

FEATURES

- ▶ Industrial Standard SIP-3 Package
- ▶ Pin-out compatible with LM78xx Linear Regulators
- ▶ Fully Regulated Output Voltage
- ▶ Low Ripple & Noise
- ▶ Excellent Efficiency up to 96%
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ Low No Load Power Consumption
- ▶ No Min. Load Requirement
- ▶ Over Temp. and Short Circuit Protection



PRODUCT OVERVIEW

The MINMAX M78AR-1 series is a new range of switching regulators designed as a drop-in replacement for old LM78xx linear regulators with low efficiency. 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 ⁽⁶⁾ VDC	Output Voltage VDC	Output Current	Max. capacitive Load μF	Efficiency (typ.) @Min. Vin	Efficiency (typ.) @Max. Vin
			Max. mA		%	%
M78AR033-1	6.5 ~ 32	3.3	1000	470	93	87
M78AR05-1	6.5 ~ 32	5	1000	470	94	90
M78AR12-1	15 ~ 32	12	1000	470	96	94

Input Specifications

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

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit	
Output Voltage Setting Accuracy		---	---	±2.0	%Vnom.	
Line Regulation	Vin=Min. to Max. @Full Load	3.3V, 5V	---	±0.2	±0.4	%
		12V	---	±0.1	±0.2	%
Load Regulation	Io=10% to 100%	3.3V, 5V	---	±0.4	±0.6	%
		12V	---	±0.25	±0.4	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20MHz Bandwidth	3.3V, 5V	---	---	50	mV _{p-p}
		12V	---	---	75	mV _{p-p}
Transient Recovery Time	50% Load Step Change	---	250	---	μsec	
Transient Response Deviation		---	±2	---	%	
Temperature Coefficient		---	---	±0.015	%/°C	
Short Circuit Protection	Continuous, Automatic Recovery					

General Specifications

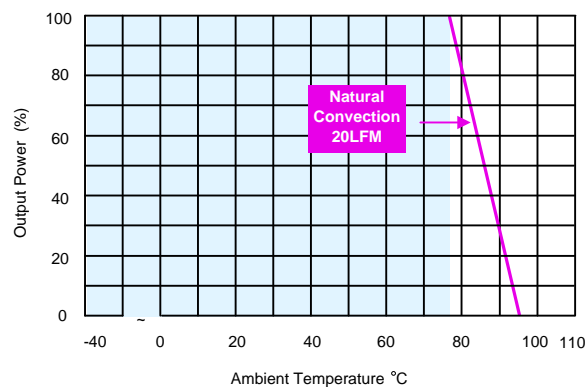
Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	None				
Switching Frequency		---	420	---	KHz
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	9,000,000	---	---	Hours

Environmental Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	Natural Convection	-40	---	+85	°C
Case Temperature		---	---	+95	°C
Storage Temperature		-55	---	+125	°C
Thermal Shutdown	Internal IC junction	---	150	---	°C
Humidity (non condensing)		---	---	95	% rel. H
Cooling	Natural Convection				
Lead-free reflow solder process (1.5mm from case for 10Sec.)		---	---	260	°C

EMC Specifications

Parameter	Standards & Level	Performance	
EMI	Radiation without adding any external components	EN55022, FCC part 15	
	Conduction with external components		
EMS	ESD	EN61000-4-2 Air±8kV	A
	Radiated immunity	EN61000-4-3 3V/m	A
	Fast transient ⁽⁴⁾	EN61000-4-4 ±0.5kV	A
	Conducted immunity	EN61000-4-6 3Vrms	A
	PFMF	EN61000-4-8 3A/m	A

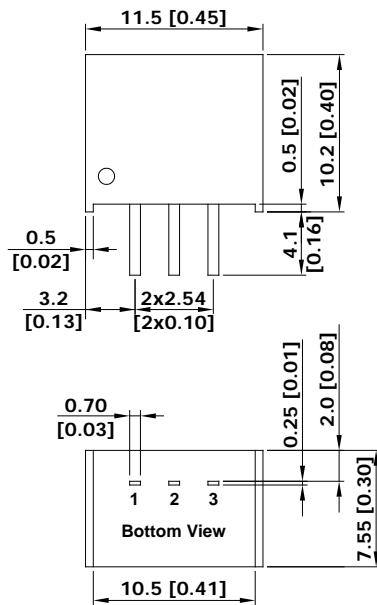
Power Derating Curve


Notes

- 1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage, rated output current unless otherwise noted.
- 2 Other input and output voltage may be available, please contact factory.
- 3 We recommend to protect the converter by a slow blow fuse in the input supply line.
- 4 The M78AR-1 series can meet EN61000-4-4 by adding a capacitor across the input pins. Suggested capacitor: 22μF/50V(CHEMI-CON KY).
- 5 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- 6 With a input capacitor 22μF/50V (CHEMI-CON KY) for input voltage >28VDC, the input voltage allows 32VDC, max.
- 7 To meet EN55022 Class A,B an external filter, please contact MINMAX.
- 8 Specifications are subject to change without notice.

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Function
1	+Vin
2	GND
3	+Vout

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.5 (X.XX±0.02)
X.XX±0.25 (X.XXX±0.01)
- ▶ Pins ±0.05(±0.002)

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)

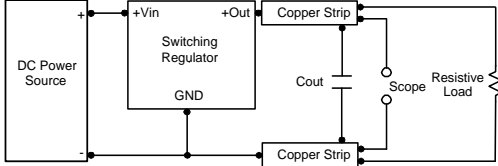
Pin Material : Alloy 42

Weight : 2.2g

Test Setup

Peak-to-Peak Output Noise Measurement Test

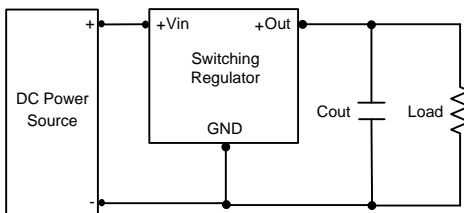
Use a C_{out} 0.47 μ F ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC/DC Converter.



Technical Notes

Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 3.3 μ F capacitors at the output.



Maximum Capacitive Load

The M78AR-1 series has limitation of maximum connected capacitance on the output. The power module may operate in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.