



# LS7100

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## BCD TO 7-SEGMENT LATCH/DECODER/DRIVER for liquid crystal (dynamic scattering) displays

### FEATURES:

- Up to -50V Segment Output
- All Inputs are TTL or CMOS Compatible
- Internal Pull-Down Resistors on all Inputs
- Operating Voltage Range From -5V to -60V

### DESCRIPTION:

The LS7100 is a monolithic, ion implanted MOS, BCD to 7-segment latched decoder/driver capable of driving displays over a wide voltage range.

This circuit is specifically intended to drive large light scattering liquid crystal displays.

### DESCRIPTION OF OPERATION:

#### COMMON (COM) INPUT

COM is the common source for 7 internal FET Switch segment outputs.

#### A, B, C, D AND LOAD (LD) INPUTS

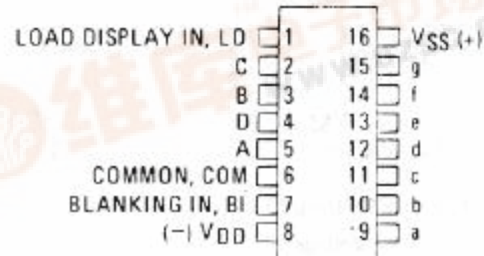
The BCD (or binary) data applied to the A,B,C,D inputs are latched into internal flip-flops when the LD input is high. If the input data changes while LD is high, the flip-flops will follow the input data. When LD is low, the inputs are isolated from the flip-flops. The latched data are decoded to 7-segments to control the opening and closing of the segment switch outputs (See display format for 0-15 binary decoding).

Each of these inputs has an internal pull-down (to logic "0") resistor.

#### SEGMENT OUTPUTS

The segment outputs are open-drain outputs of FET switches, with COM input as the common source. The electrical path from COM to any segment output is effectively an analog switch which can be either closed or opened by decoded data stored in internal latches associated with A,B,C,D inputs. The display segment drive wave-forms are not generated internally. The desired output wave-forms must be applied to the COM input. When a segment analog switch is closed, the drive wave-form at COM is connected to the respective output and when the switch is open, the output is cut off from COM and has very high impedance.

### PIN ASSIGNMENT DIAGRAM



TOP VIEW  
STANDARD 16 PIN DIP  
FIGURE 1

#### BLANKING (BI) INPUT

Blanking of the display is provided by the BI. When BI is high, all FET switches are opened thereby turning off display segments. When BI is low, the selected FET switches are closed.

BI has an internal pull-down (to logic "0") resistor.

#### INPUT INTERFACE

LS7100 inputs can be interfaced with TTL, CMOS, NMOS or PMOS outputs by connecting VSS to the positive terminal (output logic "1", reference supply) of the TTL, CMOS, NMOS or PMOS supply.

The information included herein is believed to be accurate and reliable. However, LSI Computer Systems, Inc. assumes no responsibilities for inaccuracies, nor for any infringements of patent rights of others which may result from its use.



**ABSOLUTE MAXIMUM RATINGS:**(All voltages referenced to  $V_{SS}$ , Pin 16)

	SYMBOL	VALUE	UNIT
DC Supply Voltage	$V_{DD}$	+0.3 to -60	V
Common In	$V_{CI}$	+0.3 to -60	V
All other inputs	$V_{IN}$	+0.3 to -30	V
Operating Temperature	$T_A$	-40 to +70	$^{\circ}C$
Storage Temperature	$T_{stg}$	-65 to +125	$^{\circ}C$

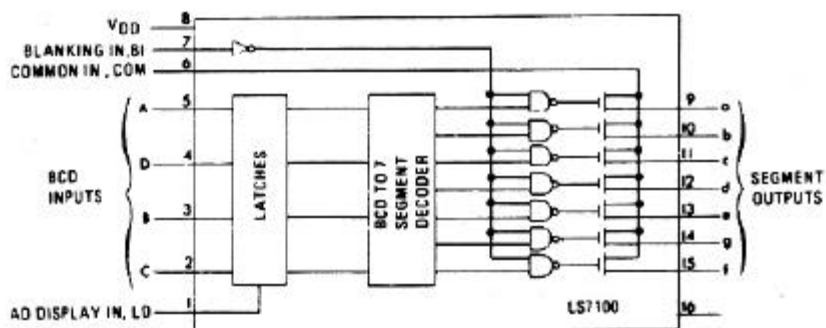
**ELECTRICAL CHARACTERISTICS:**-40 $^{\circ}C$   $T_A$  70 $^{\circ}C$  unless otherwise specified $V_{SS} = 0$  unless otherwise specified

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS, REMARKS
<b>POWER SUPPLY</b>					
$V_{DD}$	-5	-	-60	V	
$i_{DD}$	-	600	-	$\mu A$	@ $V_{DD} = -40V$
<b>COMMON INPUT</b>					
$V_{COM}$ High	-	-5	0	V	
$V_{COM}$ Low	$V_{DD}+3$	$V_{DD}+10$	-	V	
$V_{COM}$ Low - $V_{SS}$	-	-	-50	V	
Leakage Current	-	-	5	nA	@ $V_{DD} = -40V, V_{DD} + 3V < V_{COM} - 0.5V$
<b>ALL OTHER INPUTS</b>					
Input High Voltage					
$V_{IH}$ , "1"	-1.5	-	0	V	
Input Low Voltage					
$V_{IL}$ , "0"	$V_{DD}$	-	-4	V	$V_{DD} \geq -15V$
	-15	-	-4	V	$V_{DD} < -15V$
Input High Current					
$I_{IH}$	-	-	40	$\mu A$	$T_A = 25^{\circ}C$
Input Low Current					
$I_{IL}$	-	-	40	$\mu A$	$T_A = 25^{\circ}C$
<b>SEGMENT OUTPUTS</b>					
OFF Segment					
Leakage Current	-	5	-	nA	@ $V_{DD} = -40V, V_{DD} + 3V < V_{SEG} \leq -0.5V$
ON Segment					
Output Current	-	-	5	mA	Maximum recommended

**SWITCHING CHARACTERISTICS\*** $V_{DD} = -40V, T_A = 25^{\circ}C$ 

(Outputs unloaded)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
BCD data set up time	$t_{DS}$	0	-	-	ns
BCD data hold time	$t_{HS}$	500	-	-	ns
Load pulse width	$t_{LW}$	1.0	-	-	$\mu s$
BCD data pulse width	$t_{DW}$	1.5	-	-	$\mu s$
Blank to seg off delay	$t_{PBH}$	-	1.0	-	$\mu s$
Blank to seg on delay	$t_{PBL}$	-	1.3	-	$\mu s$
Load to seg on delay	$t_{PLH}$	-	1.5	-	$\mu s$
Load to seg off delay	$t_{PLL}$	-	1.0	-	$\mu s$
Propagation delay from COM input to any segment					



LS7100 FUNCTIONAL DIAGRAM  
FIGURE 2

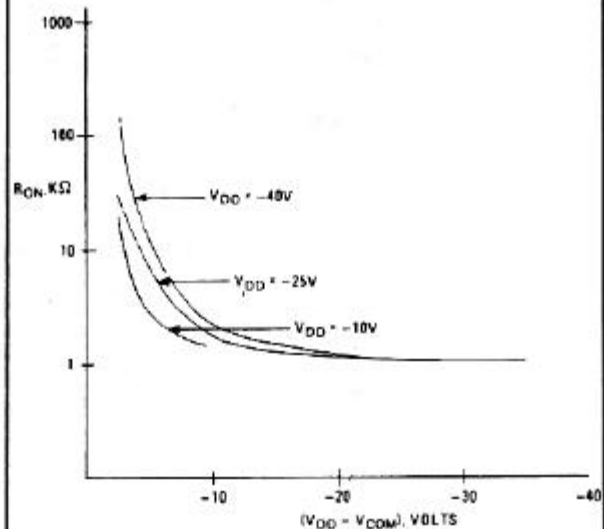
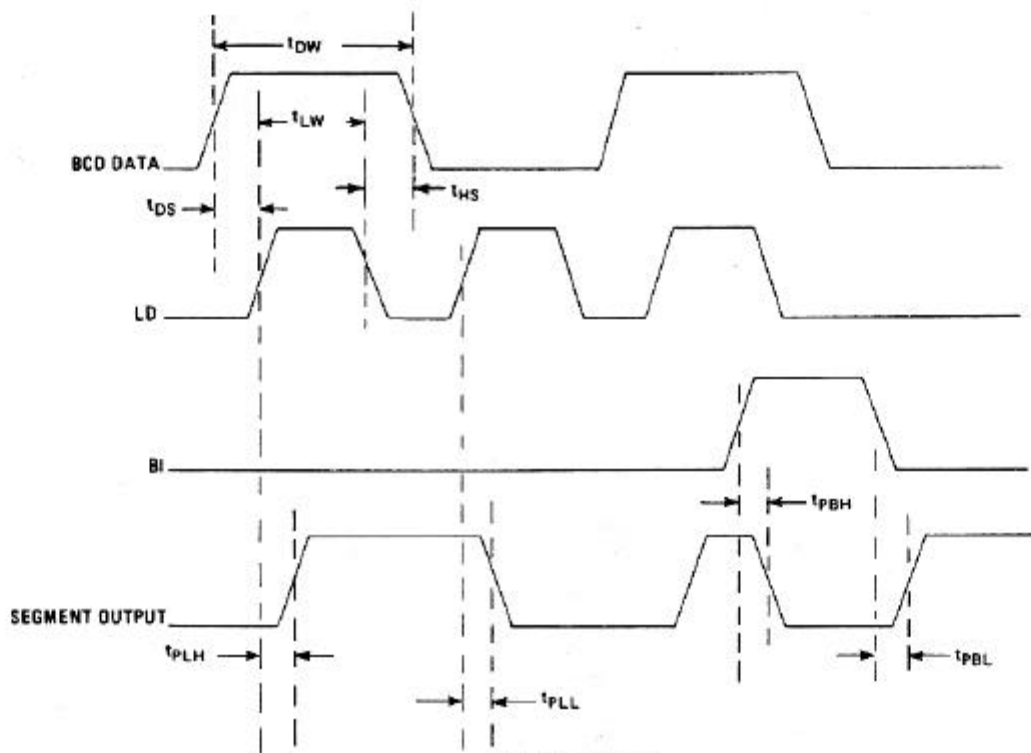


FIGURE 4  
CHANNEL ON RESISTANCE,  $R_{ON}$



TIMING DIAGRAM  
FIGURE 3

DISPLAY FORMAT

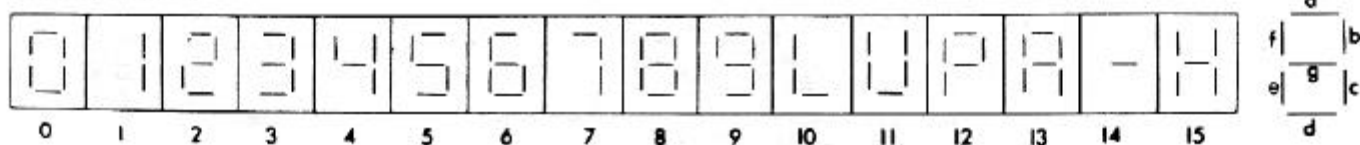
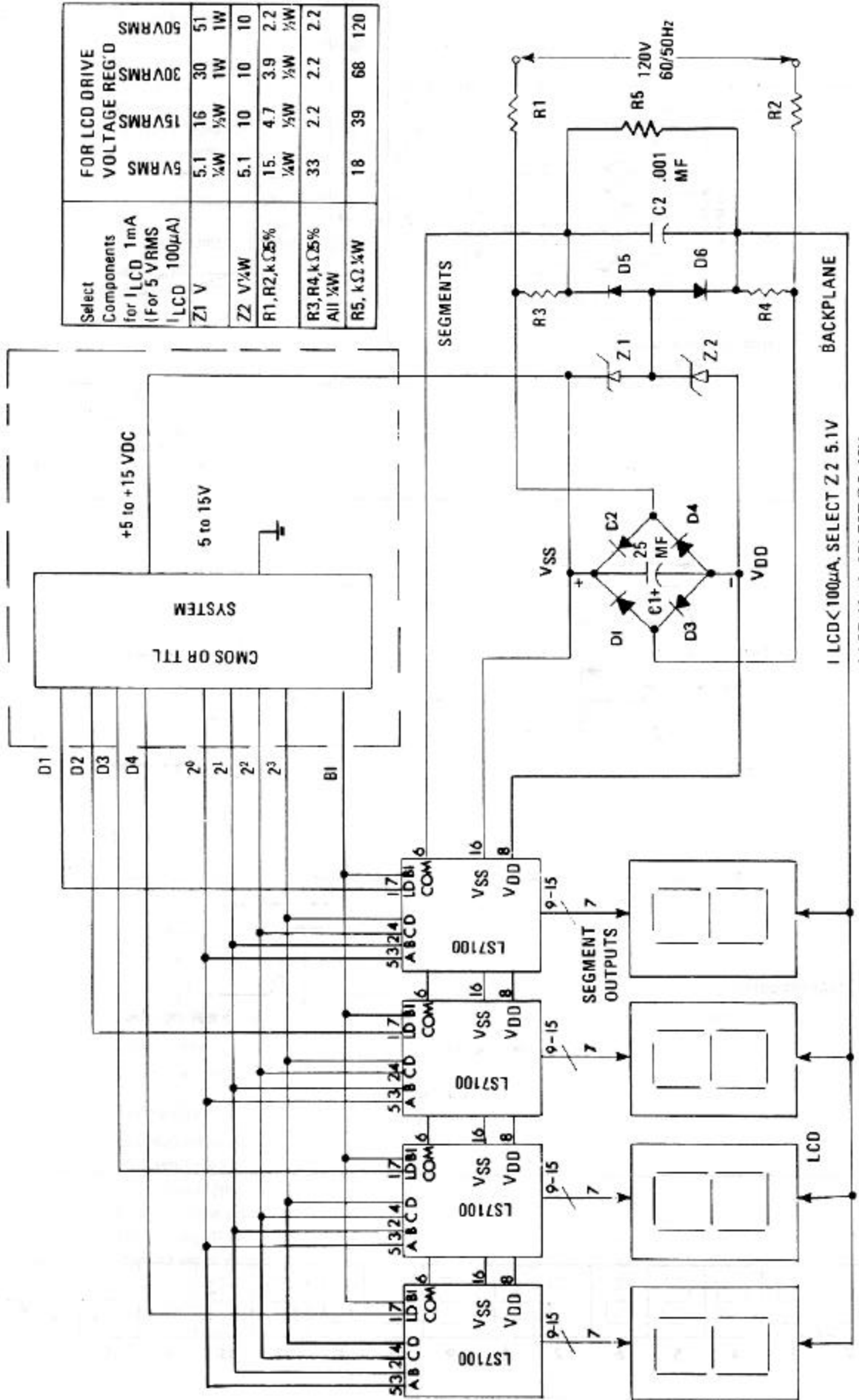


FIGURE 5



Select Components for $I_{LCD}$ 1mA (For 5 VRMS $I_{LCD}$ 100 $\mu$ A)	FOR LCD DRIVE VOLTAGE REG'D			
Z1 V	5VRMS	15VRMS	30VRMS	50VRMS
Z2 V $\frac{1}{2}$ W	5.1	16	30	51
R1, R2, k $\Omega$ 5%	$\frac{1}{4}$ W	$\frac{1}{2}$ W	1W	1W
R3, R4, k $\Omega$ 5%	5.1	10	10	10
All $\frac{1}{4}$ W	15	4.7	3.9	2.2
	$\frac{1}{4}$ W	$\frac{1}{2}$ W	$\frac{1}{2}$ W	$\frac{1}{2}$ W
	33	2.2	2.2	2.2
	18	39	68	120

APPLICATION NOTE - 4 DIGIT LCD DRIVE USING LS7100  
( from 120 VAC line)

FIGURE 6