Silicon-Based ACF Reference Design Challenges GaN-Based Chargers

Silanna Semiconductor has launched a new active clamp flyback (ACF)-based reference design that simplifies and speeds the development of 33-W 1C fast chargers built using silicon power FETs. Featuring the company's latest SZ1131 CO_2 Smart Power ACF controller technology, the RD-23 provides a route to delivering performance that matches or exceeds that of commercially available 30-W GaN-based chargers at a cost more readily associated with conventional silicon designs, according to the vendor. (For more on the SZ1131, which was introduced last August, see "Active Clamp Flyback Controller Extends Power Density, Lowers No-Load Power For Adapters" from the August 2021 issue of How2Power Today.)

The RD-23 is said to incorporate everything an engineer needs to prototype and develop a fully functional charger with low operational and no-load/ standby power consumption and minimum component count, BOM cost and size. RD-23 uses the SZ1131 ACF controller, which is rated for 65 W with universal input and above 100 W with PFC-supported applications (see Figs. 1, 2 and 3). This controller is said to offer the industry's highest level of integration by incorporating an adaptive digital PWM controller, ultra-high-voltage active clamp FET, active-clamp gate driver and startup regulator in a single 16-pin SOIC.

Providing an (uncased) power density of 22 W/in.^{3}, the RD-23 operates with a peak efficiency of over 92% and has a no-load power consumption (at 230 Vac) below 20 mW. Efficiency is flat across the universal (90 to 265 Vac) input range (see the table) and the reference design is fully production-ready as it exceeds conducted and radiated EMI requirements by more than 6-dB margins.

Ahsan Zaman, Silanna Semiconductor's director of product marketing comments, "In our benchmarking tests the RD-23 met and exceeded both the efficiency and no-load vampire power consumption of the best-in-class commercially available GaN-based power adapters. RD-23 demonstrates GaN-level performance at silicon-level costs."

To further speed designs based on the RD-23 all PCB Gerber files and production files are available on request. For more information see https://powerdensity.com/reference-design and the RD23 33-W USB PD Report.

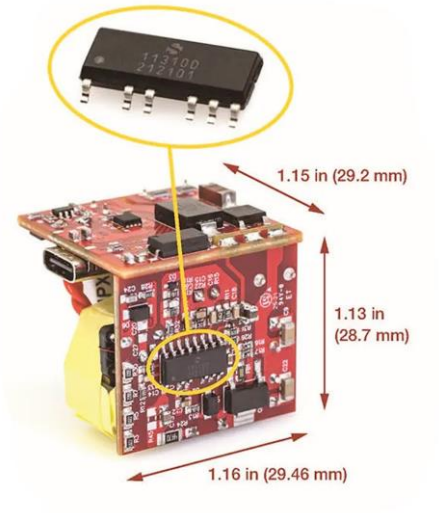


Fig. 1. The RD-23 is a 33-W USB-PD 1C reference design offering high-power density and >92% peak efficiency.

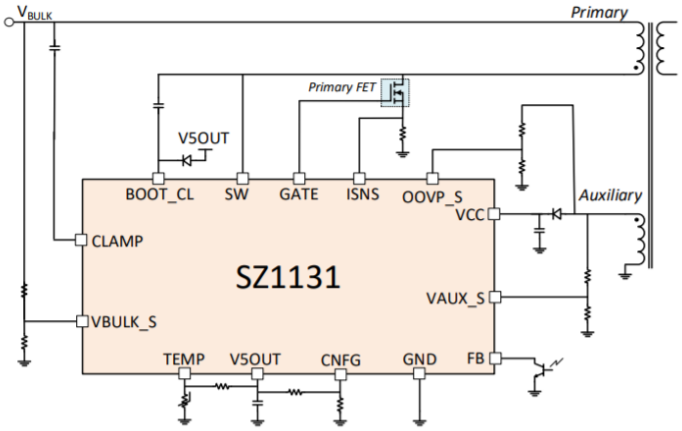
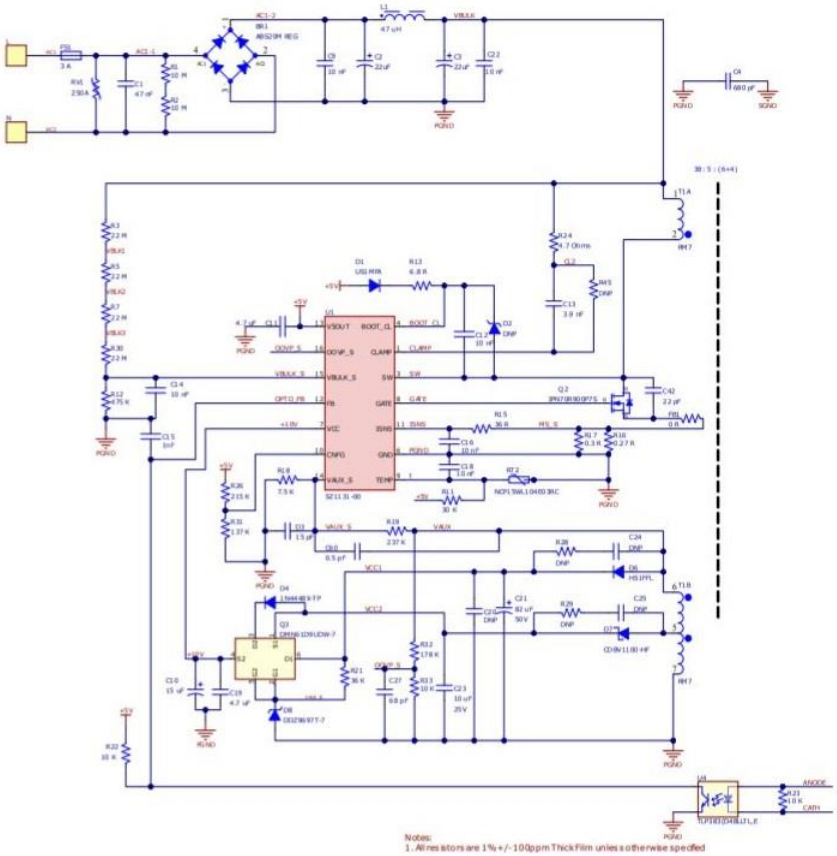
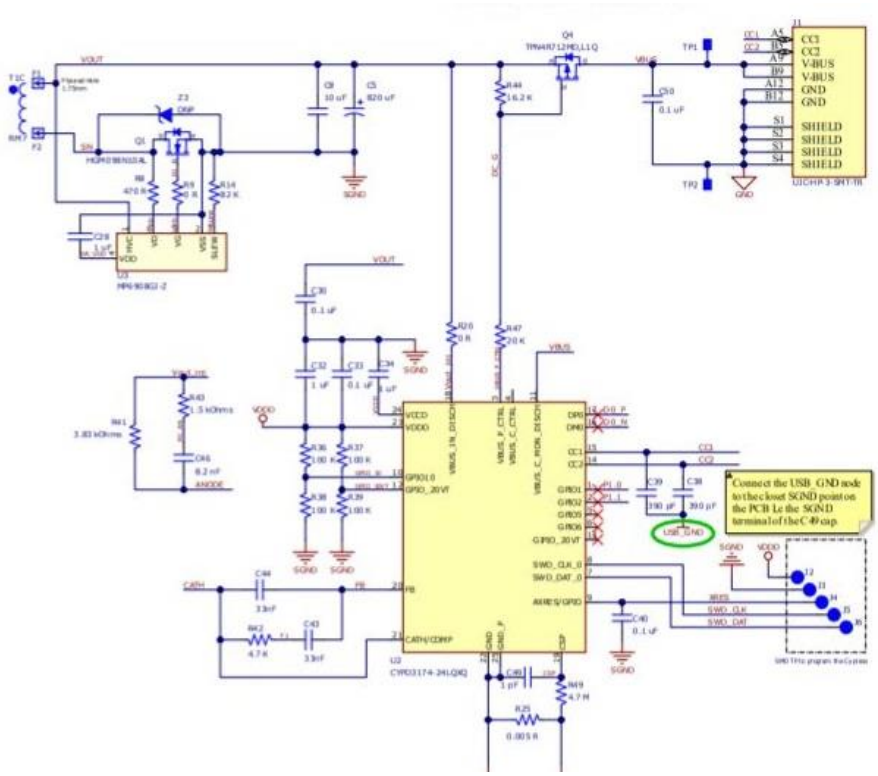


Fig. 2. A simplified primary-side schematic for the RD23 1C charger reference design. This reference design describes a 33-W universal input offline power supply with programmable output voltage (5 V/3 A, 9 V/3 A, 15 V/2.2 A, or 20 V/1.65 A). The power supply uses the SZ1131 flyback PWM controller with integrated active clamp circuit and the Cypress (now Infineon) CYPD3174 USB PD controller. This design shows the high-power density and efficiency that can be achieved due to the high level of integration of the SZ1131 controller. More details of the schematic are shown in Fig 3.



(a)



(b)

Fig. 3. The above schematic shows details of the 33-W 1C charger reference design with primary-side circuitry shown in (a) and secondary side circuitry shown in (b). For a sharper version of this schematic, see the RD23 33-W USB PD Report.

Table. Efficiency of the RD23 1C charger reference design versus DoE and CoC Efficiency requirements. This and other efficiency data appears in the RD23 33-W USB PD Report.

115Vac

Vout/Iout	4 - Point Average Efficiency Measurements	DOE level VI 4 - Point Average Efficiency Requirements	Efficiency Margin	CoC version 5 tier 2 4 - Point Average Efficiency Requirements	Efficiency Margin
5 V/3 A	89.58%	81.39%	8.19%	81.84%	7.74%
9 V/3 A	90.63%	84.61%	6.02%	85.42%	5.21%
15 V/2.2 A	91.12%	85.44%	5.68%	86.43%	4.69%
20 V/1.65 A	90.36%	85.44%	4.92%	86.43%	3.93%

230Vac

Vout/Iout	4 - Point Average Efficiency Measurements	DOE level VI 4 - Point Average Efficiency Requirements	Efficiency Margin	CoC version 5 tier 2 4 - Point Average Efficiency Requirements	Efficiency Margin
5 V/3 A	87.25%	81.39%	5.86%	81.84%	5.41%
9 V/3 A	89.42%	84.61%	4.81%	85.42%	4.00%
15 V/2.2 A	90.39%	85.44%	4.95%	86.43%	3.96%
20 V/1.65 A	89.78%	85.44%	4.34%	86.43%	3.35%

The listed efficiency values are the average of the data collected from 3 R23 EVK's.