

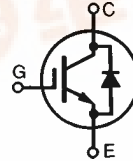


**Ultra-Low  $V_{CE(sat)}$   
IGBT with Diode**

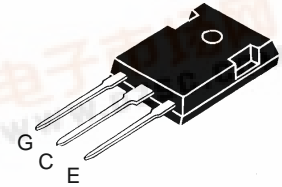
**IXGH 38N60U1**

$V_{CES} = 600\text{ V}$   
 $I_{C25} = 76\text{ A}$   
 $V_{CE(sat)} = 1.8\text{ V}$

**Combi Pack**



Symbol	Test Conditions	Maximum Ratings	TO-247 AD
$V_{CES}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$	600 V	
$V_{CGR}$	$T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GE} = 1\text{ M}\Omega$	600 V	
$V_{GES}$	Continuous	$\pm 20$ V	
$V_{GEM}$	Transient	$\pm 30$ V	
$I_{C25}$	$T_C = 25^\circ\text{C}$	76 A	
$I_{C90}$	$T_C = 90^\circ\text{C}$	38 A	
$I_{CM}$	$T_C = 25^\circ\text{C}$ , 1 ms	152 A	
<b>SSOA (RBSOA)</b>	$V_{GE} = 15\text{ V}$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 10\ \Omega$ Clamped inductive load, $L = 100\ \mu\text{H}$	$I_{CM} = 76$ @ $0.8 V_{CES}$	A
$P_C$	$T_C = 25^\circ\text{C}$	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 (M3)	1.13/10 Nm/lb.in.	
<b>Weight</b>		6 g	
	Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s	300 $^\circ\text{C}$	



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

**Features**

- International standard package JEDEC TO-247 AD
- IGBT and anti-parallel FRED in one package
- 2nd generation HDMOS™ process
- Low  $V_{CE(sat)}$  - for 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**

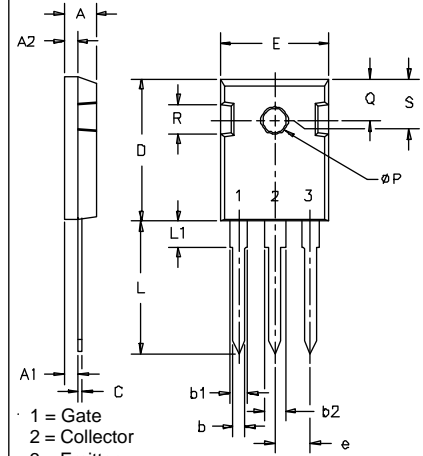
- Space savings (two devices in one package)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Reduces assembly time and cost
- High power density

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
$V_{GE(th)}$	$I_C = 250\ \mu\text{A}$ , $V_{CE} = V_{GE}$	2.5		5.5 V
$I_{CES}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0\text{ V}$		$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$	500 $\mu\text{A}$ 8 mA
$I_{GES}$	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 100$ nA
$V_{CE(sat)}$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$			1.8 V



Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$g_{fs}$	$I_C = I_{C90}$ ; $V_{CE} = 10\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $\leq 2\%$	15	20	S
$C_{ies}$	$V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$		2500	pF
$C_{oes}$			270	pF
$C_{res}$			70	pF
$Q_g$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$		125	150 nC
$Q_{ge}$			23	35 nC
$Q_{gc}$			50	75 nC
$t_{d(on)}$	<b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b>		30	ns
$t_{ri}$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$ , $V_{CE} = 0.8 V_{CES}$ , $R_G = R_{off} = 10\ \Omega$		150	ns
$t_{d(off)}$		Remarks: Switching times may increase for $V_{CE}$ (Clamp) $> 0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$	600	1200
$t_{fi}$		500	700	ns
$E_{off}$		9	15	mJ
$t_{d(on)}$	<b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b>		40	ns
$t_{ri}$	$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$ , $V_{CE} = 0.8 V_{CES}$ , $R_G = R_{off} = 10\ \Omega$		160	ns
$E_{on}$		Remarks: Switching times may increase for $V_{CE}$ (Clamp) $> 0.8 \cdot V_{CES}$ , higher $T_J$ or increased $R_G$	1	
$t_{d(off)}$		800		ns
$t_{fi}$		1000		ns
$E_{off}$		15		mJ
$R_{thJC}$				0.62 K/W
$R_{thCK}$		0.25		K/W

### TO-247 AD Outline



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

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

### Reverse Diode (FRED)

Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = I_{C90}$ , $V_{GE} = 0\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $d \leq 2\%$			1.6 V
$I_{RM}$	$I_F = I_{C90}$ , $V_{GE} = 0\text{ V}$ , $-di_F/dt = 240\text{ A}/\mu\text{s}$ $V_R = 360\text{ V}$ , $T_J = 125^\circ\text{C}$ $I_F = 1\text{ A}$ ; $-di/dt = 100\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ , $T_J = 25^\circ\text{C}$		10	15 A
$t_{rr}$			150	ns
			35	50 ns
$R_{thJC}$				1 K/W