HARRIS SEMICONDUCTOR

CD74HC22106
CD74HCT22106

QMOS 8 x 8 x 1 Crosspoint Switch with Memory Control

April 1993

Features

- **64 Analog Switches in an 8 x 8 x 1 Array**
- **On-Chip Line Decoder and Control Latches**
- **Automatic Power-Up Reset by Using a 0.1μF Capacitor at the MR Pin**
- **R_{ON} Resistanced 95Ω at V_{CC} = 4.5V**
- **Analog Signal Capability: $V_{DD}/2$**
- **Wide Operating Temp. Range: -40°C to +85°C**

Family Features

- **CD74HC Types**
  - **2V to 10V Operation**
  - **High Noise Immunity: N_{IL} = 30%, N_{IH} = 30% of V_{DD}; at V_{DD} = 5V and 10V**
- **CD74HCT Types**
  - **4.5V to 5.5V Operation**
  - **Direct LSTTL Input Logic Compatibility: V_{IL} = 0.8V Max, V_{IH} = 2V Min**
  - **CMOS Input Compatibility: I_I < 1μA at V_{OL}, V_{OH}**

Description

The CD74HC22106 and CD74HCT22106 are digitally controlled analog switches which utilize silicon-gate CMOS technology. The CD74HC22106 type features CMOS input-voltage-level compatibility and the CD74HCT22106 features LSTTL input-voltage-level compatibility.

The Master Reset has an internal pull-up resistor and is normally used with a 0.1μF capacitor. During power up all switches are automatically reset. The crosspoint switches will reset with MR = 0 even if CE is high. A 6-bit address through a 6 line to 64 line decoder selects the transmission gate which can be turned on by applying a logical ONE to the DATA input and logical ZERO to the STROBE. Similarly, any transmission gate can be turned OFF by applying a logical ZERO to the DATA input while strobing the STROBE with a logical ZERO.

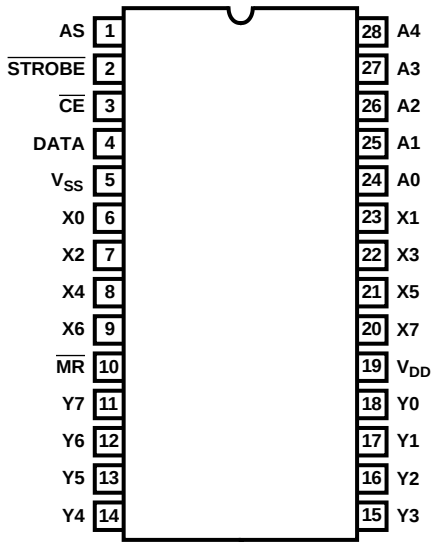
The CE pin allows the crosspoint array to be cascaded for matrix expansion in both the X and Y directions.

Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
CD74HC22106E	-40°C to +85°C	28 Lead Plastic DIP
CD74HCT22106E	-40°C to +85°C	28 Lead Plastic DIP

Pinout

CD74HC22106, CD74HCT22106
(PDIP)
TOP VIEW



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.

File Number **1719.2**

Absolute Maximum Ratings

DC Supply Voltage (V_{DD})
- Voltage Reference to V_{SS} Terminal. . . . . -0.5V to +11V

DC Input Diode Current
- I_{IK} (for V_I < -0.5 or V_I > V_{DD} +0.5V . . . . . ±20mA

DC Output Diode Current
- I_{OK} (For V_O < -0.5 or V_O > V_{DD} +0.5V . . . . . ±20mA

DC Transmission Gate Current . . . . . ±25mA

Power Dissipation per Package (P_D)
- For T_A = -40°C to +60°C (Package Type E). 500mW
- For T_A = -60°C to +85°C (Package Type E). . . . . Derate Linearily at 12mW/°C to 200mW

Junction Temperature. . . . . +175°C

Junction Temperature (Plastic Package) . . . . . +150°C

Lead Temperature (Soldering 10 Sec.). . . . . +300°C

Operating Conditions

Operating Temperature Range (T_A)
- Package Type E . . . . . -40°C to +85°C

Storage Temperature Range. . . . . -65°C ≤T_A ≤+150°C

Supply Voltage Range (for T_A = Full Package Temp. Range) V_{DD}
- CD74HC22106 . . . . . 2V to 10V
- CD74HCT22106 . . . . . 4.5V to 5.5V

DC Input or Output Voltage V_I, V_O . . . . . 0V to V_{DD}

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Static Electrical Specifications V_{SS} = GND

	CD74HC22106							CD74HCT22106							
	TEST CONDITIONS		+25°C			-40°C to +85°C		TEST CONDITIONS		+25°C			-40°C to +85°C		
PARAMETERS	V_{IS} (V)	V_{DD} (V)	MIN	TYP	MAX	MIN	MAX	V_{IS} (V)	V_{DD} (V)	MIN	TYP	MAX	MIN	MAX	UNITS
High-Level Input Voltage V_{IH}	-	2	1.5	-	-	1.5	-	-	4.5 to 5.5	2	-	-	2	-	V
	-	4.5	3.15	-	-	3.5	-	-							
	-	9	6.3	-	-	6.3	-	-							
Low-Level Input Voltage V_{IL}	-	2	-	-	0.5	-	0.5	-	4.5 to 5.5	-	-	0.8	-	0.8	V
	-	4.5	-	-	1.35	-	1.35	-							
	-	9	-	-	2.7	-	2.7	-							
Input Leakage Current (Any Control) I_L	V_{DD} or GND	10	-	-	±0.1	-	±1	Any Voltage Between V_{DD} & GND	5.5	-	-	±0.1	-	±1	µA
Quiescent Device Current, I_{CC} (with $\overline{MR}$ = 1)	V_{DD} or GND	10	-	-	5	-	50	V_{DD} or GND	5.5	-	-	2	-	20	µA
Off Leakage Current, I_L (with $\overline{MR}$ = 1)	All Switches OFF	10	-	-	0.1	-	1	-	5.5	-	-	0.1	-	1	µA
"On" Resistance R_{ON}	V_{DD} to GND Figures 8, 9	2	-	470	700	-	875	Figure 8	4.5	-	64	95	-	120	Ω
		4.5	-	64	95	-	120								
		9	-	45	70	-	90								
	V_{DD}/2	-	-	-	-	-	-	-	4.5	-	58	85	-	110	Ω
		4.5	-	58	85	-	110								
		9	-	40	60	-	80								
"On" Resistance Between Any Two Channels ΔR_{ON}	V_{DD} to GND	-	-	-	-	-	-	V_{DD} to GND	4.5	-	25	-	-	-	Ω
		4.5	-	25	-	-	-								
		9	-	23	-	-	-								

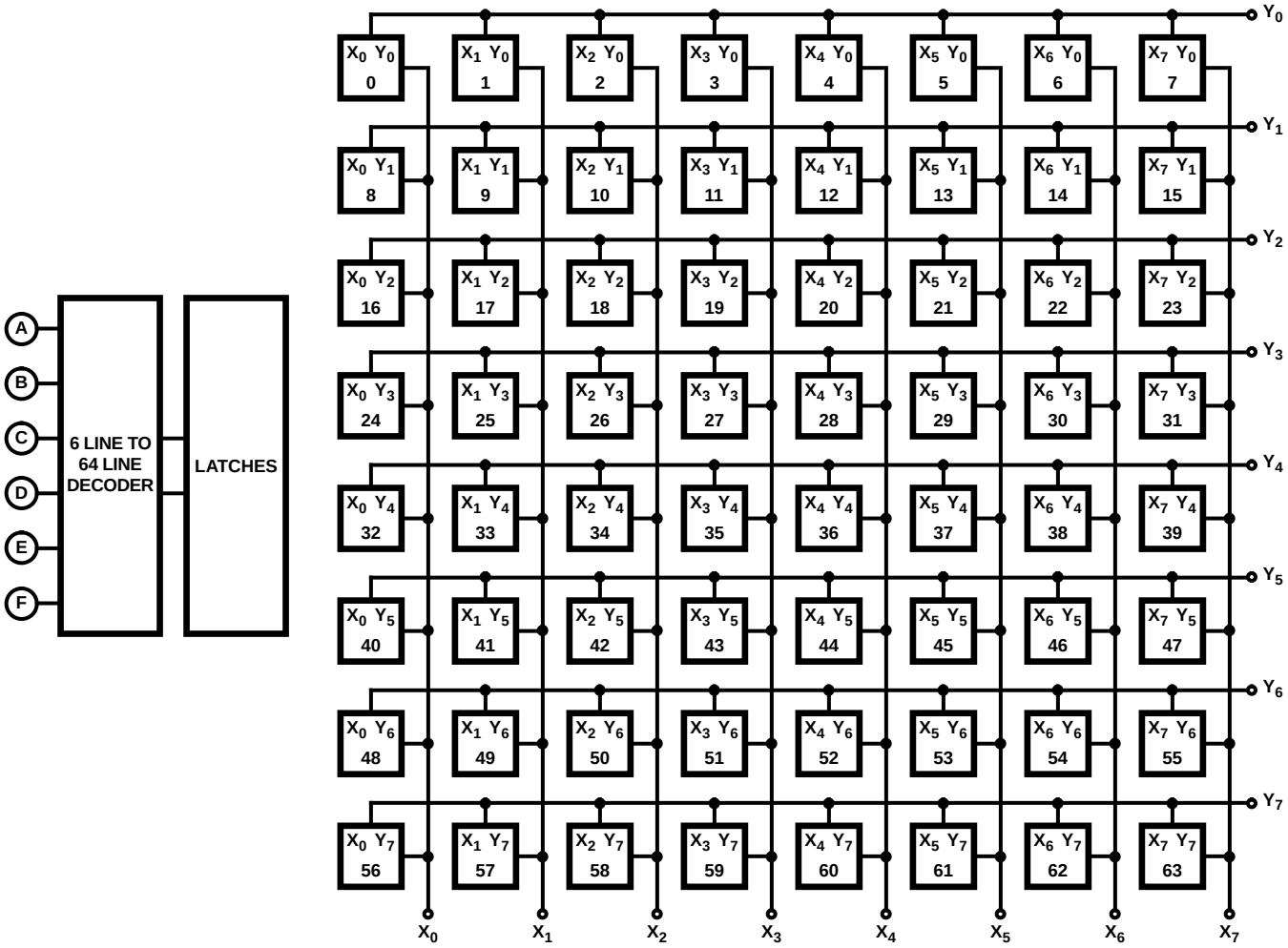
Dynamic Electrical Specifications V_{SS} = 0V

PARAMETERS	SYMBOL	TEST CONDITIONS	FIG.	V_{DD} (V)	LIMITS +25°C HC MIN	HC MAX	HCT MIN	HCT MAX	LIMITS -40°C to +85°C HC MIN	HC MAX	HCT MIN	HCT MAX	UNITS
CONTROLS													
Propagation Delay Time:	t_{PZH}	R_L = 10kΩ, C_L = 50pF, t_R, t_F = 6ns	1	2	-	370	-	-	-	385	-	-	ns
Strobe to Output (Switch Turn-On to High Level)				4.5	-	110	-	120	-	125	-	135	ns
				9	-	65	-	-	-	70	-	-	ns
Data-In to Output (Turn-On to High Level)	t_{PZH}		2	2	-	240	-	-	-	255	-	-	ns
				4.5	-	75	-	85	-	85	-	95	ns
				9	-	50	-	-	-	55	-	-	ns
Address to Output (Turn-On to High Level)	t_{PZH}		3	2	-	380	-	-	-	400	-	-	ns
				4.5	-	110	-	120	-	125	-	135	ns
				9	-	65	-	-	-	75	-	-	ns
Propagation Delay Time:	t_{PHZ}		1	2	-	400	-	-	-	420	-	-	ns
Strobe to Output				4.5	-	135	-	150	-	155	-	170	ns
				9	-	90	-	-	-	100	-	-	ns
Data-In to Output (Turn-On to Low Level)	t_{PZL}		2	2	-	240	-	-	-	255	-	-	ns
				4.5	-	75	-	85	-	85	-	95	ns
				9	-	50	-	-	-	55	-	-	ns
Address to Output (Turn-Off)	t_{PHZ}		3	2	-	420	-	-	-	440	-	-	ns
				4.5	-	140	-	150	-	155	-	170	ns
				9	-	95	-	-	-	100	-	-	ns
Minimum Set-Up Time (Data-In to Strobe Address)	t_{SU}		-	2	35	-	-	-	40	-	-	-	ns
				4.5	20	-	20	-	20	-	20	-	ns
				9	15	-	-	-	15	-	-	-	ns
Minimum Hold Time (Data-In to Strobe Address)	t_H		-	2	85	-	-	-	90	-	-	-	ns
				4.5	25	-	25	-	25	-	25	-	ns
				9	20	-	-	-	20	-	-	-	ns
Minimum Strobe Pulse Width	t_W		-	2	200	-	-	-	210	-	-	-	ns
				4.5	45	-	55	-	55	-	65	-	ns
				9	25	-	-	-	30	-	-	-	ns
Maximum Switching Frequency	F_O		-	2	0.7	-	-	-	0.6	-	-	-	MHz
				4.5	3.0	-	2.8	-	2.8	-	2.6	-	MHz
				9	7	-	-	-	6.5	-	-	-	MHz
Input (Control) Capacitance	C_I		-	-	-	10	-	10	-	10	-	10	pF

Dynamic Electrical Specifications

PARAMETERS	SYMBOL	TEST CONDITIONS	V_{IS} (V_{P-P})	V_{SS} (V)	V_{DD} (V)	LIMITS +25°C HC MIN	LIMITS +25°C HC MAX	LIMITS +25°C HCT MIN	LIMITS +25°C HCT MAX	LIMITS -40°C to +85°C HC MIN	LIMITS -40°C to +85°C HC MAX	LIMITS -40°C to +85°C HCT MIN	LIMITS -40°C to +85°C HCT MAX	UNITS
Propagation Delay Time, Signal Input to Output	t_{PLH}, t_{PHL}	R_L = 10kΩ, C_L = 50pF, t_R, t_F = 6ns	-	0	2	-	30	-	-	-	33	-	-	ns
			-	0	4.5	-	20	-	20	-	22	-	22	ns
			-	-	9	-	15	-	-	-	17	-	-	ns
						HC Typical		HCT Typical						
Switch Frequency Response at -3dB	f_{3dB}	R_S = R_L = 600Ω	2	-2.25	2.25	5		5		-	-	-	-	MHz
			2	-4.5	4.5	6		6		-	-	-	-	MHz
Crosstalk Between Any Two Channels	F_{CT}	R_S = R_L = 600Ω, f = 1kHz	2	-2.25	2.25	-110		-110		-	-	-	-	dB
		R_S = R_L = 600Ω, f = 1MHz	2	-2.25	2.25	-53		-53		-	-	-	-	dB
			2	-4.5	4.5	-55		-55		-	-	-	-	dB
Switch "OFF" -40dB Feed Through Frequency	F_{DT}	R_S = R_L = 600Ω	2	-2.25	2.25	7		7		-	-	-	-	MHz
			2	-4.5	4.5	8		8		-	-	-	-	MHz
Total Harmonic Distortion	THD	R_L = 10kΩ, f = 1kHz sine-wave	4	-2.25	2.25	0.05		0.05		-	-	-	-	%
			8	-4.5	4.5	0.05		0.05		-	-	-	-	%
		R_L = 600Ω, f = 1kHz sine-wave	4	-2.25	2.25	0.25		0.25		-	-	-	-	%
			7	-4.5	4.5	0.12		0.12		-	-	-	-	%
Control to Switch Feed-Through Noise (DATA IN, Strobe, Address)		R_L = 10kΩ, t_R, t_F = 6ns	V_{DD}	0	5	35		35		-	-	-	-	mV
			V_{DD}	0	10	65		65		-	-	-	-	mV
Capacitance, Xn to GND	C_{IS}	f = 1MHz	-	0	10	48		48		-	-	-	-	pF
Yn to GND			-	0	10	44		44		-	-	-	-	pF

Functional Diagram



TRUTH TABLE

A_5	A_4	A_3	A_2	A_1	A_0	SWITCH SELECT	A_5	A_4	A_3	A_2	A_1	A_0	SWITCH SELECT
0	0	0	0	0	0	X_0 Y_0	1	0	0	0	0	0	X_0 Y_4
0	0	0	0	0	1	X_1 Y_0	1	0	0	0	0	1	X_1 Y_4
0	0	0	0	1	0	X_2 Y_0	1	0	0	0	1	0	X_2 Y_4
0	0	0	0	1	1	X_3 Y_0	1	0	0	0	1	1	X_3 Y_4
0	0	0	1	0	0	X_4 Y_0	1	0	0	1	0	0	X_4 Y_4
0	0	0	1	0	1	X_5 Y_0	1	0	0	1	0	1	X_5 Y_4
0	0	0	1	1	0	X_6 Y_0	1	0	0	1	1	0	X_6 Y_4
0	0	0	1	1	1	X_7 Y_0	1	0	0	1	1	1	X_7 Y_4
0	0	1	0	0	0	X_0 Y_1	1	0	1	0	0	0	X_0 Y_5
0	0	1	0	0	1	X_1 Y_1	1	0	1	0	0	1	X_1 Y_5
0	0	1	0	1	0	X_2 Y_1	1	0	1	0	1	0	X_2 Y_5
0	0	1	0	1	1	X_3 Y_1	1	0	1	0	1	1	X_3 Y_5
0	0	1	1	0	0	X_4 Y_1	1	0	1	1	0	0	X_4 Y_5
0	0	1	1	0	1	X_5 Y_1	1	0	1	1	0	1	X_5 Y_5
0	0	1	1	1	0	X_6 Y_1	1	0	1	1	1	0	X_6 Y_5
0	0	1	1	1	1	X_7 Y_1	1	0	1	1	1	1	X_7 Y_5
0	1	0	0	0	0	X_0 Y_2	1	1	0	0	0	0	X_0 Y_6
0	1	0	0	0	1	X_1 Y_2	1	1	0	0	0	1	X_1 Y_6
0	1	0	0	1	0	X_2 Y_2	1	1	0	0	1	0	X_2 Y_6
0	1	0	0	1	1	X_3 Y_2	1	1	0	0	1	1	X_3 Y_6
0	1	0	1	0	0	X_4 Y_2	1	1	0	1	0	0	X_4 Y_6
0	1	0	1	0	1	X_5 Y_2	1	1	0	1	0	1	X_5 Y_6
0	1	0	1	1	0	X_6 Y_2	1	1	0	1	1	0	X_6 Y_6
0	1	0	1	1	1	X_7 Y_2	1	1	0	1	1	1	X_7 Y_6
0	1	1	0	0	0	X_0 Y_3	1	1	1	0	0	0	X_0 Y_7
0	1	1	0	0	1	X_1 Y_3	1	1	1	0	0	1	X_1 Y_7
0	1	1	0	1	0	X_2 Y_3	1	1	1	0	1	0	X_2 Y_7
0	1	1	0	1	1	X_3 Y_3	1	1	1	0	1	1	X_3 Y_7
0	1	1	1	0	0	X_4 Y_3	1	1	1	1	0	0	X_4 Y_7
0	1	1	1	0	1	X_5 Y_3	1	1	1	1	0	1	X_5 Y_7
0	1	1	1	1	0	X_6 Y_3	1	1	1	1	1	0	X_6 Y_7
0	1	1	1	1	1	X_7 Y_3	1	1	1	1	1	1	X_7 Y_7

Test Circuits and Waveforms

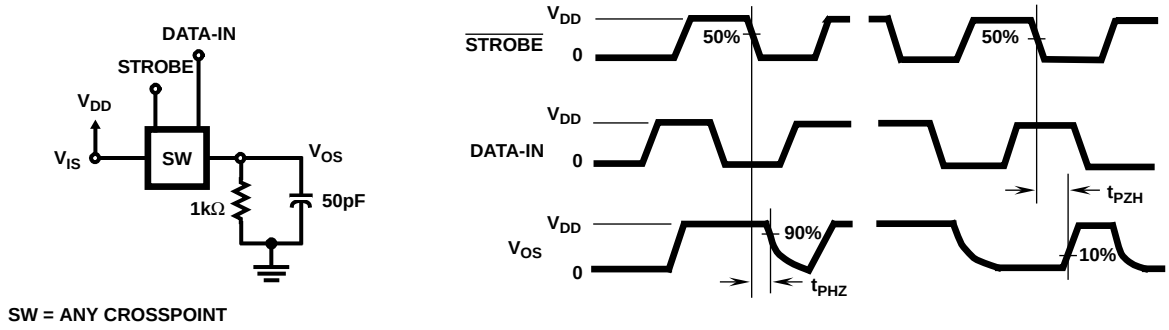


FIGURE 1. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS
(STROBE TO SIGNAL OUTPUT, SWITCH TURN-ON OR TURN-0FF)

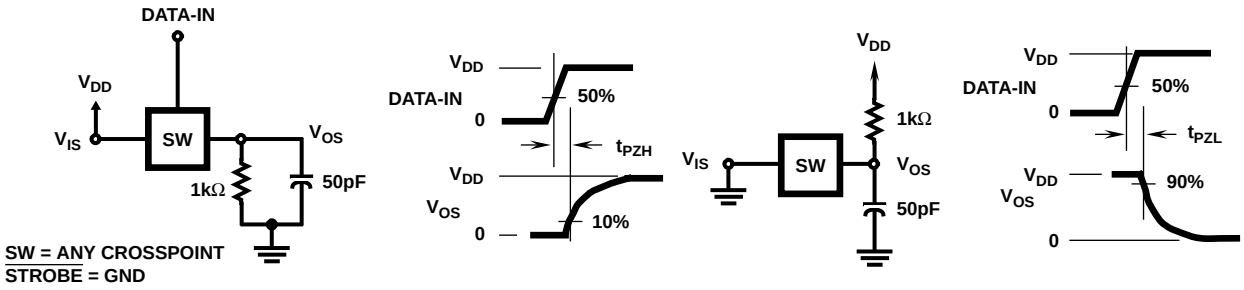


FIGURE 2. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS
(DATA-IN TO SIGNAL OUTPUT, SWITCH TURN-ON TO HIGH OR LOW LEVEL)

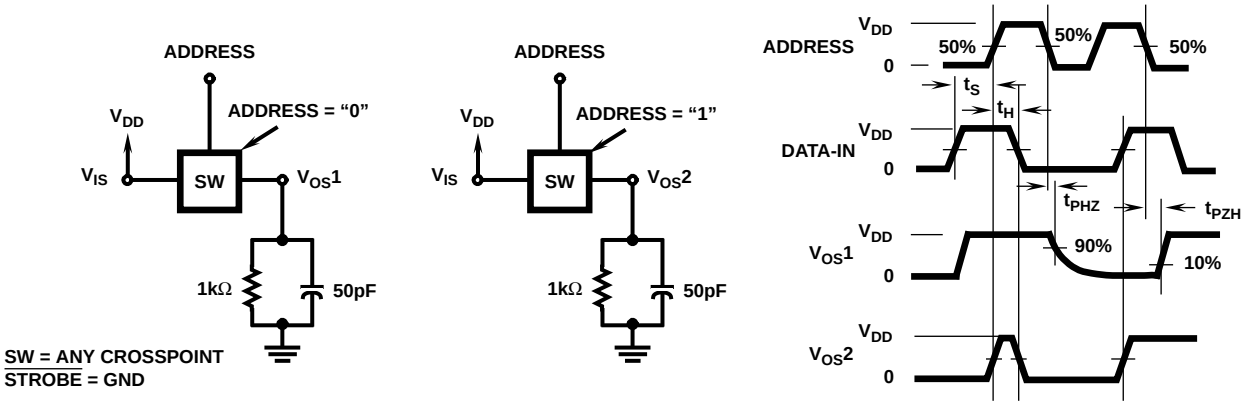


FIGURE 3. PROPAGATION DELAY TIME TEST CIRCUIT AND WAVEFORMS
(ADDRESS TO SIGNAL OUTPUT, SWITCH TURN-ON OR TURN-0FF)

Typical Application Information

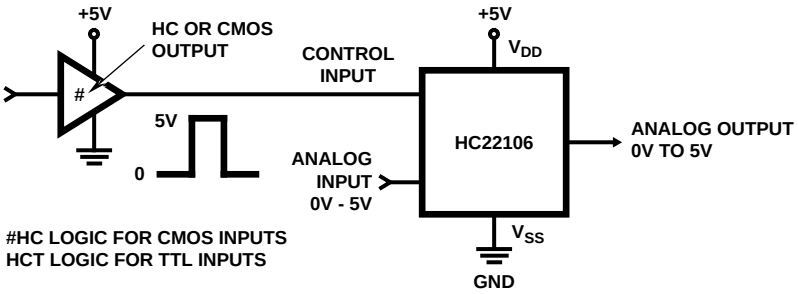


FIGURE 4. TYPICAL SINGLE SUPPLY CONNECTION FOR HC22106

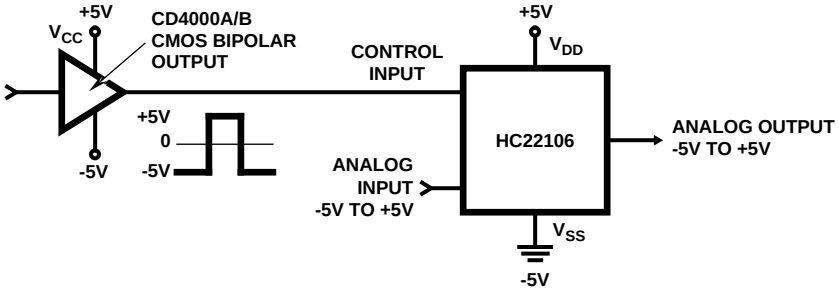


FIGURE 5. TYPICAL DUAL SUPPLY CONNECTION FOR HC22106

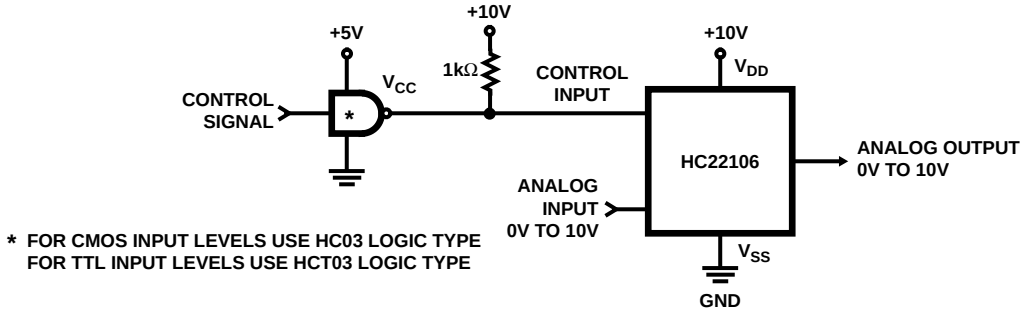


FIGURE 6. USE OF HC/HCT03 WHEN CONTROL IS 0V - 5V AND ANALOG SIGNAL IS 0V - 10V

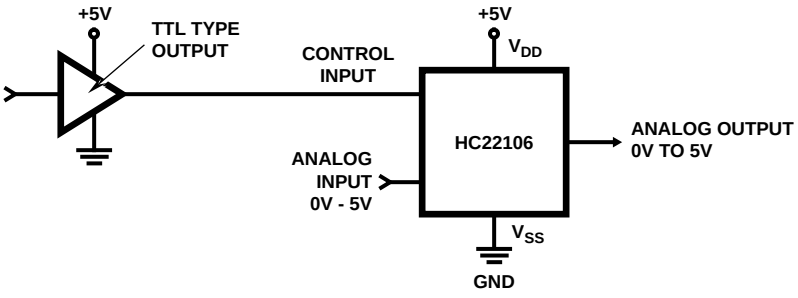


FIGURE 7. TYPICAL SINGLE SUPPLY CONNECTION FOR HCT22106 WITH TTL INPUT

Typical Performance Curves

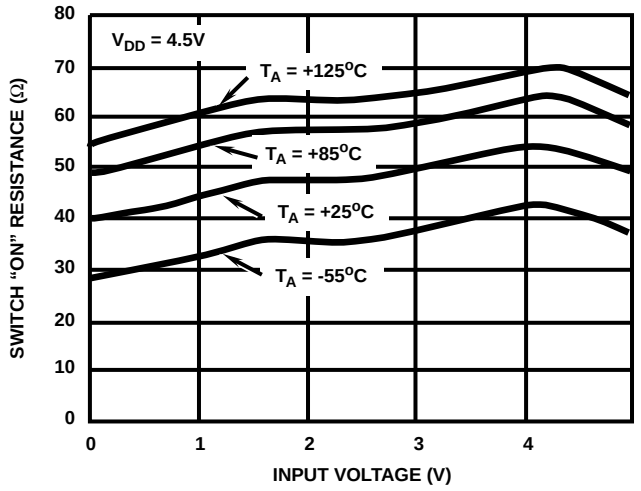


FIGURE 8. TYPICAL "ON" RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE vs TEMPERATURE

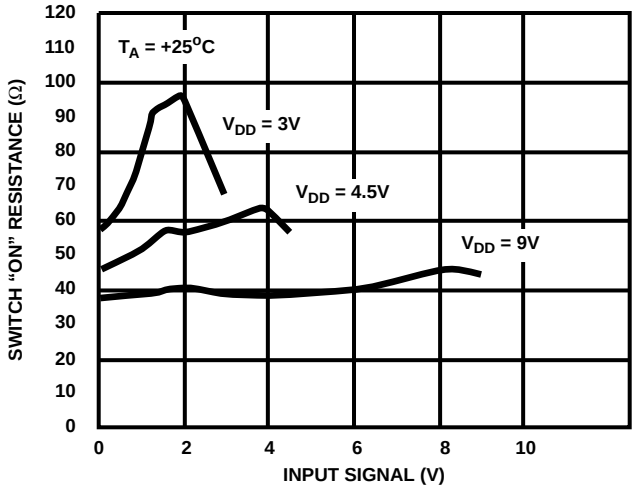


FIGURE 9. TYPICAL "ON" RESISTANCE AS A FUNCTION OF INPUT SIGNAL VOLTAGE vs V_{DD}

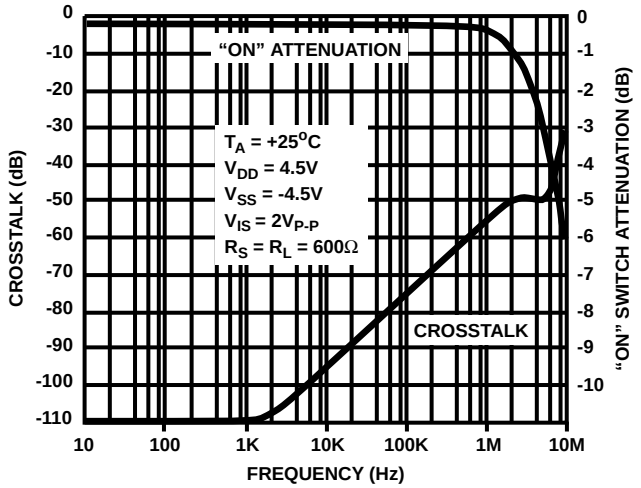


FIGURE 10. TYPICAL "ON" SWITCH ATTENUATION AND CROSSTALK AS A FUNCTION OF FREQUENCY

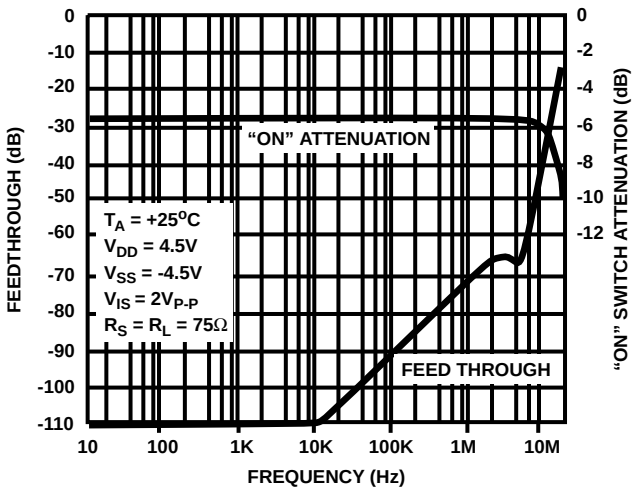


FIGURE 11. TYPICAL "ON" SWITCH ATTENUATION AND "OFF" SWITCH FEED THROUGH AS A FUNCTION OF FREQUENCY