

# 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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Suite D  
Stoughton, MA 02072  
USA

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W: www.micropowerdirect.com



### 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 Retardent, 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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Singel 3 | B-2550 Kontich | Belgium | Tel. +32 (0)3 458 30 33

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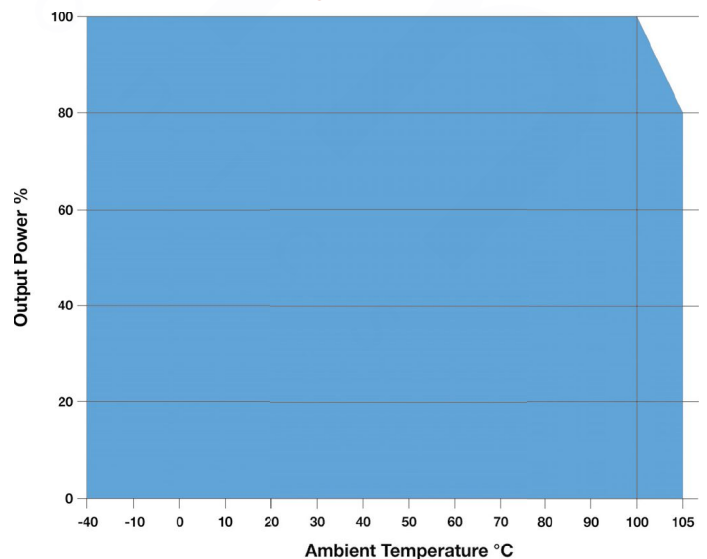
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|           | Model Number | Input         |             |              |         | Output        |                   |                   | Load Regulation (% Typ) | Output Capacitive Load (µF Max) | Efficiency (% Typ) | Fuse Rating Slow-Blow (mA) |
|-----------|--------------|---------------|-------------|--------------|---------|---------------|-------------------|-------------------|-------------------------|---------------------------------|--------------------|----------------------------|
|           |              | Voltage (VDC) |             | Current (mA) |         | Voltage (VDC) | Current (mA, Max) | Current (mA, Min) |                         |                                 |                    |                            |
|           |              | Nominal       | Range       | Full-Load    | No-Load |               |                   |                   |                         |                                 |                    |                            |
| <b>UL</b> | 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                        |
| <b>UL</b> | ML105S-03E   | 5.0           | 4.50 - 5.50 | 270          | 5       | 3.3           | 303.0             | 30.0              | ±15.0                   | 2,400                           | 74                 | 550                        |
| <b>UL</b> | ML105S-05E   | 5.0           | 4.50 - 5.50 | 270          | 5       | 5.0           | 200.0             | 20.0              | ±10.0                   | 2,400                           | 82                 | 550                        |
| <b>UL</b> | ML105S-09E   | 5.0           | 4.50 - 5.50 | 241          | 12      | 9.0           | 111.0             | 12.0              | ±8.0                    | 1,000                           | 83                 | 500                        |
| <b>UL</b> | ML105S-12E   | 5.0           | 4.50 - 5.50 | 241          | 12      | 12.0          | 84.0              | 9.0               | ±7.0                    | 560                             | 83                 | 500                        |
| <b>UL</b> | ML105S-15E   | 5.0           | 4.50 - 5.50 | 241          | 18      | 15.0          | 67.0              | 7.0               | ±6.0                    | 560                             | 83                 | 500                        |
| <b>UL</b> | ML105S-24E   | 5.0           | 4.50 - 5.50 | 241          | 18      | 24.0          | 42.0              | 4.0               | ±5.0                    | 220                             | 85                 | 500                        |
| <b>UL</b> | ML105D-05E   | 5.0           | 4.50 - 5.50 | 244          | 5       | ±5.0          | ±100.0            | ±10.0             | ±10.0                   | 1,200                           | 82                 | 500                        |
| <b>UL</b> | ML105D-09E   | 5.0           | 4.50 - 5.50 | 241          | 12      | ±9.0          | ±56.0             | ±6.0              | ±8.0                    | 470                             | 83                 | 500                        |
| <b>UL</b> | ML105D-12E   | 5.0           | 4.50 - 5.50 | 241          | 12      | ±12.0         | ±42.0             | ±5.0              | ±7.0                    | 220                             | 83                 | 500                        |
| <b>UL</b> | ML105D-15E   | 5.0           | 4.50 - 5.50 | 241          | 18      | ±15.0         | ±34.0             | ±4.0              | ±6.0                    | 220                             | 83                 | 500                        |
| <b>UL</b> | ML105D-24E   | 5.0           | 4.50 - 5.50 | 241          | 18      | ±24.0         | ±21.0             | ±3.0              | ±5.0                    | 100                             | 85                 | 500                        |
| <b>UL</b> | ML112S-03E   | 12.0          | 10.8 - 13.2 | 116          | 15      | 3.3           | 303.0             | 30.0              | ±18.0                   | 220                             | 72                 | 250                        |
| <b>UL</b> | ML112S-05E   | 12.0          | 10.8 - 13.2 | 104          | 15      | 5.0           | 200.0             | 20.0              | ±12.0                   | 220                             | 80                 | 200                        |
| <b>UL</b> | ML112S-09E   | 12.0          | 10.8 - 13.2 | 104          | 15      | 9.0           | 111.0             | 12.0              | ±8.0                    | 220                             | 80                 | 200                        |
| <b>UL</b> | ML112S-12E   | 12.0          | 10.8 - 13.2 | 104          | 15      | 12.0          | 84.0              | 9.0               | ±7.0                    | 220                             | 80                 | 200                        |
| <b>UL</b> | ML112S-15E   | 12.0          | 10.8 - 13.2 | 104          | 15      | 15.0          | 67.0              | 7.0               | ±6.0                    | 220                             | 80                 | 200                        |
| <b>UL</b> | 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                        |
| <b>UL</b> | ML124S-05E   | 24.0          | 21.6 - 26.4 | 52           | 7       | 5.0           | 200.0             | 20.0              | ±12.0                   | 220                             | 80                 | 100                        |
| <b>UL</b> | 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                        |
| <b>UL</b> | ML124S-15E   | 24.0          | 21.6 - 26.4 | 52           | 7       | 15.0          | 67.0              | 7.0               | ±6.0                    | 220                             | 80                 | 100                        |
| <b>UL</b> | 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                        |

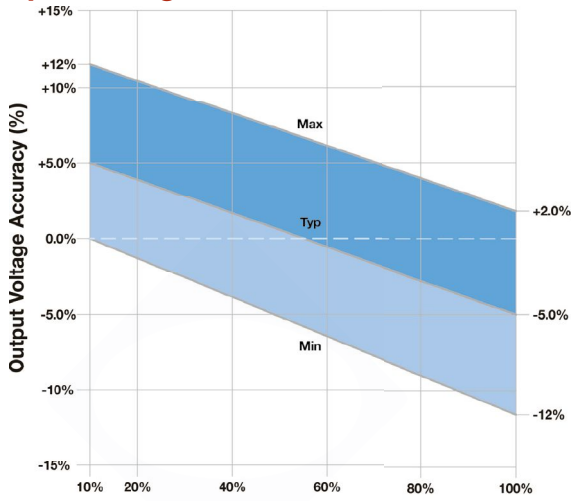
Notes:

- 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.

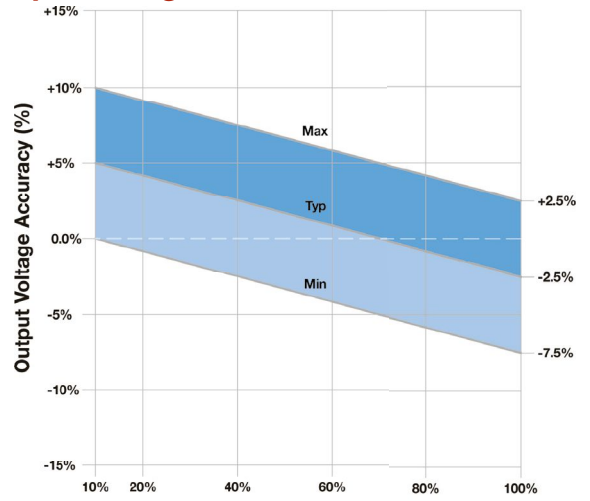
Temperature Derating Curve



**Output Voltage Tolerance: 5 VIN, 3.3 VOUT**



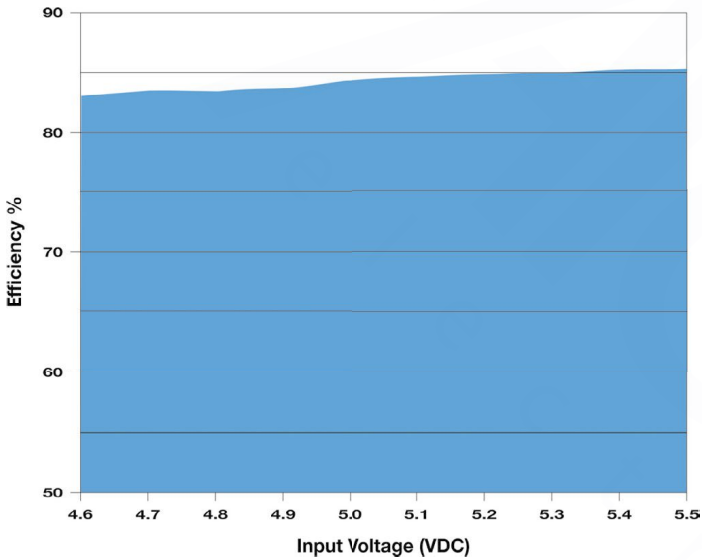
**Output Voltage Tolerance: Other 5 VIN Models**



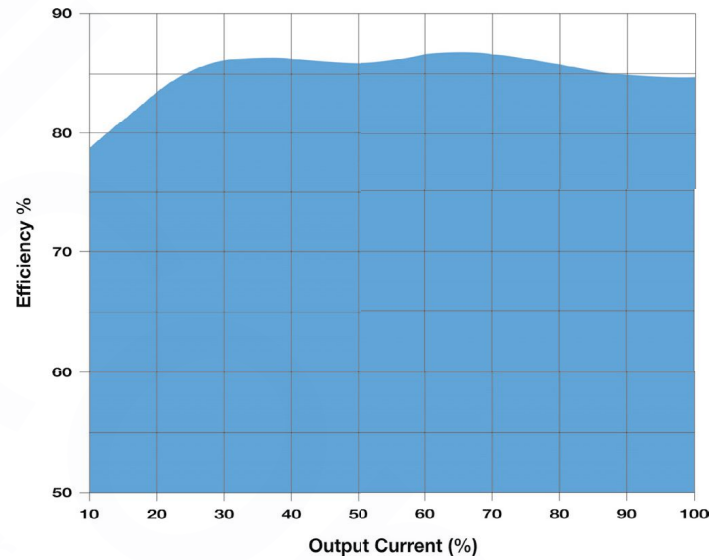
Output Current (%)

Output Current (%)

**Efficiency vs Input: ML105S-05E**



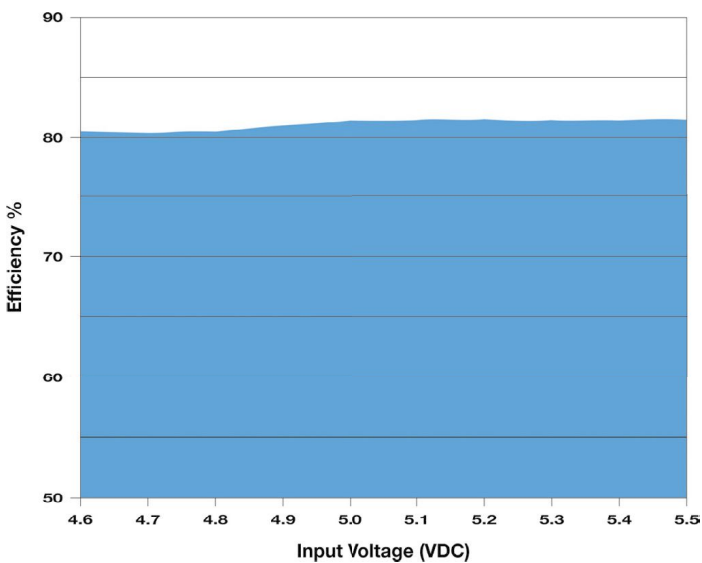
**Efficiency vs Output Load: ML105S-05E**



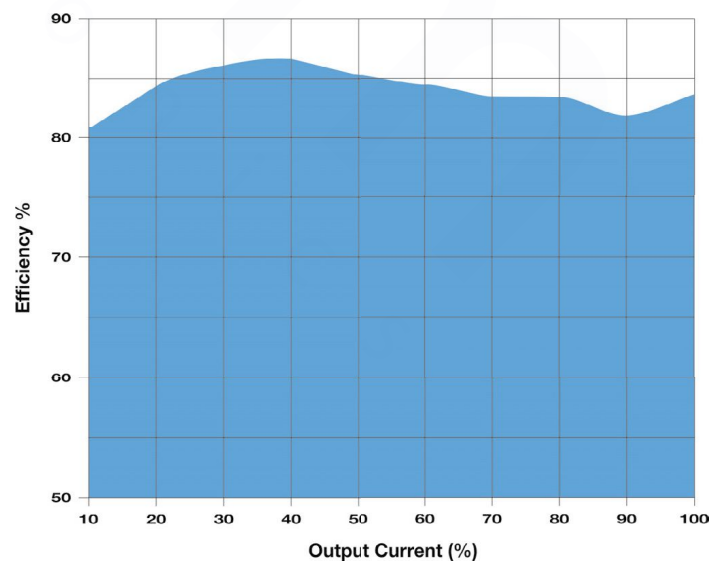
Input Voltage (VDC)

Output Current (%)

**Efficiency vs Input: ML105D-05E**



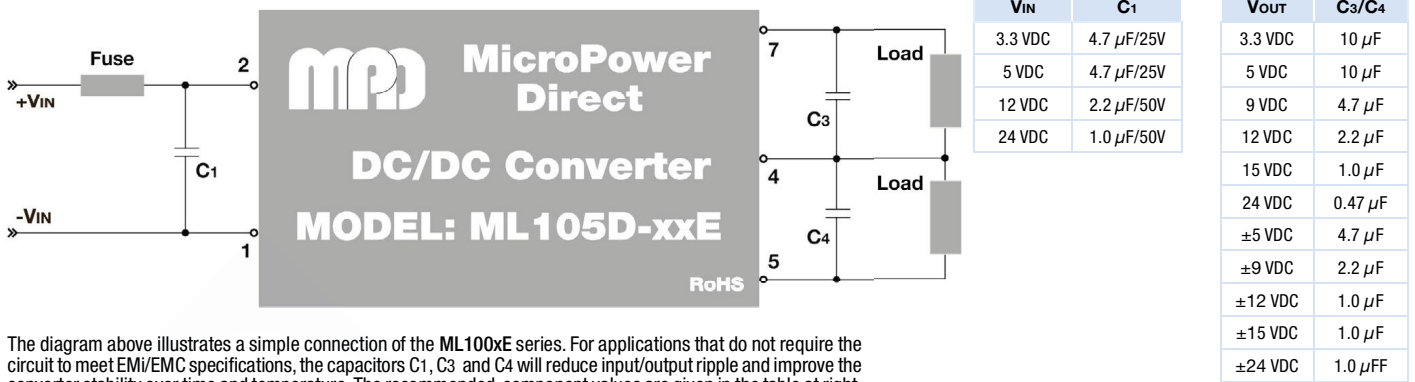
**Efficiency vs Output Load: ML105D-05E**



Input Voltage (VDC)

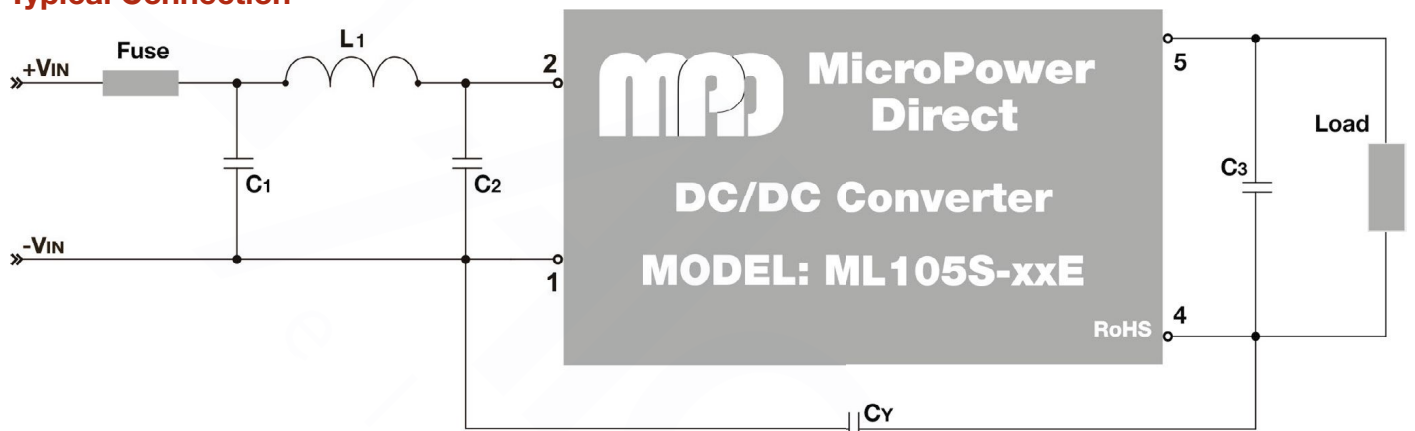
Output Current (%)

## Simple Connection



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.

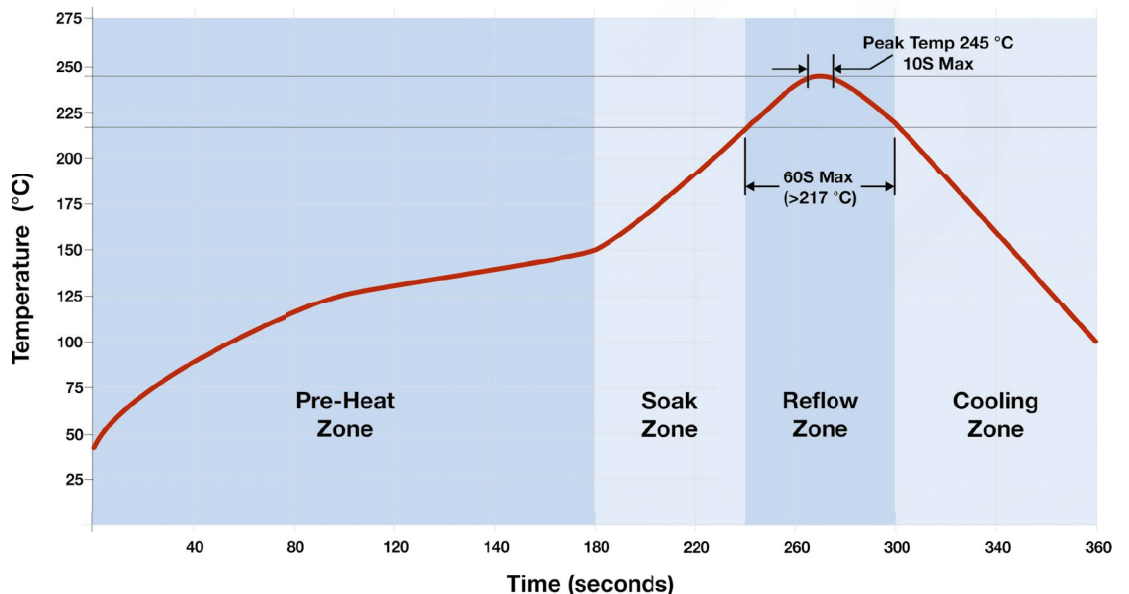
3. Suggested component values are:

| Component | V <sub>IN</sub> : 3.3V, 5V, 12V | V <sub>IN</sub> : 24V |
|-----------|---------------------------------|-----------------------|
| C1        | 4.7 μF/25V                      | 4.7 μF/50V            |
| C2        | 4.7 μF/25V                      | 4.7 μF/50V            |
| L1        | 6.8 μH                          | 6.8 μH                |
| C3        | See C3/C4 in Table Above        |                       |
| CY        | ---                             | 1 nF/4 kV             |

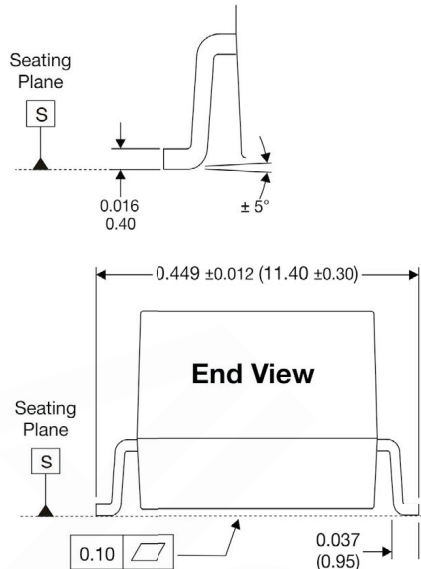
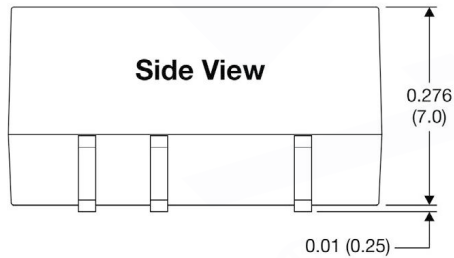
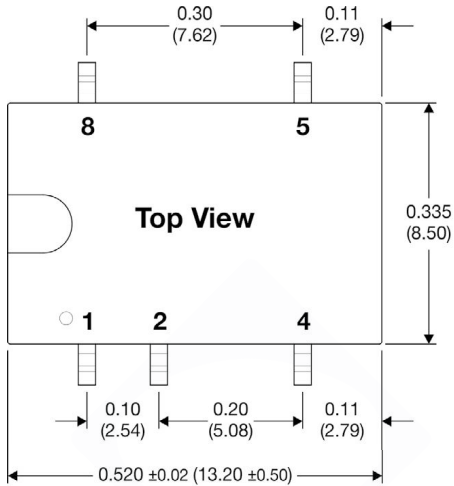
4. In many applications, simply adding input/output capacitors will enhance the input surge protection & reduce output ripple sufficiently. In this case, capacitors C1, C3 and C4 could be connected as shown in the simple connection above, without the other filter components. Recommended capacitor values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

## Reflow Solder Settings

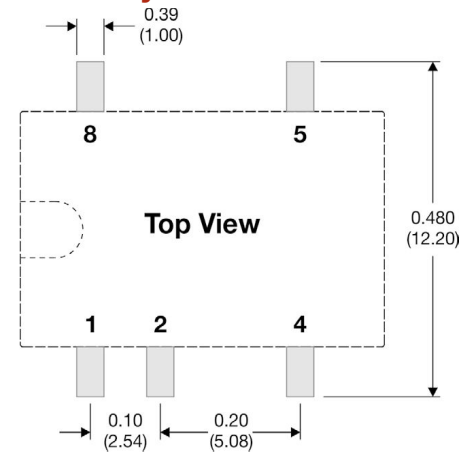
The ML100xE series is designed to meet the IPC/JEDEC standard J-STD-020D for reflow soldering. The recommended reflow settings are a peak temperature of 245 °C for a maximum period (TPK) of 10S and a time above liquidous (TL) of ≤60 seconds at 217 °C, as illustrated above. For more information, please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



## Mechanical Dimensions, Single Output



## Board Layout



## Pin Connections

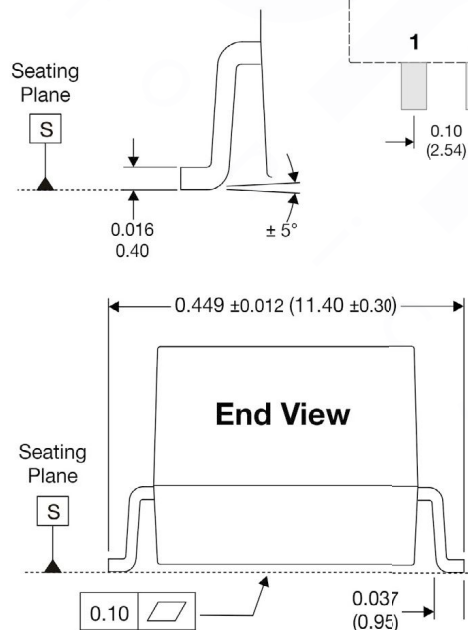
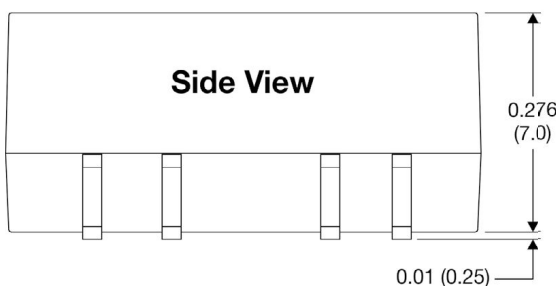
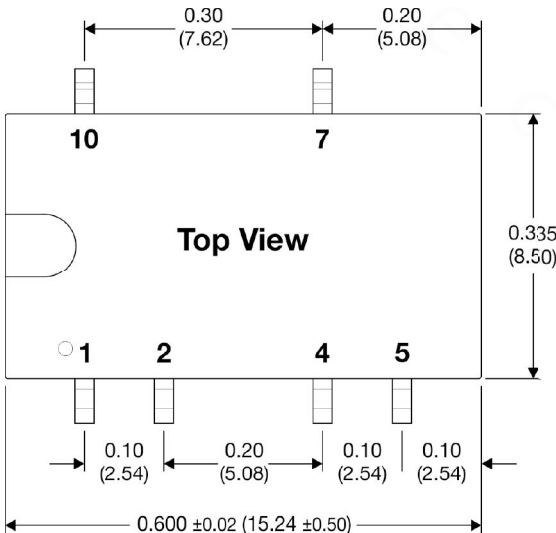
| Pin | Description | Pin | Description |
|-----|-------------|-----|-------------|
| 1   | -VIN        | 5   | +VOUT       |
| 2   | +VIN        | 8   | NC          |
| 4   | -VOUT       |     |             |

NC = Not for electrical connection

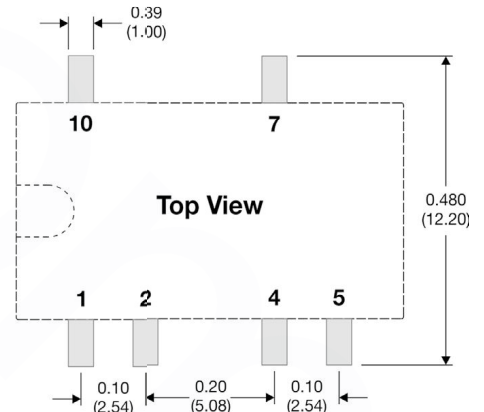
### Notes:

- 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

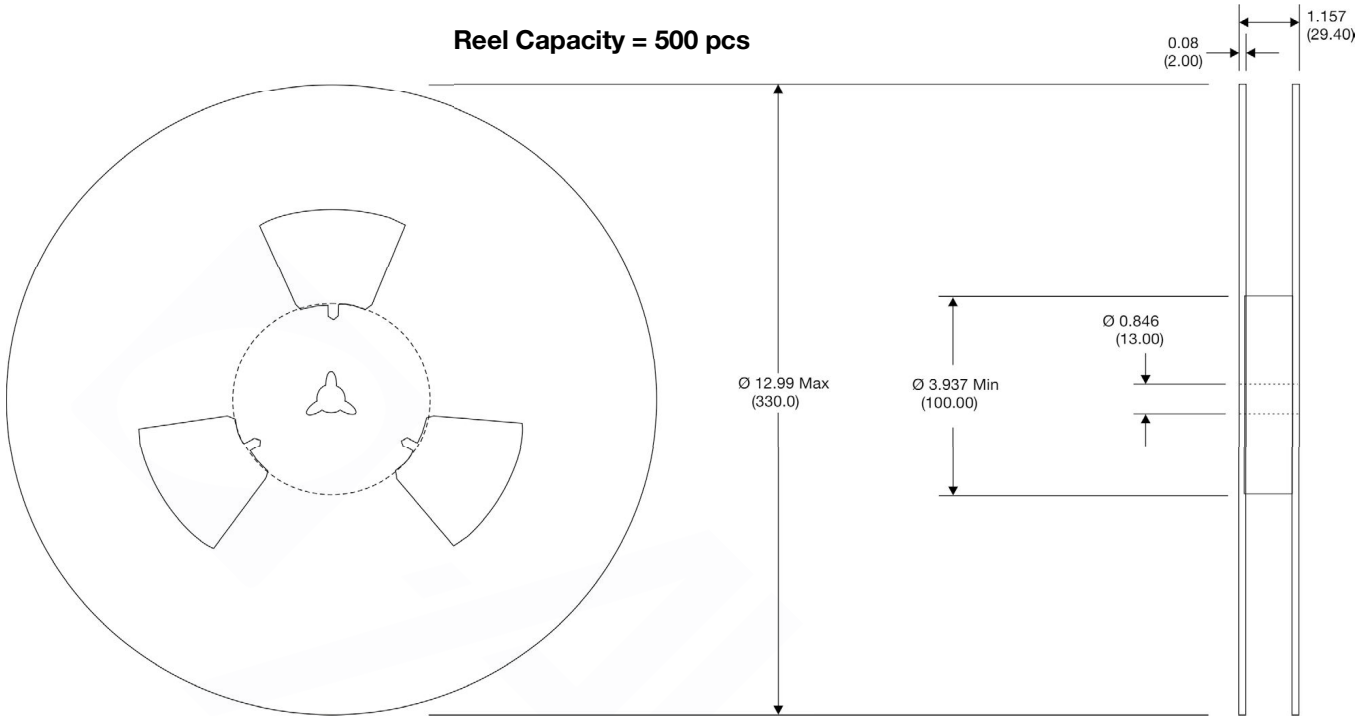
### Notes:

- 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

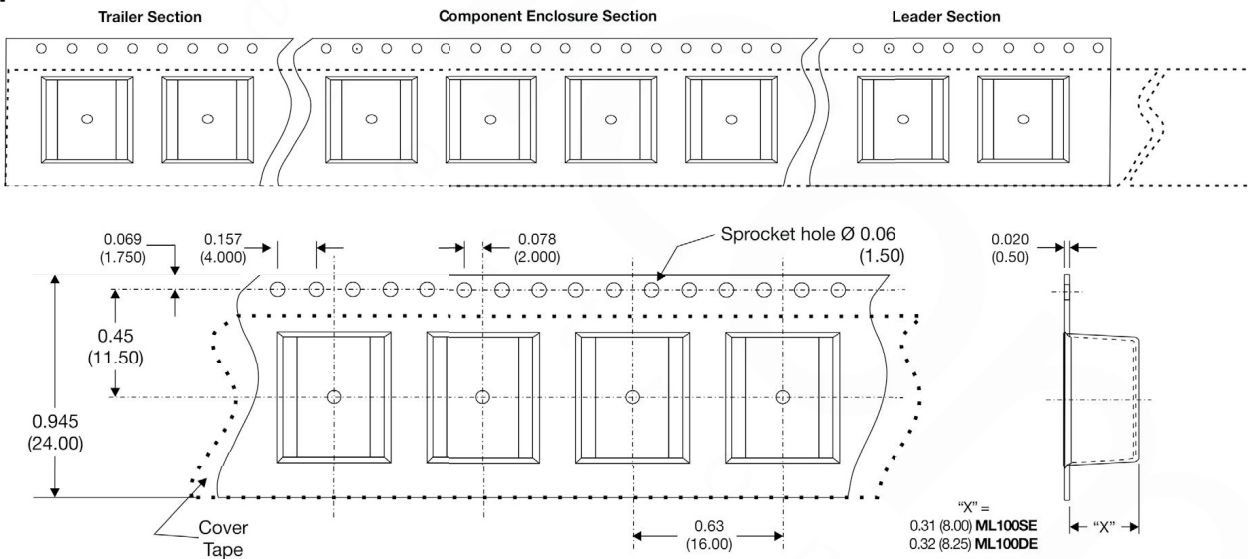
**Packaging Specifications**  
**Reel Dimensions**

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Reel Capacity = 500 pcs

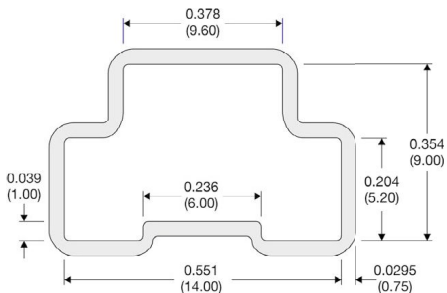


**Tape Dimensions**



**Tube Dimensions**

Tube Capacity = 38 pcs for ML100SE & 32 pcs for ML100DE



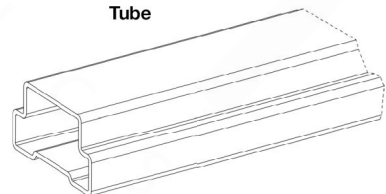
10 mm Rubber Plug



ML100SE



Tube



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Singel 3 | B-2550 Kontich | Belgium | Tel. +32 (0)3 458 30 33

info@alcom.be | www.alcom.be

Rivium 1e straat 52 | 2909 LE Capelle aan den IJssel | The Netherlands

Tel. +31 (0)10 288 25 00 | info@alcom.nl | www.alcom.nl

