

**MSAGX60F60A**  
**MSAHX60F60A**

**Features**

- Rugged polysilicon gate cell structure
- high current handling capability, latch-proof
- Hermetically sealed, surface mount power package
- Low package inductance
- Very low thermal resistance
- Reverse polarity available upon request: MSAH(G)60F60B
- high frequency IGBT, low switching losses
- anti-parallel FREDiode (MSAHX60F60A only)

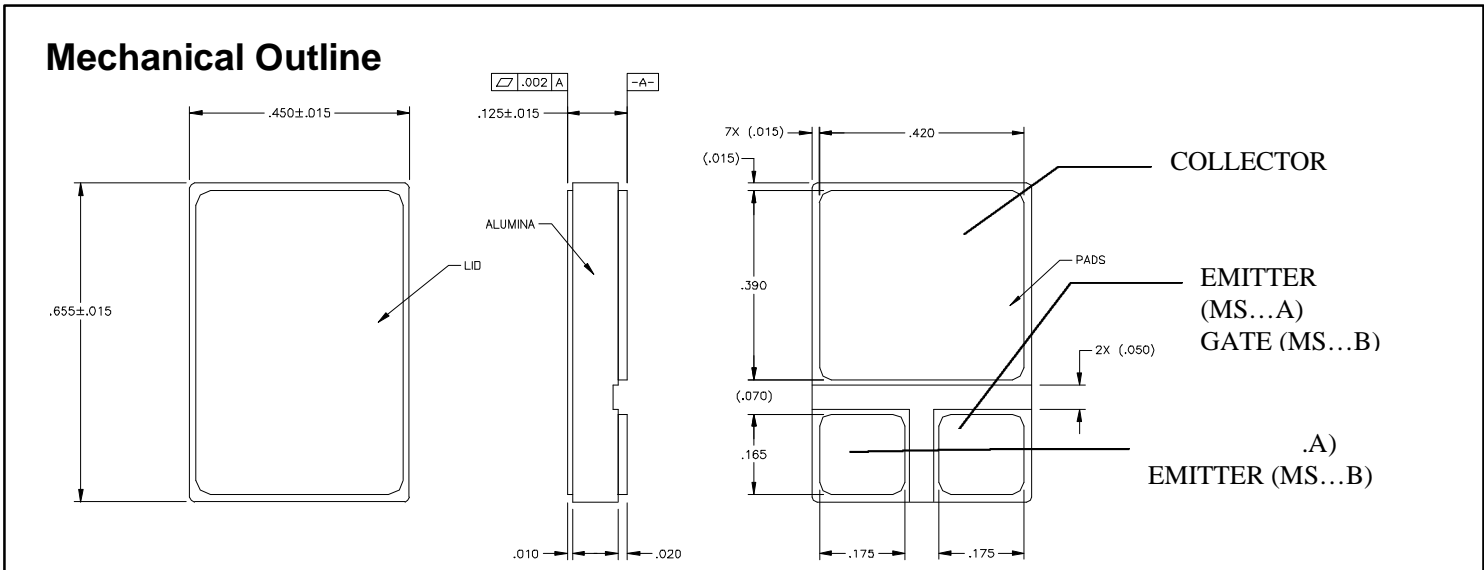
**600 Volts**  
**60 Amps**  
**2.9 Volts vce(sat)**

**N-CHANNEL**  
**INSULATED GATE**  
**BIPOLAR TRANSISTOR**

**Maximum Ratings @ 25°C (unless otherwise specified)**

DESCRIPTION	SYMBOL	MAX.	UNIT
Collector-to-Emitter Breakdown Voltage (Gate Shorted to Emitter) @ $T_J \geq 25^\circ\text{C}$	$BV_{CES}$	600	Volts
Collector-to-Gate Breakdown Voltage @ $T_J \geq 25^\circ\text{C}$ , $R_{GS} = 1\text{ M}\Omega$	$BV_{CGR}$	600	Volts
Continuous Gate-to-Emitter Voltage	$V_{GES}$	+/-20	Volts
Transient Gate-to-Emitter Voltage	$V_{GEM}$	+/-30	Volts
Continuous Collector Current $T_J = 25^\circ\text{C}$	$I_{C25}$	60	Amps
$90^\circ\text{C}$	$I_{C90}$	32	
Peak Collector Current, pulse width limited by $T_{jmax}$	$I_{CM}$	120	Amps
Safe Operating Area (RBSOA) @ $V_{GE} = 15\text{V}$ , $L = 100\mu\text{H}$ (clamped inductive load), $R_G = 4.7\Omega$ , $T_J = 125^\circ\text{C}$ , $V_{CE} = 0.8 \times V_{CES}$	$I_{max}$	64	Amps
Power Dissipation	$P_D$	300	Watts
Junction Temperature Range	$T_J$	-55 to +150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Continuous Source Current (Body Diode, MSAHX60F60A only)	$I_S$	32	Amps
Pulse Source Current (Body Diode, MSAHX60F60A only)	$I_{SM}$	100	Amps
Thermal Resistance, Junction to Case	$\theta_{JC}$	0.4	$^\circ\text{C/W}$

**Mechanical Outline**



# MSAGX60F60A MSAHX60F60A

## Electrical Parameters @ 25°C (unless otherwise specified)

DESCRIPTION	SYMBOL	CONDITIONS	MIN	TYP.	MAX	UNIT
Collector-to-Emitter Breakdown Voltage (Gate Shorted to Emitter)	$BV_{CES}$	$V_{GS} = 0\text{ V}, I_C = 250\ \mu\text{A}$	600			V
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$	2.5		5.0	V
Gate-to-Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 20V_{DC}, V_{CE} = 0$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			$\pm 100$ $\pm 200$	nA
Collector-to-Emitter Leakage Current (Zero Gate Voltage Collector Current)	$I_{CES}$	$V_{CE} = 0.8 \cdot BV_{CES}$ $V_{GE} = 0\text{ V}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			200 1000	$\mu\text{A}$
Collector-to-Emitter Saturation Voltage (1)	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $I_C = 60\text{ A}$ $I_C = 30\text{ A}$ $T_J = 25^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$		2.2 3.5 2.2	2.9	V
Forward Transconductance (1)	$g_{fs}$	$V_{CE} \geq 10\text{ V}; I_C = 30\text{ A}$	15	20		S
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1\text{ MHz}$		2500		$\mu\text{F}$
Output Capacitance	$C_{oes}$			230		
Reverse Transfer Capacitance	$C_{res}$			70		
<b>INDUCTIVE LOAD, <math>T_J = 25^\circ\text{C}</math></b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{GE} = 15\text{ V}, V_{CE} = 480\text{ V},$ $I_C = 30\text{ A}, R_G = 4.7\ \Omega,$ $L = 100\ \mu\text{H}$ note 2, 3		25		ns
Rise Time	$t_{ri}$			30		ns
Turn-off Delay Time	$t_{d(off)}$			175		ns
Fall Time	$t_{fi}$			125	175	ns
Off Energy	$E_{off}$			1.3		mJ
<b>INDUCTIVE LOAD, <math>T_J = 125^\circ\text{C}</math></b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{GE} = 15\text{ V}, V_{CE} = 480\text{ V},$ $I_C = 30\text{ A}, R_G = 4.7\ \Omega,$ $L = 100\ \mu\text{H}$ note 2, 3		25		ns
Rise Time	$t_{ri}$			35		ns
On Energy	$E_{on}$			1		mJ
Turn-off Delay Time	$t_{d(off)}$			250		ns
Fall Time	$t_{fi}$			260		ns
Off Energy	$E_{off}$		4		mJ	
Total Gate Charge	$Q_g$	$V_{GE} = 15\text{ V}, V_{CE} = 300\text{ V}, I_C = 30\text{ A}$		125	150	nC
Gate-to-Emitter Charge	$Q_{ge}$			23	35	
Gate-to-Collector (Miller) Charge	$Q_{gc}$			50	75	
Antiparallel diode forward voltage (MSAHX60F60A only)	$V_F$	$I_E = 15\text{ A}$ $I_E = 15\text{ A}$ $I_E = 30\text{ A}$ $I_E = 50\text{ A}$ $T_J = 25^\circ\text{C}$ $T_J = 150^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $T_J = 25^\circ\text{C}$			1.5 1.3 1.7 1.9	V V V V
Antiparallel diode reverse recovery time (MSAHX60F60A only)	$t_{rr}$	$I_E = 10\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$ $I_E = 30\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$		140	100	ns ns
Antiparallel diode reverse recovery charge (MSAHX60F60A only)	$Q_{rr}$	$I_E = 10\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$ $I_E = 30\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$		160 320		nC nC
Antiparallel diode peak recovery current (MSAHX60F60A only)	$I_{RM}$	$I_E = 10\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$ $I_E = 30\text{ A}, dI_E/dt = 100\text{ A/us}, T_J = 25^\circ\text{C}$		3 4.2		A A

### Notes

- (1) Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle  $\delta \leq 2\%$
- (2) switching times and losses may increase for larger  $V_{CE}$  and/or  $R_G$  values or higher junction temperatures.
- (3) switching losses include "tail" losses
- (4) Microsemi Corp. does not manufacture the igbt die; contact company for details.