MIC33030 Evaluation Board

8MHz Internal Inductor, 400mA Buck Regulator with HyperLight Load™

General Description

This evaluation board enables the evaluation of the MIC33030, a fully-integrated 400mA, 8MHz switching regulator featuring an internal inductor and HyperLight Load™ mode. The MIC33030 is efficient throughout the entire output current range, drawing just 20µA of quiescent current in operation. The tiny 2.0mm x 2.5mm MLF® package, in combination with the internal inductor, enables a compact solution with only two external components. The MIC33030 provides accurate output voltage regulation under the most demanding conditions and responds extremely quickly to a load transient with exceptionally small output voltage ripple.

Requirements

This board needs a single 2W bench power source adjustable from 2.7V to 5.5V. The loads can either be active (electronic load) or passive (resistor) with the capability to dissipate 1W. It is ideal to have an oscilloscope available to view the circuit waveforms, but not essential. For the simplest tests, two voltage meters are required to measure input and output voltage. For efficiency measurements, two Voltage meters and two Ammeters are required to prevent errors due to measurement inaccuracies.

Precautions

There is no reverse input protection on this board. Be cautious when connecting the input source to ensure correct polarity is observed.

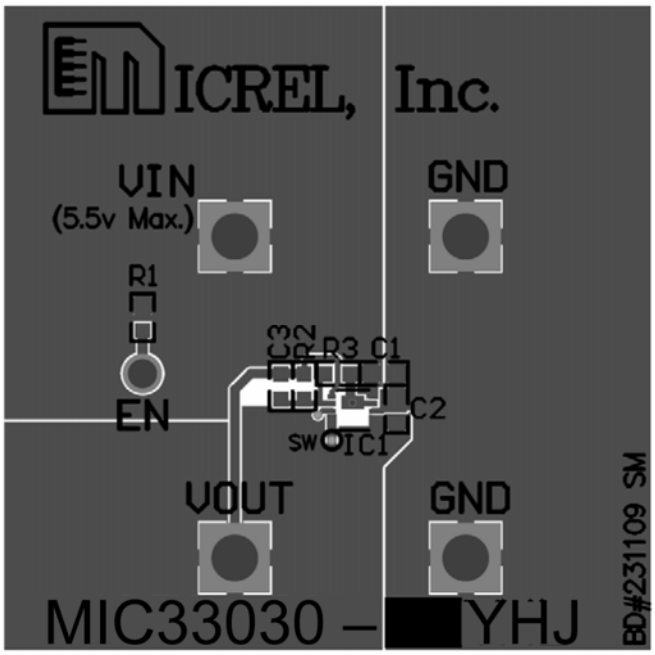
Getting Started

1. **Connect an external supply to the V_{IN} terminal and GND**. With the output of the power supply disabled, set its voltage to the desired input test voltage ($2.7V \leq V_{IN} \leq 5.5V$). An ammeter may be placed between the input supply and the V_{IN} terminal. Be sure to monitor the supply voltage at the V_{IN} terminal, as the ammeter and/or power lead resistance can reduce the voltage supplied to the device.
2. **Connect a load to the V_{OUT} and GND terminals.** The load can be either passive (resistive) or active (electronic load). An ammeter may be placed between the load and the output terminal. Ensure the output voltage is monitored at the V_{OUT} terminal.
3. **Enable the MIC33030**. The MIC33030 evaluation board has a pull-up resistor to V_{IN}. By default, the output voltage will be enabled when the input supply of ≥ 2.7V is applied. To disable the device, apply a voltage below 0.5V to the EN terminal or jumper the EN terminal-to-GND.

Ordering Information

Part Number	Description
MIC33030-AYHJ	MIC33030 Internal Inductor Buck Regulator, Adjustable Evaluation Board
MIC33030-4YHJ	MIC33030 Internal Inductor Buck Regulator, V_{OUT}=1.2V Evaluation Board

Evaluation Board



Other Features

Feedback Resistors (R2, R3) for Adjustable Output

The output voltage is set nominally to 1.8V. This output can be changed by adjusting the upper resistor (R2) in the feedback potential divider. Therefore:

$$R2 = R3*(V_O-V_{REF})/V_{REF}$$

Where V_{REF} = 0.62V

Some example values are:

V_{OUT}	R2	R3
1.2V	274k	294k
1.5V	316k	221k
1.8V	301k	158k
2.5V	324k	107k
3.3V	309k	71.5k

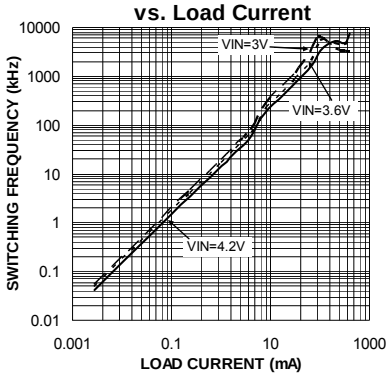
The Feed-forward capacitor (C3) is typically not fitted since transient load regulation is already very good. However, it can be improved slightly by fitting a capacitor at C3 to inject fast output voltage deviations directly into the feedback comparator. This improved load regulation is at the expense of slightly increasing the amount of noise on the output at higher loads. Values between 100pF and 1nF are recommended to prevent instability.

HyperLight Load™ Mode

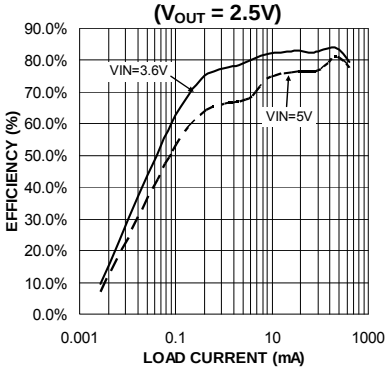
The MIC33030 uses a minimum on and off time proprietary control loop (patented by Micrel). When the output voltage falls below the regulation threshold, the error comparator begins a switching cycle that turns the PMOS on and keeps it on for the duration of the minimum-on-time. This increases the output voltage. If the output voltage is over the regulation threshold, then the error comparator turns the PMOS off for a minimum-off-time until the output drops below the threshold. 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, the MIC33030 works in pulse frequency modulation (PFM) to regulate the output. As the output current increases, the off-time decreases, thus provides more energy to the output. This switching scheme improves the efficiency of MIC33030 during light load currents by only switching when it is needed. As the load current increases, the MIC33030 goes into continuous conduction mode (CCM) and switches at a frequency centered at 8MHz. The load current at which the MIC33030 goes into continuous conduction mode may be approximated to 150mA.

Evaluation Board Performance

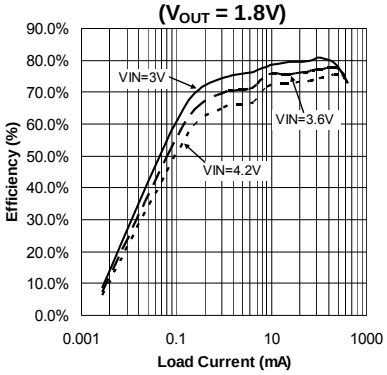
Switching Frequency vs. Load Current



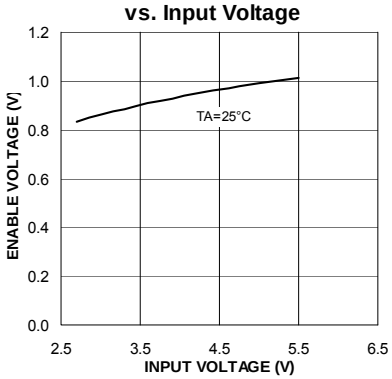
Efficiency vs. Load (V_{OUT} = 2.5V)



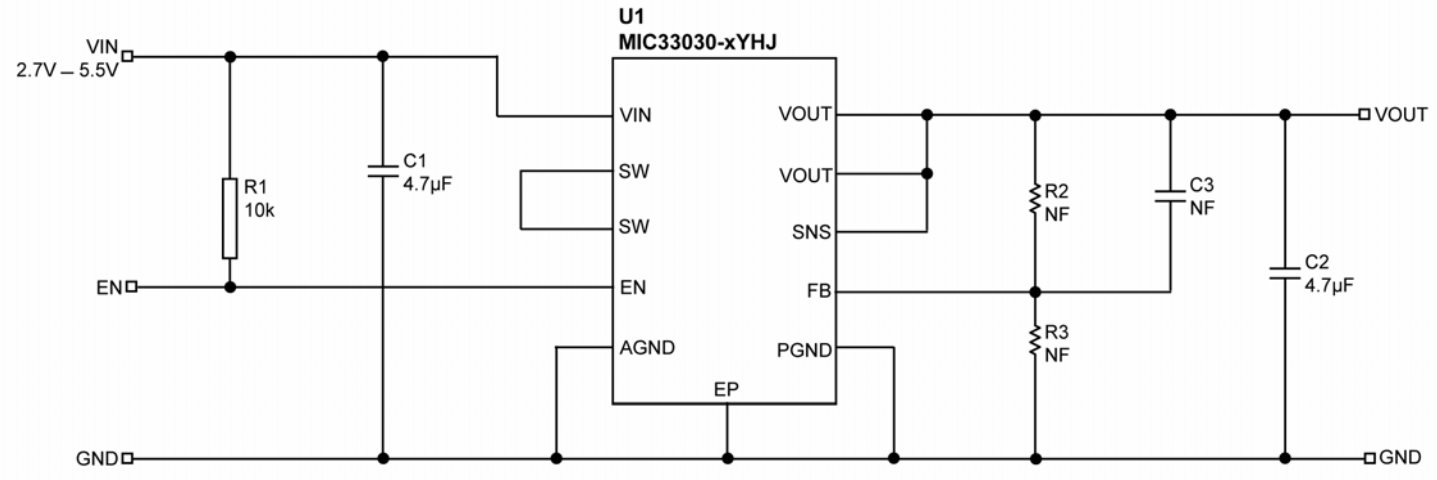
Efficiency vs Load (V_{OUT} = 1.8V)



Enable (ON) Voltage vs. Input Voltage



MIC33030 Evaluation Board Schematic (Fixed Output)



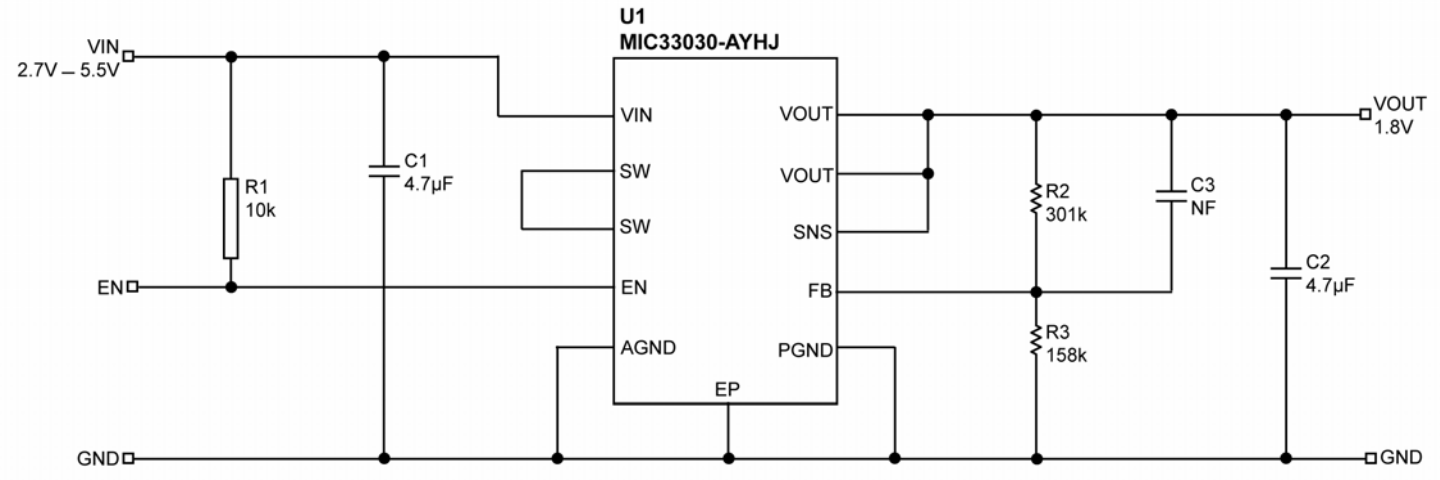
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1, C2	C1608X5R0J475K	TDK[1]	Ceramic Capacitor, 4.7µF, 6.3V, X5R, Size 0603	2
	GRM188R60J475KE19D	Murata[2]		
C3	–	–	Not Fitted (NF)	0
R1	CRCW06031002FKEA	Vishay[3]	Resistor, 10k, Size 0603	1
R2, R3	–	–	Not Fitted (NF)	0
U1	**MIC33030-xYHJ**	**Micrel, Inc.[4]**	**8MHz, 400mA Internal Inductor Buck Regulator with HyperLight Load™**	**1**

Notes:

1. TDK: www.tdk.com.
2. Murata: www.murata.com.
3. Vishay: www.vishay.com.
4. **Micrel, Inc.: www.micrel.com.**

MIC33030 Evaluation Board Schematic (Adjustable Output)



V_{OUT} = 1.8v

Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1, C2	C1608X5R0J475K	TDK[1]	Ceramic Capacitor, 4.7µF, 6.3V, X5R, Size 0603	2
	GRM188R60J475KE19D	Murata[2]		
C3	NF	–	Not Fitted	0
R1	CRCW06031002FKEA	Vishay[3]	Resistor, 10k, Size 0603	1
R2	CRCW06031583FKEA	Vishay[3]	Resistor, 158k, Size 0603	1
R3	CRCW06033013FKEA	Vishay[3]	Resistor, 301k, Size 0603	1
U1	**MIC33030-AYHJ**	**Micrel, Inc.[4]**	**8MHz, 400mA Internal Inductor Buck Regulator with HyperLight Load™, with Adjustable Output Voltage**	**1**

Notes:

1. TDK: www.tdk.com.
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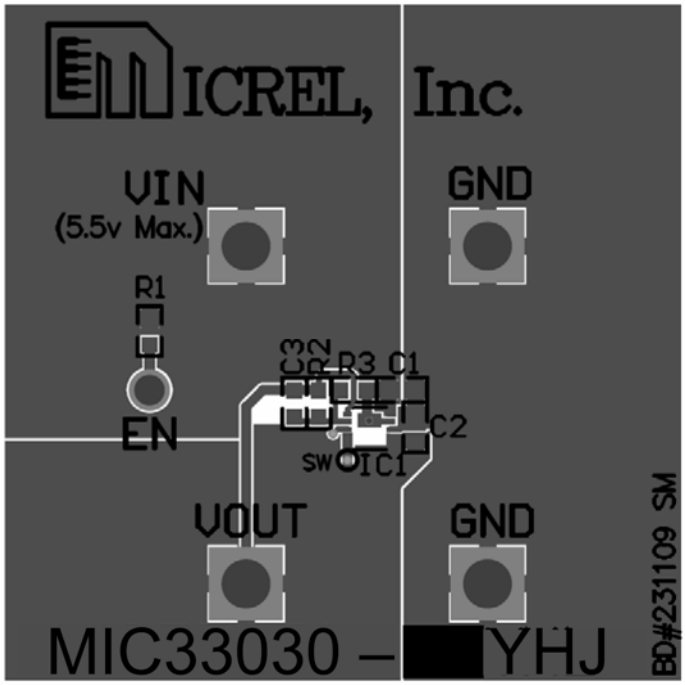
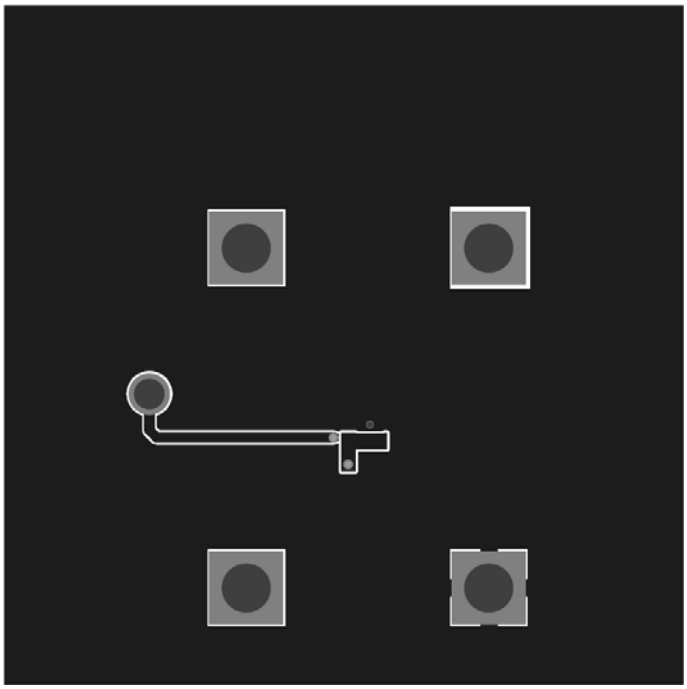
PCB Layout Recommendations



MIC33030 EVB Top Layer



MIC33030 EVB Bottom Layer

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