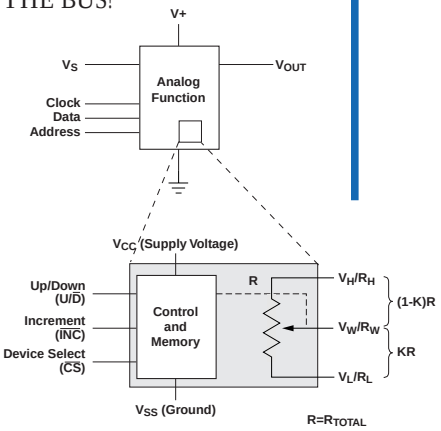
TECH BRIEF

The Premise

The computer has extended the capabilities of electronic products and systems by adding the dimensions of control, computation and programmability. The world of analog products, however, has not been able to take advantage of these advances. We can now have the best of both worlds by combining Xicor digitally controlled potentiometers (XDCPs)™ with standard analog functions. The XDCP allows the designer to "computerize" the analog function by PUTTING ANALOG ON THE BUS!



If the parameters of the analog function are varied using the XDCP, and the XDCP is controlled by a microprocessor, then the analog function is now digitally controlled.

ANY analog function (see figure above) whose performance depends on resistance is a candidate for "computerization" using XDCPs!

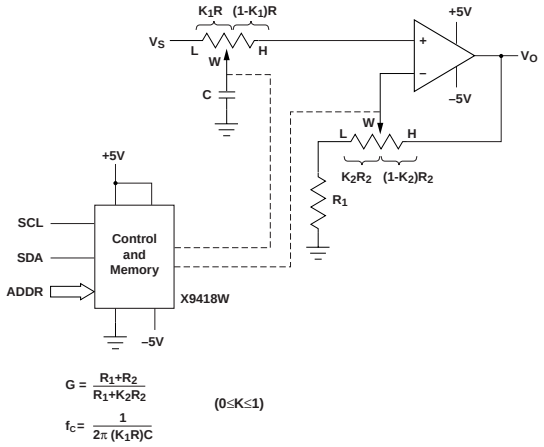
HOW MANY WAYS CAN YOU USE A PROGRAMMABLE RESISTOR?

The Design: IMPLEMENTING PROGRAMMABLE VOLTAGE AMPLIFIERS USING XDCPs

Two of the most common analog building blocks used today are the inverting and non-inverting amplifier. For these circuits, the two most critical parameters of concern to designers are gain (G_0) and frequency response (f_c), which are determined by external resistors and capacitors.

By replacing the external fixed resistors with Xicor XDCPs, designers now have a PROGRAMMABLE voltage amplifier that can be directly programmed using a microcontroller or microprocessor…The Analog is On The Bus!

The figure below shows a typical non-inverting amplifier with XDCPs providing the resistive control.



By using the programmable variable resistance function of the XDCPs, the designer can program both the voltage gain and cutoff frequency of the amplifier circuit.

XDCP R_2 controls the voltage gain of the circuit through the equation

$$G = \frac{R_1 + R_2}{R_1 + K_2R_2}$$

where K_2 is the tap position of the XDCP and R_2 is the end to end resistance of the XDCP.

Similarly, XDCP R, in conjunction with capacitor C, controls the cutoff frequency of the amplifier through

$$f_c = \frac{1}{2\pi(K_1R)C}$$

where K is the proportionate tap position of XDCP R.

As we can see from the above, both gain and cutoff frequency are now programmable and can be digitally controlled by a microprocessor or microcontroller.

A Xicor Design Education Series

www.xicor.com.

Xicor Mixed Signal Products-Digitally Controlled Potentiometers

PRODUCT	DESCRIPTION	PKG CODE*	TEMP RANGE	IC (mA)	ISB (µA)	V_H/V_L	V+	V-	DATA SHEET	SAMPLES	PRODUCTION
Quad 256 Tap											
X9250U,T	Quad 256 tap XDCP, low power, SPI interface, dual supply	S24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	Q3
X9258U,T	Quad 256 tap XDCP, low power, two-wire interface, dual supply	S24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	Q3
Quad 64 Tap											
X9241Y,W U,M	Quad 64 tap XDCP, two-wire interface, single supply	P(20) S(20),V(20)	C,I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9400Y,W	Quad 64 tap XDCP, low power, SPI interface, dual supply	S24, V24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9401W	Quad 64 tap XDCP, low power, SPI interface, single supply	S24, V24	C,I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q3	Q3
X9408Y,W	Quad 64 tap XDCP, low power, two-wire interface, dual supply	S24, V24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9409W	Quad 64 tap XDCP, low power, two-wire interface, single supply	S24, V24	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q3	Q3
Dual 64 Tap											
X9221Y, W,U	Dual 64 tap XDCP, two-wire interface, single supply	P(20) S(20)	C,I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9410Y,W	Dual 64 tap XDCP, low power, SPI interface, dual supply	S24, V24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9411W	Dual 64 tap XDCP, low power, SPI interface, single supply	S24, V24	C,I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q4	Q1
X9418Y,W	Dual 64 tap XDCP, low power, two-wire interface, dual supply	S24, V24	C,I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to +5.5V	NOW	NOW	NOW
X9419W	Dual 64 tap XDCP, low power, two-wire interface, single supply	S24, V24	C,I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q4	Q1
Single 100 Tap											
X9C102	Single 100 tap XDCP, 1k Ω increment/decrement interface, single supply	P, S	C, I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9C103	Single 100 tap XDCP, 10k Ω increment/decrement interface, single supply	P, S	C, I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9C104	Single 100 tap XDCP, 100k Ω increment/decrement interface, single supply	P, S	C, I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9C303	Single 100 tap XDCP, 32k Ω increment/decrement interface, single supply	P, S V8	C, I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9C503	Single 100 tap XDCP, 50k Ω increment/decrement interface, single supply	P, S	C, I	3	500	-5.5V to +5.5V	N/A	N/A	NOW	NOW	NOW
X9312W, Z,T	Single 100 tap XDCP, 1k Ω increment/decrement interface, 0-15V terminal voltage single supply	P, S, No V	C, I	3	1000	0 to +15V	N/A	N/A	NOW	NOW	NOW
X9317W,U	Single 100 tap XDCP, low power increment/decrement interface, single supply	P, S8 V8	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	NOW	NOW
Single 64 Tap											
X9420Y,W	Single 64 tap XDCP, low power SPI interface, dual supply	S16, V14	C, I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9421W	Single 64 tap XDCP, low power SPI interface, single supply	S16, V14	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q4	Q1
X9428Y,W	Single 64 tap XDCP, low power two-wire interface, dual supply	S16, V14	C, I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9429W	Single 64 tap XDCP, low power two-wire interface, single supply	S16, V14	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q4	Q1
Single 32 Tap											
X9313Z, W,U	Single 32 tap XDCP, increment/decrement interface single supply	M, P, S	C, I C	3	500	-5V to +5V	N/A	N/A	NOW	NOW	NOW
X9315W,N	Single 32 tap XDCP, low power increment/decrement interface, single supply	M, P, S(8)	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	NOW	NOW
Single 16 Tap											
X9116W	Single 16 tap XDCP, low power increment/decrement interface, single supply	S8, M8	C, I	0.4	1	0V to +5.5V	N/A	N/A	NOW	Q3	Q3
32 Tap PushPots											
X9511W,Z	Single 32 tap pushpot XDCP, pushbutton interface, single supply	P, S	C, I	3	500	-5V to +5V	N/A	N/A	NOW	NOW	NOW
Smart Analog											
X9440Y,W	Dual smart comparator with dual 64 tap XDCP, low power SPI interface, dual supply	S24, V24	C, I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW
X9448Y,W	Dual smart comparator with dual 64 tap XDCP, low power two-wire interface, dual supply	S24, V24	C, I	0.4	1	-5.5V to +5.5V	+2.7V to +5.5V	-2.7V to -5.5V	NOW	NOW	NOW

***PKG Codes: P=PDIP, S=SOIC, V=TSSOP**
Resistor Values (Ohms): Z=1K, Y=2K, W=10K, U=50K, T=100K, M=2K, 10K, 10K, 50K, N=500K

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