# MFSU01 Series

## Electric Characteristic Note

**DC-DC CONVERTER 1W**


## Features

- **Industrial Standard DIP-8 Package**
- **Unregulated Output Voltage**
- **I/O Isolation 1500VDC**
- **Operating Ambient Temp. Range -40℃ to +85℃**
- **Short Circuit Protection**

## Applications

- Distributed power architectures
- Workstations
- Computer equipment
- Communications equipment

## Product Overview

The MINMAX MFSU01 series is a range of isolated 1W DC-DC converter modules in DIP-8. There are 9 models available for 5,12 or 24VDC input. Advanced circuit topology provides continuous short circuit protection and a high efficiency up to 83% which allows operating ambient temperatures range of -40℃ to +85℃ without power derating. These converters offer a better solution for all applications where fault condition protection are required.

## Table of contents

## Model Selection Guide

| Model Number | Input Voltage (Range) | Output Voltage | Output Current | Input Current | | Load Regulation | Max. capacitive Load | Efficiency (typ.) |
|---|---|---|---|---|---|---|---|---|
| | | | Max. | @Max. Load | @No Load | | | @Max. Load |
| | VDC | VDC | mA | mA(typ.) | mA(typ.) | % (max.) | μF | % |
| **MFSU01-05S05** | 5 (4.5 ~ 5.5) | 5 | 200 | 250 | 30 | 11 | 220 | 80 |
| **MFSU01-05S12** | | 12 | 84 | 246 | | 9 | | 82 |
| **MFSU01-05S15** | | 15 | 67 | 242 | | 8 | | 83 |
| **MFSU01-12S05** | 12 (10.8 ~ 13.2) | 5 | 200 | 105 | 17 | 8 | 220 | 79 |
| **MFSU01-12S12** | | 12 | 84 | 104 | | 8 | | 81 |
| **MFSU01-12S15** | | 15 | 67 | 102 | | 8 | | 82 |
| **MFSU01-24S05** | 24 (21.6 ~ 26.4) | 5 | 200 | 53 | 10 | 8 | 220 | 78 |
| **MFSU01-24S12** | | 12 | 84 | 53 | | 8 | | 80 |
| **MFSU01-24S15** | | 15 | 67 | 52 | | 7 | | 81 |

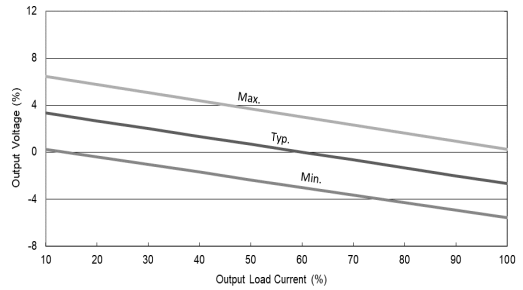
## Input Specifications

| 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 | |
| Input Surge Voltage (1 sec. max.) | 5V Input Models | -0.7 | --- | 9 | |
| | 12V Input Models | -0.7 | --- | 18 | |
| | 24V Input Models | -0.7 | --- | 30 | |
| Input Filter | All Models | Internal Capacitor | | | |

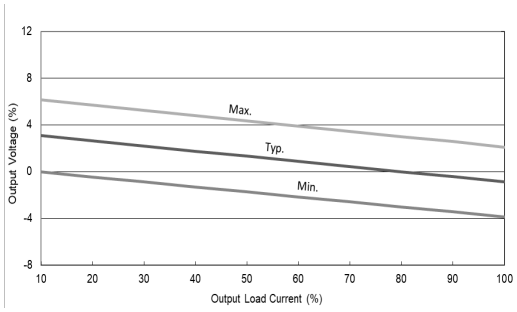
## Output Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Output Voltage Setting Accuracy | | --- | --- | ±3.0 | %Vnom. |
| Line Regulation | For Vin Change of 1% | --- | ±1.2 | ±1.5 | % |
| Load Regulation | Io=10% to 100% | See Model Selection Guide | | | |
| Ripple & Noise | 0-20 MHz Bandwidth | --- | --- | 100 | $mV_{P-P}$ |
| Temperature Coefficient | | --- | ±0.01 | ±0.02 | %/℃ |
| Short Circuit Protection | Continuous, Automatic Recovery | | | | |

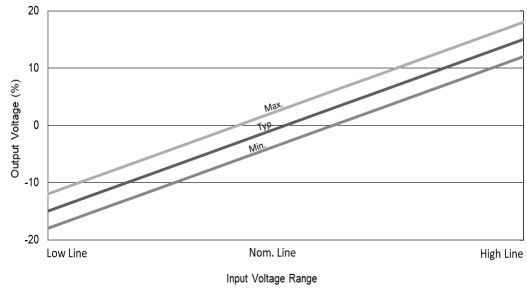
## Output Voltage Tolerance




Output Voltage VS Output Load Current
For 5V Output Models




Output Voltage VS Output Load Current
For 12V & 15V Output Models




Output Voltage VS Input Voltage Range

## General Specifications

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| I/O Isolation Voltage | 60 Seconds | 1500 | --- | --- | VDC |
| | 1 Second | 1800 | --- | --- | VDC |
| I/O Isolation Resistance | 500 VDC | 1000 | --- | --- | MΩ |
| I/O Isolation Capacitance | 100kHz, 1V | --- | 20 | --- | pF |
| Switching Frequency | | 20 | 50 | 95 | kHz |
| MTBF (calculated) | MIL-HDBK-217F@25℃, Ground Benign | 5,067,163 | --- | --- | Hours |

## EMC Specifications

| Parameter | Standards & Level | | | Performance |
|---|---|---|---|---|
| EMI | Conduction | EN 55032 | With external components | Class $B_{(5}$ |
| | Radiation | | | |
| EMS | EN 55024, EN 55035 | | | |
| | ESD | Direct discharge | Indirect discharge HCP & VCP | A |
| | | EN61000-4-2 Air ± 8kV | Contact ± 6kV | |
| | Radiated immunity | EN 61000-4-3 10V/m | | A |
| | Fast transient (6) | EN 61000-4-4 ±2kV | | A |
| | Surge (6) | EN 61000-4-5 ±1kV | | A |
| | Conducted immunity | EN 61000-4-6 10Vrms | | A |
| | PFMF | EN 61000-4-8 30A/m | | A |

## Environmental Specifications

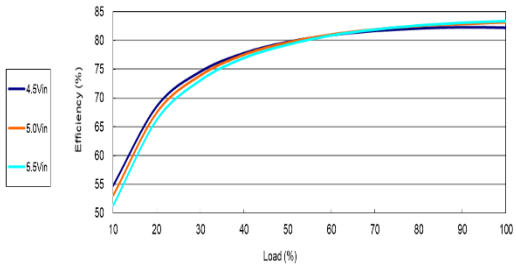
| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| Operating Ambient Temperature Range | -40 | +85 | ℃ |
| Case Temperature | --- | +95 | ℃ |
| Storage Temperature Range | -50 | +125 | ℃ |
| Humidity (non condensing) | --- | 95 | % rel. H |
| Lead Temperature (1.5mm from case for 10Sec.) | --- | 260 | ℃ |

## Notes

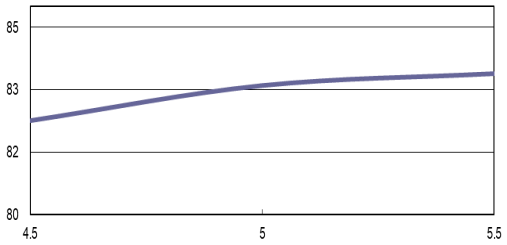
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
3 We recommend to protect the converter by a fast blow fuse in the input supply line.
4 Other input and output voltage may be available, please contact MINMAX.
5 To meet EN55032 Class B an external filter, please contact MINMAX.
6 To meet EN61000-4-4 & EN61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
7 Specifications are subject to change without notice.
8 The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

## Characteristic Curves

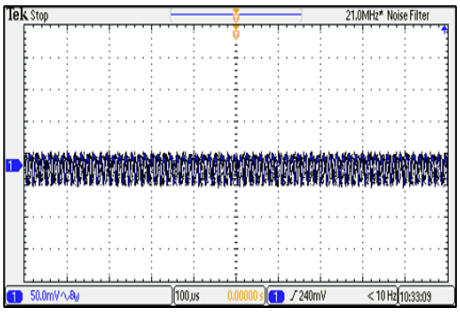
All test conditions are at 25℃ The figures are identical for MFSU01-05S05



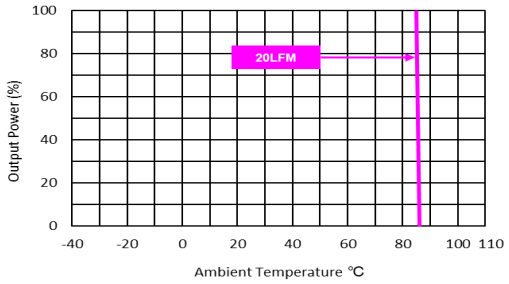

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



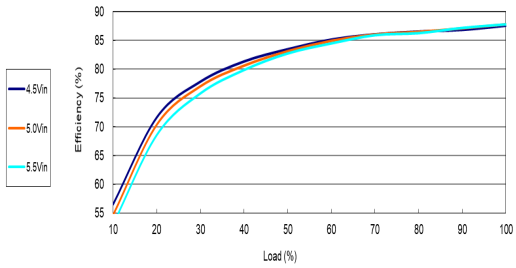

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



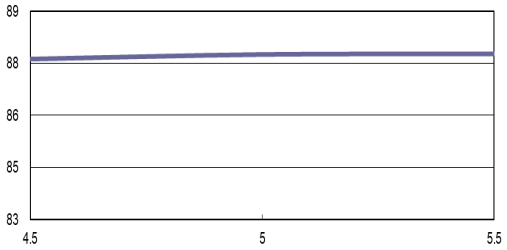

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

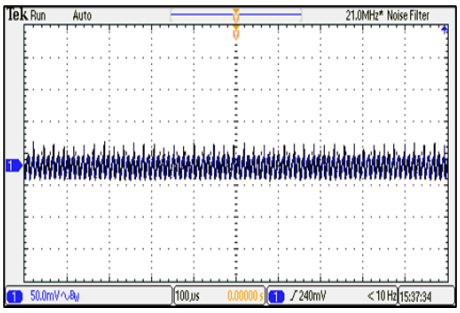
All test conditions are at 25℃ The figures are identical for MFSU01-05S12



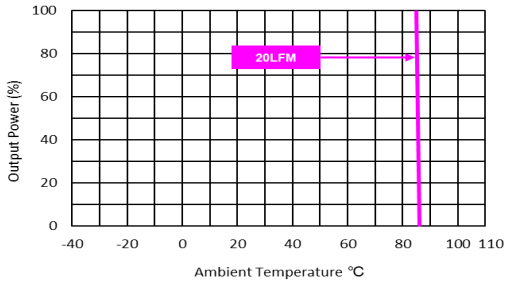

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



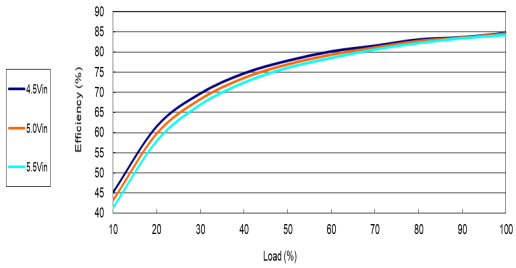

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



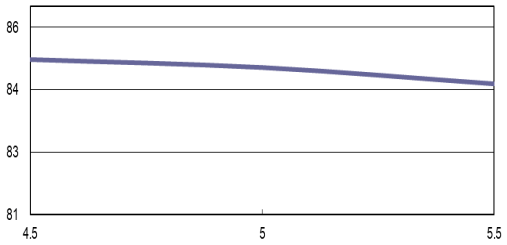

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

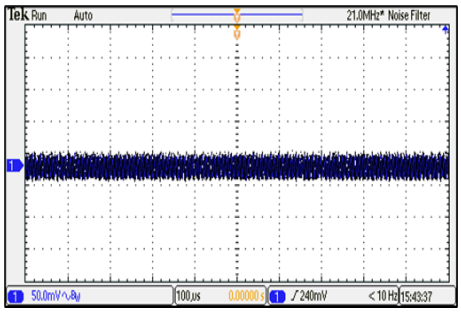
All test conditions are at 25℃ The figures are identical for MFSU01-05S15



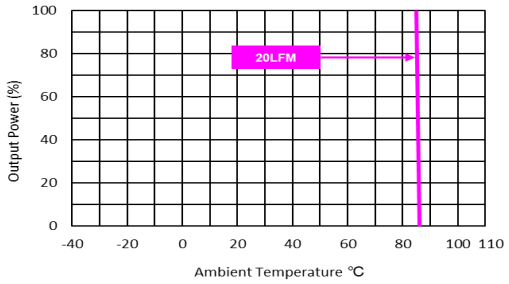

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



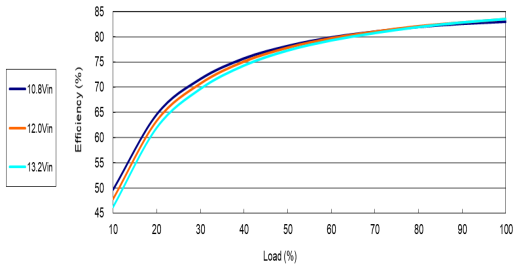

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



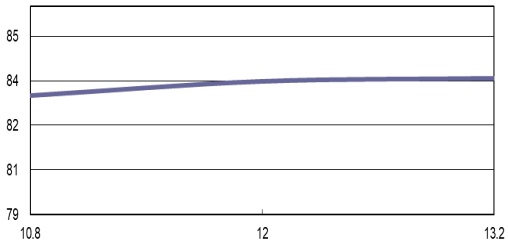

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

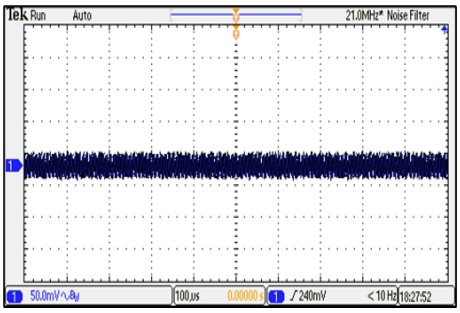
All test conditions are at 25℃ The figures are identical for MFSU01-12S05



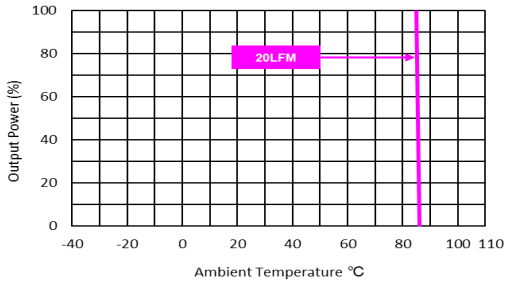

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



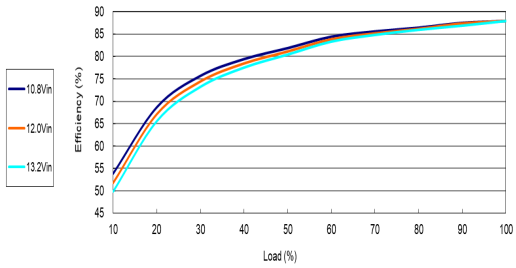

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



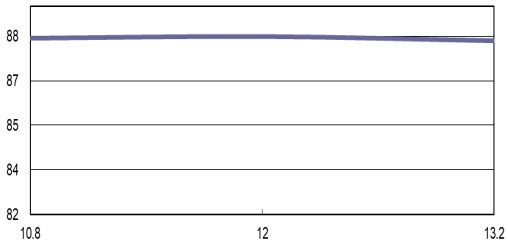

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

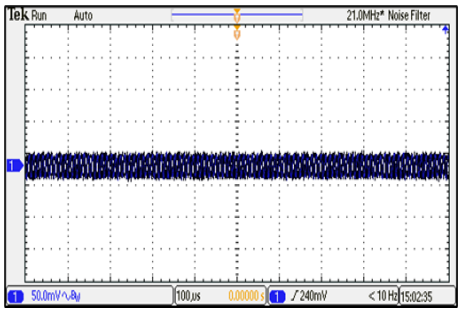
All test conditions are at 25℃ The figures are identical for MFSU01-12S12



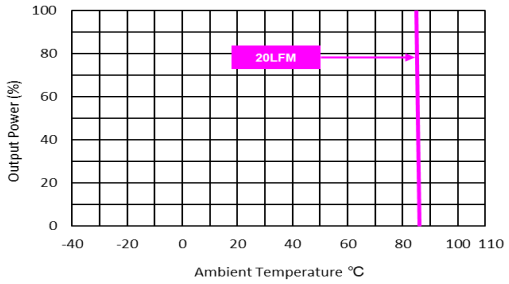

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



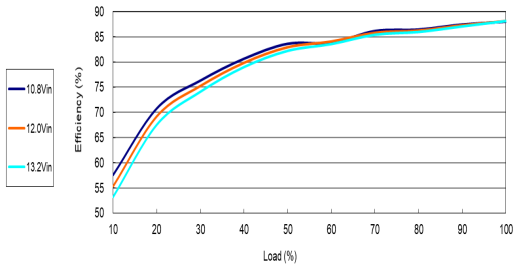

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



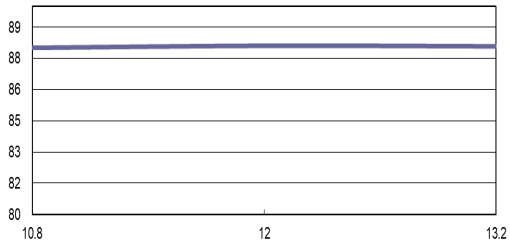

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

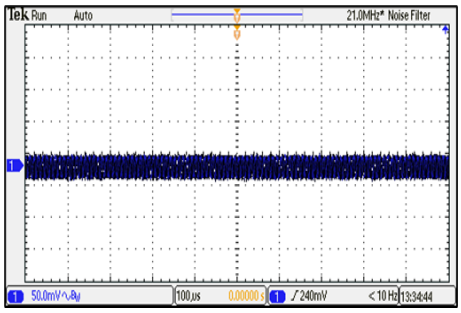
All test conditions are at 25℃ The figures are identical for MFSU01-12S15



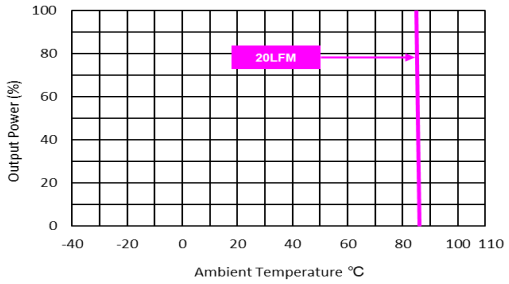

Efficiency Versus Output Current




Efficiency Versus Input Voltage
Full Load



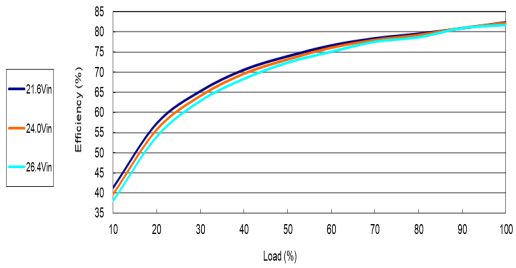

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



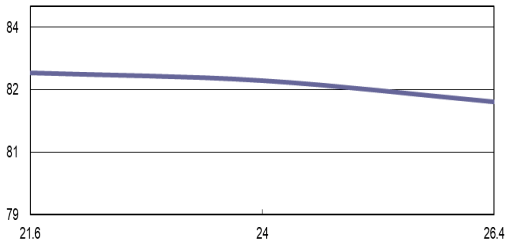

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

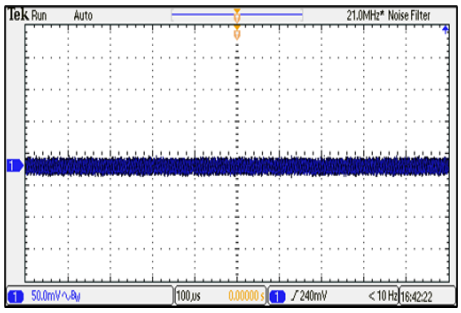
All test conditions are at 25℃ The figures are identical for MFSU01-24S05



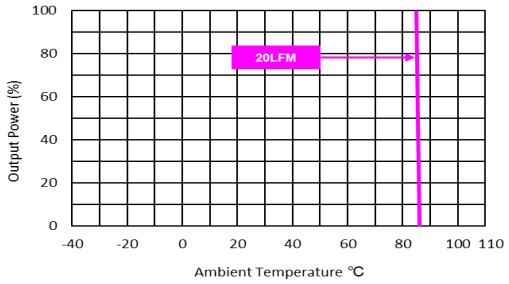

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



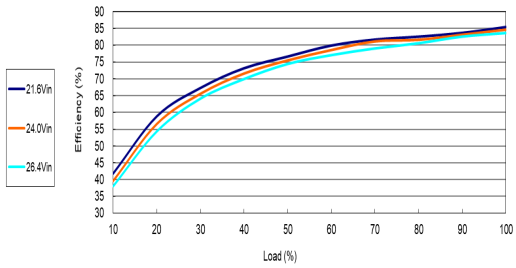

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



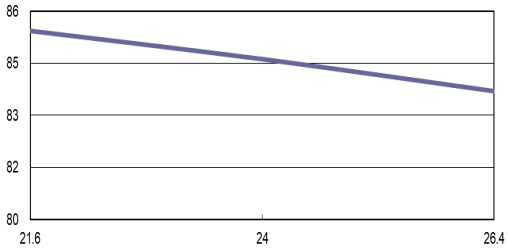

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

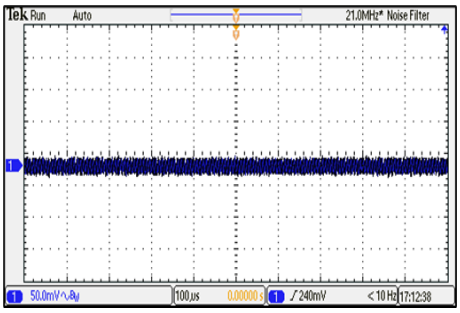
All test conditions are at 25℃ The figures are identical for MFSU01-24S12



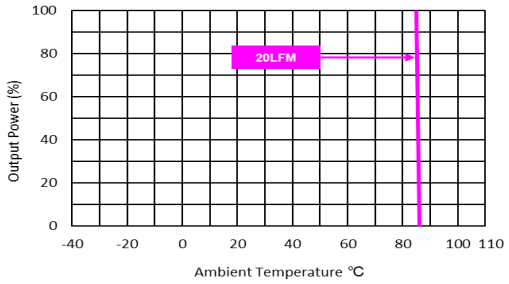

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



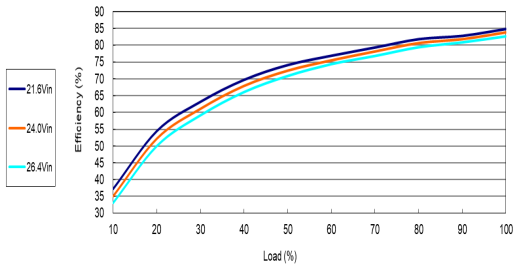

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load



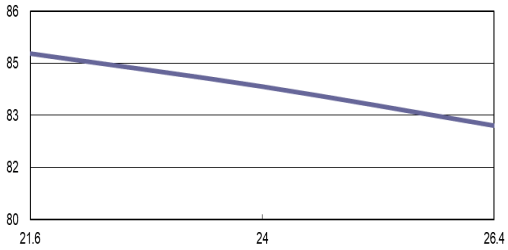

Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Characteristic Curves

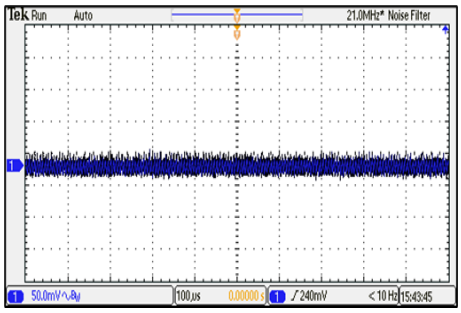
All test conditions are at 25℃ The figures are identical for MFSU01-24S15



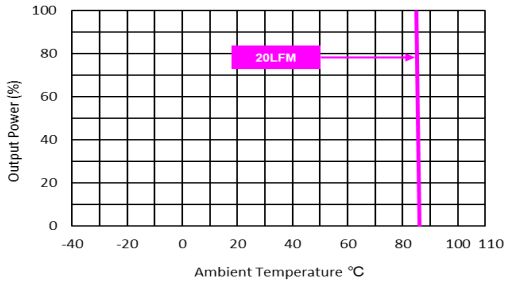

Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



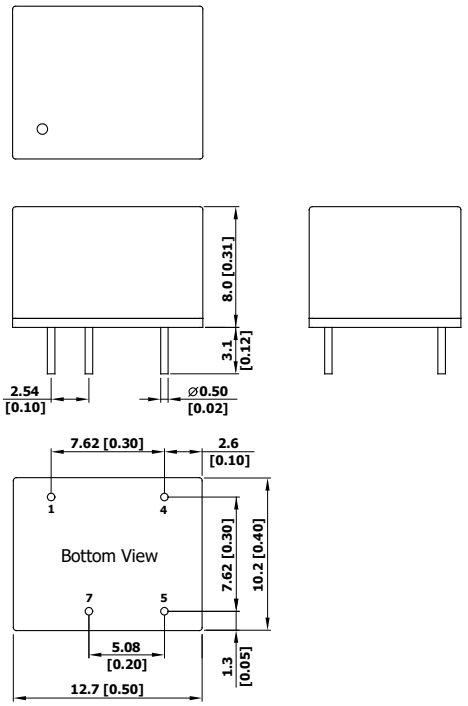

Typical Output Ripple and Noise
$V_{in}$=$V_{in\ nom}$ ; Full Load




Derating Output Power Versus Ambient Temperature
$V_{in}$=$V_{in\ nom}$

## Package Specifications

Mechanical Dimensions




Pin Connections

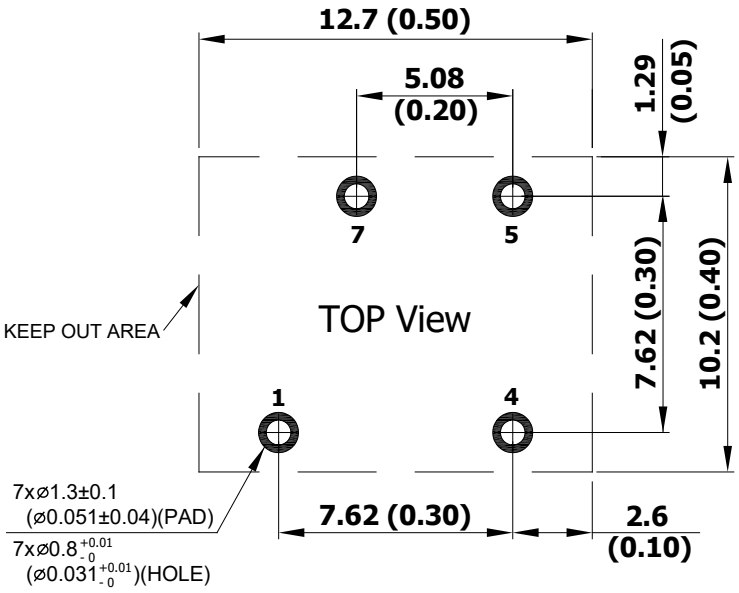
| Pin | Function |
|---|---|
| 1 | -Vin |
| 4 | +Vin |
| 5 | +Vout |
| 7 | -Vout |

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pins ±0.05 (±0.002)

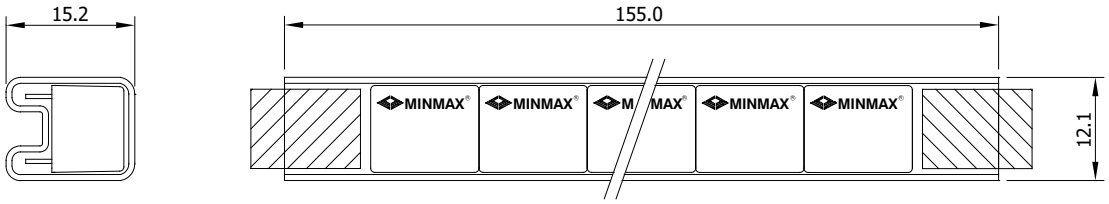
## Physical Characteristics

| | | |
|---|---|---|
| Case Size | : | 12.7x8.0x10.2mm (0.50x0.31x0.40 inches) |
| Case Material | : | Non-Conductive Black Plastic (flammability to UL 94V-0 rated) |
| Pin Material | : | Phosphor Bronze with Tin Plate Over Nickel Subplate |
| Weight | : | 2.1g |

## Recommended Pad Layout for Single Output Converter



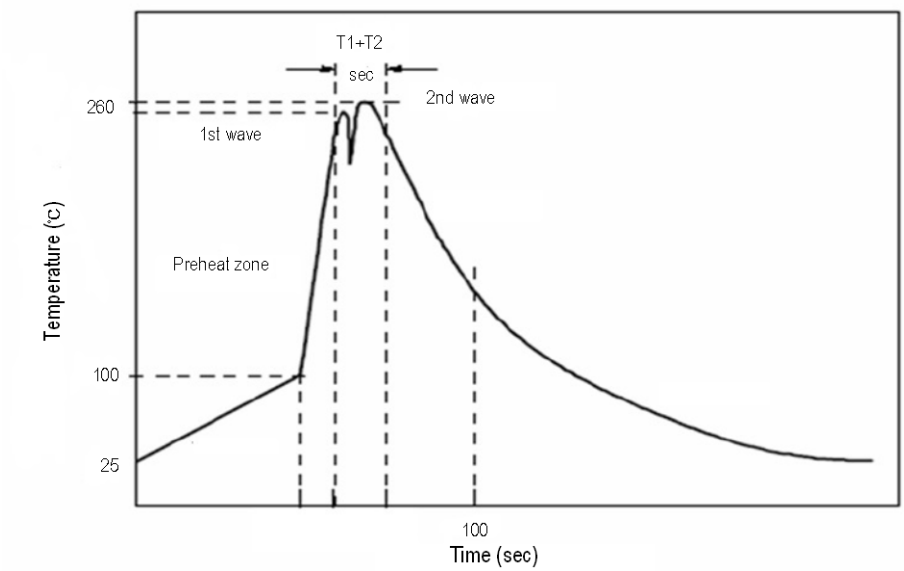
## Packaging Information




Unit: mm
10 PCS per TUBE

## Wave Soldering Considerations

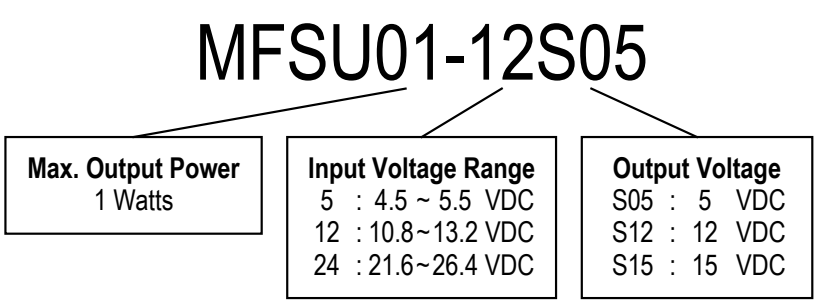
Lead free wave solder profile




| Profile Feature | Reference Parameter |
|---|---|
| Heating rate during preheat | Rise temp. speed：3 ℃/sec max. |
| Final preheat temperature | Preheat temp.：100~130 ℃ |
| Peak temperature | Peak temp.：250~260 ℃ |
| Time within peak temperature | Peak time(T1+T2)：4~6 sec |
| Ramp-down rate | 5 ℃/sec max. |

Reference Solder: Sn-Ag-Cu, Sn-Cu, Sn-Ag
Hand Welding: Soldering iron, Power 60W
Welding Time: 2~4 sec
Temp.: 380~400℃

## Part Number Structure




## MTBF and Reliability

The MTBF of MFSU01 series of DC-DC converters has been calculated using

MIL-HDBK 217F NOTICE2, Operating Temperature 25℃, Ground Benign.

| Model | MTBF | Unit |
|---|---|---|
| MFSU01-05S05 | 5,426,133 | Hours |
| MFSU01-05S12 | 5,301,870 | |
| MFSU01-05S15 | 5,090,709 | |
| MFSU01-12S05 | 5,290,929 | |
| MFSU01-12S12 | 5,218,877 | |
| MFSU01-12S15 | 5,067,163 | |
| MFSU01-24S05 | 5,469,299 | |
| MFSU01-24S12 | 5,173,918 | |
| MFSU01-24S15 | 5,428,380 | |