



Key Features:

- Constant Current Output
- Wide 7V to 30V Input Range
- Efficiency to 95%
- Miniature MiniDIP Case
- IP67 Rated
- Meets EN 60950
- 1.6 MHrs MTBF
- Digital & Analog Dimming!

Board Mount Models **Available**









MicroPower Direct

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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.	Тур.	Max.	Units	
Input Voltage Range		7.0	24	30.0	VDC	
Max Input Voltage	0.5 Sec. Max			40.0	VDC	
Input Filter	Internal Capacitor					
Output						

Input Filter	internal Capacitor						
Output							
Parameter	Conditions	Min.	Тур.	Max.	Units		
Output Voltage Range	VIN = 30V	2		28	VDC		
Output Current	See Model Selection Guide						
Output Current Accuracy	See Model Se	lection (Guide				
Output Power	See Model Selection Guide						
Efficiency	See Model Se	lection (Guide				
Capacitive Load				47	μ F		
Operating Frequency		55		320	kHz		
Ripple & Noise (20 MHz)	See Model Se	lection (Guide				
Temperature Coefficient				±0.03	%/°C		
Thermal Impedance	Natural Convection			+50	°C/W		
Output Short Circuit	Regulated At Rated Output Current						
Environmental							

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Parameter	meter Conditions		Тур.	Max.	Units
Operating Temperature Bange	Ambient	-40	+25	+85	°C
Operating Temperature Range	Case			+105	°C
Storage Temperature Range		-40		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%
Lead Temperature (Solder)	1.5 mm From Case For 10 Sec			260	°C
Physical					

Physical	
Case Size	0.92 x 0.55 x 0.40 Inches (23.40 x 14.00 x 10.16 mm)
Case Material	Non-Conductive Black Plastic (UL94-V0)
Weight	0.392 Oz (11.1g)
Remote On/Off Control	

Parameter	Conditions	Min.	Тур.	Max.	Units
DC/DC On		Open or 0.3V <			VADJ <1.25V
DC/DC Off		VADJ			VADJ < 0.15V
Remote Pin Drive Current	$V_{ADJ} = 1.25V$			1	mA
Quiescent Input Current (Shutdown Mode)	Vin = 30V			25	μΑ
PWM Dimming					

Parameter	Conditions	Min.	Тур.	Max.	Units
Operation Frequency	Recommended Maximum			1.0	kHz
Switch On Time		200			nS
Switch Off Time		200			nS
Analog Dimming					

Analog Diffining						
Parameter	Conditions	Min.	Тур.	Max.	Units	
Input Voltage Range	At VADJ Input (Pin 4)	0.3		1.25	VDC	
Output Current Adjustment		25		100	%	
Control Valtage Banga Limita	On	0.20		0.30	VDC	
Control Voltage Range Limits	Off	0.15		0.25	VDC	
Drive Current	VADJ = 1.25V			1.0	mA	

Drive Current	VADJ = 1.25V		1.0	mA	
EMC Compliance					
EMI/RFI	Radiated/Conducted		EN 5501	5 (CISPR22)	
Electrostatic Discharge (ESD)	Class A	A IEC/EN 61000-4-2,			
RF Field Susceptibility	Class A	A IEC/EN 6100			
Electrical Fast Transients/Bursts On Mains	Class A		IEC/EI	N 61000-4-4	
EMS Immunity				EN61547	
Reliability Specifications					

Parameter Conditions MIL HDBK 217F, 25°C, Gnd Benign **MTBF**

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Model Selection Guide

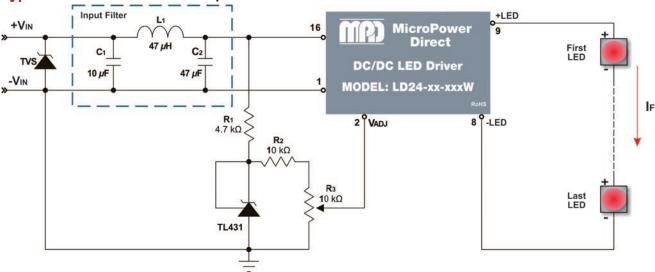
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	Input		Output		Maximum	Maximum Ripple &			
Model Number	Voltage (VDC)	Voltage (VDC)	Current		Current		Power	Noise	Efficiency (%, Typ)
	Range	Range	Max (mA)	Accuracy (%)	(W)	(mV P-P, Max)	(/-, -,)		
LD24-08-350W(A)	7.0 - 30.0	2.0 - 28.0	350	±6	8	200	95		
LD24-14-500W(A)	7.0 - 30.0	2.0 - 28.0	500	±8	14	250	95		
LD24-20-700W(A)	7.0 - 30.0	2.0 - 28.0	700	±8	20	250	95		
LD28-24-1000W(A)	7.0 - 30.0	2.0 - 28.0	1,000	±8	24	300	95		

Notes:

- A reversed power source could damage the unit. No connection should be made between input ground and the output.
- These are step-down devices, the maximum output open voltage is equal to the input voltage.
- 4. The VabJ input should be left open if not used. Grounding VabJ will shut the unit down. Connecting VabJ to Vin may damage the unit.
- 5. Exceeding the specified maximum output power could cause damage to the unit.

Typical Connection: DC/DC Input

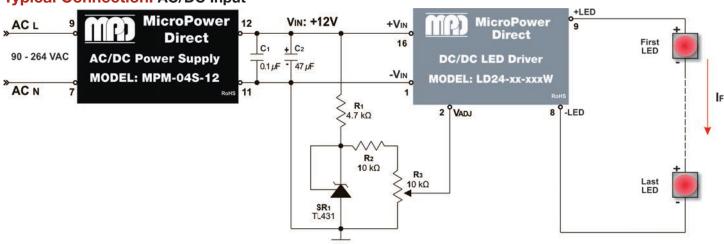


Connection Notes:

To comply with EN61000-4-5, a TVS should be installed before the input filter components. A 3.0SMCJ48A or SMCJ48A is recommended. The TVS max clamping voltage (@max peak pulse current Vc) must be $\leq \pm 60$ V. This will prevent any surge from exceeding the maximum input of the driver (65 VDC). Exceeding the maximum input rating could damage the driver.

The filter shown (C1, C2 and L1) will help to meet conducted emission requirements. With the addition of the filter, the unit should meet the levels of EN 55015.

Typical Connection: AC/DC Input



Connection Notes:

This is a distributed (or two-stage) AC connection. In this configuration, the AC line in (90 to 264 VAC) is connected to the MPM-04S-12, a miniature 4W AC/DC power supply. The MPM-04S-12 provides a tightly regulated 12 VDC output at 333 mA. The 12 VDC output powers the LED driver.

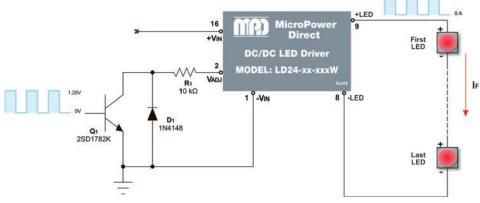
The two stage approach can simplify the safety approval process (most AC/DC power supplies on the market are approved to EN 60950) and may increase design flexibility. Besides the output power, other specifications to consider when selecting the input AC/DC supply would include input range, safety approvals, PFC rating (which may be needed for various system energy ratings) and operating temperature range.



Note: The output current adjustment circuit shown in both connection diagrams is discussed on page 4.

PWM Output Current Control

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An LED operates at its maximum efficiency when operated at the rated drive current specified by the manufacturer. Operating an LED at lower than its rated forward current not only decreases the system efficiency; but may cause color (or wavelength) shifting. In illumination applications, this could cause visible changes to lighting.

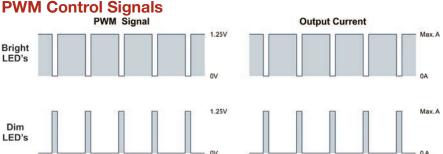
A preferred method is using pulse width modulation (PWM). As shown at left, the output current is adjusted by applying a PWM signal to the VADJ input. By varying the signal duty cycle the average output current is adjusted up or down. To avoid visible flicker, the PWM signal should be greater than 100 Hz.

For duty cycles (DPWM) between 0 and 1, the output current is derived by the formula:

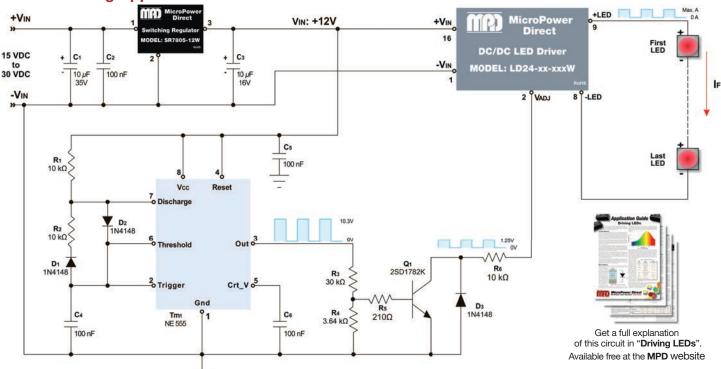
$I_{\text{NOM}} = I_{\text{MAX}} \ X \ D_{\text{PWM}}$

The VADJ input may be driven via an open collector transistor (as shown). The diode and resistor suppress high amplitude negative spikes that may be caused by the drain-source capacitance of the transistor. Negative spikes on the control input of the unit could cause errors in output current or erratic operation.

The Vapu input can also be driven by the open drain output of a microcontroller. Again, any high amplitude negative spikes that may be caused by the drain-source capacitance of the FET must be supressed.



PWM Dimming Application



A simple method of achieving digital (or PWM) dimming is by using a 555 timer to apply a series of pulses to the VADJ input, as illustrated above. The 555 operates over a supply voltage range of 4.5 VDC to 15VDC. Here it is connected to the 12 VDC output of the **SR7805** switching regulator (this is also the VIN of the LED driver). Care should be taken to minimize ripple at the Vcc input. Excess ripple could cause timing errors.

The timer is connected for a table (free run) operation. The frequency is set by R₁, R₂ and C₄. The timing capacitor (C₄) charges through R₁ and D₂. When it reaches the level of 2 /3 Vcc, the discharge pin (pin 7) goes low and C₄ will discharge through D₁ and R₂ to the internal discharge transistor. When the C₄ voltage drops to 1 /3 Vcc, the discharge pin goes high and C₄ begins to charge

again. The formulas for calculating the frequency and duty cycle are included in the MPD application note "*Driving LEDs*".

The diodes (D₁ and D₂) allow duty cycles below 50% to be set. Diode D₁ bypasses R₂ while C₄ is charging. Diode D₂ is optional (but recommended), essentially blocking R₂ during the charge period. Theoretically, this circuit will allow for duty cycles over a range of approximately 5% to 95%. If manual adjustment is desired, a potentiometer may be substituted for R₂ (with some adjustment of the circuit).

The size of C4 is generally not critical, but it should be as low leakage as possible. In order to avoid excessive current flow through the internal discharge transistor, it is recommended that R1 be at least $5~\mathrm{k}\Omega$.

The output current of the unit can also be set by adjusting the voltage level on the VADJ input to a value between 0.3V to 1.25V (IOUT will vary from 25% to 100% of rated output current). Care must be taken not to exceed 1.25V on this input, or the driver may be damaged.

A simple analog circuit using two low cost, switching regulators is shown at left. Working from inputs that can range from 15 to 32 VDC, the top regulator (SR1) keeps the input to the LED driver at 12 VDC.

The other regulator (SR2), driven off the same input line maintains the control voltage (for the VADJ input) at 5 VDC. The resister network of R1 and R2 can now be used to set the output current level of the LED driver. This level is equal to:

$$V_{\text{ADJ}} = \frac{R_2}{R_1 + R_2} \; X \; V_{\text{CTRL}} \label{eq:VADJ}$$

In the second circuit, the 5 VDC regulator (SR2) is replaced by the shunt regulator (D1) circuit connected in parallel with the resistor network. The regulator will maintain the voltage across R2 and R₃ at 2.5 VDC, insuring that the 1.25 VDC limit on the VADJ pin will not be exceeded. This circuit will work for inputs between 7VDC and 30 VDC.

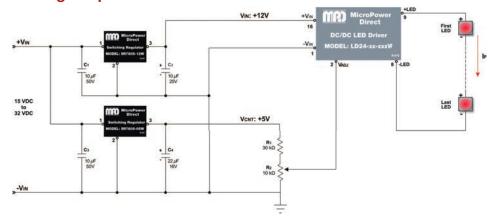
When using the analog control input, the nominal output current is equal to:

$$I_{NOM} = I_{MAX} \times \frac{V_{ADJ}}{1.25}$$

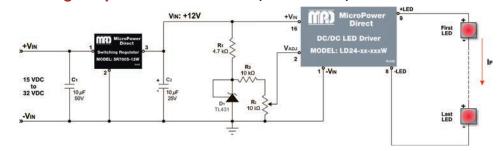
The VADJ input should be left open if not used. Grounding VADJ will shut the unit down. Connecting VADJ to directly to +VIN may damage the unit.

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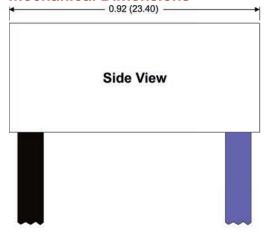
Analog Output Current Control



Analog Output Current Control (7 - 30 VDC IN)

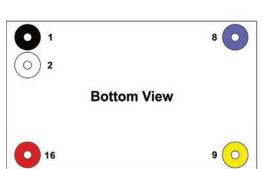


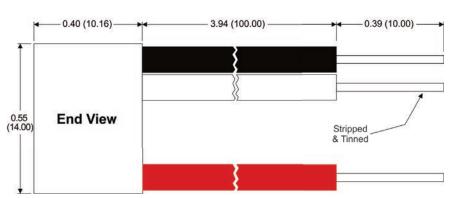
Mechanical Dimensions



Pin Connections

Pin	Color	LI	LD24-xx-xxxW		Color
1	Black	-VIN	-DC Supply	1	Black
2	White		No Wire	2	White
8	Blue	-LED	LED Cathode Conn.	8	Blue
9	Yellow	+LED	LED Anode Conn.	9	Yellow
16	Red	+Vin +DC Supply		16	Red





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- All dimensions are typical in inches (mm)
- Tolerance $x.xx = \pm 0.02 (\pm 0.50)$
- Pin 1 is marked by a "dot" or indentation on the top of the unit

LD24-xx-xxxWA

-DC Supply PWM, On/Off

LED Cathode Conn.

LED Anode Conn.

+DC Supply

-VIN

VADJ

-LED

+LED

+VIN