

FEATURES

- ▶ SIP-Package 11.5x7.55x10.2 mm
- ▶ Pin-out compatible with LM78xx Linear Regulators
- ▶ Very high Efficiency up to 97%
- ▶ Excellent Line/Loads Regulation
- ▶ Low Ripple and Noise
- ▶ Short Circuit Protection
- ▶ Operating Temp. Range -40°C to +90°C
- ▶ Thermal Shutdown
- ▶ Low Stand-by Current
- ▶ 3 Years Product Warranty



PRODUCT OVERVIEW

The MINMAX M78A series is a new range of switching regulators designed as a drop-in replacement for old LM78xx linear regulators with low efficiency. The very high efficiency of these step-down converters allow an operating temperature up to 80°C at full-load without need of any heatsink. The regulators come in a package which fits in the standard TO-220 footprint of linear regulators. The high efficiency and low stand-by power consumption of these switching regulators offer the designer a new, cost-efficient solution for many applications.

Model Selection Guide

| Model Number | Input Voltage (Range) Note 8 VDC | Output Voltage VDC | Output Current | Max. capacitive Load μF | Efficiency (typ.) @Min. Vin | Efficiency (typ.) @Max. Vin |
|--------------|--|-----------------------|----------------|----------------------------|--------------------------------|--------------------------------|
| | | | Max. mA | | % | % |
| M78AR015-0.5 | 4.75 ~ 32 | 1.5 | 500 | 220 | 73 | 63 |
| M78AR018-0.5 | | 1.8 | 500 | 220 | 82 | 71 |
| M78AR025-0.5 | | 2.5 | 500 | 220 | 87 | 77 |
| M78AR033-0.5 | | 3.3 | 500 | 220 | 91 | 81 |
| M78AR05-0.5 | 6.5 ~ 32 | 5 | 500 | 220 | 94 | 86 |
| M78AR065-0.5 | 8 ~ 32 | 6.5 | 500 | 220 | 95 | 88 |
| M78AR09-0.5 | 11 ~ 32 | 9 | 500 | 220 | 96 | 92 |
| M78AR12-0.5 | 15 ~ 32 | 12 | 500 | 220 | 97 | 94 |
| M78AR15-0.5 | 18 ~ 32 | 15 | 500 | 220 | 97 | 95 |

Input Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|------------|-----------|------|------|------|
| Input Surge Voltage (1 sec. max.) | | -0.3 | --- | 34 | VDC |
| Internal Filter Type | | Capacitor | | | |
| Internal Power Dissipation | | --- | --- | 0.4 | W |
| Short Circuit Input Power | | --- | --- | 1.5 | W |
| Input Current | @No Load | --- | 5 | --- | mA |

Output Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit | |
|---------------------------------|-----------------------------|--------------|------|--------|--------|-------------------|
| Output Voltage Setting Accuracy | | --- | ±2.0 | ±3.0 | %Vnom. | |
| Line Regulation | Vin=Min. to Max. | 1.5V to 6.5V | --- | ±0.2 | ±0.4 | % |
| | | 9V to 15V | --- | ±0.1 | ±0.2 | % |
| Load Regulation | Io=10% to 100% | 1.5V to 6.5V | --- | ±0.4 | ±0.6 | % |
| | | 9V to 15V | --- | ±0.25 | ±0.4 | % |
| Min. Load | No minimum Load Requirement | | | | | |
| Ripple & Noise | 0-20MHz Bandwidth | 1.5V to 6.5V | --- | --- | 30 | mV _{P-P} |
| | | 9V to 15V | --- | --- | 40 | mV _{P-P} |
| Transient Recovery Time | 50% Load Step Change | --- | 100 | --- | μsec | |
| Transient Response Deviation | | --- | ±2 | --- | % | |
| Temperature Coefficient | | --- | --- | ±0.015 | %/°C | |
| Output Current Limit | | --- | --- | 1 | A | |
| Short Circuit Protection | Continuous | | | | | |

General Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------------------------|-----------|------|------|-------|
| I/O Isolation Voltage | None | | | | |
| Switching Frequency | | 280 | 330 | 380 | KHz |
| MTBF(calculated) | MIL-HDBK-217F@25°C, Ground Benign | 2,000,000 | --- | --- | Hours |

Input Fuse (recommended)

| 1.5V,1.8V Output Models | 2.5V Output Models | 3.3V Output Models | 5V,6.5V,9V,12V,15V Output Models |
|-------------------------|----------------------|----------------------|----------------------------------|
| 500mA Slow-Blow Type | 600mA Slow-Blow Type | 700mA Slow-Blow Type | 1000mA Slow-Blow Type |

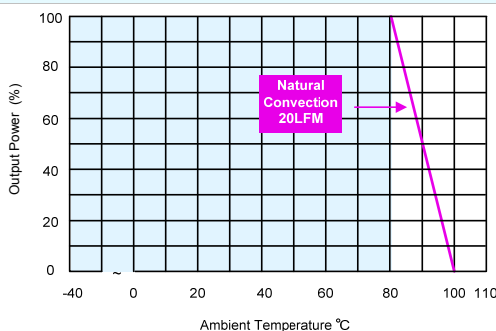
Environmental Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--|----------------------|------|------|------|----------|
| Operating Ambient Temperature Range (See Power Derating Curve) | Natural Convection | -40 | --- | +90 | °C |
| Case Temperature | | --- | --- | +100 | °C |
| Storage Temperature | | -55 | --- | +125 | °C |
| Thermal Shutdown | Internal IC junction | --- | 160 | --- | °C |
| Humidity (non condensing) | | --- | --- | 95 | % rel. H |
| Lead Temperature (1.5mm from case for 10Sec.) | | --- | --- | 260 | °C |

EMC Specifications

| Parameter | Standards & Level | Performance |
|-------------------------|---------------------------------------|----------------------|
| Conducted EMI | Compliance to EN55022 and FCC part 15 | Class B (See Page 3) |
| Radiated Emissions | EN55022 | Class B |
| ESD | EN61000-4-2 | Class A |
| Radiated immunity | EN61000-4-3 | Class A |
| Fast transient (4) | EN61000-4-4 | Class A |
| Conducted immunity | EN61000-4-6 | Class A |
| Magnetic Field Immunity | EN61000-4-8 | Class A |

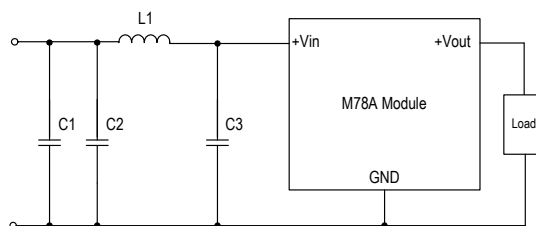
Power Derating Curve



Notes

- Specifications typical at Ta=+25°C, resistive load, nominal input voltage, rated output current unless otherwise noted.
- Other input and output voltage may be available, please contact factory.
- We recommend to protect the converter by a slow blow fuse in the input supply line.
- The M78A series can meet EN61000-4-4 by adding a capacitor across the input pins. Suggested capacitor CHEMI-CON KY 330µF/100V.
- That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- It needs to increase 1V for Vin(min) under high and low temperature.
- With a input capacitor 22µF/50V for input voltage >28VDC, the input voltage allows 32VDC, max.
- Specifications are subject to change without notice.

EMI-Filter to meet EN 55022, class A, class B; FCC part 15, level A



| Class | Model | C1 | C2 | C3 | L1 |
|---------|-------------|---------------------------|---------------------------|---------------------------|--------------------------------|
| Class A | M78A series | --- | 4.7 μ F/50V 1206 MLCC | 4.7 μ F/50V 1206 MLCC | Würth Elektronik NO. 744774033 |
| Class B | M78A series | 4.7 μ F/50V 1206 MLCC | 4.7 μ F/50V 1206 MLCC | 4.7 μ F/50V 1206 MLCC | Würth Elektronik NO. 74477410 |

Package Specifications

| Mechanical Dimensions | Pin Connections | | | | | | | | |
|-----------------------|--|-----|----------|---|------|---|-----|---|-------|
| | <table border="1"> <thead> <tr> <th>Pin</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+Vin</td> </tr> <tr> <td>2</td> <td>GND</td> </tr> <tr> <td>3</td> <td>+Vout</td> </tr> </tbody> </table> | Pin | Function | 1 | +Vin | 2 | GND | 3 | +Vout |
| Pin | Function | | | | | | | | |
| 1 | +Vin | | | | | | | | |
| 2 | GND | | | | | | | | |
| 3 | +Vout | | | | | | | | |
| | <ul style="list-style-type: none"> ▶ All dimensions in mm (inches) ▶ Tolerance: X.X\pm0.5 (X.XX\pm0.02) X.XX\pm0.25 (X.XXX\pm0.01) ▶ Pins \pm0.05(\pm0.002) | | | | | | | | |

Physical Characteristics

| | |
|---------------|---|
| Case Size | : 11.5x7.55x10.2mm (0.45x0.30x0.40 inches) |
| Case Material | : Non-Conductive Black Plastic (flammability to UL 94V-0 rated) |
| Pin Material | : Alloy 42 |
| Weight | : 1.95g |