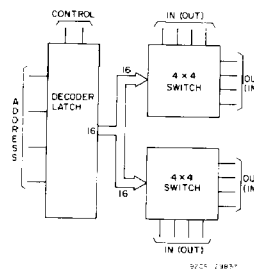


CD22101, CD22102

COS/MOS 4 x 4 x 2 Crosspoint Switches With Control Memory

Features:

- Low ON resistance - 75 Ω typ. at $V_{DD} = 12$ V
- "Built-in" latched inputs
- Large analog signal capability - $\pm V_{DD}/2$
- 10-MHz switch bandwidth
- Matched switch characteristics
 $\Delta R_{ON} = 8 \Omega$ typ. at $V_{DD} = 12$ V
- High linearity - 0.25% distortion (typ.) at $f = 1$ kHz,
 $V_{IN} = 5$ Vp-p, $V_{DD} - V_{SS} = 10$ V, and $R_L = 1$ k Ω
- Standard COS/MOS noise immunity



CD22101, CD22102
Functional Diagram

The RCA-CD22101 and CD22102 crosspoint switches consist of 4 x 4 x 2 arrays of crosspoints (transmission gates), 4-line to 16-line decoders, and 16 latch circuits. Any one of the sixteen crosspoint pairs can be selected by applying the appropriate four-line address, and any number of crosspoints can be ON simultaneously. Corresponding crosspoints in each array are turned on and off simultaneously, also.

In the CD22101, the selected crosspoint pair can be turned on or off by applying a logical ONE or ZERO, respectively, to the data input, and applying a ONE to the strobe input. When the device is "powered up", the states of the 16 switches are indeterminate. Therefore, all switches must be turned off by putting the strobe high, data-in low, and then addressing all switches in succession.

Applications:

- Telephone system
- Studio audio switching
- Multisystem bus interconnect
- PBX

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

(Voltages referenced to V_{SS} Terminal) -0.5 to +20 V

INPUT VOLTAGE RANGE, ALL INPUTS -0.5 to $V_{DD} + 0.5$ V

DC INPUT CURRENT, ANY ONE INPUT * ± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -40$ to $+60^\circ\text{C}$ (PACKAGE TYPE E) 500 mW

For $T_A = +60$ to $+85^\circ\text{C}$ (PACKAGE TYPE E) Derate Linearly at 12 mW/ $^\circ\text{C}$ to 200 mW

For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPES D, F) 500 mW

For $T_A = +100$ to $+125^\circ\text{C}$ (PACKAGE TYPES D, F) Derate Linearly at 12 mW/ $^\circ\text{C}$ to 200 mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100 mW

OPERATING-TEMPERATURE RANGE (T_A):

PACKAGE TYPES D, F, H -55 to $+125^\circ\text{C}$

PACKAGE TYPE E -40 to $+85^\circ\text{C}$

STORAGE TEMPERATURE RANGE (T_{STG}) -65 to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch (1.59 ± 0.79 mm) from case for 10 s max. $+265^\circ\text{C}$

* Maximum current through transmission gates (switches) = 25 mA.

CD22101, CD22102

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	LIMITS		UNITS
	Min.	Max.	
Supply-Voltage Range (For T_A = Full Package-Temperature Range)	3	18	V

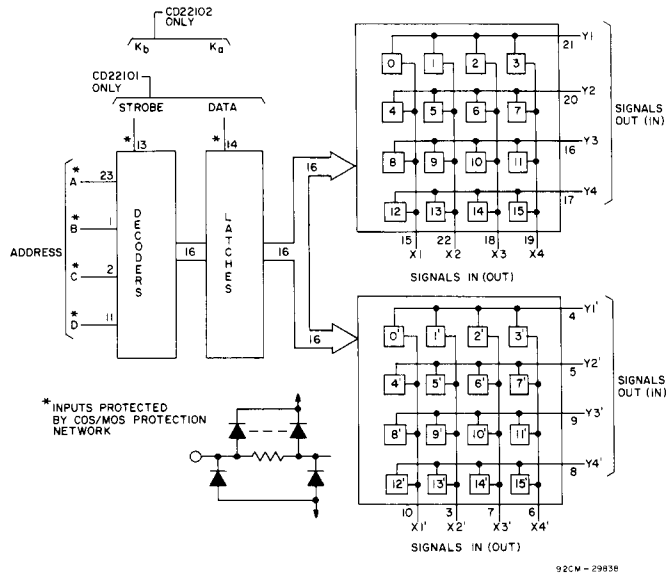


Fig. 1 — Functional block diagram.

DECODER TRUTH TABLE

Address	Select	Address	Select
A B C D		A B C D	
0 0 0 0	$X1Y1 \& X1'Y1'$	0 0 0 1	$X1Y3 \& X1'Y3'$
1 0 0 0	$X2Y1 \& X2'Y1'$	1 0 0 1	$X2Y3 \& X2'Y3'$
0 1 0 0	$X3Y1 \& X3'Y1'$	0 1 0 1	$X3Y3 \& X3'Y3'$
1 1 0 0	$X4Y1 \& X4'Y1'$	1 1 0 1	$X4Y3 \& X4'Y3'$
0 0 1 0	$X1Y2 \& X1'Y2'$	0 0 1 1	$X1Y4 \& X1'Y4'$
1 0 1 0	$X2Y2 \& X2'Y2'$	1 0 1 1	$X2Y4 \& X2'Y4'$
0 1 1 0	$X3Y2 \& X3'Y2'$	0 1 1 1	$X3Y4 \& X3'Y4'$
1 1 1 0	$X4Y2 \& X4'Y2'$	1 1 1 1	$X4Y4 \& X4'Y4'$

CONTROL TRUTH TABLE FOR CD22101

Function	Address	Strobe	Data	Select
	A B C D			
Switch On	1 1 1 1	1	1	15 ($X4Y4$) & 15' ($X4'Y4'$)
Switch Off	1 1 1 1	1	0	15 ($X4Y4$) & 15' ($X4'Y4'$)
No Change	X X X X	0	X	X X X X

1 = High Level; 0 = Low Level; X = Don't Care

CD22101, CD22102

CONTROL TRUTH TABLE FOR CD22102

Function	Address				K_a	K_b	Select
Switch On	A	B	C	D	1	0	15 (X4Y4) & 15' (X4'Y4')
Switch Off	1	1	1	1	0	1	15 (X4Y4) & 15' (X4'Y4')
All Switches Off#	X	X	X	X	1	1	All
No Change	X	X	X	X	0	0	X X X X

1 = High Level; 0 = Low Level; X = Don't Care

In the event that K_a and K_b are changed from levels 1,1 to 0,0 K_b should not be allowed to go to 0 before K_a , otherwise a switch which was off will inadvertently be turned on.

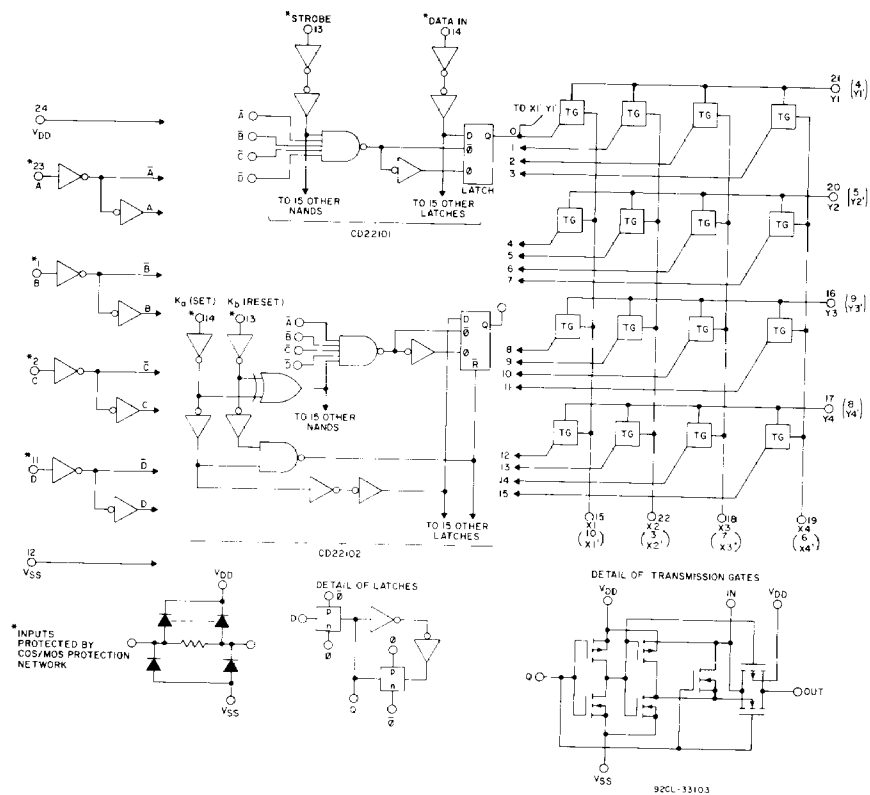


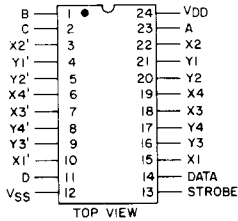
Fig. 2 — Logic diagram.

CD22101, CD22102

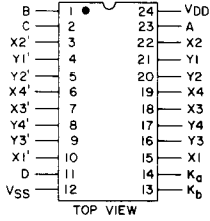
STATIC ELECTRICAL CHARACTERISTICS

CHARAC- TERISTIC	CONDITIONS	LIMITS at Indicated Temperature (°C)									Units
		Values at -55,+25,+125,apply to D,F,H pkg									
		Values at -40,+25,+85,apply to E pkg									
		V _{IS} (V)	V _{DD} (V)	-55	-40	+85	+125	+25			
							Min.	Typ.	Max.		
CROSSPOINTS											
Quiescent Device Cur- rent, I _{DD} Max.		-	5	5	5	150	150	-	0.04	5	μA
		-	10	10	10	300	300	-	0.04	10	
		-	15	20	20	600	600	-	0.04	20	
		-	20	100	100	3000	3000	-	0.08	100	
ON Resist- ance R _{ON} Max.	Any Switch V _{IS} = 0 to V _{DD}	-	5	475	500	725	800	-	225	600	Ω
		-	10	135	145	205	230	-	85	180	
		-	12	100	110	155	175	-	75	135	
		-	15	70	75	110	125	-	65	95	
ΔON Resist- ance, ΔR _{ON}	Between any two switches	-	5	-	-	-	-	-	25	-	Ω
		-	10	-	-	-	-	-	10	-	
		-	12	-	-	-	-	-	8	-	
		-	15	-	-	-	-	-	5	-	
OFF Leak- age Current I _L Max.	All switches OFF	0,18	18	±1000				-	±1	±100*	nA
CONTROLS											
Input Low Voltage V _{IL} Max.	OFF switch I _L < 0.2 μA;	-	5	1.5				-	-	1.5	V
		-	10	3				-	-	3	
		-	15	4				-	-	4	
Input High Voltage, V _{IH} Min.	ON switch see R _{ON} characteristic	-	5	3.5				3.5	-	-	
		-	10	7				7	-	-	
		-	15	11				11	-	-	
Input Current, I _{IN} Max.	Any control	0,18	18	±0.1	±0.1	±1	±1	-	±10 ⁻⁵	±0.1	μA

* Determined by minimum feasible leakage measurement for automatic testing.



92CS-29839
CD22101 Terminal Diagram



92CS-29840
CD22102 Terminal Diagram

CD22101, CD22102

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$

CHARACTERISTIC	CONDITIONS				LIMITS			UNITS
	f_{is} kHz	R_L k Ω	V_{is}^* (V)	V_{DD} (V)	Min.	Typ.	Max.	
CROSSPOINTS								
Propagation Delay Time, (Switch ON) Signal Input to Output, t_{PHL} , t_{PLH}	—	10	5	5	—	30	60	ns
			10	10	—	15	30	
			15	15	—	10	20	
$C_L = 50\text{ pF}; t_r, t_f = 20\text{ ns}$								
Frequency Response, (Any Switch ON)	1	1	5	10	—	40	—	MHz
	Sine wave input, $20 \log \frac{V_{os}}{V_{is}} = -3\text{ dB}$							
Sine Wave Response, (Distortion)	1	1	2.5	5	—	1	—	%
	1	1	5	10	—	0.25	—	
	1	1	7.5	15	—	0.15	—	
Feedthrough All Switches OFF (See Fig. 24)	1.6	0.6	2 $\square$	10	—	-96	—	dB
	Sine wave input							
Frequency for Signal Crosstalk Attenuation of 40 dB	—	0.6	1 $\square$	10	—	2.5	—	MHz
	Sine wave input							
Capacitance, X_n to Ground Y_n to Ground Feedthrough		—	—	—	—	25	—	pF
		—	—	—	—	60	—	
		—	—	—	—	—	0.6	
CONTROLS			See Fig.					
Propagation Delay Time, High Impedance to High Level or Low Level, t_{pZH} , t_{pZL} Strobe to Output, CD22101	$R_L = 1\text{ k}\Omega$, $C_L = 50\text{ pF}$, $t_r, t_f = 20\text{ ns}$			5	—	500	1000	ns
				10	—	230	460	
			16	15	—	170	340	
Data-In to Output, CD22101				5	—	515	1000	
				10	—	220	440	
			17	15	—	170	340	
K_a to Output, CD22102				5	—	500	1000	
				10	—	215	430	
				15	—	160	320	
Address to Output, CD22101, CD22102				5	—	480	960	
			18	10	—	225	450	
				15	—	155	300	
Propagation Delay Time, High Level or Low Level to High Impedance, t_{pHZ} , t_{pLZ} Strobe to Output, CD22101				5	—	450	900	
				10	—	200	400	
			16	15	—	135	270	
K_b to Output, CD22102				5	—	450	900	
				10	—	200	400	
				15	—	130	260	
Data-In to Output, CD22101				5	—	450	900	
				10	—	165	330	
				15	—	110	220	
$K_a \cdot K_b$ to Output, CD22102				5	—	280	560	
				10	—	130	260	
				15	—	90	180	

* Peak-to-peak voltage symmetrical about V_{DD} unless otherwise specified.

■ RMS

CD22101, CD22102

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$ (cont'd)

CHARACTERISTIC	CONDITIONS				LIMITS			UNITS
	f _{is} kHz	R _L kΩ	V _{is} • (V)	V _{DD} (V)	Min.	Typ.	Max.	
CONTROLS (cont'd)			See Fig.					
Address to Output, CD22101, CD22102	R _L = 1 k, C _L = 50 pF, t _r , t _f = 20 ns		18	5	—	425	850	ns
10				—	190	380		
15				—	130	260		
Minimum Strobe Pulse Width t _W CD22101				5	—	260	500	
10				—	120	240		
15				—	80	160		
Address to Strobe Setup or Hold Times, t _{SU} , t _H , CD22101			19	5	—	−160	0	
10				—	−70	0		
15	—	−50		0				
Strobe to Data-In Hold Time, Time, t _{HHL} ; t _{HLH} , CD22101	20	5	—	200	400			
10		—	80	160				
15		—	60	120				
Address to K _a and K _b Setup or Hold Times, t _{SU} , t _H , CD22102		5	—	−160	0			
10		—	−70	0				
15		—	−50	0				
Minimum K _a •K _b Pulse Width, t _W CD22102		5	—	375	750			
10		—	160	320				
15		—	110	220				
Minimum K _a Pulse Width, t _W CD22102		5	—	425	850			
10		—	175	350				
15		—	120	240				
Minimum K _b Pulse Width, t _W CD22102		5	—	200	400			
10		—	90	180				
15		—	70	140				
Control Crosstalk, Data-In, Address, or Strobe to Output,	100	10	21	5	—	75	—	mv (peak)
	Square wave input = 5 V, t _r , t _f = 20 ns, R _s = 1 kΩ							
Input Capacitance, C _{IN}	Any Control Input			—	—	5	7.5	pF

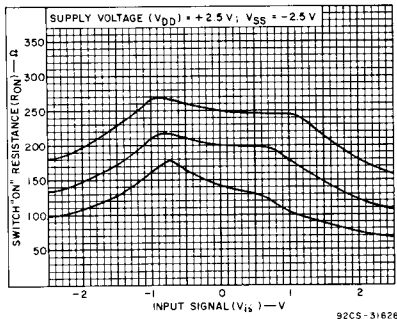


Fig. 3 — Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 2.5\text{ V}$.

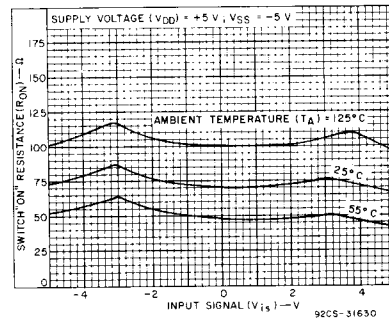


Fig. 4 — Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 5\text{ V}$.

CD22101, CD22102

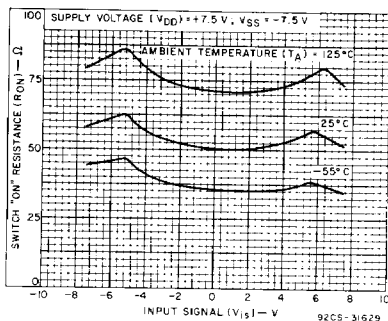


Fig. 5 - Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 7.5\text{ V}$.

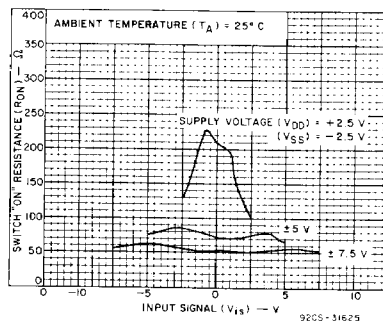


Fig. 6 - Typical ON resistance as a function of input signal voltage at $T_A = 25^\circ\text{C}$.

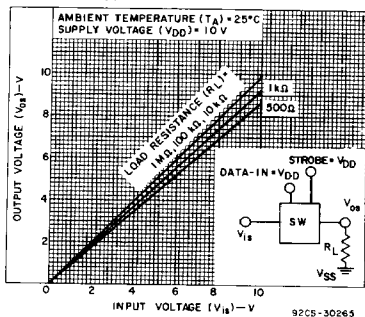


Fig. 7 - Typical switch ON transfer characteristics (1 of 16 switches).

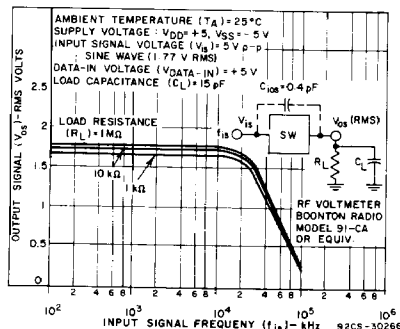


Fig. 8 - Typical switch ON frequency response characteristics.

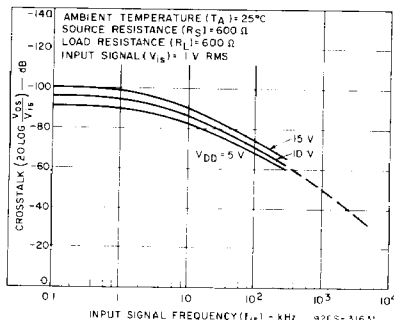


Fig. 9 - Typical crosstalk between switches as a function of signal frequency.

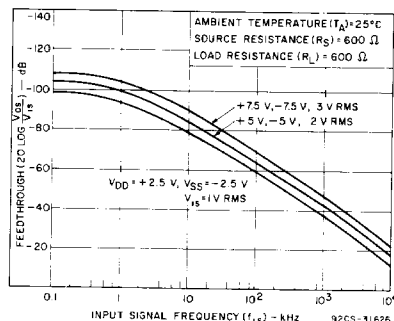


Fig. 10 - Typical feedthrough, any OFF switch as a function of frequency.

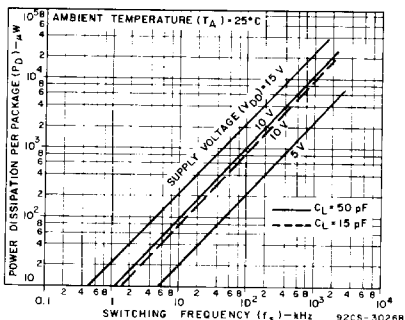


Fig. 11 - Typical dynamic power dissipation as a function of switching frequency for CD22101.

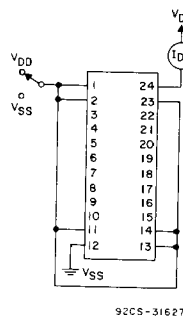


Fig. 12 - Quiescent current test circuit.

CD22101, CD22102

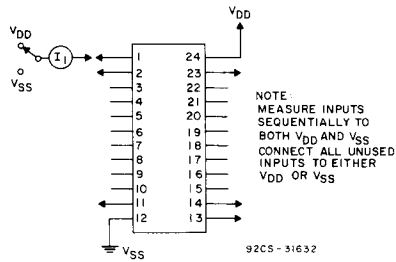


Fig. 13 - Input current test circuit.

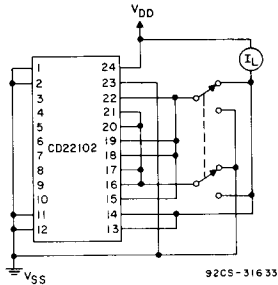


Fig. 15 - OFF switch input or output leakage current test circuit (16 of 32 switches).

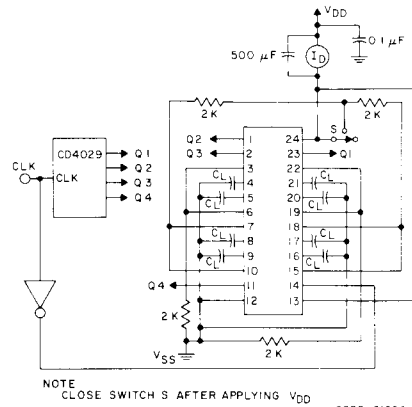


Fig. 14 - Dynamic power dissipation test circuit for CD22101.

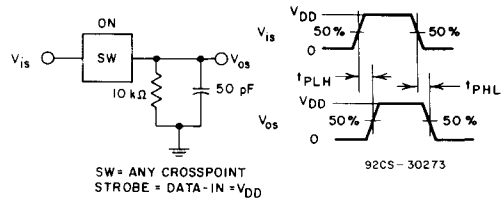


Fig. 16 - Propagation delay time test circuit and waveforms (signal input to signal output, switch ON).

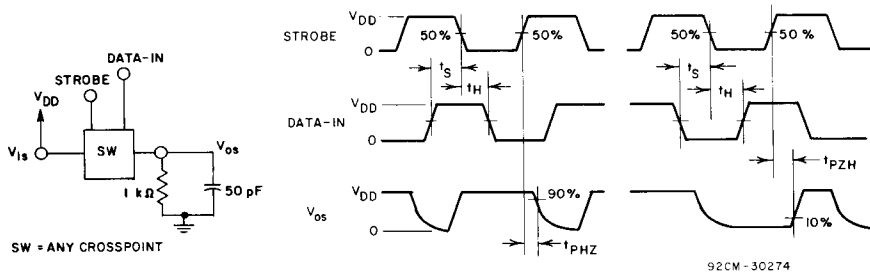


Fig. 17 - Propagation delay time test circuit and waveforms (strobe to signal output, switch Turn-ON or Turn-OFF).

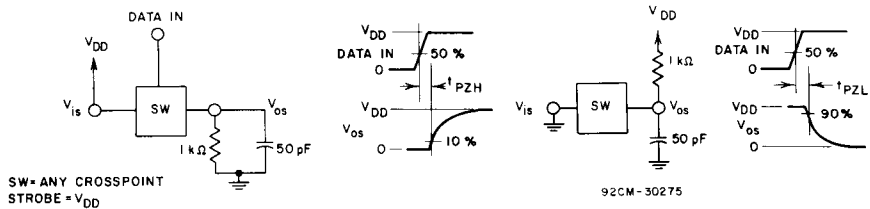


Fig. 18 - Propagation delay time test circuit and waveforms (data-in to signal output, switch Turn-ON to high or low level).

CD22101, CD22102

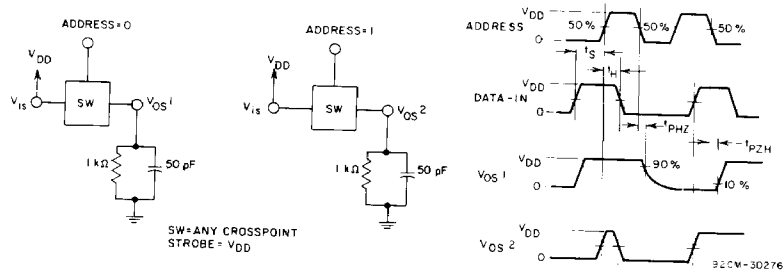


Fig. 19 — Propagation delay time test circuit and waveforms (address to signal output, switch turn-ON or Turn-OFF).

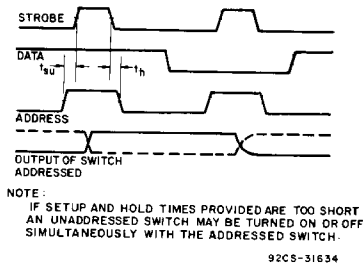


Fig. 20 — Address to strobe setup and hold times.

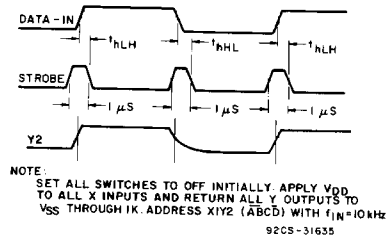


Fig. 21 — Strobe to Data-In hold time t_H for CD22101.

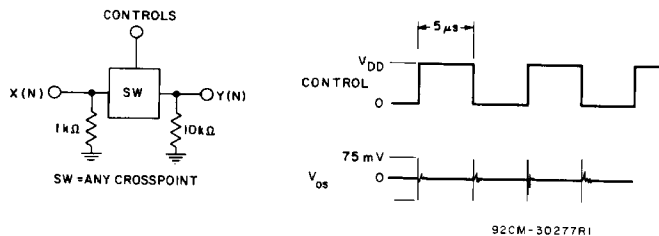


Fig. 22 — Test circuit and waveforms for crosstalk (control input to signal output).

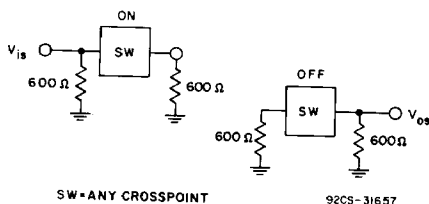


Fig. 23 — Test circuit for crosstalk between switch circuits in the same package.

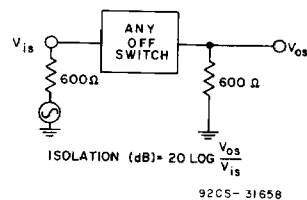
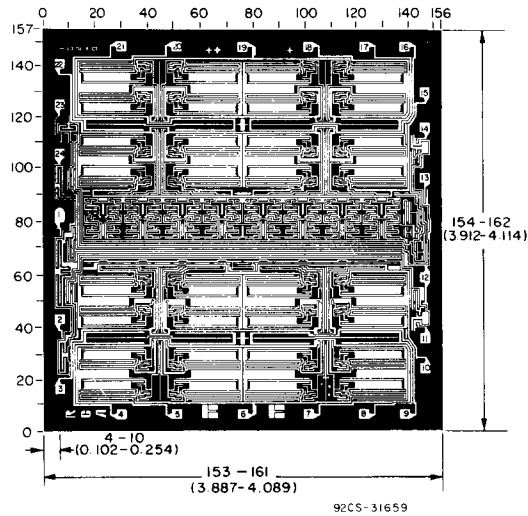
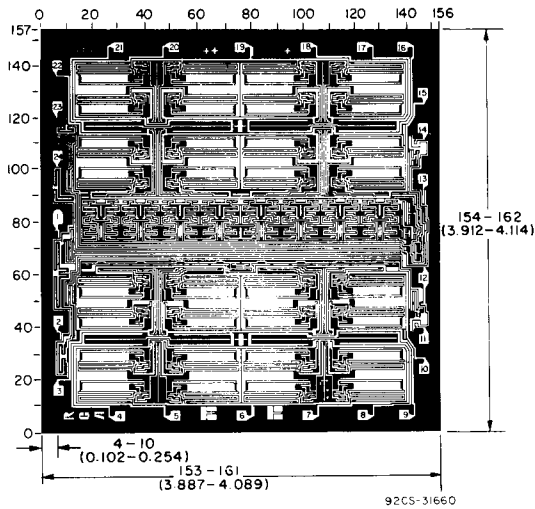


Fig. 24 — Test circuit for feedthrough (any OFF switch).

CD22101, CD22102



Dimensions and pad layout for CD22101H.



Dimensions and pad layout for CD22102H.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

The photographs and dimensions of each COS/MOS chip represent a chip when it is part of the wafer. When the wafer is cut into chips, the cleavage angles are 57° instead of 90° with respect to the face of the chip. Therefore, the isolated chip is actually 7 mils (0.17 mm) larger in both dimensions.