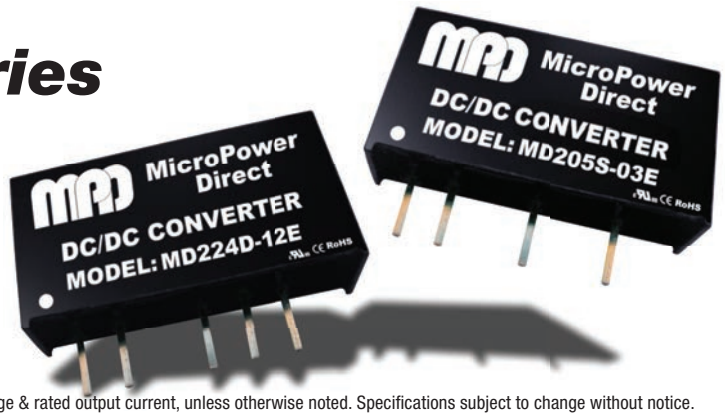
MD200E Series

Low Cost, 2W Miniature SIP DC/DC Converters



Key Features:

- 2W Output Power
- Miniature SIP Case
- EN 60950 Approved
- Single & Dual Outputs
- 1,500 VDC Isolation
- >3.5 MHour MTBF
- -40°C to +105°C Operation
- LOW COST

3.0 kV Isolation Models Available

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 Voltage Range	5 VDC Input	4.50	5.0	5.50	VDC
	9 VDC Input	8.10	9.0	9.90	
	12 VDC Input	10.80	12.0	13.20	
	15 VDC Input	13.50	15.0	16.50	
	24 VDC Input	21.60	24.0	26.40	
Input Filter	Internal Capacitor				

Output

Parameter		Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy		See Tolerance Graphs (Page 3)				
Line Regulation	3.3 VDC Output	For VIN Change of 1%			±1.5	%
	All Other Outputs				±1.2	
Load Regulation, See Note 3		See Model Selection Guide				
Ripple & Noise (20 MHz)		See Note 4		75	200	mV P - P
Temperature Coefficient					±0.03	%/°C
Output Short Circuit, See Note 5		All 5 VIN Models except 24 VOUT	Continuous (Autorecovery)			
		All Other Models	Momentary (1S)			

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	60 Seconds	1,500			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz, 1V		20		pF
Switching Frequency			100		kHz

EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Page 3	EN 55032		Class B
Conducted Emissions, See Page 3	EN 55032		Class B
ESD, Single Output Models	EN 61000-4-2	B	Contact ±8 kV
ESD, Dual Output Models	EN 61000-4-2	B	Contact ±6 kV

Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+105	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Physical

Case Size	See Mechanical Dimensions (Page 4)
Case Material	Non-Conductive Black Plastic (UL-94V0)
Weight	0.08 Oz (2.4g)

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	3.5			MHours

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (1 Sec)	5 VDC Input			9.0	VDC
	9 VDC Input			12.0	
	12 VDC Input			18.0	
	15 VDC Input			21.0	
	24 VDC Input			30.0	
Lead Temperature	1.5 mm From Case For 10 Sec			300	°C

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

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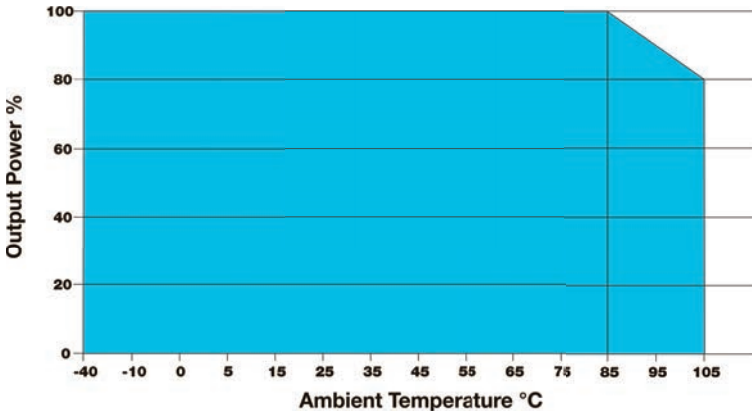
Model Selection Guide

	Model Number	Input				Output			Load Regulation (%, Typ)	Output Capacitive Load (µF 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							
	MD205S-03E	5	4.5 - 5.5	334	35	3.3	400	40.0	18.0	220	79	700
UL	MD205S-05E	5	4.5 - 5.5	476	35	5.0	400	40.0	12.0	220	84	1,000
UL	MD205S-09E	5	4.5 - 5.5	506	35	9.0	222	22.0	9.0	220	79	1,000
UL	MD205S-12E	5	4.5 - 5.5	476	35	12.0	167	17.0	8.0	220	84	1,000
UL	MD205S-15E	5	4.5 - 5.5	476	35	15.0	133	13.0	7.0	220	84	1,000
UL	MD205S-24E	5	4.5 - 5.5	476	35	24.0	83	8.0	6.0	220	84	1,000
	MD205D-03E	5	4.5 - 5.5	500	35	±3.3	±303	±30.0	18.0	100	71	1,000
UL	MD205D-05E	5	4.5 - 5.5	500	35	±5.0	±200	±20.0	12.0	100	80	1,000
UL	MD205D-09E	5	4.5 - 5.5	476	35	±9.0	±111	±11.0	9.0	100	84	1,000
UL	MD205D-12E	5	4.5 - 5.5	476	35	±12.0	±83	±8.0	8.0	100	84	1,000
UL	MD205D-15E	5	4.5 - 5.5	487	35	±15.0	±67	±7.0	7.0	100	82	1,000
UL	MD205D-24E	5	4.5 - 5.5	476	35	±24.0	±42	±4.0	6.0	100	84	1,000
	MD209S-05E	9	8.1 - 9.9	281	25	5.0	400	40.0	12.0	220	79	600
	MD209S-12E	9	8.1 - 9.9	267	25	12.0	167	17.0	9.0	220	83	600
	MD212S-03E	12	10.8 - 13.2	139	20	3.3	400	40.0	18.0	220	79	300
UL	MD212S-05E	12	10.8 - 13.2	203	20	5.0	400	40.0	12.0	220	82	500
UL	MD212S-09E	12	10.8 - 13.2	206	20	9.0	222	22.0	9.0	220	81	500
UL	MD212S-12E	12	10.8 - 13.2	198	20	12.0	167	17.0	8.0	220	84	500
UL	MD212S-15E	12	10.8 - 13.2	196	20	15.0	133	13.0	7.0	220	85	500
UL	MD212S-24E	12	10.8 - 13.2	194	20	24.0	83	8.0	6.0	220	86	500
UL	MD212D-05E	12	10.8 - 13.2	208	20	±5.0	±200	±20.0	12.0	100	80	500
UL	MD212D-09E	12	10.8 - 13.2	198	20	±9.0	±111	±11.0	9.0	100	84	500
UL	MD212D-12E	12	10.8 - 13.2	198	20	±12.0	±83	±8.0	8.0	100	84	500
UL	MD212D-15E	12	10.8 - 13.2	198	20	±15.0	±67	±7.0	7.0	100	84	500
UL	MD212D-24E	12	10.8 - 13.2	198	20	±24.0	±42	±4.0	6.0	100	84	500
	MD215S-05E	15	13.5 - 16.5	166	15	5.0	400	40.0	12.0	220	80	400
	MD215S-15E	15	13.5 - 16.5	157	15	15.0	133	13.0	7.0	220	85	400
	MD215S-24E	15	13.5 - 16.5	162	15	24.0	83	8.0	6.0	220	82	400
	MD215D-05E	15	13.5 - 16.5	166	15	±5.0	±200	±20.0	12.0	100	80	400
	MD215D-15E	15	13.5 - 16.5	153	15	±15.0	±67	±7.0	7.0	100	84	400
	MD224S-03E	24	21.6 - 26.4	70	10	3.3	400	40.0	18.0	220	79	200
UL	MD224S-05E	24	21.6 - 26.4	104	10	5.0	400	40.0	12.0	220	80	250
UL	MD224S-09E	24	21.6 - 26.4	97	10	9.0	222	22.0	9.0	220	86	250
UL	MD224S-12E	24	21.6 - 26.4	99	10	12.0	167	17.0	8.0	220	84	250
UL	MD224S-15E	24	21.6 - 26.4	97	10	15.0	133	13.0	7.0	220	86	250
UL	MD224S-24E	24	21.6 - 26.4	97	10	24.0	83	8.0	6.0	220	86	250
	MD224D-03E	24	21.6 - 26.4	104	10	±3.3	±303	±30.0	18.0	100	80	250
UL	MD224D-05E	24	21.6 - 26.4	104	10	±5.0	±200	±20.0	12.0	100	80	250
UL	MD224D-09E	24	21.6 - 26.4	97	10	±9.0	±111	±11.0	9.0	100	86	250
UL	MD224D-12E	24	21.6 - 26.4	99	10	±12.0	±83	±8.0	8.0	100	84	250
UL	MD224D-15E	24	21.6 - 26.4	99	10	±15.0	±67	±7.0	7.0	100	84	250
UL	MD224D-24E	24	21.6 - 26.4	99	10	±24.0	±42	±4.0	6.0	100	84	250

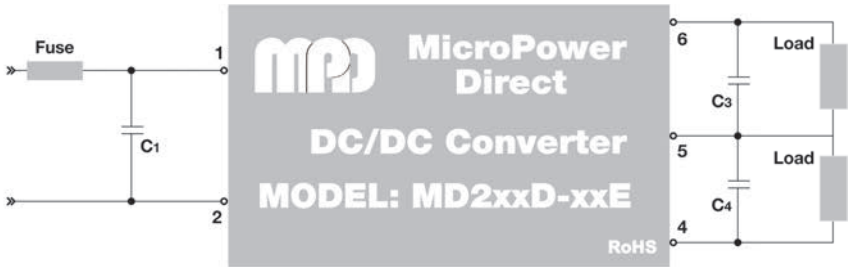
Notes:

1. Units that are marked with the "*UL*" in the model selection table above are approved to EN 60950.
2. Output capacitive load is specified for each output.
3. Output load regulation is specified for a load change of 10% to 100%.
4. When measuring output ripple, it is recommended that an external 1 µF ceramic capacitor & 10 µF electrolytic capacitor be placed in parallel from the +VOUT pin to the -VOUT pin for single output models, or from each output to common for dual output models.
5. Units with limited short circuit protection must be restarted after a fault.
6. Operation at no load will not damage these units, however, they may not meet all specifications.
7. It is recommended that a fuse be used on the input of a power supply for protection. See the Model Selection table above for the correct rating.

Derating Curve



Simple Connection

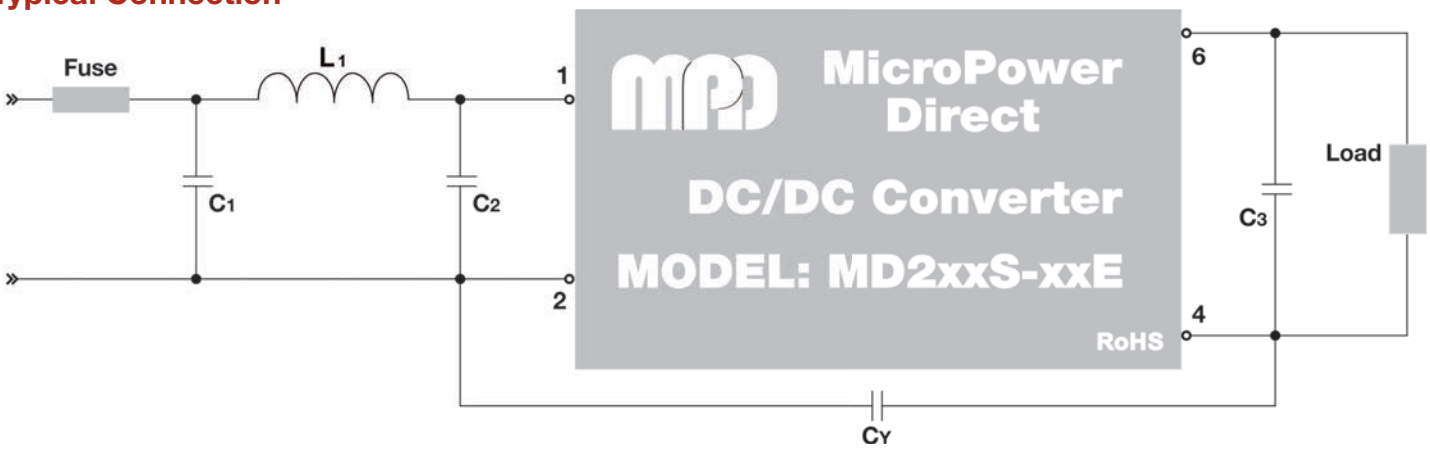


VIN	C1
5 VDC	4.7 µF/50V
12 VDC	2.2 µF/50V
15 VDC	2.2 µF/50V
24 VDC	1.0 µF/50V

VOUT	C3/C4
3.3 VDC	10 µF
5 VDC	10 µF
9 VDC	2.2 µF
12 VDC	2.2 µF
15 VDC	1.0 µF
24 VDC	1.0 µF
±3.3 VDC	4.7 µF
±5 VDC	4.7 µF
±9 VDC	1.0 µF
±12 VDC	1.0 µF
±15 VDC	0.47 µF
±24 VDC	0.47 µF

The diagram above illustrates a simple connection of the **MD200xE** series. For applications that do not require the circuit to meet EMi/EMC specifications, the capacitors C1, C3 and C4 will reduce input/output ripple and improve the converter stability over time and temperature. The recommended component values are given in the table at right.

Typical Connection



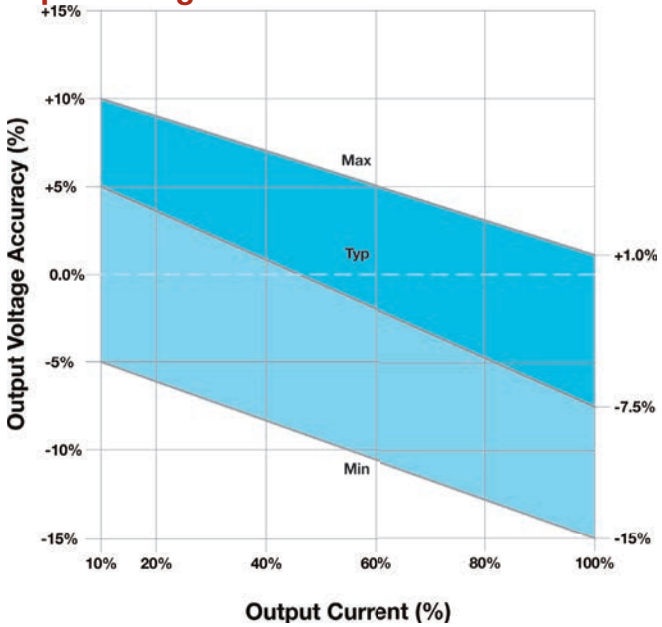
The diagram above illustrates a typical connection of the **MD200xE** series for an application that requires compliance to EMI/EMC standards EN 55032 and EN 61000-4 (as specified on page 1). Some notes on these components are:

1. An external fuse is recommended to protect the unit in the event of a fault on the input line. A recommended value is given in model selection table on page 2.
2. The output filtering capacitor (C3) is a high frequency, low resistance electrolytic capacitor. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. Voltage derating of capacitors should be 80% or above.
3. Suggested component values are:

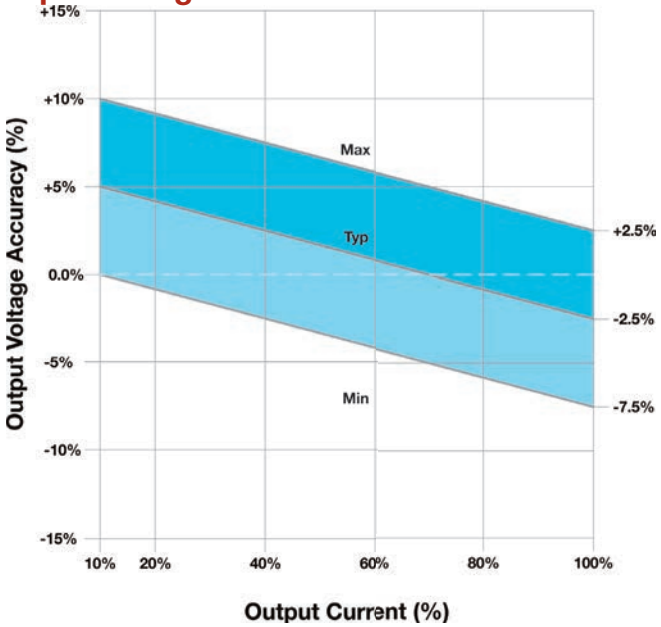
Component	VIN: 5V, 12V, 15V	VIN: 24V
C1	4.7µF/50V	4.7µF/50V
C2	4.7µF/50V	4.7µF/50V
L1	6.8 µH	6.8 µH
C3	See C3/C4 in Table Above	
CY	---	1 nF/3 kV

4. In many applications, simply adding input/output capacitors will enhance the input surge protection & and reduce output ripple sufficiently. In this case, capacitors C1, C3 and C4 could be connected as shown in the simple connection above, without the other filter components. Recommended capacitor values are given in the table above.

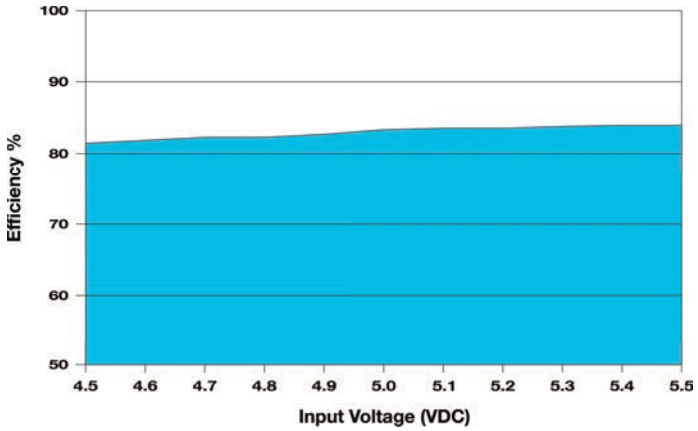
Output Voltage Tolerance: 3.3 VOUT Models



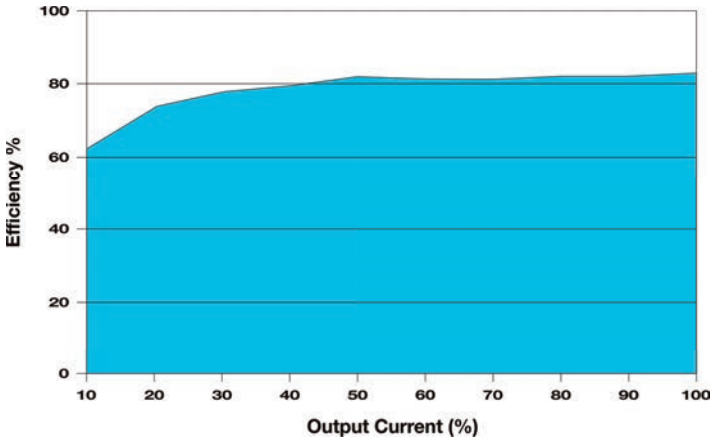
Output Voltage Tolerance: All Other Models



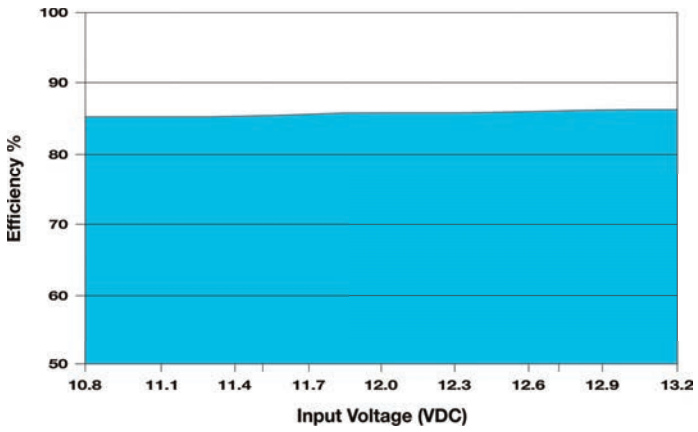
Efficiency vs Input Voltage (5VIN, Full Load)



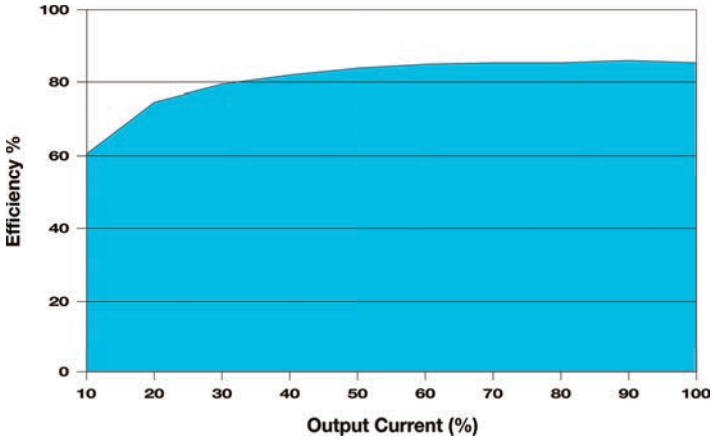
Efficiency vs Output Power (VIN = 5 VDC)



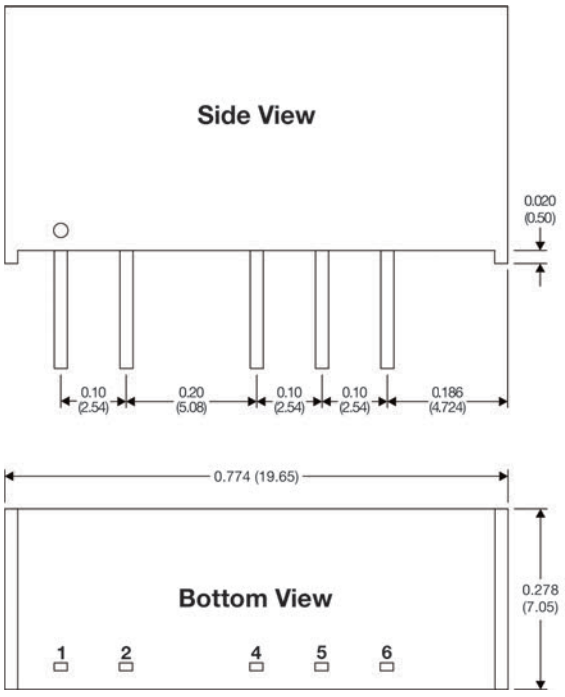
Efficiency vs Input Voltage (12VIN, Full Load)



Efficiency vs Output Power (VIN = 12 VDC)



Mechanical Dimensions



Pin Connections

Pin	Single	Dual
1	+VIN	+VIN
2	-VIN	-VIN
4	-VOUT	-VOUT
5	No Pin	Common
6	+VOUT	+VOUT

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)
- Pin 1 is marked by a "dot" or indentation on the unit

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