DC-DC Controllers Integrate Active EMI filter For Smaller Solution Size

Texas Instruments' new family of synchronous dc-dc buck controllers enable engineers to shrink the size of the power-supply solution and lower its electromagnetic interference (EMI). Featuring an integrated active EMI filter (AEF) and dual-random spread-spectrum (DRSS) technology, the LM25149-Q1 and LM25149 enable engineers to cut the area of the external EMI filter in half, lower the conducted EMI of the power design by as much as 55 dBµV across multiple frequency bands, or achieve a combination of reduced filter size and low EMI (Fig. 1).

According to the company, the LM25149-Q1 and LM25149 controllers are the industry's first dc-dc controllers with an integrated active EMI filter. However, another vendor, Vicor, offers active EMI filter modules with its QPI family.

Reducing EMI in the power supply is a growing design challenge, especially as electronic content increases in advanced driver assistance systems (ADAS), automotive infotainment and cluster, building automation, and aerospace and defense designs. A traditional way to ensure that a design meets conducted EMI specifications involves increasing the size of the external passive EMI filter, which in turn increases the overall power supply solution size. By integrating the AEF, the LM25149-Q1 and LM25149 buck controllers enable engineers to meet EMI standards while increasing their design's power density.

The most stringent industry requirements for low-EMI designs are the CISPR 25 Class 5 automotive EMI specifications. The LM25149-Q1 and LM25149 buck controllers help engineers meet those requirements by mitigating conducted EMI across multiple frequency bands (Fig. 2). The two models are identical except that the LM25149-Q1 is an AEC-Q100-grade version.

The integrated AEF helps detect and reduce conducted EMI in the low-frequency band of 150 kHz to 10 MHz, enabling engineers to attenuate EMI by up to 50 dBµV at a switching frequency of 440 kHz, relative to a design with the AEF disabled, or as much as 20 dBµV when compared to a design with a typical passive filter. In both design scenarios, the DRSS technology helps mitigate EMI by an additional 5 dBµV across low- and high-frequency bands.

To further reduce EMI, both buck controllers feature frequency synchronization to an external clock, helping engineers mitigate undesired beat frequencies in applications sensitive to EMI.

Maintaining low EMI in the power supply and achieving a small solution size are usually at odds in switching power-supply designs. The LM25149-Q1 and LM25149 buck controllers allow engineers to meet challenging EMI standards and shrink solution size by reducing the area and volume of the passive EMI filter.

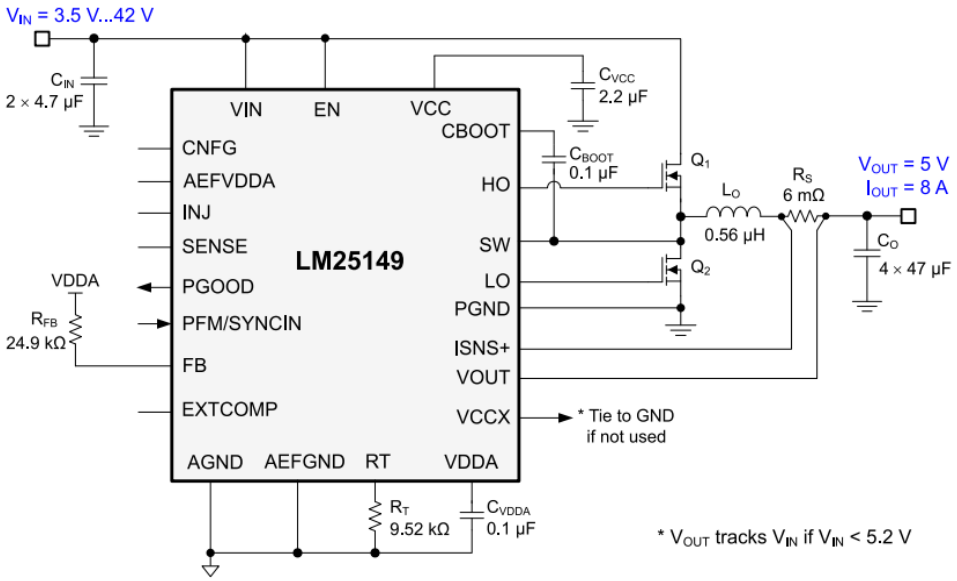
Compared to competing solutions, engineers can achieve maximum savings of nearly 50% in area and over 75% in volume of the front-end EMI filter at 440 kHz, according to TI. By lessening the filtering burden on the passive elements, the integrated AEF reduces their size, volume and cost, enabling engineers to achieve the smallest possible low-EMI power design.

The LM25149-Q1 and LM25149 controllers further increase power density by enabling interleaved dual-phase operation and by integrating the bootstrap diode, loop compensation and output-voltage feedback components, which in turn reduces design complexity and cost. Engineers also have an option to use external feedback and loop compensation to further optimize their designs.

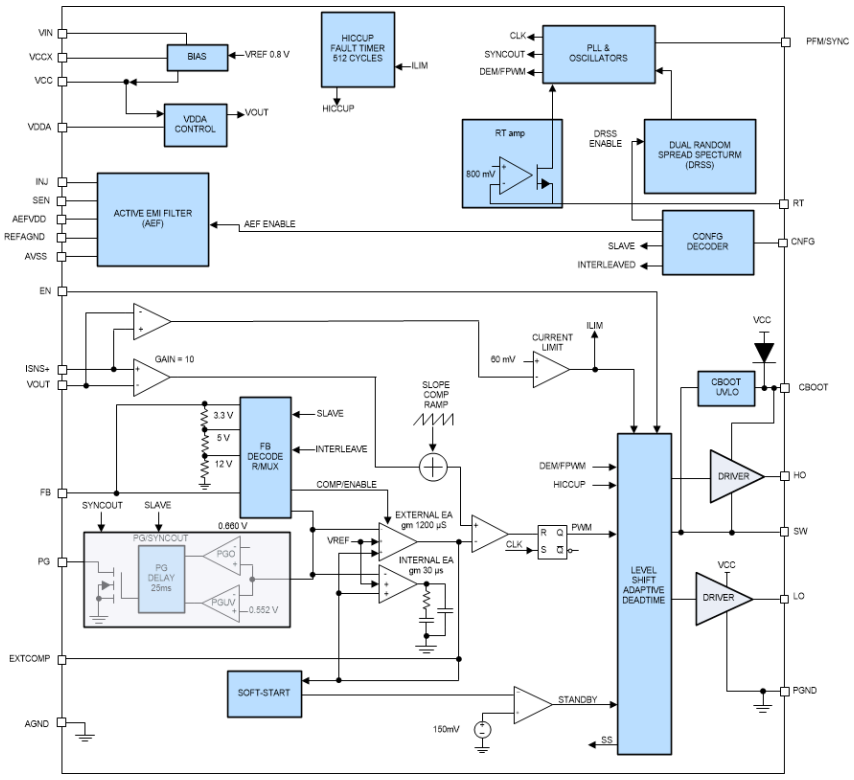
Preproduction quantities of the 42-V LM25149-Q1 and LM25149 are available now, only on TI.com, in a 3.5-mm-by-5.5-mm thermally enhanced, 24-pin very thin quad flat no-lead (VQFN) package. Pricing starts at $1.42 and $1.20 in 1,000-unit quantities, respectively. The LM25149-Q1EVM-2100 evaluation module is available on TI.com for $75. Multiple payment and shipping options are available on TI.com. TI expects both devices to be available in volume production in the fourth quarter of 2021. In addition, TI is also working on a pin-to-pin compatible 80-V version of both devices.

To learn how an integrated AEF works, read the technical article, "How to reduce EMI and shrink power-supply size with an integrated active EMI filter" by Orlando Murray and Tim Hegarty. Or see the latest installment in Tim Hegarty's series on EMI in How2Power Today, "The Engineer's Guide To EMI In DC-DC Converters (Part 17): Active And Hybrid Filter Circuits". To learn more about EMI mitigation techniques, read the white paper, "Time-Saving and Cost-Effective Innovations for EMI Reduction in Power Supplies" or see the extensive

How2Power's Power Supply EMI Anthology. For more information on the new controllers, see the LM25149 product page.

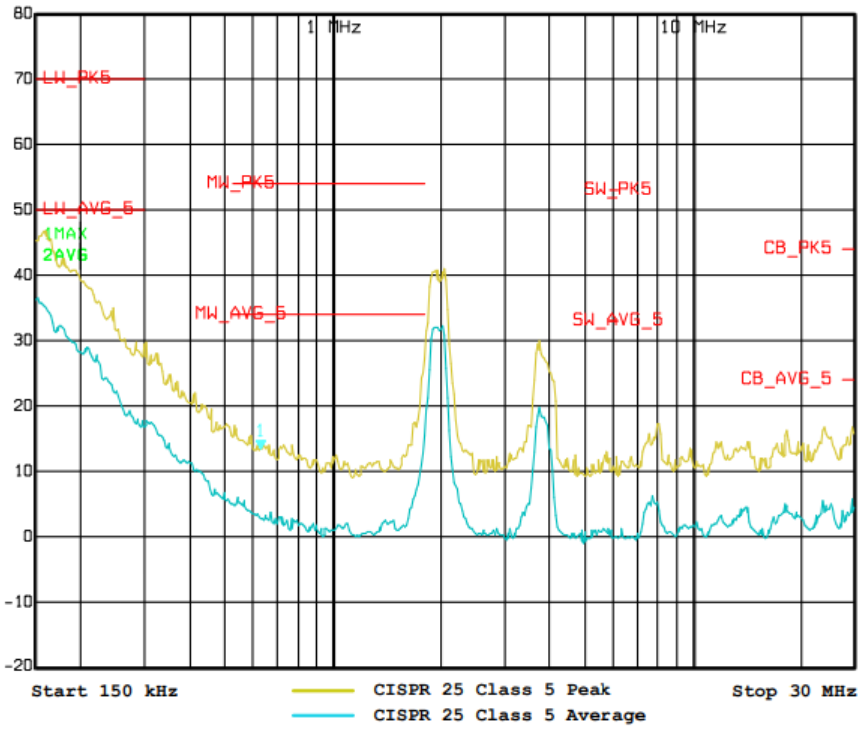


(a)



(b)

Fig. 1. The LM25149 is a 42-V synchronous buck dc-dc controller with ultra-low I_Q and integrated active EMI filter. A typical application circuit is shown (a) along with the internal block diagram (b). The LM25149-Q1 and LM25149 enable engineers to cut the area of the external EMI filter in half (compared with conventional passive EMI filters), lower the conducted EMI of the power design by as much as 55 dBµV across multiple frequency bands, or achieve a combination of reduced filter size and low EMI.



CISPR 25 EMI Performance 150 kHz–30 MHz

Fig. 2. The LM25149-Q1 and LM25149 buck controllers help engineers meet CISPR 25 Class 5 automotive EMI specifications, which are said to be the industry's most stringent requirements for electromagnetic compliance.