

# MAC12D, MAC12M, MAC12N

Preferred Device

## Triacs

### Silicon Bidirectional Thyristors

Designed for high performance full-wave ac control applications where high noise immunity and commutating di/dt are required.

#### Features

- Blocking Voltage to 800 Volts
- On-State Current Rating of 12 Amperes RMS at 70°C
- Uniform Gate Trigger Currents in Three Quadrants, Q1, Q2, and Q3
- High Immunity to dv/dt – 250 V/μs Minimum at 125°C
- High Commutating di/dt – 6.5 A/ms Minimum at 125°C
- Industry Standard TO-220 AB Package
- High Surge Current Capability – 100 Amperes
- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Off-State Voltage (Note 1) (T <sub>J</sub> = -40 to 125°C, Sine Wave, 50 to 60 Hz, Gate Open)	V <sub>DRM</sub> , V <sub>RRM</sub>		V
	MAC12D	400	
	MAC12M	600	
	MAC12N	800	
On-State RMS Current (All Conduction Angles; T <sub>C</sub> = 70°C)	I <sub>T(RMS)</sub>	12	A
Peak Non-Repetitive Surge Current (One Full Cycle, 60 Hz, T <sub>J</sub> = 125°C)	I <sub>TSM</sub>	100	A
Circuit Fusing Consideration (t = 8.33 ms)	I <sup>2</sup> t	41	A <sup>2</sup> sec
Peak Gate Power (Pulse Width ≤ 1.0 μs, T <sub>C</sub> = 80°C)	P <sub>GM</sub>	16	W
Average Gate Power (t = 8.3 ms, T <sub>C</sub> = 80°C)	P <sub>G(AV)</sub>	0.35	W
Operating Junction Temperature Range	T <sub>J</sub>	-40 to +125	°C
Storage Temperature Range	T <sub>stg</sub>	-40 to +150	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. V<sub>DRM</sub> and V<sub>RRM</sub> for all types can be applied on a continuous basis. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

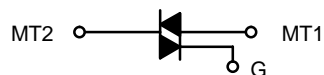
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



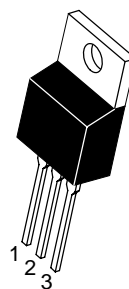
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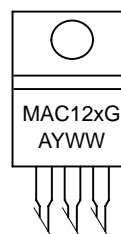
**TRIACS**  
**12 AMPERES RMS**  
**400 thru 800 VOLTS**



#### MARKING DIAGRAM



TO-220AB  
CASE 221A-09  
STYLE 4



x = D, M, or N  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

#### PIN ASSIGNMENT

Pin	Assignment
1	Main Terminal 1
2	Main Terminal 2
3	Gate
4	Main Terminal 2

#### ORDERING INFORMATION

Device	Package	Shipping
MAC12D	TO-220AB	50 Units / Rail
MAC12DG	TO-220AB (Pb-Free)	50 Units / Rail
MAC12M	TO-220AB	50 Units / Rail
MAC12MG	TO-220AB (Pb-Free)	50 Units / Rail
MAC12N	TO-220AB	50 Units / Rail
MAC12NG	TO-220AB (Pb-Free)	50 Units / Rail

Preferred devices are recommended choices for future use and best overall value.

# MAC12D, MAC12M, MAC12N

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	2.2	$^{\circ}\text{C}/\text{W}$
Junction-to-Ambient	$R_{\theta JA}$	62.5	
Maximum Lead Temperature for Soldering Purposes 1/8" from Case for 10 Seconds	$T_L$	260	$^{\circ}\text{C}$

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise noted; Electricals apply in both directions)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Peak Repetitive Blocking Current ( $V_D = \text{Rated } V_{DRM}, V_{RRM}, \text{ Gate Open}$ )	$T_J = 25^{\circ}\text{C}$ $T_J = 125^{\circ}\text{C}$	$I_{DRM}$ $I_{RRM}$	- -	- -	0.01 2.0	mA
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### ON CHARACTERISTICS

Peak On-State Voltage (Note 2) ( $I_{TM} = \pm 17 \text{ A}$ )	$V_{TM}$	-	-	1.85	V
Gate Trigger Current (Continuous dc) ( $V_D = 12 \text{ V}, R_L = 100 \Omega$ )	$I_{GT}$	5.0	13	35	mA
MT2(+), G(+)		5.0	13	35	
MT2(+), G(-)		5.0	13	35	
MT2(-), G(-)		5.0	13	35	
Hold Current ( $V_D = 12 \text{ V}, \text{ Gate Open}, \text{ Initiating Current} = \pm 150 \text{ mA}$ )	$I_H$	-	20	40	mA
Latch Current ( $V_D = 24 \text{ V}, I_G = 35 \text{ mA}$ )	$I_L$	-	20	50	mA
MT2(+), G(+)		-	30	80	
MT2(+), G(-)		-	20	50	
MT2(-), G(-)		-	20	50	
Gate Trigger Voltage (Continuous dc) ( $V_D = 12 \text{ V}, R_L = 100 \Omega$ )	$V_{GT}$	0.5	0.78	1.5	V
MT2(+), G(+)		0.5	0.70	1.5	
MT2(+), G(-)		0.5	0.71	1.5	
MT2(-), G(-)		0.5	0.71	1.5	

### DYNAMIC CHARACTERISTICS

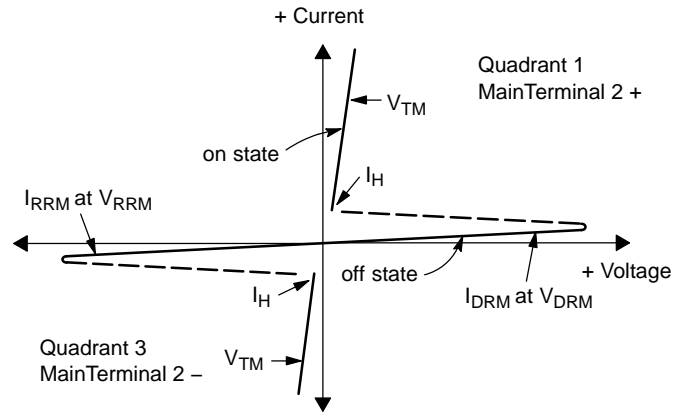
Rate of Change of Commutating Current ( $V_D = 400 \text{ V}, I_{TM} = 4.4 \text{ A}, \text{ Commutating } dv/dt = 18 \text{ V}/\mu\text{s}, \text{ Gate Open}, T_J = 125^{\circ}\text{C}, f = 250 \text{ Hz}, \text{ No Snubber}$ )	$(di/dt)_c$	6.5	-	-	A/ms
Critical Rate of Rise of Off-State Voltage ( $V_D = \text{Rated } V_{DRM}, \text{ Exponential Waveform}, \text{ Gate Open}, T_J = 125^{\circ}\text{C}$ )	$dv/dt$	250	500	-	V/ $\mu\text{s}$
Repetitive Critical Rate of Rise of On-State Current IPK = 50 A; PW = 40 $\mu\text{sec}$ ; $di_G/dt = 200 \text{ mA}/\mu\text{sec}$ ; $f = 60 \text{ Hz}$	$di/dt$	-	-	10	A/ $\mu\text{s}$

2. Pulse Test: Pulse Width  $\leq 2.0 \text{ ms}$ , Duty Cycle  $\leq 2\%$ .

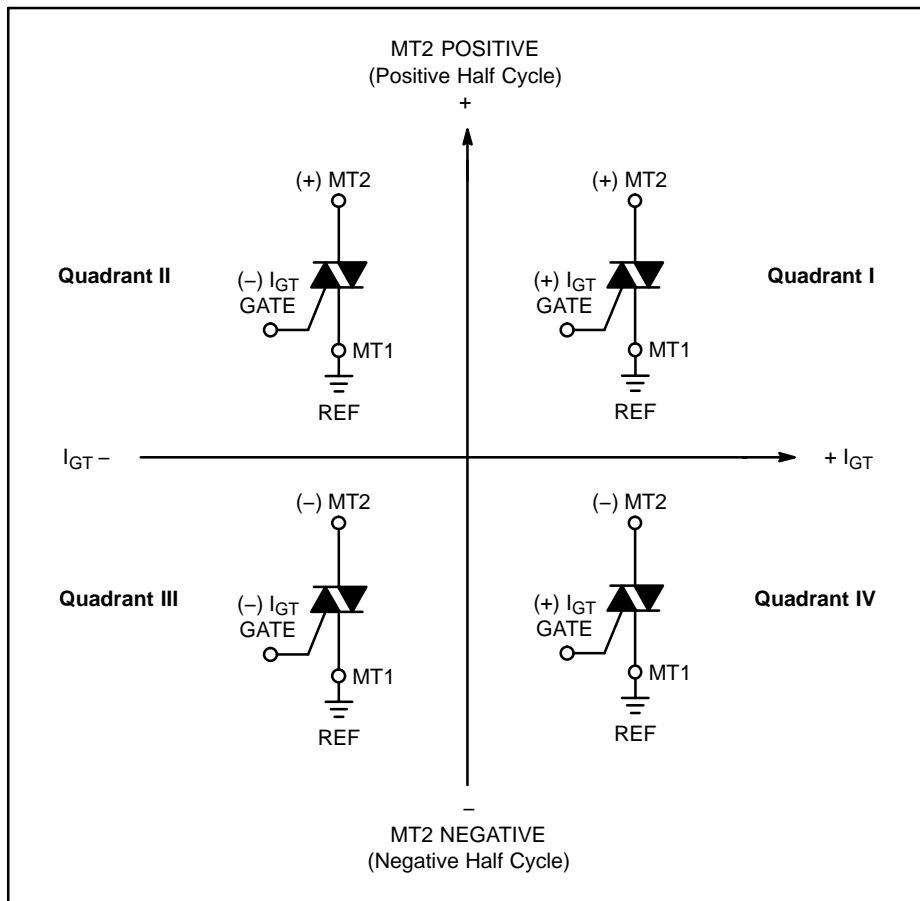
# MAC12D, MAC12M, MAC12N

## Voltage Current Characteristic of Triacs (Bidirectional Device)

Symbol	Parameter
$V_{DRM}$	Peak Repetitive Forward Off State Voltage
$I_{DRM}$	Peak Forward Blocking Current
$V_{RRM}$	Peak Repetitive Reverse Off State Voltage
$I_{RRM}$	Peak Reverse Blocking Current
$V_{TM}$	Maximum On State Voltage
$I_H$	Holding Current



### Quadrant Definitions for a Triac



All polarities are referenced to MT1.  
With in-phase signals (using standard AC lines) quadrants I and III are used.

# MAC12D, MAC12M, MAC12N

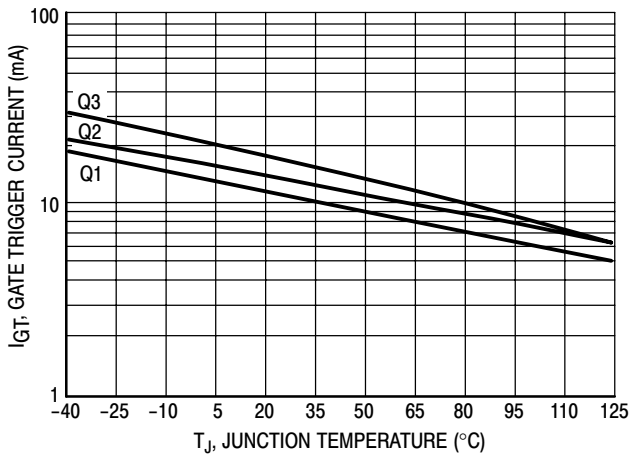


Figure 1. Typical Gate Trigger Current versus Junction Temperature

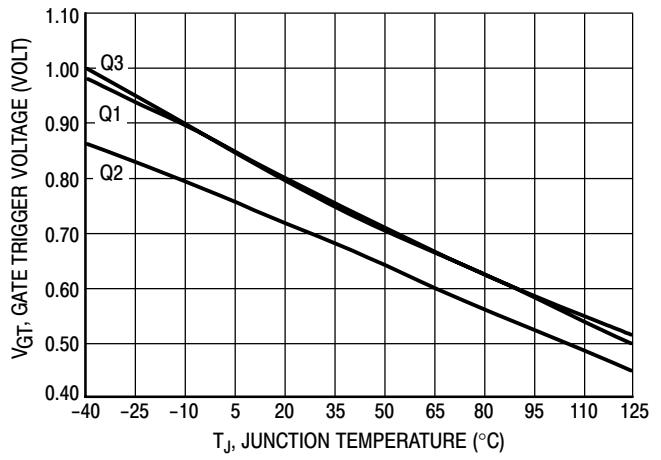


Figure 2. Typical Gate Trigger Voltage versus Junction Temperature

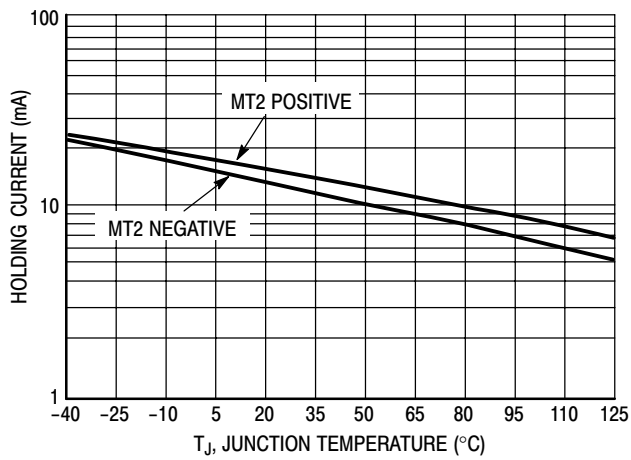


Figure 3. Typical Holding Current versus Junction Temperature

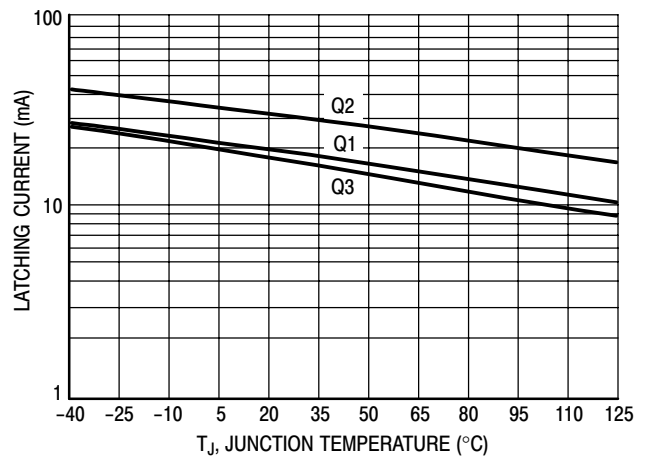


Figure 4. Typical Latching Current versus Junction Temperature

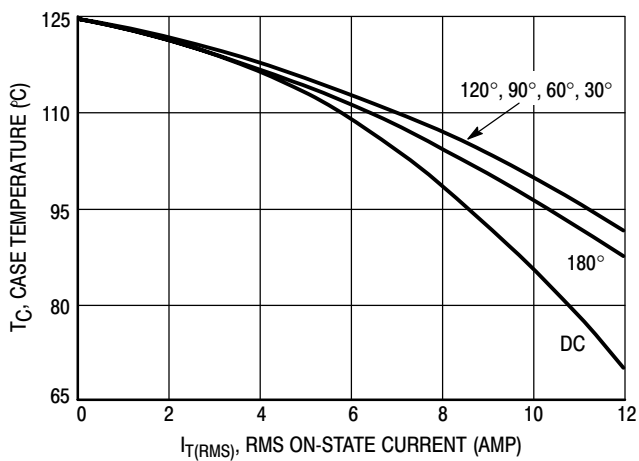


Figure 5. Typical RMS Current Derating

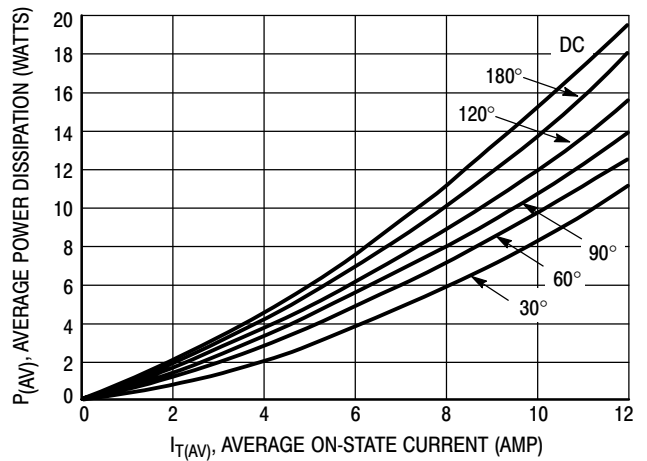


Figure 6. On-State Power Dissipation

MAC12D, MAC12M, MAC12N

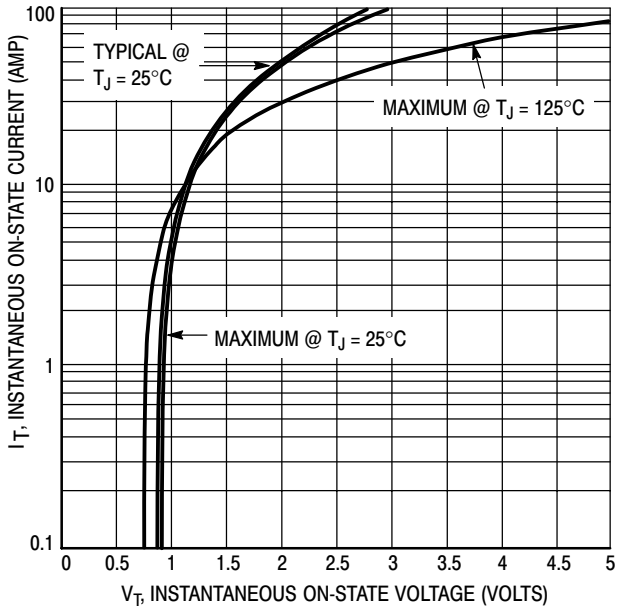


Figure 7. Typical On-State Characteristics

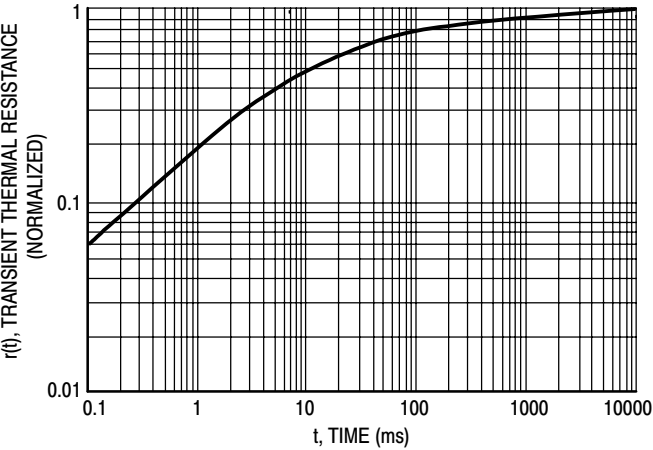
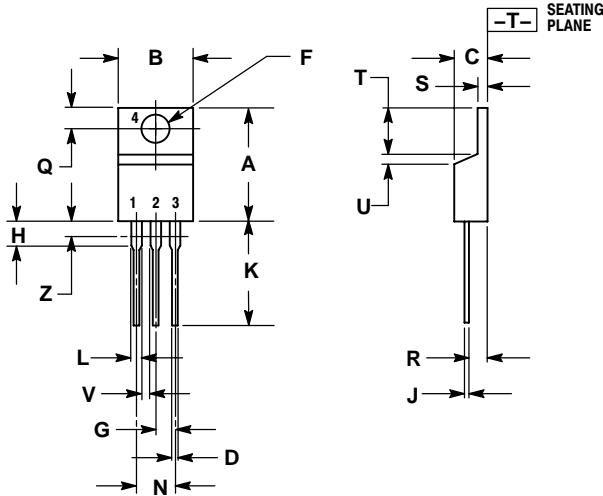


Figure 8. Typical Thermal Response

# MAC12D, MAC12M, MAC12N

## PACKAGE DIMENSIONS

TO-220AB  
CASE 221A-09  
ISSUE AA



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

### STYLE 4:

1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

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