CMJA5050 Ideal Applications
Adjustable Current Limiting Diode

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Introduction

In resistively biased circuits where a constant current is required, a great deal of power is wasted on resistors before current is passed to the load. Additionally, because of the resistors' linear relationship between current and voltage, small variances in voltage can lead to undesirable variances in current. Central Semiconductor's CMJA5050 adjustable current limiting diode (CLD) solves both dilemmas, providing constant current over a wide range of voltages, while consuming minimal power. Featuring the innovative DFN123F package, Central's CMJA5050 also delivers unrivaled thermal efficiency while saving board space.

Effectively, a CLD is a JFET in which gate and source are shorted by a small resistance, indicated in the figures below. The current of the CMJA5050 can be adjusted by varying the resistance placed in parallel, also shown below. Note that this resistor is external to the diode, unlike the RS within the device.

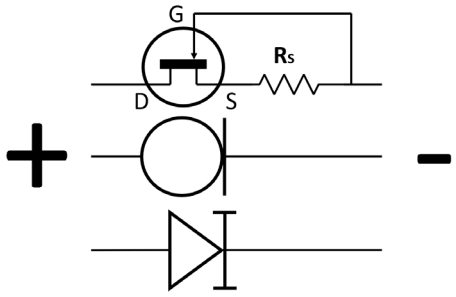

Figure 1:
Three circuit symbols for a current limiting diode (CLD)

REGULATOR CURRENT PER RESISTANCE:

Steady State Regulator Current I_L @ V_T=12V			Resistor (1/4W)
MIN mA	NOM mA	MAX mA	Ω
45	50	55	none*
49.5	55	60.5	1000
54	60	66	800
58.5	65	71.5	600
67.5	75	82.5	500
72	80	88	400

Figure 2:
How a parallel resistor changes current of the CMJA5050

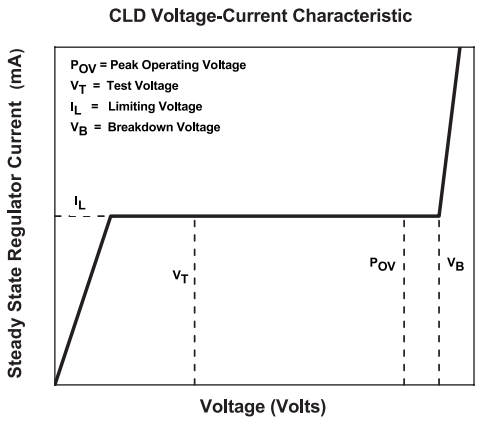

Figure 3:
Constant current of the CMJA5050

LED Driver

A common application of CLDs providing a constant current source is LED circuits. Despite the constant voltage drop across LEDs, increasing the voltage will also increase current through the LED, which can both increase brightness and waste energy. Once the small voltage required to power the diode is crossed, the CMJA5050 will provide a constant current to the load, regardless of how voltage is increased. This occurs until the breakdown voltage is reached - unlikely in most applications – assuming power consumption is not increased. For an LED, constant current means constant brightness across a wide range of voltages. Additionally, a CLD ensures that the LED does not burn out or reach electrical breakdown following the application of an especially high voltage, increasing lifespan. Below is a circuit powering two LEDs in series with a rectified AC source, featuring the CMJA5050 with its current-regulating resistor. Though LEDs are used, this solution can be used for any lighting application.

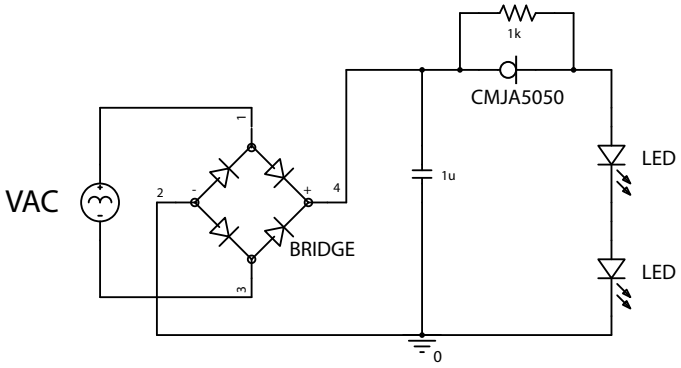

Figure 4:
LED Driver

Battery Charger

When in a charging circuit, a large spike in current has a chance of destroying the battery. CLDs are an affordable and effective way to regulate current without impeding the charging voltage, thus solving this potential problem. This can be contrasted to the LM338 as a voltage regulator, which is a more expensive and complex component. Also shown is Central Semiconductor's CBRDFA4-100 bridge rectifier, utilized in this instance to convert the AC input to DC, in addition to an indicator LED.

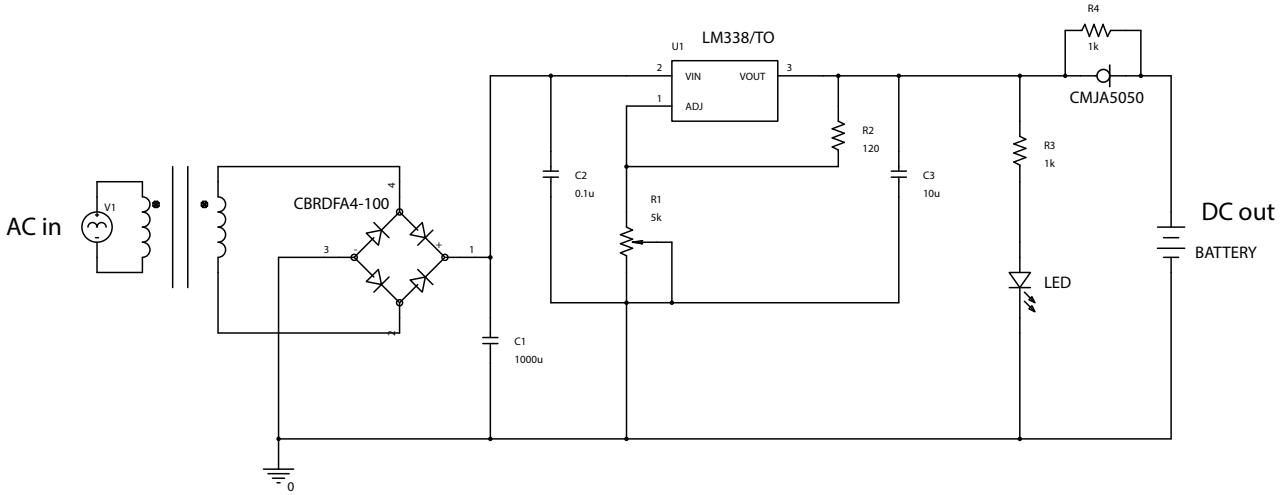

Figure 5:
Battery Charger

Sawtooth Generator

A sawtooth wave is a basic non-sinusoidal waveform consisting of a linearly increasing voltage followed by a sharp drop to 0, repeated. With a capacitor and a CLD, one of the simplest function generators can be created, producing a sawtooth wave. The key stems from the capacitor equation:

$$i = C\frac{dv}{dt}$$

Assuming all values are nonzero, C is a constant, and i is constant, a benefit of the CLD. If both of these are true, then dv/dt must also be a nonzero constant, meaning v(t) is a linear function. If a switch (MOSFET in this example) is placed parallel to the capacitor, it will charge linearly while the switch is open. The switch will then release its energy, falling to 0, when the switch is closed. Using a microcontroller to quickly turn the switch on and off will produce a sawtooth wave across it.

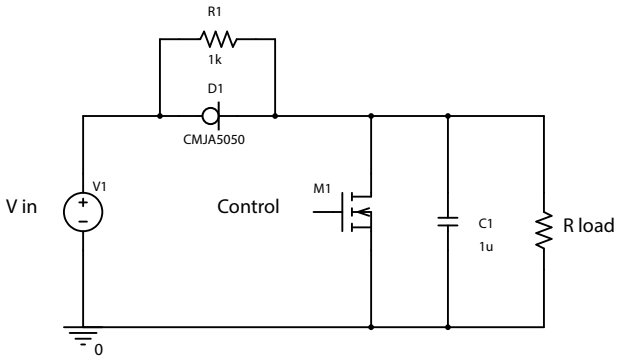

Figure 6:
Sawtooth Generator

Conclusion

A constant current can be difficult to achieve when building a circuit with ordinary passive components, despite being a common requirement for many projects. Not only does Central's CMJA5050 provide this benefit, but the current can be easily adjusted by changing the parallel resistance, often with a variable resistor.

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