

## 275V 40-Channel Row Driver with SCR Outputs

### Ordering Information

Device	Package Options		
	80-Lead Ceramic Gullwing	64-Lead 3-Sided Plastic Gullwing	Die
HV506	HV506DG	HV506PG	HV506X

### Features

- ❑ Processed with HVDI® technology
- ❑ Symmetric row drive
- ❑ Output voltage up to 275V
- ❑ Source/Sink current 300mA (min.)
- ❑ Shift Register Speed 3MHz
- ❑ Pin-programmable shift direction (DIR)
- ❑ Hi-Rel processing available

### Absolute Maximum Ratings

Logic supply voltage, $V_{DD}$ <sup>1</sup>	-0.5V to +15V	
Output supply voltage, $V_{DD}$ <sup>1</sup>	-0.5V to +15V	
Substrate bias voltage, $V_{sub}$	See Note 3	
Output voltage, $HV_{OUT}$	±300V	
Logic input levels	-0.5V to $V_{DD} + 0.5V$	
Continuous total power dissipation <sup>2</sup>	Ceramic	1900mW
	Plastic	1200mW
Operating temperature range	Plastic	-40°C to +85°C
	Ceramic	-55°C to +125°C
Storage temperature range	-65°C to +150°C	
Lead temperature 1.6mm (1/16 inch) from case for 10 seconds	260°C	

#### Notes:

1. All voltages are referenced to  $V_{SS}$ .
2. For operation above 25°C ambient derate linearly to maximum operating temperature at 20mW/°C for plastic and at 19mW/°C for ceramic.
3.  $V_{sub}$  must be the most positive with respect to  $V_{SS}$ .

### General Description

The HV506 is a low-voltage serial to high-voltage parallel converter with push-pull outputs. It is especially suitable for use as a symmetric row driver in AC thin-film electroluminescent (ACTFEL) displays.

When the data reset pin ( $DR_{IO}$ ) is at logic high, it will reset all the outputs of the internal shift register to zero. At the same time, the output of the shift register will start shifting a logic high from the least significant bit to the most significant bit. The  $DR_{IO}$  can be triggered at any time. The DIR pin controls the direction of data through the device. When DIR is at logic high,  $DR_{IOA}$  is the input and  $DR_{IOB}$  is the output. When DIR is grounded,  $DR_{IOB}$  is the input and the  $DR_{IOA}$  is the output. See the Output Sequence Operation Table for output sequence. The  $\overline{POL}$  and  $\overline{OE}$  pins perform the polarity select and output enable function respectively. Data is clocked through the shift register loaded on the low to high transition of the clock. A logic high in the shift register will cause the other corresponding output to swing to  $V_{DD}$  if  $\overline{POL}$  is high, or to  $V_{SS}$  if  $\overline{POL}$  is low. All other outputs will be in the High-Z state. If OE is at logic high all outputs will be in the High-Z state. An output in the High-Z state may block up to 275V above  $V_{SS}$  or 275V below  $V_{DD}$ . The  $D_P/D_N$  pins are for the positive/negative discharge of the high voltage output  $HV_{OUT}$ . Data output buffers are provided for cascading devices.

$V_{DD}$  requires low current for the HV506 logic section.  $V_{DD}$  requires high current for the output section. Typically these two pins are at the same potential. The same current and potential conditions apply to the  $V_{SS}$ , logic, and  $V_{SS}$ , output pins.  $V_{sub}$  must always be equal or greater than the most positive supply.

# Electrical Characteristics

(over recommended operating conditions of  $V_{DD} = 12V$ ,  $LV_{DD} = 12V$ , and  $T_A = 25^\circ C$  unless noted)

## DC Characteristics

Symbol	Parameter	Min	Max	Units	Conditions
$I_{DD}$	$V_{DD}$ supply current		10	mA	$f_{CLK} = 3MHz$
$I_{DDQ}$	Quiescent $V_{DD}$ supply current		100	$\mu A$	All $V_{IN} = V_{SS}$ or $V_{DD}$
$V_{OH}$	High-level output	$HV_{OUT}$	$V_{DD}-10$	V	$I_O = -300mA$
		Data out	10.8	V	$I_O = -100\mu A$
$V_{OL}$	Low-level output	$HV_{OUT}$		$V_{SS}+10$	$I_O = 300mA$
		Data out		1.2	$I_O = 100\mu A$
$I_{IH}$	High-level logic input current		1	$\mu A$	$V_{IH} = V_{DD}$
$I_{IL}$	Low-level logic input current		-1	$\mu A$	$V_{IL} = V_{SS}$
$I_{OFF}$	Output OFF leakage current (High-Z)		10	$\mu A$	$HV_{OUT} - V_{SS} = 275V$ , $V_{sub} = HV_{OUT}$
			10	$\mu A$	$V_{DD} - HV_{OUT} = 275V$ , $V_{sub} = V_{DD}$

### Notes:

1. Only one output can be turned on at a time.

## SCR Characteristics

Symbol	Parameter	Min	Max	Units	Conditions
$V_{OH}$	High-level output	$V_{DD}-10$		V	$I_O = -300mA$
$V_{OL}$	Low-level output		$V_{SS}+10$	V	$I_O = 300mA$
$I_L$	Latching Current		15	mA	
$V_L$	Latching Voltage		100	V	
$I_H$	Holding Current	10		mA	
$V_H$	Holding Voltage	10		V	
$I_{OFF}$	Output OFF leakage current (High-Z)		10	$\mu A$	$HV_{OUT} - V_{SS} = 275V$ , $V_{sub} = HV_{OUT}$
			10	$\mu A$	$V_{DD} - HV_{OUT} = 275V$ , $V_{sub} = V_{DD}$

## AC Characteristics

Symbol	Parameter	Min	Max	Units	Conditions
$f_{CLK}$	Clock frequency		3	MHz	
$t_{W(H/L)}$	Pulse width - clock high or low	150		ns	
$t_{SUD}$	Data set-up time before clock rises	50		ns	
$t_{HD}$	Data hold time after clock rises	50		ns	
$t_{SUC}$	HV <sub>OUT</sub> delay from clock rises (Hi-Z to H or L)		1	μs	C <sub>L</sub> = 10nF
$t_{SUE}$	HV <sub>OUT</sub> delay from $\overline{\text{Output Enable}}$ rises		600	ns	C <sub>L</sub> = 10nF
$t_{HC}$	HV <sub>OUT</sub> delay from clock rises (H or L to Hi-Z)		2	μs	C <sub>L</sub> = 10nF
$t_{HE}$	HV <sub>OUT</sub> delay from $\overline{\text{Output Enable}}$ rises		600	ns	C <sub>L</sub> = 10nF
$t_{DHL}^*$	Delay time clock to data output falls		250	ns	C <sub>L</sub> = 15pF
$t_{DLH}^*$	Delay time clock to data output rises		250	ns	C <sub>L</sub> = 15pF
$t_{OFF(SCR)}$	Turn off time of output SCR		4	μs	Time after I <sub>OUT</sub> ≤ 2mA, C <sub>L</sub> = 10nF
$t_{OFF(D)}$	Turn off time of output diode		2	μs	Time after I <sub>OUT</sub> ≤ 2mA, C <sub>L</sub> = 10nF
$t_{POW}$	$\overline{\text{POL}}$ pulse width	3		μs	
$t_{OEW}$	$\overline{\text{Output Enable}}$ pulse width	3		μs	
SR	Slew rate of HV <sub>OUT</sub>		200	V/μs	

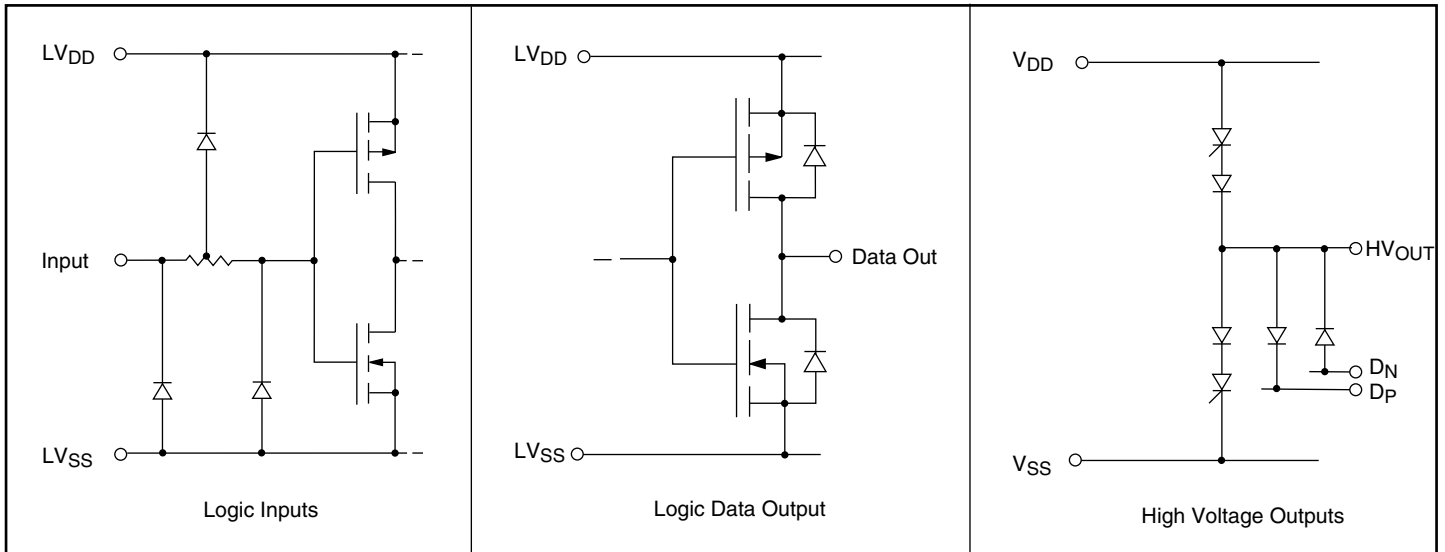
\* The delay is measured from the trailing edge of the clock but the data is triggered by the rising edge of the clock. There is an internal delay for the data output which is equal to  $t_{WH}$ . Therefore the delay is measured from the trailing edge of the clock.

# Recommended Operating Conditions

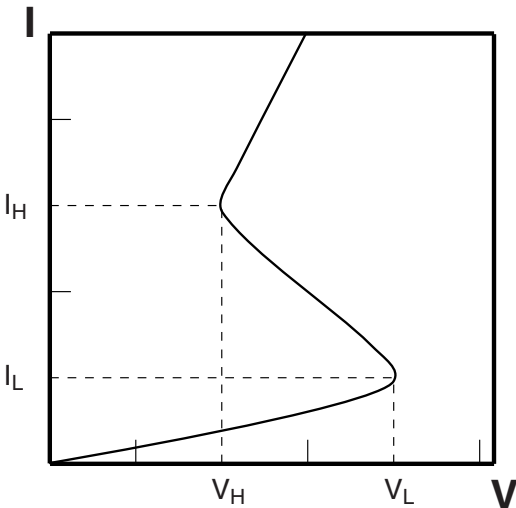
Symbol	Parameter	Min	Max	Units	
$LV_{DD}$	Logic supply voltage	10.8	13.2	V	
$V_{DD}$	Output supply voltage	10.8	13.2	V	
$V_{IH}$	High-level input voltage	$0.8LV_{DD}$	$LV_{DD}$	V	
$V_{IL}$	Low-level input voltage	0	$0.2LV_{DD}$	V	
$f_{CLK}$	Clock frequency		3	MHz	
$I_O$	High voltage output current		$\pm 300$	mA	
$T_A$	Operating free-air temperature	Plastic	-40	+85	$^{\circ}C$
		Ceramic	-55	+125	$^{\circ}C$
$I_{OD}$	Allowable pulse current through diodes		$\pm 500$	mA	

**Notes:**  
 The substrate pin  $V_{sub}$  (pin 39) must be biased for proper output breakdown voltage.  $V_{sub} \geq V_{DD}$  or  $HV_{OUT}$  whichever is higher.  
 $LV_{DD}/V_{DD}$  are measured with respect to  $LV_{SS}/V_{SS}$ .

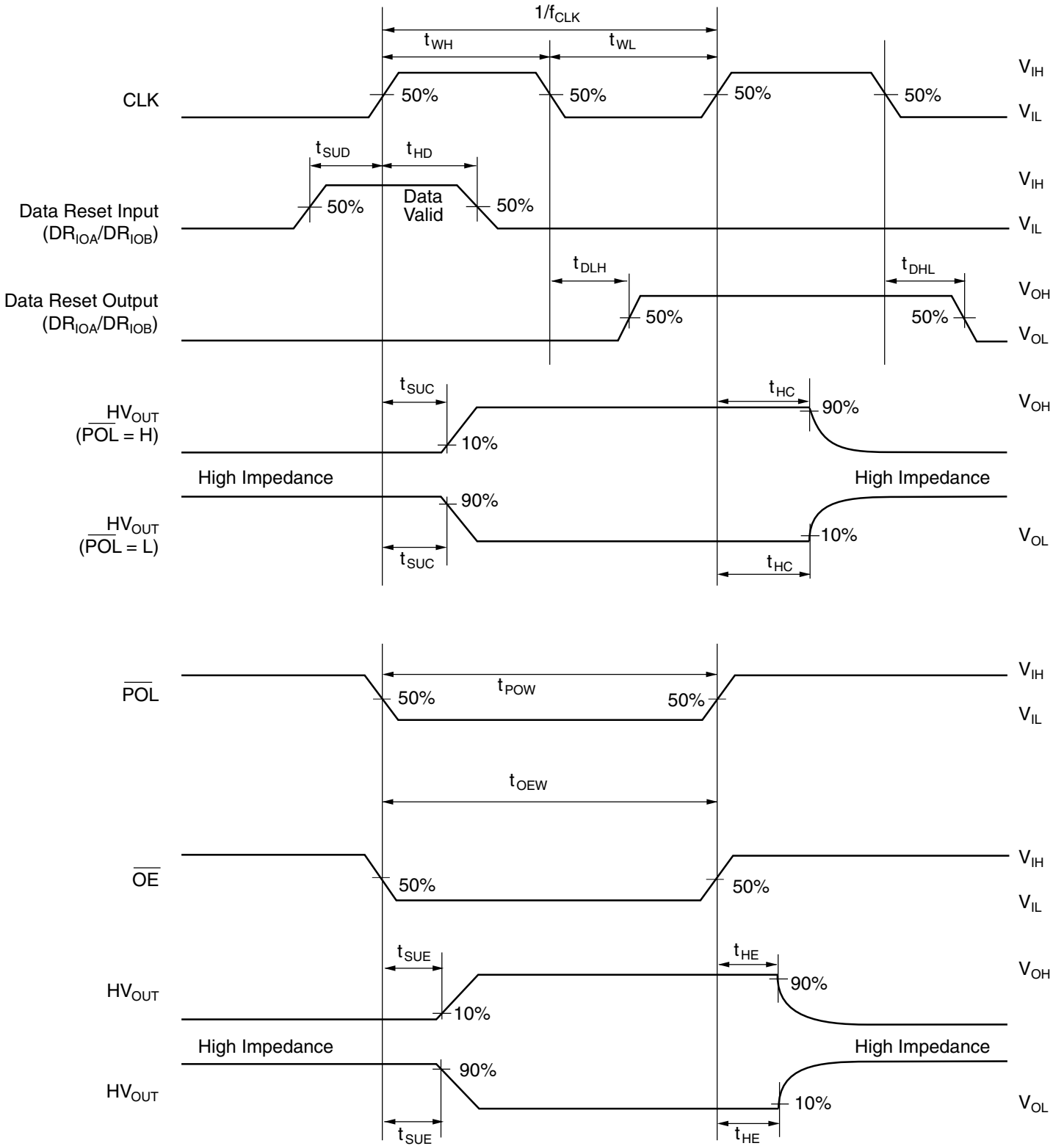
# Input and Output Equivalent Circuits



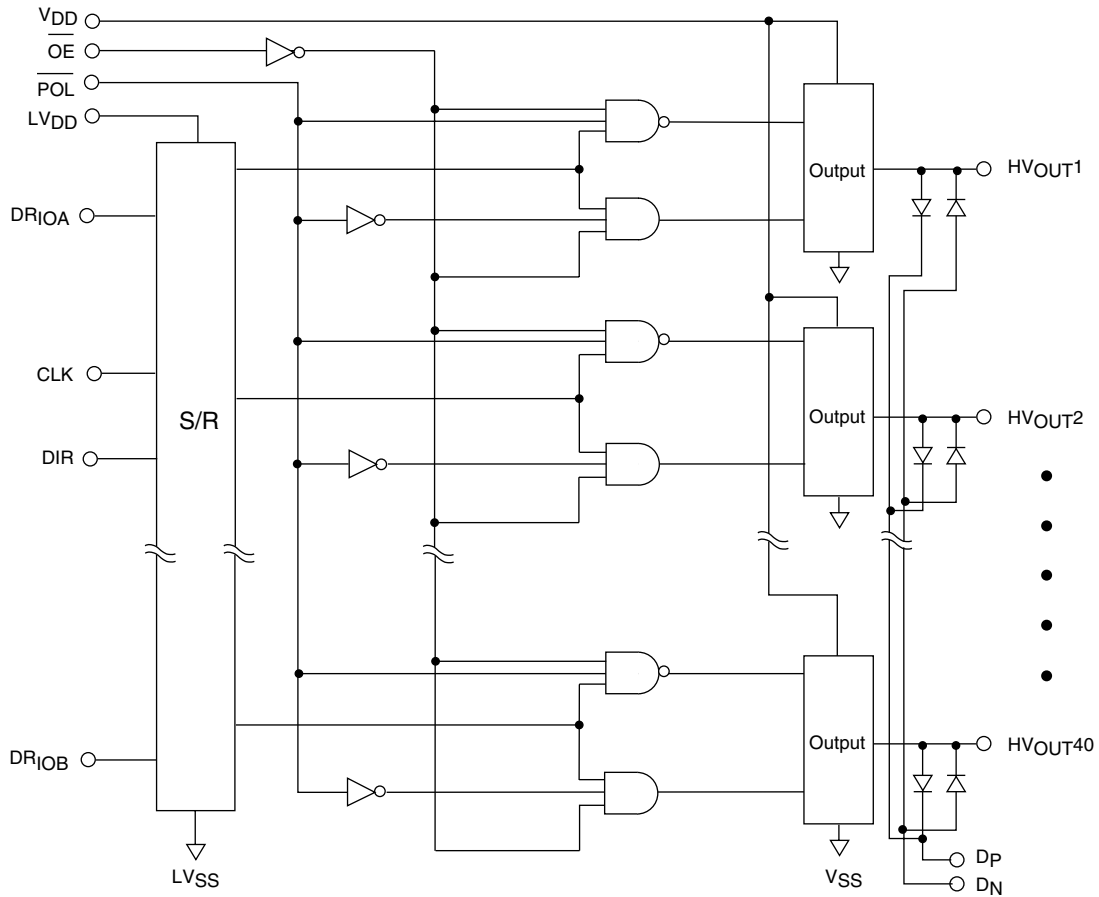
# SCR Characteristics



# Switching Waveforms



# Functional Block Diagram



## Function Table

I/O Relations	Inputs					HV Outputs
	CLK	DIR	S/R Data	$\overline{POL}$	$\overline{OE}$	
O/P HIGH	X	X	H	H	L	H
O/P OFF	X	X	L	X	L	HIGH-Z
O/P LOW	X	X	H	L	L	L
O/P OFF	X	X	X	X	H	All O/P HIGH-Z

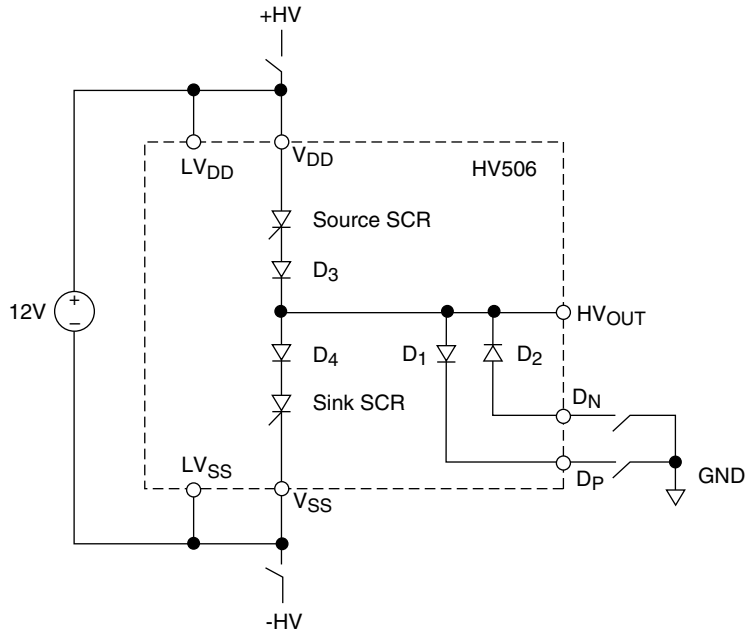
**Note:**  
H = logic high level, L = logic low level, X = irrelevant

## Output Sequence Operation Table

DIR	Data Reset In	Data Reset Out	HV <sub>OUT</sub> # Sequence	Direction <sup>3</sup>
L	DR <sub>IOB</sub>	DR <sub>IOA</sub> <sup>1</sup>	40 → 1	↻
H	DR <sub>IOA</sub>	DR <sub>IOB</sub> <sup>2</sup>	1 → 40	↻

**Notes:**  
1. DR<sub>IOA</sub> is DR<sub>IOB</sub> delayed by 40 clock pulses.  
2. DR<sub>IOB</sub> is DR<sub>IOA</sub> delayed by 40 clock pulses.  
3. Reference to chip layout drawing.

# Typical Output Circuit Connections

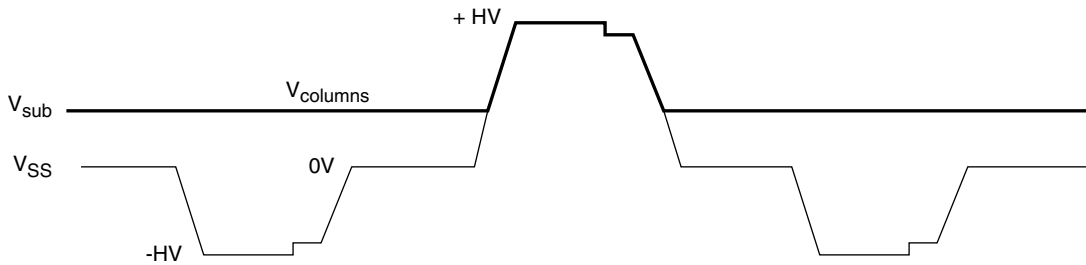


**Note:** The voltage potential between LV<sub>DD</sub>/V<sub>DD</sub> and LV<sub>SS</sub>/V<sub>SS</sub> must not exceed recommended operating conditions of 10.8V - 13.2V (12V typical)

## Substrate Bias Operation

In order to achieve the desired output breakdown voltage, the substrate must be biased to the most positive potential of any circuit node. For this condition,  $V_{sub} \geq V_{DD}$  or  $HV_{OUT}$  whichever is

higher. Refer to Typical Output Circuit Connections for wiring. A typical  $V_{sub}$  signal is shown below.

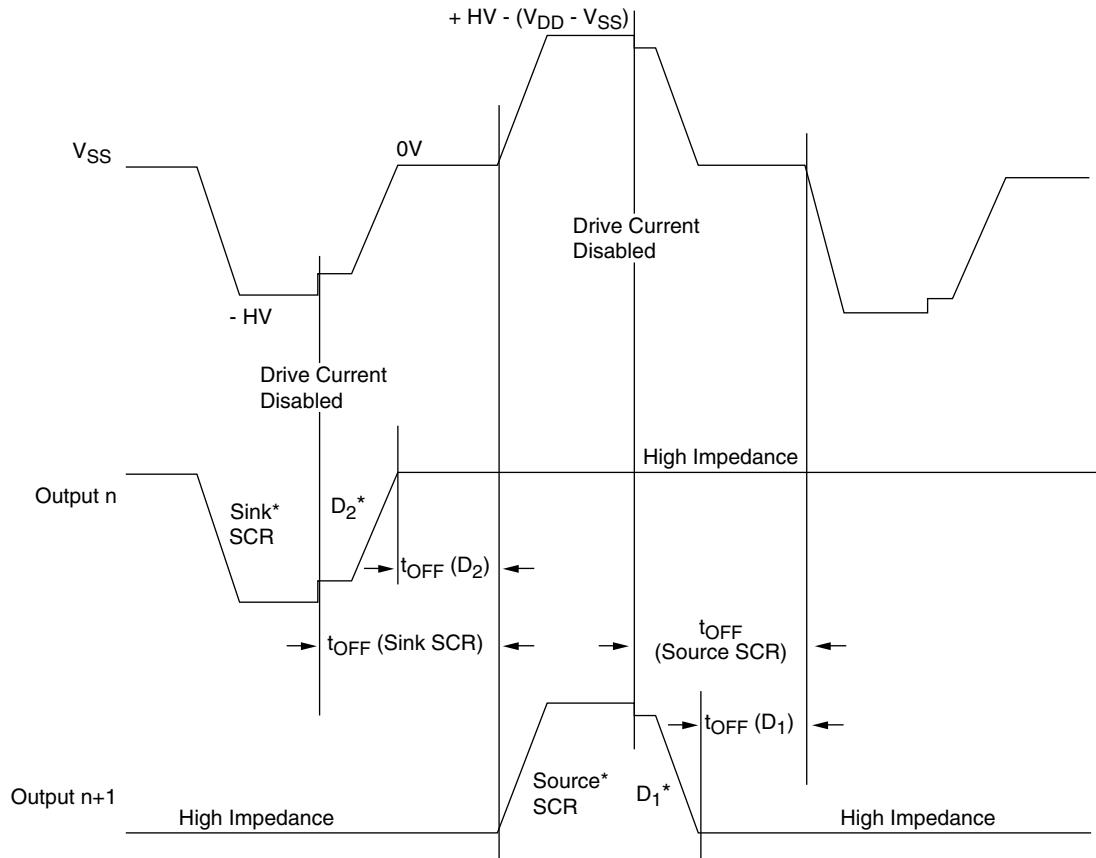


**Note:** In general, when driving the outputs positive,  $V_{sub} = +HV$ . And when driving outputs negative,  $V_{sub}$  equals most positive voltage; e.g. GND or >0V.

# HV Switching Waveforms and Operation

To drive a TFEL row with a negative pulse: The desired sink SCR is enabled and  $V_{SS}$  is connected to  $-HV$  via a current limited switch. After holding the output at the  $-HV$  level, the switch is opened in order to set the sink SCR current to zero. The row is

then discharged through a discharge diode when  $D_2$  is switched to GND. The application of a positive pulse to a row operates in a similar manner using the selected source SCR and  $D_1$ .



\* Notes internal device handling current flow. Refer to Typical Output Circuit Connections for schematic.



## Pin Configurations

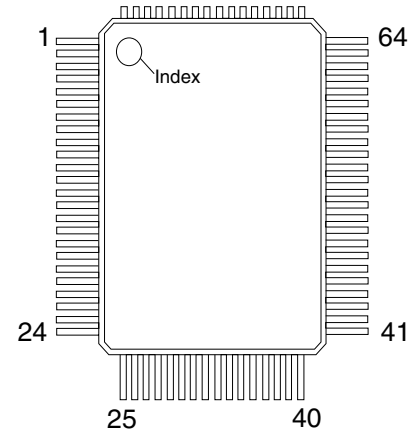
### HV506

#### Option A:

Pin	Function	Pin	Function
1	HV <sub>OUT</sub> 1	33	$\overline{OE}$
2	HV <sub>OUT</sub> 2	34	$\overline{POL}$
3	HV <sub>OUT</sub> 3	35	LV <sub>DD</sub>
4	HV <sub>OUT</sub> 4	36	V <sub>SS</sub>
5	HV <sub>OUT</sub> 5	37	V <sub>DD</sub>
6	HV <sub>OUT</sub> 6	38	LV <sub>SS</sub>
7	HV <sub>OUT</sub> 7	39	V <sub>sub</sub>
8	HV <sub>OUT</sub> 8	40	N/C
9	HV <sub>OUT</sub> 9	41	N/C
10	HV <sub>OUT</sub> 10	42	D <sub>N</sub>
11	HV <sub>OUT</sub> 11	43	D <sub>P</sub>
12	HV <sub>OUT</sub> 12	44	N/C
13	HV <sub>OUT</sub> 13	45	HV <sub>OUT</sub> 21
14	HV <sub>OUT</sub> 14	46	HV <sub>OUT</sub> 22
15	HV <sub>OUT</sub> 15	47	HV <sub>OUT</sub> 23
16	HV <sub>OUT</sub> 16	48	HV <sub>OUT</sub> 24
17	HV <sub>OUT</sub> 17	49	HV <sub>OUT</sub> 25
18	HV <sub>OUT</sub> 18	50	HV <sub>OUT</sub> 26
19	HV <sub>OUT</sub> 19	51	HV <sub>OUT</sub> 27
20	HV <sub>OUT</sub> 20	52	HV <sub>OUT</sub> 28
21	N/C	53	HV <sub>OUT</sub> 29
22	D <sub>P</sub>	54	HV <sub>OUT</sub> 30
23	D <sub>N</sub>	55	HV <sub>OUT</sub> 31
24	N/C	56	HV <sub>OUT</sub> 32
25	N/C	57	HV <sub>OUT</sub> 33
26	LV <sub>SS</sub>	58	HV <sub>OUT</sub> 34
27	V <sub>DD</sub>	59	HV <sub>OUT</sub> 35
28	DIR	60	HV <sub>OUT</sub> 36
29	V <sub>SS</sub>	61	HV <sub>OUT</sub> 37
30	CLOCK	62	HV <sub>OUT</sub> 38
31	DR <sub>IOA</sub>	63	HV <sub>OUT</sub> 39
32	DR <sub>IOB</sub>	64	HV <sub>OUT</sub> 40

**Note:** Pins 65–80 are NC.

## Package Outline



top view

3-sided Plastic 64-pin Gullwing Package