

## 32-Channel $\pm 40V$ Liquid Crystal Display Row Driver

### Ordering Information

Device	Package Options			
	44-J Lead Quad Plastic Chip Carrier	44 -J Lead Quad Ceramic Chip Carrier	44-Lead Quad Plastic Gullwing	Die
HV6008	HV6008PJ	HV6008DJ	HV6008PG	HV6008X

### Features

- Symmetrical  $\pm 40V$  output swing
- Active return to GND
- 15mA peak source/sink/GND current per channel
- +5V control logic
- Special shift register with clear
- Phase shift control
- Output enable
- Data out enable
- 1MHz shift register
- Surface mount package available

### General Description

#### Not recommended for new designs.

The HV60 is a 32-channel liquid crystal display driver with 3-state DMOS outputs. Each output can be set to +40V, -40V, or GND. A symmetric waveform can be applied to a capacitive load using the phase shift feature of the HV60.

The HV60 consists of a 32-bit shift register with Clear, Enable, and Phase Shift logic, and 32 high voltage output buffers. With the Enable pin held low, all outputs are placed in the return to zero (GND) state. When Enable is high, each output reflects the data in its shift register bit. All outputs with a logic "0" in their shift register will be in the return to zero state. Outputs with a logic "1" in their shift register will reflect the state of the phase shift pin. These outputs will be switched to  $V_{PP}$  when phase shift is high and  $V_{NN}$  when phase shift is logic "0".

Additional functions provided are Shift Register Clear and Data Out. All bits of the shift register are changed to logic "0" when Clear is pulled low. With Clear at a logic "1", normal shift register operation proceeds. The data output reflects the status of the 32nd shift register stage.

### Absolute Maximum Ratings

Supply voltage, $V_{DD1}$ <sup>1</sup>	-6V
Supply voltage, $V_{DD2}$ <sup>1</sup>	+6V
Supply voltage, $V_{PP}$ <sup>1,2</sup>	+42V
Supply voltage, $V_{NN}$ <sup>1,2</sup>	-42V
Logic input levels <sup>1</sup>	$V_{DD1} - 0.3V$ to $V_{DD2} + 0.3V$
Ground current <sup>2</sup>	700mA
Continuous total power dissipation <sup>3</sup>	1W
Operating temperature range	-40°C to +85°C
Storage temperature range	-65°C to +150°C

#### Notes:

1. All voltages are referenced to GND.
2. Duty cycle is limited by the total power dissipated in the package.
3. For operation above 25°C ambient derate linearly to 85°C at 16.7mW/°C.

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# Electrical Characteristics (over recommended operating conditions unless noted)

## DC Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$I_{DD1,2}$	$V_{DD}$ supply current	$V_{DD1}$		500	$\mu\text{A}$	$V_I = 4\text{V}, V_{DD1} = -6\text{V}$
		$V_{DD2}$				$V_I = 4\text{V}, V_{DD2} = +6\text{V}$
$V_{IH}$	Logic input high	+2		$V_{DD2}$	V	$V_{DD1} = -4.5\text{V},$
$V_{IL}$	Logic input low	$V_{DD1}$		-2	V	$V_{DD2} = +4.5\text{V}$
$V_{OH}$	Logic output high	+2			V	$V_{DD1} = -4.5\text{V}$
$V_{OL}$	Logic output low			-2	V	$V_{DD2} = +4.5\text{V}$
						$I_{OH} = -15\mu\text{A}$ $I_{OL} = 250\mu\text{A}$
$I_{IH}$	High-level logic input current			+3	$\mu\text{A}$	$V_I = V_{DD}, V_{DD1,2} = \text{max}$
$I_{IL}$	Low-level logic input current			-50	$\mu\text{A}$	$V_I = 0\text{V}, V_{DD1,2} = \text{max}$
$I_{PP}$	High voltage supply current			+1	mA	Static, no load
$I_{NN}$	High voltage supply current			-1	mA	Static, no load
$V_{OH}$	Output voltage high	+39			V	$V_{PP}, V_{NN} = \pm 40$ No load
$V_{CL}$	Output voltage clamp	-20		+20	mV	
$V_{OL}$	Output voltage low			-39	V	
$Z_{OH}$	Output switch impedance high		1000		$\Omega$	$V_{PP}, V_{NN} = \pm 40$ $I_O = \pm 15\text{mA}$
$Z_{CL}$	Output switch impedance clamp		500			
$Z_{OL}$	Output switch impedance low		700			
$I_O$	DC output current	Output H or L		5	mA	1 output only
		Data out H or L		150	$\mu\text{A}$	

## AC Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$t_{WH}$	Width of high data pulse	500			ns	
$t_{WL}$	Width of low data pulse	500			ns	
$t_{SU}$	Data set-up time before clock falls	25			ns	
$t_H$	Data hold time after clock falls	10			ns	
	Phase shift duty cycle		50		%	

## Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units
$V_{DD1}$	Logic supply voltage	-4		-6	V
$V_{DD2}$	Logic supply voltage	+4		+6	V
$V_{PP}$	High voltage supply	+10		+40	V
$V_{NN}$	High voltage supply	-10		-40	V
$V_{IH}$	High-level input voltage	+2V		$V_{DD2}$	V
$V_{IL}$	Low-level input voltage	-2V		$V_{DD1}$	V
$I_{O\text{Pk}}$	Peak output current (any state)			$\pm 80$	mA
$T_A$	Operating free-air temperature	-40		+70	$^{\circ}\text{C}$
$f_{DIN}$	Input data rate			1	MHz
$f_{PS}$	Phase shift rate			20	KHz

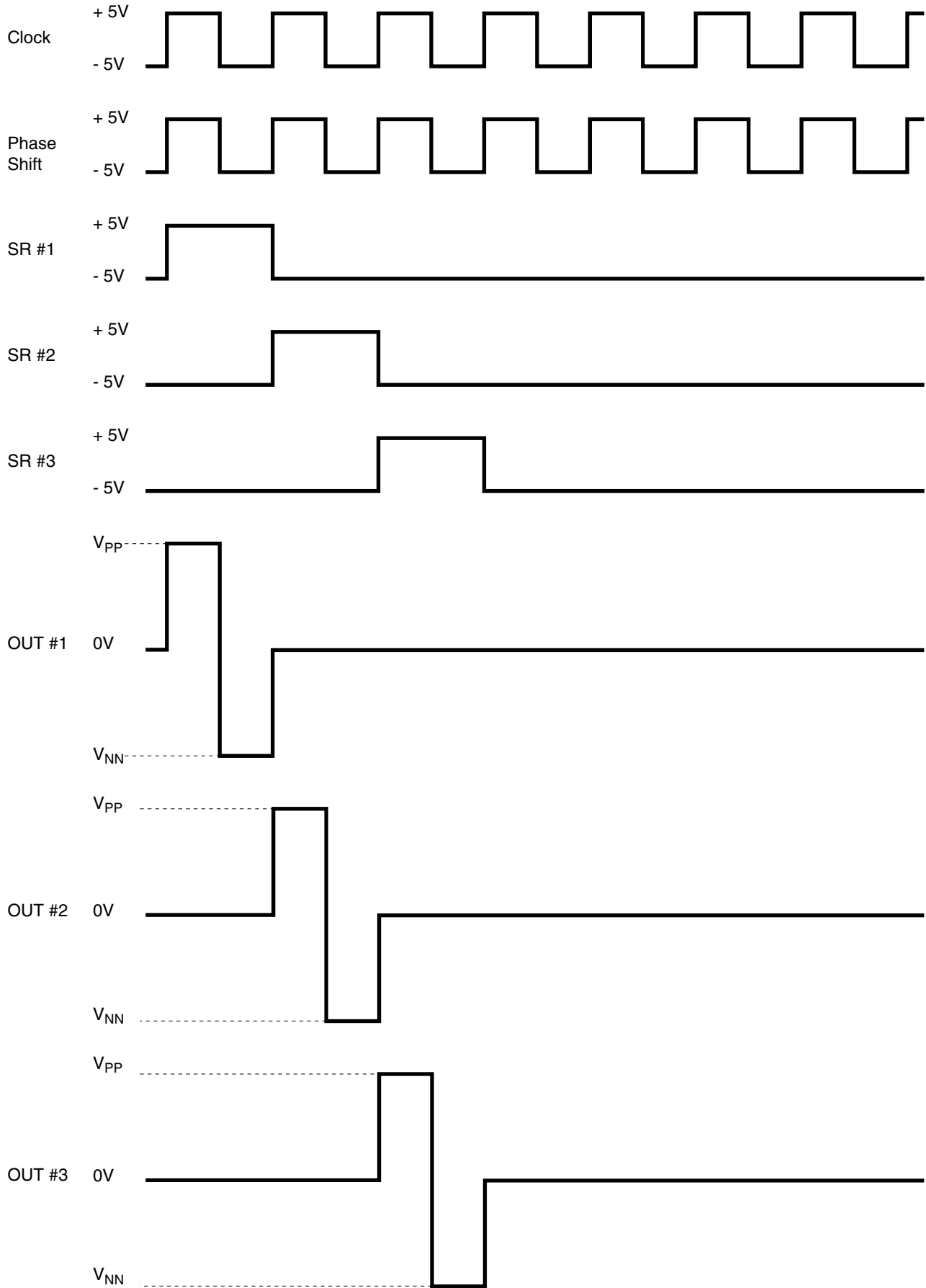
### Note:

Power-up sequence should be the following:

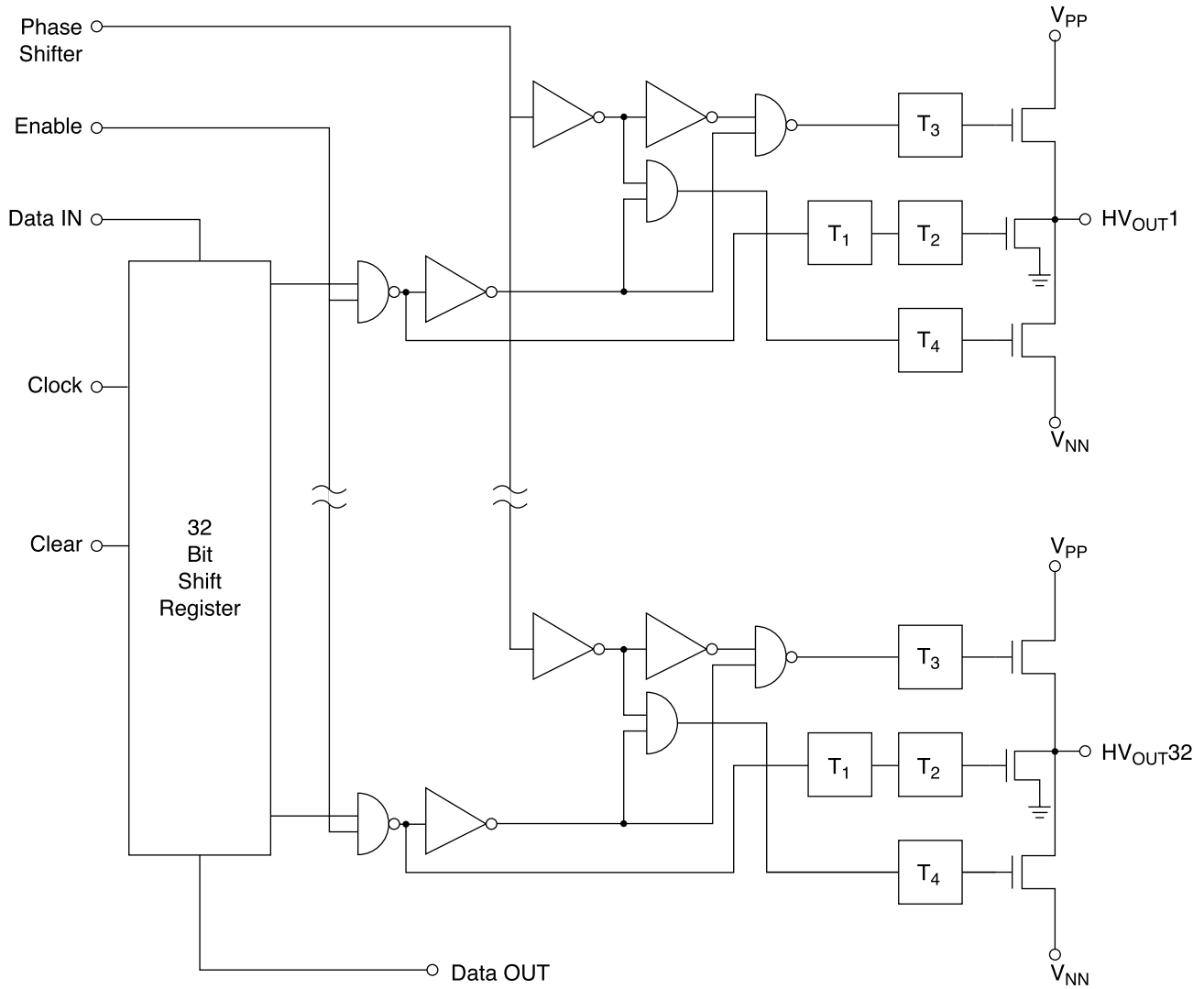
1. Connect ground.
2. Apply  $V_{DD}$ .
3. Set all inputs (Data, CLK, Enable, etc.) to a known state.
4. Apply  $V_{PP}$  and  $V_{NN}$ .

Power-down sequence should be the reverse of the above.

# Switching Waveform



# Functional Block Diagram



# Function Table

Function	Inputs					Outputs		
	Data In	CLK	CLR	Enable	Phase Shift	Shift Reg 1 2...32	HV Outputs 1 2...32	Data Out
CLR Reg	X	X	H	X	X	ALL L	ALL GND	L
All output GND	X	X	X	L	X	* *...*	ALL GND	*
Load S/R	H or L	↓	L	L	X	H or L *...*	ALL GND	*
Output State	X	H or L	L	H	X	L L...L	GND GND...GND	*
					H	H H...H	V <sub>PP</sub> V <sub>PP</sub> ...V <sub>PP</sub>	*
					L	H H...H	V <sub>NN</sub> V <sub>NN</sub> ...V <sub>NN</sub>	*

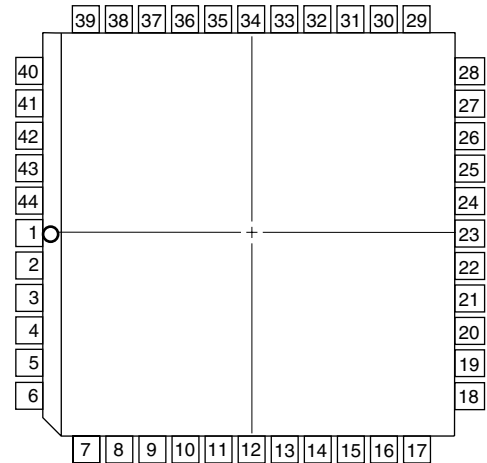
**Notes:**  
 X = Irrelevant  
 \* = Dependent on previous stage's state before the last CLK  
 ↓ = High to low transition  
 H = High level  
 L = Low level

# Pin Configurations

# Package Outlines

## 44-Pin J-Lead

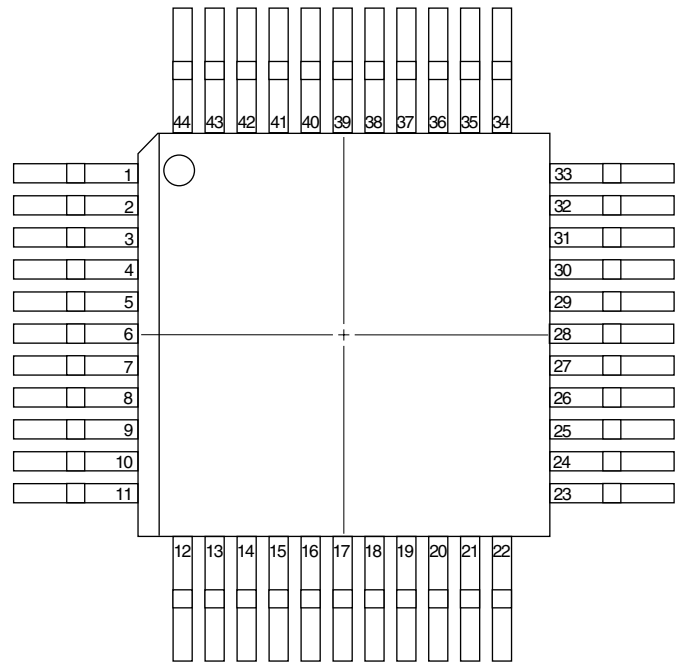
Pin	Function	Pin	Function
1	HV <sub>OUT</sub> 16	23	V <sub>DD1</sub>
2	HV <sub>OUT</sub> 15	24	Enable
3	HV <sub>OUT</sub> 14	25	V <sub>DD2</sub>
4	HV <sub>OUT</sub> 13	26	GND
5	HV <sub>OUT</sub> 12	27	Data Out
6	HV <sub>OUT</sub> 11	28	HV <sub>OUT</sub> 32
7	HV <sub>OUT</sub> 10	29	HV <sub>OUT</sub> 31
8	V <sub>PP</sub>	30	HV <sub>OU</sub> 30
9	HV <sub>OUT</sub> 9	31	HV <sub>OUT</sub> 29
10	HV <sub>OUT</sub> 8	32	HV <sub>OUT</sub> 28
11	HV <sub>OUT</sub> 7	33	HV <sub>OUT</sub> 27
12	HV <sub>OUT</sub> 6	34	HV <sub>OUT</sub> 26
13	HV <sub>OUT</sub> 5	35	HV <sub>OUT</sub> 25
14	HV <sub>OUT</sub> 4	36	HV <sub>OUT</sub> 24
15	HV <sub>OUT</sub> 3	37	V <sub>NN</sub>
16	HV <sub>OUT</sub> 2	38	HV <sub>OUT</sub> 23
17	HV <sub>OUT</sub> 1	39	HV <sub>OUT</sub> 22
18	Data In	40	HV <sub>OUT</sub> 21
19	GND	41	HV <sub>OUT</sub> 20
20	Phase Shift	42	HV <sub>OUT</sub> 19
21	Clock	43	HV <sub>OUT</sub> 18
22	Clear	44	HV <sub>OUT</sub> 17



top view  
44-pin J Lead Package

## 44-Pin Quad Palstic Package

Pin	Function	Pin	Function
1	HV <sub>OUT</sub> 21	23	Data In
2	HV <sub>OUT</sub> 20	24	GND
3	HV <sub>OUT</sub> 19	25	Phase Shift
4	HV <sub>OUT</sub> 18	26	Clock
5	HV <sub>OUT</sub> 17	27	Clear
6	HV <sub>OUT</sub> 16	28	V <sub>DD1</sub>
7	HV <sub>OUT</sub> 15	29	Enable
8	HV <sub>OUT</sub> 14	30	V <sub>DD2</sub>
9	HV <sub>OUT</sub> 13	31	GND
10	HV <sub>OUT</sub> 12	32	Data Out
11	HV <sub>OUT</sub> 11	33	HV <sub>OUT</sub> 32
12	HV <sub>OUT</sub> 10	34	HV <sub>OUT</sub> 31
13	V <sub>PP</sub>	35	HV <sub>OUT</sub> 30
14	HV <sub>OUT</sub> 9	36	HV <sub>OUT</sub> 29
15	HV <sub>OUT</sub> 8	37	HV <sub>OUT</sub> 28
16	HV <sub>OUT</sub> 7	38	HV <sub>OUT</sub> 27
17	HV <sub>OUT</sub> 6	39	HV <sub>OUT</sub> 26
18	HV <sub>OUT</sub> 5	40	HV <sub>OUT</sub> 25
19	HV <sub>OUT</sub> 4	41	HV <sub>OUT</sub> 24
20	HV <sub>OUT</sub> 3	42	V <sub>NN</sub>
21	HV <sub>OUT</sub> 2	43	HV <sub>OUT</sub> 23
22	HV <sub>OUT</sub> 1	44	HV <sub>OUT</sub> 22



top view  
44-pin Quad Plastic Gullwing Package