



CD22100

CMOS 4 x 4 Crosspoint Switch with Control Memory High-Voltage Types (20V Rating)

August 1991

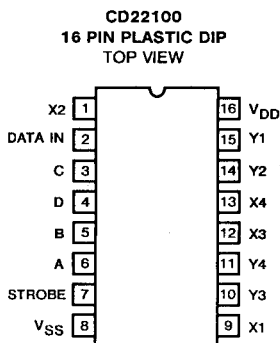
Features

- Low ON Resistance 75Ω Typ. at $V_{DD} = 12V$
- "Built-In" Control Latches
- Large Analog Signal Capability $\pm V_{DD}/2$
- 10MHz Switch Bandwidth
- Matched Switch Characteristics $\Delta R_{ON} = 18\Omega$ Typ. at $V_{DD} = 12V$
- High Linearity - 0.5% Distortion (Typ.) at $f = 1kHz$, $V_{IN} = 5V_{p-p}$, $V_{DD} = 10V$, and $R_L = 1k\Omega$
- Standard CMOS Noise Immunity
- 100% Tested for Maximum Quiescent Current at 20V

Description

CD22100 combines a 4 x 4 array of crosspoints (transmission gates) with a 4-line-to-16-line decoder and 16 latch circuits. Any one of the sixteen transmission gate (crosspoints) can be selected by applying the appropriate four line address. The selected transmission gate can be turned on or off by applying a logical one or zero, respectively, to the data input and strobing the strobe input to a logical one. Any number of the transmission gates can be ON simultaneously. When the required operating power is applied to the CD22100, the states of the 16 switches are indeterminate. Therefore, all switches must be turned off by putting the strobe high and data-in low, and then addressing all switches in succession.

Pinout



Functional Diagram

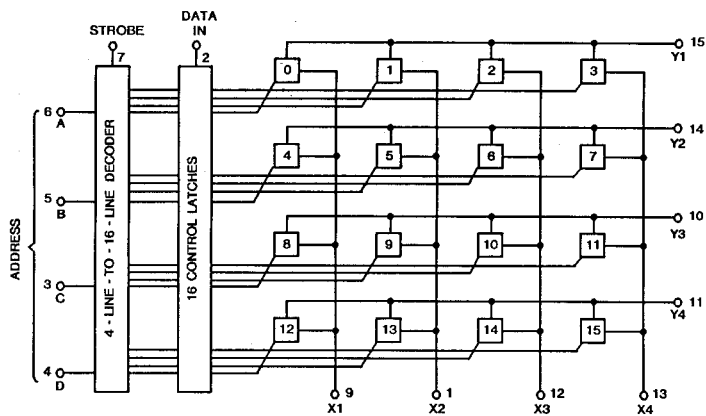


FIGURE 1.

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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 $+80^\circ\text{C}$ (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 TRANSMISSION GATE FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	100 mW
OPERATING-TEMPERATURE RANGE (T_A):	
PACKAGE TYPES D, F	-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) = 25mA

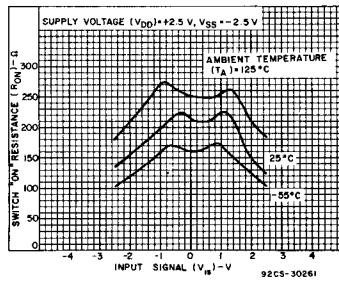


Fig. 2— Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 2.5$ V.

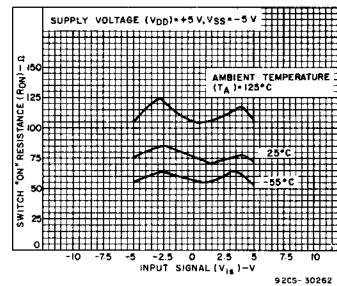


Fig. 3— Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 5$ V.

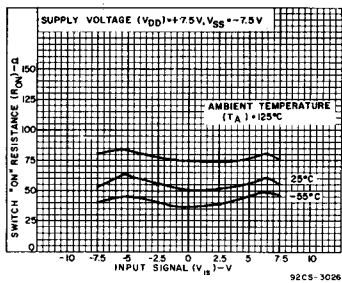


Fig. 4— Typical ON resistance as a function of input signal voltage at $V_{DD} = -V_{SS} = 7.5$ V.

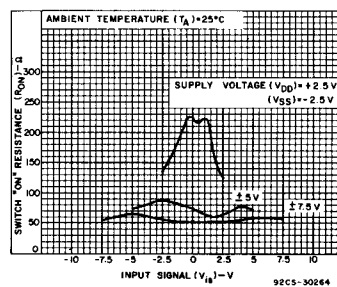


Fig. 5— Typical ON resistance as a function of input signal voltage at $T_A = 25^\circ\text{C}$.

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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

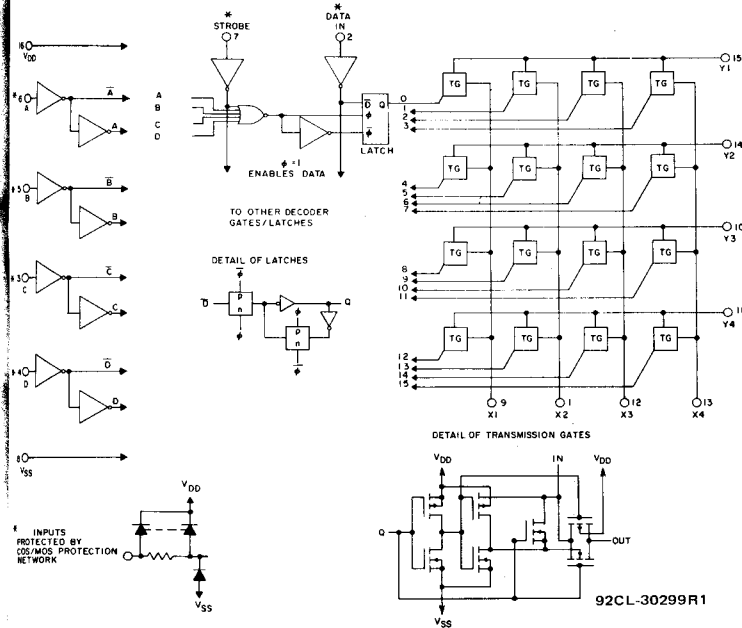


Fig. 6— Schematic diagram.

TRUTH TABLE									
Address				Select	Address				Select
A	B	C	D		A	B	C	D	
0	0	0	0	X1Y1	0	0	0	1	X1Y3
1	0	0	0	X2Y1	1	0	0	1	X2Y3
0	1	0	0	X3Y1	0	1	0	1	X3Y3
1	1	0	0	X4Y1	1	1	0	1	X4Y3
0	0	1	0	X1Y2	0	0	1	1	X1Y4
1	0	1	0	X2Y2	1	0	1	1	X2Y4
0	1	1	0	X3Y2	0	1	1	1	X3Y4
1	1	1	0	X4Y2	1	1	1	1	X4Y4

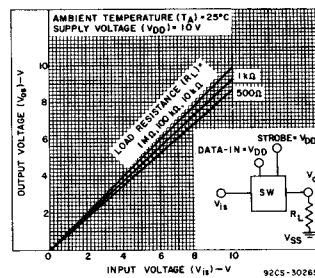


Fig. 7— Typical switch ON transfer characteristics (1 of 16 switches).

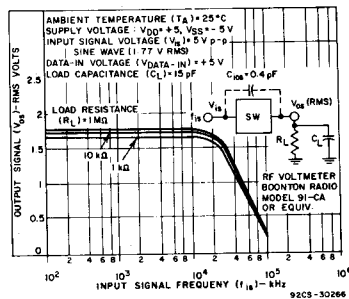


Fig. 8— Typical switch ON frequency response characteristics.

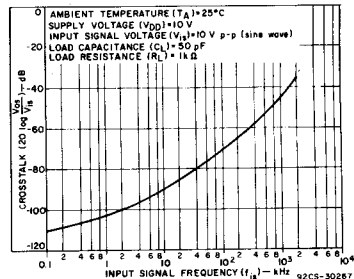


Fig. 9— Typical crosstalk between switches as a function of signal frequency.

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STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS	LIMITS at Indicated Temperature (°C)								Units	
		V _{IN} (V)	V _{DD} (V)	Values at -55,+25,+125, apply to D,F,H pkg				+25			
				-55	-40	+85	+125	Min.	Typ.		Max.
CROSSPOINTS											
Quiescent Device Current, 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 Resistance 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 Resistance, ΔR _{ON}	Between any two switches	-	5	-	-	-	-	-	25	-	Ω
		-	10	-	-	-	-	-	10	-	
		-	12	-	-	-	-	-	8	-	
		-	15	-	-	-	-	-	5	-	
OFF Switch Leakage Current I _L Max.	All switches OFF	0,18	18	±100		±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		-		-	V
		-	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.

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A = 25°C

CHARACTERISTIC	CONDITIONS				LIMITS			UNITS
	f _{is} kHz	R _L kΩ	V _{is} * (V)	V _{DD} (V)	Min.	Typ.	Max.	
CROSSPOINTS								
Propagation Delay Time, (Switch ON) Signal Input to Output, t _{PHL} , t _{PLH}	-	10	10	10	-	30	60	ns
	C _L = 50 pF; t _r , t _f = 20 ns				-	15	30	
Frequency Response, (Any Switch ON)	1	1	5	10	-	40	-	MHz
	Sine wave input, 20 log $\frac{V_{os}}{V_{is}} = -3$ dB				-	-	-	
Sine Wave Response, (Distortion)	1	1	5	10	-	0.5	-	%
Feedthrough (All Switches OFF)	1.6	1	5	10	-	-80	-	dB
	Sine wave input				-	-	-	

*Peak-to-peak voltage symmetrical about $\frac{V_{DD}}{2}$.

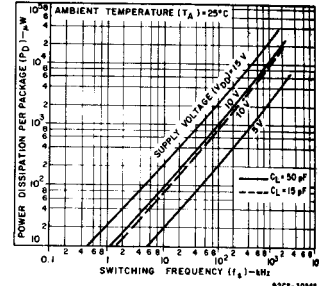


Fig. 10 - Typical dynamic power dissipation as a function of switching frequency.

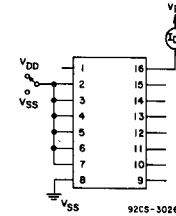


Fig. 11 - Quiescent current test circuit.

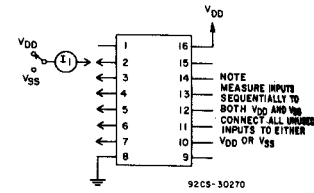


Fig. 12 - Input current test circuit.

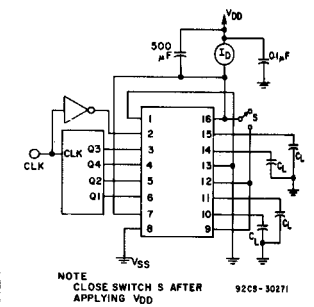


Fig. 13 - Dynamic power dissipation test circuit.

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DYNAMIC ELECTRICAL CHARACTERISTICS at T_A = 25°C

CHARACTERISTIC	CONDITIONS				LIMITS			UNITS	
	f _{is} kHz	R _L kΩ	V _{is} [•] (V)	V _{DD} (V)	Min.	Typ.	Max.		
CROSSPOINTS (CONT'D)									
Frequency for Signal Crosstalk Attenuation of 40 dB	—	1	10	10	—	1.5	—	MHz	
Attenuation of 110 dB	Sine wave input				—	0.1	—	kHz	
Capacitance, X _n to Ground Y _n to Ground Feedthrough	—	—	—	5-15	—	18	—	pF	
	—	—	—	5-15	—	30	—	pF	
	—	—	—	—	—	0.4	—	pF	
CONTROLS									
Propagation Delay Time: Strobe to Output, t _{pZH} (Switch Turn-ON to High Level)	R _L =1kΩ, C _L =50pF, t _r , t _f = 20 ns			See Fig. 18	5	—	300	600	ns
				10	—	125	250		
				15	—	80	160		
Data-In to Output, t _{pZH} (Turn-On to High Level)				19	5	—	110	220	ns
				10	—	40	80		
				15	—	25	50		
Address to Output, t _{pZH} (Turn-ON to High Level)				20	5	—	350	700	ns
				10	—	135	270		
				15	—	90	180		
Propagation Delay Time: Strobe to Output, t _{pHZ} (Switch Turn-OFF)				18	5	—	165	330	ns
				10	—	85	170		
				15	—	70	140		
Data-In to Output, t _{pZL} (Turn-ON to Low Level)				19	5	—	210	420	ns
				10	—	110	220		
				15	—	100	200		
Address to Output, t _{pHZ} (Turn-OFF)				20	5	—	435	870	ns
				10	—	210	420		
				15	—	160	320		
Minimum Setup Time, Data-In to Strobe, Address, t _{SU}				5	—	—	95	190	ns
				10	—	25	50		
				15	—	15	30		
Minimum Hold Time, Data-In to Strobe, Address, t _H				5	—	—	180	360	ns
				10	—	110	220		
				15	—	35	70		
Maximum Switching Frequency, f _φ	R _L =1kΩ, C _L =50pF t _r , t _f = 20 ns			5	0.6	1.2	—	MHz	
				10	1.6	3.2	—		
				15	2.5	5	—		
Minimum Strobe Pulse Width, t _W				5	—	—	300	600	ns
				10	—	120	240		
				15	—	90	180		
Control Crosstalk, Data-In, Address, or Strobe to Output	—	10	10	10	—	75	—	mV (peak)	
	Square wave input t _r , t _f = 20 ns				—	—	—	—	
Input Capacitance, C _{IN}	Any Control Input				—	—	5	7.5	pF

[•]Peak-to-peak voltage symmetrical about $\frac{V_{DD}}{2}$

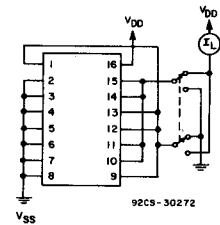


Fig. 14 — OFF switch input or output leakage current test circuit.

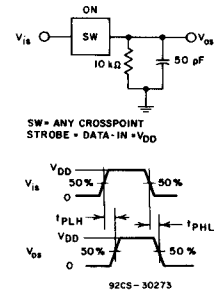


Fig. 15 — Propagation delay time test circuit and waveforms (signal input to signal output, switch ON).

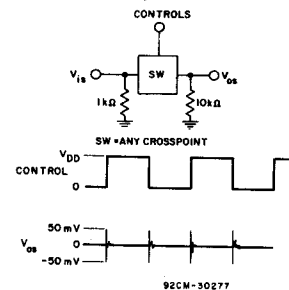


Fig. 16 — Test circuit and waveforms for crosstalk (control input to signal output).

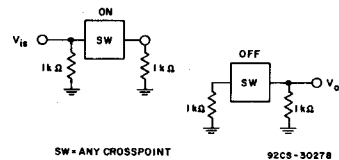


Fig. 17 — Test circuit for crosstalk between switch circuits in the same package.

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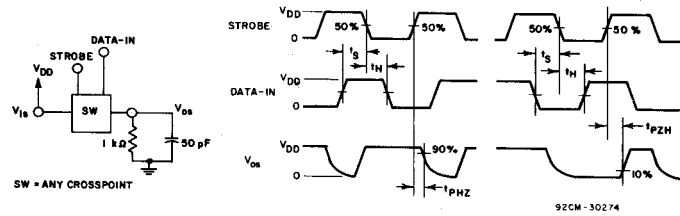


Fig. 18 — Propagation delay time test circuit and waveforms (strobe to signal output, switch Turn-ON or Turn-OFF).

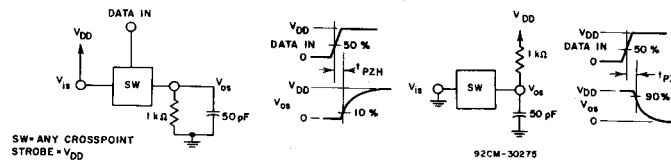


Fig. 19 — Propagation delay time test circuit and waveforms (data-in to signal output, switch Turn-ON to high or low level).

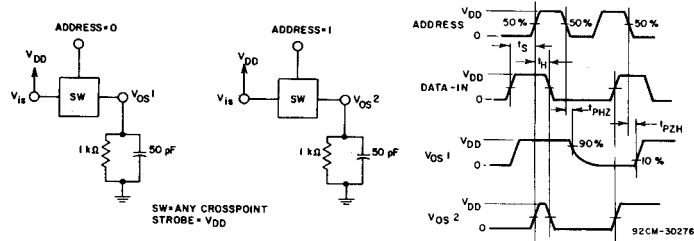
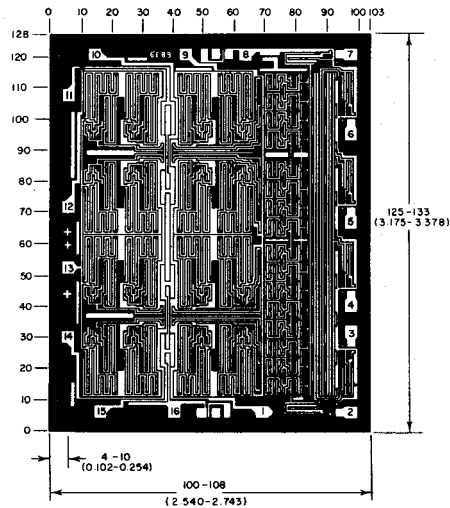


Fig. 20 — Propagation delay time test circuit and waveforms (address to signal output, switch Turn-On or Turn-Off).



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