

ML100E Series

Single & Dual, 1W Ultra-Miniature SMT DC/DC Converters



Key Features:

- 1W Output Power
- Ultra-Miniature SMT Case
- EN 62368 Approved
- 1,500 VDC Isolation
- Short Circuit Protected
- Single & Dual Output
- -40°C to +105°C Operation
- >3.5 MHour MTBF
- 41 Standard Models
- Available on Tape/Reel
- **LOW COST!**

**3.0 kV Isolation
Models
Available**



MicroPower Direct

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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 Voltage Range	3.3 VDC Input	2.97	3.3	3.63	VDC
	5 VDC Input	4.5	5.0	5.5	
	12 VDC Input	10.8	12.0	13.2	
	24 VDC Input	21.6	24.0	26.4	
Reflected Ripple Current			15		mA
Input Filter	Capacitor				

Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy	See Tolerance Graphs (Page 3)				
Line Regulation, See Note 3	For VIN Change of 1%			±1.2	%
Load Regulation, See Note 4	See Model Selection Guide				
Ripple & Noise (20 MHz), See Note 5	5 VIN, 24 VOUT		50	100	mV P - P
	All Other Models		30	75	
	All Other Models		60		
Temperature Coefficient			±0.02		%/°C
Output Short Circuit, See Note 6	Continuous (Autorecovery)				

General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	See Note 7	1,500			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz, 0.1V		20		pF
Switching Frequency			270		kHz

EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Page 4	CISPR32/EN 55032		Class B
Radiated Emissions	CISPR32/EN 55032		Class B
ESD	EN 61000-4-2	B	±8 kV Air
			±4 kV Contact

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 Drawing (Page 5)				
Case Material	Flame Retardant, Non-Conductive, Black Plastic (UL94-V0)				
Weight	0.046 Oz (1.40g)				

Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	3.5			MHours
Safety Standards, See Note 1	UL/cUL 62368-1 recognition (UL certificate)				

Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (1 Sec)	3.3 VDC Input			5.0	VDC
	5 VDC Input			9.0	
	12 VDC Input			18.0	
	24 VDC Input			30.0	
Peak Reflow Temperature	See Note 8			245	°C
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.

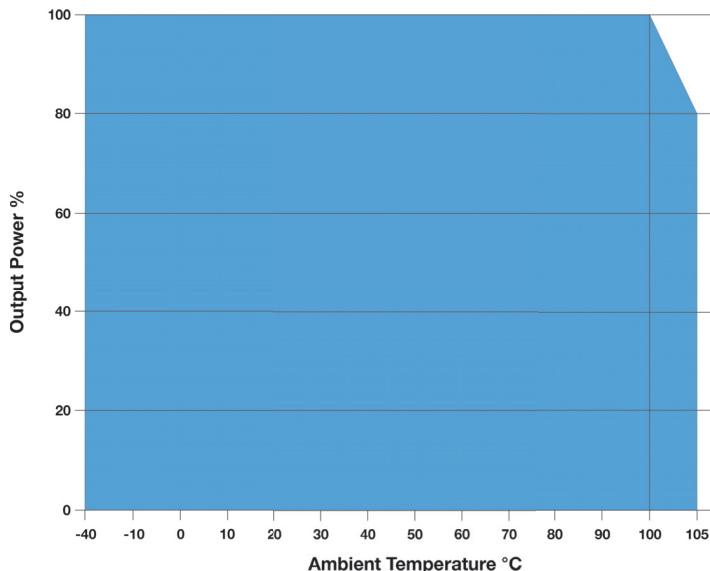
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	Model Number	Input				Output			Load Regulation (% Typ)	Output Capacitive Load (µF Max)	Efficiency (% Typ)	Fuse Rating Slow-Blow (mA)
		Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)				
		Nominal	Range	Full-Load	No-Load							
UL	ML103S-03E	3.3	2.97 - 3.63	433	25	3.3	303.0	30.0	±18.0	220	69	850
	ML103S-05E	3.3	2.97 - 3.63	409	25	5.0	200.0	20.0	±12.0	220	74	800
	ML103S-09E	3.3	2.97 - 3.63	388	25	9.0	111.0	12.0	±8.0	220	78	800
	ML103S-12E	3.3	2.97 - 3.63	378	25	12.0	84.0	9.0	±7.0	220	80	800
	ML103S-15E	3.3	2.97 - 3.63	378	25	15.0	67.0	7.0	±6.0	220	80	800
	ML103S-24E	3.3	2.97 - 3.63	378	25	24.0	42.0	4.0	±5.0	220	80	800
	ML103D-05E	3.3	2.97 - 3.63	388	25	±5.0	±100.0	±10.0	±12.0	100	78	800
	ML103D-12E	3.3	2.97 - 3.63	379	25	±12.0	±42.0	±5.0	±7.0	100	80	800
	ML103D-15E	3.3	2.97 - 3.63	379	25	±15.0	±33.0	±3.0	±6.0	100	80	800
UL	ML105S-03E	5.0	4.50 - 5.50	270	5	3.3	303.0	30.0	±15.0	2,400	74	550
UL	ML105S-05E	5.0	4.50 - 5.50	270	5	5.0	200.0	20.0	±10.0	2,400	82	550
UL	ML105S-09E	5.0	4.50 - 5.50	241	12	9.0	111.0	12.0	±8.0	1,000	83	500
UL	ML105S-12E	5.0	4.50 - 5.50	241	12	12.0	84.0	9.0	±7.0	560	83	500
UL	ML105S-15E	5.0	4.50 - 5.50	241	18	15.0	67.0	7.0	±6.0	560	83	500
UL	ML105S-24E	5.0	4.50 - 5.50	241	18	24.0	42.0	4.0	±5.0	220	85	500
UL	ML105D-05E	5.0	4.50 - 5.50	244	5	±5.0	±100.0	±10.0	±10.0	1,200	82	500
UL	ML105D-09E	5.0	4.50 - 5.50	241	12	±9.0	±56.0	±6.0	±8.0	470	83	500
UL	ML105D-12E	5.0	4.50 - 5.50	241	12	±12.0	±42.0	±5.0	±7.0	220	83	500
UL	ML105D-15E	5.0	4.50 - 5.50	241	18	±15.0	±34.0	±4.0	±6.0	220	83	500
UL	ML105D-24E	5.0	4.50 - 5.50	241	18	±24.0	±21.0	±3.0	±5.0	100	85	500
UL	ML112S-03E	12.0	10.8 - 13.2	116	15	3.3	303.0	30.0	±18.0	220	72	250
UL	ML112S-05E	12.0	10.8 - 13.2	104	15	5.0	200.0	20.0	±12.0	220	80	200
UL	ML112S-09E	12.0	10.8 - 13.2	104	15	9.0	111.0	12.0	±8.0	220	80	200
UL	ML112S-12E	12.0	10.8 - 13.2	104	15	12.0	84.0	9.0	±7.0	220	80	200
UL	ML112S-15E	12.0	10.8 - 13.2	104	15	15.0	67.0	7.0	±6.0	220	80	200
UL	ML112S-24E	12.0	10.8 - 13.2	104	15	24.0	42.0	4.0	±5.0	220	80	200
	ML112D-05E	12.0	10.8 - 13.2	104	15	±5.0	±100.0	±10.0	±12.0	100	80	200
	ML112D-09E	12.0	10.8 - 13.2	104	15	±9.0	±56.0	±6.0	±8.0	100	80	200
	ML112D-12E	12.0	10.8 - 13.2	103	15	±12.0	±42.0	±5.0	±7.0	100	81	200
	ML112D-15E	12.0	10.8 - 13.2	103	15	±15.0	±33.0	±3.0	±6.0	100	81	200
	ML112D-24E	12.0	10.8 - 13.2	103	15	±24.0	±21.0	±2.0	±5.0	100	81	200
UL	ML124S-05E	24.0	21.6 - 26.4	52	7	5.0	200.0	20.0	±12.0	220	80	100
UL	ML124S-09E	24.0	21.6 - 26.4	52	7	9.0	110.0	11.0	±8.0	220	80	100
	ML124S-12E	24.0	21.6 - 26.4	52	7	12.0	84.0	9.0	±7.0	220	80	100
UL	ML124S-15E	24.0	21.6 - 26.4	52	7	15.0	67.0	7.0	±6.0	220	80	100
UL	ML124S-24E	24.0	21.6 - 26.4	52	7	24.0	42.0	4.0	±5.0	220	80	100
	ML124D-05E	24.0	21.6 - 26.4	51	7	±5.0	±100.0	±10.0	±12.0	100	82	100
	ML124D-09E	24.0	21.6 - 26.4	51	7	±9.0	±56.0	±6.0	±8.0	100	82	100
	ML124D-12E	24.0	21.6 - 26.4	51	7	±12.0	±42.0	±5.0	±7.0	100	82	100
	ML124D-15E	24.0	21.6 - 26.4	51	7	±15.0	±33.0	±3.0	±6.0	100	82	100
	ML124D-24E	24.0	21.6 - 26.4	51	7	±24.0	±21.0	±2.0	±5.0	100	82	100

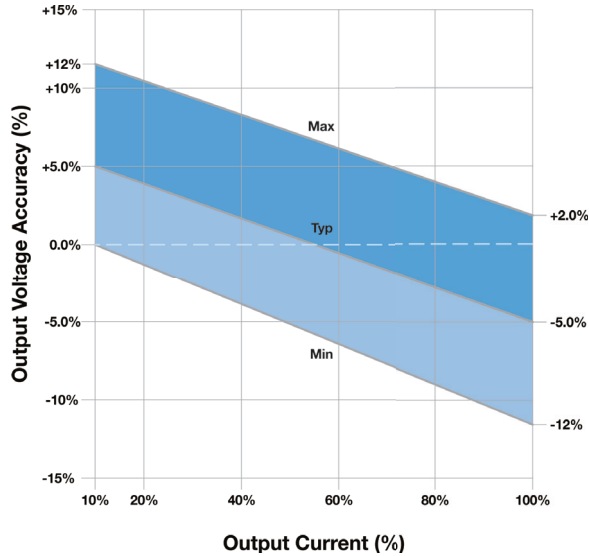
Notes:

- Units that are marked "UL" in the model selection table above are approved to EN 62368 (5 VIN models) or EN 60950 (12 VIN & 24 VIN models).
- Output capacitive load is specified for each output.
- Single 3.3 Vout models have a specified line regulation of 1.5 %/ %.
- Output load regulation is specified for a load change of 10% to 100%.
- When measuring output ripple, it is recommended that an external 1 µF ceramic capacitor & a 10 µF electrolytic capacitor be placed in parallel from the +Vout pin to the -Vout pin for single output units or from each output to common for dual output models.
- The ML124S-xxE models have momentary (1S) protection against short circuit faults.
- Isolation voltage is specified for a period 60S with a leakage current lower than 1 mA.
- The recommended reflow settings are a peak temperature of 245 °C for a maximum period (Tpk) of 10S and a time above liquidous (TL) of ≤60 seconds at 217 °C. This is illustrated at the bottom of page 4. For more information, please contact the factory.
- Operation at no load will not damage these units, however, they may not meet all specifications.
- 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.

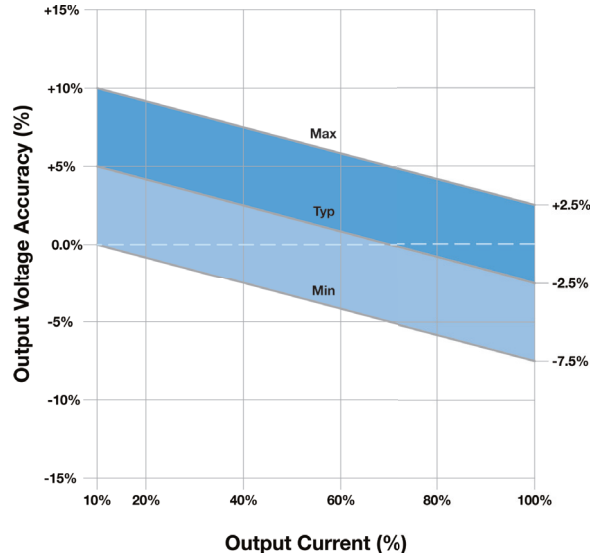
Temperature Derating Curve



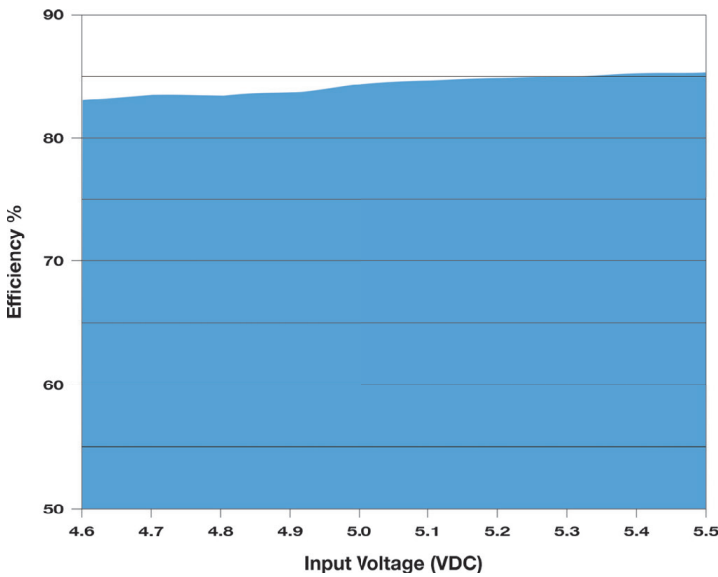
Output Voltage Tolerance: 5 VIN, 3.3 VOUT



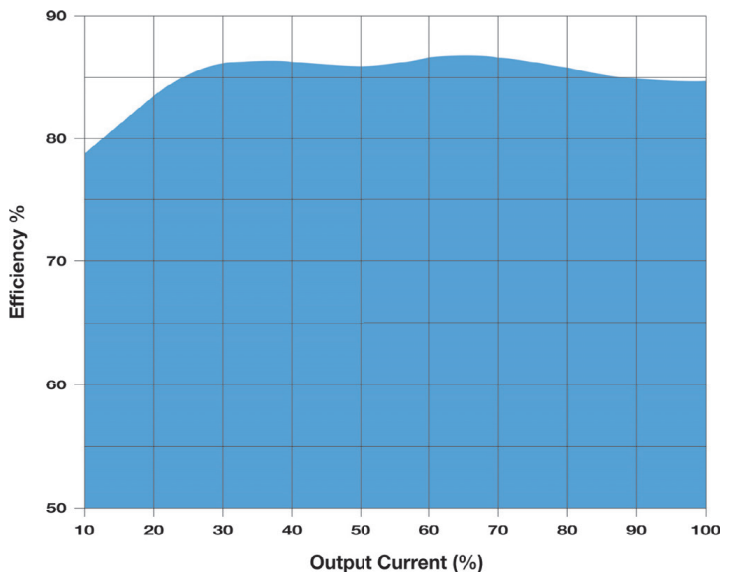
Output Voltage Tolerance: Other 5 VIN Models



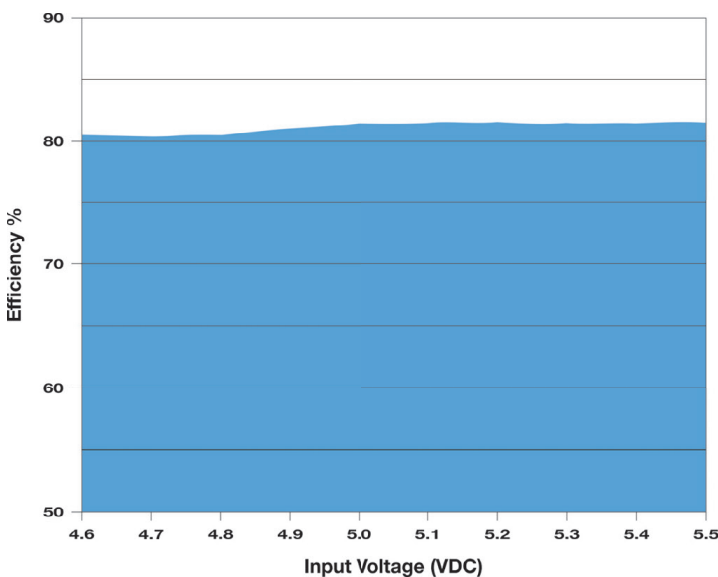
Efficiency vs Input: ML105S-05E



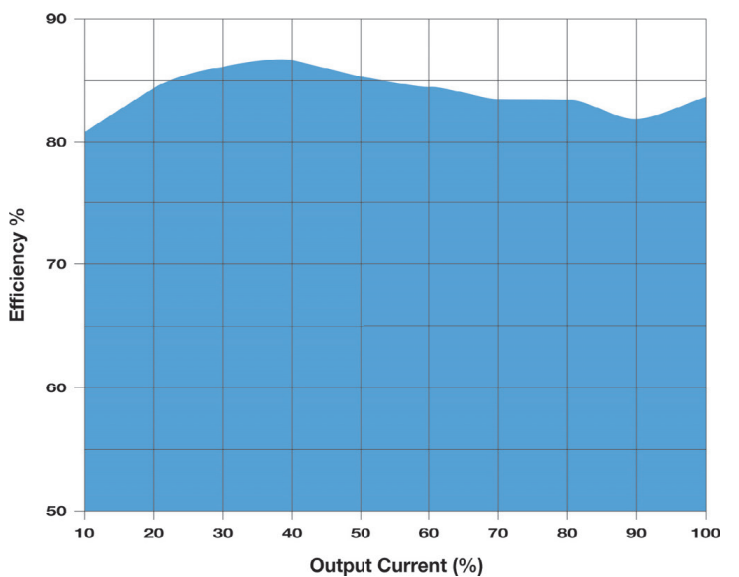
Efficiency vs Output Load: ML105S-05E



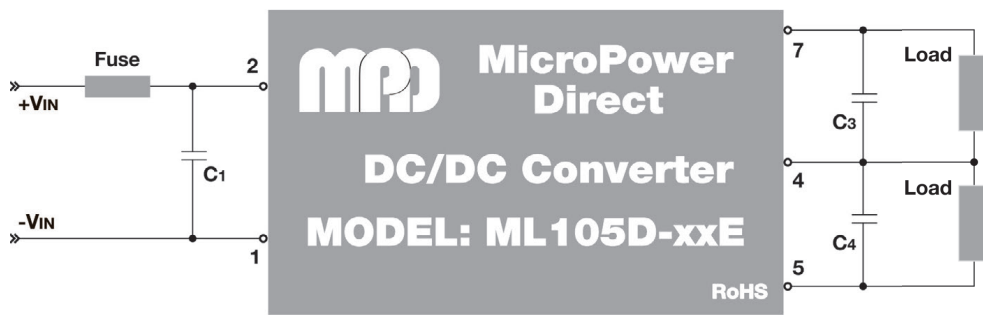
Efficiency vs Input: ML105D-05E



Efficiency vs Output Load: ML105D-05E



Simple Connection

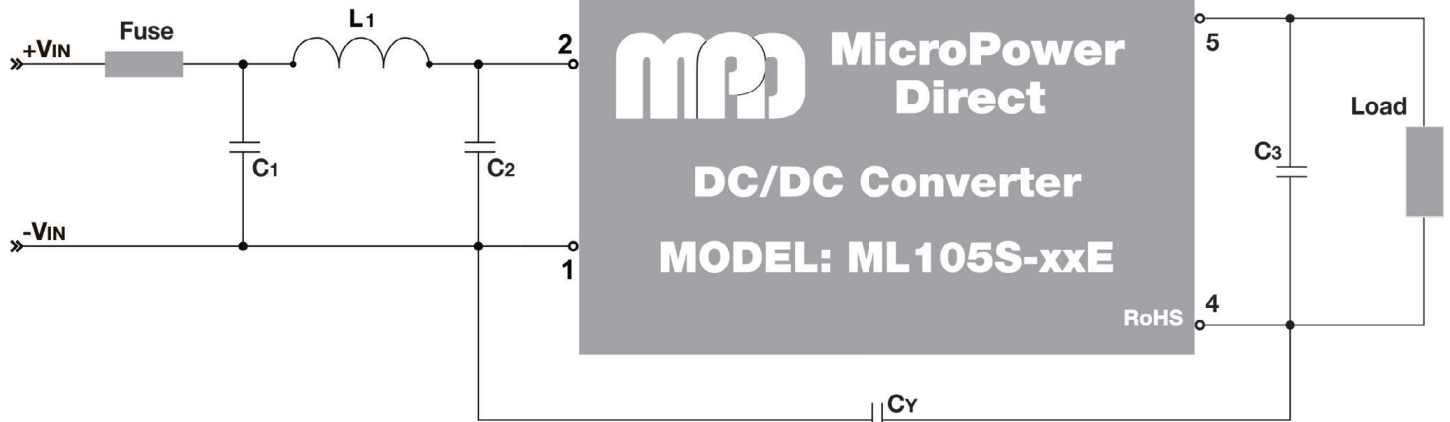


V _{IN}	C ₁
3.3 VDC	4.7 μ F/25V
5 VDC	4.7 μ F/25V
12 VDC	2.2 μ F/50V
24 VDC	1.0 μ F/50V

V _{OUT}	C _{3/C4}
3.3 VDC	10 μ F
5 VDC	10 μ F
9 VDC	4.7 μ F
12 VDC	2.2 μ F
15 VDC	1.0 μ F
24 VDC	0.47 μ F
\pm 5 VDC	4.7 μ F
\pm 9 VDC	2.2 μ F
\pm 12 VDC	1.0 μ F
\pm 15 VDC	1.0 μ F
\pm 24 VDC	1.0 μ FF

The diagram above illustrates a simple connection of the ML100xE 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 ML100xE 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.

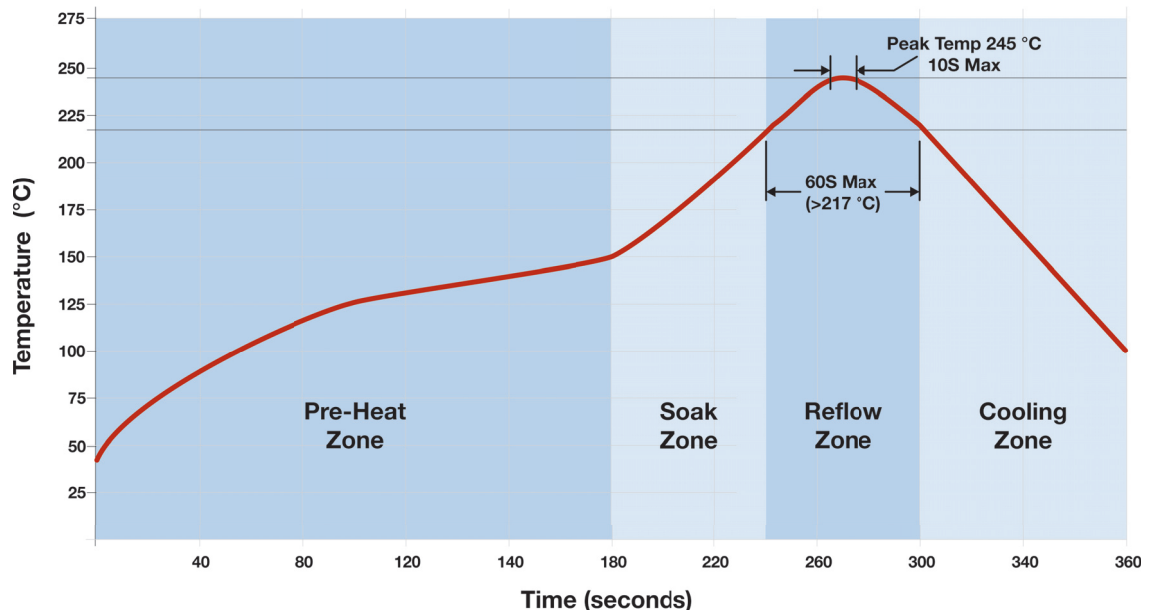
3. Suggested component values are:

Component	V _{IN} : 3.3V, 5V, 12V	V _{IN} : 24V
C1	4.7 μ F/25V	4.7 μ F/50V
C2	4.7 μ F/25V	4.7 μ F/50V
L1	6.8 μ H	6.8 μ H
C3	See C3/C4 in Table Above	
C4	---	1 nF/4 kV

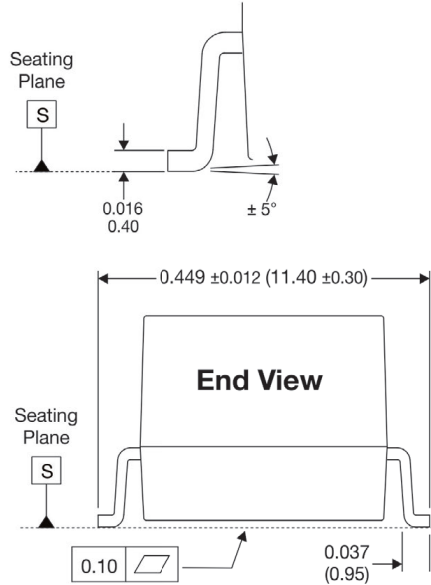
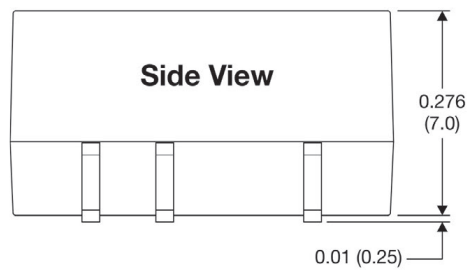
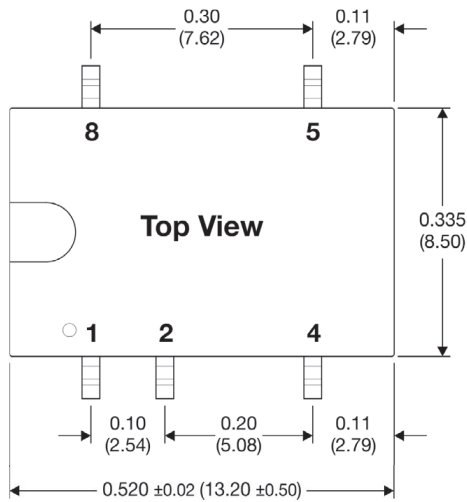
4. In many applications, simply adding input/output capacitors will enhance the input surge protection & and reduce output ripple sufficiently. In this case, capacitors C1, C3 and C4 could be connected as shown in the simple connection above, without the other filter components. Recommended capacitor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

Reflow Solder Settings

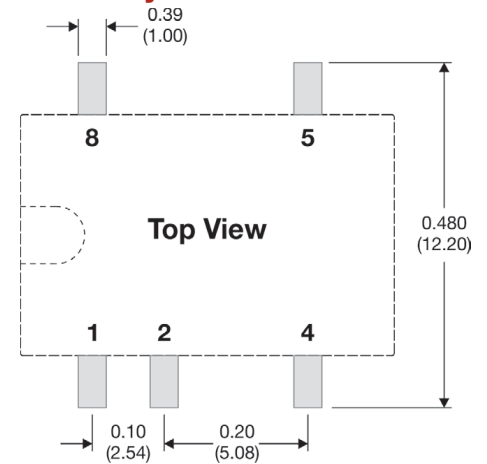
The ML100xE series is designed to meet the IPC/JEDEC standard J-STD-020D for reflow soldering. The recommended reflow settings are a peak temperature of 245 °C for a maximum period (TPK) of 10S and a time above liquidous (TL) of \leq 60 seconds at 217 °C, as illustrated above. For more information, please contact the factory.



Mechanical Dimensions, Single Output



Board Layout



Pin Connections

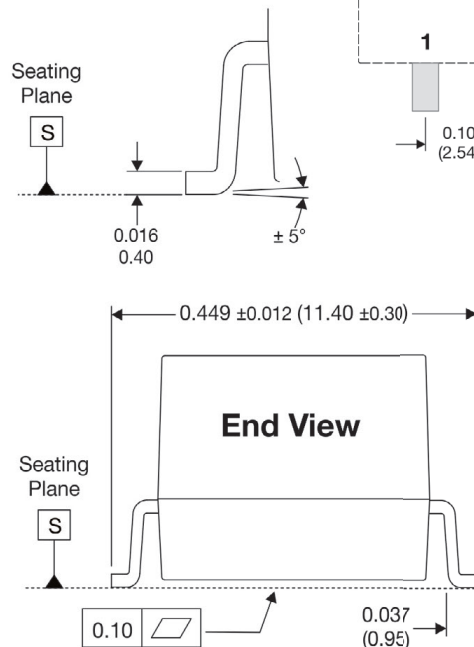
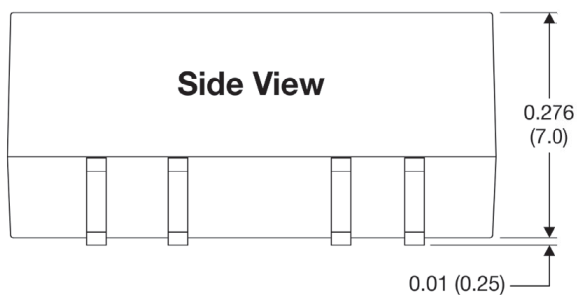
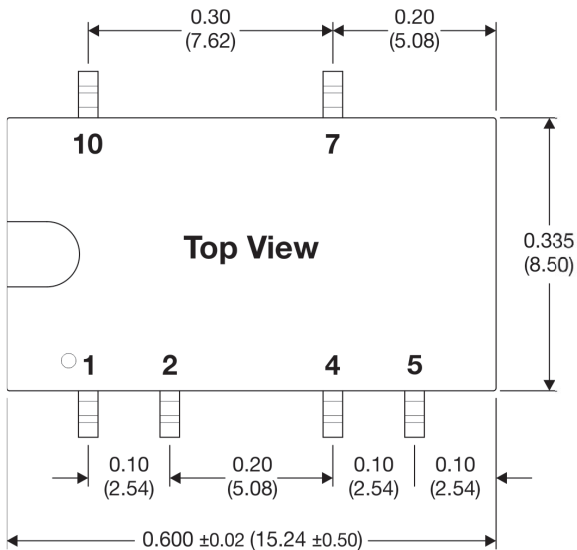
Pin	Description	Pin	Description
1	-VIN	5	+VOUT
2	+VIN	8	NC
4	-VOUT		

NC = Not for electrical connection

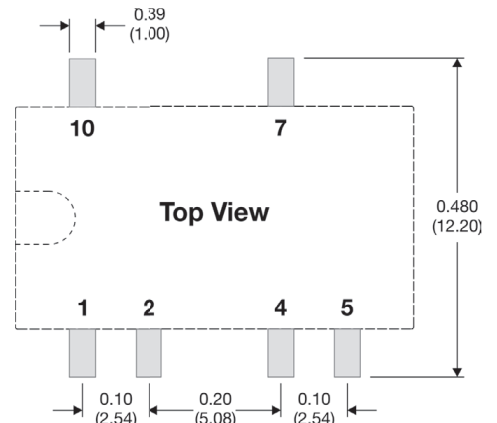
Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.01 (±0.25)
- Pin 1 is marked by a "dot" or indentation on the unit

Mechanical Dimensions, Dual Output



Board Layout



Pin Connections

Pin	Description
1	-VIN
2	+VIN
4	Common
5	-VOUT
7	+VOUT
10	NC

NC = Not for electrical connection

Notes:

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.01 (±0.25)
- Pin 1 is marked by a "dot" or indentation on the unit

