TTL/MSI 93141/74141
1-OF-10 DECODER/DRIVER (NIXIE)

DESCRIPTION — The 93141/74141 is a BCD-to-Decimal Decoder Driver that is designed to take a 4-bit BCD code input and drive cold-cathode indicator tubes. This decoder utilizes design improvements that minimize switching transients in order to maintain a stable display.

The segments and numeric designations chosen to represent the decimal numbers are shown below. For binary inputs 10 through 15, the outputs are off. These invalid codes can be used in blanking leading or trailing-edge zeros in a display.

The ten high performance, NPN output transistors have a maximum reverse current of 50μA at 55V. Typical power dissipation is 55 mW.

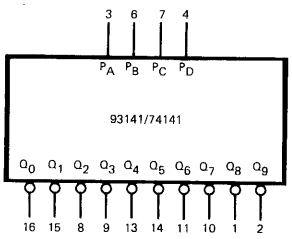
PIN NAMES

		LOADING
P_A	Address Input	1 U.L.
P_B, P_C, P_D	Address Input	2 U.L.
$\overline{Q}_0$ to $\overline{Q}_9$	Outputs	*

*See output characteristics.
Max. Current Into Output During "ON" state 7 mA
Output Leakage at 55 V 50 μA

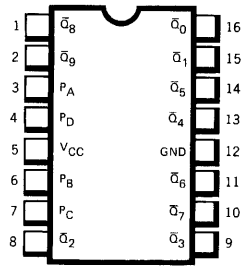
1 U.L. = 40 μA HIGH/1.6 mA LOW.

LOGIC SYMBOL



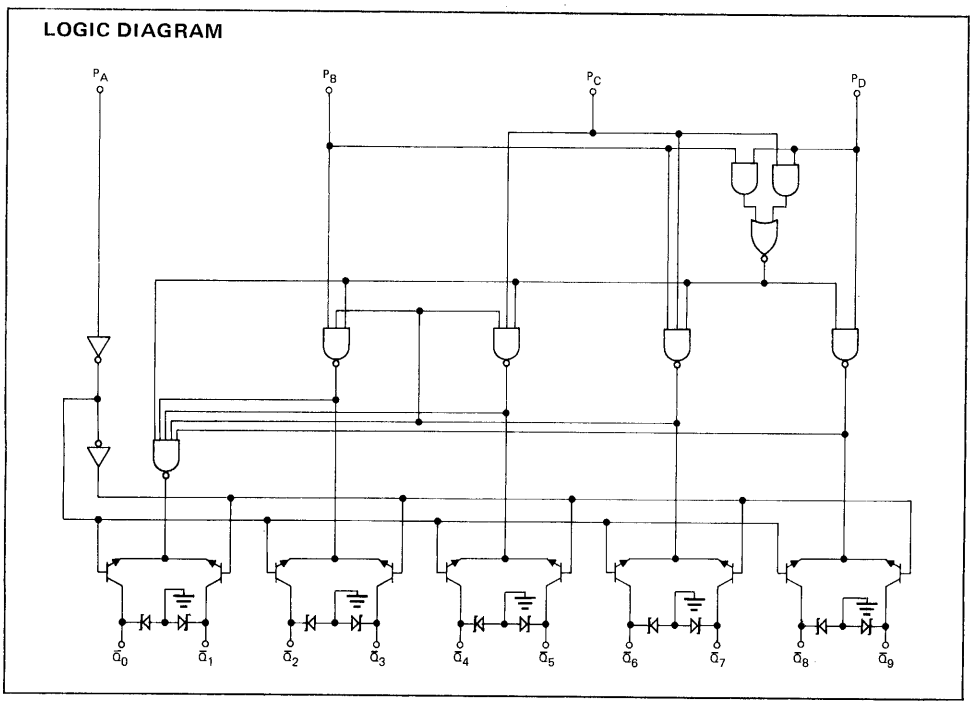
V_{CC} = PIN 5
GND = PIN 12

CONNECTION DIAGRAM
DIP (TOP VIEW)



Positive Logic: See Truth Table

LOGIC DIAGRAM



TRUTH TABLE

INPUT				OUTPUT
P_D	P_C	P_B	P_A	ON†
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	L	L	L	8
H	L	L	H	9
H	L	H	L	NONE
H	L	H	H	NONE
H	H	L	L	NONE
H	H	L	H	NONE
H	H	H	L	NONE
H	H	H	H	NONE

H = HIGH level,
L = LOW level.
†All other outputs are off

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ABSOLUTE MAXIMUM RATINGS (above which the useful life may be impaired)

Storage Temperature	-65°C to +150°C
Temperature (Ambient) Under Bias	0°C to 70°C
V_{CC} Pin Potential to Ground Pin	-0.5 V to +7.0 V
*Input Voltage (dc)	-0.5 V to +5.5 V
*Input Current (dc)	-30 mA to +5.0 mA
Voltage Applied to Outputs (Output HIGH)	-0.5 V to +V_{CC} value
Output Current (dc) (Output LOW)	+30 mA

*Either Input Voltage limit or Input Current limit is sufficient to protect the inputs.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	93141XC/74141XC			UNITS
	MIN.	TYP.	MAX.	
Supply Voltage V_{CC} (See Note 3)	4.75	5.0	5.75	Volts
Operating Free Air Temperature Range	0	25	70	°C
Output Voltage (See Notes 3 & 4)			65	V

X = package type; F for Flatpak, D for Ceramic Dip, P for Plastic Dip. See Packaging Information Section for packages available on this product.

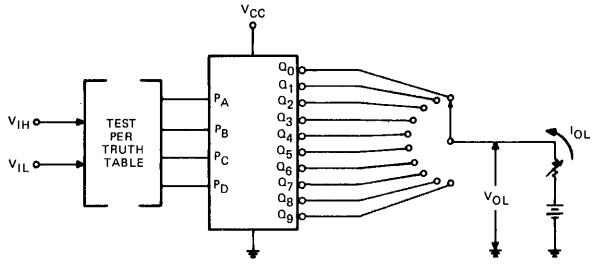
ELECTRICAL CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (Unless Otherwise Noted)

SYMBOL	PARAMETER	LIMITS			UNITS	TEST CONDITIONS	TEST FIGURE
		MIN.	TYP. (Note 2)	MAX.			
V_{IH}	Input HIGH Voltage	2.0			Volts	Guaranteed Input HIGH Voltage	1 & 2
V_{IL}	Input LOW Voltage			0.8	Volts	Guaranteed Input LOW Voltage	1 & 2
V_{OL}	Output LOW Voltage			2.5	Volts	V_{CC} = MIN., I_{OL} = 7.0 mA	1
V_{OH}	Output HIGH Voltage for input counts 0 thru 9	60			Volts	V_{CC} = MAX., I_{OH} = 0.5 mA	2
I_{OH}	Output HIGH Current			50	µA	V_{CC} = MAX., V_{OUT} = 55 V	2
	Output HIGH Current for input counts 10 thru 15			5.0	µA	V_{CC} = MAX., V_{OUT} = 30 V	2
I_{IH}	Input HIGH Current at P_A			40	µA	V_{CC} = MAX., V_{IN} = 2.4 V	3
				1.0	mA	V_{CC} = MAX., V_{IN} = 5.5 V	
	Input HIGH Current at P_B, P_C, or P_D			80	µA	V_{CC} = MAX., V_{IN} = 2.4 V	3
				1.0	mA	V_{CC} = MAX., V_{IN} = 5.5 V	
I_{IL}	Input LOW Current Into P_A			-1.6	mA	V_{CC} = MAX., V_{IN} = 0.4 V	4
	Input LOW Current Into P_B, P_C, or P_D			-3.2	mA		
I_{CC}	Supply Current		16	25	mA	V_{CC} = MAX.	3

NOTES:
(1) For conditions shown as MIN. or MAX., use the appropriate value specified under recommended operating conditions for the applicable device type.
(2) Typical limits are at V_{CC} = 5.0 V, 25°C.
(3) Voltage values are with respect to network ground terminal.
(4) This is the maximum voltage which should be applied to any output when it is in the off state.

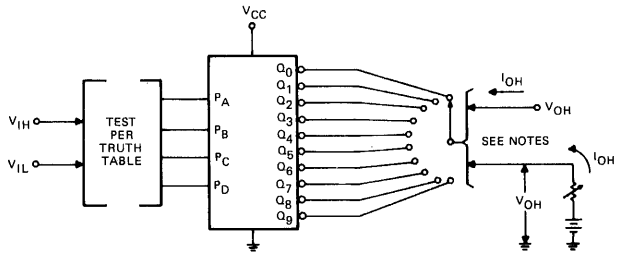
PARAMETER MEASUREMENT INFORMATION

DC TEST CIRCUITS*



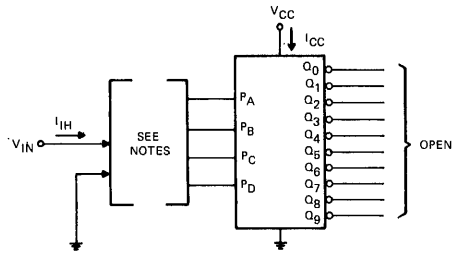
Each output is tested separately.

Fig. 1 V_{IH}, V_{IL}, V_{OL}



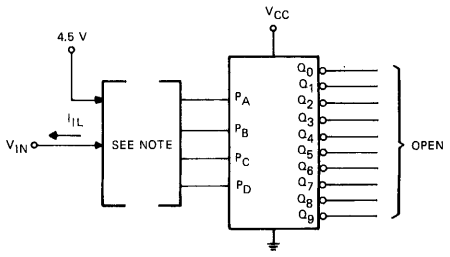
1. Each output is tested separately.
2. V_{OH} is tested at I_{OH} = 0.5 mA and I_{OH} is tested at V_{OH} = 55 V for all inputs counts. I_{OH} is tested also at V_{OH} = 30 V for input counts 10 through 15.

Fig. 2 V_{IH}, V_{IL}, I_{OH}, V_{OH}



1. When testing I_{IH}, each input is tested separately with all other inputs grounded.
2. When testing I_{CC}, all inputs are grounded.

Fig. 3 I_{IH}, I_{CC}



Each input is tested separately, with all other inputs at 4.5 V.

Fig. 4 I_{IL}

*Arrows indicate actual direction of current flow. Current into a terminal is a positive value.

APPLICATIONS

GENERAL – When these decoder/drivers are used in close proximity (on the same circuit board) with standard digital integrated circuits, care should be exercised to ensure that the impedance of the ground bus (including interconnections) is sufficiently low to absorb the normal energy levels resulting from switching the tube elements.

DRIVING INDICATOR TUBES – As shown in Figure 5, the 93141/74141 requires no external components for driving cold-cathode indicator tubes. The versatility here is limited only by the system capability to control the data inputs.

A suggested method for blanking extraneous zeros is shown in Figure 6. Any input count above decimal 9 may be used for blanking. In the following application decimal 12 is used. When the most significant bit (MSB) or the least significant bit (LSB) is decimal 0(0000), that indicator is blanked while decimal 12 (binary 1100) is applied to the 93141/74141 inputs causing all the outputs to be off. If the MSB or LSB is decimal 0 and being blanked, this signal is gated with and blanks the next smaller digit. This scheme is easily expandable to n digits.

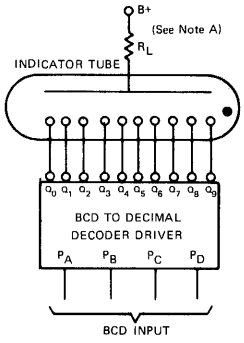
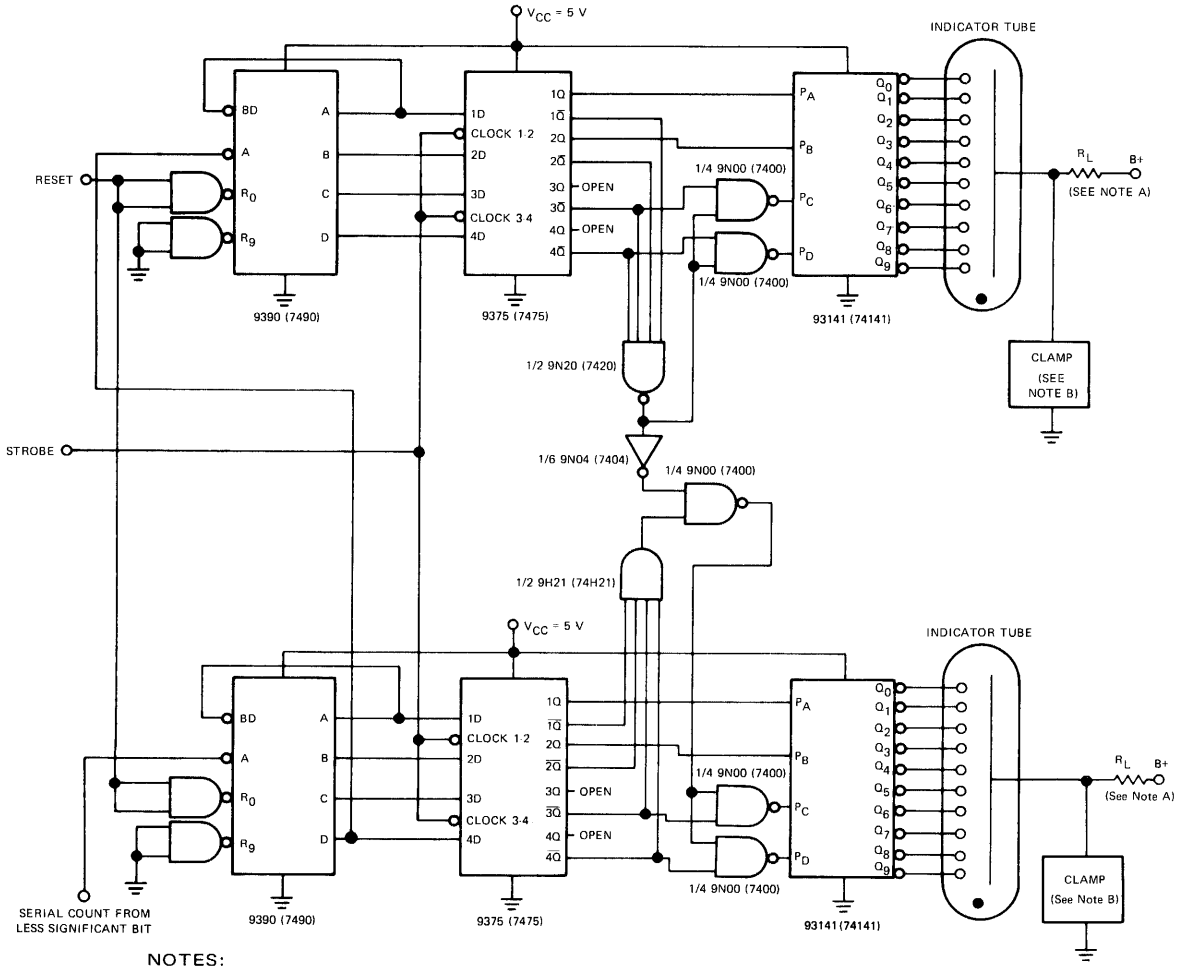


Fig. 5



NOTES:

A. Values for B+ and R_L are as specified by the tube manufacturer.

B. Blanking is assured only if the anode of the indicator tube is clamped at 150 volts maximum.

Fig. 6