Adjustable Switching Voltage Regulators

For non-isolated switching voltage regulators (SVR or SR), such as our SRAD20 series, the feedback control of the PWM is used to adjust the output voltage of the regulator.

In Figure 1, the output voltage V_O is given by:

$$V_O = (1+(RF/R1))2 - (RF/R_{IN})V_{IN}$$

for V_{IN} = 0V to 2V, V_O = 200V to 0V.

The PWM voltage reference is 2 volts with an accuracy between 1% and 3%. When the converter is required to provide a more accurate output voltage the connection in Figure 2 can be used. The external voltage reference can be any voltage from 1.225V (LM4041) to 5V with an accuracy from 0.1% to 0.5%. Choosing 0.1% accurate resistors and a high open loop gain amplifier for A1 (100–120dB), the overall output voltage of the converter will be within 0.2% to 0.6%. A compensation network R_C and C_C is also required and a clamp diode D1 or a zener diode to clamp the output of A1 to V_{REF} - D1.

In applications where additional short start time is required, such as high output voltage charging high output capacitors, the circuits in Figures 3 and 4 can be used.

Figure 5 shows the turn on delay and soft start time generated with the external networks of Figures 3 and 4.

In Figure 6, a current output digital-to-analog (D/A) converter is used to drive the output pin (Pin 9) of the SRAD20.

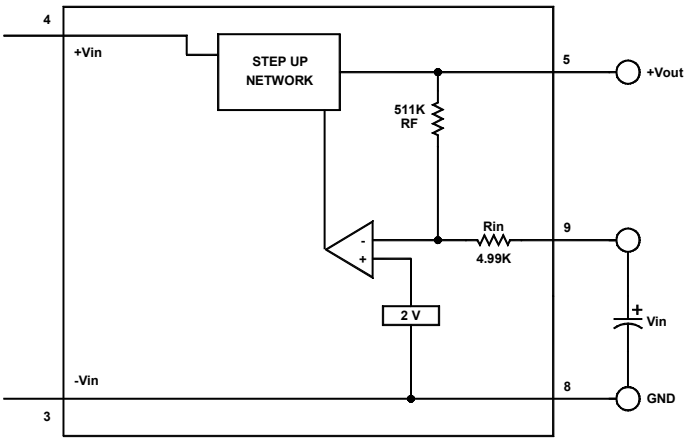

FIGURE 1. Output voltage

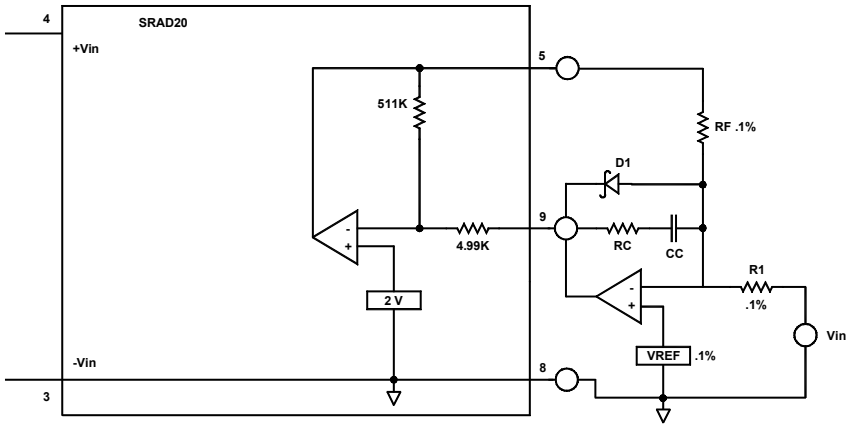

FIGURE 2. External network for VO accuracy of 0.2% to 0.3%

$V_O = (1+(RF/R1))V_{REF} - (RF/R_{IN})V_{IN}$ Open Loop Gain of A1≥100dB

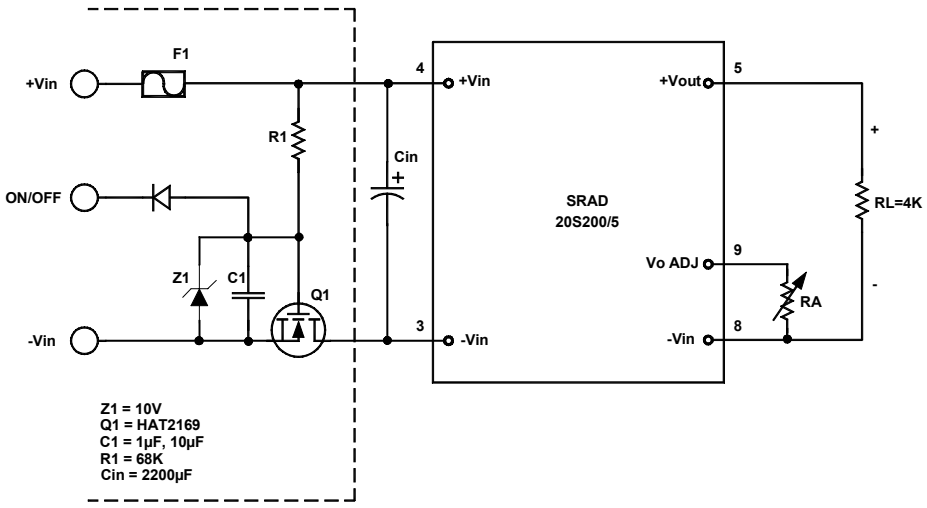

FIGURE 3. For increasing external turn on delay and soft start
See waveforms in Figure 5 (Top Half)

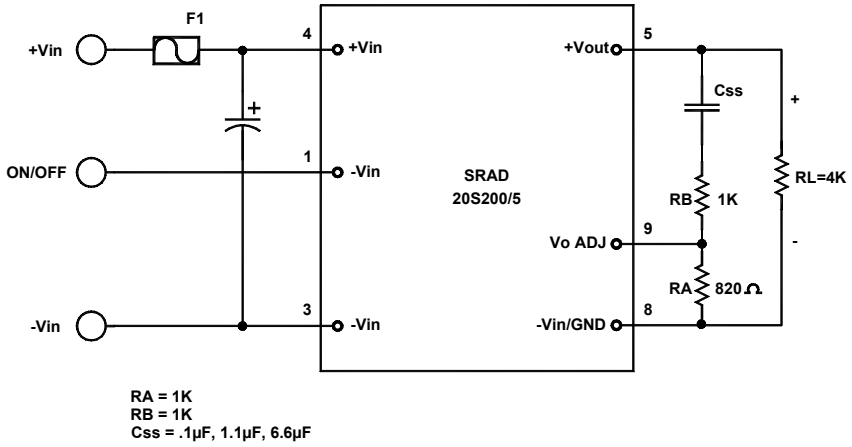

FIGURE 4. For increasing soft start time
See waveforms in Figure 5 (Bottom Half)

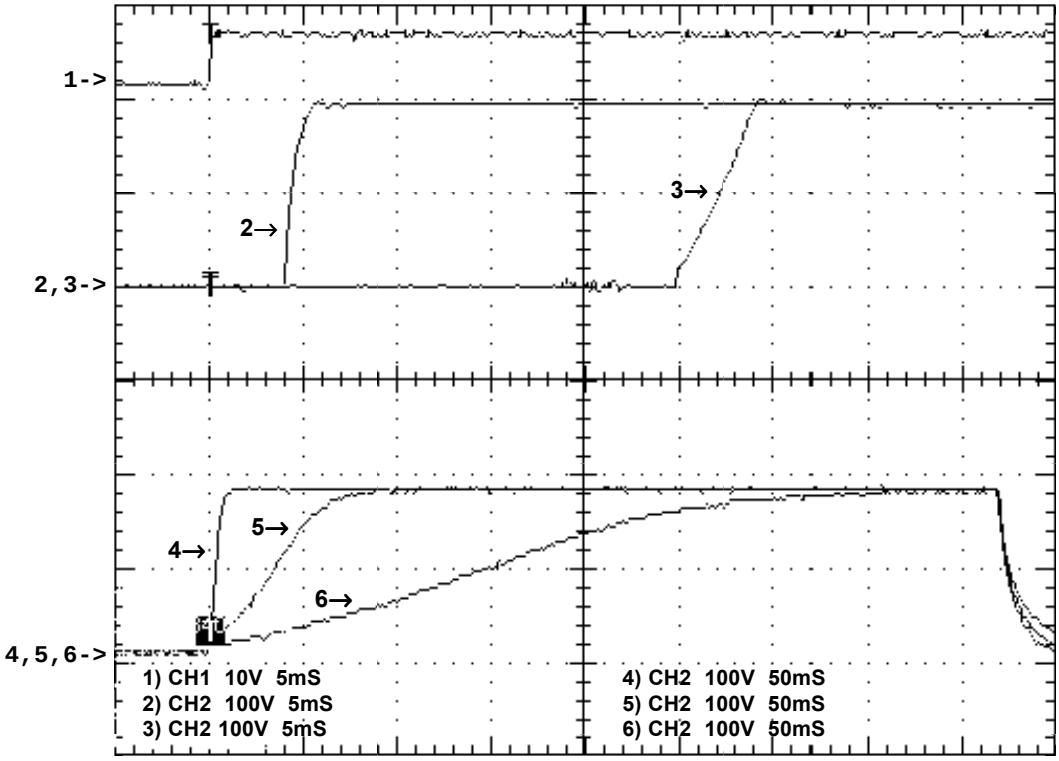

FIGURE 5 (Top Half). Turn on delay with soft start obtained from Figure 3

1) On/Off signal
2) Turn on delay and soft start with C1 = 1µF
3) Turn on delay and soft start with C1 = 10µF

NOTE: The turn on delay remains constant; only the soft start time increases when Figure 2 is used to increase the soft start time.

FIGURE 5 (Bottom Half). Soft start time obtained from Figure 4

4) C_{SS} = 0.1µF
5) C_{SS} = 1.1 µF
6) C_{SS} = 6.6µF

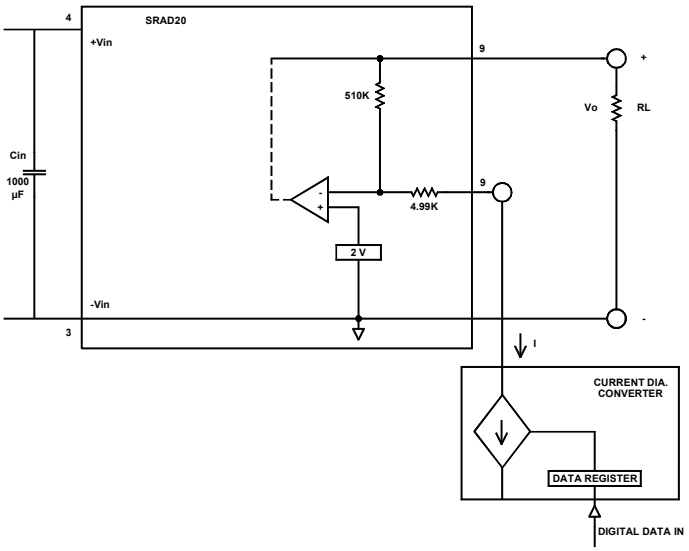

FIGURE 6. Digital programmable output ($I_{D/A}$ FS ≅ 400µA)

For a 10-bit D/A converter with I_O FS = 400µA, one least significant bit (LSB) will produce a 150mV change in the output of the converter