

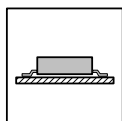
# MSLU400 Series

2W, Miniature SMD, Single & Dual Output DC/DC Converters

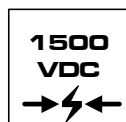


## Key Features

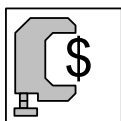
- Efficiency up to 80%
- 1500VDC Isolation
- MTBF > 2,000,000 Hours
- Low Cost
- Input 5, 12 and 24VDC
- Output 3.3, 5, 12,  $\pm 5$ ,  $\pm 12$  and  $\pm 15$ VDC
- Temperature Performance  $-25^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$
- Lead Frame Technology
- UL 94V-0 Package Material
- Internal SMD Construction



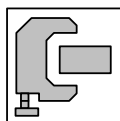
SMD



I/O Isolation



Low Cost



Low Profile

Minmax's MSLU400 2W DC/DC's are in "gull-wing" SMT package, weigh a mere 2.2 grams. The series consists of 18 models with input voltages of 5V, 12V and 24VDC which offers standard output voltages of 3.3V, 5V, 12V,  $\pm 5$ V,  $\pm 12$ V and  $\pm 15$ VDC for the choice.

Their impressive guaranteed efficiencies enable all models to deliver their fully rated output power from  $-25^{\circ}\text{C}$  to  $+75^{\circ}\text{C}$  without heat sinking or forced-air cooling.

The MSLU400 series are excellent selections for a variety of applications including data communication equipments, distributed power systems, telecommunication equipments and industrial robot systems.

The MSLU400 units are available in tape and reel package.

## Absolute Maximum Ratings

| Parameter                                      |                    | Min. | Max. | Unit               |
|------------------------------------------------|--------------------|------|------|--------------------|
| Input Surge Voltage<br>(1000 mS)               | 5VDC Input Models  | -0.7 | 9    | VDC                |
|                                                | 12VDC Input Models | -0.7 | 18   | VDC                |
|                                                | 24VDC Input Models | -0.7 | 30   | VDC                |
| Lead Temperature (1.5mm from case for 10 Sec.) |                    | ---  | 300  | $^{\circ}\text{C}$ |
| Internal Power Dissipation                     |                    | ---  | 650  | mW                 |

Exceeding the absolute maximum ratings of the unit could cause damage.  
These are not continuous operating ratings.

Leadfree Reflow Solder Process as per IPC/JEDEC J-STD-020C peak temp. 245C/10 sec.

## Environmental Specifications

| Parameter             | Conditions          | Min. | Max. | Unit               |
|-----------------------|---------------------|------|------|--------------------|
| Operating Temperature | Ambient             | -25  | +75  | $^{\circ}\text{C}$ |
| Operating Temperature | Case                | -25  | +90  | $^{\circ}\text{C}$ |
| Storage Temperature   |                     | -25  | +125 | $^{\circ}\text{C}$ |
| Humidity              |                     | ---  | 95   | %                  |
| Cooling               | Free-Air Convection |      |      |                    |

## Model Selection Guide

| Model Number | Input Voltage       | Output Voltage | Output Current |      | Input Current |           | Load Regulation | Efficiency |
|--------------|---------------------|----------------|----------------|------|---------------|-----------|-----------------|------------|
|              |                     |                | Max.           | Min. | @Max. Load    | @No Load  |                 |            |
|              | VDC                 | VDC            | mA             | mA   | mA (Typ.)     | mA (Typ.) | % (Max.)        | % (Typ.)   |
| MSLU401      | 5<br>(4.5 ~ 5.5)    | 3.3            | 500            | 10   | 471           | 60        | 11              | 70         |
| MSLU402      |                     | 5              | 400            | 8    | 548           |           | 11              | 73         |
| MSLU404      |                     | 12             | 165            | 3    | 514           |           | 11              | 77         |
| MSLU406      |                     | ±5             | ±200           | ±4   | 541           |           | 10              | 74         |
| MSLU408      |                     | ±12            | ±83            | ±1.5 | 524           |           | 7               | 76         |
| MSLU409      |                     | ±15            | ±66            | ±1   | 521           |           | 7               | 76         |
| MSLU411      | 12<br>(10.8 ~ 13.2) | 3.3            | 500            | 10   | 191           | 30        | 8               | 72         |
| MSLU412      |                     | 5              | 400            | 8    | 222           |           | 8               | 75         |
| MSLU414      |                     | 12             | 165            | 3    | 209           |           | 5               | 79         |
| MSLU418      |                     | ±12            | ±83            | ±1.5 | 208           |           | 5               | 80         |
| MSLU419      |                     | ±15            | ±66            | ±1   | 206           |           | 5               | 80         |
| MSLU421      | 24<br>(21.6 ~ 26.4) | 3.3            | 500            | 10   | 96            | 15        | 8               | 72         |
| MSLU422      |                     | 5              | 400            | 8    | 111           |           | 8               | 75         |
| MSLU424      |                     | 12             | 165            | 3    | 105           |           | 5               | 79         |
| MSLU428      |                     | ±12            | ±83            | ±1.5 | 105           |           | 5               | 79         |
| MSLU429      |                     | ±15            | ±66            | ±1   | 104           |           | 5               | 79         |

## Capacitive Load

| Models by Vout          | 3.3V | 5V | 12V | ±5V # | ±12V # | ±15V # | Unit |
|-------------------------|------|----|-----|-------|--------|--------|------|
| Maximum Capacitive Load | 47   | 47 | 10  | 10    | 4.7    | 4.7    | uF   |

# For each output

## Input Fuse Selection Guide

| 5V Input Models         | 12V Input Models       | 24V Input Models       |
|-------------------------|------------------------|------------------------|
| 1000mA Slow – Blow Type | 500mA Slow – Blow Type | 200mA Slow – Blow Type |

## Input Specifications

| Parameter                      | Model            | Min.               | Typ. | Max. | Unit |
|--------------------------------|------------------|--------------------|------|------|------|
| Input Voltage Range            | 5V Input Models  | 4.5                | 5    | 5.5  | VDC  |
|                                | 12V Input Models | 10.8               | 12   | 13.2 |      |
|                                | 24V Input Models | 21.6               | 24   | 26.4 |      |
| Reverse Polarity Input Current | All Models       | ---                | ---  | 0.3  | A    |
| Input Filter                   |                  | Internal Capacitor |      |      |      |

## Output Specifications

| Parameter               | Conditions                  | Min.                      | Typ.       | Max.       | Unit   |
|-------------------------|-----------------------------|---------------------------|------------|------------|--------|
| Output Voltage Balance  | Dual Output, Balanced Loads | ---                       | $\pm 0.1$  | $\pm 1.0$  | %      |
| Line Regulation         | For $V_{in}$ Change of 1%   | ---                       | $\pm 1.2$  | $\pm 1.5$  | %      |
| Load Regulation         | $I_o = 20\%$ to 100%        | See Model Selection Guide |            |            | %      |
| Ripple & Noise (20MHz)  |                             | ---                       | 100        | 120        | mV P-P |
| Ripple & Noise (20MHz)  | Over Line, Load & Temp.     | ---                       | ---        | 200        | mV P-P |
| Ripple & Noise (20MHz)  |                             | ---                       | ---        | 15         | mV rms |
| Temperature Coefficient |                             | ---                       | $\pm 0.01$ | $\pm 0.02$ | %/°C   |
| Output Short Circuit    | 0.5 Second Max.             |                           |            |            |        |

## General Specifications

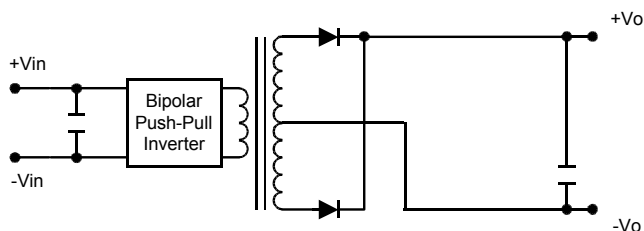
| Parameter               | Conditions                          | Min. | Typ. | Max. | Unit    |
|-------------------------|-------------------------------------|------|------|------|---------|
| Isolation Voltage Rated | 60 Seconds                          | 1500 | ---  | ---  | VDC     |
| Isolation Voltage Test  | Flash Tested for 1 Second           | 1650 | ---  | ---  | VDC     |
| Isolation Resistance    | 500VDC                              | 10   | ---  | ---  | GΩ      |
| Isolation Capacitance   | 100KHz, 1V                          | ---  | 60   | 100  | pF      |
| Switching Frequency     |                                     | 50   | 100  | 120  | KHz     |
| MTBF                    | MIL-HDBK-217F @ 25°C, Ground Benign | 2000 | ---  | ---  | K Hours |

### Notes :

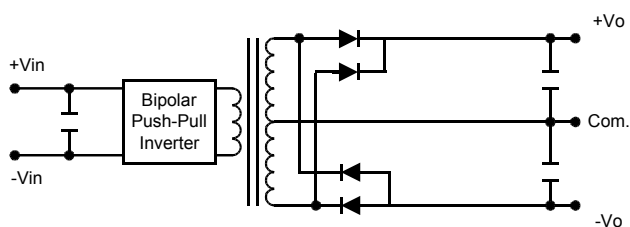
1. Specifications typical at  $T_a = +25^\circ\text{C}$ , resistive load, nominal input voltage, rated output current unless otherwise noted.
2. Ripple & Noise measurement bandwidth is 0-20 MHz.
3. These power converters require a minimum output loading to maintain specified regulation.
4. Operation under no-load conditions will not damage these modules; however, they may not meet all specifications listed.
5. All DC/DC converters should be externally fused on the front end for protection.
6. Other input and output voltage may be available, please contact factory.
7. Specifications subject to change without notice.
8. It is not recommended to use water-washing process on SMT units.

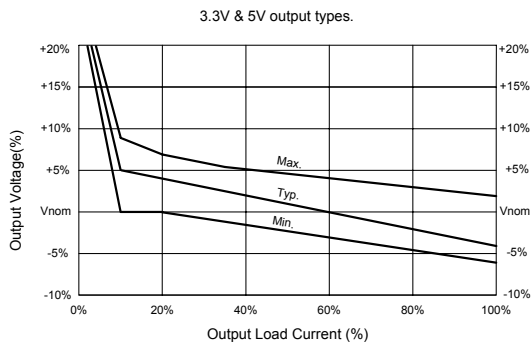
## Block Diagram

### Single Output

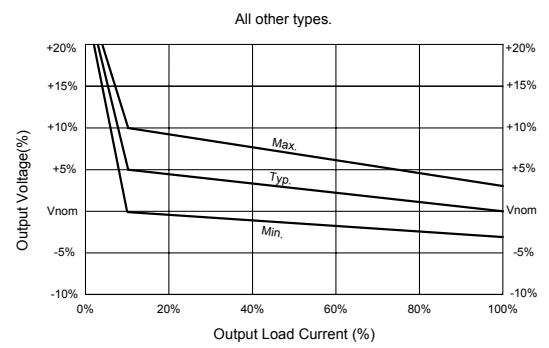


### Dual Output





**Tolerance Envelopes Graph (3.3V & 5V Output)**



**Tolerance Envelopes Graph (All other Output)**

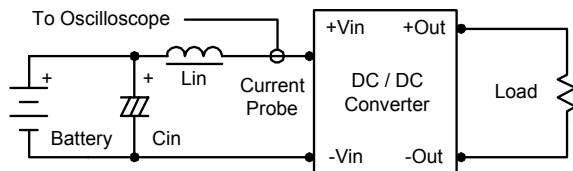
## Test Configurations

### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  (4.7uH) and  $C_{in}$  (220uF, ESR < 1.0Ω at 100 KHz) to simulate source impedance.

Capacitor  $C_{in}$ , offsets possible battery impedance.

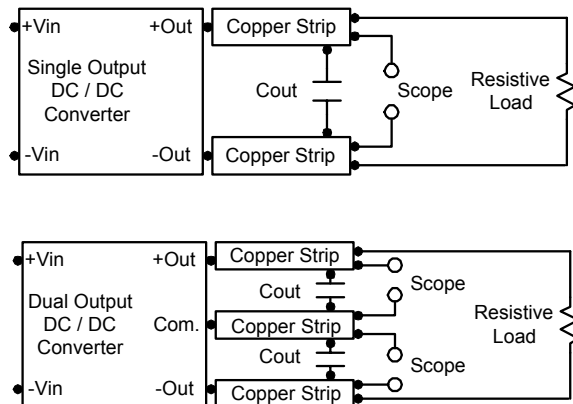
Current ripple is measured at the input terminals of the module, measurement bandwidth is 0–500 KHz.



### Peak-to-Peak Output Noise Measurement Test

Use a  $C_{out}$  0.33uF ceramic capacitor.

Scope measurement should be made by using a BNC socket, measurement bandwidth is 0–20 MHz. Position the load between 50 mm and 75 mm from the DC/DC Converter.



## Design & Feature Considerations

### Maximum Capacitive Load

The MSLU400 series has limitation of maximum connected capacitance at the output.

The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time.

The maximum capacitance can be found in the data sheet.

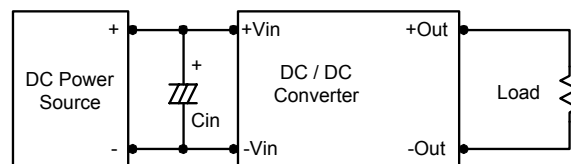
### Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.

In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.

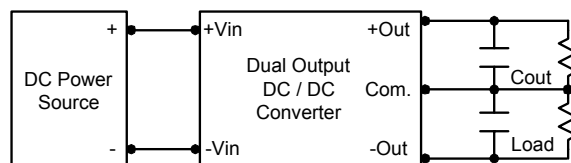
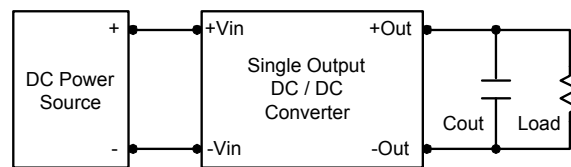
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 KHz) capacitor of a 2.2uF for the 5V input devices, a 1.0uF for the 12V input devices and a 0.47uF for the 24V devices.

### Output Ripple Reduction



A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance.

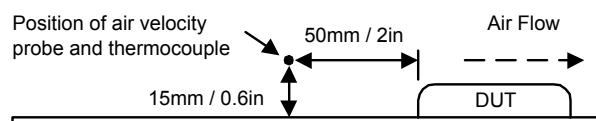
To reduce output ripple, it is recommended to use 1.5uF capacitors at the output.



### Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 90°C.

The derating curves are determined from measurements obtained in an experimental apparatus.

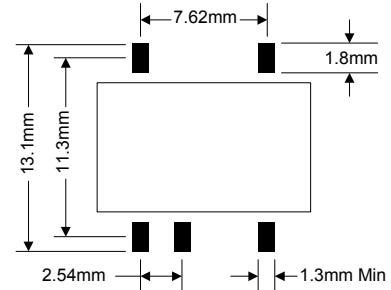
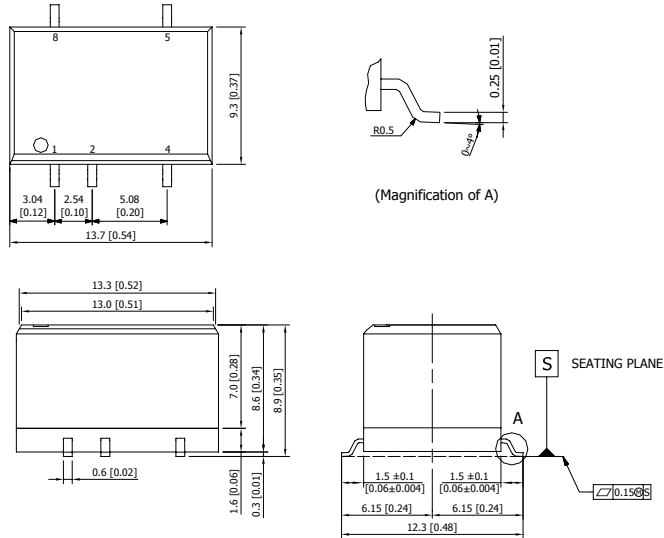


## Mechanical Dimensions

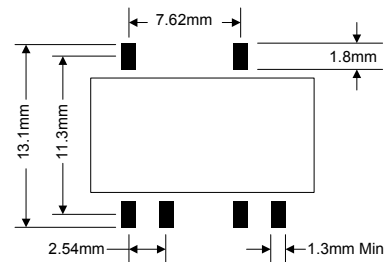
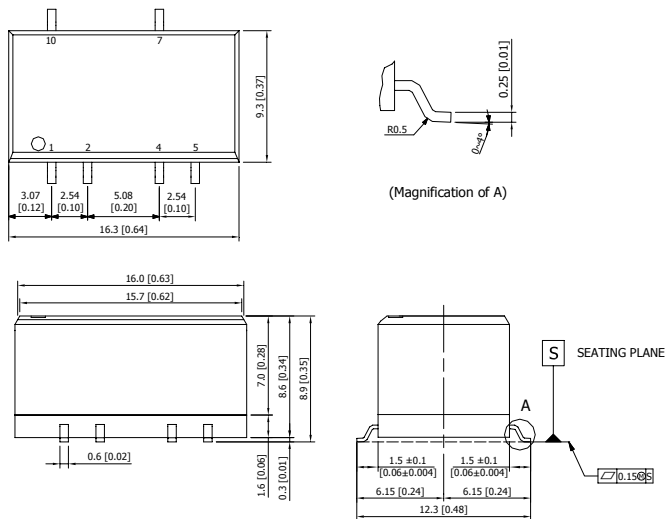
## Connecting Pin Patterns

Top View ( 2.54 mm / 0.1 inch grids )

### Single Output



### Dual Output



| Tolerance | Millimeters     | Inches            |
|-----------|-----------------|-------------------|
|           | $X.X \pm 0.25$  | $X.XX \pm 0.01$   |
|           | $X.XX \pm 0.13$ | $X.XXX \pm 0.005$ |
| Pin       | $\pm 0.05$      | $\pm 0.002$       |

## Pin Connections

| Pin | Single Output | Dual Output |
|-----|---------------|-------------|
| 1   | -Vin          | -Vin        |
| 2   | +Vin          | +Vin        |
| 4   | -Vout         | Common      |
| 5   | +Vout         | -Vout       |
| 7   | No Pin        | +Vout       |
| 8   | NA            | No Pin      |
| 10  | No Pin        | NA          |

NA : Not Available for Electrical Connection

## Physical Characteristics

**Case Size (Single Output)** : 13.7×9.3×8.7 mm  
0.54×0.37×0.34 inches

**Case Size (Dual Output)** : 16.3×9.3×8.7 mm  
0.64×0.37×0.34 inches

**Case Material** : Non-Conductive Black Plastic

**Weight (Single Output)** : 1.5g

**Weight (Dual Output)** : 2.2g

**Flammability** : UL94V-0