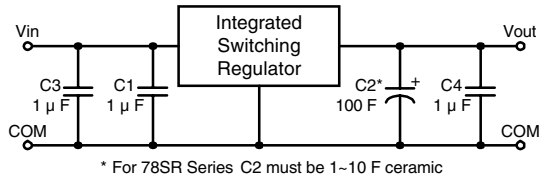
ISR Input/Output Filters

Power Trends includes internal input and output capacitors in all of their ISRs. However, some applications require much lower levels of either input or output ripple/noise. This application note describes various filters and design techniques found to be successful in reducing both input and output ripple/noise.

Input/Output Capacitors

The easiest way to reduce output ripple/noise is to add one or more 1µF ceramic capacitors, such as C4 shown in Figure 17. They should be placed as close as possible to the output pin of the ISR. A single 1µF capacitor will reduce the output ripple/noise by 30-50% for ISRs with Iout < 3A. (Note: C2 is required for loop stability and does not reduce output ripple/noise).

Figure 17



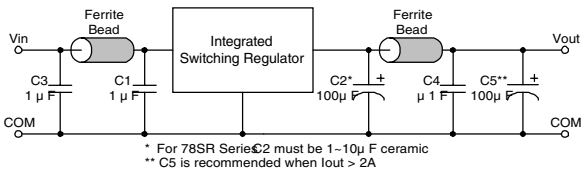
ISRs are switching regulators and as such draw current from the input line in pulses at their operating frequency. The amount of upstream (input) ripple/noise generated by an ISR is directly proportional to the equivalent source impedance of the power source including the impedance of any input lines. The addition of C3, a 1µF ceramic capacitor, near the input pins of the ISR, will reduce upstream conducted ripple/noise by 30-50%.

PI Filters

If you need further reduction in the ripple/noise level for your application, higher order filters must be used. A π (pi) filter employing a ferrite bead (Fair-Rite p/n 2673000701 or equivalent) in series with the input or output lines of the ISR (see Figures 18 and 20) reduces the ripple/noise by at least 20 db (See Figure 19).

These beads form an excellent filter because they are lossy at the ISR's switching frequency (650kHz - 1MHz). The placement of this filter is critical. It must be located as close as possible to the input or output pins of the ISR. The ferrite bead is small (12.5mm long x 3mm diameter), easy to use, low cost, and has low DC resistance. Fair-Rite also manufactures an SMD bead (p/n 2773021447) rated to 5 Amps, but in this application, it is only effective to 2A.

Figure 18



PI FILTER ATTENUATION VS OUTPUT CURRENT

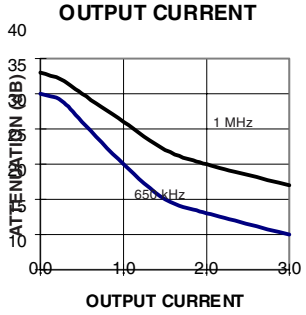


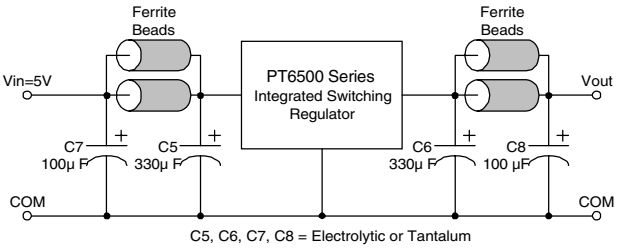
Figure 19

C1, C3, and C4 are ceramic capacitors which have excellent high-frequency performance and low impedance. Capacitor C2 should be a 100µF, low ESR type aluminum electrolytic or tantalum capacitor. All capacitors must have short leads and traces to be effective.

When using ISRs with output currents greater than 3A, such as the PT6500 Series, we recommend using two ferrite beads in parallel as shown in Figure 20.

Off The Shelf Filters

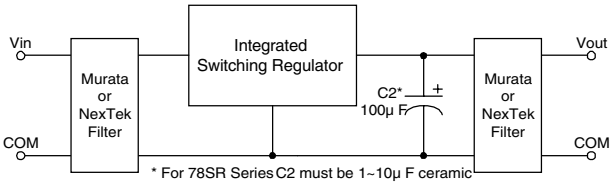
Figure 20



There are several manufacturers of completely self-contained filters with excellent rejection characteristics:

1. Murata Erie (BNX002A) - Ripple/noise reduction is greater than 20db and it filters both Vin/Vout and ground return. Maximum current capacity is 10ADC.

Figure 21



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