

# MA40H Series

40W, Encapsulated DIP2"x1" Package DC/DC Converters



## Features

- Rated power: 40W Max
- Input voltage 40...160VDC
- Regulated output with 10% trimming range
- High efficiency up to 91%
- Isolation voltage 3KVDC
- Low ripple and noise
- Remote On/Off control
- Operating temperature range: -40 ~ +85°C ambient
- RoHS compliant
- Standard 2"x1" package
- Six-sided metal shielding package
- Under voltage, over voltage, over current, and short circuit protection
- Meet EN/IEC 62368-1, EN50155 standards
- Designed for railway apps
- 3 year warranty



## Overview

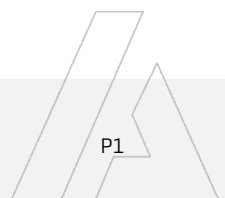
MA40H series are 2"x1" package DC/DC converters specially designed for railway applications. The series meet EN50155 Europe railway standard and IEC/EN62368 industrial standards. They are input under voltage protected, output over voltage, over current, and short circuit protected, 500Khrs minimum MTBF, highly reliable, and ideally suitable for the railway applications.

## Model Numbers

Model Number	Input Voltage [VDC]			V <sub>OUT</sub> [VDC]	Output Current [mA]		Efficiency [%] Typ.	Capacitive Load [uF] Max.
	Nom.	Range	*Max.		Max.	Min.		
MA40H-033	110	40-160	170	3.3	10000	0	87	10000
MA40H-050	110	40-160	170	5	8000	0	88	10000
MA40H-120	110	40-160	170	12	3333	0	91	2700
MA40H-150	110	40-160	170	15	2667	0	91	1680
MA40H-240	110	40-160	170	24	1667	0	89	680
MA40H-480	110	40-160	170	48	833	0	89	470

\* Input voltage exceed the Max. value may cause permanent damage.

\* Only typical models are listed. Other models may be available upon request.

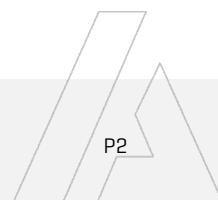


## Electrical Specifications

Unless otherwise indicated, specifications are measured at  $T_A=25^{\circ}\text{C}$ , nominal input voltage, full load after warm up.

Parameters	Conditions	Min.	Typ.	Max.	Unit	Note
Input current Full load	$V_{OUT}=3.3\text{V}$	-	345	-	mA	
	Others		413			
Input current No load	$V_{OUT}=3.3\text{V}$		5	-	mA	
	Others		3			
Reflected ripple current		-	25	-	mA	
Input voltage surge 1 second max		-0.7	-	180	VDC	
Startup input voltage	Full load	-	-	40	VDC	
Startup time	Resistive load	-	20	-	mS	
Input under voltage shutdown		28	32	-	VDC	
Remote On/Off control "Ctrl" pin open or logic high [ON] "Ctrl" pin grounded or logic low [OFF]	Logic high	3.5	-	12	VDC	Positive Logic
	Logic low	0	-	1.2	VDC	
	Ctrl pin current	-	2	10	mA	
Output voltage accuracy	$I_{OUT}=5\%$ to $100\%$	-	$\pm 1$	$\pm 3$	%	
Line regulation Full load, $V_{IN}=V_{IN, Min}$ to $V_{IN, Max}$		-	$\pm 0.4$	$\pm 1.0$	%	
Load regulation $I_{OUT}=5\%$ to $100\%$ of $I_{OUT, rated}$		-	$\pm 0.5$	$\pm 1.0$	%	
Output ripple and noise 20MHz bandwidth, peak to peak		-	150	200	mVp-p	
Temperature coefficient	Full load	-	-	0.03	%/ $^{\circ}\text{C}$	
Dynamic load response $I_{OUT}=25\% \sim 50\% \sim 75\%$ of $I_{OUT, rated}$	Peak deviation*		$\pm 5$	$\pm 8$	% $V_{OUT}$	* $V_{OUT}=3.3, 5\text{V}$
	Peak deviation	-	$\pm 3$	$\pm 5$	% $V_{OUT}$	
	Recovery time		300	500	$\mu\text{S}$	
Output voltage trim	Trim range	-	-	$\pm 10$	% $V_{OUT}$	
Output over voltage protection		110	-	160	% $V_{OUT}$	
Output over current protection		110	140	190	% $I_{OUT}$	
Output short circuit protection		Continuous, automatic recovery				
Input filter		PI filter				
Hot plug		None				

\* Operating with less than 5% of rated load will not cause damage to the converters, but the performances data may not fall into the specifications, and stable operating is not assured.



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## General Specifications

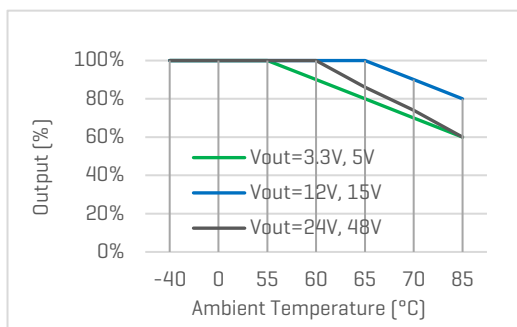
Parameters	Conditions	Min.	Typ.	Max.	Unit	Note
<b>Isolation voltage</b> 1 minute, leakage current 1mA max.	I/P to O/P	3000	-	-	VDC	
<b>Isolation resistance</b> Tested at 500VDC	I/P to O/P	1000	-	-	M ohm	
<b>Isolation capacitance</b> 100KHz, 0.1V	I/P to O/P	-	2200	3000	pF	
<b>Switching frequency*</b>	Full load	-	220	-	KHz	PWM mode
<b>Operating temperature</b>	See "Derating Curve"	-40	-	85	°C	
<b>Storage temperature</b>		-55	-	125	°C	
<b>Storage humidity</b>	None condensing	5	-	95	%RH	
<b>Pin soldering resistance</b> 1.5mm away from case for 10 sec		-	-	300	°C	
<b>Vibration</b>		IEC/EN61373 - Category 1, Grade B				
<b>Cooling method</b>		Free air convection				
<b>Case material</b>		Aluminum alloy				
<b>MTBF</b>	MIL-HDBK-217F	>500,000 Hours, T <sub>A</sub> =25°C				
<b>Design based on standards</b>		EN/IEC 62368-1, EN50155				
<b>Safety certifications</b>		EN/IEC 62368-1				
<b>EMC</b>		CISPR32, EN55032 Class B, IEC/EN61000-4-2, 3, 4, 5, 6 EN50155, IEC/EN50121-3-2, EN55016-2-1				
<b>Size, and Weight</b>		50.8 x 25.4 x 12 mm, 41g				

\* Switching frequency is measured at full load. The converter reduces the switching frequency at low load [less than 50% load] for better efficiency.

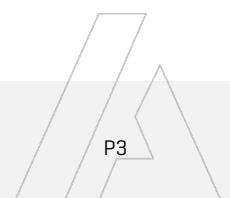
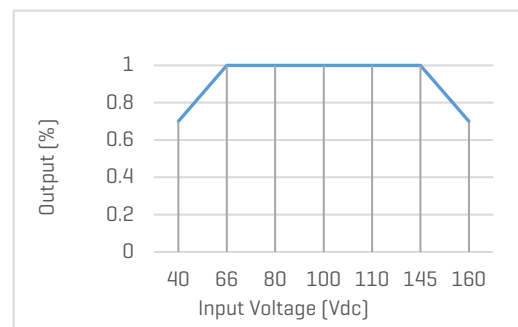
## Characteristic Curves

### Derating Curve

Output vs Ambient Temperature



Output vs Input Voltage



## Recommended Application Circuit

### Typical External Circuit

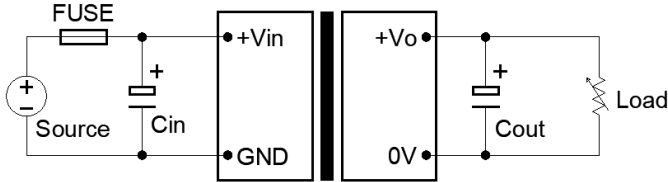


Figure 1. Typical external circuit

#### Note

\*Typical application circuit is to further lower the input and output ripple. It is not required for general use.

\*Recommended component specifications are typical values. Excessive external capacitive load may cause startup problem.

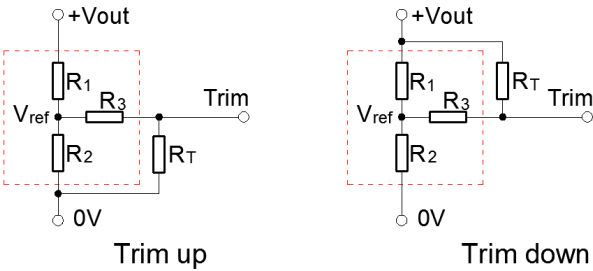
[Table 1] Recommended component spec

V <sub>OUT</sub>	3.3, 5V	12, 15V	24, 48V
C <sub>OUT</sub>	470uF, 50V	220uF, 50V	100uF, 100V

\*Recommended FUSE to be 2A slow blow, and C<sub>IN</sub> to be 100uF, 100V

### Circuits for Output Trim

\* Components within the red block are internal components of the converter.



\* The formulas to calculate the desired resistance of Trim resistor "RT".

$$\text{Trim up: } R_T = \frac{a R_2}{R_2 - a} - R_3 \quad a = \frac{V_{ref}}{V_{OUT} - V_{ref}} R_1$$

$$\text{Trim down: } R_T = \frac{a R_1}{R_1 - a} - R_3 \quad a = \frac{V_{OUT} - V_{ref}}{V_{ref}} R_2$$

[Table 3] Internal Component Spec

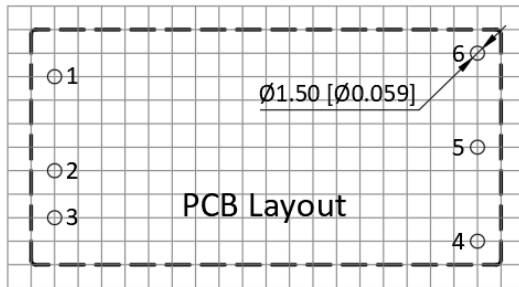
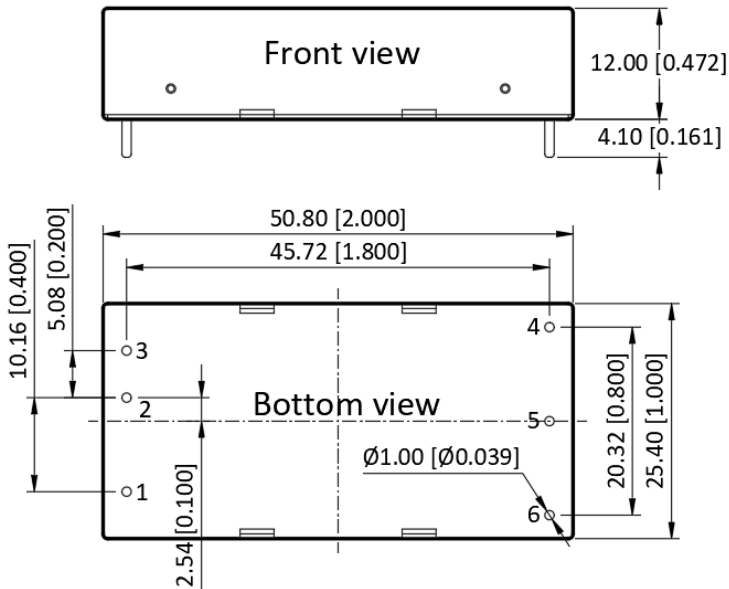
V <sub>OUT</sub> [V]	R1 [K Ohm]	R2 [K Ohm]	R3 [K Ohm]	V <sub>ref</sub> [V]
3.3	4.801	2.87	10	1.24
5	2.883	2.87	10	2.5
12	11.000	2.87	15	2.5
15	14.384	2.87	15	2.5
24	24.872	2.87	17.8	2.5
48	55.28	3.0	20	2.5

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## Mechanical Specifications



### Pin Definition

Pin #	Single Out
1	Ctrl
2	GND
3	V <sub>IN</sub>
4	+V <sub>OUT</sub>
5	0V
6	Trim

\* Unless otherwise specified unit: mm [inch]

\* General tolerance:  $\pm 0.50$  [ $\pm 0.020$ ]

\* Pin thickness:  $\pm 0.10$  [ $\pm 0.004$ ]

\* Footprint grid 2.54 x 2.54 mm

