - drive simplicity

Applications

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

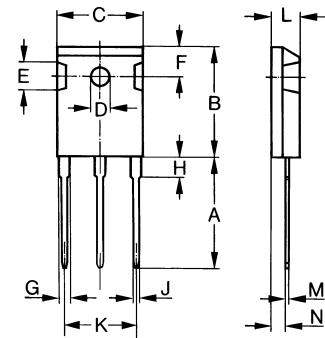
Advantages

- Easy to mount with 1 screw (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 3 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 4 \text{ mA}$, $V_{CE} = V_{GE}$	4	6	8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$, $V_{GE} = 0 \text{ V}$			400 μA 1.2 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			3 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 $d \leq 2\%$		26	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		170	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		4150	pF
C_{oes}			285	pF
C_{res}			65	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5\text{ V}_{CES}$		150	200 nC
Q_{ge}			45	60 nC
Q_{gc}			75	100 nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{ri}			250	ns
$t_{d(off)}$			400	ns
t_{fi}			1000	ns
E_{off}			21	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 0.8\text{ V}_{CES}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G		80	ns
t_{ri}			250	ns
E_{on}			7.1	mJ
$t_{d(off)}$			450	ns
t_{fi}			1200	ns
E_{off}			27	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.25	K/W

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

Fig.1 Saturation Characteristics

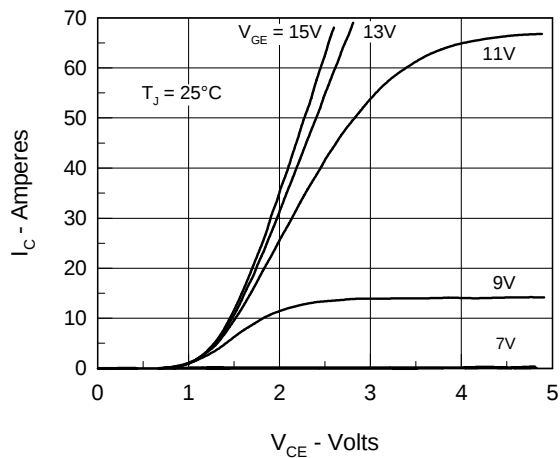


Fig.2 Output Characteristics

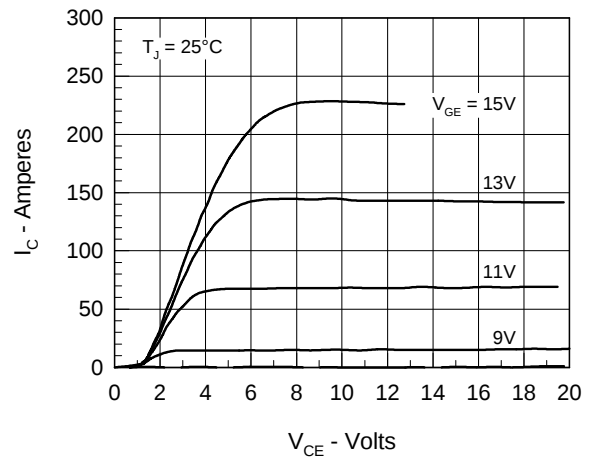


Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

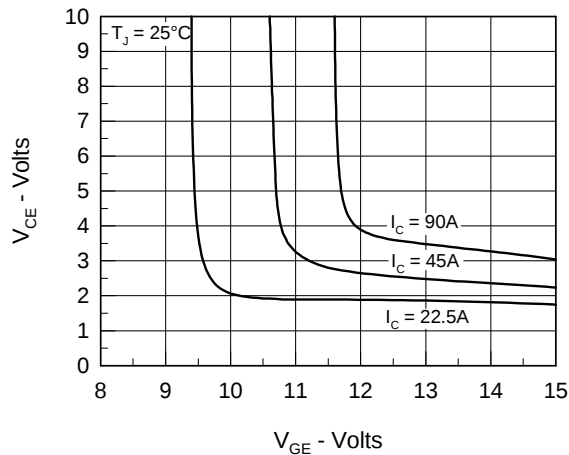


Fig.4 Temperature Dependence of Output Saturation Voltage

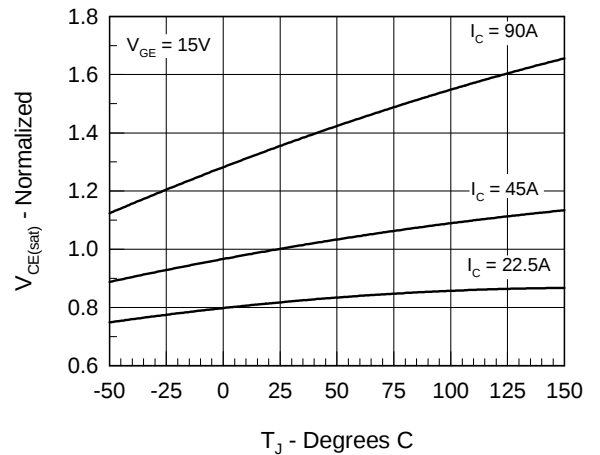


Fig. 5 Input Admittance

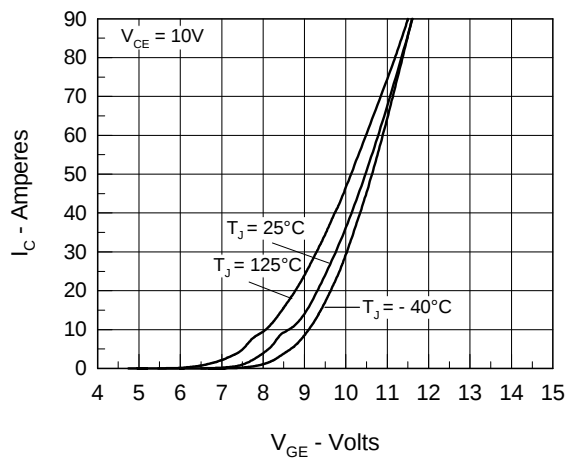


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

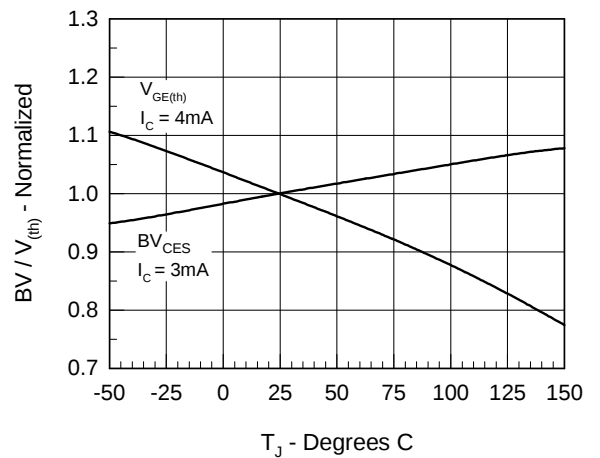


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

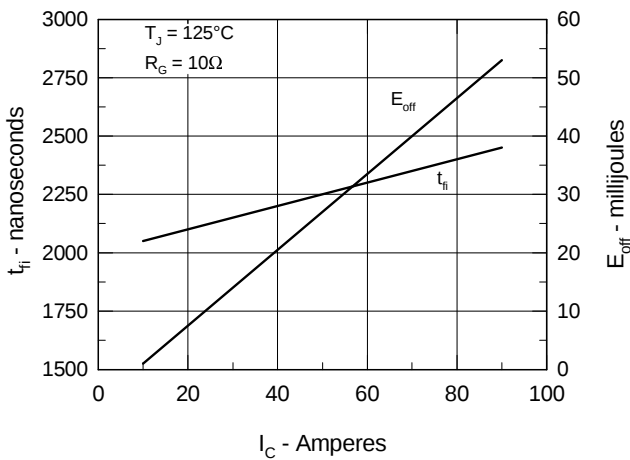


Fig.9 Gate Charge Characteristic Curve

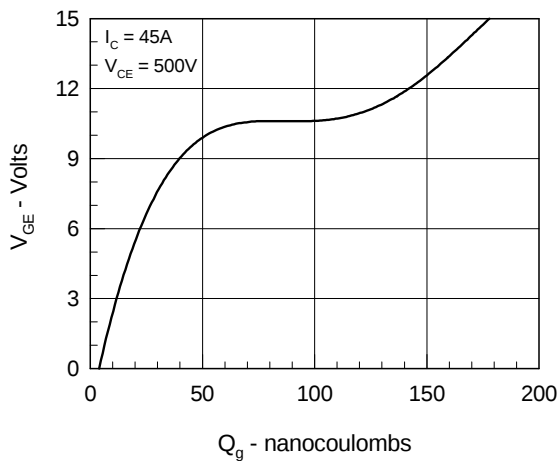


Fig.11 Transient Thermal Impedance

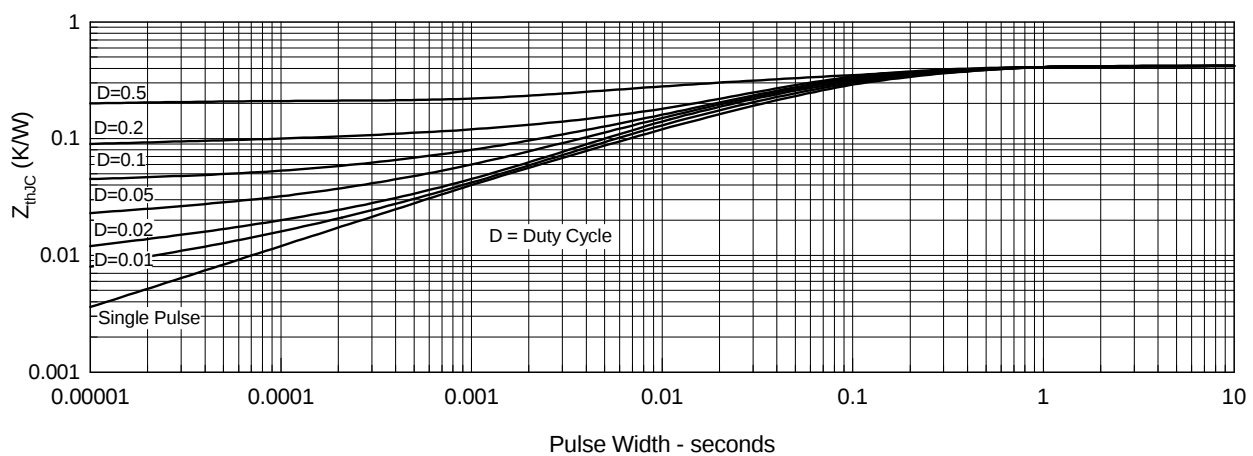


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on R_G

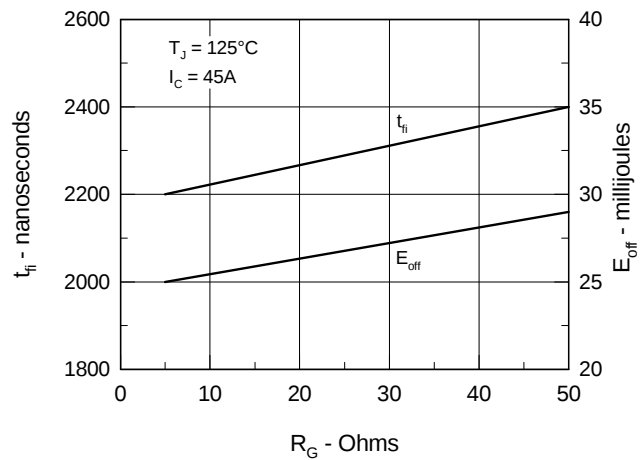
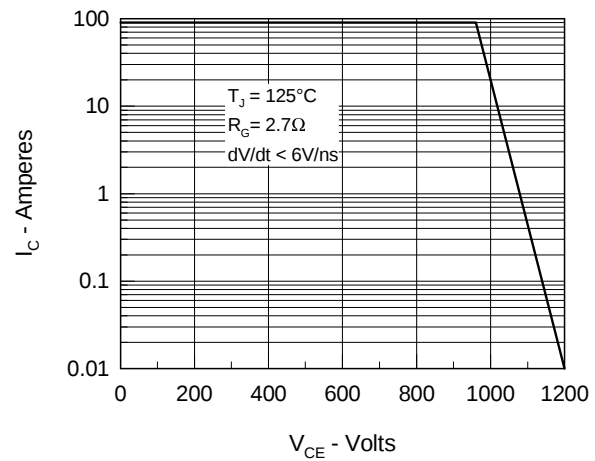


Fig.10 Turn-Off Safe Operating Area



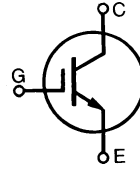
High Voltage IGBT

IXSH 45N120B
IXST 45N120B

"S" Series - Improved SCSOA Capability

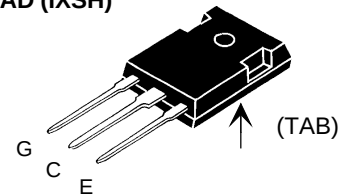
$$\begin{aligned} I_{C25} &= 75 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat)} &= 3.0 \text{ V} \end{aligned}$$

Preliminary data

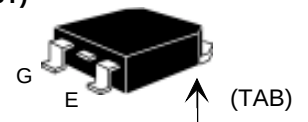


Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C}$ to 150°C	1200	V
V_{CGR}	$T_J = 25^\circ\text{C}$ to 150°C ; $R_{GE} = 1 \text{ M}\Omega$	1200	V
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$ (limited by leads)	75	A
I_{C90}	$T_C = 90^\circ\text{C}$	45	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	180	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$, $R_G = 5 \Omega$ Clamped inductive load	$I_{CM} = 90$ @ $0.8 V_{CES}$	A
t_{SC}	$T_J = 125^\circ\text{C}$, $V_{GE} = 720 \text{ V}$; $V_{GE} = 15 \text{ V}$, $R_G = 5 \Omega$	10	μs
P_C	$T_C = 25^\circ\text{C}$	300	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 (TO-247)	1.13/10	Nm/lb.in.
Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s		300	$^\circ\text{C}$
Weight	TO-247	6	g

TO-247 AD (IXSH)



TO-268 (IXST)



G = Gate
S = Emitter

C = Collector
TAB = Collector

Features

- Epitaxial Silicon drift region
 - fast switching
 - small tail current
- MOS gate turn-on for drive simplicity

Applications

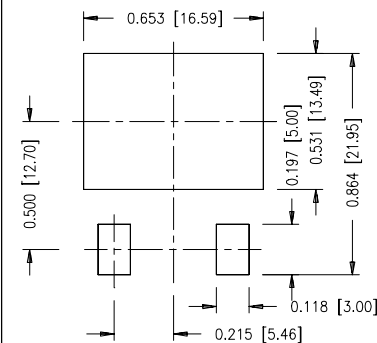
- AC motor speed control
- DC servo and robot drives
- Uninterruptible power supplies (UPS)
- Switched-mode and resonant-mode power supplies
- Welding

Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 1.0 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 250 \mu\text{A}$, $V_{CE} = V_{GE}$	3		6 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ Note 1 $T_J = 125^\circ\text{C}$			50 μA 2.5 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 100 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$ Note 2 $T_J = 125^\circ\text{C}$	2.5 2.6		3.0 V V

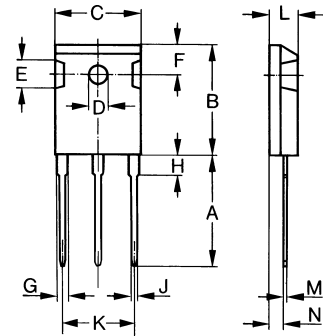
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
g_{fs}	$I_C = I_{C90}$; $V_{CE} = 10\text{ V}$, Note 2	16	23	S
C_{ies}			3300	pF
C_{oes}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		240	pF
C_{res}			65	pF
Q_g			120	nC
Q_{ge}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		40	nC
Q_{gc}			45	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$		36	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		27	ns
$t_{d(off)}$	$R_G = 5\ \Omega$		360	500 ns
t_{fi}	$V_{CE} = 0.8 V_{CES}$		380	750 ns
E_{off}	Note 3		13	22 mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		38	ns
t_{ri}	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$		29	ns
E_{on}	$R_G = 5\ \Omega$, $V_{CE} = 0.8 V_{CES}$		2.9	mJ
$t_{d(off)}$	Note 3		440	ns
t_{fi}			700	ns
E_{off}			22	mJ
R_{thJC}				0.42 K/W
R_{thCK}	(TO-247)		0.25	K/W

- Notes: 1. Device must be heatsunk for high temperature leakage current measurements to avoid thermal runaway.
2. Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$
3. Switching times may increase for V_{CE} (Clamp) $> 0.8 \cdot V_{CES}$, higher T_J or increased R_G .

Min. Recommended Footprint

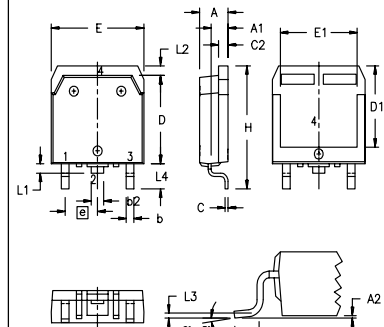


TO-247 AD (IXSH) Outline



Dim.	Millimeter Min. Max.	Inches 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-268AA (D³ PAK)



Dim.	Millimeter Min. Max.	Inches Min. Max.
A	4.9 5.1	.193 .201
A ₁	2.7 2.9	.106 .114
A ₂	.02 .25	.001 .010
b	1.15 1.45	.045 .057
b ₂	1.9 2.1	.075 .083
C	.4 .65	.016 .026
D	13.80 14.00	.543 .551
E	15.85 16.05	.624 .632
E ₁	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
L ₁	1.20 1.40	.047 .055
L ₂	1.00 1.15	.039 .045
L ₃	.25 BSC	.010 BSC
L ₄	3.80 4.10	.150 .161

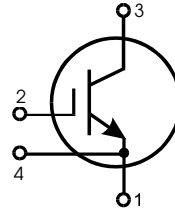
High Voltage IGBT

IXSN 55N120A

$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 110 \text{ A} \\ V_{CE(sat)} &= 4 \text{ V} \end{aligned}$$

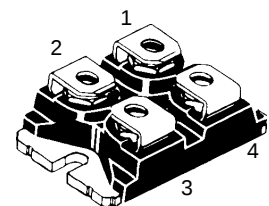
Short Circuit SOA Capability

Preliminary Data



Symbol	Test Conditions	Maximum Ratings	
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	1200	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	1200	A
V_{GES}	Continuous	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	110	A
I_{C90}	$T_C = 90^\circ\text{C}$	55	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	160	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 110$ @ $0.8 V_{CES}$	A
t_{SC} (SCSOA)	$V_{GE} = 15 \text{ V}, V_{CE} = 0.6 V_{CES}, T_J = 125^\circ\text{C}$ $R_G = 22 \Omega$, non-repetitive	10	μs
P_C	$T_C = 25^\circ\text{C}$ IGBT	500	W
V_{ISOL}	50/60 Hz $I_{ISOL} \leq 1 \text{ mA}$	$t = 1 \text{ min}$	2500 V~
		$t = 1 \text{ s}$	3000 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	1.5/13	Nm/lb.in.
	Terminal connection torque (M4)	1.5/13	Nm/lb.in.
Weight		30	g

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
- Aluminium-nitride isolation
 - high power dissipation
- Isolation voltage 3000 V~
- UL registered E 153432
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- Low collector-to-case capacitance (<100 pF)
 - reduces 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

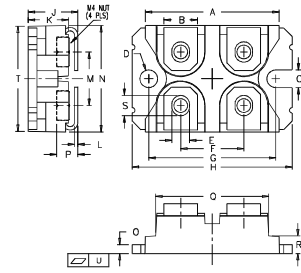
Advantages

- 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.
BV_{CES}	$I_C = 6 \text{ mA}, V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 8 \text{ mA}, V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 V_{CES}$ $V_{GE} = 0 \text{ V}$			1 mA
				2.5 mA
I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$			$\pm 200 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15 \text{ V}$			4 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 $d \leq 2\%$	32	45	S
$I_{C(on)}$	$V_{CE} = 10\text{ V}, V_{GE} = 15\text{ V}$		340	A
C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		8000	pF
C_{oes}			590	pF
C_{res}			120	pF
Q_g	$I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.5 V_{CES}$		300	nC
Q_{ge}			80	nC
Q_{gc}			140	nC
$t_{d(on)}$	Inductive load, $T_J = 25^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) $> 0.8 V_{CES}$, higher T_J or increased R_G		140	ns
t_{ri}			220	ns
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}			18	mJ
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$ $I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.8 V_{CES}, R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for V_{CE} (Clamp) $> 0.8 V_{CES}$, higher T_J or increased R_G		140	ns
t_{ri}			250	ns
$t_{d(off)}$			600	ns
t_{si}			900	ns
t_c			950	ns
$E_{(on)}$			6	mJ
E_{off}			25	mJ
R_{thJC}				0.25 K/W
R_{thCK}			0.05	K/W

miniBLOC, SOT-227 B



M4 screws (4x) supplied

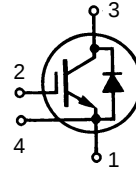
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	31.50	31.88	1.240	1.255
B	7.80	8.20	0.307	0.323
C	4.09	4.29	0.161	0.169
D	4.09	4.29	0.161	0.169
E	4.09	4.29	0.161	0.169
F	14.91	15.11	0.587	0.595
G	30.12	30.30	1.186	1.193
H	38.00	38.23	1.496	1.505
J	11.68	12.22	0.460	0.481
K	8.92	9.60	0.351	0.378
L	0.76	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

High Voltage IGBT with Diode

IXSN 55N120AU1

Short Circuit SOA Capability

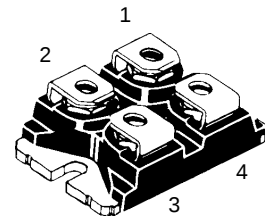
Preliminary data



$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 110 \text{ A} \\ V_{CE(sat)} &= 4 \text{ V} \end{aligned}$$

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}	$T_C = 25^\circ\text{C}$	110	A
I_{C90}	$T_C = 90^\circ\text{C}$	55	A
I_{CM}	$T_C = 25^\circ\text{C}$, 1 ms	160	A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}$, $T_{VJ} = 125^\circ\text{C}$, $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 110$ @ $0.8 V_{CES}$	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	$T_C = 25^\circ\text{C}$	500	W
P_D		175	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.

miniBLOC, SOT-227 B



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 ($< 60 \text{ pF}$)
 - reduces RFI
- Low package inductance ($< 10 \text{ nH}$)
 - 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

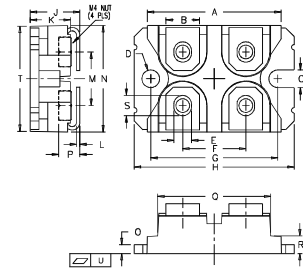
Advantages

- 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.
BV_{CES}	$I_C = 8 \text{ mA}$, $V_{GE} = 0 \text{ V}$	1200		V
$V_{GE(th)}$	$I_C = 8 \text{ mA}$, $V_{CE} = V_{GE}$	4		V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			1 mA 16 mA
I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$			$\pm 200 \text{ nA}$
$V_{CE(sat)}$	$I_C = I_{C90}$, $V_{GE} = 15 \text{ V}$			4 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 $d \leq 2\%$	32	45	S
$I_{C(on)}$	$V_{CE} = 10\text{ V}$, $V_{GE} = 15\text{ V}$		340	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		8000	pF
C_{oes}			590	pF
C_{res}			90	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$		300	nC
Q_{ge}			80	nC
Q_{gc}			140	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		140	ns
t_{ri}			220	ns
$t_{d(off)}$			400	ns
t_{fi}			700	ns
E_{off}			18	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		140	ns
t_{ri}			250	ns
$t_{d(off)}$			600	ns
t_{fi}			900	ns
t_c			950	ns
E_{on}			6	mJ
E_{off}			25	mJ
R_{thJC}				0.25 K/W
R_{thCK}			0.05	K/W

miniBLOC, SOT-227 B



M4 screws (4x) supplied

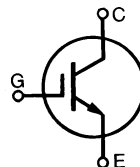
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	31.50	31.88	1.240	1.255
B	7.80	8.20	0.307	0.323
C	4.09	4.29	0.161	0.169
D	4.09	4.29	0.161	0.169
E	4.09	4.29	0.161	0.169
F	14.91	15.11	0.587	0.595
G	30.12	30.30	1.186	1.193
H	38.00	38.23	1.496	1.505
J	11.68	12.22	0.460	0.481
K	8.92	9.60	0.351	0.378
L	0.76	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

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 $d \leq 2\%$			2.55 V
I_{RM}	$I_F = I_{C90}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 480\text{ A}/\mu\text{s}$ $V_R = 540\text{ V}$ $I_F = 1\text{ A}$; $-di/dt = 200\text{ A}/\mu\text{s}$; $V_R = 30\text{ V}$		32	36 A
t_{rr}			300	ns
			40	ns
R_{thJC}				0.71 K/W

High Voltage, High speed IGBT

Short Circuit SOA Capability

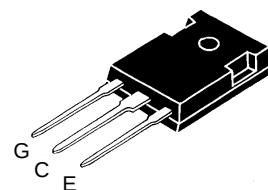
IXSH 35N140A
IXSH 35N135A



V_{CES}	I_{C25}	$V_{CE(sat)}$
1400 V	70 A	4 V
1350 V	70 A	4 V

Symbol	Test Conditions	Maximum Ratings		
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	35N140A	1400	V
		35N135A	1350	V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1\text{ M}\Omega$	35N140A	1400	V
		35N135A	1350	V
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}	$T_C = 25^\circ\text{C}, 1\text{ ms}$		140	A
SSOA (RBSOA)	$V_{GE} = 15\text{ V}, T_J = 125^\circ\text{C}, R_G = 22\text{ }\Omega$ Clamped inductive load, $L = 30\text{ }\mu\text{H}$		$I_{CM} = 70$ @ 960	A V
t_{SC} (SCSOA)	$V_{GE} = 15\text{ V}, V_{CE} = 840\text{ V}, T_J = 125^\circ\text{C}$ $R_G = 22\text{ }\Omega$, non repetitive		10	μs
P_C	$T_C = 25^\circ\text{C}$		300	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.
Weight			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



Features

- International standard package JEDEC TO-247
- High frequency IGBT with guaranteed Short Circuit SOA capability
- Fast Fall Time for switching speeds up to 20 kHz
- 2nd generation HDMOS™ process
- Low $V_{CE(sat)}$
 - for minimum on-state conduction losses
- MOS Gate turn-on
 - drive simplicity

Applications

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

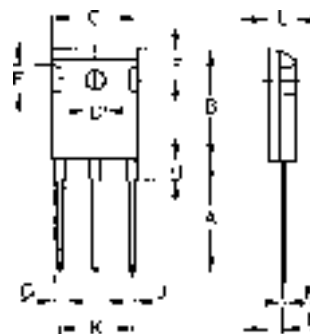
Advantages

- Easy to mount with 1 screw (isolated mounting screw hole)
- High power density

Symbol	Test Conditions	Characteristic Values (T _J = 25°C, unless otherwise specified)			
			min.	typ.	max.
BV _{CES}	I _C = 3 mA, V _{GE} = 0 V	35N140A 35N135A	1400 1350		V
V _{GE(th)}	I _C = 4 mA, V _{CE} = V _{GE}		5		8 V
I _{CES}	V _{CE} = 0.8 • V _{CES} V _{GE} = 0 V	T _J = 25°C T _J = 125°C			400 μA 2 mA
I _{GES}	V _{CE} = 0 V, V _{GE} = ±20 V				±100 nA
V _{CE(sat)}	I _C = I _{C90} , V _{GE} = 15 V			3.4	4 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 $d \leq 2\%$		26	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$, $V_{CE} = 10\text{ V}$		210	A
C_{ies}	$V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$		4150	pF
C_{oes}			235	pF
C_{res}			55	pF
Q_g	$I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5\text{ V}_{CES}$		165	nC
Q_{ge}			45	nC
Q_{gc}			75	nC
$t_{d(on)}$	Inductive load, $T_j = 25^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 960\text{ V}$, $R_G = 2.7\text{ }\Omega$ Switching times may increase for $V_{CE}(\text{Clamp}) > 960\text{ V}$, higher T_j or increased R_G		100	ns
t_{ri}			150	ns
$t_{d(off)}$			200	400 ns
t_{fi}			400	750 ns
E_{off}			12	mJ
$t_{d(on)}$			100	ns
t_{ri}	Inductive load, $T_j = 125^\circ\text{C}$ $I_C = I_{C90}$, $V_{GE} = 15\text{ V}$, $L = 100\text{ }\mu\text{H}$ $V_{CE} = 960\text{ V}$, $R_G = 2.7\text{ }\Omega$ Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 960\text{ V}$, higher T_j or increased R_G		150	ns
E_{on}			4	mJ
$t_{d(off)}$			200	ns
t_{fi}			800	ns
E_{off}			18	mJ
R_{thJC}				0.42 K/W
R_{thCK}			0.25	K/W

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