

# MAC16DG, MAC16MG, MAC16NG

## TRIAC – 400V - 800V



### Description

The MAC16 Series is designed for high performance full-wave ac control applications where high noise immunity and high commutating di/dt are required.

### Features

- Blocking Voltage to 800 Volts
- On-State Current Rating of 16 Amperes RMS at 80°C
- Uniform Gate Trigger Currents in Three Quadrants
- High Immunity to dv/dt – 500 V/μs minimum at 125°C
- Minimizes Snubber Networks for Protection
- Industry Standard TO–220 Package
- High Commutating di/dt – 9.0 A/ms minimum at 125°C
- These Devices are Pb–Free and are RoHS Compliant

### Additional Information



Resources

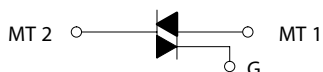


Accessories

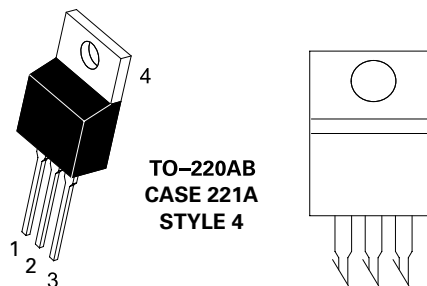


Samples

### Functional Diagram



### Pin Out



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

| Rating   | Symbol   | Value             | Unit               |
|--|--|-------------------|--------------------|
| Peak Repetitive Off-State Voltage (Note 1)<br>(– 40 to 125°C, Sine Wave, 50 to 60 Hz, Gate Open) | MAC16D<br>MAC16M<br>MAC16N<br>$V_{DRM}$<br>$V_{RRM}$ | 400<br>600<br>800 | V                  |
| On-State RMS Current (Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 80°C)                        | $I_T$ (RMS)  | 16                | A                  |
| Peak Non-Repetitive Surge Current<br>(One Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 125°C)   | $I_{TSM}$  | 150               | A                  |
| Circuit Fusing Consideration (t = 8.3 ms)  | $I^2t$   | 93                | A <sup>2</sup> sec |
| Peak Gate Power (T <sub>C</sub> = 80°C, Pulse Width ≤ 1.0 μs)                                    | $P_{GM}$   | 20                | W                  |
| Average Gate Power (t = 8.3 ms, T <sub>C</sub> = 80°C)   | $P_{G(AV)}$  | 0.5               | W                  |
| Operating Junction Temperature Range   | T <sub>J</sub>                                       | –40 to +125       | °C                 |
| Storage Temperature Range  | T <sub>stg</sub>                                     | –40 to +150       | °C                 |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1.  $V_{DRM}$  and  $V_{RRM}$  for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

### Thermal Characteristics

| Rating   | Symbol                             | Value       | Unit |
|--|------------------------------------|-------------|------|
| Thermal Resistance,<br>Junction-to-Case (AC)<br>Junction-to-Ambient            | $R_{\theta JC}$<br>$R_{\theta JA}$ | 2.0<br>62.5 | °C/W |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds | T <sub>L</sub>                     | 260         | °C   |

### Electrical Characteristics - OFF (T<sub>J</sub> = 25°C unless otherwise noted ; Electricals apply in both directions)

| Characteristic   | Symbol                 | Min | Typ | Max  | Unit |
|--|------------------------|-----|-----|------|------|
| Peak Repetitive Blocking Current<br>(V <sub>D</sub> = V <sub>DRM</sub> = V <sub>RRM</sub> ; Gate Open) | $I_{DRM}$<br>$I_{RRM}$ | –   | –   | 0.01 | mA   |
|  |                        | –   | –   | 2.0  |      |

### Electrical Characteristics - ON (T<sub>J</sub> = 25°C unless otherwise noted; Electricals apply in both directions)

| Characteristic  | Symbol   | Min               | Typ                  | Max               | Unit |
|---|--|-------------------|----------------------|-------------------|------|
| Peak On-State Voltage (Note 2) (I <sub>TM</sub> = ±21 A Peak)                                   | V <sub>TM</sub>  | –                 | 1.2                  | 1.6               | V    |
| Gate Trigger Current<br>(Continuous dc)<br>(V <sub>D</sub> = 12 V, R <sub>L</sub> = 100 Ω)      | MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)<br>$I_{GT}$ | 10<br>10<br>10    | 16<br>18<br>22       | 50<br>50<br>50    | mA   |
| Gate Trigger Voltage<br>(Continuous dc)<br>(V <sub>D</sub> = 12 V, R <sub>L</sub> = 100 Ω)      | MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)<br>$V_{GT}$ | 0.5<br>0.5<br>0.5 | 0.75<br>0.72<br>0.82 | 1.5<br>1.5<br>1.5 | V    |
| Latching Current<br>(V <sub>D</sub> = 24 V, I <sub>G</sub> = 50 mA)                             | MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)<br>$V_{GD}$ | –<br>–<br>–       | 33<br>36<br>33       | 50<br>80<br>50    | V    |
| Holding Current (V <sub>D</sub> = 12 V <sub>dc</sub> , Gate Open, Initiating Current = ±150 mA) | I <sub>H</sub>   | –                 | 20                   | 50                | mA   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Indicates Pulse Test: Pulse Width ≤ 2.0 ms, Duty Cycle ≤ 2%.

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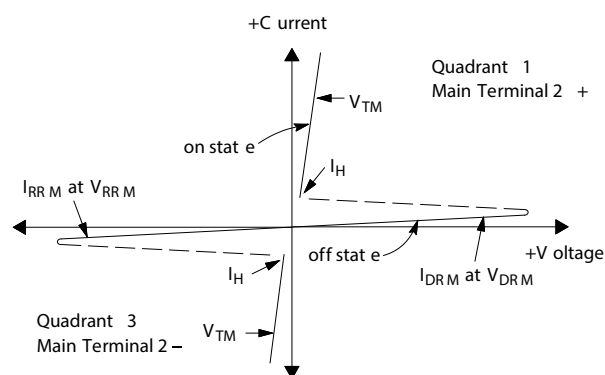
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### Dynamic Characteristics

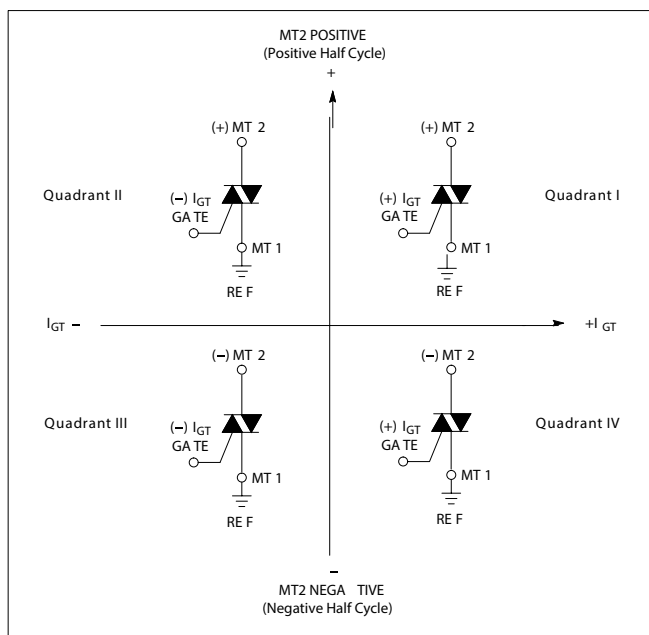
| Characteristic  | Symbol      | Min | Typ | Max | Unit             |
|---|-------------|-----|-----|-----|------------------|
| Rate of Change of Commutating Current, See Figure 10. ( $V_D = 400\text{ V}$ , $I_{TM} = 6.0\text{ A}$ , Commutating $dv/dt = 24\text{ V}/\mu\text{s}$ , Gate Open, $T_J = 125^\circ\text{C}$ , $f = 250\text{ Hz}$ , No Snubber) | $(di/dt)_c$ | 9.0 | –   | –   | A/ms             |
| Critical Rate of Rise of Off-State Voltage<br>( $V_D = \text{Rated } V_{DRM}$ , Exponential Waveform, Gate Open, $T_J = 125^\circ\text{C}$ )  | $dv/dt$     | 500 | –   | –   | V/ $\mu\text{s}$ |

### Voltage Current Characteristic of SCR

| 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

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Figure 1. RMS Current Derating

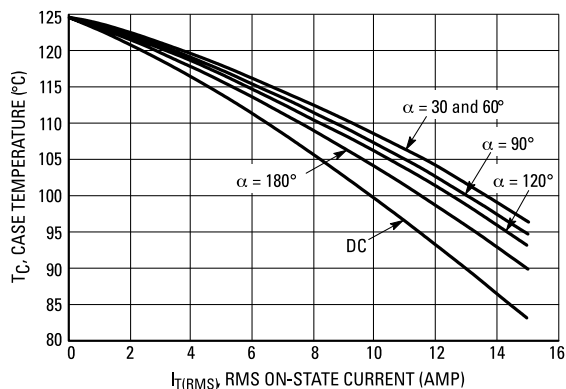


Figure 2. On-State Power Dissipation

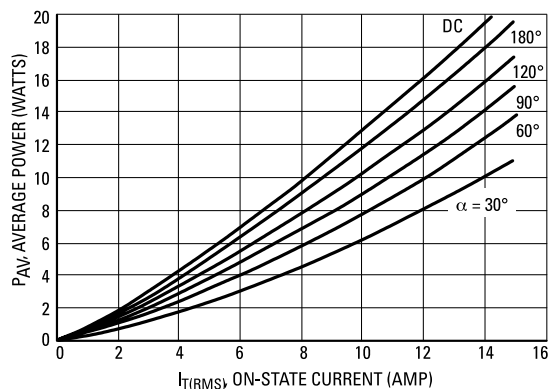


Figure 3. On-State Characteristics

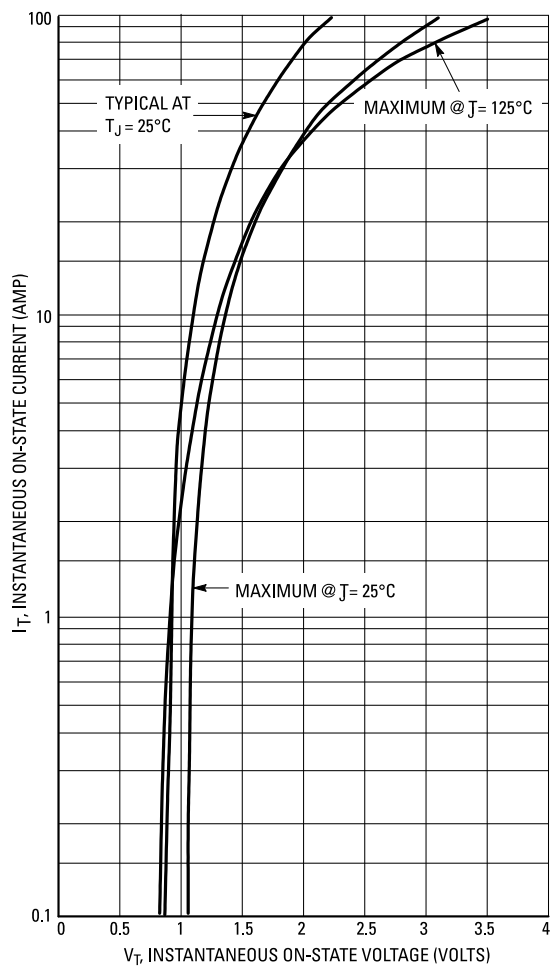


Figure 4. Thermal Response

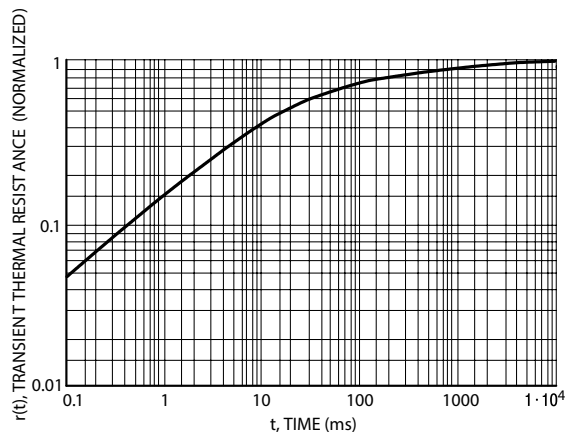
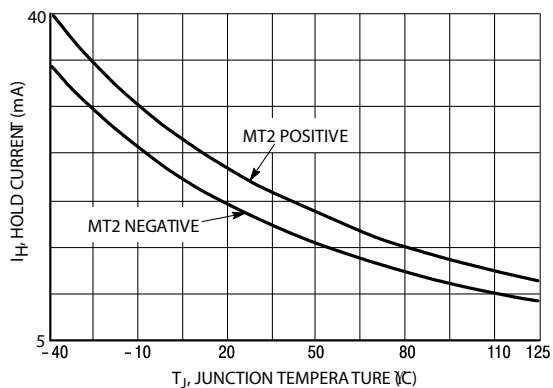


Figure 5. Hold Current Variation



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Figure 6. Typical Holding Current vs Junction Temperature

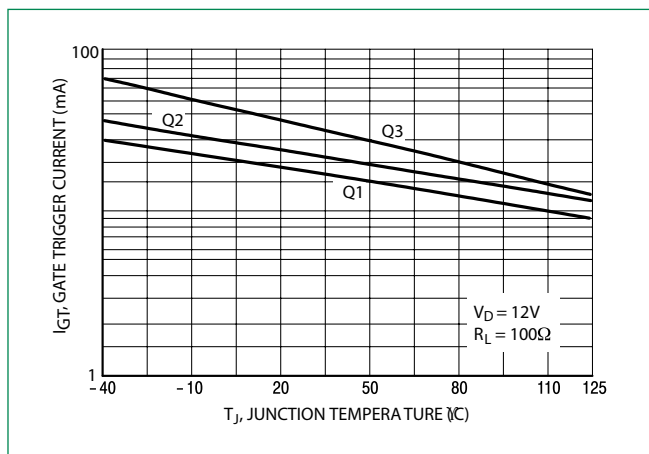


Figure 7. Gate Trigger Voltage vs Junction Temperature

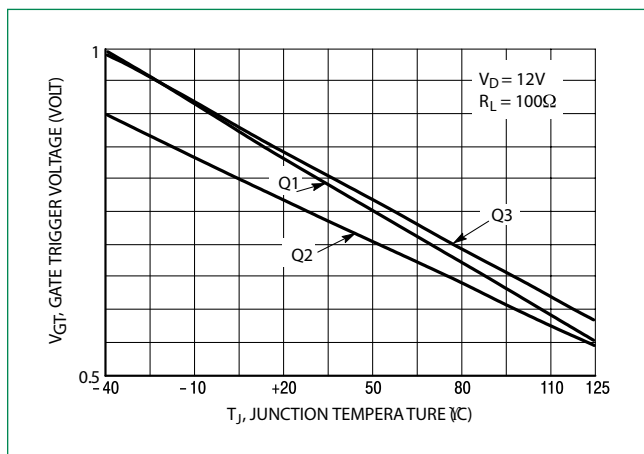


Figure 8. Critical Rate of Rise of Off-State Voltage (Exponential)

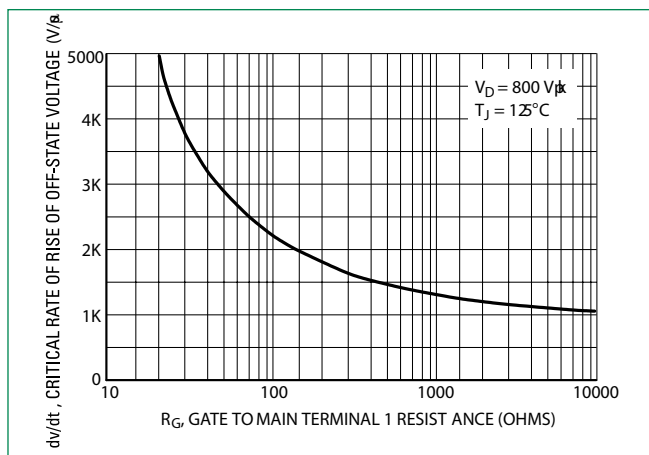


Figure 9. Critical Rate of Rise of Commutating Voltage

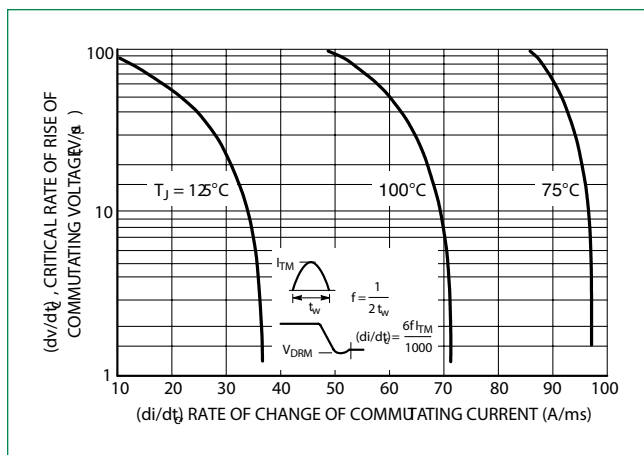
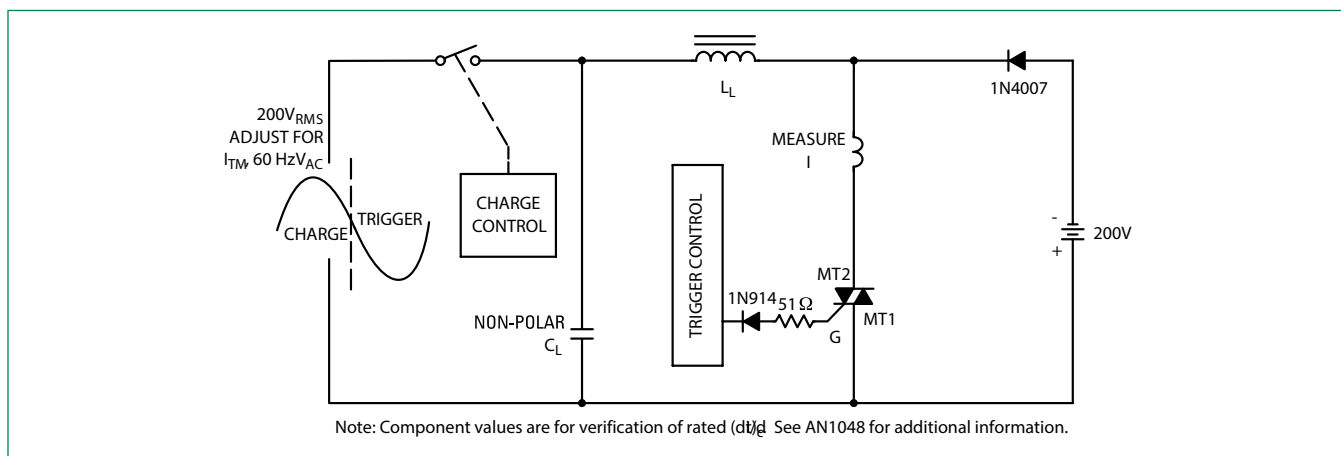


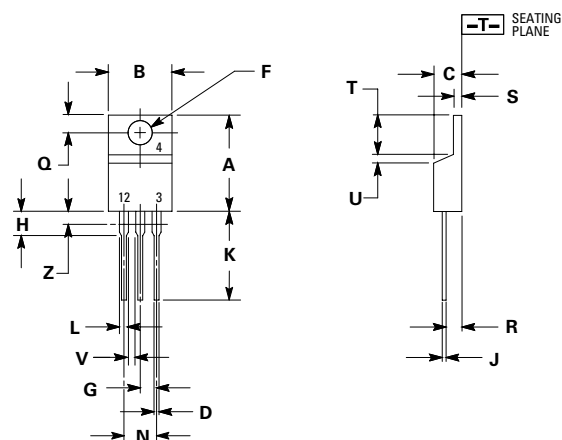
Figure 10. Simplified Test Circuit to Measure the Critical Rate of Rise of Commutating Current (di/dt)<sub>c</sub>



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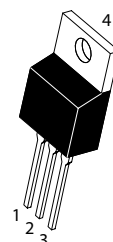
### Dimensions



| Dim | Inches |       | Millimeters |       |
|-----|--------|-------|-------------|-------|
|     | Min    | Max   | Min         | Max   |
| A   | 0.590  | 0.620 | 14.99       | 15.75 |
| B   | 0.380  | 0.420 | 9.65        | 10.67 |
| C   | 0.178  | 0.188 | 4.52        | 4.78  |
| D   | 0.025  | 0.035 | 0.64        | 0.89  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.41        | 2.67  |
| H   | 0.110  | 0.130 | 2.79        | 3.30  |
| J   | 0.018  | 0.024 | 0.46        | 0.61  |
| K   | 0.540  | 0.575 | 13.72       | 14.61 |
| L   | 0.060  | 0.075 | 1.52        | 1.91  |
| N   | 0.195  | 0.205 | 4.95        | 5.21  |
| Q   | 0.105  | 0.115 | 2.67        | 2.92  |
| R   | 0.085  | 0.095 | 2.16        | 2.41  |
| S   | 0.045  | 0.060 | 1.14        | 1.52  |
| 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  |

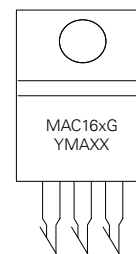
1. Dimensioning and tolerancing per ANSI Y14.5M, 1982.
2. Controlling dimension: inch.
3. Dimension Z defines a zone where all body and lead irregularities are allowed.

### Part Marking System



TO-220AB  
CASE 221A  
STYLE 12

x = D, M or N  
Y = Year  
M = Month  
A = Assembly Site  
XX = Lot Serial Code  
G = Pb-Free Package



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

### Ordering Information

| Device  | Package             | Shipping        |
|---------|---------------------|-----------------|
| MAC16DG | TO-220<br>(Pb-Free) | 1000 Units/ Box |
| MAC16MG |                     |                 |
| MAC16NG |                     |                 |

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