DC-DC LED DRIVERS

MDL48 SERIES

stadium POWER

HIGH EFFICIENCY STEP DOWN LED DRIVER

Features

- RoHS-compliant 24 Pin DIL Package
- Constant Current Output (±7% Output Current Accuracy)
- LED Driver Current 150 / 250 / 300 / 350 / 500 / 600 / 700 / 1000 mA
- Power LED Driver
- Wide Input Voltage Range: 7V to 60V (65V for 0.5sec.)
- Output Power 9 / 14 / 17 / 20 / 29 / 34 / 40 / 48W
- Driver LED Strings of up to 57V (2V to 57V)
- High Efficiency (up to 97%)
- PWM/Digital Dimming and Analog Voltage Dimming
- Open and Short LED Protection
- -40°C ~ 85°C Operation Temperature Range
- With MLCC Capacitors only

Application

- 12V,24V,36V and 48V Lighting Systems
- Household/Commercial lighting
- Suitable for high illumination LED
- Power limited (battery) lighting system

MDL48 Series is a high efficiency step-down converter optimized to drive high current LEDs. The control algorithm allows highly efficient and accurate LED current regulation. The device operates from an input 7Vdc to 60Vdc and provides an externally adjustable output current of up to 1000mA and output power up to 48 watts. Compact size of DIL24 allows designer to integrate this driver together with LED module. UL 94V-0 grade molded case with high grade filling material provide excellent fire proof characters.

(Typical at Ta = +25°C, nominal input voltage, rated output current unless otherwise specified.

Electrical Specifications:	
Input Voltage (Vdc)	7V ~ 60V (65V for 0.5 sec)
Input Filter	Capacitor
Output Voltage Range (Vin = 60V)	2V to 57V
Output Current Range (Vin - Vout > 3V)	See table
Output Current Accuracy	See table
Output Power	See table
Ripple and Noise, (20 MHz bandwidth)	See table
Maximum Efficiency at Full Load	97%
Capacitive Load	470uF
Operating Frequency	20 kHz ~ 500 kHz
Short Circuit Protection	Regulated at Rated Output Current
Temperature Coefficient	±0.03%/°C Max.
Thermal Impedance (Nature Convection)	+30°C/W
Safety Standard : (designed to meet)	IEC / EN 60950-1

Environmental Specifications	
Operating Temperature Range	-40°C to +85°C (See Derating Curve)
Storage Temperature Range	-40°C to +125°C
Humidity	95% rel H
Maximum Case Tempeature	+110°C
Cooling	Nature Convection
Reliability Calculated MTBF (MIL-HDBK-217F)	>950 Khrs
Soldering Temperature (1.5mm from case 10 sec.)	+260°C

EMC SPECIFICATIONS (design to meet)	
EMI Radiated & Conducted Emissions	EN 55015 (CISPR22)

PWM Dimming and ON/OFF Control (Leave Open if NotUsed):	
Remote ON/OFF	
DC/DC ON	Open or 0.3V < V_{ADJ} < 1.25V
DC/DC OFF (Shutdown)	V_{ADJ} < 0.15V
Remote Pin Drive Current (V_{ADJ} = 1.25V)	<1mA
Quiescent Input Current in Shutdown Mode (Vin = 60V)	100uA Max.
PWM Dimming	
Recommended Maximum Operation Frequency	1KHz
Adjust Output Current (PWM Freguency < 300Hz)	0.1% to 100%

Analog Dimming Control (Leave Open if NotUsed):	
V_{ADJ} Input Voltage Range	0.3V to 1.25V
Adjust Output Current (Vin - Vout < 30V)	25% to 100%
Control Voltage Range Limits	
ON	0.2V ~ 0.3V
OFF	0.15V ~ 0.25V
Analog Pin Drive Current (V_{ADJ} = 1.25V)	<1mA

Physical Specifications	
Case Material	Non-Conductive Black Plastic (UL94V-0 rated)
Potting Material	Epoxy (UL94V-0 rated)
	Silicon (UL94V-0 rated)
Pin Material	Ø0.5mm Brass Solder-coated
Weight	17.7g
Dimensions	1.25"x0.80"x0.49"

NOTE

1. Reversed power source damages the circuit, No connection is allowed between input ground and output.
2. DO NOT operate the driver over output power.
3. Leave pin V_{ADJ} open if not in use, ground pin to shut down the converter. Connecting V_{ADJ} to Vin damages the circuit.
4. Maximum output open voltage is equal to input voltage.

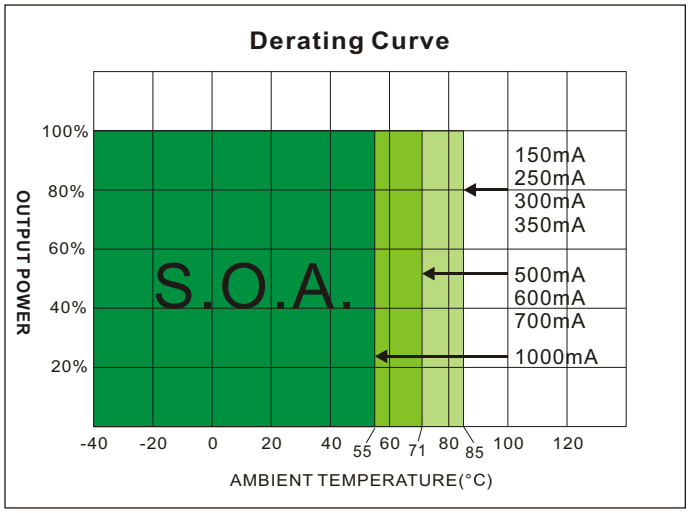
HIGH EFFICIENCY STEP DOWN LED DRIVER

PART NUMBER STRUCTURE

MDL48 - 60 - 1000

- MDL48 — Series Name
- 60 — Input Max. Voltage
- 1000 — Output Current

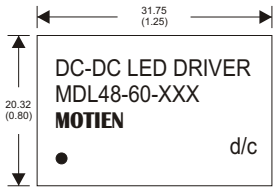
150	-	150mA
250	-	250mA
300	-	300mA
350	-	350mA
500	-	500mA
600	-	600mA
700	-	700mA
1000	-	1000mA

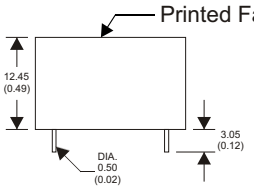


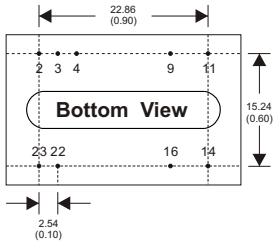
MODEL SELECTION GUIDE

MODEL NUMBER	INPUT	OUTPUT		OUTPUT C urrent	OUTPUT	EFFICIENCY	Ripple and Noise	Capacitor
	Voltage Range (Vdc)	Voltage Range (Vdc)	Current (mA)	Accuracy (%)	Power (W) Max.	@FL(%) Max.	mVp-p Max.	Load(uF)
MDL48-60-150	7-60	2 ~57	150	±8	9	97	150	470
MDL48-60-250	7-60	2 ~57	250	±7	14	97	200	470
MDL48-60-300	7-60	2 ~57	300	±6	17	97	250	470
MDL48-60-350	7-60	2 ~57	350	±5	20	97	300	470
MDL48-60-500	7-60	2 ~57	500	±5	29	97	400	470
MDL48-60-600	7-60	2 ~57	600	±5	34	97	450	470
MDL48-60-700	7-60	2 ~57	700	±5	40	97	500	470
MDL48-60-1000	7-60	2 ~48	1000	±5	48	97	800	470

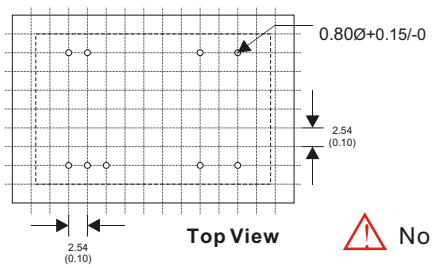
MECHANICAL DIMENSION







Recommended Foorprint Details



24 Pin DIL Package

Notes : All dimensions are typical in millimeters (inches).
1. Pin diameter: 0.5±0.05 (0.02±0.002)
2. Pin pitch tolerance: ±0.35 (±0.014)
3. Case Tolerance: ±0.5 (±0.02)

Pin #	CONNECTIONS	
2,3	- V Input	- DC Supply
4	VADJ	PWM/ON/OFF or not used
9,11	- V Output	LED Cathode Connection
14,16	+V Output	LED Anode Connection
22,23	+V Input	+DC Supply

⚠ No connection is allowed between input and output

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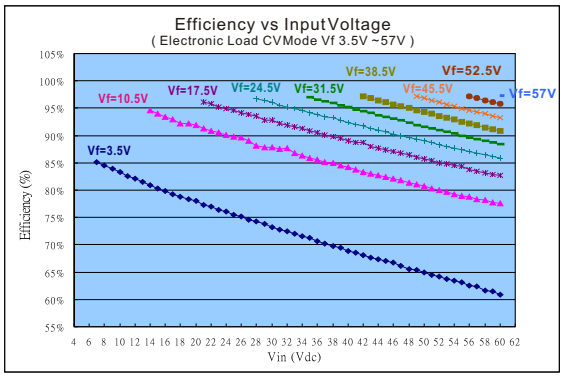
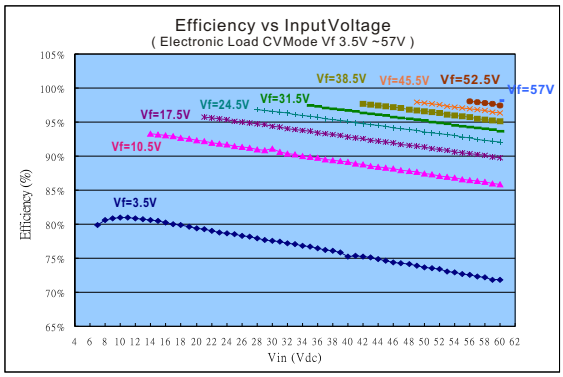
Typical Operating Conditions

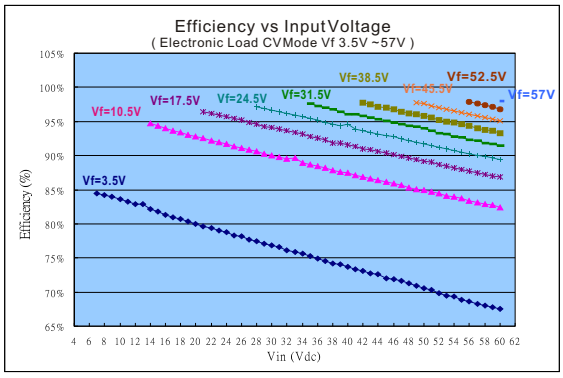
MDL48-60-150



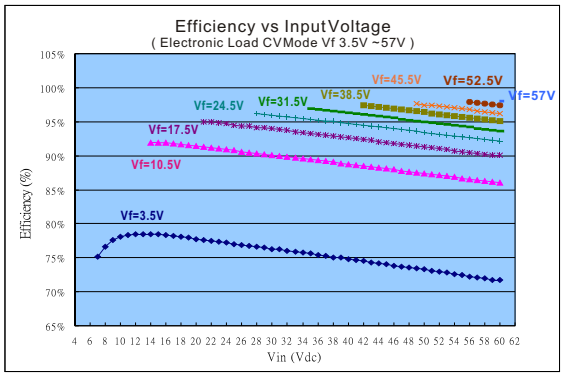
MDL48-60-500



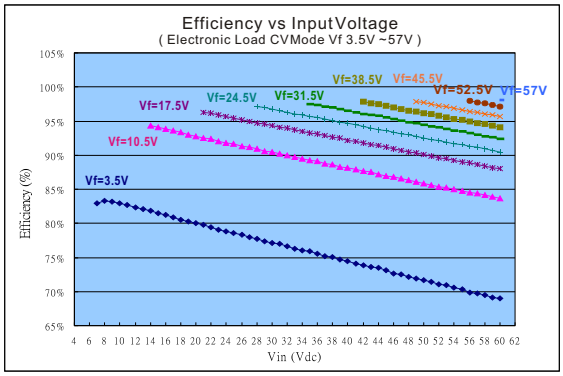
MDL48-60-250



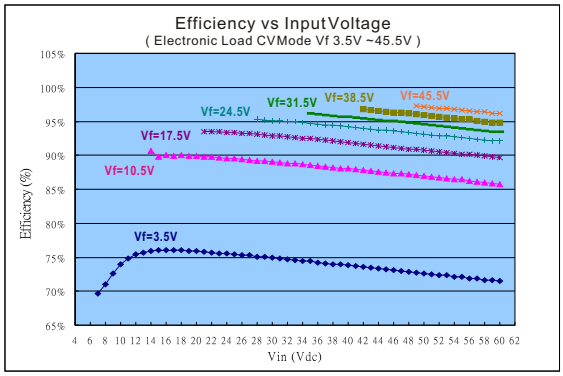
MDL48-60-700



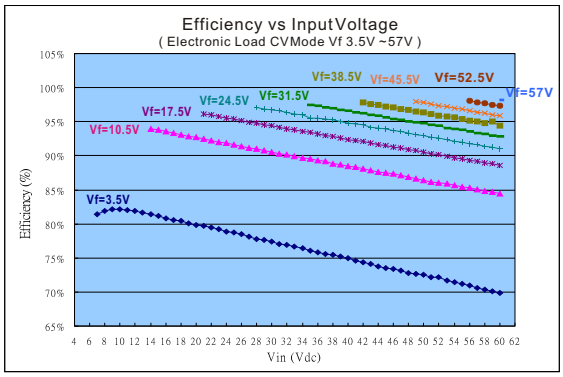
MDL48-60-300



MDL48-60-1000



MDL48-60-350



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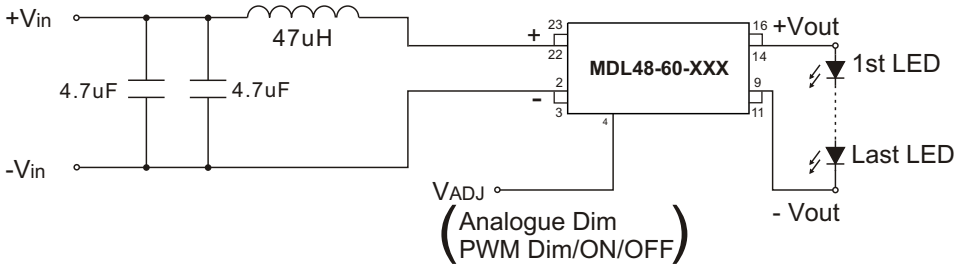
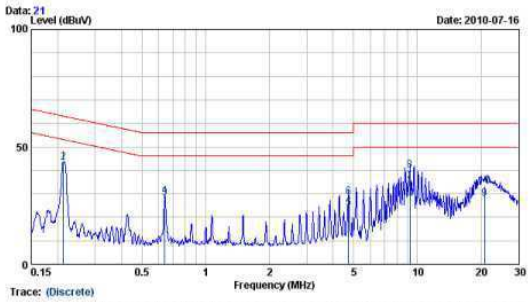
EMC Characteristics meet EN55022

EN55015 Conduction Class B Filter Suggestion



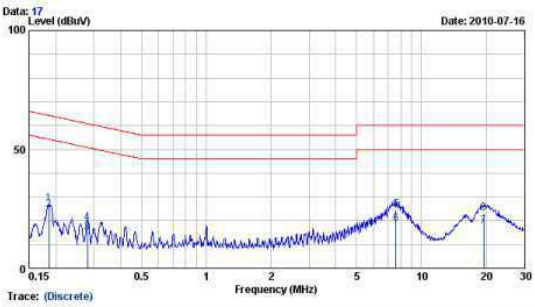
Vin=60V Vout=30V(LED Load Vf=3.3V , 9LED≒30V)



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.213	9.93	0.03	33.77	43.73	63.10	-19.36	QP
0.213	9.93	0.03	33.37	43.33	53.10	-9.76	AVERAGE
0.641	9.95	0.06	18.14	28.15	46.00	-17.85	AVERAGE
0.641	9.95	0.06	18.84	28.85	56.00	-27.15	QP
4.721	9.96	0.06	13.66	23.68	46.00	-22.32	AVERAGE
4.721	9.96	0.06	18.66	28.68	56.00	-27.32	QP
9.212	10.01	0.07	24.91	34.99	50.00	-15.01	AVERAGE
9.212	10.01	0.07	29.72	39.80	60.00	-20.20	QP
20.814	10.04	0.12	17.76	27.91	50.00	-22.09	AVERAGE
20.814	10.04	0.12	23.23	33.38	60.00	-26.62	QP

REMARKS:1.Level(dBuV/m)=Read Level(dBuV)+Antenna Factor(dB/m)+Cable loss(dB)
2.Over Limit value(dB)=Level(dBuV/m)-Limit Line(dBuV/m)

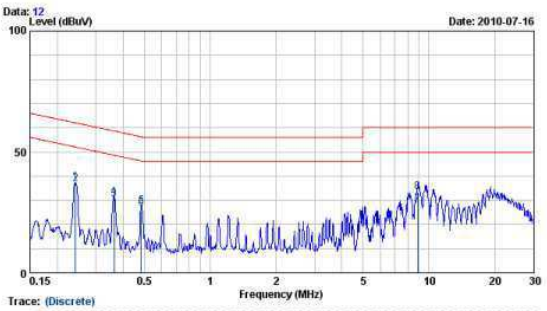
Vin=12V Vout=3.3V(LED Load Vf=3.3V , 1LED≒30V)



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.185	9.92	0.04	16.97	26.92	64.24	-37.32	QP
0.185	9.92	0.04	14.56	24.51	54.24	-29.73	AVERAGE
0.280	9.95	0.04	5.10	15.10	50.81	-35.71	AVERAGE
0.280	9.95	0.04	9.09	19.09	60.81	-41.72	QP
7.606	9.99	0.08	14.56	24.63	60.00	-35.37	QP
7.606	9.99	0.08	8.70	18.77	50.00	-31.23	AVERAGE
19.428	10.03	0.10	7.33	17.46	50.00	-32.54	AVERAGE
19.428	10.03	0.10	12.82	22.95	60.00	-37.05	QP

REMARKS:1.Level(dBuV/m)=Read Level(dBuV)+Antenna Factor(dB/m)+Cable loss(dB)
2.Over Limit value(dB)=Level(dBuV/m)-Limit Line(dBuV/m)

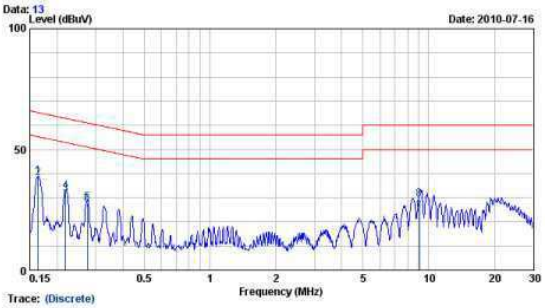
Vin=60V Vout=48V(LED Load Vf=3.3V , 14LED≒15V)



Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.242	9.94	0.04	27.29	37.27	62.04	-24.77	QP
0.242	9.94	0.04	26.56	36.54	52.04	-15.50	AVERAGE
0.363	9.95	0.05	20.52	30.52	48.65	-18.13	AVERAGE
0.363	9.95	0.05	21.22	31.22	58.65	-27.43	QP
0.484	9.94	0.06	17.42	27.42	56.27	-28.85	QP
0.484	9.94	0.06	16.58	26.58	46.27	-19.69	AVERAGE
8.869	10.00	0.07	17.71	27.79	50.00	-22.21	AVERAGE
8.869	10.00	0.07	23.20	33.28	60.00	-26.72	QP

REMARKS:1.Level(dBuV/m)=Read Level(dBuV)+Antenna Factor(dB/m)+Cable loss(dB)
2.Over Limit value(dB)=Level(dBuV/m)-Limit Line(dBuV/m)

Vin=7V Vout=3.3V(LED Load Vf=3.3V , 1LED≒30V)

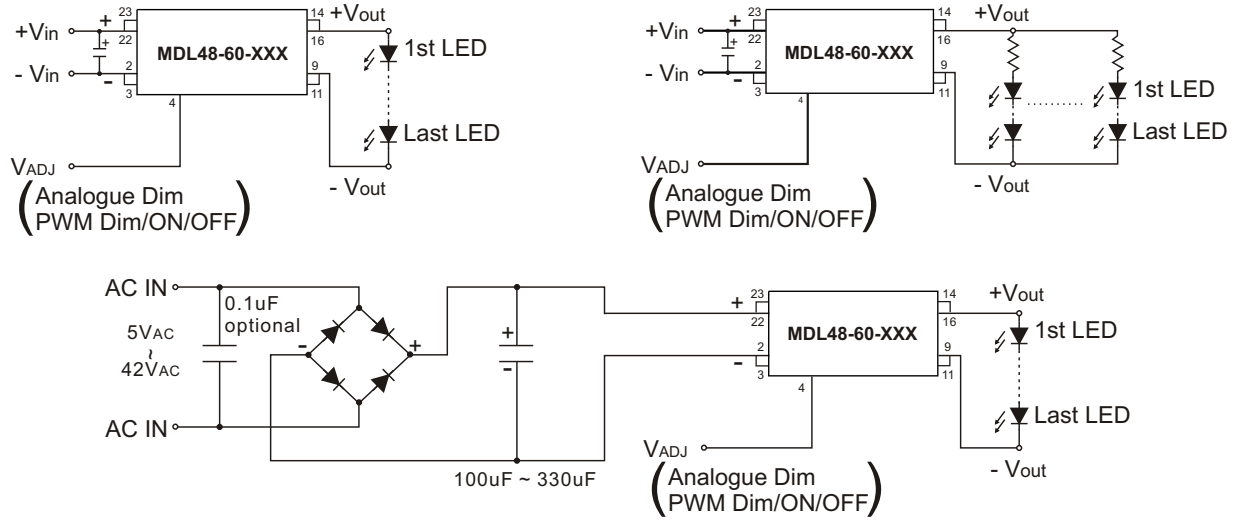


Freq. MHz	LISN Factor dB	Cable Loss dB	Meter Reading dBuV	Measured Level dBuV	Limits dBuV	Over Limits dBuV	Detector
0.163	9.91	0.04	28.96	38.91	65.30	-26.38	QP
0.163	9.91	0.04	28.15	38.10	55.30	-17.19	AVERAGE
0.219	9.93	0.03	21.65	31.62	52.88	-21.26	AVERAGE
0.219	9.93	0.03	22.81	32.78	62.88	-30.10	QP
0.274	9.95	0.04	17.94	27.93	60.98	-33.05	QP
0.274	9.95	0.04	17.26	27.25	50.98	-23.73	AVERAGE
9.059	10.00	0.07	14.24	24.32	50.00	-25.68	AVERAGE
9.059	10.00	0.07	19.41	29.49	60.00	-30.51	QP

REMARKS:1.Level(dBuV/m)=Read Level(dBuV)+Antenna Factor(dB/m)+Cable loss(dB)
2.Over Limit value(dB)=Level(dBuV/m)-Limit Line(dBuV/m)

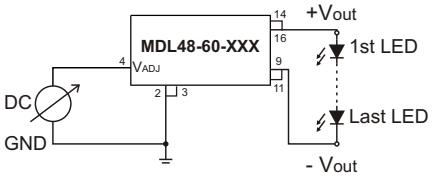
HIGH EFFICIENCY STEP DOWN LED DRIVER

Typical Application

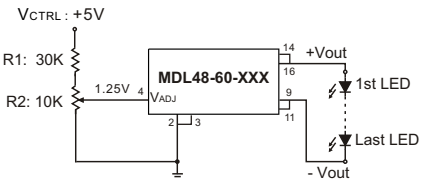


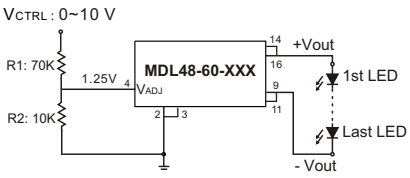
Output Current Adjustment By External DC Control Voltage (V_{CTRL})

$V_{ADJ}=V_{CTRL}$ [If V_{CTRL}=0~1.25Vdc]



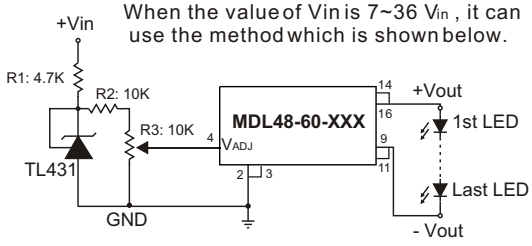
$V_{ADJ} = \frac{R2}{R1 + R2} \times V_{CTRL}$ [If V_{CTRL} > 1.25 Vdc]



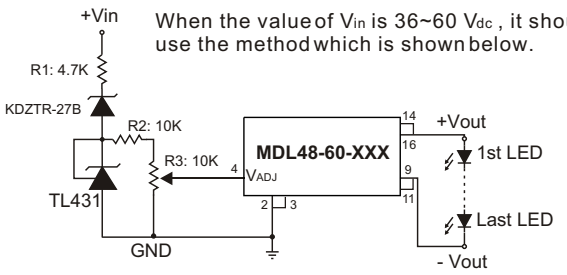


$V_{ADJ} = \frac{R3}{R2 + R3} \times 2.5$ [If V_{CTRL}= V_{in}]

When the value of Vin is 7~36 V_{in} , it can use the method which is shown below.



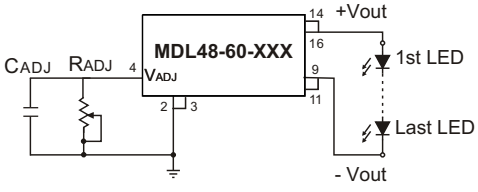
When the value of V_{in} is 36~60 V_{dc} , it should use the method which is shown below.



The nominal output current ($Iout_{nom}$) is given by: $Iout_{nom} \approx Iout \times \frac{V_{ADJ}}{1.25}$

Resistor dimming

By connecting a variable resistor between ADJ and GND, simple dimming can be achieved. Capacitor C_{ADJ} is optional for better AC mains interference and HF noise rejection. Recommend value of C_{ADJ} is 0.22uF.



The current output $Iout_{nom}$ can be determined using the equation:

$$Iout_{nom} = \frac{Iout \times R_{ADJ}}{(R_{ADJ} + 50K)}$$

If the value of R_{ADJ} is 0 to 2M ohm, the maximum adjust range of output current is 25% to 90%. (For Vin-Vout < 30V)

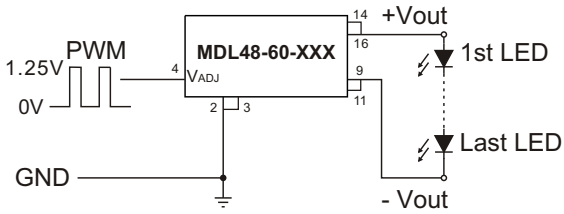
HIGH EFFICIENCY STEP DOWN LED DRIVER

Typical Application

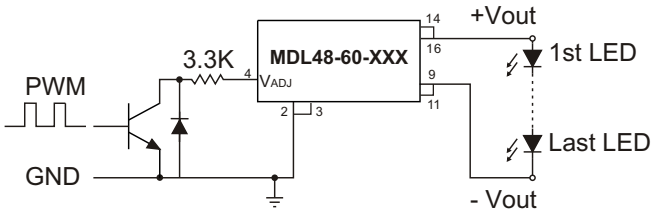
Output Current Adjustment By PWM Control

Directly driving ADJ input
A Pulse Width Modulated (PWM) signal with duty cycle D_{PWM} can be applied to the ADJ pin, as shown below

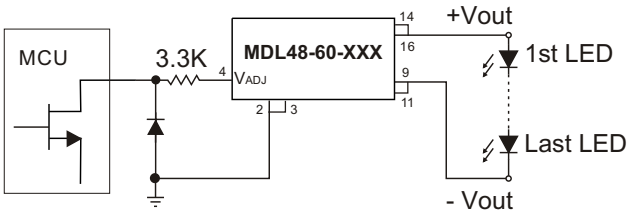
$Iout_{nom} \approx Iout \times D_{PWM}$ [If PWM frequency <300Hz, for $0.001<D_{PWM}<1$]



Driving the ADJ input via open collector transistor
The diode and resistor suppress possible high amplitude negative spikes on the ADJ input resulting from the drain-source capacitance of the transistor. Negative spikes at the input to the device should be avoided as they may cause errors in output current, or erratic device operation.



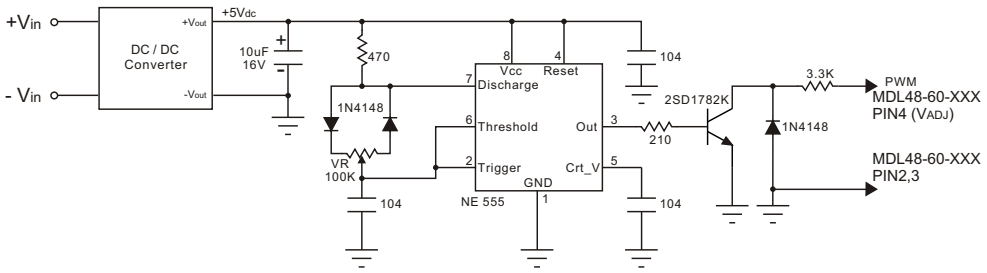
Driving the ADJ input from a microcontroller
Another possibility is to drive the device from the open drain output of a microcontroller. The diagram below shows one method of doing this:



The diode and resistor suppress possible high amplitude negative spikes on the ADJ input resulting from the drain-source capacitance of the FET. Negative spikes at the input to the device should be avoided as they may cause errors in output current, or erratic device operation.

Output Current Adjustment By PWM Control (Dimming)

To avoid visible flicker the PWM signal must be greater than 100Hz.



Output Current Adjustment By PWM Control (Flash)