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A Compendium of Application Circuits for Intersil Digitally-Controlled (XDCP) Potentiometers

Introduction

This application note lists a number of application circuits for Intersil's digitally-controlled (XDCP) potentiometers. The application circuits illustrate the wide variety of possible functions which can be implemented using the variability of the potentiometer in conjunction with standard active devices like operational amplifiers and comparators. The types of circuits include control circuits, converters, filters, signal processing circuits, regulators, wave shapers, analog computing circuits and signal sources. The circuits are shown in basic form and do not include supply decoupling or proper grounding techniques. The user must account for these in the final design.

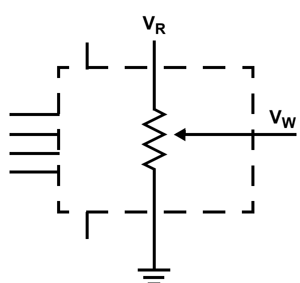
Intersil's potentiometers are controlled through the 2-wire, I^2C, 3-wire, or SPI computer serial-interfaces or buses. For front panel, push button type applications, Intersil's push pots are recommended.

Electronic digitally-controlled (XDCP) potentiometers provide three powerful application advantages:

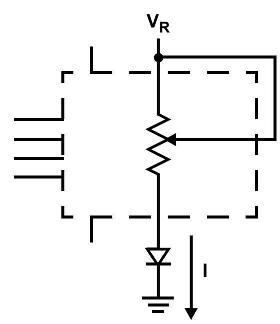
1. The variability and reliability of a solid-state potentiometer.
2. The flexibility of computer-based digital controls.
3. The retentivity of nonvolatile memory used for the storage of multiple potentiometer settings or data.

In addition, the packages of the potentiometers are completely compatible with other electronic components and hence reduce manufacturing assembly costs.

Applications



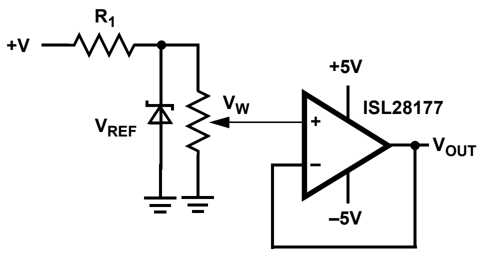
THREE TERMINAL POTENTIOMETER;
VARIABLE VOLTAGE DIVIDER



TWO TERMINAL VARIABLE RESISTOR;
VARIABLE CURRENT

FIGURE 1. BASIC CONFIGURATIONS OF ELECTRONIC POTENTIOMETERS

Application Circuits



$V_{OUT} = V_W$

FIGURE 2. BUFFERED REFERENCE VOLTAGE

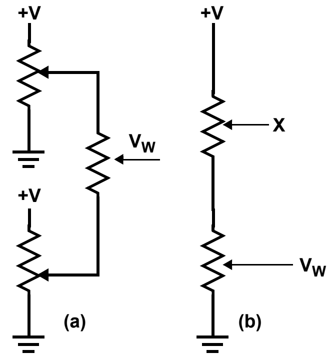
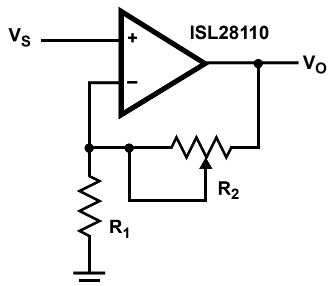
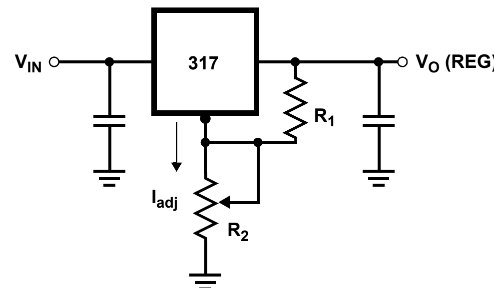


FIGURE 3. CASCADING TECHNIQUES



$V_O = (1+R_2/R_1)V_S$

FIGURE 4. NONINVERTING AMPLIFIER



$V_O\,(REG) = 1.25V\,(1+R_2/R_1)+I_{adj}\,R_2$

FIGURE 5. VOLTAGE REGULATOR

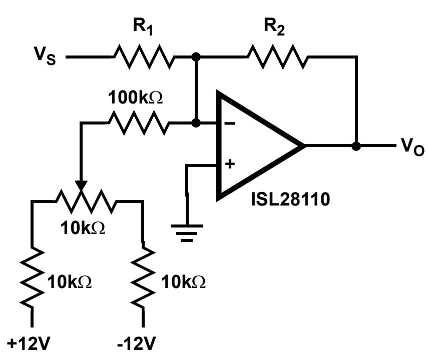
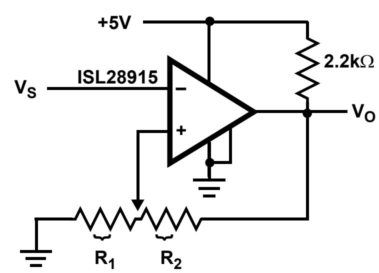


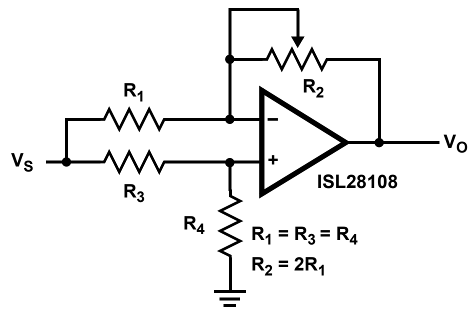
FIGURE 6. OFFSET VOLTAGE ADJUSTMENT



$V_{UL} = \{R_1/(R_1+R_2)\}\ V_O(MAX)$
$V_{LL} = \{R_1/(R_1+R_2)\}\ V_O(MIN)$

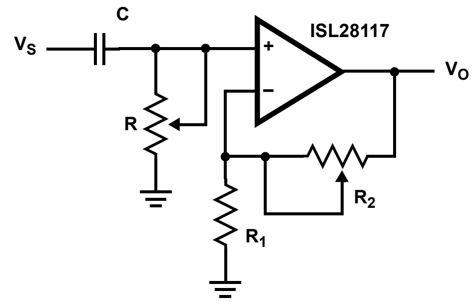
FIGURE 7. COMPARATOR WITH HYSTERISIS

Application Circuits (Continued)



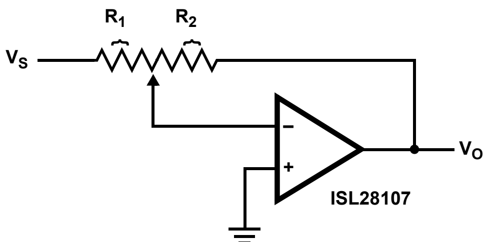
$V_O = G\ V_S$
$-1/2 \le G \le +1/2$

FIGURE 8. ATTENUATOR



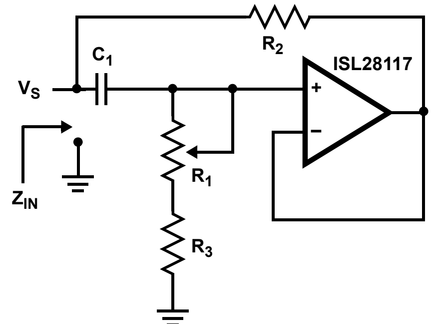
$G_O = 1 + R_2/R_1$
$fc = 1/(2\pi RC)$

FIGURE 9. FILTER



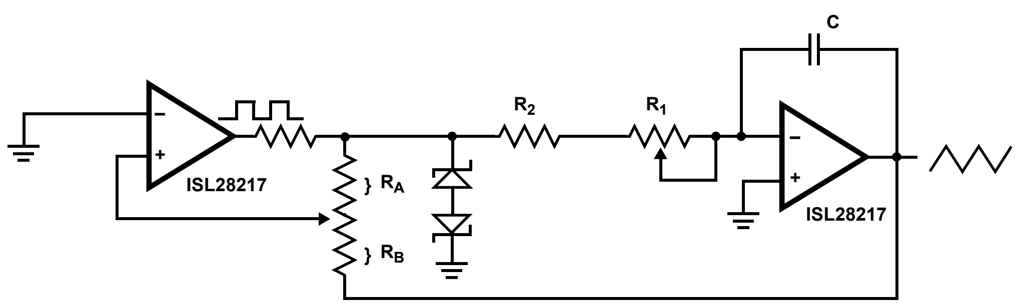
$V_O = G\ V_S$
$G = - R_2/R_1$

FIGURE 10. INVERTING AMPLIFIER



$Z_{IN} = R_2 + s\ R_2\ (R_1 + R_3)\ C_1 = R_2 + s\ Leq$
$(R_1 + R_3) >> R_2$

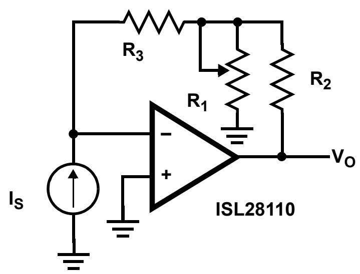
FIGURE 11. EQUIVALENT L-R CIRCUIT



FREQUENCY $\propto R_1, R_2, C$
AMPLITUDE $\propto R_A, R_B$

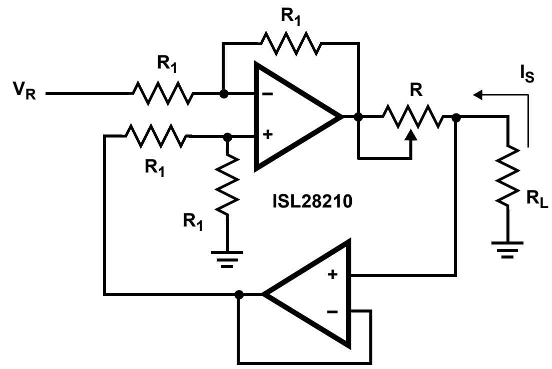
FIGURE 12. FUNCTION GENERATOR

Application Circuits (Continued)



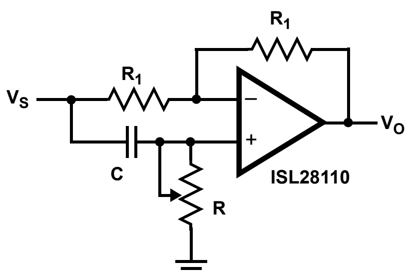
$V_O / I_S = -R_3(1+R_2/R_1) + R_2$

FIGURE 13. I TO V CONVERTER



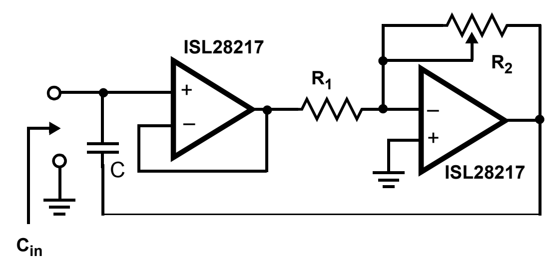
$I_S = V_R/R$

FIGURE 14. CURRENT SOURCE



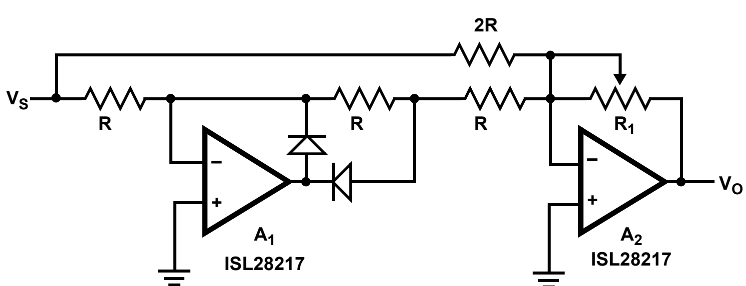
$\measuredangle\ V_O/V_S = 180° - 2\tan^{-1}\omega RC$

FIGURE 15. PHASE SHIFTER



$C_{IN} = C\ (1 + R_2/R_1)$

FIGURE 16. CAPACITANCEV MULTIPLIER



$$V_O = |V_S|\ \frac{R_1}{R}$$

FIGURE 17. ABSOLUTE VALUE AMPLIFIER WITH GAIN

Application Circuits (Continued)

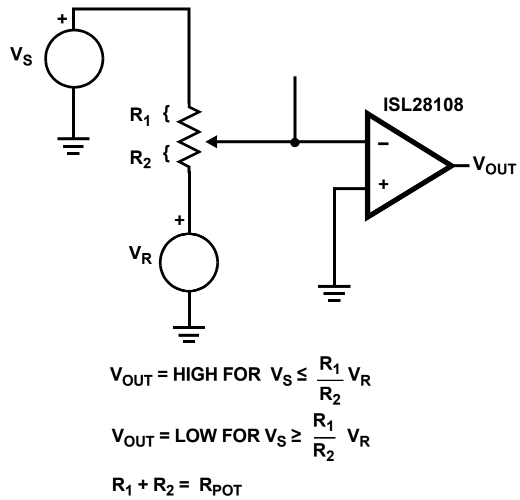


FIGURE 18. LEVEL DETECTOR

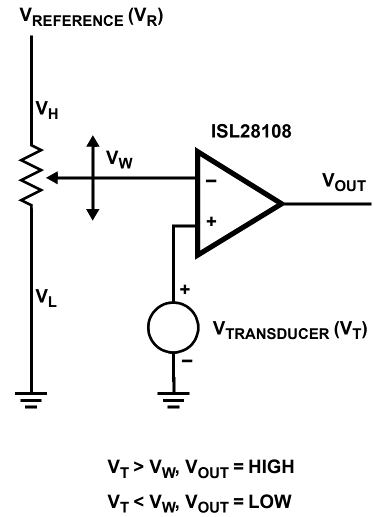


FIGURE 19. LEVEL DETECTOR

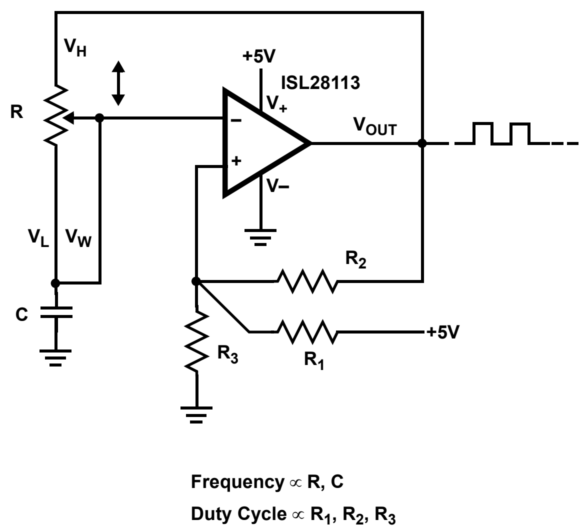


FIGURE 20. OSCILLATOR

Application Circuits (Continued)

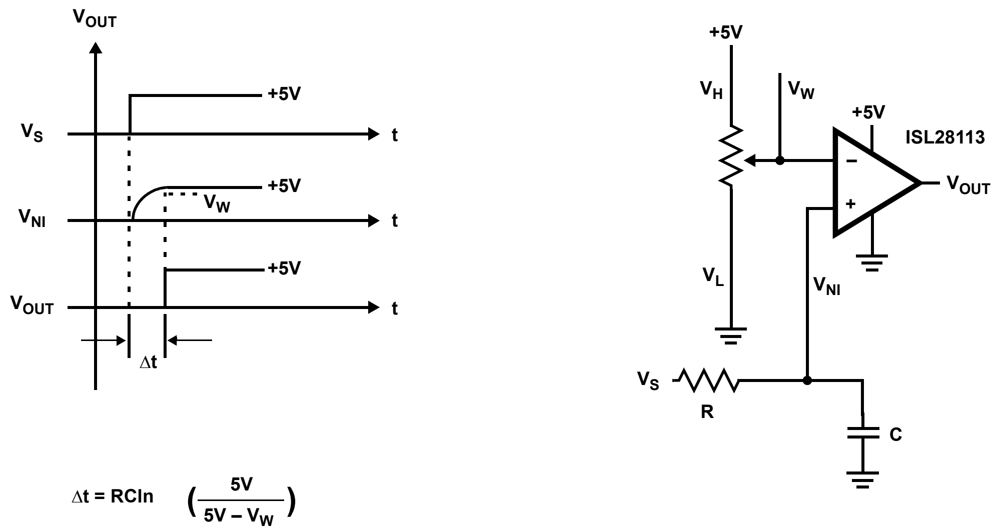


FIGURE 21. TIME DELAY

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