Offline Switcher ICs Adopt GaN For Higher Power Output And Efficiency

Power Integrations' has extended the power output capability of its InnoSwitch3 families of offline CV/CC flyback switcher ICs by offering two new models with GaN power switches as the primary-side switch in place of the silicon MOSFET used by existing InnoSwitch3 devices. The two new ICs, the INN3X79C and INN3X70C, increase the output power obtainable from enclosed adapter designs from 40 W using the silicon-based InnoSwitch3 devices all the way up to 100 W, assuming 230 Vac input, or an increase from 36 W to 75 W with a universal ac input. Slightly higher levels are possible when using the GaN-based parts in open-frame designs (see the table).

The increased output power is enabled by an efficiency of up to 95% in the GaN-based InnoSwitch3. That's a little more than 1% higher than the top efficiency of the silicon-based models, according to Doug Bailey, VP of marketing at Power Integrations (PI). Fig. 1 shows the efficiency that's attainable in 60-W USB adapter applications with 20-V output (as for a laptop) or 5-V output (as for a smart phone).

InnoSwitch3 encompasses three families of offline switchers. The quasi-resonant InnoSwitch3-CP, the InnoSwitch3-EP and the InnoSwitch3-Pro IC. The InnoSwitch3-CP and -EP variants are hardware-configurable, while the InnoSwitch3-Pro incorporates a digital interface for software control of CV and CC setpoints, exception handing and safety-mode options. Mainly, that means that the same 'Pro model can be stocked and used to build adapters with different output voltages.

Members of each InnoSwitch3 family combine primary, secondary and feedback circuits in a single surface-mounted package as depicted in the simplified application circuit shown for InnoSwitch3-Pro in Fig. 2. Targeting high-efficiency flyback designs, such as USB-PD and high-current chargers/adapters for mobile devices, set-top boxes, displays, appliances, networking and gaming products, the ICs provide accurate CV/CC/CP independent of external components, and easily interface to fast-charging protocol ICs.

Comments Balu Balakrishnan, president and CEO of Power Integrations: "GaN is a pivotal technology offering significant efficiency and size benefits over silicon. We anticipate a rapid conversion from silicon transistors to GaN in many power applications. InnoSwitch3 has been the clear technology leader in the offline switcher IC market since we launched the silicon variants 18 months ago, and the new GaN-based ICs further extend our lead by advancing both the efficiency and power capability of our flyback products."

Power Integrations designed the GaN switch used in InnoSwitch3 so that it would be optimized for the device's hard-switching operation. This contrasts with some of the comparable discrete GaN devices on the market, which have typically been designed with soft switching in mind.

PI worked with a foundry partner to develop the proprietary process in which the GaN switch is fabricated. So the process and the part are said to be unique to PI.

According to Bailey, designers will adopt the GaN switch-based Innoswitch3s in power supply applications that require the higher power levels in combination with small size and efficiency. In general, that means applications where the designated power levels are needed but there's no room for a heatsink. Mobile adapters for phones and laptops would be examples. Similarly, in TVs, where there's no room for a heatsink, the GaN-based Innoswitches will allow designers to take a 40-W power supply design they may be using in 32-inch TVs and push the same design up to 80 to 100 W for use in 50-inch TVs. Video games and servers might offer other uses.

Bailey notes that currently, to achieve similar levels of performance (without heatsinks), designers must opt for resonant designs or active-clamp topologies. However, designs using the Innoswitch3 will cost less, he says.

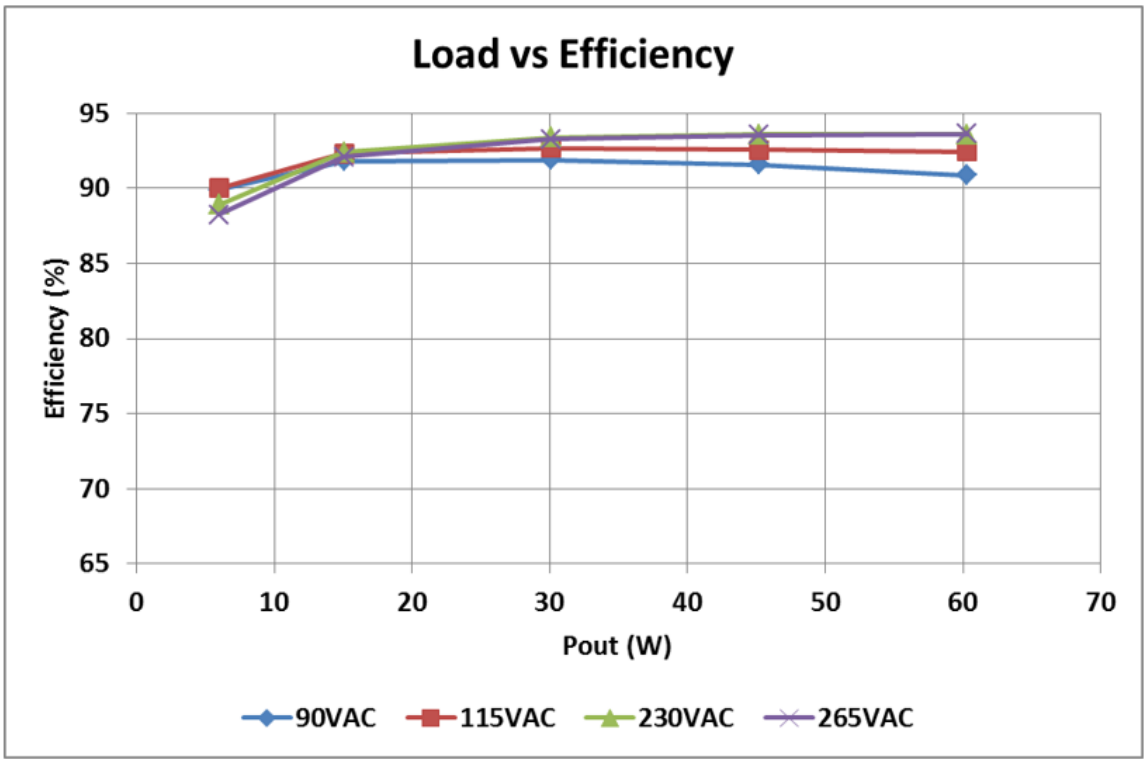
A key point according to Bailey, is that PI has addressed the requirements for driving GaN internally, so that for the users—the power supply designers—designing with the GaN-based Innoswitch3s is no different than designing with the silicon-based models. The reference design is essentially the same.

So in changing from silicon to GaN "we've made it seamless to the customer," says Bailey. "So if you're measuring the power supply waveforms or EMI or ESD, you can't tell at the black box level of the design if it's GaN or silicon." This approach is meant to eliminate the anxiety and hence reluctance of some power supply designers to adopt GaN.

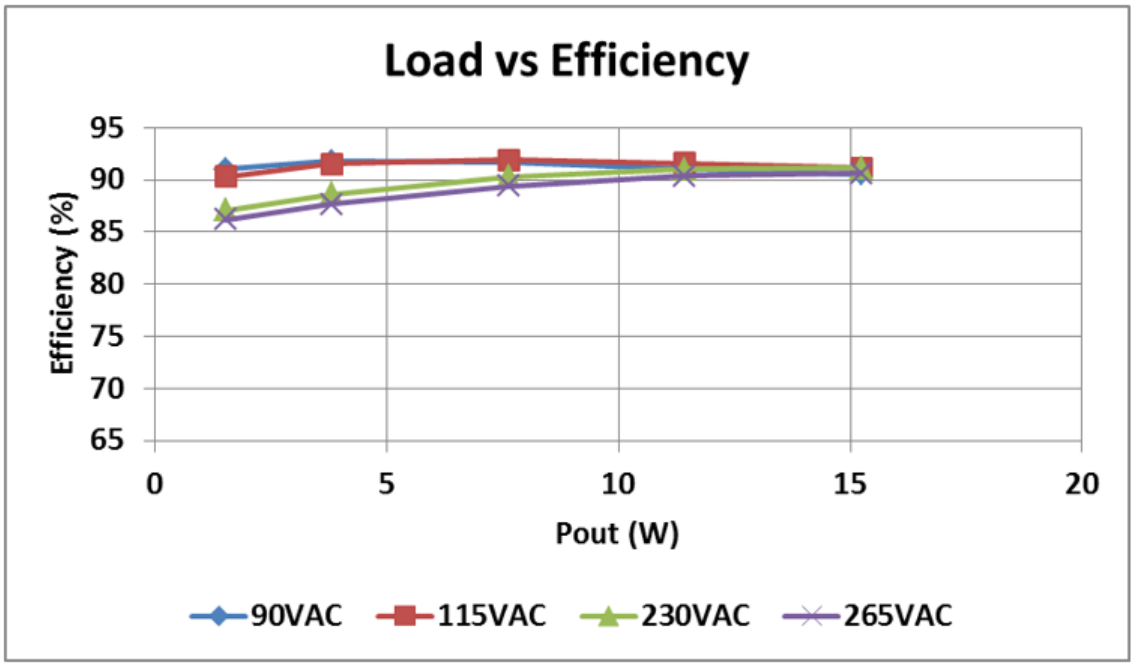
Power Integrations' new InnoSwitch3 ICs are available now, priced at $4/unit in 10,000-piece quantities. Five new reference designs describing USB-PD chargers from 60 W to 100 W are available on the Power Integrations website, along with an automated design tool, PI Expert, and other technical support documentation. For more information on the three InnoSwitch3 families see the CP, the EP and the Pro pages.

Table. Estimated power ratings for ac-dc power supply designs (flyback converters) based on Innoswitch3 devices. The first four parts listed here use a conventional silicon MOSFET as the primary-side power switch, while the last two parts (in red box) incorporate the company's proprietary GaN power switch.

Part Number	230 VAC ± 15%		85 - 264 VAC	
	Adapter	Open Frame	Adapter	Open Frame
INN3X74C	20 W	25 W	15 W	20 W
INN3X75C	25 W	30 W	22 W	25 W
INN3X76C	35 W	40 W	27 W	36 W
INN3X77C	40 W	45 W	36 W	40 W
INN3X79C	**90 W**	**100 W**	**65 W**	**75 W**
INN3X70C	**100 W**	**115 W**	**75 W**	**85 W**



(a)



(b)

Fig 1. Efficiency of a 60-W USB-PD adapter design using a GaN-based Innoswitch3 device at 20-V output (a) and 5-V output (b).

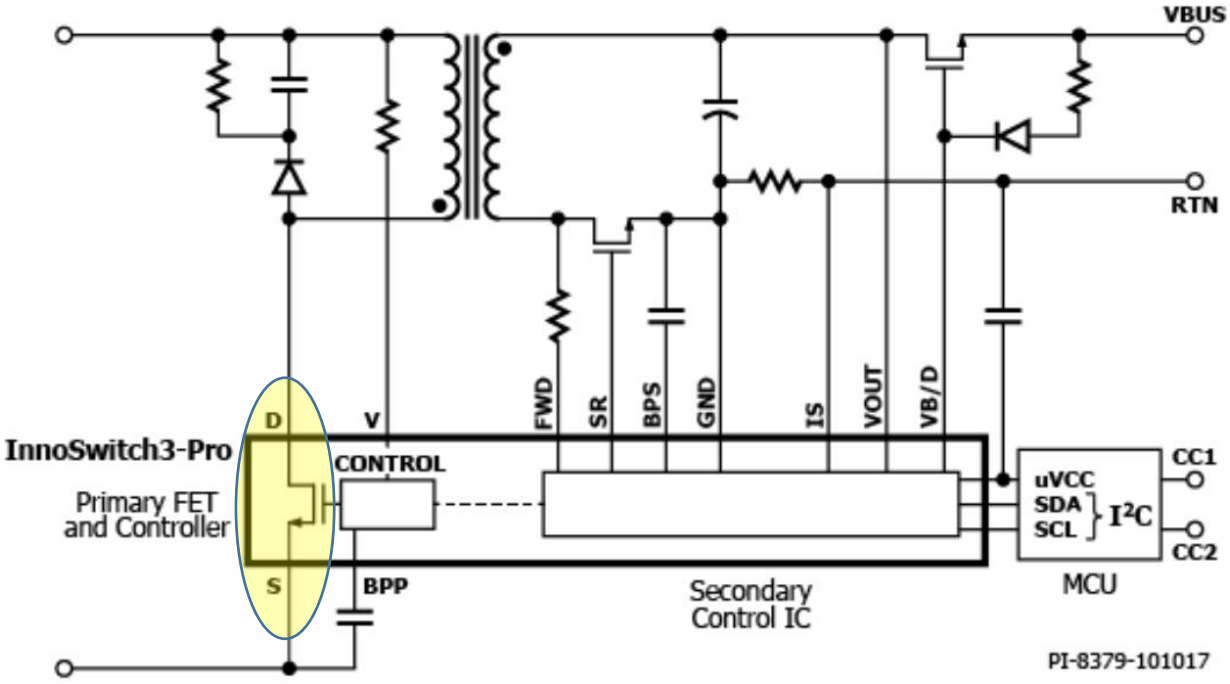


Fig. 2. In the new InnoSwitch-3 models, the conventional silicon primary-side MOSFET (highlighted in yellow) has been replaced with a GaN-based power switch developed by Power Integrations and produced in a partner foundry. According to the company, for the power supply designer, designing with the new GaN-based InnoSwitch3 chips should be no different than designing with the existing silicon models. The power supply's operating waveforms, its EMI and ESD measurements should all look the same. Any of the subtleties of driving the GaN switch have been handled internally, so that the transition from the silicon-based switchers to GaN appears seamless to the user.