



## Application Hint 70

### MIC2193 3.3V to 2.5V/5A with Ceramic Cout Application Circuit

By Steven Chenetz

#### General Description

The MIC2193 is a 400kHz Synchronous Buck controller that uses a P-channel high-side FET. It has the advantage of running at 100% duty cycle (high-side Fet always on), which is useful for applications where the input and output voltage are close together. This application circuit converts a 3.3V +/-10% input to a 2.5V/5A output. The circuit uses ceramic capacitors on both the input and output.

#### Efficiency's effect on duty cycle

The relationship between  $V_{in}$ ,  $V_{out}$  and duty cycle ( $D$ ) in an ideal buck converter (100% efficiency) is:

$$D = \frac{V_{out}}{V_{in}}$$

Losses in the circuit force the duty cycle to increase to maintain output regulation. The duty cycle equation becomes:

$$D = \frac{V_{out}}{\eta \times V_{in}} \quad \text{where } \eta = \text{efficiency}$$

For a 3.3V input with +/-10% regulation and 88% efficiency, the operating duty cycle is:

$$D = \frac{2.5V}{0.88 \times 2.97V} = 0.957$$

Although some N-channel Buck controllers can operate in the 95% duty cycle range, there is no margin to increase the duty cycle when responding to output current transients. For this case, a P-channel controller is a better option.

The schematic and BOM are shown below in Figures 1 and 2:

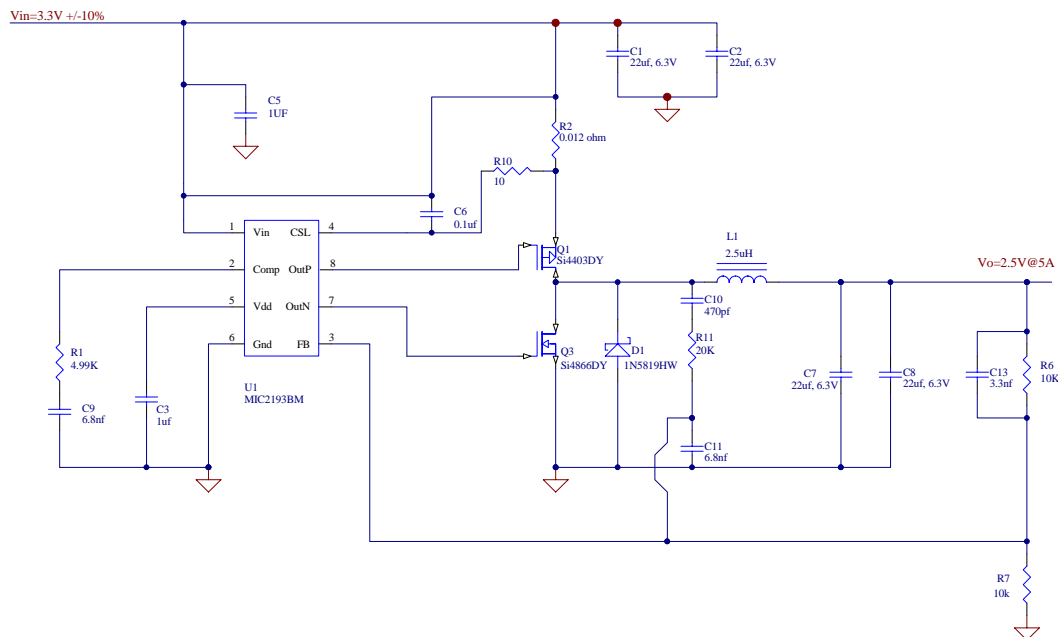


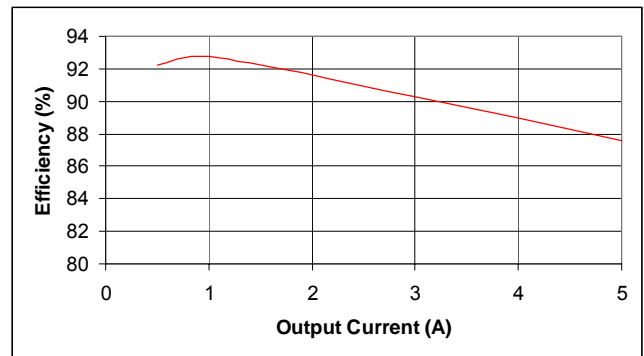
Figure 1

### Bill of Materials

Quant	Part Description	Ref Des	Vendor	Vendor P/N
1	Buck controller	U1	Micrel.Inc	MIC2193BM
1	MOSFET	Q1	Vishay/Siliconix	Si4403DY
			Fairchild	FDS6375
1	MOSFET	Q3	Vishay/Siliconix	Si4866DY
			Fairchild	NDS8425
1	1A, 30V Schottky diode	D1	Diodes Inc	1N5819HW
1	2.5uH, 6A inductor	L1	Sumida	CDRH104R-2R5
			Cooper Electronics	CD1-2R5
4	22uf, 6.3V	C1, C2, C7, C8	TDK	C3225X5R0J226M
2	6.8nf/25V ceramic cap	C9, C11	Vishay	VJ0805Y682KXXAT
2	1uF/25V, ceramic cap	C3, C5	Vishay	VJ0805S105KXJAT
1	0.1uf/25V, X7R ceramic cap	C6	Vishay	VJ0805Y104KXXAT
1	3.3nf, X7R ceramic cap	C13	Vishay	VJ0805Y332KXXAT
1	470pf ceramic cap	C10	Vishay	VJ0805Y471KXXAT
1	4.99K, 0805, 1/10W, 1%	R1	Vishay	VJ08054991FRT1
1	20K, 0805, 1/10W, 1%	R11	Vishay	VJ08052002FRT1
1	0.012 ohms (2010 size), 1%	R2	Vishay	WSL-2010-R012-F
1	10K (0805 size), 1%	R6	Vishay	VJ08051002FRT1
1	10K (0805 size), 1%	R7	Vishay	VJ08051002FRT1
1	10 ohms (0805 size), 1%	R10	Vishay	VJ080510R0FRT1

Notes:

1. Micrel Semiconductor Tel: 408-944-0800
2. Diodes Inc. Tel: 805-446-4800
3. TDK Tel: 847-803-6100
4. Sumida Tel: 408-982-9660
5. Vishay Tel: 402-644-4218
6. Cooper ET Tel: 561-752-5000
7. Fairchild Tel: 972-910-8000



Efficiency for 3.3Vin to 2.5Vo

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