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***DISCRETE POWER DIODES and THYRISTORS***  
***DATA BOOK***

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## PHASE CONTROL THYRISTORS

Stud Version

### Features

- Center amplifying gate
- Hermetic metal case with ceramic insulator  
(Also available with glass-metal seal up to 1200V)
- International standard case TO-209AB (TO-93)
- Threaded studs UNF 3/4 - 16UNF2A or ISO M16x1.5
- Compression Bonded Encapsulation for heavy duty operations such as severe thermal cycling

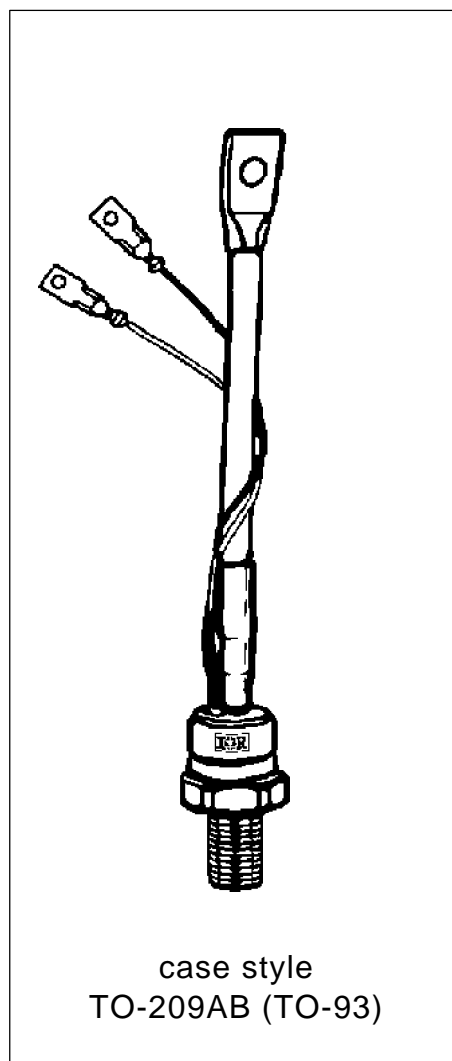
230A

### Typical Applications

- DC motor controls
- Controlled DC power supplies
- AC controllers

### Major Ratings and Characteristics

Parameters	ST230S	Units
$I_{T(AV)}$	230	A
@ $T_C$	85	°C
$I_{T(RMS)}$	360	A
$I_{TSM}$ @ 50Hz	5700	A
@ 60Hz	5970	A
$I^2t$ @ 50Hz	163	KA <sup>2</sup> s
@ 60Hz	149	KA <sup>2</sup> s
$V_{DRM}/V_{RRM}$	400 to 1600	V
$t_q$ typical	100	μs
$T_J$	- 40 to 125	°C



case style  
TO-209AB (TO-93)

**ELECTRICAL SPECIFICATIONS**

## Voltage Ratings

Type number	Voltage Code	$V_{DRM}/V_{RRM}$ , max. repetitive peak and off-state voltage V	$V_{RSM}$ , maximum non-repetitive peak voltage V	$I_{DRM}/I_{RRM}$ max. @ $T_J = T_J$ max mA
ST230S	04	400	500	30
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	

## On-state Conduction

Parameter	ST230S	Units	Conditions
$I_{T(AV)}$ Max. average on-state current @ Case temperature	230	A	180° conduction, half sine wave
	85	°C	
$I_{T(RMS)}$ Max. RMS on-state current	360	A	DC @ 78°C case temperature
$I_{TSM}$ Max. peak, one-cycle non-repetitive surge current	5700	A	t = 10ms No voltage reappplied
	5970		t = 8.3ms
	4800		t = 10ms 100% $V_{RRM}$ reappplied
	5000		t = 8.3ms
$I^2t$ Maximum $I^2t$ for fusing	163	KA <sup>2</sup> s	t = 10ms No voltage reappplied
	148		t = 8.3ms
	115		t = 10ms 100% $V_{RRM}$ reappplied
	105		t = 8.3ms
$I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing	1630	KA <sup>2</sup> √s	t = 0.1 to 10ms, no voltage reappplied
$V_{T(TO)1}$ Low level value of threshold voltage	0.92	V	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J$ max.
$V_{T(TO)2}$ High level value of threshold voltage	0.98		$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ max.
$r_{t1}$ Low level value of on-state slope resistance	0.88	mΩ	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J$ max.
$r_{t2}$ High level value of on-state slope resistance	0.81		$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ max.
$V_{TM}$ Max. on-state voltage	1.55	V	$I_{pk} = 720A$ , $T_J = T_J$ max, $t_p = 10ms$ sine pulse
$I_H$ Maximum holding current	600	mA	$T_J = 25^\circ C$ , anode supply 12V resistive load
$I_L$ Max. (typical) latching current	1000 (300)		

## Switching

Parameter	ST230S	Units	Conditions
di/dt Max. non-repetitive rate of rise of turned-on current	1000	A/μs	Gate drive 20V, 20Ω, $t_r \leq 1\mu s$ $T_J = T_J$ max, anode voltage $\leq 80\% V_{DRM}$
$t_d$ Typical delay time	1.0	μs	Gate current 1A, $di_g/dt = 1A/\mu s$ $V_d = 0.67\% V_{DRM}$ , $T_J = 25^\circ C$
$t_q$ Typical turn-off time	100		$I_{TM} = 300A$ , $T_J = T_J$ max, $di/dt = 20A/\mu s$ , $V_R = 50V$ $dv/dt = 20V/\mu s$ , Gate 0V 100Ω, $t_p = 500\mu s$

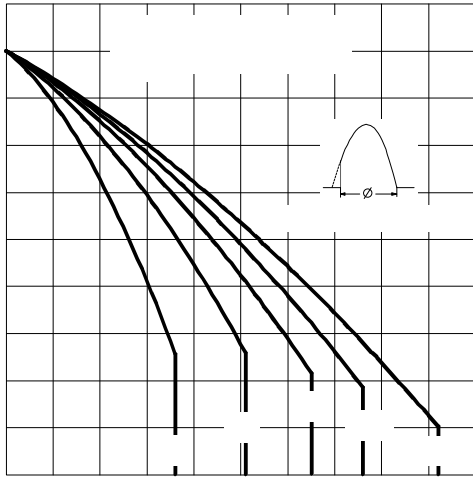


Fig. 1 - Current Ratings Characteristics

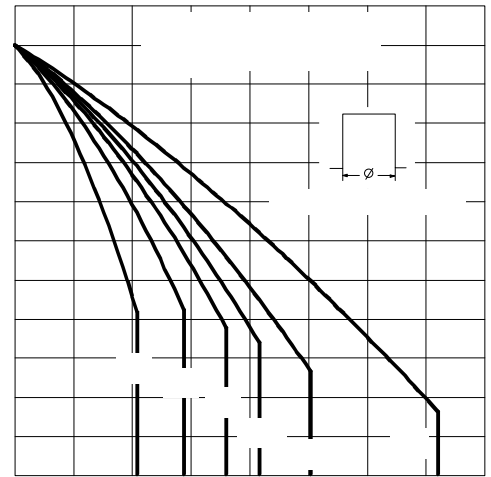


Fig. 2 - Current Ratings Characteristics

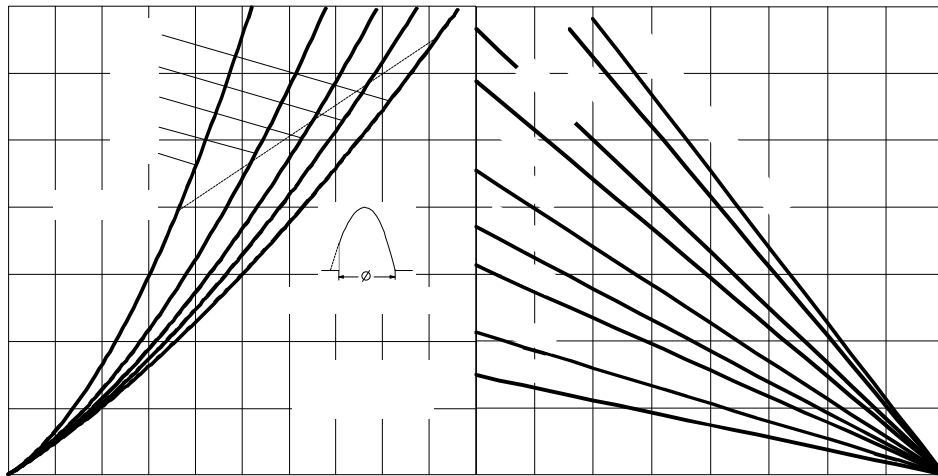


Fig. 3 - On-state Power Loss Characteristics

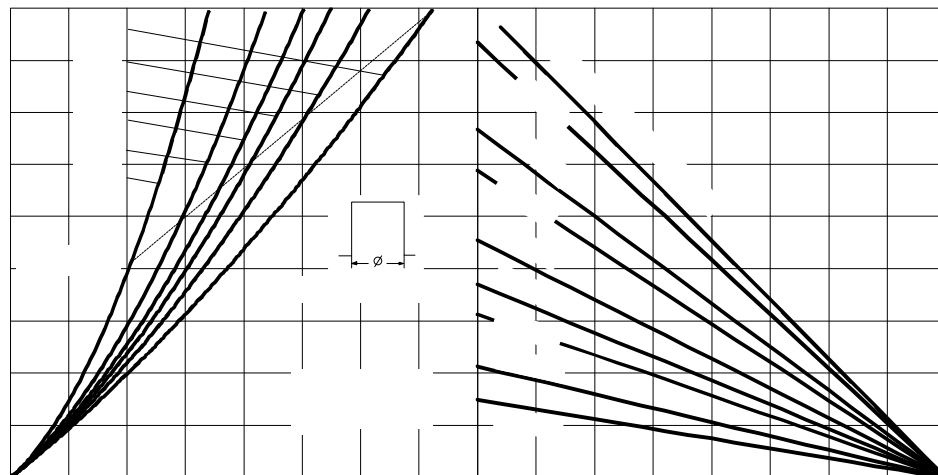


Fig. 4 - On-state Power Loss Characteristics

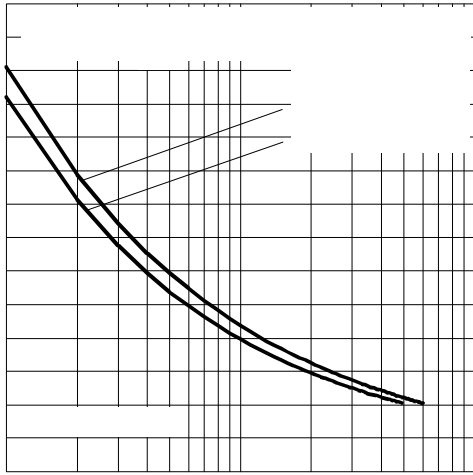


Fig. 5 - Maximum Non-Repetitive Surge Current

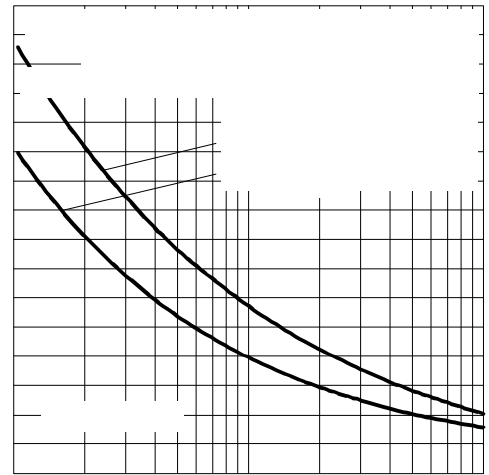


Fig. 6 - Maximum Non-Repetitive Surge Current

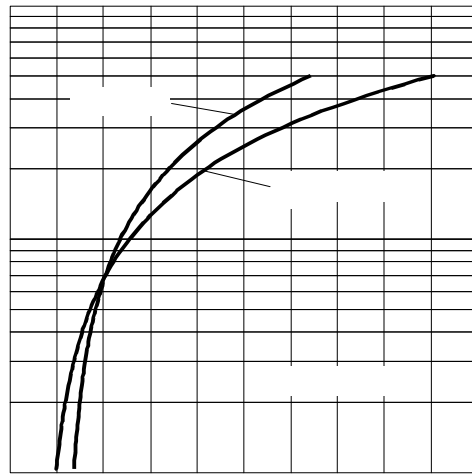


Fig. 7 - On-state Voltage Drop Characteristics

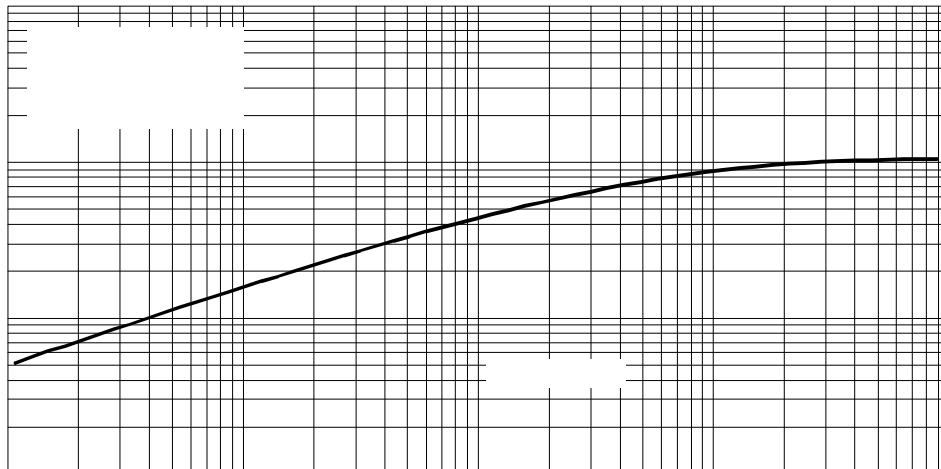


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

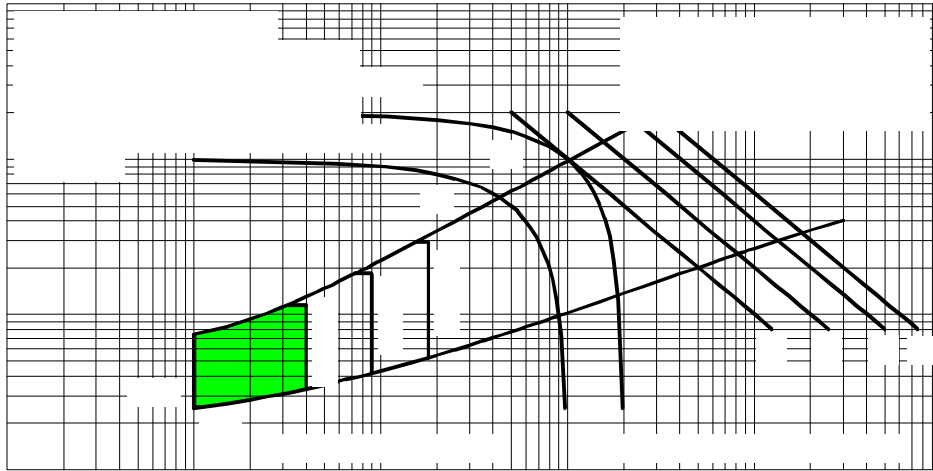


Fig. 9 - Gate Characteristics

## Blocking

Parameter	ST230S	Units	Conditions
dv/dt Maximum critical rate of rise of off-state voltage	500	V/μs	T <sub>J</sub> = T <sub>J</sub> max. linear to 80% rated V <sub>DRM</sub>
I <sub>DRM</sub> I <sub>RDM</sub> Max. peak reverse and off-state leakage current	30	mA	T <sub>J</sub> = T <sub>J</sub> max, rated V <sub>DRM</sub> /V <sub>RDM</sub> applied

## Triggering

Parameter	ST230S	Units	Conditions
P <sub>GM</sub> Maximum peak gate power	10.0	W	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
P <sub>G(AV)</sub> Maximum average gate power	2.0		T <sub>J</sub> = T <sub>J</sub> max, f = 50Hz, d% = 50
I <sub>GM</sub> Max. peak positive gate current	3.0	A	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
+V <sub>GM</sub> Maximum peak positive gate voltage	20	V	T <sub>J</sub> = T <sub>J</sub> max, t <sub>p</sub> ≤ 5ms
-V <sub>GM</sub> Maximum peak negative gate voltage	5.0		
I <sub>GT</sub> DC gate current required to trigger	TYP.	MAX.	T <sub>J</sub> = - 40°C T <sub>J</sub> = 25°C T <sub>J</sub> = 125°C Max. required gate trigger/ current/ voltage are the lowest value which will trigger all units 12V anode-to-cathode applied
	180	-	
	90	150	
V <sub>GT</sub> DC gate voltage required to trigger	2.9	-	T <sub>J</sub> = - 40°C T <sub>J</sub> = 25°C T <sub>J</sub> = 125°C
	1.8	3.0	
	1.2	-	
I <sub>GD</sub> DC gate current not to trigger	10	mA	T <sub>J</sub> = T <sub>J</sub> max Max. gate current/ voltage not to trigger is the max. value which will not trigger any unit with rated V <sub>DRM</sub> anode-to-cathode applied
V <sub>GD</sub> DC gate voltage not to trigger	0.25	V	

## Thermal and Mechanical Specification

Parameter	ST230S	Units	Conditions
T <sub>J</sub> Max. operating temperature range	-40 to 125	°C	
T <sub>stg</sub> Max. storage temperature range	-40 to 150		
R <sub>thJC</sub> Max. thermal resistance, junction to case	0.10	K/W	DC operation
R <sub>thCS</sub> Max. thermal resistance, case to heatsink	0.04		Mounting surface, smooth, flat and greased
T Mounting torque, ± 10%	31 (275)	Nm (lbf-in)	Non lubricated threads
	24.5 (210)		Lubricated threads
wt Approximate weight	280	g	
Case style	TO - 209AB (TO-93)		See Outline Table

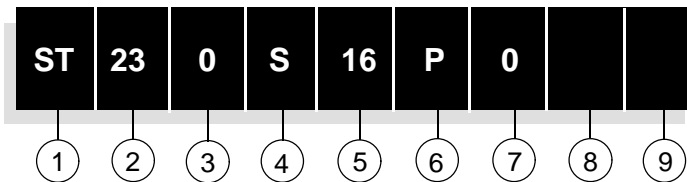
## $\Delta R_{thJC}$ Conduction

(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

Conduction angle	Sinusoidal conduction	Rectangular conduction	Units	Conditions
180°	0.016	0.012	K/W	$T_J = T_{J \text{ max.}}$
120°	0.019	0.020		
90°	0.025	0.027		
60°	0.036	0.037		
30°	0.060	0.060		

## Ordering Information Table

### Device Code

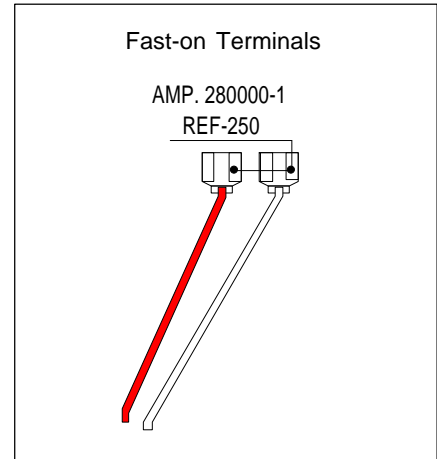
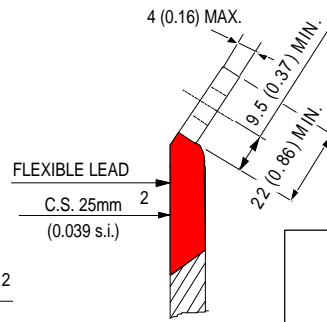
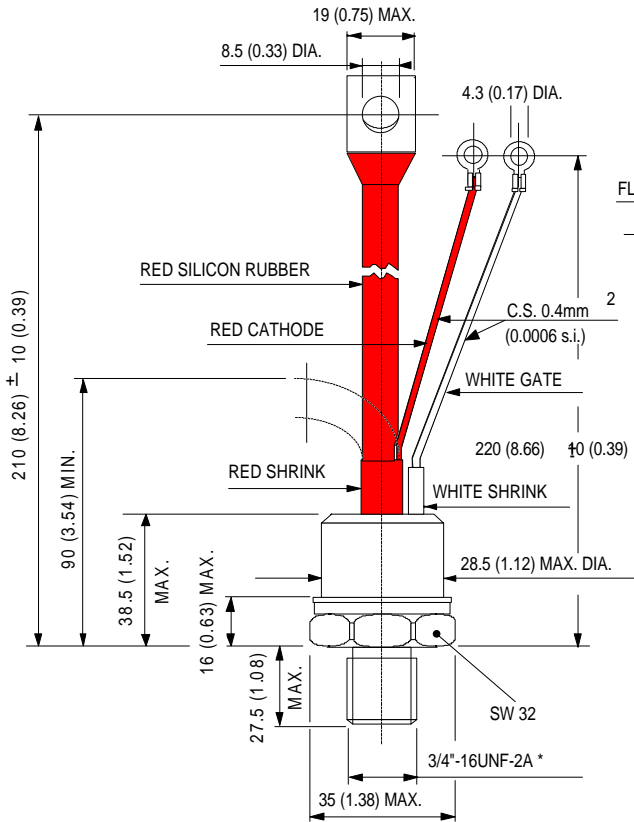


- 1** - Thyristor
- 2** - Essential part number
- 3** - 0 = Converter grade
- 4** - S = Compression bonding Stud
- 5** - Voltage code: Code x 100 =  $V_{RRM}$  (See Voltage Rating Table)
- 6** - P = Stud base 16UNF threads  
M = Stud base metric threads (M16 x 1.5)
- 7** - 0 = Eyelet terminals (Gate and Auxiliary Cathode Leads)  
1 = Fast - on terminals (Gate and Auxiliary Cathode Leads)  
2 = Flag terminals (For Cathode and Gate Terminals)
- 8** - V = Glass-metal seal (only up to 1200V)  
None = Ceramic housing (over 1200V)
- 9** - Critical dv/dt: None = 500V/ $\mu$ sec (Standard selection)  
L = 1000V/ $\mu$ sec (Special selection)



Outline Table

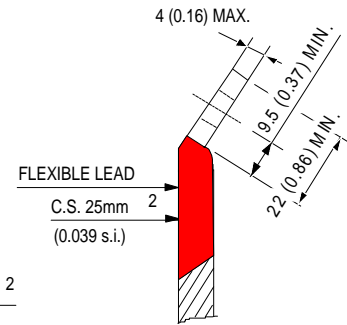
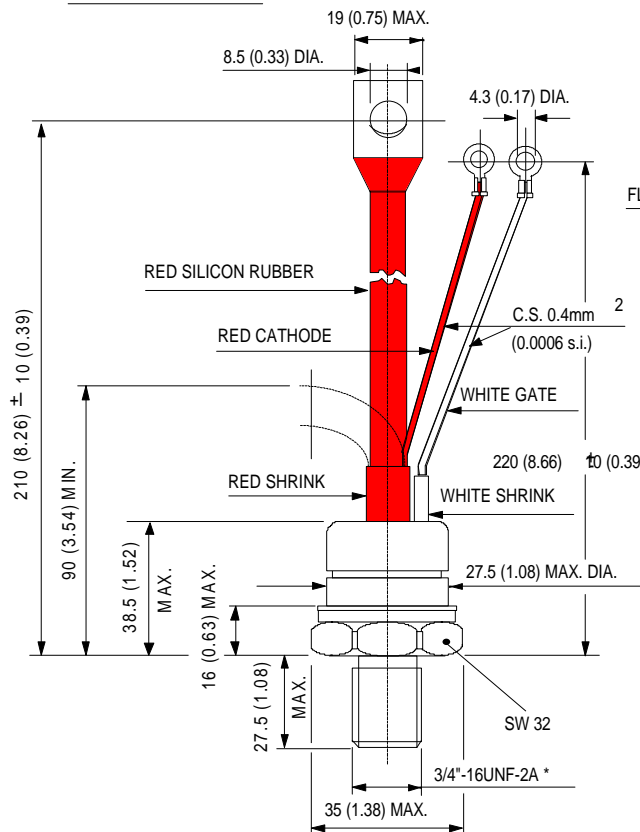
GLASS METAL SEAL



Case Style TO-209AB (TO-93)  
All dimensions in millimeters (inches)

\* FOR METRIC DEVICE : M16 x 1.5 - LENGHT 21 (0.83) MAX.

CERAMIC HOUSING

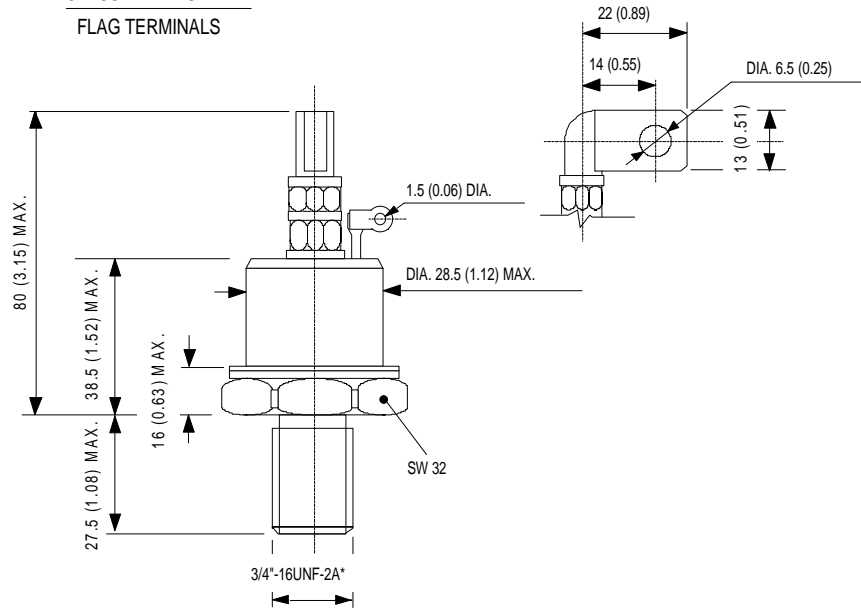


\* FOR METRIC DEVICE : M16 x 1.5 - LENGHT 21 (0.83) MAX.

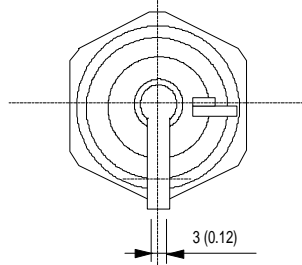
## Outline Table

### GLASS-METAL SEAL

#### FLAG TERMINALS



\*FOR METRIC DEVICE. M16 X 1.5 - LENGHT 21 (0.83) MAX.

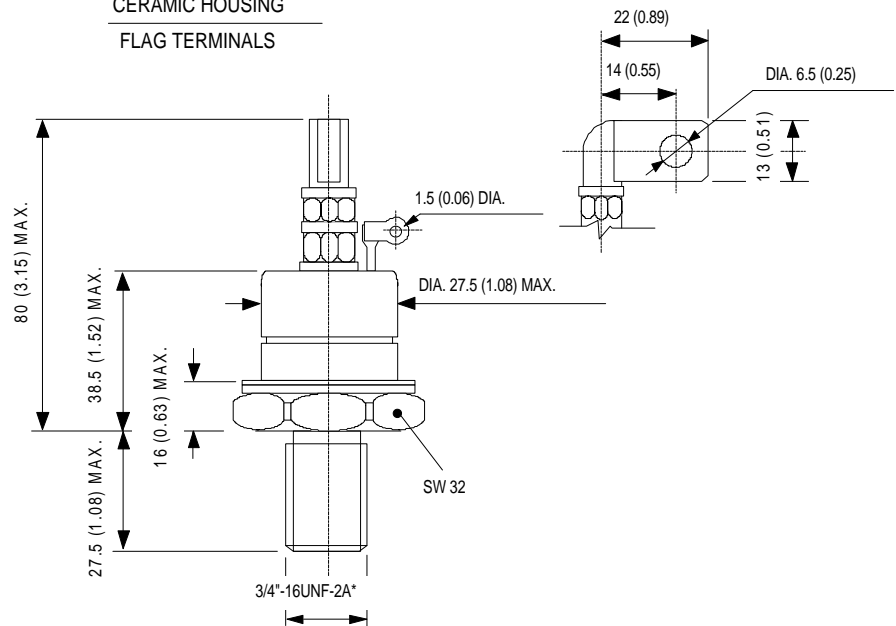


### Case Style TO-209AB (TO-93) Flag

All dimensions in millimeters (inches)

### CERAMIC HOUSING

#### FLAG TERMINALS



\*FOR METRIC DEVICE. M16 X 1.5 - LENGHT 21 (0.83) MAX.

