MIC2130/1 Evaluation Board

High Voltage Synchronous Buck Controller IC with Low EMI Option

General Description

This MIC2130/1 evaluation board is a high voltage input PWM synchronous buck converter. The schematic is shown in Figure 1. The MIC2130/1 is a voltage mode controller with a fast hysteretic control loop (FHyCL) employed during fast line and load transients. The MIC2130/1 has an internal transconductance error amplifier, gate drivers, current limit, enable and under voltage lock out and soft start circuitry. The internal gate drivers are designed to drive high current MOSFETs. The evaluation board output voltage is selected by a jumper for pre-selected voltage divider network, 1.8V, 3.3V, 5V or leaving the jumper open for 0.7 V. The maximum current limit is set at 9A. The input voltage is 8V to 40V.

The MIC2130 family of control ICs implements fixed frequency PWM control. The MIC2130/1-1 parts run at 150kHz and the MIC2130/1-4 parts run at 400kHz. The MIC2131 is the fully functional version of the family and implements a new feature to minimize EMI. The MIC2131 dithers the switching frequency ±12% to produce a spread spectrum thereby lowering the EMI peaks. This function is critical for systems that need to be compliant with EMI standards throughout the world. The MIC2131 also allows the user to program a higher current limit for a short duration.

The under voltage lockout is used to prevent operation below 8V. The input of the converter can be 8V to 40V and the output can be from 0.7V to 0.85*V_{IN} but the output caps are rated at 6.3V. For higher output voltages the output caps have to be replaced with higher voltage ratings. Table 1 provides a summary of the specifications. The evaluation board schematic is shown in Figure 1 and the parts list is shown in the Bill of Materials section.

Requirements

1. Voltage source capable of supplying 50 Watts
2. Load: a resistive or a electronic load
3. Scope
4. Voltage meter

Precautions

The evaluation board does not have reverse polarity protection. Applying a negative voltage to the V_{IN} terminal may damage the device. The maximum input voltage is limited to 40V. The power MOSFETS are rated for 40V Max.

Getting Started

1. Connect an external supply to the V_{IN}. Apply desired input voltage to the V_{IN} (J1) and ground J2 terminals of the evaluation board, paying careful attention to polarity and supply voltage ($8 \le V_{IN} \le 40V$).
2. Ensure that the supply voltage is monitored at the V_{IN} terminal. The power lead resistance can reduce the voltage supplied to the input.
3. Connect a resistive or electronic load to the output J3 and J4.
4. Monitor the Switch node with a scope to monitor the switch waveform

R_{SET} – Current Limit Sensing

The MIC2130/31 features output current limit sensing. Current limit is set by an external resistor by the following equation:

R10 is the current limit resistor

$$R10 = R_{DSON} * I_L / 200\mu A$$

Where, I_L is the peak inductor current that will trigger the current limit, R_{DSON} is that of the MOSFET (9.5m Ω/2 for 2 Si7484 in parallel). Default setting for the evaluation board is R10 = 316Ω with the current limit set at 9A.

HCL (MIC2131 only)

The high current limit (HCL) is a function of the MIC2131 only. It allows for twice the output load current (for a time T determined by the HCL cap) before the current limit comparator trips. During the time T, the current sense current source (200µA nominal) is increased to 400µA.

$$T = CHCL * 2/13\mu = CHCL * 153.85 * 1e3$$

Where, CHCL is the cap at the HCL pin.

Frequency Dithering

The MIC2131 has an additional useful feature. The switching frequency is dithered ±12% in order to spread the frequency spectrum over a wider range to lower the EMI noise peaks generated by the switching components. A pseudo random generator is used to generate the dithering which reduces the EMI noise peaks.

Ordering Information

Part Number	Description
MIC2130 EV	Evaluation board with the MIC2130-1YTSE (150kHz) device
MIC2131 EV	Evaluation board with the MIC2131-1YTSE (150kHz with dither) device

	MIN	TYP	MAX
V_{IN}	8V		40V
Output Voltage	0.7	1.8V, 3.3V, 5V	0.85*V_{IN}
Output Current	0		9A
Power Out	0		50W
Efficiency			96%
Output Ripple		50mV	
Switching Frequency		150kHz 400kHz	
Line Regulation			<1%
Line Transients			<1%
Load Regulation			<1%
Load Transients			<1%
Ambient Temperature	–40°C	+25°C	+85°C
Over-current HCL*			18A
Dither Frequency*		±12%	

*MIC2131 Only

*Output Cap change required for higher than 5V out

Table 1. Design Specifications

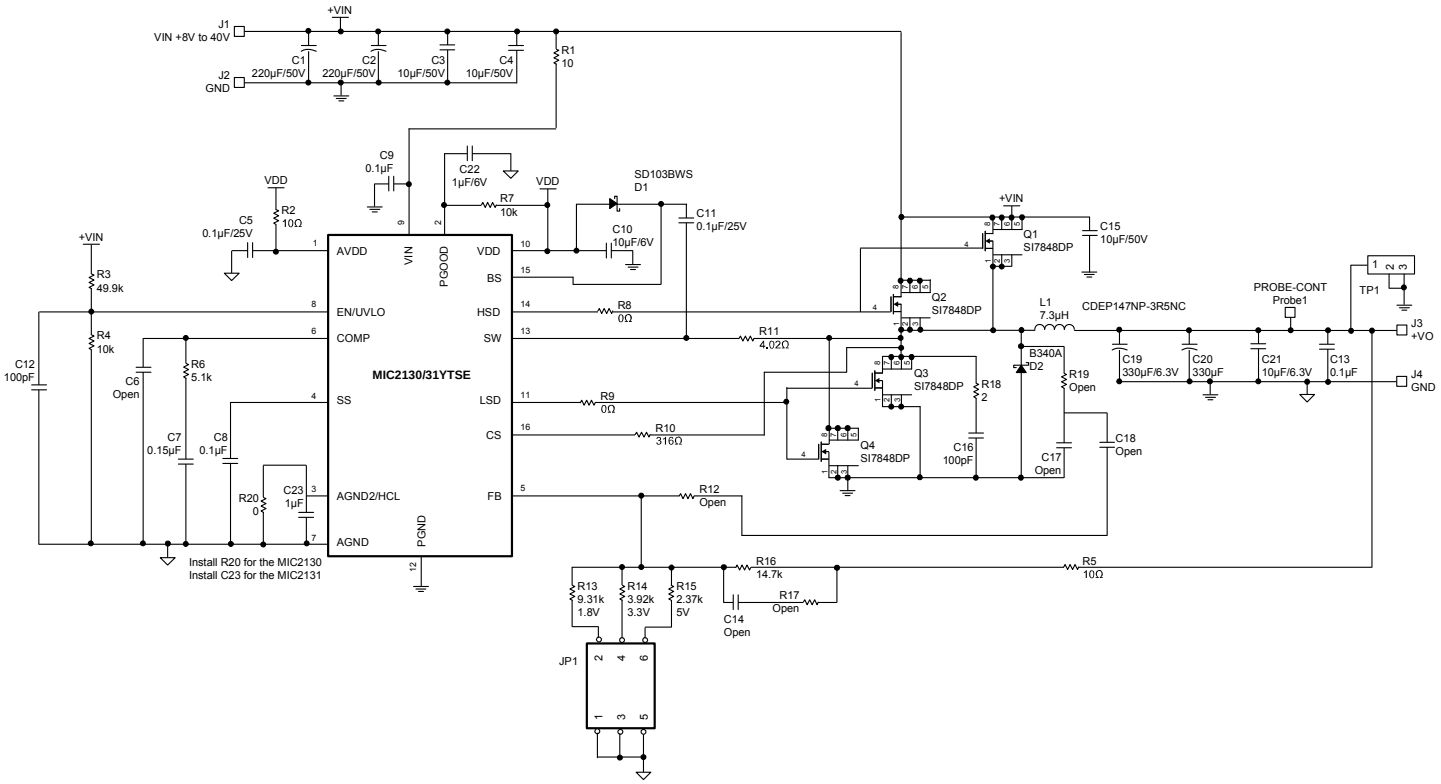


Figure 1. Schematic Diagram

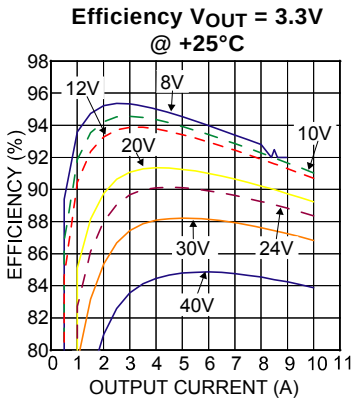


Figure 2. Typical Characteristics

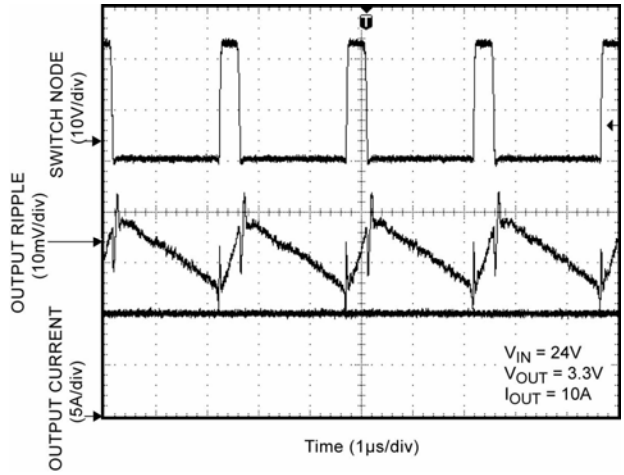


Figure 3. Functional Characteristics (I_{OUT} = 10A)

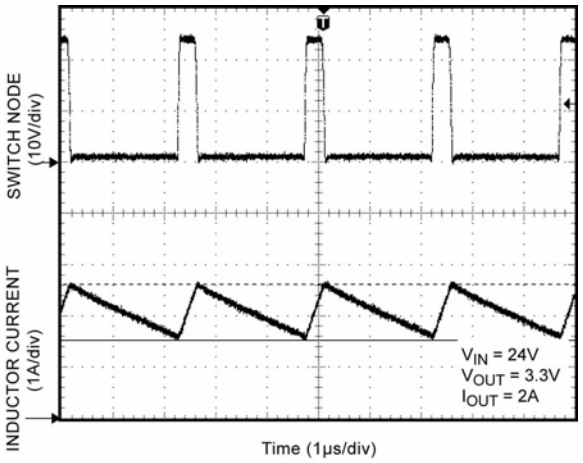


Figure 4. Functional Characteristic (I_{OUT} = 2A)

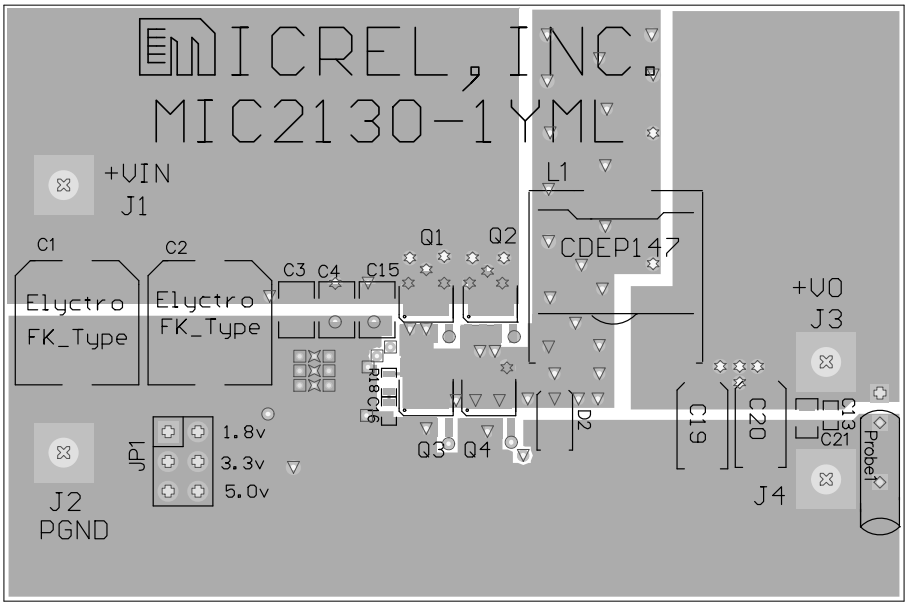
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty
C1, C2	PCE4324CT-ND	DigiKey[1]	220µF/50V, Aluminum Electrolytic	2
C3, C4, C15	GRM32ER71H106	Murata[2]	4.7µF/50V, Ceramic Capacitor	3
	GRM42-2X7R106K50			
C5, C8, C9, C11, C13	VJ0603Y104KXAAT	Vishay Vitramon[3]	0.1µF/ 50V, Ceramic Capacitor	5
	GRM188R71E104KA01D	Murata[2]		
C6	VJ0603A470KXAAT	Vishay Vitramon[3]	47pF/50V, X7R (Open Location)	0
C7	GRM188R71A154KA01D	Murata[2]	0.15µF/6.3V, Ceramic Capacitor	1
	VJ0603Y154KXJCW1BC	Vishay Vitramon[3]		
C10, C12	CM21X5R106M06AT	AVX[4]	10µF/6.3V, Ceramic Capacitor	2
	GRM21BR60J106M	Murata[2]		
	C2012X5R0J106M	TDK[5]		
C12, C16	VJ0603A101KXXAT	Vishay Vitramon[3]	100pF/25V, Ceramic Capacitor	2
C14	VJ0603YxxxKXXAT	Vishay Vitramon[3]	Open	1
C17, C18	VJ0603YxxxKXXAT	Vishay Vitramon[3]	Open	2
C19, C20	54D337X06R3D2T	Vishay Dale[3]	330µF/6.3V, Tantalum Capacitor	2
	TPSD337M06R30100	AVX[4]		
C22	GRM188R61A105KA01D	Murata[2]	1µF/10V, Ceramic Capacitor	1
C23	VJ0603Y105KXQAT	Vishay[3]	1µF/10V, Ceramic Capacitor	1
D1	SD103BWS	Vishay[3]	200mW, Small Diode	1
D2	SS34L	Vishay[3]	3A/40V Schottky Diode	1
	B340A	Diodes, Inc.[6]		
L1	CDEP-147NP-7R3MC-73	Sumida[7]	7.3µH/14.6A, Inductor	1
Q1, Q2, Q3, Q4	Si7848DP-T1-E3	Vishay Siliconix[3]	40V, N-Channel MOSFET	4
	IRF7842	International Rectifier[8]		
R1	CRCW080510R0FRT1	Vishay Dale[3]	10Ω, 0805, 1%	1
R2, R5	CRCW060310R0FRT1	Vishay Dale[3]	10Ω, 0603, 1%.	2
R3	CRCW06034992FRT1	Vishay Dale[3]	49.9K, 0603, 1%	1
R4, R7	CRCW06031002FRT1	Vishay Dale[3]	10K, 0603, 1%	2
R6	CRCW06033161FRT1	Vishay Dale[3]	3.16K, 0603, 1%	1
R8, R9	CRCW06030000FRT1	Vishay Dale[3]	0Ω, 0603, 1%	2
R10	CRCW06033160FRT1	Vishay Dale[3]	316Ω, 0603, 1%	1
R11	CRCW08054R02FRT1	Vishay Dale[3]	4.02Ω, 0805, 1%	1
R12	CRCW06031001FRT1	Vishay Dale[3]	Open	1
R13	CRCW06039311FRT1	Vishay Dale[3]	9.31K, 0603, 1%	1
R14	CRCW06032371FRT1	Vishay Dale[3]	3.92K, 0603, 1%	1
R15	CRCW06031001FRT1	Vishay Dale[3]	2.37K, 0603, 1%	1
R16	CRCW06031472FRT1	Vishay Dale[3]	14.7K, 0603, 1%	1
R17	CRCW0603xxxxFRT1	Vishay Dale[3]	Open	1
R18	CRCW06032R00FRT1	Vishay Dale[3]	2Ω, 0603, 1%	1
R19	CRCW0603xxxxFRT1	Vishay Dale[3]	Open	1
R20	CRCW06030000FRT1	Vishay Dale[3]	MIC2130 ONLY, otherwise install C23	1
U1	**MIC2130-1YTSE Or MIC2131-1YTSE**	**Micrel, Inc.[9]**	**High Voltage Synchronous Buck Control IC**	**1**

Notes:

1. DigiKey: www.digikey.com
2. Murata: www.murata.com
3. Vishay: www.vishay.com
4. AVX: www.avx.com
5. TDK: www.tdk.com
6. Diodes, Inc.: www.diodes.com
7. Sumida: www.sumida.com
8. International Rectifier: www.irf.com
9. **Micrel, Inc: www.micrel.com**

PCB Layout Recommendations



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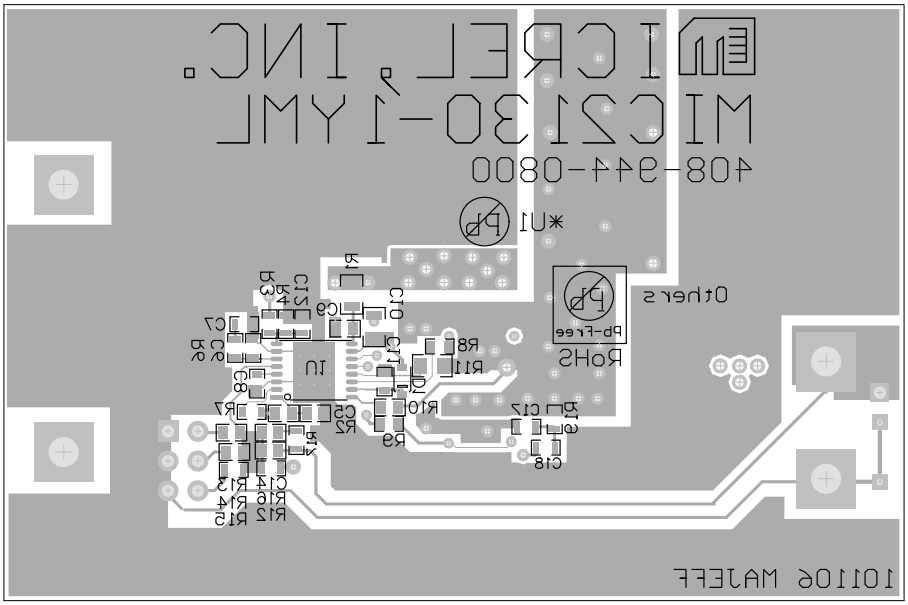

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