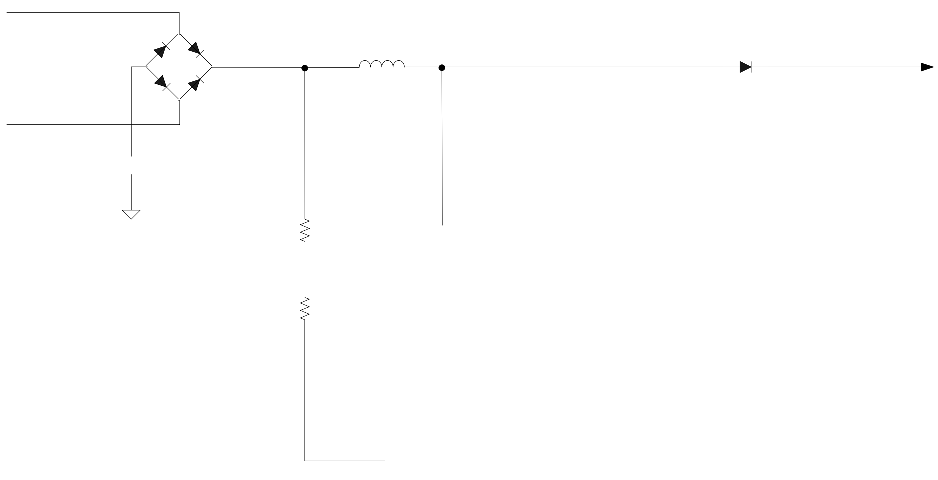

[1,2] and another application note [3] were written more commonly, focusing on making the design process easier to follow. They aim at most typical applications: universal input range (90 to 264 Vac) and European input range (180 to 264 Vac) with design equations simplified according to preassumed designed values.

This application note means to explain those functions in terms that are more general. Information here makes readers

impedance is around 5 k . Sinking too much of current from

Although differential input rejects common-mode noise inherently, the common-mode voltage on each of the input pin still affects the operation of the controller. A common-mode filter is generally implemented to filter out the common-mode noise. Figure 11. shows a schematic of the common-mode filter. Bandwidth of the common-mode filter is

$$f_{BW-comon} = \frac{1}{2\pi \cdot R_f \cdot C_C} \quad \text{(eq. 7)}$$

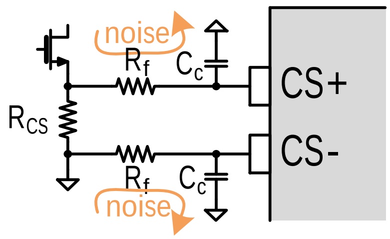

Figure 11. Common-mode Filter for CS Pin

Due to a mismatch between the resistors and capacitors in the common-mode filter, common-mode noise may be filtered differently between CS+ and CS-. As a result, a differential-mode noise appears on the CS signals. To tackle with the differential-mode noise, we add a capacitor to filter out the differential-mode noise.

With the resultant CS filter in Figure 12, which combines common-mode and differential-mode filters, the bandwidth of a low-pass filter for the differential CS signals becomes

$$f_{BW-diff} = \frac{1}{2\pi \cdot 2R_f \cdot \left(C_d + \frac{1}{2} \cdot C_c\right)} \quad \text{(eq. 8)}$$

The bandwidth of the filter should be set based on noise that is generated in actual design result. In a 5 kW reference design for FAN9673 with 40 kHz of switching frequency, we set at 154 kHz and at 51.3 kHz.

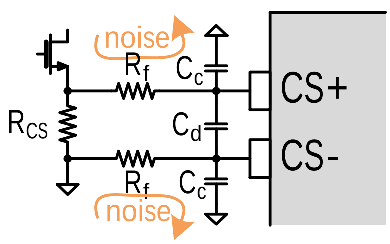

Figure 12. CS Pin Filter

Effect of Input Range Setting

VIR pin of FAN967x sets two different modes that optimize for universal input range and European input range, respectively. This pin sources a constant current. A resistance value connecting between VIR and GND decides the voltage on the VIR pin. The voltage on the VIR pin needs to be set higher than 3.5 V or lower than 1.5 V. Avoid anything in between.

The setting on the VIR pin changes some internal signals of FAN967x, which are collected in Table 1. A constant appears in the table. According to the test cases of V_{LPK}, which can be found in electrical characteristics in the datasheet, K_{RLPK} is 2.465.

Table 1. Effects of VIR Setting

V_{VIR}	< 1.5 V	> 3.5 V
Optimized for	Universal-input range (90~264 Vac)	European-input

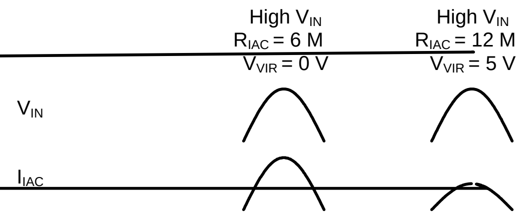

Figure 16. V_{IN} Related Signals under Different VIR and R_{IAC} Setting

To make inductor track current command well, the bandwidth of the current tracking loop need to set high enough. When the complex pole formed by L and C_{OUT} is at a frequency much lower than the control bandwidth of $T_I(s)$

$$Loopgain(s) = \frac{(V_{IN.PEAK} \cdot |\sin(\omega t)|)^2}{V_{IN.RMS}^{\;2}} \cdot \frac{1}{V_{OUT}} \cdot \frac{1}{s \cdot C_{OUT}} \cdot \frac{P_{MAX}}{(V_{VEA.MAX} - 0.6)} \cdot \frac{V_{FBPFC}}{V_{OUT}} \cdot G_{mv}(s) \qquad \text{(eq. 25)}$$

$$Loopgain(s)_{ac-cycle} = \frac{1}{s \cdot C_{OUT}} \cdot \frac{P_{MAX} \cdot I_{OUT}}{(V_{VEA.MAX} - 0.6) \cdot V_{OUT}}$$