



IGBT with Diode

IXSN40N60AU1

High Short Circuit SOA Capability

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

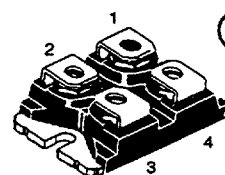
$$V_{CES} = 600 \text{ V}$$

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



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	± 20	V
V_{GEM}	Transient	± 30	V
I_{C25}	$T_C = 25^\circ\text{C}$	45	A
I_{C90}	$T_C = 90^\circ\text{C}$	29	A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	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	μs
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 3000 V~ V~
M_d	Mounting torque (M4) Terminal connection torque (M4)	1.5/13 1.5/13	Nm/lb.in. 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)
- 2nd generation HDMOSTM 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

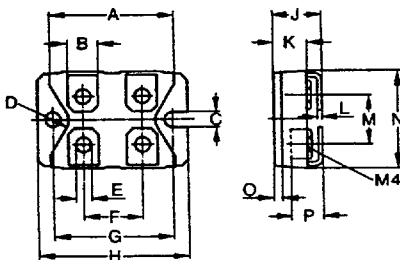
Symbol	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
BV_{CES}	$I_C = 6 \text{ mA}, V_{GE} = 0 \text{ V}$	600		V
$V_{GE(th)}$	$I_C = 10 \text{ mA}, V_{CE} = V_{GE}$	5		8 V
I_{CES}	$V_{CE} = 0.8 \cdot V_{CES}$ $V_{GE} = 0 \text{ V}$			$T_J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

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, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\delta \leq 2\%$	10	20	S
$I_{C(on)}$	$V_{GE} = 15\text{ V}$		340	A
C_{ies}	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$		4.5	nF
C_{oes}			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
$t_{d(off)}$	$V_{CE} = 0.6 \cdot V_{CES}, R_{on} = 6.8\text{ }\Omega, R_{off} = 22\text{ }\Omega$		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

Reverse Diode (FRED)

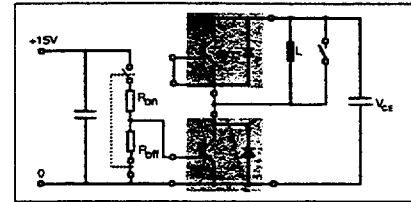
	Test Conditions	Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified)		
		min.	typ.	max.
V_F	$I_F = I_{C90}, V_{GE} = 0\text{ V}$ Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle $\delta \leq 2\%$			2.3 V
I_{RM}	$I_F = I_{C90}, V_{GE} = 0\text{ V}, -di_F/dt = 100\text{ A}/\mu\text{s}$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

Dimensions

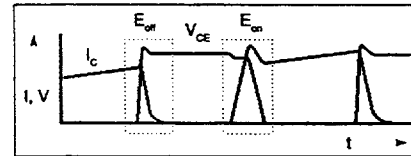


M4 screws (4x) supplied

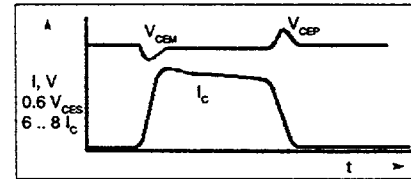
Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	31.5	31.7	1.241	1.249
B	7.8	8.2	0.307	0.323
C	4.0	-	0.158	-
D	4.1	4.3	0.162	0.169
E	4.1	4.3	0.162	0.169
F	14.9	15.1	0.587	0.595
G	30.1	30.3	1.186	1.193
H	38.0	38.2	1.497	1.505
J	11.8	12.2	0.465	0.481
K	8.9	9.1	0.351	0.359
L	0.75	0.85	0.030	0.033
M	12.6	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



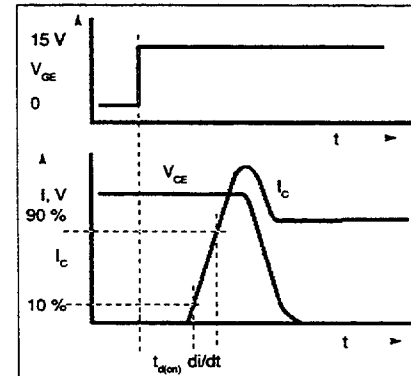
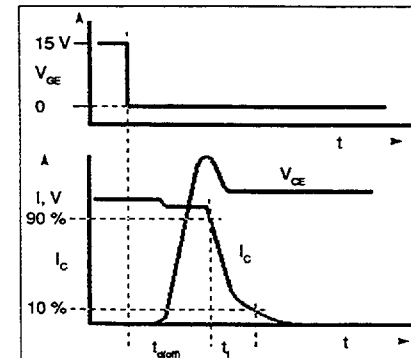
Test circuit for E_{on} , E_{off} , SCSOA and RBSOA
 $R_{on} = 6.8\text{ }\Omega$, $L > 100\text{ }\mu\text{H}$
 $R_{off} = 22\text{ }\Omega$ for RBSOA, E_{off}



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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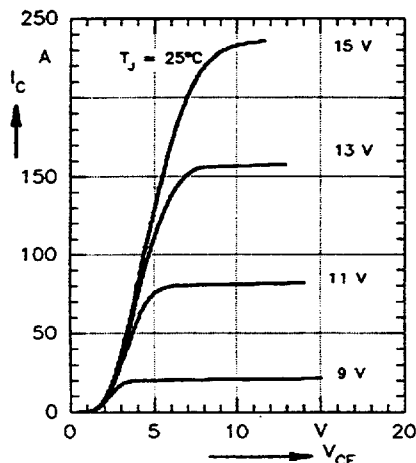


Fig. 1 Typ. output characteristics

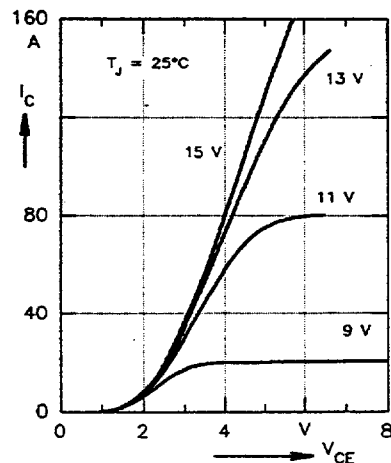


Fig. 2 Typ. output characteristics

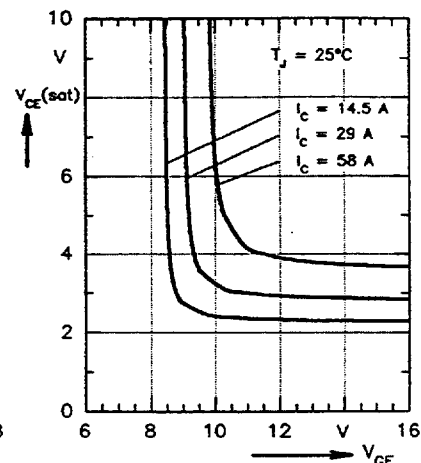


Fig. 3 Typ. on-state characteristics

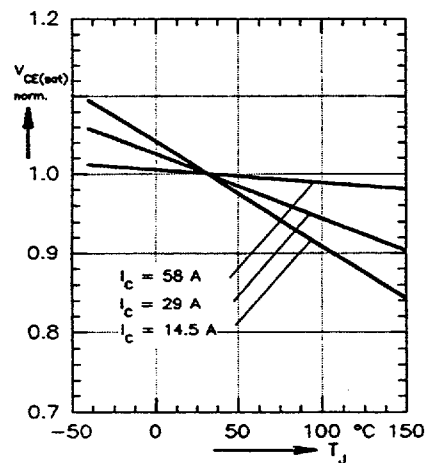
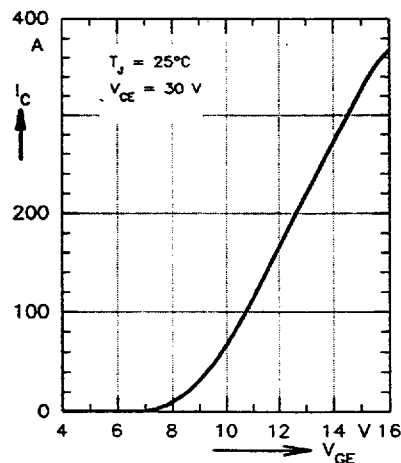

Fig. 4 Typ. temperature dependence of $V_{CE(sat)}$


Fig. 5 Typ. transfer characteristics

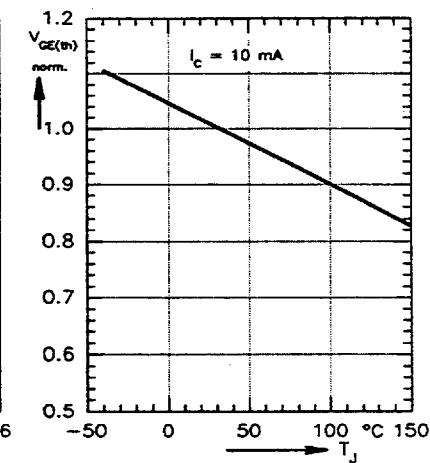
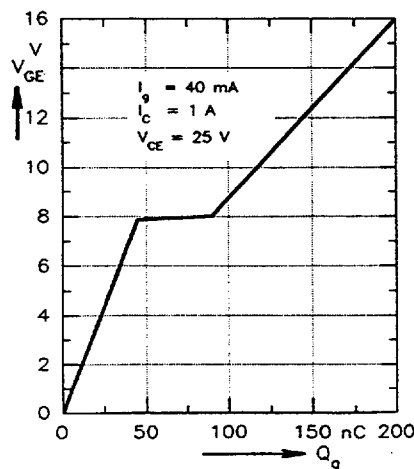
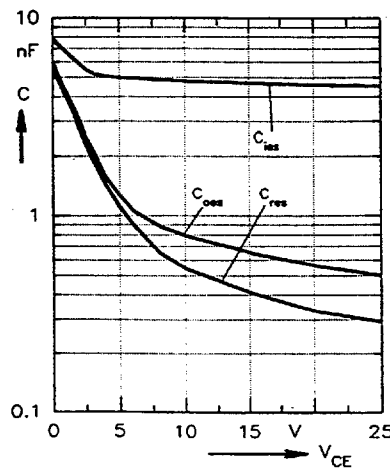

Fig. 6 Typ. temperature dependence of normalized $V_{GE(th)}$

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


Fig. 8 Typ. capacitances

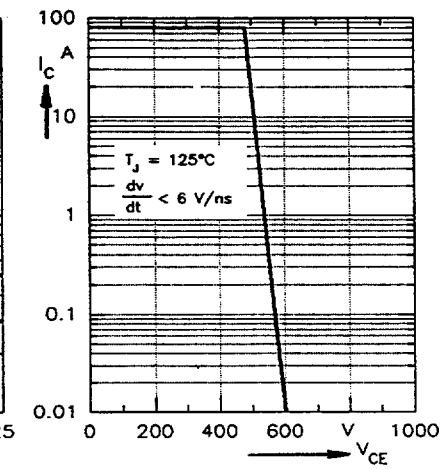


Fig. 9 Reverse biased safe operating area

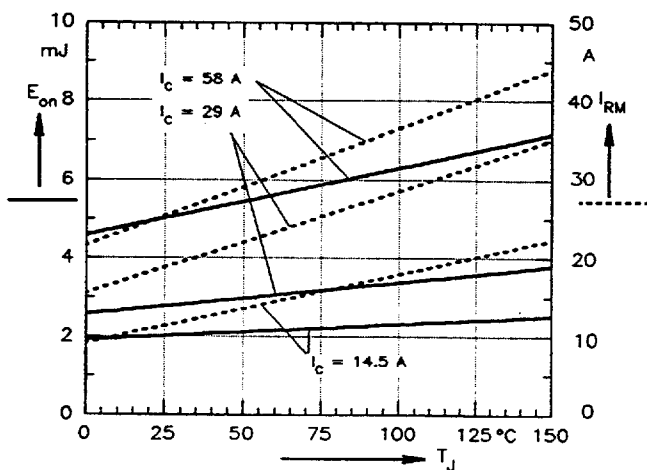


Fig. 10 Typ. turn-on energy per pulse

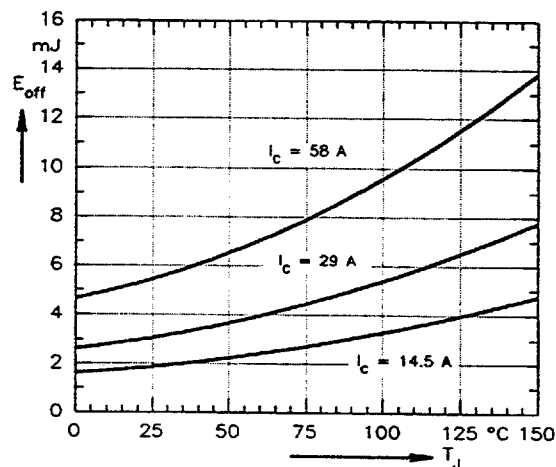


Fig. 11 Typ. turn-off energy per pulse

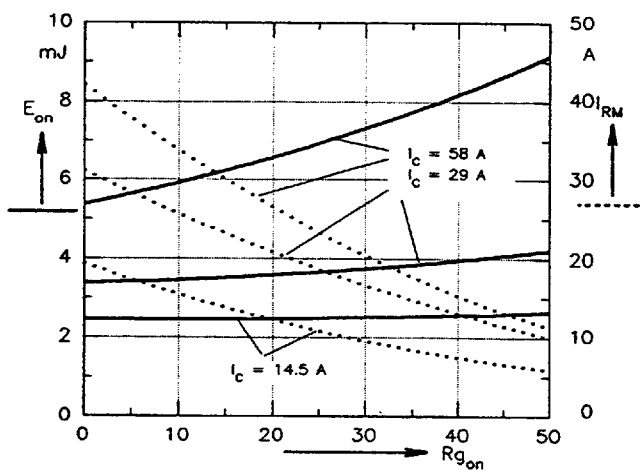


Fig. 12 Typ. turn-on energy per pulse

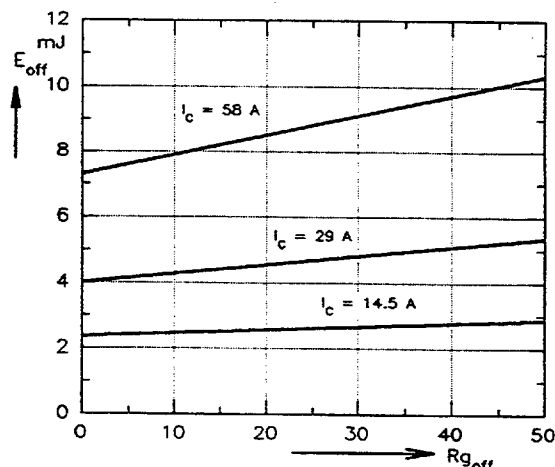


Fig. 13 Typ. turn-off energy per pulse

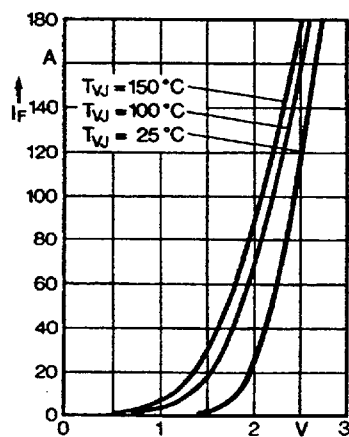


Fig. 15 Forward characteristic of reverse diode

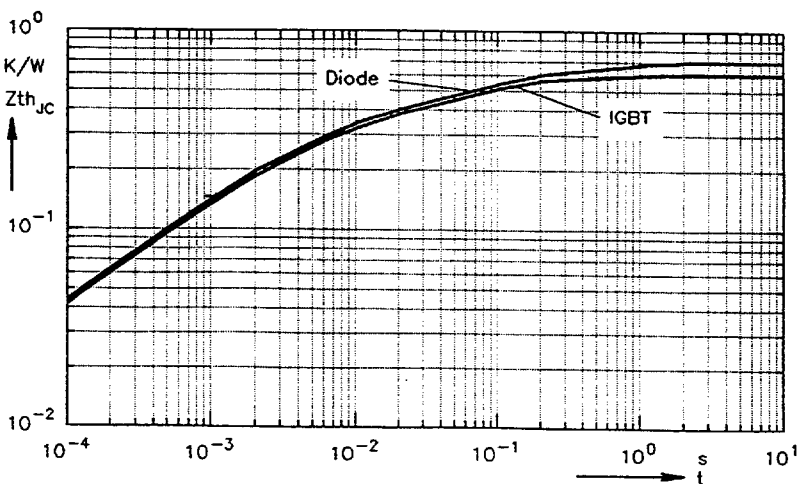


Fig. 15 Transient thermal resistance junction to case of IGBT and Diode