DESIGN TIPS

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INTERNATIONAL RECTIFIER • 233 KANSAS ST. • EL SEGUNDO, CA. 90245 • TEL (310)322-3331 • FAX (310)322-3332

REDUCING SWITCHING LOSSES IN PORTABLE DC/DC CONVERTERS

By Chris Davis

Efficiency and power density is critical in power converters for portable systems. Synchronous buck regulators are commonly employed to convert battery input voltage in the range of 10 to 20V to various output voltages including 12V, 5V, 3.3V and lower. Efficiencies of 85-90% are common for these 5 to 20W converters. To improve on these efficiencies and to achieve greater power densities, all sources of power losses need to be addressed. Higher frequencies can be employed, particularly to reduce the size of magnetics. As frequencies increase, switching losses of the MOSFET play a much greater role in the losses of the system, sometimes greater than the on-resistance.

The latest high density power MOSFET designs have been incorporated into our recently upgraded SO-8 product offering. Generation 5 process technology provides the same on resistance but with a 50-65% reduction in die sizes. This die shrink allows smaller footprint package styles to be used allowing for increased power densities, and also results in a lower gate charge than found in earlier technology devices. An advantage of this lower gate charge is reduced switching losses which improves efficiency in high frequency applications. Figures 1 and 2 were generated from test data obtained from MAXIM Integrated Products MAX786 demonstration boards under different input voltage conditions.

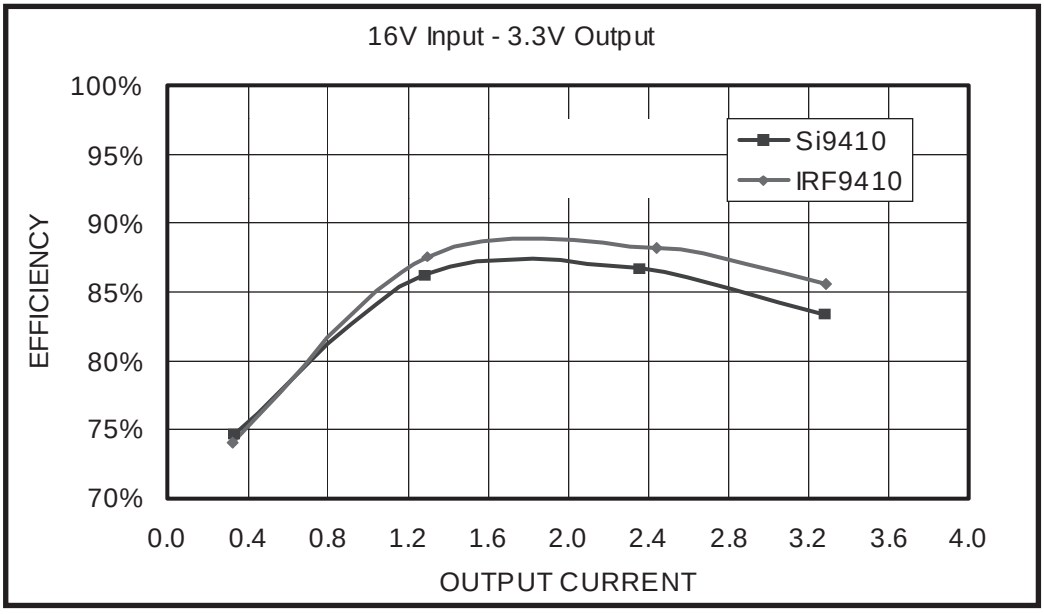

Figure 1– Efficiency comparison between Si9410 and IRF9410 in a typical battery-operated synchronous buck regulator with 16V input

The MAX786 is a popular controller for portable system dc-dc converters. This evaluation employs a synchronous buck regulator topology operating at 300kHz. The tests compared the new Generation 5 IRF9410 against the Si9410. As you can see, the IRF9410 gives you 1-2% higher efficiency which represents a power loss reduction of 10% in total converter losses.

The IRF9410 is one in a series of new SO-8 devices that take advantage of the die shrink and lower gate charge capability of IR's generation 5 process technology. Table 1 below lists others available in the initial family. The devices can be dropped in as direct replacements to the other industry part numbers listed for an immediate switching loss reduction and efficiency gain.

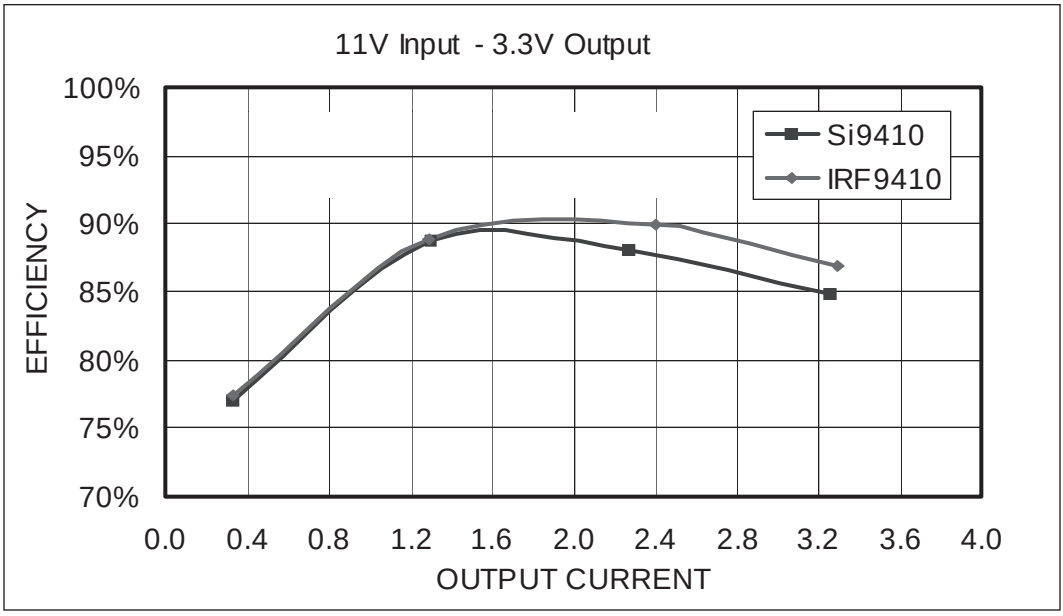

Figure 2 – Efficiency comparison between Si9410 and IRF9410 in a typical battery-operated synchronous buck regulator with 11V input

Part Number		Rds(on) (Ω)	Qg(max) nC	Qg(max) improvement
IRF9410	Single 30V N Ch	0.03	27	46%
Si9410		0.03	50	
IRF9956	Dual 30V N Ch	0.1	14	53%
Si9956		0.1	30	
IRF9953	Dual 30V P Ch	0.25	12	52%
Si9953		0.25	25	
IRF9952	30V Complimentary	0.1	14	48%
		0.25	12	52%
Si9952		0.1	27	
		0.25	25	

Table 1– Comparison of improved gate charge ratings between new Gen 5 "die shrink" SO-8s and other industry part numbers