

**FEATURES**

- ▶ Industrial Standard SMD Package
- ▶ I/O Isolation 4000VAC with Reinforced Insulation, rated for 250Vrms Working Voltage
- ▶ Low Leakage Current < 2μA
- ▶ Operating Ambient Temp. Range -40°C to 95°C
- ▶ Short Circuit Protection
- ▶ Medical EMC Standard meets 4<sup>th</sup> Edition of EMI EN55011 and EMS EN60601-1-2
- ▶ Medical Safety meets 2xMOPP per 3<sup>rd</sup> Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1 with CE Marking


**PRODUCT OVERVIEW**

The MINMAX MSCU01M series is a new range of medical approved 1W isolated dc-dc converter within enclosed SMD-14 package which specifically design for medical applications. There are 15 models available for input voltage of 5, 12, 24VDC and 5, 12, 15, ±12, ±15VDC output. The I/O isolation is specified for 4000VAC with reinforced insulation, which rated for 250Vrms working voltage. Further features include short circuit protection, low leakage current 2μA max. and operating ambient temp. range by -40°C to 95°C without derating. MSCU01M series conform to 4<sup>th</sup> edition medical EMC standard, medical safety approval meets 2xMOPP (Means Of Patient Protection) per 3<sup>rd</sup> edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1.

The MSCU01M series offer a economical solution for demanding application in medical instrument requesting a certified supplementary and reinforced insulation system to comply with latest medical safety approval for 2xMOPP requirement.

**Model Selection Guide**

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load		@Max. Load
			VDC	VDC	mA	mA		mA(typ.)
MSCU01-05S05M	5 (4.5 ~ 5.5)	5	200	4	263	50	220	76
MSCU01-05S12M		12	84	1.68	252			80
MSCU01-05S15M		15	68	1.36	246			83
MSCU01-05D12M		±12	±42	±0.84	252		100#	80
MSCU01-05D15M		±15	±33	±0.66	236			84
MSCU01-12S05M	12 (10.8 ~ 13.2)	5	200	4	110	35	220	76
MSCU01-12S12M		12	84	1.68	106			79
MSCU01-12S15M		15	68	1.36	106			80
MSCU01-12D12M		±12	±42	±0.84	106		100#	79
MSCU01-12D15M		±15	±33	±0.66	103			80
MSCU01-24S05M	24 (21.6 ~ 26.4)	5	200	4	55	20	220	76
MSCU01-24S12M		12	84	1.68	53			80
MSCU01-24S15M		15	68	1.36	53			80
MSCU01-24D12M		±12	±42	±0.84	53		100#	80
MSCU01-24D15M		±15	±33	±0.66	52			80

# For each output

**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	VDC
	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		---	±1.0	±3.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	±0.1	±1.0	%
Line Regulation	For Vin Change of 1%	---	±1.2	±1.5	%
Load Regulation	Io=10% to 100%	---	---	±10	%
Ripple & Noise	0-20 MHz Bandwidth	---	---	100	mV p-p
Temperature Coefficient		---	±0.01	±0.02	%/°C
Short Circuit Protection	Continuous, Automatic Recovery				

**Isolation, Safety Standards**

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds Reinforced insulation, rated for 250Vrms working voltage	4000	---	---	VACrms
Leakage Current	240VAC, 60Hz	---	---	2	μA
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100KHz, 1V	---	20	---	pF
Safety Standards	ANSI/AAMI ES60601-1, CAN/CSA-C22.2 No. 60601-1 IEC/EN 60601-1 3 <sup>rd</sup> Edition 2xMOPP				
Safety Approvals	ANSI/AAMI ES60601-1 2xMOPP recognition (UL certificate), IEC/EN 60601-1 3 <sup>rd</sup> Edition (CB-report)				

**General Specifications**

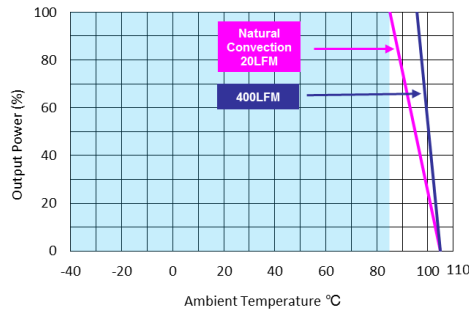
Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency		---	55	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	4,771,507	---	---	Hours
Moisture Sensitivity Level (MSL)	IPC/JEDEC J-STD-020D.1	Level 2			

**Environmental Specifications**

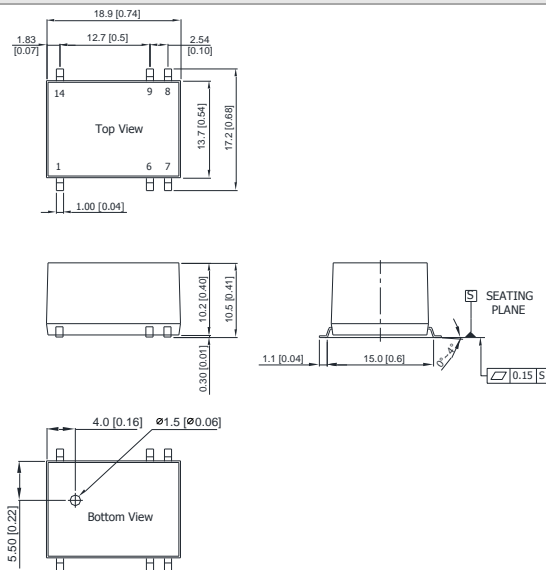
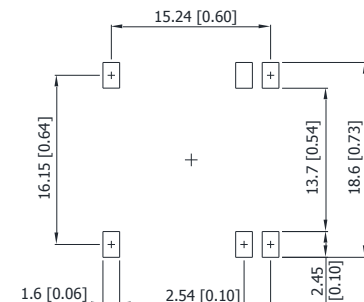
Parameter	Conditions	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	Natural Convection	-40	+95	°C
Case Temperature		---	+105	°C
Storage Temperature Range		-50	+125	°C
Humidity (non condensing)		---	95	% rel. H
Cooling	Natural Convection			
Lead-free Reflow Solder Process	IPC/JEDEC J-STD-020D.1			

**EMC Specifications**

Parameter	Standards & Level		Performance
EMI	Conduction	EN 55011, FCC part 15	Class A <sub>(5)</sub>
	EN 60601-1-2 4 <sup>th</sup>		
EMS	ESD	EN 61000-4-2 Air ± 15kV, Contact ± 8kV	A
	Radiated immunity	EN 61000-4-3 10V/m	A
	Fast transient <sup>(6)</sup>	EN 61000-4-4 ±2kV	A
	Surge <sup>(6)</sup>	EN 61000-4-5 ±1kV	A
	Conducted immunity	EN 61000-4-6 10Vrms	A
	PFMF	EN 61000-4-8 30A/m	A

**Power Derating Curve**

**Notes**

- 1 Specifications typical at Ta=+25°C, 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 slow blow fuse in the input supply line.
- 4 Other input and output voltage may be available, please contact factory.
- 5 To meet EN 55011 Class A an external filter, please contact MINMAX.
- 6 To meet EN 61000-4-4 & EN61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
- 7 That "natural convection" is about 20LFM but is not equal to still air (0 LFM).
- 8 Specifications are subject to change without notice.

**Package Specifications**
**Mechanical Dimensions**

**Connecting Pin Patterns**


- ▶ 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)

Pin Connections		
Pin	Single Output	Dual Output
1	-Vin	-Vin
6	NC	Common
7	NC	-Vout
8	+Vout	+Vout
9	-Vout	Common
14	+Vin	+Vin

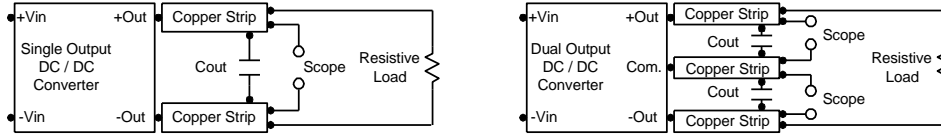
Physical Characteristics	
Case Size	: 18.9x13.7x10.2 mm (0.74x0.54x0.40 inches)
Case Material	: Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	: Phosphor Bronze
Weight	: 4.1g

NC: No Connection

Order Code Table	
Standard	For water-washable process
MSCU01-05S05M	MSCU01-05S05M-W
MSCU01-05S12M	MSCU01-05S12M-W
MSCU01-05S15M	MSCU01-05S15M-W
MSCU01-05D12M	MSCU01-05D12M-W
MSCU01-05D15M	MSCU01-05D15M-W
MSCU01-12S05M	MSCU01-12S05M-W
MSCU01-12S12M	MSCU01-12S12M-W
MSCU01-12S15M	MSCU01-12S15M-W
MSCU01-12D12M	MSCU01-12D12M-W
MSCU01-12D15M	MSCU01-12D15M-W
MSCU01-24S05M	MSCU01-24S05M-W
MSCU01-24S12M	MSCU01-24S12M-W
MSCU01-24S15M	MSCU01-24S15M-W
MSCU01-24D12M	MSCU01-24D12M-W
MSCU01-24D15M	MSCU01-24D15M-W

**Test Setup**
**Peak-to-Peak Output Noise Measurement Test**

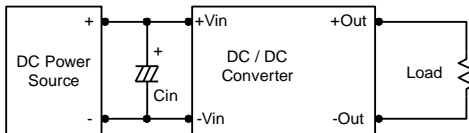
Refer to the output specifications or add 4.7 $\mu$ F capacitor if the output specifications undefine  $C_{out}$ . Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC/DC Converter.


**Technical Notes**
**Maximum Capacitive Load**

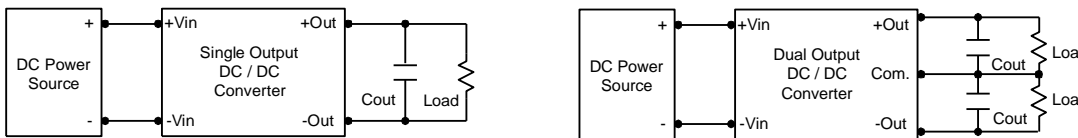
The MSCU01M series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. For optimum performance we recommend 100 $\mu$ F maximum capacitive load for dual outputs and 220 $\mu$ F capacitive load for single outputs. 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 < 1.0 $\Omega$  at 100 KHz) capacitor of a 2.2 $\mu$ F for the 5V input devices, a 1.0 $\mu$ F for the 12V input devices and a 0.47 $\mu$ F for the 24V input 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 3.3 $\mu$ F 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 105 $^{\circ}$ C. The derating curves are determined from measurements obtained in a test setup.

