



## MIC23051 Evaluation Board

### 4MHz PWM Buck Regulator with HyperLight Load™ and Voltage Scaling

## General Description

Micrel's MIC23051 is a 600mA 4MHz switching regulator with HyperLight Load™ mode. The MIC23051 is highly efficient throughout the load range and only draws 20µA of quiescent current. Sub-1mm solution is easily obtainable using the tiny package (2mm x 2mm x 0.85mm) MIC23051, which only requires four external components. Small and fast, the MIC23051 can respond to a load transient at ultra-fast speed while reducing output peak-to-peak voltage. The MIC23051 also features a voltage scaling function that can be used to set the output voltage to two different voltage levels.

The MIC23051 has two modes of operation which is automatically selected by the internal circuitry. Under light load conditions from 1mA to 50mA, the MIC23051 goes into HyperLight Load™ mode. The MIC23051 HyperLight Load™ uses a Pulse-Frequency Modulation (PFM) control scheme that controls the off time at light load and keeps constant switching frequency in continuous mode. This allows the device to reduce the amount of switching needed at light loads, thus reducing the switching losses. The MIC23051 can attain 85% efficiency at 1mA output load. When the load is more than 50mA, HyperLight Load automatically switches back to Pulse-Width Modulation (PWM) mode to ensure high efficiency at higher loads. The two modes of operation ensure that the MIC23051 maintains the highest efficiency throughout the load range.

The MIC23051 features Voltage Scaling via the VSC pin. This function allows the MIC23051 to alternate between two different voltage levels. A high input logic on the VSC pin will cause the MIC23051 to regulate at the higher voltage level, while a low input logic will set the MIC23051 to regulate at the lower voltage level.

The MIC23051 operates from a 2.7V to 5.5V input and features internal power MOSFETs that can supply up to 600mA of output current. It can operate with a maximum duty cycle of 80%.

## Requirements

The MIC23051 evaluation board requires an input power source that is able to deliver greater than 650mA at 2.7V. The output load can either be an active or passive source.

## Getting Started

1. **Connect an external supply to the V<sub>IN</sub> (J1) terminal.** Apply desired input voltage to the V<sub>IN</sub> (J1) and ground (J2 and J4) terminals of the evaluation board, paying careful attention to polarity and supply voltage ( $2.7V \leq V_{IN} \leq 5.5V$ ). An ammeter may be placed between the input supply and the V<sub>IN</sub> (J1) terminal to the evaluation board. Be sure to monitor that the supply voltage at the V<sub>IN</sub> (J1) terminal. The ammeter and/or power lead resistance can reduce the voltage supplied to the input.
2. **Connect a load to the V<sub>O</sub> (J3) output and ground terminal.** The load can be either passive (resistive) or active (electronic load). An ammeter can be placed between the load and the output terminal. Ensure that the output voltage is monitored at the V<sub>O</sub> (J3) terminal.
3. **Scale the output voltage.** Connect the VSC (J6) pin to V<sub>IN</sub> (J1) to scale the output voltage to the higher voltage. Connect the VSC (J6) pin to GND (J2) to scale the output voltage to the lower voltage. Do not leave floating.
4. **Enable the MIC23051.** Apply a 1.2V or greater voltage source to the enable pin (EN). Be sure that the enable voltage never exceeds the input voltage. Do not leave floating.

## Output Voltage

The MIC23051 evaluation board has fixed voltage options (1.2V/1V and 1.8V/1V) available.

## Ordering Information

Part Number	Description
MIC23051-C4YML EV	1.2V / 1V Output Evaluation Board
MIC23051-CGYML EV	1.8V / 1V Output Evaluation Board

HyperLight Load is a trademark of Micrel, Inc.

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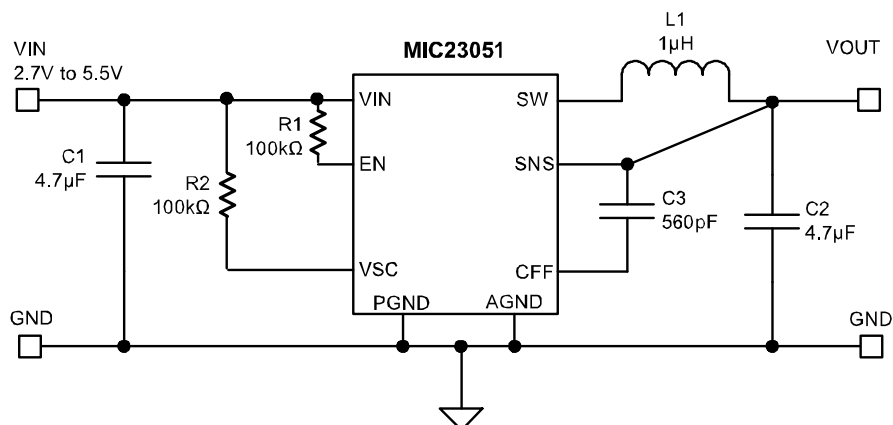
**HyperLight Load™ Mode**

MIC23051 uses a minimum on and off time proprietary control loop. When the output voltage falls below the regulation threshold, the error comparator begins a switching cycle that turns the PMOS on and keeps it on for the duration of the minimum-on-time. When the output voltage is over the regulation threshold, the error comparator turns the PMOS off for a minimum-off-time. The NMOS acts as an ideal rectifier that conducts when the PMOS is off. Using a NMOS switch instead of a diode allows for lower voltage drop across the switching device when it is on. The asynchronous switching combination between the PMOS and the NMOS allows the control loop to work in discontinuous mode for light load operations. In

discontinuous mode MIC23051 works in pulse frequency modulation (PFM) to regulate the output. As the output current increases, the switching frequency increases. This improves the efficiency of MIC23051 during light load currents. As the load current increases, the MIC23051 goes into continuous conduction mode (CCM) at a constant frequency of 4MHz. The equation to calculate the load when the MIC23051 goes into continuous conduction mode may be approximated by the following formula:

$$I_{LOAD} = \left( \frac{(V_{IN} - V_{OUT}) \times D}{2L \times f} \right)$$

## MIC23051 Evaluation Board Schematic



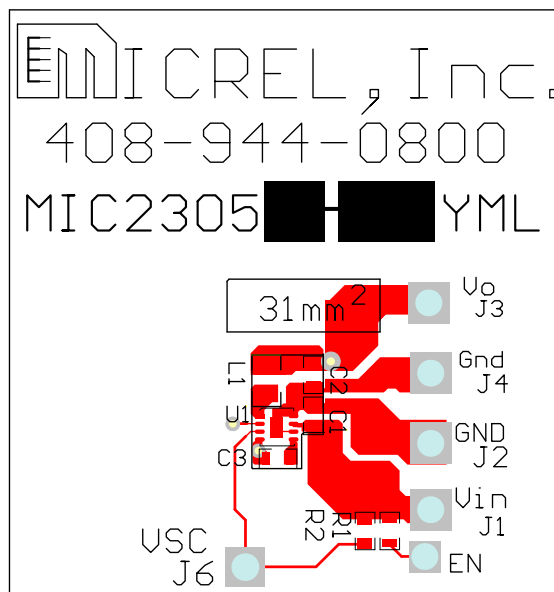
## Bill of Materials

Item	Part Number	Manufacturer	Description	Qty
C1, C2	C1608X5R0J476K	TDK <sup>(1)</sup>	4.7µF Ceramic Capacitor, 6.3V, X5R, Size 0603	2
C3	C1608C0G1H561J	TDK <sup>(1)</sup>	560pF Ceramic Capacitor, 50V, NPO, Size 0603	1
L1	LQM21PN1R0MC0D	Murata <sup>(2)</sup>	1µH, 0.8A, 190mΩ, L2mm x W1.25mm x H0.5mm	1
	LQH32CN1R0M33	Murata <sup>(2)</sup>	1µH, 1A, 60mΩ, L3.2mm x W2.5mm x H2.0mm	
	LQM31PN1R0M00	Murata <sup>(2)</sup>	1µH, 1.2A, 120mΩ, L3.2mm x W1.6mm x H0.95mm	
	CPL2512T1R0M	TDK <sup>(1)</sup>	1µH, 1.5A, 100mΩ, L2.5mm x W1.5mm x H1.2mm	
	LQM31PNR47M00	Murata <sup>(2)</sup>	0.47µH, 1.4A, 80mΩ, L3.2mm x W1.6mm x H0.85mm	
	MIPF2520D1R5	FDK <sup>(3)</sup>	1.5µH, 1.5A, 70mΩ, L2.5mm x W2mm x H1.0mm	
R1, R2	CRCW06031003FKEYE3	Vishay <sup>(4)</sup>	100kΩ, 1%, 1/16W, Size 0603	2
U1	MIC23051-xxYML	Micrel, Inc. <sup>(5)</sup>	4MHz PWM Buck Regulator with HyperLight Load™ Mode	1

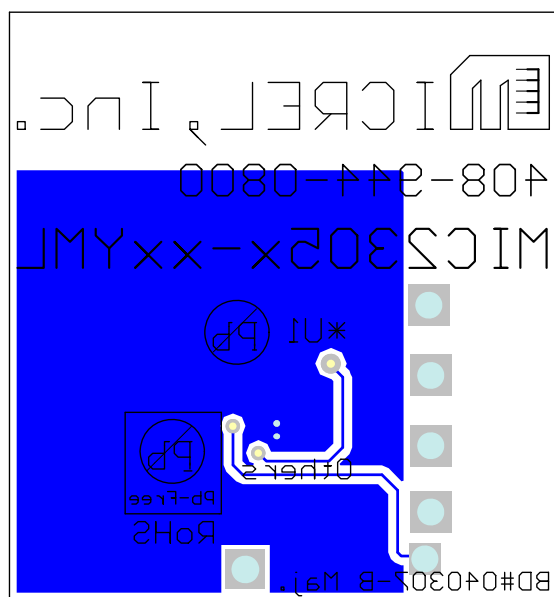
### Notes:

1. TDK: [www.tdk.com](http://www.tdk.com)
2. Murata: [www.murata.com](http://www.murata.com)
3. FDK: [www.fdk.co.jp](http://www.fdk.co.jp)
4. Vishay: [www.vishay.com](http://www.vishay.com)
5. Micrel, Inc: [www.micrel.com](http://www.micrel.com)

## PCB Layout Recommendations



Top Layer



Bottom Layer

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