

# MA600MHI Series

## High Isolation, 6W Medical Approved DC/DC Converters



### Key Features:

- 6W Output Power
- 4 kVAC rms Isolation
- Reinforced Insulation
- 2  $\mu$ A Leakage Current Max
- Wide 2:1 Input Range
- Compact DIP Case
- Single & Dual Outputs
- Meets EN55022
- 700 kHz MTBF
- EN 60950 Approved
- EN 60601 Approved



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### Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

Input						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Input Start Voltage	12 VDC Input	7.0	8.0	9.0	VDC	
	24 VDC Input	13.0	15.0	18.0		
	48 VDC Input	30.0	33.0	36.0		
Under Voltage Shutdown	12 VDC Input			8.5	VDC	
	24 VDC Input			16.0		
	48 VDC Input			34.0		
Input Filter	$\pi$ (Pi) Filter (Complies with EN55022 Class A)					
Leakage Current	240 VAC, 60 Hz			2	$\mu$ A	
Short Circuit Input Power				3,000	mW	

Output						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Output Voltage Accuracy			$\pm 0.5$	$\pm 1.0$	%	
Output Voltage Balance	Dual Output, Balanced Loads		$\pm 0.5$	$\pm 2.0$	%	
Line Regulation	$V_{in} = \text{Min to Max}$		$\pm 0.3$	$\pm 0.5$	%	
Load Regulation	$I_{out} = 25\% \text{ to } 100\%$		$\pm 0.5$	$\pm 1.0$	%	
Ripple & Noise (20 MHz), See Note 1	5V Output		75	100	mV P - P	
	All Other Outputs		100	150		
Ripple & Noise (20 MHz)	Over Line, Load & Temp.			180	mV P - P	
Ripple & Noise (20 MHz)				25		
Output Power Protection		120			%	
Transient Recovery Time, See Note 2	25% Load Step Change		300	500	$\mu$ Sec	
Transient Response Deviation			$\pm 3.0$	$\pm 6.0$		
Temperature Coefficient			$\pm 0.02$	$\pm 0.05$	%/°C	
Output Short Circuit	Continuous (Autorecovery)					

General						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Isolation Voltage, Rated	60 Seconds	4,000			VAC rms	
Isolation Test Voltage	Flash Tested For 1 Sec	6,000			VPk	
Reinforced Insulation Working Voltage		300			VAC	
Isolation Resistance	500 VDC	1,000			M $\Omega$	
Isolation Capacitance	100 kHz, 1V		7	13	pF	
Switching Frequency			150		kHz	

Environmental						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Operating Temperature Range	Ambient	-40		+75	°C	
Operating Temperature Range	Case	-40		+95	°C	
Storage Temperature Range		-50		+125	°C	
Cooling	Free Air Convection					
Humidity	RH, Non-condensing			95	%	

Physical						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Case Size		1.25 x 0.80 x 0.47 Inches (31.8 x 20.3 x 12.0 mm)				
Case Material		Non-Conductive Black Plastic (UL94-V0)				
Weight		0.63 Oz (18.0g)				

### Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units	
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	700			kHours	
Safety Approvals	UL 60601, UL 60950, EN 60601, EN 60950					

### Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units	
Input Voltage Surge (1 Sec)	12 VDC Input	-0.7		25.0	VDC	
	24 VDC Input	-0.7		50.0		
	48 VDC Input	-0.7		100.0		
Lead Temperature	1.5 mm From Case For 10 Sec			260	°C	
Internal Power Dissipation	All Models			2,500	mW	

**Caution:** Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.

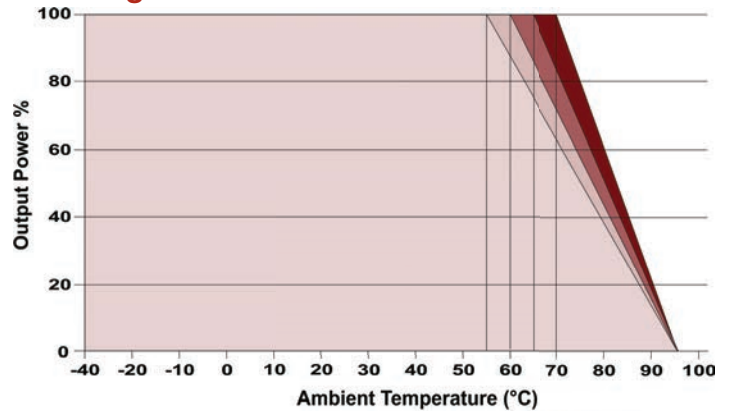
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Model Number	Input				Reflected Ripple Current (mA, Typ)	Output			Capacitive Load ( $\mu$ F, Max)	Efficiency (% , Typ)	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)			Voltage (VDC)	Current (mA, Max)	Current (mA, Min)			
	Nominal	Range	Full-Load	No-Load							
MA612MS-05HI	12	9.0 - 18.0	570	30	60	5.0	1,000	200.0	1,000	75	1,200
MA612MS-12HI	12	9.0 - 18.0	641	30	60	12.0	500	100.0	470	78	1,200
MA612MD-12HI	12	9.0 - 18.0	641	30	60	$\pm$ 12.0	$\pm$ 250	$\pm$ 50.0	$\pm$ 220	78	1,200
MA612MD-15HI	12	9.0 - 18.0	641	30	60	$\pm$ 15.0	$\pm$ 200	$\pm$ 40.0	$\pm$ 220	78	1,200
MA624MS-05HI	24	18.0 - 36.0	278	20	30	5.0	1,000	200.0	1,000	77	600
MA624MS-12HI	24	18.0 - 36.0	313	20	30	12.0	500	100.0	470	80	600
MA624MD-12HI	24	18.0 - 36.0	313	20	30	$\pm$ 12.0	$\pm$ 250	$\pm$ 50.0	$\pm$ 220	80	600
MA624MD-15HI	24	18.0 - 36.0	313	20	30	$\pm$ 15.0	$\pm$ 200	$\pm$ 40.0	$\pm$ 220	80	600
MA648MS-05HI	48	36.0 - 75.0	139	10	15	5.0	1,000	200.0	1,000	77	300
MA648MS-12HI	48	36.0 - 75.0	156	10	15	12.0	500	100.0	470	80	300
MA648MD-12HI	48	36.0 - 75.0	156	10	15	$\pm$ 12.0	$\pm$ 250	$\pm$ 50.0	$\pm$ 220	80	300
MA648MD-15HI	48	36.0 - 75.0	156	10	15	$\pm$ 15.0	$\pm$ 200	$\pm$ 40.0	$\pm$ 220	80	300

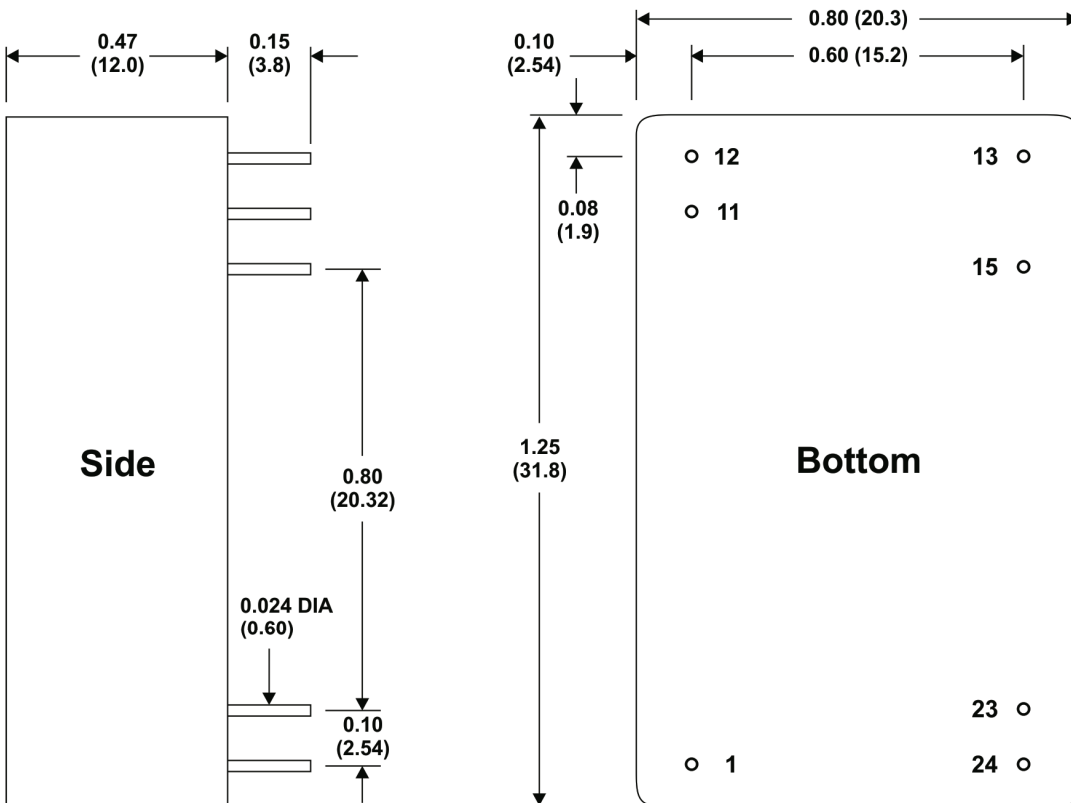
Notes:

- When measuring output ripple, it is recommended that an external 0.47  $\mu$ F ceramic capacitor be placed from the +Vout pin to the -Vout pin for single output units and from each output to common for dual output units. For noise sensitive applications, the use of 3.3  $\mu$ F capacitors will reduce the output ripple.
- Transient recovery is measured to within a 1% error band for a load step change of 75% to 100%.
- Dual output units may be connected to provide a 24 VDC or 30 VDC output. To do this, connect the load across the positive (+Vout) and negative (-Vout) outputs and float the output common.
- The converter should be connected to a low ac-impedance source. An input source with a highly inductive impedance may affect the stability of the converter. In applications where the converter output loading is high and input power is supplied over long lines, it may be necessary to use a capacitor on the input to insure start-up. In this case, it is recommended that a low ESR (ESR <1.0 $\Omega$  at 100 kHz) capacitor be mounted close to the converter. For 12V input units a 10.0  $\mu$ F is recommended, for 24V a 4.7  $\mu$ F and for 48V units a 2.2  $\mu$ F.
- It is recommended that a fuse be used on the input of a power supply for protection. See the table above for the correct rating.

Derating Curve



Mechanical Dimensions



Pin Connections

Pin	Single	Dual
1	+VIN	+VIN
11	No Pin	Common
12	-VOUT	No Pin
13	+VOUT	-VOUT
15	No Pin	+VOUT
23	-VIN	-VIN
24	-VIN	-VIN

Mechanical Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx =  $\pm$ 0.01 ( $\pm$ 0.25)