



# MIC33263/4 Evaluation Board

4MHz PWM 2A Buck Regulator with  
Integrated Inductor and HLL<sup>®</sup> Technology

## General Description

The MIC33263/4 evaluation board allows the customer to evaluate a fully-integrated MOSFETs & Inductor 2A, 4MHz synchronous buck regulator that features HyperLight Load<sup>®</sup> mode, a Power Good output indicator, and programmable soft-start. The MIC33263/4 is highly efficient throughout the output current range. The tiny 2.5mm x 3mm QFN package, in combination with the 4MHz switching frequency, provides a compact sub-1.9mm height solution and 7mm x 4.6mm total solution size that requires few external components.

The MIC33263/4 has a maximum 100% duty cycle, and the MIC33264 also incorporates an active discharge feature when disabled. It 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

The MIC33263/4 evaluation board requires a single 15W bench power source adjustable from 2.7V to 5.5V. The loads can either be active (electronic load) or passive (resistor), and must be able to dissipate 10W. It is ideal, but not essential, to have an oscilloscope available to view the circuit waveforms. The simplest tests require two voltage meters to measure input and output voltages. Efficiency measurements require two voltage meters and two ammeters to prevent errors caused by measurement inaccuracies.

## Precautions

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

Datasheets and support documentation are available on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

## Getting Started

### 1. Connect an external supply to the V<sub>IN</sub> (J1) and GND (J2) terminals.

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<sub>IN</sub> (J1) terminal. Be sure to monitor the supply voltage at the V<sub>IN</sub> (J1) terminal, as the ammeter and/or power lead resistance can reduce the voltage supplied to the device.

### 2. Connect a load to the V<sub>OUT</sub> (J3) and GND (J4) terminals.

The load can be either passive (resistive) or active (electronic load). An ammeter may be placed between the load and the output terminal. Make sure the output voltage is monitored at the V<sub>OUT</sub> (J3) terminal.

### 3. Enable the MIC33263/4.

The MIC33263/4 evaluation board has a pull-up resistor (R3) to V<sub>IN</sub>. By default, the output voltage is enabled when the input supply of >2.7V is applied. To disable the device, apply a voltage below 0.5V to the EN (J6) terminal.

### 4. Power Good.

A PG test point (J5) is provided to monitor the Power Good feature. The Power Good output will go high (V<sub>OUT</sub>) approximately 90 $\mu$ s after the output voltage reaches 92% of its nominal voltage.

## Ordering Information

| Part Number    | Description               |
|----------------|---------------------------|
| MIC33263YGK EV | MIC33263 Evaluation Board |
| MIC33264YGK EV | MIC33264 Evaluation Board |

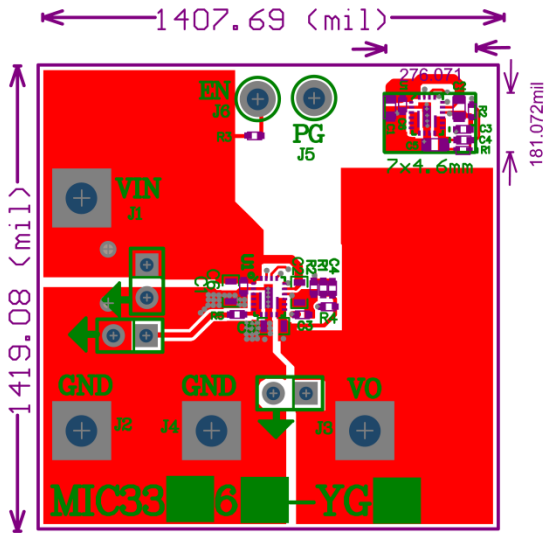
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Revision 1.0

## Evaluation Board



| V <sub>OUT</sub> | R1   | R2   |
|------------------|------|------|
| 1.2V             | 215k | 301k |
| 1.5V             | 301k | 261k |
| 1.8V             | 340k | 215k |
| 2.5V             | 274k | 107k |
| 3.3V             | 383k | 102k |
| 5V               | 634k | 102k |

The feedforward capacitor, C4, provides essential compensation for the MIC33263/4. A typical value range of 15pF to 68pF is recommended.

### Power Good (PG)

The evaluation board has a test point provided for testing the Power Good feature. This is an open-drain connection with an on-board pull-up resistor of 100kΩ (R4) to the output voltage. Power Good is asserted high approximately 90µs after the output voltage passes 92% of the nominal set voltage.

### HyperLight Load Mode

MIC33263/4 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 more than 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 an NMOS switch instead of a diode allows for lower voltage drop across the switching device when the NMOS 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 MIC33263/4 works in pulse frequency modulation (PFM) to regulate the output. As the output current increases, the off-time decreases. This provides more energy to the output. This switching scheme improves the efficiency of MIC33263/4 during light load currents by only switching when it is needed.

As the load current increases, the MIC33263/4 goes into continuous conduction mode (CCM) and switches at a frequency centered at 4MHz.

## Features

### Soft-Start Capacitor (C3)

The soft start (SS) pin is used to control the output voltage ramp-up time. Setting C3 to 1nF sets the start-up time to the minimum. The start-up time can be determined by Equation 1:

$$T_{SS} = 250 \times 10^3 \times \ln(10) \times C_{SS} \quad \text{Eq. 1}$$

The action of the soft-start capacitor is to control the rise time of the internal reference voltage between 0% and 100% of its nominal steady-state value.

### Feedback Resistors (R1, R2)

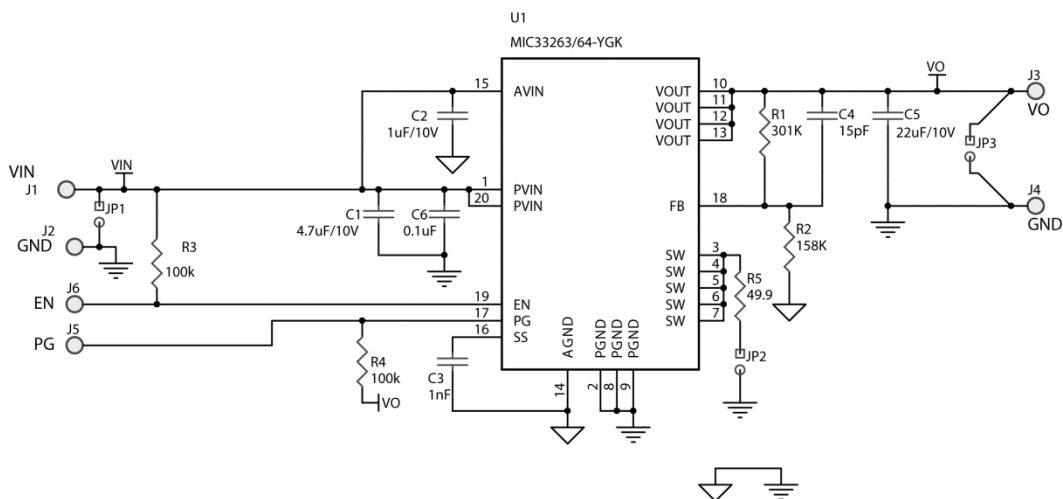
The output voltage of the evaluation board is set to 2V. This output can be changed by adjusting the upper resistor, R1, in the feedback potential divider. The output voltage can be programmed between 0.7V and 5V using:

$$V_{OUT} = V_{REF} \times \left( 1 + \frac{R1}{R2} \right)$$

Where  $V_{REF} = 0.7V$

**Table 1. Example Feedback Resistor Values**

## Evaluation Board Schematic



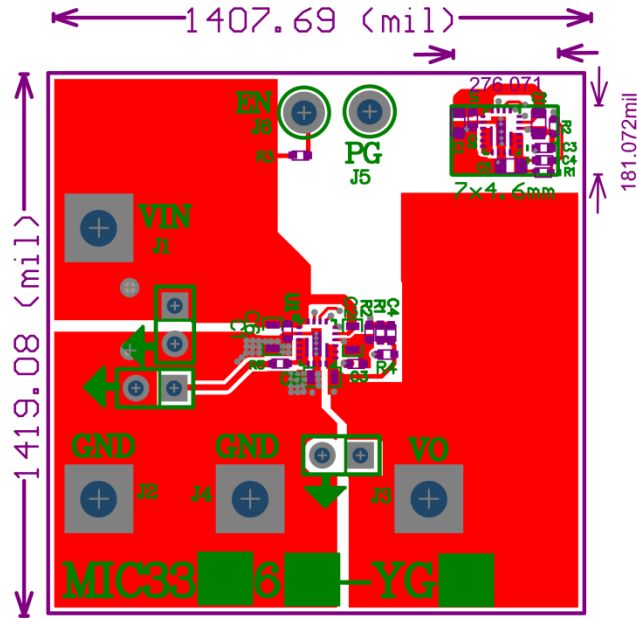
## Bill of Materials

| Item   | Part Number         | Manufacturer                | Description                                                                                      | Qty. |
|--------|---------------------|-----------------------------|--------------------------------------------------------------------------------------------------|------|
| C1     | C1608X5R1A475K080AC | TDK <sup>(1)</sup>          | 4.7μF, 10V, X5R, Size 0603                                                                       | 1    |
|        | GRM188R60J475KE19D  | Murata <sup>(2)</sup>       |                                                                                                  |      |
| C2     | C1608X5R1A105K      | TDK                         | 1μF, 10V, X5R, Size 0603                                                                         | 1    |
| C3     | C1005C0G1H102J050BA | TDK                         | 1nF, 50V, 0402                                                                                   | 1    |
| C4     | C1005C0G1H150J050BA | TDK                         | 15pF, 50V, 0402                                                                                  | 1    |
|        | GRM1555C1H150JZ01D  | Murata                      |                                                                                                  |      |
| C5     | C1608X5R1A226M080AC | TDK                         | 22μF, 10V, X5R, Size 0603                                                                        | 1    |
| C6     | C1608X7R1A104K      | TDK                         | 0.1μF, 10V, X7R, Size 0603                                                                       | 1    |
| R1     | CRCW0402301KFKEA    | Vishay <sup>(3)</sup>       | 301kΩ, 1%, 1/16W, Size 0402                                                                      | 1    |
| R2     | CRCW0402158K0FKEA   | Vishay                      | 158kΩ, 1%, 1/16W, Size 0402                                                                      | 1    |
| R3, R4 | CRCW0402100KFKEA    | Vishay                      | 100kΩ, 1%, 1/16W, Size 0402                                                                      | 2    |
| R5     | CRCW040249R9FKED    | Vishay                      | 49.9Ω, 1%, 1/16W, Size 0402                                                                      | 1    |
| U1     | MIC33163YGK         | Micrel, Inc. <sup>(4)</sup> | 4MHz, 2A, 100% Duty Cycle Buck Regulator with Integrated Inductor and HyperLight Load Technology | 1    |
|        | MIC33164YGK         |                             |                                                                                                  |      |

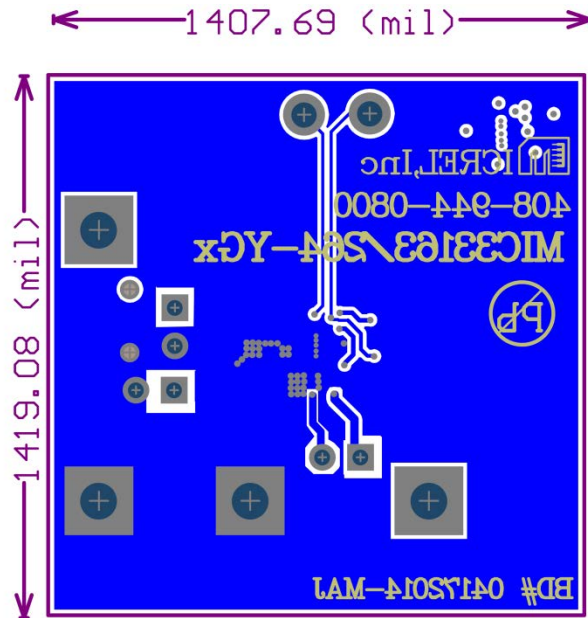
**Notes:**

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

# PCB Layout



Top Layer



Bottom Layer

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