

# M60 Series

## 60W 2:1 Regulated Single output

### Features

- Wide 2:1 Input Range
- 1600 VDC Isolation
- No Minimum Load Required
- Efficiency up to 91%
- -40 ~ 85°C Operation Temperature Range
- Adjustable Output Voltage
- Remote On/Off Control (CTRL)
- Continuous Short Circuit Protection
- Over Current Protection
- Over Voltage Protection
- Over Temperature Protection
- Soft Start
- Built-in EMC filter meets EN55022 ClassA without external components



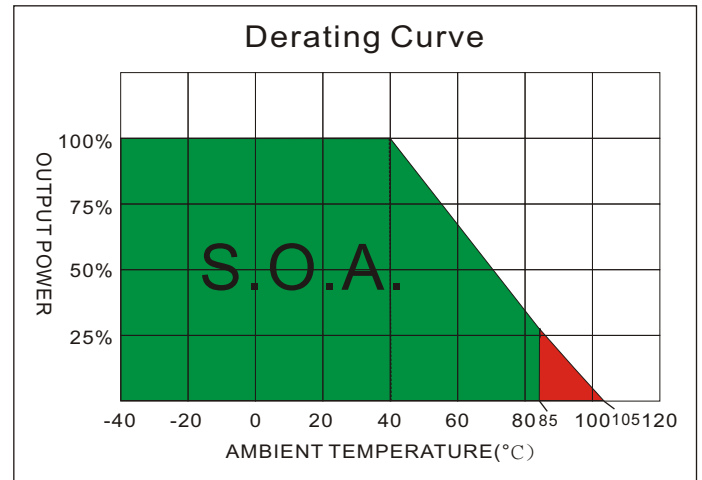
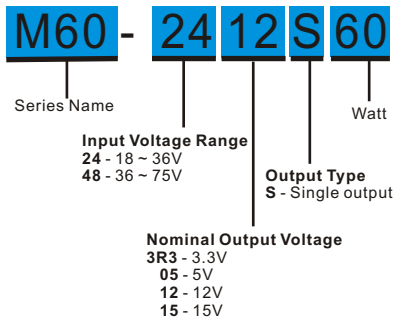
The M60 series is a family of high performance 60W single output DC-DC converters. These converters combine nickle-coated copper package in a 2"x2" case with high performance features such as Active Clamp Technology, continuous short circuit protection with automatic restart and tight line / load regulation. Devices are encapsulated using flame retardant resin. Input voltages of 24 and 48 with output voltage of 3.3, 5, 12, 15Vdc. High performance features include high efficiency operation up to 91% and output voltage accuracy of  $\pm 1\%$  maximum.

ALL SPECIFICATIONS ARE TYPICAL AT 25°C, NOMINAL INPUT AND FULL LOAD UNLESS OTHERWISE NOTED.

OUTPUT SPECIFICATIONS		GENERAL SPECIFICATIONS	
Output Voltage Accuracy	$\pm 1\%$	Efficiency	See table, typ.
Output Voltage Adjustability (Trim) (1)	$\pm 10\%$ , max.	I/O Isolation Voltage (60 sec)	
Maximum Output Current	See table	Input/Output	1600Vdc
Line Regulation	$\pm 0.5\%$ , max.	Case/Input & Output	1600Vdc
Load Regulation (0% to 100% FL)	$\pm 0.5\%$ , max.	Isolation Resistance	1000 M $\Omega$ , min.
Ripple&Noise (2)	3.3V&5.0V output: 75mVpk-pk, max. 12V&15V output: 100mVpk-pk, max.	Isolation Capacitance	2000 pF, typ.
Over Voltage Protection	3.3V output 3.9V 5V output 6.2V ( Zener diode clamp) 12V output 15V 15V output 18V	Switching frequency	270kHz, typ.
Over Load Protection	135% of FL,typ.	Humidity	95% rel H
Short Circuit Protection	Indefinite(hiccup) (Automatic Recovery)	Reliability Calculated MTBF (MIL-HDBK-217 F)	>110Khrs
Temperature Coefficient	$\pm 0.02\%/^{\circ}\text{C}$	Safety Standard (design to meet)	IEC/EN 60950-1
Capacitive Load (3)	See table	<b>EMC CHARACTERISTICS</b>	
Transient Recovery Time (4)	250us, typ.	Radiated Emissions	EN55022 CLASSA
Transient Response Deviation (4)	$\pm 3\%$ , max.	Conducted Emissions	EN55022 CLASSA
<b>INPUT SPECIFICATIONS</b>		ESD	IEC61000-4-2 Perf. Criteria A
Input Voltage Range	See table	RS	IEC61000-4-3 Perf. Criteria A
Under Voltage Lockout		EFT(8)	IEC61000-4-4 Perf. Criteria A
24V Models Module ON / OFF	17.8Vdc / 16Vdc, typ.	Surge (8)	IEC61000-4-5 Perf. Criteria A
48V Models Module ON / OFF	33.5Vdc / 30.5Vdc, typ.	CS	IEC61000-4-6 Perf. Criteria A
Start up Time	20mS, typ.	PFMF	IEC61000-4-8 Perf. Criteria A
(Nominal Vin and constant resistive load)		<b>PHYSICAL SPECIFICATIONS</b>	
Input Filter	Pi Type	Case Material	Nickel-coated Copper
Input Current (No-Load)	See table, max.	Base Material	Non-conductive Black Plastic (UL94V-0 rated)
Input Current (Full-Load)	See table, typ.	Pin Material	$\Phi 1.0\text{mm}$ Brass Solder-coated
Input Reflected Ripple Current (5)	20mApk-pk, typ.	Potting Material	Epoxy (UL94V-0 rated)
Remote On/Off (CTRL) (6)		Weight	70.0g
ON: 3.0 ... 12Vdc or open circuit		Dimensions	2.00"x2.00"x0.40"
OFF: 0 ... 1.2Vdc or Short circuit pin2 and pin 3		<b>ENVIRONMENTAL SPECIFICATIONS</b>	
OFF idle current: 5.0 mA, typ.		Operating Ambient Temperature	-40°C ~ +85°C(See Derating Curve) -40°C ~ +40°C(For 100% load)
<b>ABSOLUTE SPECIFICATIONS (7)</b>		Maximum Case Temperature	110°C
These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability.		Storage Temperature	-55°C ~ +125°C
Input Surge Voltage (100mS)		Over Temperature Protection (Case)	120°C, typ.
24 Models	50 Vdc, max.	Cooling(9)	Nature Convection
48 Models	100 Vdc, max.		
Soldering Temperature	260C, max.		
(1.5mm from case 10 sec. max.)			

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### PART NUMBER STRUCTURE



## MODEL SELECTION GUIDE

MODEL NUMBER	INPUT Voltage Range (Vdc)	INPUT Current		OUTPUT Voltage (Vdc)	OUTPUT Current		EFFICIENCY @FL(%)	Capacitor Load(μF)
		No-Load (mA)	Full Load (mA)		Min. load (mA)	Full load (mA)		
M60-243R3S60	18-36	80	2151	3.3	0	14000	91	36000
M60-2405S60	18-36	100	2762	5	0	12000	91	20400
M60-2412S60	18-36	40	2793	12	0	5000	90	3550
M60-2415S60	18-36	40	2793	15	0	4000	90	2300
M60-483R3S60	36-75	50	1075	3.3	0	14000	91	36000
M60-4805S60	36-75	60	1389	5	0	12000	91	20400
M60-4812S60	36-75	40	1397	12	0	5000	91	3550
M60-4815S60	36-75	40	1397	15	0	4000	91	2300

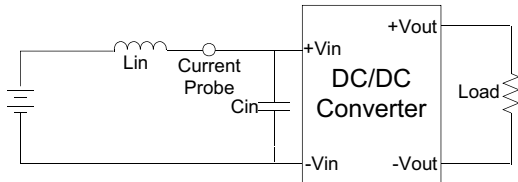
### NOTE

- Maximum output deviation is 10% inclusive of remote sense and trim. If remote sense is not being used, the +sense should be connected to its corresponding +OUTPUT and likewise the -sense should be connected to its corresponding -OUTPUT.
- Measured with 20MHz bandwidth and 1.0uF ceramic capacitor.
- Tested by minimal Vin and constant resistive load.
- Tested by normal Vin and 25% load step change ( 75%-50%-25% of Io ).
- Measured Input reflected ripple current with a simulated source inductance of 12uH.
- The remote on/off control pin is referenced to -Vin(pin2).
- Exceeding the absolute ratings of the unit could cause damage.  
It is not allowed for continuous operating.
- An external filter capacitor is required if the module has to meet IEC61000-4-4 and IEC61000-4-5.  
The filter capacitor Motien suggest: Nippon chemi-con KY series, 220uF/100V.
- Nature Convection" is usually about 30-65 LFM but is not equal to still air (0 LFM).

**TEST CONFIGURATIONS**

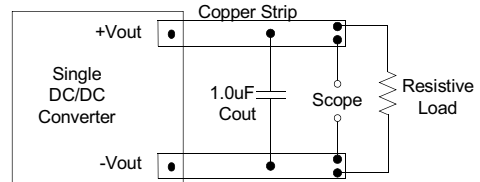
**Input Reflected Ripple Current Test Step**

Input reflected ripple current is measured through a source inductor  $L_{in}$  (12uH) and a source capacitor  $C_{in}$  (47uF, ESR<1.0Ω at 100KHz) at nominal input and full load.



**Output Ripple & Noise Measurement Test**

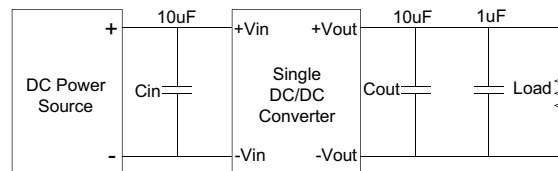
Use a capacitor  $C_{out}$  (1.0uF) measurement. The Scope measurement bandwidth is 0-20MHz.



**DESIGN & FEATURE CONFIGURATIONS**

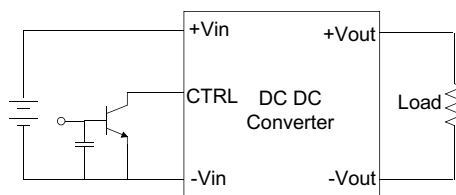
**Output Ripple & Noise Reduction**

To reduce ripple and noise, it is recommended to use a 1uF ceramic disk capacitor and a 10uF electrolytic capacitor to at the output.



**CTRL Module ON / OFF**

Positive logic turns on the module during high logic and off during low logic. Ctrl module on/off can be controlled by an external switch between the ctrl terminal and -Vin terminal. The switch can be an open collector or open drain. For positive logic if the ctrl feature is not used, please leave the ctrl pin floating.



**Over Voltage Protection**

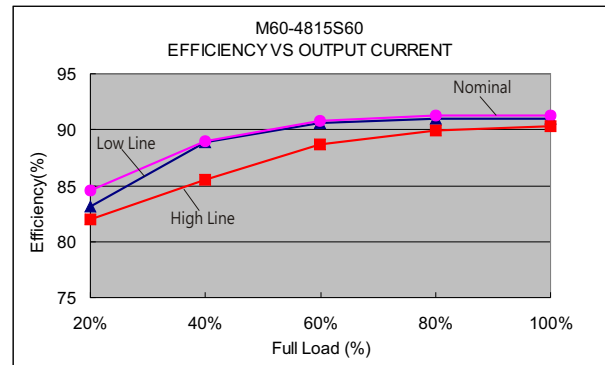
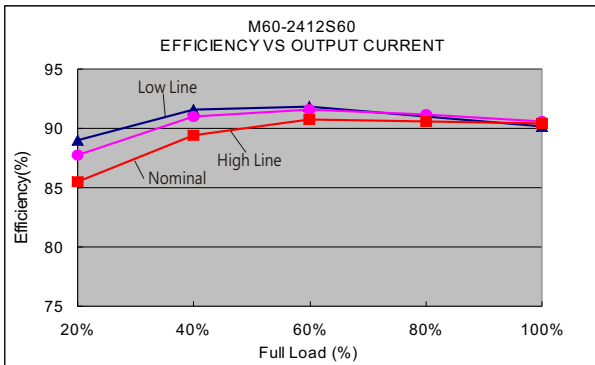
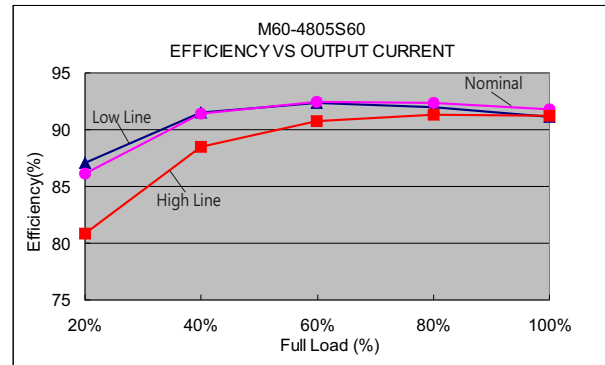
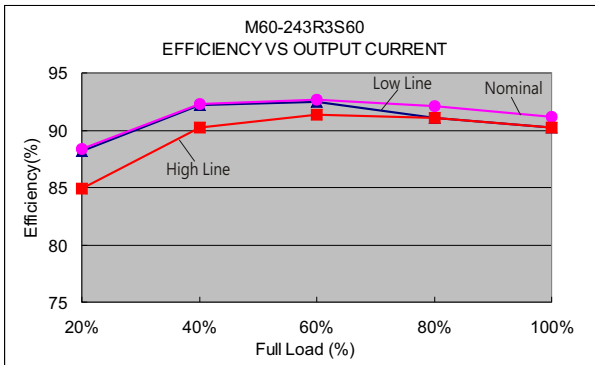
The module includes an internal output over voltage protection circuit, which monitors the voltage on the output terminals. If this voltage exceeds the over voltage set point, the module will activate the control loop of internal circuit to clamp the output voltage.

**Over Current Protection**

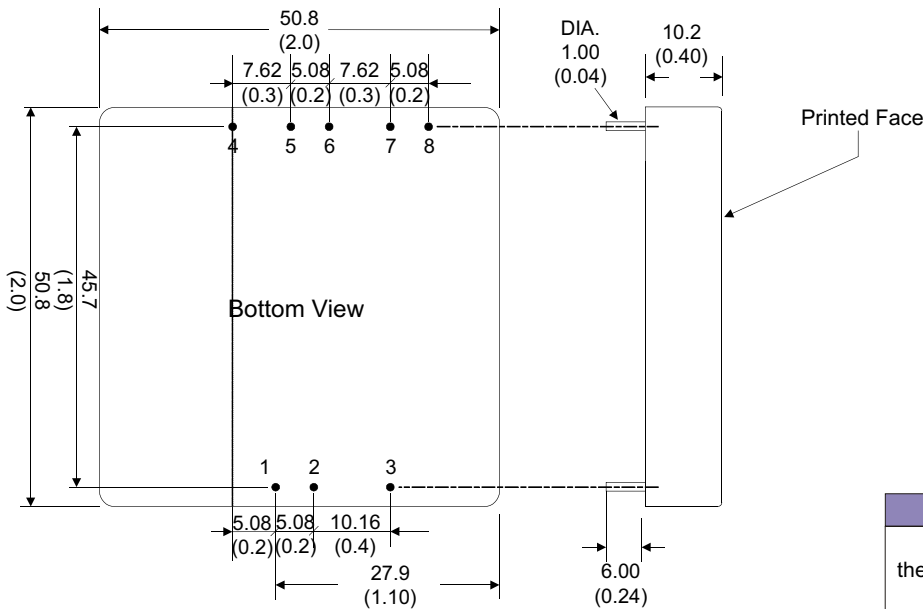
The module includes an internal over current protection circuit, which will endure current limiting for an unlimited duration during output over load condition. If the output current exceeds the OCP set point, the module will shut down automatically (hiccup). The module will try to restart after shut down. If the over load condition still exists, the module will shut down again.

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## ELECTRICAL CHARACTERISTIC CURVES



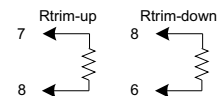
## MECHANICAL SPECIFICATIONS



PIN CONNECTIONS	
PIN NUMBER	SINGLE
1	+Vin
2	-Vin
3	CTRL
4	-Sense
5	+Sense
6	+Vout
7	-Vout
8	Trim

### EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method as below.



All dimensions are typical in millimeters ( inches ).

1. Pin diameter:  $1.0 \pm 0.05$  (  $0.04 \pm 0.002$  )
2. Pin pitch and length tolerance:  $\pm 0.35$  (  $\pm 0.014$  )
3. Case Tolerance:  $\pm 0.5$  (  $\pm 0.02$  )