

**S23DF SERIES**  
**1200-1000 VOLTS RANGE**  
**STANDARD TURN-OFF TIME 16  $\mu$ s**  
**210 AMP RMS, RING AMPLIFYING GATE**  
**INVERTER TYPE STUD MOUNTED SCRs**

**VOLTAGE RATINGS**

VOLTAGE CODE (1)	$V_{RRM}, V_{DRM}$ - (V) Max. rep. peak reverse and off-state voltage	$V_{RSM}$ - (V) Max. non-rep. peak reverse voltage $t_p \leq 5ms$	NOTES
	$T_J = -40^\circ$ to $125^\circ C$	$T_J = 25^\circ$ to $125^\circ C$	
12	1200	1300	Gate open
10	1000	1100	

**MAXIMUM ALLOWABLE RATINGS**

PARAMETER	VALUE	UNITS	NOTES
$T_J$ Junction temperature	-40 to 125	$^\circ C$	
$T_{stg}$ Storage temperature	-40 to 150	$^\circ C$	
$I_T(AV)$ Max. av. current	135	A	180 $^\circ$ half sine wave
@ Max. $T_C$	85	$^\circ C$	
$I_T(RMS)$ Max. RMS current	210	A	
$I_{TSM}$ Max. peak non-repetitive surge current	3800	A	50Hz half cycle sine wave Initial $T_J = 125^\circ C$ , rated $V_{RRM}$ applied after surge.
	4000		60Hz half cycle sine wave
	4550		50Hz half cycle sine wave Initial $T_J = 125^\circ C$ , no voltage applied after surge.
	4750		60Hz half cycle sine wave
$I^2 t$ Max. $I^2 t$ capability	73	$kA^2 s$	$t = 10ms$ Initial $T_J = 125^\circ C$ , rated $V_{RRM}$ applied after surge.
	67		$t = 8.3ms$
	105		$t = 10ms$ Initial $T_J = 125^\circ C$ , no voltage applied after surge.
	95		$t = 8.3ms$
$I^2 \sqrt{t}$ Max. $I^2 \sqrt{t}$ capability	1050	$kA^2 / s$	Initial $T_J = 125^\circ C$ , no voltage applied after surge. $I^2 t$ for time $t_x = I^2 \sqrt{t} \cdot \sqrt{t_x}$ , $0.1 \leq t_x \leq 10ms$ .
$di/dt$ Max. non-repetitive rate-of-rise of current	800	A/ $\mu s$	$T_J = 125^\circ C$ , $V_D = V_{DRM}$ , $I_{TM} = 1600A$ . Gate pulse: 20V, 20 $\mu s$ , 10Hz, 0.5 $\mu s$ rise time. Max. repetitive $di/dt$ is approximately 40% of non-repetitive value.
$P_{GM}$ Max. peak gate power	10	W	$t_p \leq 5ms$
$P_G(AV)$ Max. av. gate power	2	W	
$+I_{GM}$ Max. peak gate current	3	A	$t_p \leq 5ms$
$-V_{GM}$ Max. peak negative gate voltage	15	V	
T Mounting torque	$31(275) \pm 10\%$	N*m	Non-lubricated threads
	$24.5(210) \pm 10\%$	(lbf-in)	Lubricated threads

(1) To complete the part number, refer to the Ordering Information table.

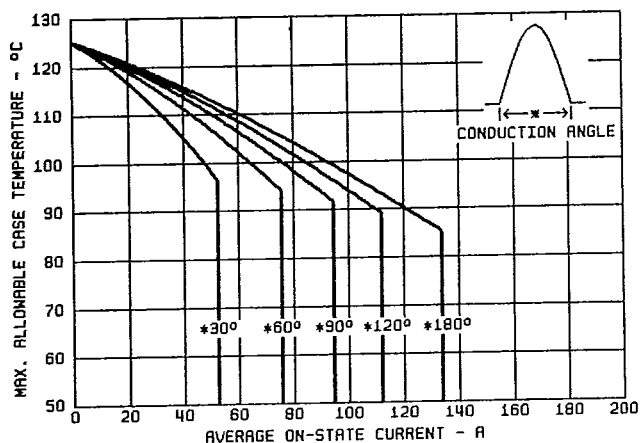


## S23DF SERIES 1200-1000 VOLTS RANGE

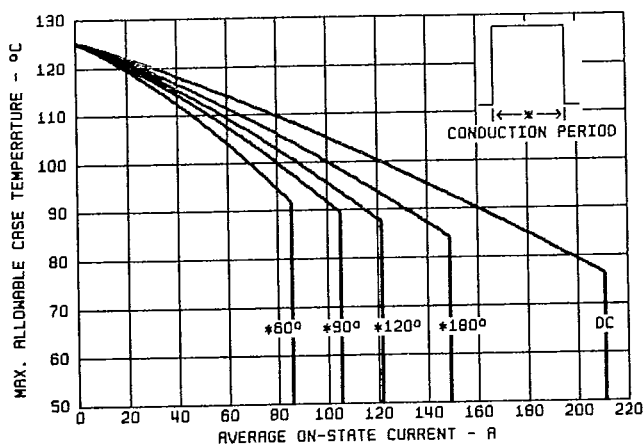
### CHARACTERISTICS

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
$V_{TH}$ Peak on-state voltage	—	1.80	1.97	V	Initial $T_J = 25^\circ\text{C}$ , 50-60Hz half sine, $I_{peak} = 425\text{A}$ .
$V_{T(TO)1}$ Low-level threshold	—	—	1.26	V	$T_J = 125^\circ\text{C}$ Av. power = $V_{T(TO)} \cdot I_{T(AV)} + r_T \cdot [I_{T(RMS)}]^2$ Use low level values for $I_{TH} \leq \pi$ rated $I_{T(AV)}$
$V_{T(TO)2}$ High-level threshold	—	—	1.58		
$r_{T1}$ Low-level resistance	—	—	1.73	m $\Omega$	
$r_{T2}$ High-level resistance	—	—	1.06		
$I_L$ Latching current	—	270	—	mA	$T_C = 25^\circ\text{C}$ , 12V anode. Gate pulse: 10V, 20 $\Omega$ , 100 $\mu\text{s}$ .
$I_H$ Holding current	—	80	500	mA	$T_C = 25^\circ\text{C}$ , 12V anode. Initial $I_T = 5\text{A}$ .
$t_d$ Delay time	—	0.5	1.5	$\mu\text{s}$	$T_C = 25^\circ\text{C}$ , $V_D = \text{rated } V_{DRM}$ , 50A resistive load. Gate pulse: 10V, 20 $\Omega$ , 10 $\mu\text{s}$ , 1 $\mu\text{s}$ rise time.
$t_q$ Turn-off time	"A" suffix	—	16	$\mu\text{s}$	$T_J = 125^\circ\text{C}$ . $I_{TH} = 300\text{A}$ , $di_R/dt = 15\text{A}/\mu\text{s}$ , $V_R = 50\text{V}$ , $dv/dt = 200\text{V}/\mu\text{s}$ lin. to 80% rated $V_{DRM}$ . Gate: 0V, 100 $\Omega$ .
	"B" suffix	—	20		
$t_{q(\text{diode})}$ Turn-off time with feedback diode	"A" suffix	—	20	$\mu\text{s}$	$T_J = 125^\circ\text{C}$ . $I_{TH} = 300\text{A}$ , $di_R/dt = 15\text{A}/\mu\text{s}$ , $V_R = 1\text{V}$ , $dv/dt = 600\text{V}/\mu\text{s}$ lin. to 40% rated $V_{DRM}$ . Gate: 0V, 100 $\Omega$ .
	"B" suffix	—	25		
$I_{RM(REC)}$ Recovery current	—	62	—	A	$T_J = 125^\circ\text{C}$ , $I_{TH} = 500\text{A}$ , $di_R/dt = 50\text{A}/\mu\text{s}$ .
$Q_{RR}$ Recovered charge	—	68	—	$\mu\text{C}$	
$dv/dt$ Critical rate-of-rise of off-state voltage	500	700	—	V/ $\mu\text{s}$	$T_J = 125^\circ\text{C}$ . Exp. to 100% or lin. Higher $dv/dt$ values to 80% $V_{DRM}$ , gate open, available.
	1000	—	—		$T_J = 125^\circ\text{C}$ . Exp. to 67% $V_{DRM}$ , gate open.
$I_{RM}$ , $I_{DM}$ Peak reverse and off-state current	—	15	30	mA	$T_J = 125^\circ\text{C}$ . Rated $V_{RM}$ and $V_{DM}$ , gate open.
$I_{GT}$ DC gate current to trigger	—	—	300	mA	$T_C = -40^\circ\text{C}$ +12V anode-to-cathode. For recommended gate drive see "Gate Characteristics" figure.
	40	60	150		$T_C = 25^\circ\text{C}$
$V_{GT}$ DC gate voltage to trigger	—	—	3.3	V	$T_C = -40^\circ\text{C}$
	—	1.2	2.5		$T_C = 25^\circ\text{C}$
$V_{GD}$ DC gate voltage not to trigger	—	—	0.3	V	$T_C = 125^\circ\text{C}$ . Max. value which will not trigger with rated $V_{DRM}$ anode-to-cathode.
$R_{thJC}$ Thermal resistance, junction-to-case	—	—	0.140	$^\circ\text{C}/\text{W}$	DC operation
	—	—	0.159	$^\circ\text{C}/\text{W}$	180 $^\circ$ sine wave
	—	—	0.164	$^\circ\text{C}/\text{W}$	120 $^\circ$ rectangular wave
$R_{thCS}$ Thermal resistance, case-to-sink	—	—	0.080	$^\circ\text{C}/\text{W}$	Mtg. surface smooth, flat and greased.
wt Weight	—	227(8)	—	g(oz.)	
Case Style	TO-209AB (TO-93)			JEDEC	

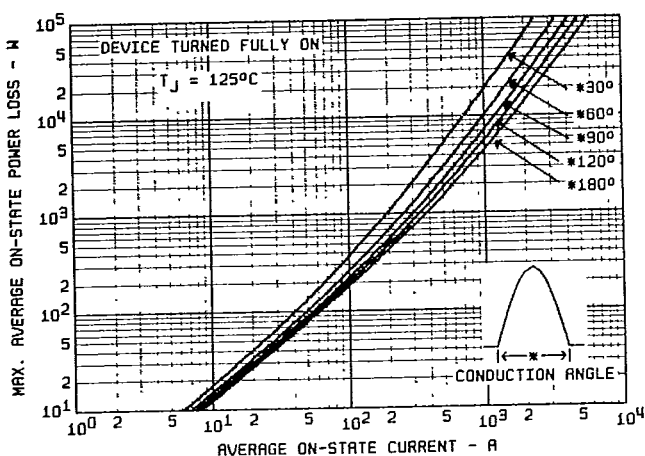
### S23DF SERIES 1200-1000 VOLTS RANGE



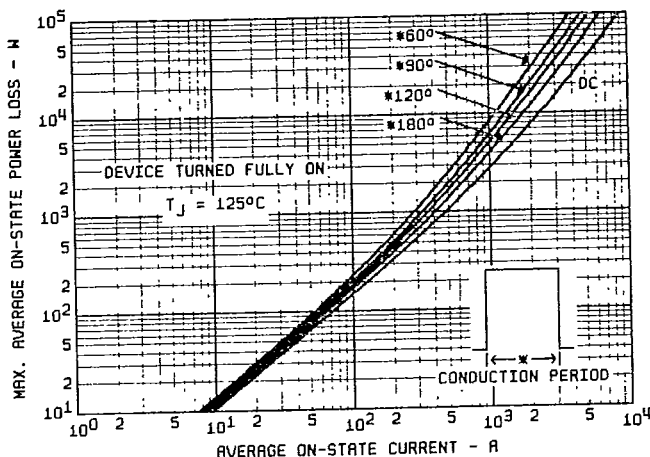
**Fig. 1 — Case Temperature Ratings  
— Sinusoidal Waveforms, 50 to 400 Hz**



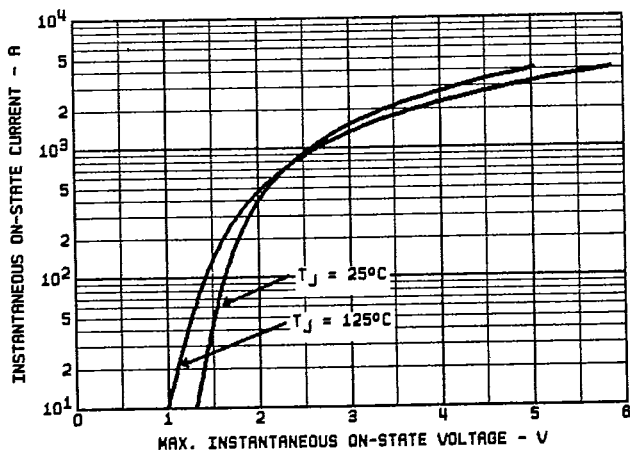
**Fig. 2 — Case Temperature Ratings  
— Rectangular Waveforms, 50 to 400 Hz**



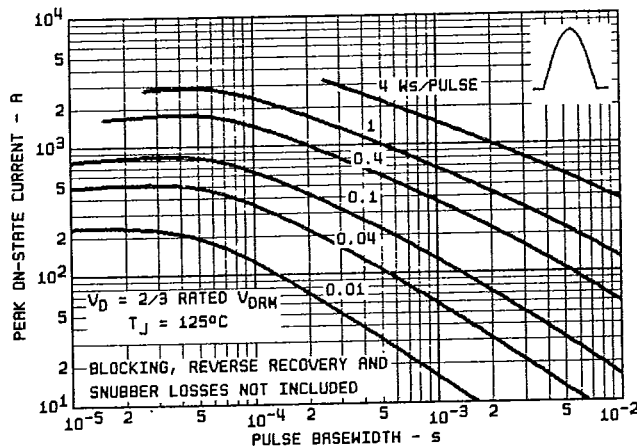
**Fig. 3 — Power Loss Characteristics  
— Sinusoidal Waveforms**



**Fig. 4 — Power Loss Characteristics  
— Rectangular Waveforms**

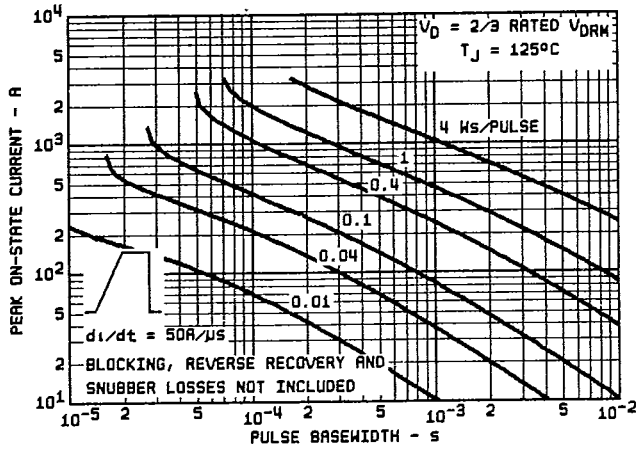


**Fig. 5 — On-State Characteristics**

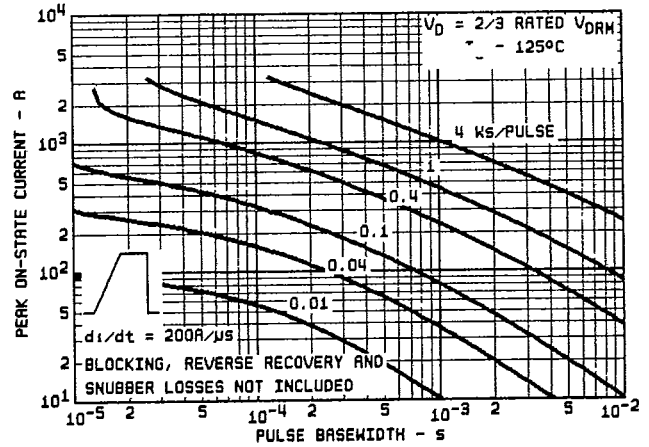


**Fig. 6 — Max. Energy Loss per Pulse  
— Sinusoidal Waveforms**

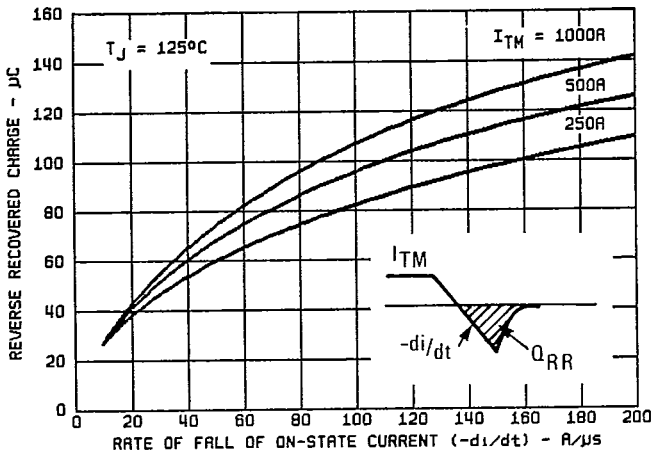
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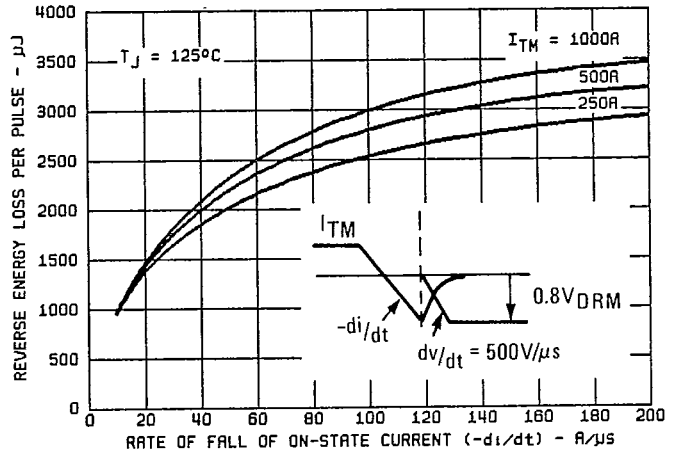
**Fig. 7 — Max. Energy Loss per Pulse  
— Trapezoidal Waveforms,  $di/dt = 50 \text{ A}/\mu\text{s}$**



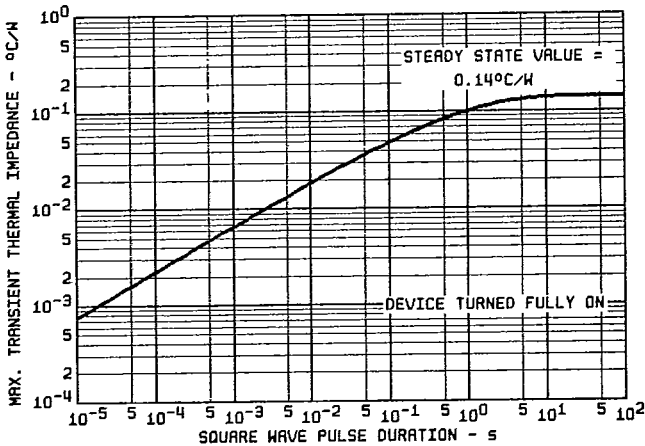
**Fig. 8 — Max. Energy Loss per Pulse  
— Trapezoidal Waveforms,  $di/dt = 200 \text{ A}/\mu\text{s}$**



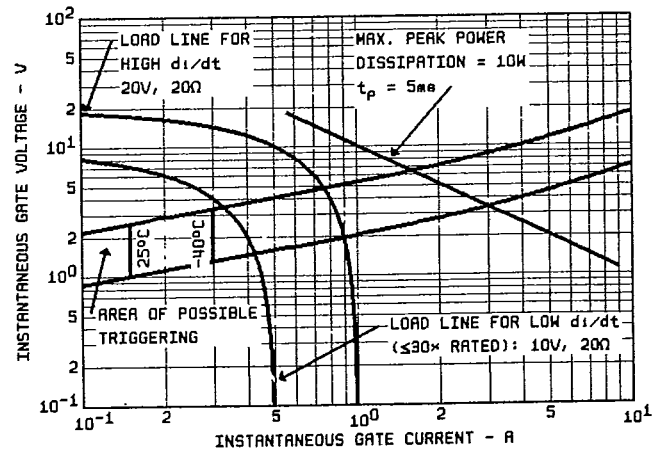
**Fig. 9 — Typical Recovered Charge**



**Fig. 10 — Typical Reverse Energy Losses**



**Fig. 11 — Transient Thermal Impedance,  
Junction-to-Case**



**Fig. 12 — Gate Characteristics**

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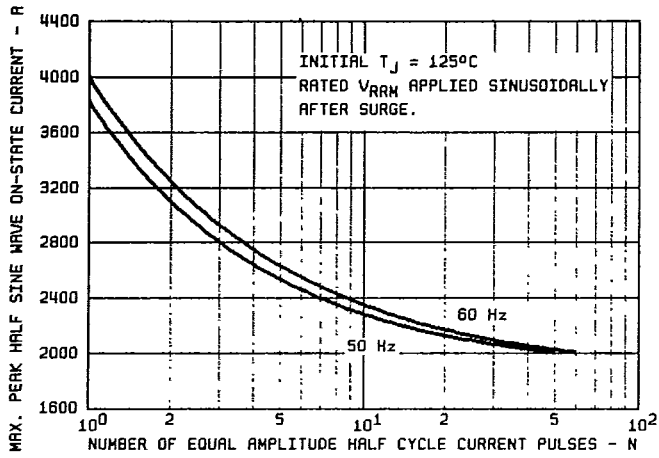


Fig. 13 — Non-Repetitive Surge Current Ratings

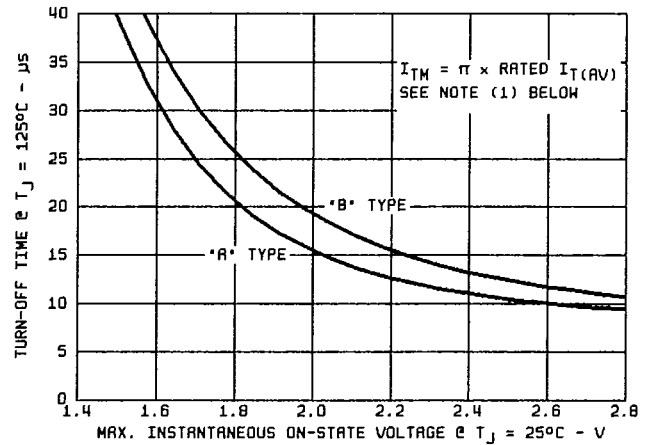


Fig. 14 — Trend for Turn-Off Time vs. On-State Voltage

- (1) These curves are intended as a guideline. To specify non-standard  $t_q/V_{TM}$  contact factory.

## ORDERING INFORMATION

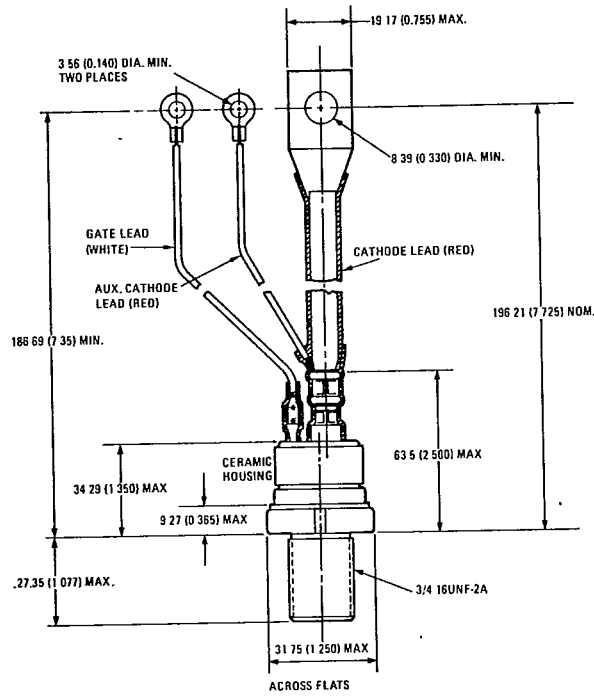
TYPE	PACKAGE (1)		FAST	TEMPERATURE		VOLTAGE		TURN-OFF		LEADS & TERMINALS	
	CODE	DESCRIPTION		CODE	MAX. $T_J$	CODE	$V_{DRM}$	CODE	MAX. $t_q$	CODE	DESCRIPTION
S23	D	3/4" stud, ceramic housing. Standard in USA. (Fig. 1)	F	—	125°C	12	1200V	A	16μs	0	Flexible leads, eyelet terminals. Standard in USA. (Fig. 1)
	DP	3/4" stud, compression bonded, ceramic housing. Standard in Europe. (Fig. 2)				10	1000V	B	20μs	1	Flexible leads, fast-on terminals. Standard in Europe. (Fig. 2)

- [1] Other packages are available:  
 - flat base, similar to TO-209AB (TO-93) with stud removed.  
 For further details contact factory.

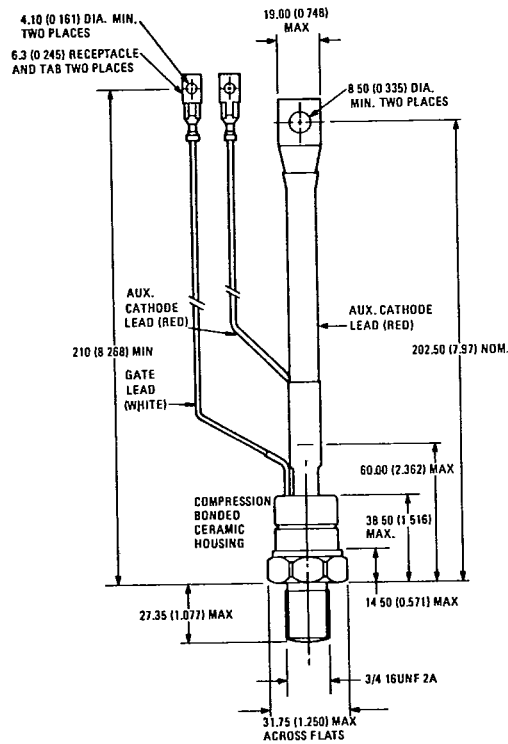
For example, for a device with standard USA case, max.  $T_J = 125^\circ\text{C}$ ,  $V_{DRM} = 1200\text{V}$ , max.  $t_q = 16\mu\text{s}$ , order as: S23DF12AD.



### S23DF SERIES 1200-1000 VOLTS RANGE



**Fig. 1 — Conforms to JEDEC Outline TO-209AB (TO-93)**  
Dimensions in Millimeters and (Inches)



**Fig. 2 — Similar to JEDEC Outline TO-209AB (TO-93)**  
Dimensions in Millimeters and (Inches)