



# IGBT with Diode

# IXSN40N60AU1

High Short Circuit SOA Capability

$$I_C = 45 \text{ A}$$

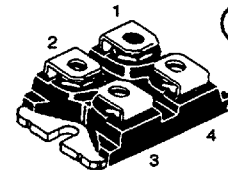
$$V_{CES} = 600 \text{ V}$$

$$V_{CE(sat)} = 3 \text{ V}$$



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	$\pm 20$	V
$V_{GEM}$	Transient	$\pm 30$	V
$I_{C25}$	$T_C = 25^\circ\text{C}$	45	A
$I_{C90}$	$T_C = 90^\circ\text{C}$	29	A
$I_{CM}$	$T_C = 25^\circ\text{C}$ , 1 ms	58	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	$\mu\text{s}$
RBSOA	$V_{GE} = 15 \text{ V}$ , $T_J = 125^\circ\text{C}$ , $R_G = 22 \Omega$ Clamped inductive load, $L = 30 \mu\text{H}$	$I_{CM} = 58$ @ $0.8 V_{CES}$	A
$P_C$	$T_C = 25^\circ\text{C}$	205	W
$T_J$		-40 ... +150	$^\circ\text{C}$
$T_{JM}$		150	$^\circ\text{C}$
$T_{stg}$		-40 ... +150	$^\circ\text{C}$
$V_{ISOL}$	50/60 Hz $I_{ISOL} = 1 \text{ mA}$	$t = 1 \text{ min}$ $t = 1 \text{ s}$	2500 V~ 3000 V~
$M_d$	Mounting torque (M4) Terminal connection torque (M4)	1.5/13 Nm/lb.in. 1.5/13 Nm/lb.in.	
Weight		30	g

miniBLOC, SOT-227 B



UL E72873 (M)

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

### Features

- International standard package miniBLOC (ISOTOP compatible)
- Isolation voltage 2500 V (RMS)
- 2<sup>nd</sup> generation HDMOS<sup>TM</sup> process
  - for high short circuit SOA
- Fast current fall time
  - for minimum switching losses at high frequency
- MOS Gate turn-on
  - drive simplicity
- Fast Recovery Epitaxial Diode (FRED)
  - short  $t_n$  and low  $I_{RM}$
- Low collector-to-case capacitance (< 45 pF)
  - reduced RFI
- Low package inductance (< 5 nH)
  - easy to drive and to protect

### Applications

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

### Advantages

- Easy to mount
- Space savings
- High power density

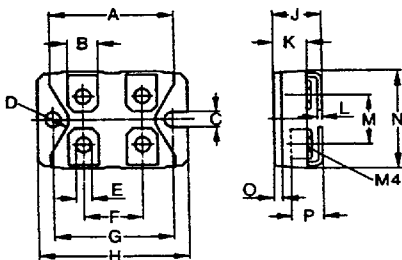
Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$BV_{CES}$	$I_C = 6 \text{ mA}$ , $V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 10 \text{ mA}$ , $V_{CE} = V_{GE}$	5		8 V
$I_{CES}$	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$		$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$	750 $\mu\text{A}$ 15 mA
$I_{GES}$	$V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$			$\pm 500 \text{ nA}$

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Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_{CE(sat)}$	$I_C = I_{C90}, V_{GE} = 15\text{ V}$			3 V
$g_{fs}$	$I_C = I_{C90}, V_{CE} = 20\text{ V}$ , Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $\delta \leq 2\%$	10	20	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$		340	A
$C_{les}$	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		4.5	nF
$C_{oss}$			0.5	nF
$C_{res}$			0.09	nF
$Q_g$	$I_C = I_{C90}, V_{GE} = 15\text{ V}, V_{CE} = 0.5 \cdot V_{CES}$		200	nC
$Q_{ge}$			45	nC
$Q_{gc}$			90	nC
$t_{d(on)}$	Inductive load, $T_J = 125^\circ\text{C}$		55	ns
$t_{ri}$	$I_C = I_{C90}, V_{GE} = 15\text{ V}$		170	ns
$t_{d(off)}$	$V_{CE} = 0.6 \cdot V_{CES}, R_{on} = 6.8\ \Omega, R_{off} = 22\ \Omega$		340	ns
$t_{st}$	Remarks: Switching times may increase for $V_{CE}(\text{Clamp}) > 0.6 \cdot V_{CES}, T_J > 125^\circ\text{C}$ or increased $R_g$		340	ns
$E_{on}$			3.5	mJ
$E_{off}$			4.5	mJ
$R_{thJC}$				0.61 K/W
$R_{thCK}$				0.05 K/W

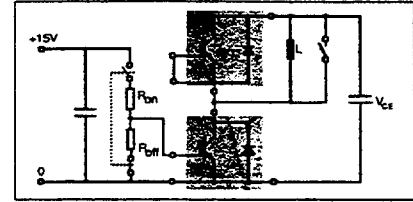
Symbol	Test Conditions	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$V_F$	$I_F = I_{C90}, V_{GE} = 0\text{ V}$ Pulse test, $t \leq 300\ \mu\text{s}$ , duty cycle $\delta \leq 2\%$			2.3 V
$I_{RM}$	$I_F = I_{C90}, V_{GE} = 0\text{ V}, -di/dt = 100\text{ A}/\mu\text{s}$			33 A
$t_{rr}$	$T_J = 125^\circ\text{C}, V_R = 360\text{ V}$		150	ns
$R_{thJC}$				0.7 K/W

### Dimensions

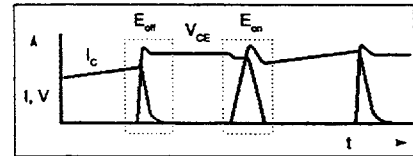


M4 screws (4x) supplied

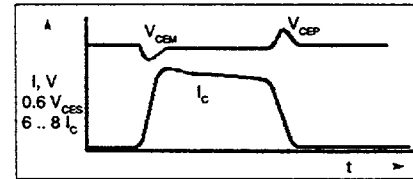
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	31.5	31.7	1.241	1.249
B	7.8	8.2	0.307	0.323
C	4.0	-	0.158	-
D	4.1	4.3	0.162	0.169
E	4.1	4.3	0.162	0.169
F	14.9	15.1	0.587	0.595
G	30.1	30.3	1.186	1.193
H	38.0	38.2	1.497	1.505
J	11.8	12.2	0.465	0.481
K	8.9	9.1	0.351	0.359
L	0.75	0.85	0.030	0.033
M	12.6	12.8	0.496	0.504
N	25.2	25.4	0.993	1.001
O	1.95	2.05	0.077	0.081
P	-	5.0	-	0.197



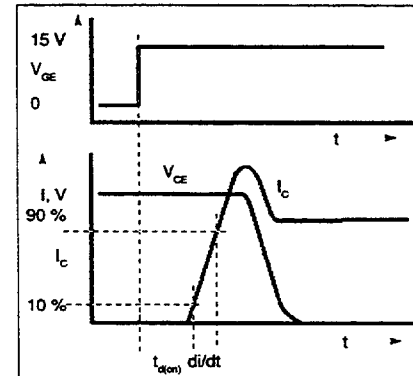
Test circuit for  $E_{on}, E_{off}$  SCSOA and RBSOA  
 $R_{on} = 6.8\ \Omega$   $L > 100\ \mu\text{H}$   
 $R_{off} = 22\ \Omega$  for RBSOA,  $E_{off}$



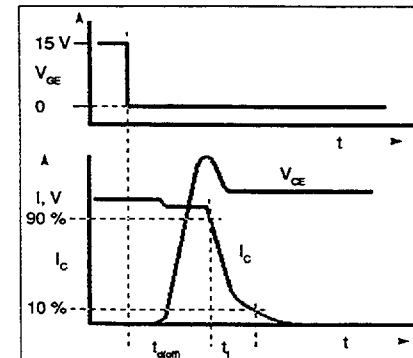
Typical V/I waveforms for inductive load



SCSOA conditions  $V_{CE} = 0.6 V_{CES}$   
 $V_{CEM} = 0.5 V_{CES}, V_{CEP} < V_{CES}, T_J = 125^\circ\text{C}$



Turn-on waveforms  $E_{on}$



Turn-off waveforms  $E_{off}$  RBSOA

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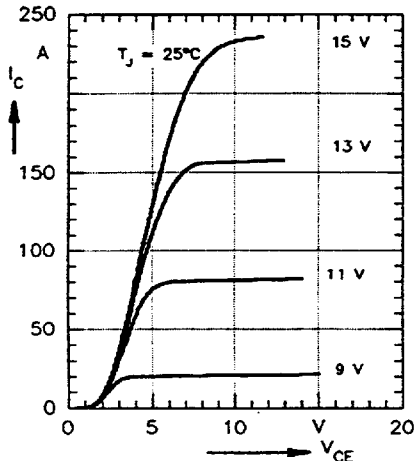


Fig. 1 Typ. output characteristics

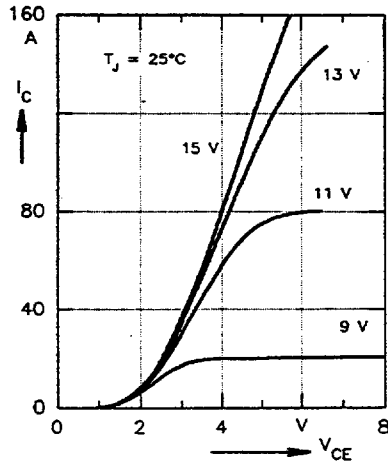


Fig. 2 Typ. output characteristics

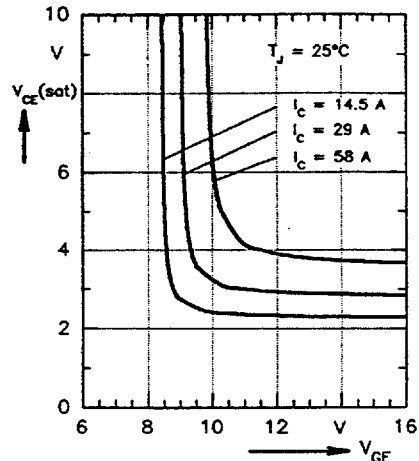


Fig. 3 Typ. on-state characteristics

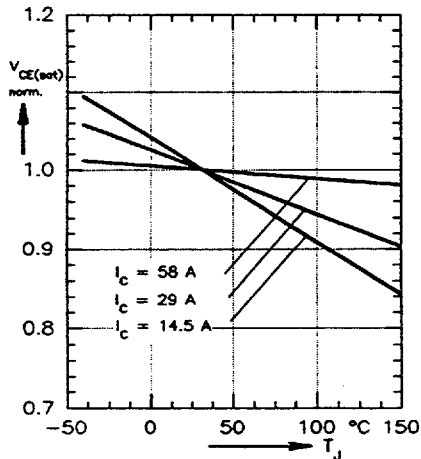


Fig. 4 Typ. temperature dependence of  $V_{CE(sat)}$

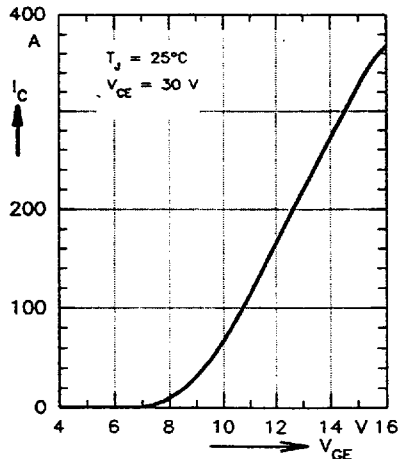


Fig. 5 Typ. transfer characteristics

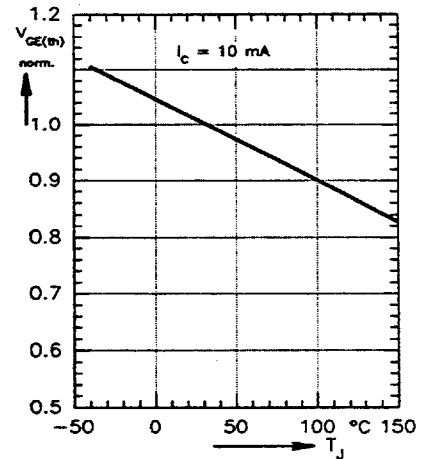


Fig. 6 Typ. temperature dependence of normalized  $V_{GE(th)}$

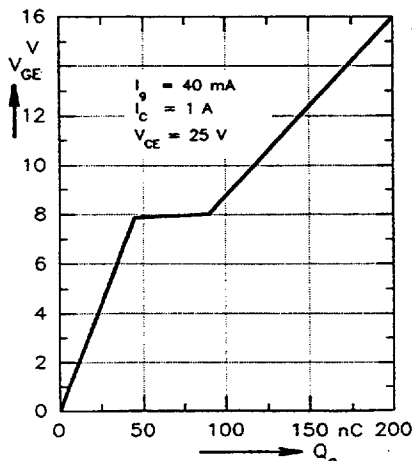


Fig. 7 Typ. turn-on gate charge characteristics,  $V_{GE} = f(Q_g)$

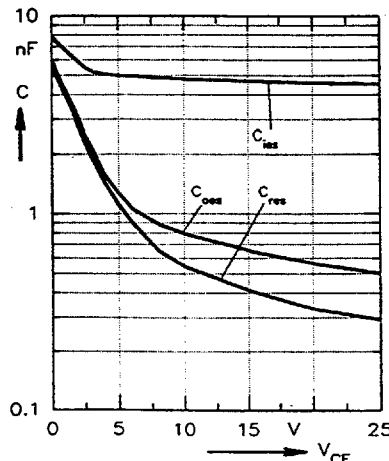


Fig. 8 Typ. capacitances

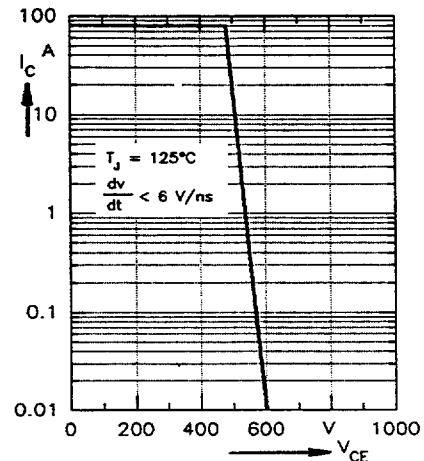


Fig. 9 Reverse biased safe operating area

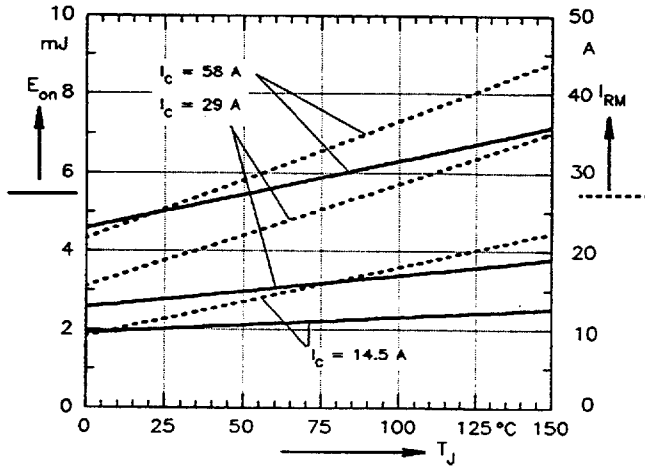


Fig. 10 Typ. turn-on energy per pulse

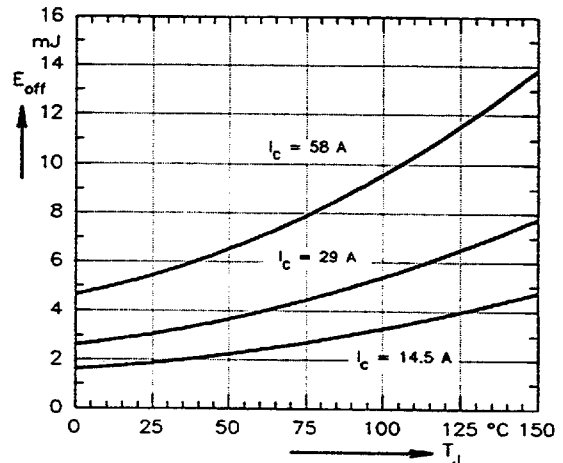


Fig. 11 Typ. turn-off energy per pulse

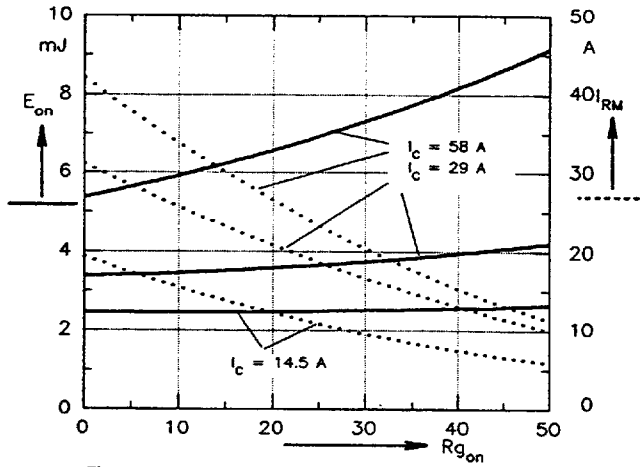


Fig. 12 Typ. turn-on energy per pulse

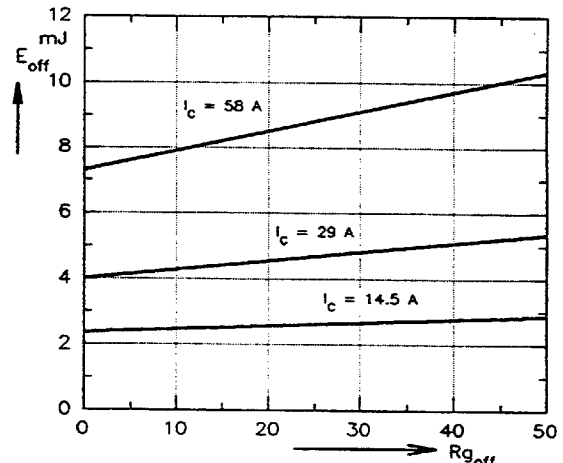


Fig. 13 Typ. turn-off energy per pulse

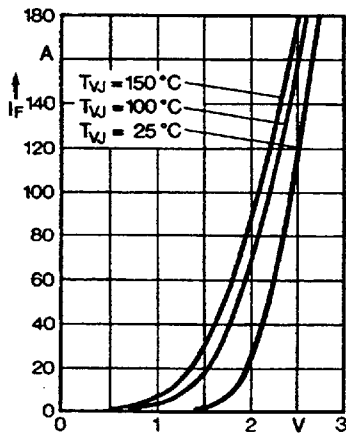


Fig. 15 Forward characteristic of reverse diode

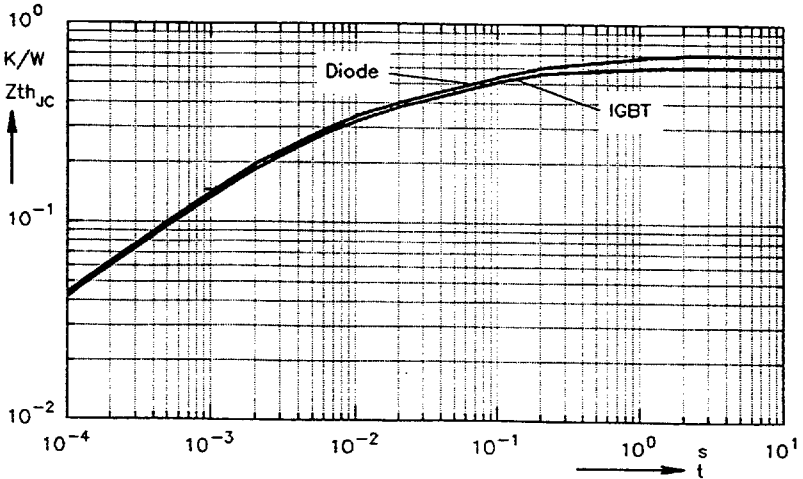


Fig. 15 Transient thermal resistance junction to case of IGBT and Diode