Not Recommended for New Designs

This product was manufactured for Maxim by an outside wafer foundry using a process that is no longer available. It is not recommended for new designs. The data sheet remains available for existing users.

A Maxim replacement or an industry second-source may be available. Please see the QuickView data sheet for this part or contact technical support for assistance.

For further information, contact Maxim's Applications Tech Support.

19-0167; Rev 2; 6/95

EVALUATION KIT MANUAL FOLLOWS DATA SHEET

5V/3.3V/3V/Adjustable-Output, 1A, Step-Down, PWM, Switch-Mode DC-DC Regulators

General Description

The MAX830/MAX831/MAX832/MAX833 are monolithic, bipolar, pulse-width-modulation (PWM), switch-mode, step-down DC-DC regulators. Each is rated at 1A. Very few external components are needed for standard operation because the power switch, oscillator, feedback, and control circuitry are all on-chip. Employing a classic buck topology, these regulators perform high-current step-down functions.

These regulators have excellent dynamic and transient response characteristics, while featuring cycle-by-cycle current limiting to protect against overcurrent faults and short-circuit output faults. They have a wide 8V to 30V input range. Outputs for the MAX831/MAX832/MAX833 are fixed at 5V/3.3V/3V, respectively. The MAX830 output is adjustable.

Available in 16-pin SO packages, the MAX830–MAX833 have a preset 100kHz oscillator frequency. In addition, the preset current limit and micropower shutdown can be externally controlled. See the MAX724/MAX726 data sheet for more applications information.

Applications

Distributed Power from High-Voltage Buses

High-Current, High-Voltage Step-Down Applications

Multiple-Output Buck Converter

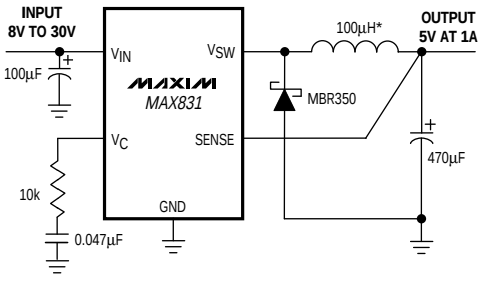
Features

- **Input Range: Up to 30V**
- **1A On-Chip Power Switch**
- **Adjustable Output (MAX830)**
  Fixed Outputs: 5V (MAX831)
  3.3V (MAX832)
  3V (MAX833)
- **100kHz Switching Frequency**
- **Excellent Dynamic Characteristics**
- **Few External Components**
- **8mA Quiescent Current**
- **16-Pin SO Package**
- **Evaluation Kit Available**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX830CWE	0°C to +70°C	16 Wide SO
MAX831CWE	0°C to +70°C	16 Wide SO
MAX832CWE	0°C to +70°C	16 Wide SO
MAX833CWE	0°C to +70°C	16 Wide SO

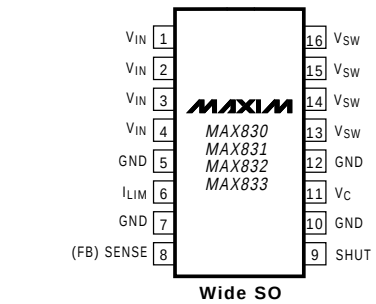
Typical Operating Circuit



STEP-DOWN CONVERTER

* CoilCraft DO3316-104

Pin Configuration



Wide SO

T_j (MAX) = +125°C, θ_{JA} = +55°C/W*

( ) ARE FOR MAX830

* THIS THERMAL RESISTANCE NUMBER IS WITH THE DEVICE WELL MOUNTED ON 1 oz. COPPER WITH THERMAL PASTE BETWEEN THE IC AND THE UNDERLYING GROUND PLANE. LOWER THERMAL RESISTANCE IS POSSIBLE (SEE APPLICATIONS SECTION).

ABSOLUTE MAXIMUM RATINGS

Input Voltage 40V
Switch Voltage with Respect to Input Voltage 50V
Switch Voltage with Respect to GND
(V_{SW} negative) (Note 1) 20V
FB/SENSE Voltage ..... -0.3V, +10V
SHUT Voltage (not to exceed V_{IN}) 30V

I_{LIM} Voltage (forced) 5.5V
Operating Temperature Range ..... 0°C to +70°C
Junction Temperature Range ..... 0°C to +125°C
Storage Temperature Range ..... -65°C to +160°C
Lead Temperature (soldering, 10sec) ..... +300°C

Note 1: Do not exceed switch-to-input voltage limitation.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 25V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Input Supply Voltage Range			8		30	V
Switch-On Voltage (Note 2)	I_{SW} = 0.2A				1.1	V
	I_{SW} = 1A				1.4	
Switch-Off Leakage	V_{IN} = 25V, V_{SW} = 0V	T_A = +25°C			150	µA
	V_{IN} = 30V, V_{SW} = 0V				250	
Supply Current (Note 3)	$V_{IN} \le$ 30V, V_{SENSE} = 5.5V (MAX831/MAX832/MAX833) or V_{FB} = 2.5V (MAX830)			8	11	mA
	V_{SHUT} = 0.1V (Note 4)			140	500	µA
Minimum Supply Voltage (Note 5)	Normal mode			7.3	8.0	V
	Startup mode			3.5	4.8	
Switch-Current Limit (Note 6)	I_{LIM} open		1.2	1.7	2.2	A
	R_{LIM} = 10kΩ (Note 7)	T_A = +25°C		1.2		
	R_{LIM} = 7kΩ (Note 7)			0.8		
Maximum Duty Cycle			85	90		%
Switching Frequency		T_A = +25°C	90	100	110	kHz
			85		120	
	V_{FB} or V_{SENSE} = 0V (Note 6)	T_A = +25°C		20		
Switching-Frequency Line Regulation	8V ≤ V_{IN} ≤ 30V			0.03	0.10	%/V
Error-Amplifier Voltage Gain	1V ≤ V_C ≤ 4V	T_A = +25°C		2000		V/V
Error-Amplifier Transconductance		T_A = +25°C	3000	5000	9000	µmho
Error-Amplifier Source Current	V_{FB} = 2.0V (MAX830) or V_{SENSE} = 2.0V (MAX831/832/833)	T_A = +25°C	100	140	225	µA
Error-Amplifier Sink Current	V_{FB} = 2.5V (MAX830) or V_{SENSE} = 5.5V (MAX831/832/833)	T_A = +25°C	0.6	1.0	1.7	mA

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = 25V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNIT
SENSE Voltage	V_C = 2V	MAX831	4.85	5.00	5.15	V
		MAX832	3.20	3.30	3.40	
		MAX833	2.90	3.00	3.10	
SENSE Divider Resistance	T_A = +25°C	MAX831	3.0	5.0	8.0	kΩ
		MAX832	2.5	4.2	7.0	
		MAX833	2.2	3.8	6.5	
SENSE Voltage Tolerance (Note 8)	V_{OUT} (nominal) = 5V (MAX831), 3.3V (MAX832), or 3V (MAX833)	T_A = +25°C		±0.5	±2.0	%
				±0.5	±3.0	
FB Bias Current	V_{FB} = V_{REF} (MAX830)			0.5	2.0	µA
Reference Voltage	V_C = 2V (MAX830) (Note 9)		2.155	2.21	2.265	V
Reference Voltage Tolerance (Notes 8, 9)	V_{REF} (nominal = 2.21V) (MAX830)	T_A = +25°C		±0.5	±1.5	%
				±1.0	±2.5	
Output Voltage Line Regulation	8V ≤ V_{IN} ≤ 30V			0.005	0.020	%/V
V_C Voltage	0% duty cycle	T_A = +25°C		1.5		V
V_C Voltage Temperature Coefficient	0% duty cycle			-4		mV/°C
SHUT Current	V_{SHUT} = 5V			10	20	µA
	V_{SHUT} = 0.1V (shutdown)				50	
SHUT Threshold	(shutdown)		0.10	0.20	0.50	V

Note 2: For switch currents between 0.2A and 1A, maximum switch-on voltage can be calculated via linear interpolation.

Note 3: By setting the SENSE pin to 5.5V (or the FB pin to 2.5V), the V_C pin is forced to its low clamp level and the switch duty cycle is forced to zero, approximating the zero load condition.

Note 4: Device shut down. Switch leakage current not included.

Note 5: For proper regulation, total voltage from V_{IN} to GND must be ≥ 8V after start-up. During start-up mode, device is switching but not regulating.

Note 6: To avoid extremely short switch-on times, the switch frequency is internally scaled down when V_{FB} or V_{SENSE} is less than 1.3V. Switch current limit is tested with V_{SENSE} or V_{FB} adjusted to give a 1µs minimum switch-on time.

Note 7: $R_{LIM} = \left[\frac{I_{LIM}}{1A} \times 7.6k\Omega\right] + 1k\Omega$. Typical value only. Minimum to maximum deviation in current limit will be ±30%, comparable to that with I_{LIM} pin open.

Note 8: All conditions of input voltage, output voltage, temperature, and load current.

Note 9: FB is at the reference voltage when the MAX830 output voltage is in regulation.

5V/3.3V/3V/Adjustable-Output, 1A, Step-Down, PWM, Switch-Mode DC-DC Regulators

Pin Description

PIN	NAME	FUNCTION
8	SENSE (MAX831/2/3)	For the MAX831/MAX832/MAX833, SENSE input is the internal error amplifier's input, and should be directly connected to V_{OUT}. SENSE also aids current limiting by reducing oscillator frequency when V_{OUT} is low.
	FB (MAX830)	For the MAX830, the FB input is the internal error amplifier's input, and should be connected to the mid-point of a potential divider between V_{OUT} and GND (Figure 1). The output voltage, during regulation, will be that value that forces 2.21V (V_{REF}) at the FB pin.
11	V_C	Error-amplifier output. A series RC network connected to this pin compensates the device. Output swing is limited to about 5.8V in the positive direction and -0.7V in the negative direction. V_C can also synchronize the device to an external TTL clock in the 115kHz to 170kHz range.
5, 7, 10, 12	GND	Ground requires a short, low-noise connection to ensure good load regulation. The internal reference is referred to GND, so errors at this pin are multiplied by the error amplifier. Use thick copper for low thermal resistance.
13, 14, 15, 16	V_{SW}	Internal power switch output (rated for 1A load current)
1, 2, 3, 4	V_{IN}	V_{IN} supplies power to the internal circuitry and also connects to the collector of the internal power switch. V_{IN} must be bypassed with a low-ESR capacitor, typically 100µF.
6	I_{LIM}	Switch-current limit can be reduced by connecting an external resistor (R_{LIM}) from I_{LIM} to GND (See Note 7 in *Electrical Characteristics*). Leave I_{LIM} floating for maximum current limit.
9	SHUT	Shutdown is achieved by pulling SHUT low. Leave SHUT floating for normal operation.

Applications Information

Although the MAX830–MAX833 are high-efficiency step-down voltage converters, certain precautions are required to avoid excessive chip temperature (the absolute maximum rating for this parameter, T_j, is +125°C). The 16-pin SO package has thermal resistance of +55°C/W when mounted properly; this limits continuous chip power dissipation to the 1W range.

When installing these chips:

1) Use wide and, if possible, thick copper traces to connect the leads (especially the GND pins) to reduce thermal resistance.
2) Bond the package firmly to the board or use a clip-style heatsink. A very small drop of thermal paste between the chip package and the copper ground plane is also helpful.
3) Confirm that the range of device operation is such that the chip temperature does not exceed the allowed maximum of T_j = +125°C. This can be determined from Tables 1 and 2.

Tables 1 and 2 show numbers for maximum allowed load current based on not exceeding the T_j = +125°C limit. If the input voltage range, ambient temperature, and/or output voltage setting allow for an unsafe level of load current, limit the load current to a safe value by connecting the appropriate resistor from the I_{LIM} pin to GND. With no external resistor, the preset switch current limit (typically 1.7A) will limit the load current to about 1.3A. Table 1 shows safe operating load currents for the MAX830 for various values of input and output voltage and at three different ambient temperatures of T_A = +25°C, +45°C, and +70°C, respectively. Table 2 shows the same information, but for the fixed output voltage MAX831, MAX832, and MAX833.

When consulting these tables, note that power surges of less than 30sec need not be considered from a thermal standpoint. It is important for proper regulation, however, that a power surge not require a peak switch current exceeding the 1.2A (min) switch current limit. Also, the inductor's current rating should exceed I_{PEAK}. For highest efficiency, the inductor series resistance should be 0.4Ω or less. I_{PEAK} and I_{LOAD} are related by the following formula:

$$I_{PEAK} = I_{LOAD} + \frac{[V_{OUT} \times (V_{IN} - V_{OUT})]}{V_{IN} \times L \times 200{,}000}$$

Example: MAX830 with V_{IN} = 30V, V_{OUT} = 15V, I_{LOAD} = 0.5A continuous, L = 100µH and T_A = +70°C:
I_{PEAK} = 0.86A (which is below 1.2A (min) preset switch current limit);
and from Table 1:
maximum I_{LOAD} allowed = 0.8A continuous (i.e., operation is safe).

Table 1. MAX830 Maximum Load Current (continuous with θ_{jA} = +55°C/W) vs. Output Voltage and Ambient Temperature

OUTPUT VOLTAGE	CONTINUOUS LOAD CURRENT		
	T_A = +25°C	T_A = +45°C	T_A = +70°C
Up to 10V	1A	1A	1A
10V to 15V	1A	1A	0.8A
15V to 20V	1A	0.8A	0.7A
20V to 25V	0.8A	0.7A	0.6A

Table 2. MAX831/MAX832/MAX833 Maximum Load Current (continuous with θ_{jA} = +55°C/W) vs. Ambient Temperature

OUTPUT VOLTAGE	CONTINUOUS LOAD CURRENT		
	T_A = +25°C	T_A = +45°C	T_A = +70°C
Fixed: 5V, 3.3V or 3V	1A	1A	1A

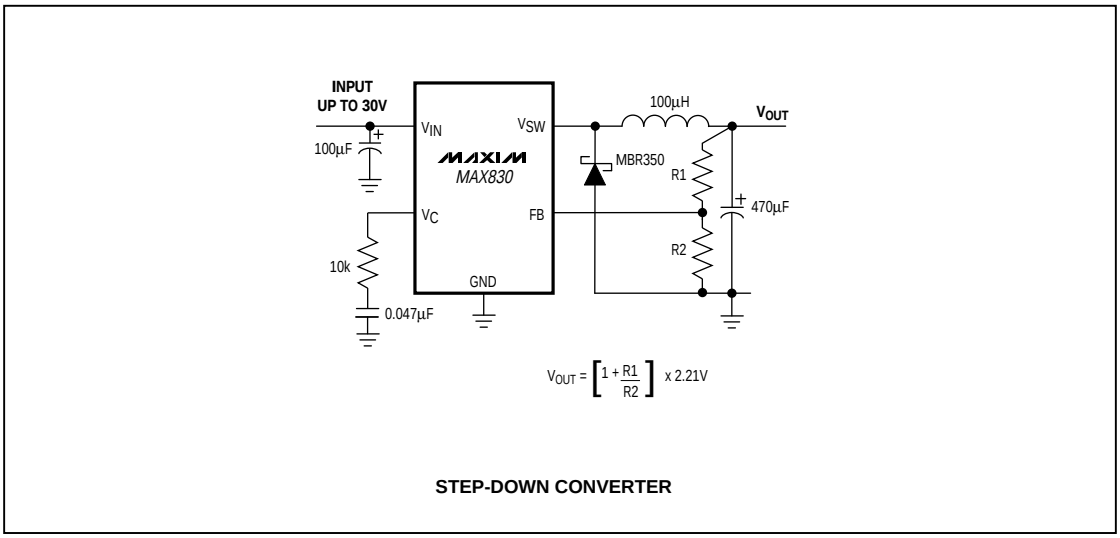


Figure 1. MAX830 Typical Operating Circuit