MA20H Series

20W, Encapsulated DIP2"X1" Package DC/DC Converters for Railway Applications

Features

- Rated power: 20W Max
- Input voltage 40...160VDC
- Regulated output with 10% trimming range
- High efficiency up to 88%
- Isolation voltage 2250VDC
- 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 IEC/EN 62368-1, EN50155 standards
- Designed for railway apps
- 5 year warranty

Overview

MA20H 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, 1000Khrs minimum MTBF, highly reliable, and ideally suitable for the railway applications.

Model Numbers

Model Number	Input Voltage [VDC]			V_{OUT} [VDC]	Output Current [mA]		Efficiency [%] Typ.	Capacitive Load [uF] Max.
	Nom.	Range	*Max.		Max.	Min.		
MA20H-033	110	40-160	170	3.3	5000	0	82	10000
MA20H-050	110	40-160	170	5	4000	0	85	10000
MA20H-120	110	40-160	170	12	1667	0	86	2700
MA20H-150	110	40-160	170	15	1333	0	86	1680
MA20H-240	110	40-160	170	24	833	0	87	680
MA20H-480	110	40-160	170	48	417	0	88	470

* Input voltage exceed the Max. value may cause permanent damage.
* Only typical models are listed. Other models may be available upon request.
* Check Mechanical Specifications for different types of pinouts. Model numbers listed here are for default options, add suffix for other pinout options, e.g. MA20H-050A.

Electrical Specifications

Unless otherwise indicated, specifications are measured at T_A=25°C, nominal input voltage, full load after warm up.

Parameters	Conditions	Min.	Typ.	Max.	Unit	Note
Input current Full load	V_{OUT}=3.3V Others	-	183 214	-	mA	
Input current No load	V_{OUT}=3.3V Others		10 3	-	mA	
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	-	10	-	mS	
Input under voltage shutdown		28	33	-	VDC	
Remote On/Off control "Ctrl" pin open or logic high [ON] "Ctrl" pin grounded or logic low [OFF]	Logic high Logic low Ctrl pin current	3.5 0 -	- - 2	12 1.2 7	VDC VDC mA	Positive Logic
Output voltage accuracy	I_{OUT}=5% to 100%	-	±1	±3	%	
Line regulation Full load, V_{IN}=$V_{IN, Min}$ to $V_{IN, Max}$		-	±0.4	±1.0	%	
Load regulation I_{OUT}=5% to 100% of $I_{OUT, rated}$		-	±0.5	±1.0	%	
Output ripple and noise 20MHz bandwidth, peak to peak		-	50	100	mVp-p	
Temperature coefficiency	Full load	-	-	0.03	%/°C	
Dynamic load response I_{OUT}=25%~50%~75% of $I_{OUT, rated}$	Peak deviation* Peak deviation Recovery time	-	±3 ±3 300	±8 ±5 500	% V_{OUT} % V_{OUT} uS	*V_{OUT}=3.3, 5V
Output voltage trim	Trim range	-	-	±10	% V_{OUT}	
Output over voltage protection		110	-	-	% V_{OUT}	
Output over current protection		120	-	-	% 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.

General Specifications

Parameters	Conditions	Min.	Typ.	Max.	Unit	Note
Isolation voltage 1 minute, leakage current 1mA max.	I/P to O/P I/P & O/P to Case	2250 1600	-	-	VDC	
Isolation resistance Tested at 500VDC	I/P to O/P	1000	-	-	M ohm	
Isolation capacitance 100KHz, 0.1V	I/P to O/P	-	2200	-	pF	
Switching frequency*	Full load	-	300	-	KHz	PWM mode
Operating temperature	See "Derating Curve"	-40	-	85	°C	
Storage temperature		-55	-	125	°C	
Storage humidity	None condensing	5	-	95	%RH	
Pin soldering resistance 1.5mm away from case for 10 sec		-	-	300	°C	
Cooling method		Free air convection				
Case material		Aluminum alloy				
Vibration		IEC/EN61373 – Category 1, Grade B				
MTBF	MIL-HDBK-217F	>1,000,000 Hours, T_A=25°C				
Design based on standards		EN/IEC 62368-1, EN50155				
Safety certifications		EN/IEC 62368-1				
EMC		CISPR32, EN55032 Class B, IEC/EN61000-4-2, 3, 4, 5, 6 EN50155, IEC/EN50121-3-2, EN55016-2-1				
Size, and Weight		50.8 x 25.4 x 12 mm, 41g				

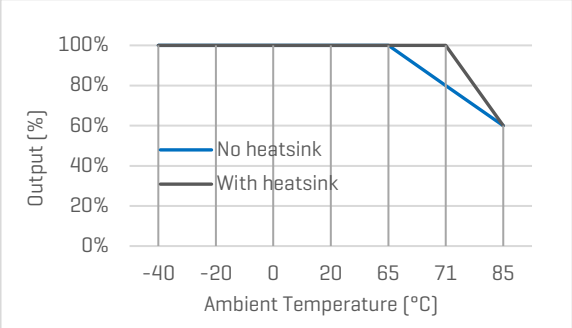
* Switching frequency is measured at full load. The converter reduces the switching frequency at low load (less than 50% load) for better efficiency.

Characteristic Curves

Derating Curve

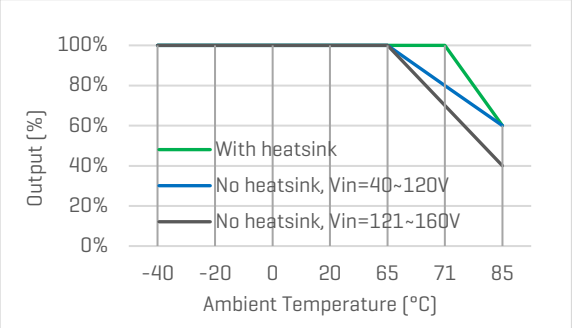
Output vs Ambient Temperature

V_{IN}=40~160V, V_{OUT}=12, 15, 24, 48V

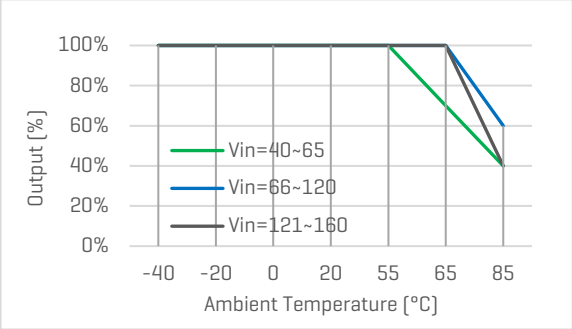


Output vs Input Voltage

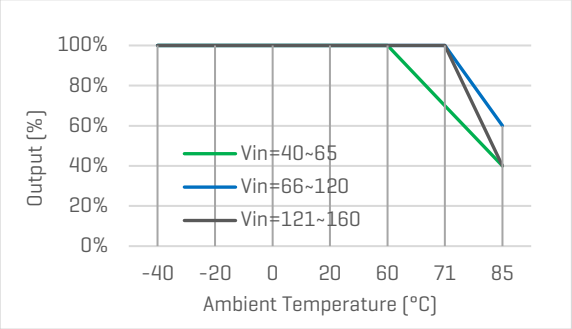
V_{OUT}=3.3V



V_{OUT}=5V, no heatsink



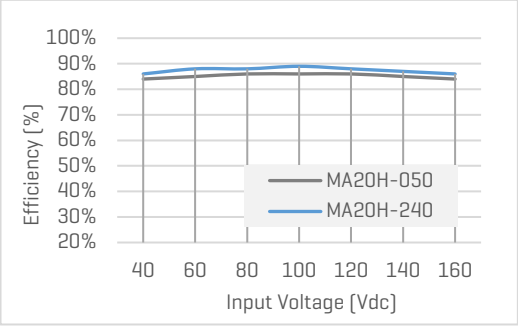
V_{OUT}=5V, with heatsink



Efficiency Curve

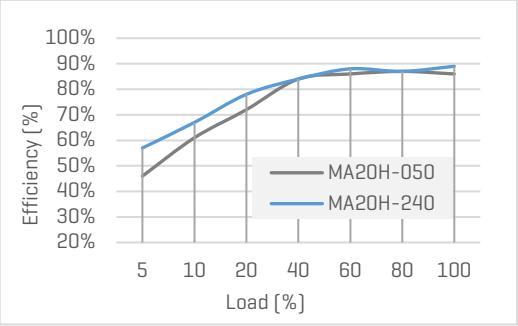
Efficiency vs Input Voltage

Full load



Efficiency vs Load

V_{IN}=110Vdc



Recommended Application Circuit

Typical External Circuit

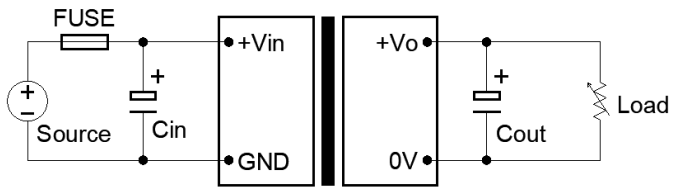


Figure 1. Typical external circuit

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_{OUT}	3.3, 5V	12, 15V	24, 48V
C_{OUT}	470uF	220uF	100uF

*Recommended FUSE to be 2A slow blow, and C_{IN} to be 10...47uF

Circuit for EMC Enhancement

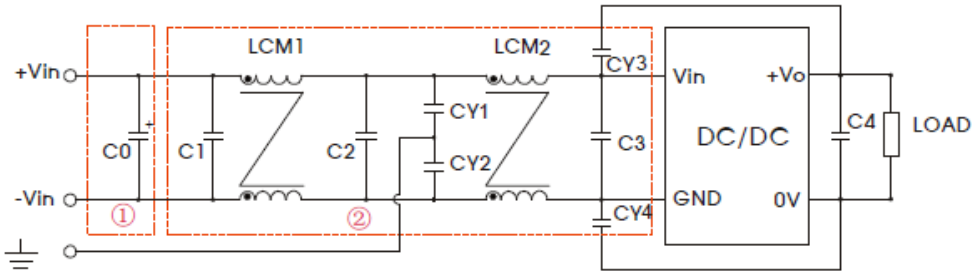


Figure 2: Circuit for EMC Enhancement

Recommended component specifications

Symbol	Condition	Recommended value
Fuse		2A, slow blow
LCM1		2.2mH
LCM2		0.53mH
C0		100uF, 200V
C1, C2		0.22uF, 250V
C3		10~47uF
C4		Refer to C_{OUT} in Table 1
CY1 ... CY4		1000pF, 400Vac

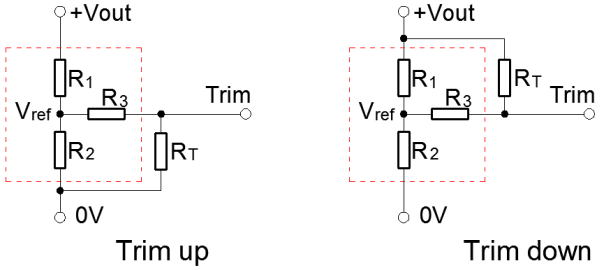
* Do not use two converters in parallel to supply higher power.

* Consult our technical staff for more information about application.

Recommended Application Circuit

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 "R_T".

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

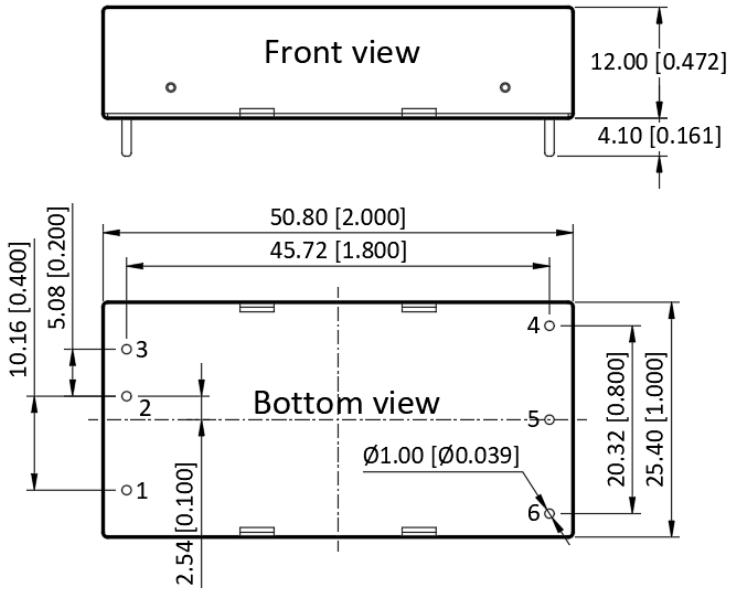
Trim down: $R_T = \frac{a\,R_1}{R_1 - a} - R_3$ $\quad a = \frac{V_{OUT} - V_{ref}}{V_{ref}} R_2$

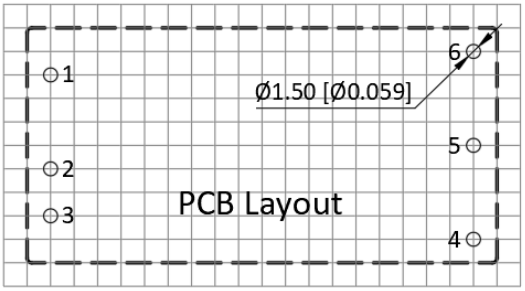
[Table 3]Internal Component Spec

V_{OUT} [V]	R1 [K Ohm]	R2 [K Ohm]	R3 [K Ohm]	V_{ref} [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

Mechanical Specifications

Default Package





Pin Definition

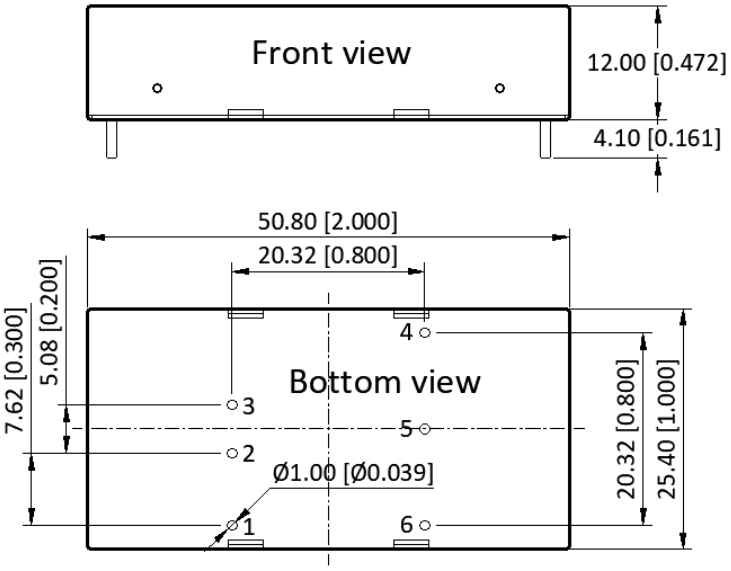
Pin #	Single Out
1	Ctrl
2	GND
3	V_{IN}
4	$+V_{OUT}$
5	0V
6	Trim

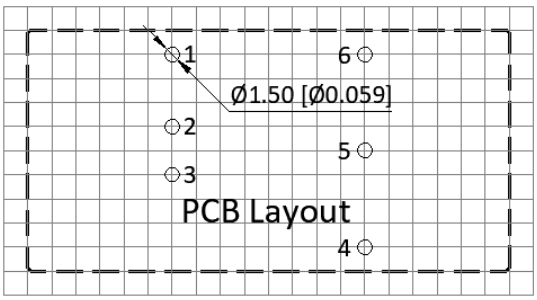
* Unless otherwise specified unit: mm [inch]
* General tolerance: ±0.50 [±0.020]
* Pin thickness: ±0.10 [±0.004]
* Footprint grid 2.54 x 2.54 mm

Mechanical Specifications

Suffix "A" Package

Add suffix "A" to model numbers for this type of pinout. E.g. MA20H-050A





Pin Definition

Pin #	Single Out
1	Ctrl
2	GND
3	V_{IN}
4	$+V_{OUT}$
5	Trim
6	0V

* Unless otherwise specified unit: mm [inch]
* General tolerance: ±0.50 [±0.020]
* Pin thickness: ±0.10 [±0.004]
* Footprint grid 2.54 x 2.54 mm