Small Footprint, 10us Response Time, 10mV Output Ripple, 1MHz, 6A Step-Down Regulator

One benefit of high-frequency switching is the fast loop response. This translates to smaller footprint and lower cost, because the ceramic capacitors can be used. The MAX1945 internal switch step-down regulator is designed for high-frequency switching. It can be switched at 1MHz. Its peak current mode control architecture allows simple Type II compensation (R2 and C2) to achieve high bandwidth, further reducing the external component count.

As shown in Figure 1, for 6A output, only two 1210 footprint ceramic capacitors are needed to meet the 50% step load change, thus greatly reducing the output capacitor size when compared to switching at 500kHz or less. A second benefit is due to the low ESR of the ceramic capacitors. Large inductor ripple current is allowed to achieve the 1% ripple voltage requirement.The value of the output inductor is 0.68uH, resulting in a footprint of 8.2mm x 8.2mm for 6A output current, further reducing buck converter size.

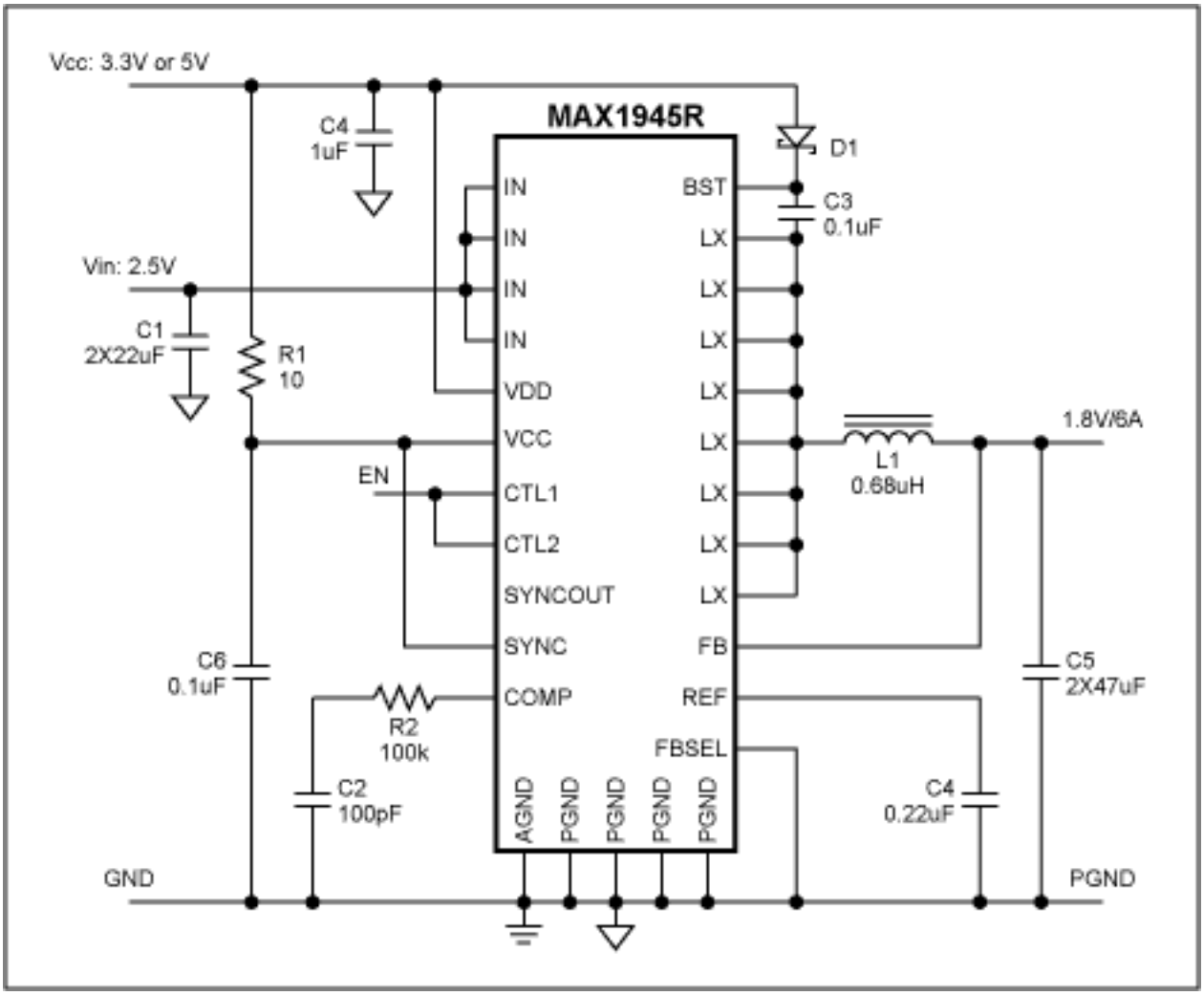

Figure 1. Schematic of the MAX1945 for 1MHz all ceramic capacitor application.

In Figure 1, the output inductor is the largest external component with the footprint of 8.2mm x 8.2mm. However, with the new developments at TOKO and Sumida we expect the inductor size to be reduced to 7.2mm x 7.2mm, further reducing the regulator footprint size.

Figure 2 shows the output ripple voltage, whose peak-to-peak value is less than 10mV for 1.8V output, well less than 1%.

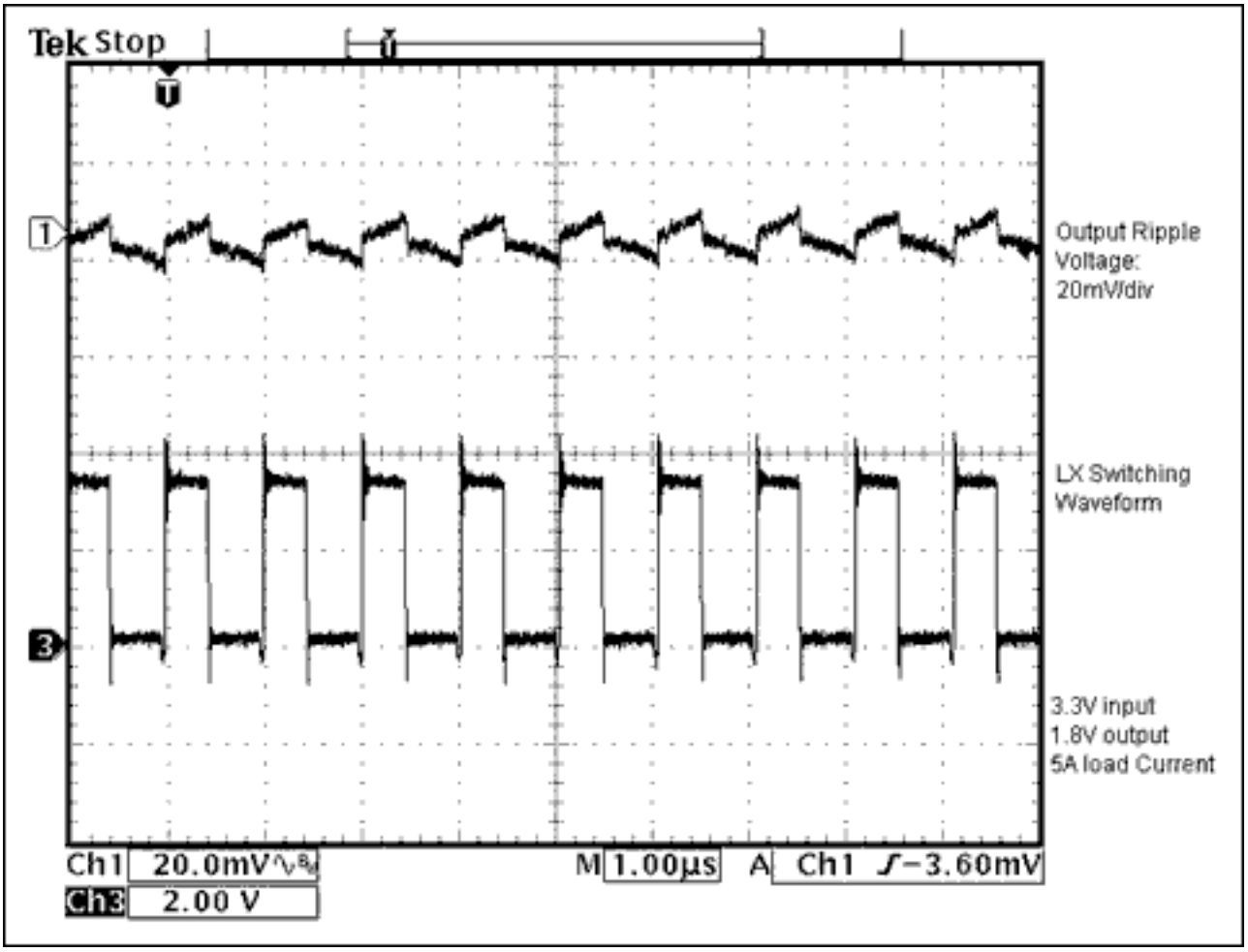

Figure 2. Output ripple voltage and LX switching waveforms.

Figure 3 shows the load transient response. With two 47uF ceramic output capacitors, the maximum output voltage deviation can meet ±5% for 50% step load change (3A). In addition, the transient response finishes within 10us. Table 1 lists the bill of materials.

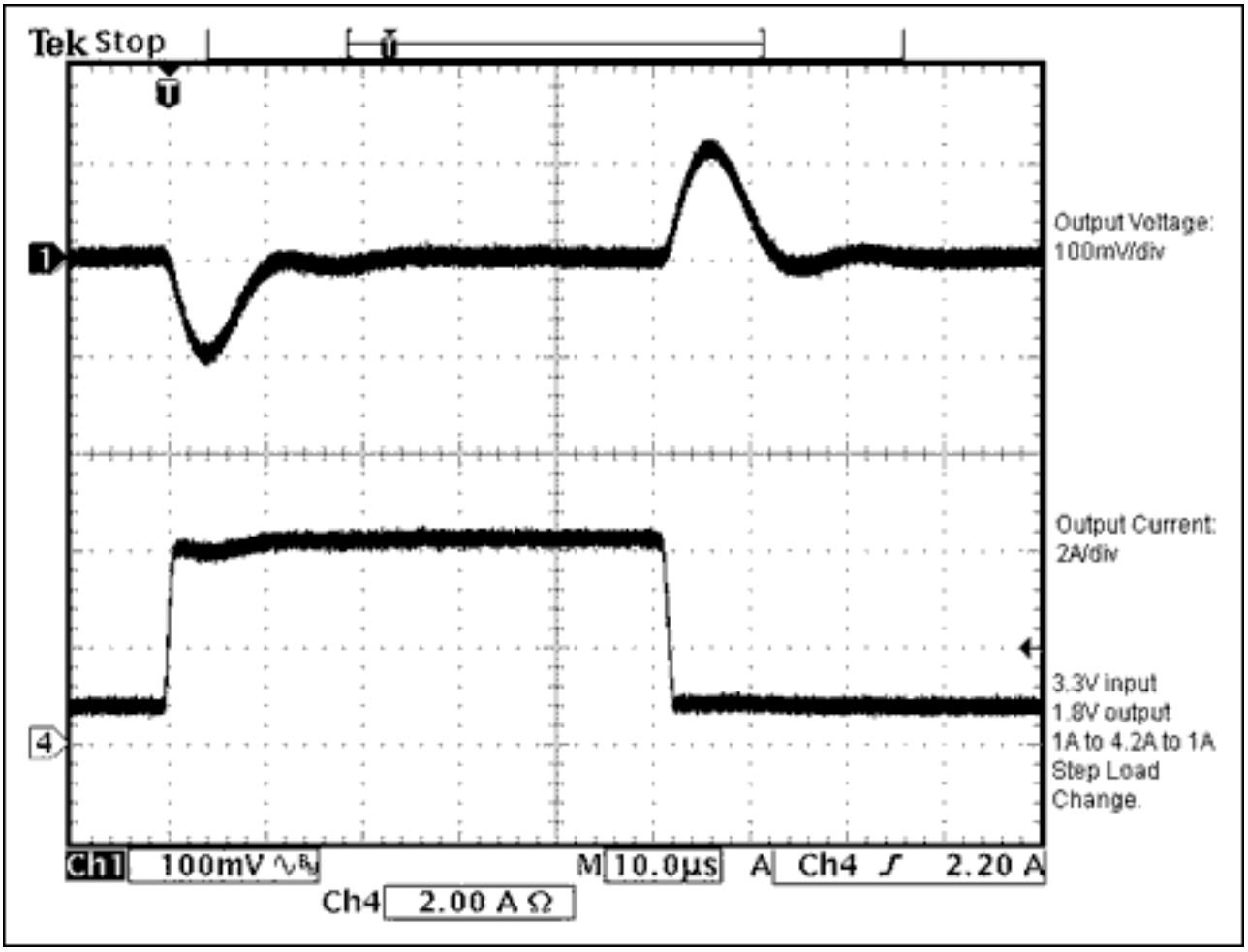

Figure 3. Step load transient response: output current from 1A to 4.2A back to 1A. The output voltage back to regulation within 10us for 50% step load change.

Table 1. Bill of Materials

Component	Function	Part Number	Vender
L1	Output inductor	0.68uH/12A, 6mΩ ESR max, 4783-T007	Sumida
C1	Input filtering cap.	2 x 22uF/6.3V ceramic caps. 20mΩ max each cap. LMK325BJ226MM	Taiyo Yuden
C2	Loop compensation capacitor	100pF/10V, X7R ceramic capacitor	
C3	Bootstrap cap.	0.1uF/10V, X7R ceramic capacitor	
C4	Reference bypass cap.	0.22F/6.3V, X7R ceramic capacitor	

C5	Output filtering cap.	2 x 47uF/6.3V ceramic caps. 20mΩ max each cap. JMK325BJ476	Taiyo Yuden
C6	Input filtering cap	0.1uF/10V, X7R ceramic capacitor	
R1	Vcc filtering resistor	10Ω, 5%	
R2	Loop compensation resistor	100k, 1%	
D1	Bootstrap diode	BAT54A, Shorttky diode	Central Semiconductor
IC1	6A step-down regulator	MAX1945R	MAXIM

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