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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



64-Channel Serial to Parallel Converter with P-Channel Open Drain Controllable Output Current

Features

- ▶ HVCMOS® technology
- ▶ 5.0V CMOS Logic
- ▶ Output voltage up to -85V
- ▶ Output current source control
- ▶ 16MHz equivalent data rate
- ▶ Latched data outputs
- ▶ Forward and reverse shifting options (DIR pin)
- ▶ Diode to VDD allows efficient power recovery

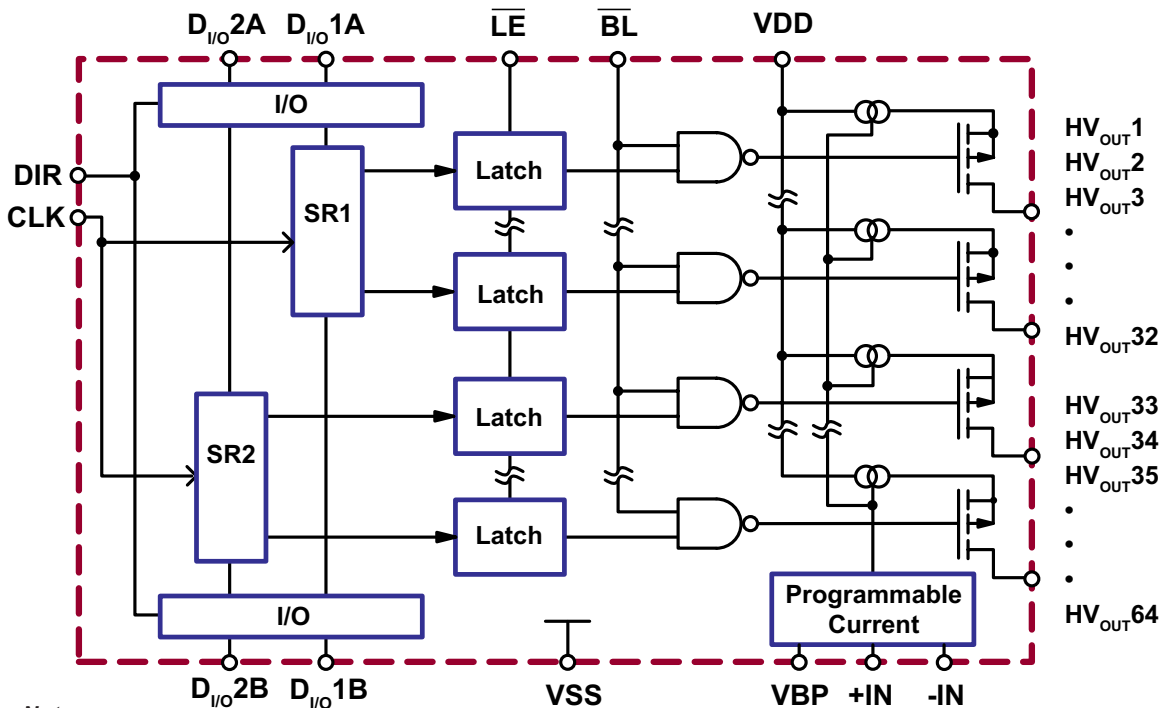
General Description

The HV57009 is a low-voltage serial to high-voltage parallel converter with P-channel open drain outputs. This device has been designed for use as a driver for plasma panels.

The device has two parallel 32-bit shift registers, permitting data rates twice the speed of one (they are clocked together). There are also 64 latches and control logic to perform the blanking of the outputs. HV_{OUT}1 is connected to the first stage of the first shift register through the blanking logic. Data is shifted through the shift registers on the logic low to high transition of the clock. The DIR pin causes CCW shifting when connected to VSS, and CW shifting when connected to VDD. A data output buffer is provided for cascading devices. This output reflects the current status of the last bit of the shift register (HV_{OUT}64). Operation of the shift register is not affected by the \overline{LE} (latch enable), or the \overline{BL} (blanking) inputs. Transfer of data from the shift registers to latches occurs when the \overline{LE} input is high. The data in the latches is stored when \overline{LE} is low.

The HV570 has 64 channels of output constant current sourcing capability. They are adjustable from 0.1 to 2.0mA through one external resistor or a current source.

Functional Block Diagram



Note: Each SR (shift register) provides 32 outputs. SR1 supplies outputs 1 to 32 and SR2 supplies outputs 33 to 64.

Ordering Information

Part Number	Package Option	Packing
HV57009PG-G	80-Lead PQFP	66/Tray

-G denotes a lead (Pb)-free / RoHS compliant package

Absolute Maximum Ratings

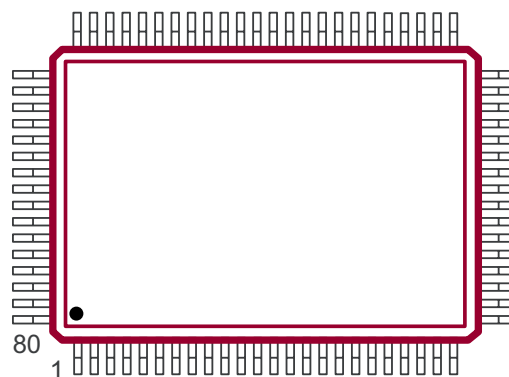
Parameter	Value
Supply voltage, V_{DD}^1	-0.5V to +7.5V
Output voltage, V_{NN}^1	$V_{DD} + 0.5V$ to -95V
Logic input levels ¹	-0.3V to $V_{DD} + 0.3V$
Ground current ²	1.5A
Continuous total power dissipation ³	1200mW
Operating temperature range	-40°C to +85°C
Storage temperature range	-65°C to +150°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability.

Notes:

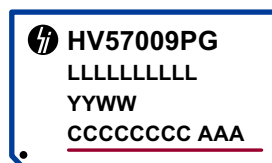
- All voltages are referenced to V_{SS} .
- Duty cycle is limited by the total power dissipated in the package.
- For operation above 25°C ambient derate linearly to maximum operating temperature at 20mW/°C.

Pin Configuration



80-Lead PQFP

Product Marking



L = Lot Number
 YY = Year Sealed
 WW = Week Sealed
 C = Country of Origin
 A = Assembler ID
 — = "Green" Packaging

Package may or may not include the following marks: Si or

80-Lead PQFP

Typical Thermal Resistance

Package	θ_{ja}
80-Lead PQFP	37°C/W

Recommended Operating Conditions

Sym	Parameter	Min	Max	Units
V_{DD}	Logic supply voltage	4.5	5.5	V
HV_{OUT}	HV output off voltage	-85	V_{DD}	V
V_{IH}	High-level input voltage	$V_{DD} - 1.2V$	V_{DD}	V
V_{IL}	Low-level input voltage	0	1.2	V
f_{CLK}	Clock frequency per register	DC	8.0 4.5	MHz
T_A	Operating free-air temperature	-40	+85	°C

Notes:

Power-up sequence should be the following:

- Connect ground
- Apply V_{DD}
- Set all inputs to a known state

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

DC Electrical Characteristics (All voltages are referenced to V_{SS} , $V_{SS} = 0$, $T_A = 25^\circ\text{C}$)

Sym	Parameter	Min	Max	Units	Conditions	
I_{DD}	V_{DD} supply current	-	15	mA	$V_{DD} = V_{DD} \text{ max}$, $f_{CLK} = 8.0\text{MHz}$	
I_{NN}	High voltage supply current	-	-10	μA	Outputs off, $HV_{OUT} = -85\text{V}$ (total of all outputs)	
I_{DDQ}	Quiescent V_{DD} supply current	-	100	μA	All inputs = V_{DD} , except $+IN = V_{SS} = \text{GND}$	
V_{OH}	High level output	Data Out	$V_{DD} - 0.5\text{V}$	-	V	$I_O = -100\mu\text{A}$
		HV_{OUT}	+1.0	V_{DD}	V	$I_O = -2.0\text{mA}$
V_{OL}	Low level output	Data Out	-	+0.5	V	$I_O = 100\mu\text{A}$
I_{IH}	High-level logic input current	-	1.0	μA	$V_{IH} = V_{DD}$	
I_{IL}	Low-level logic input current	-	-1.0	μA	$V_{IL} = 0\text{V}$	
I_{CS}	High output source current	-	-2.0	mA	$V_{REF} = 2.0\text{V}$, $R_{EXT} = 1.0\text{K}\Omega$, see Figures 1a and 1b	
		-0.1	-		$V_{REF} = 0.1\text{V}$, $R_{EXT} = 1.0\text{K}\Omega$, see Figures 1a and 1b	
ΔI_{CS}	HV output source current for $I_{REF} = 2.0\text{mA}$	-	10	%	$V_{REF} = 2.0\text{V}$, $R_{EXT} = 1.0\text{K}\Omega$	

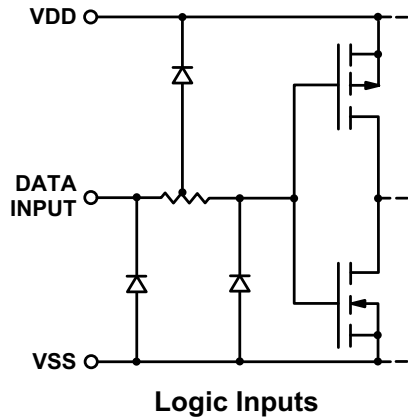
Note:

Current going out of the chip is considered negative.

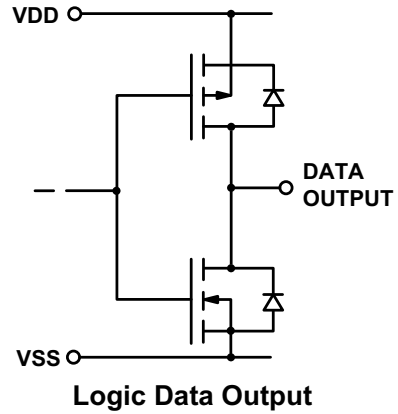
AC Electrical Characteristics (Logic signal inputs and data inputs have $t_r, t_f \leq 5\text{ns}$ [10% and 90% points] for measurements)

Sym	Parameter	Min	Max	Units	Conditions
f_{CLK}	Clock frequency	DC	8.0	MHz	Per register
			4.5		When cascading devices
t_{WL}, t_{WH}	Clock width high or low	62	-	ns	---
t_{SU}	Data set-up time before clock rises	20	-	ns	---
t_H	Data hold time after clock rises	15	-	ns	---
t_{ON}, t_{OFF}	Time from latch enable to HV_{OUT}	-	500	ns	$C_L = 15\text{pF}$
t_{DHL}	Delay time clock to data high to low	-	150	ns	$C_L = 15\text{pF}$
t_{DLH}	Delay time clock to data low to high	-	150	ns	$C_L = 15\text{pF}$
t_{DLE}	Delay time clock to \overline{LE} low to high	45	-	ns	---
t_{WLE}	\overline{LE} pulse width	25	-	ns	---
t_{SLE}	\overline{LE} set-up time before clock rises	0	-	ns	---
t_r, t_f	Max. allowable clock rise and fall time (10% and 90% points)	-	100	ns	---

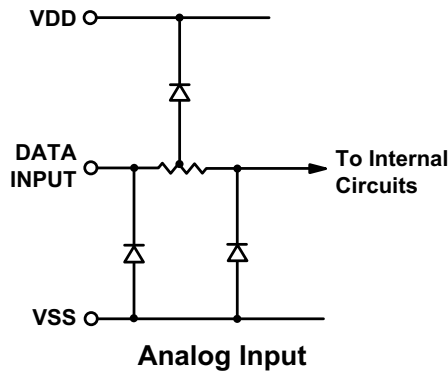
Input and Output Equivalent Circuits



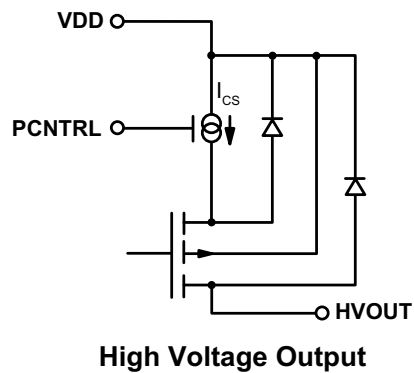
Logic Inputs



Logic Data Output

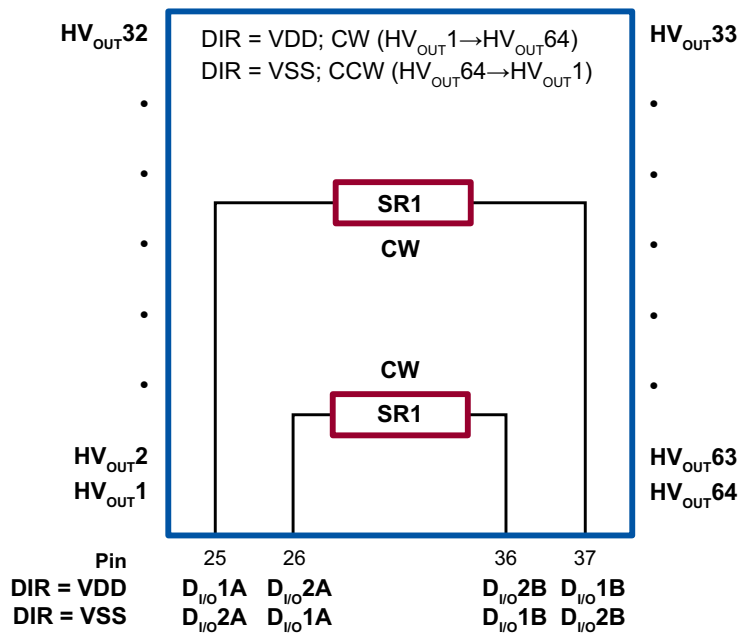


Analog Input

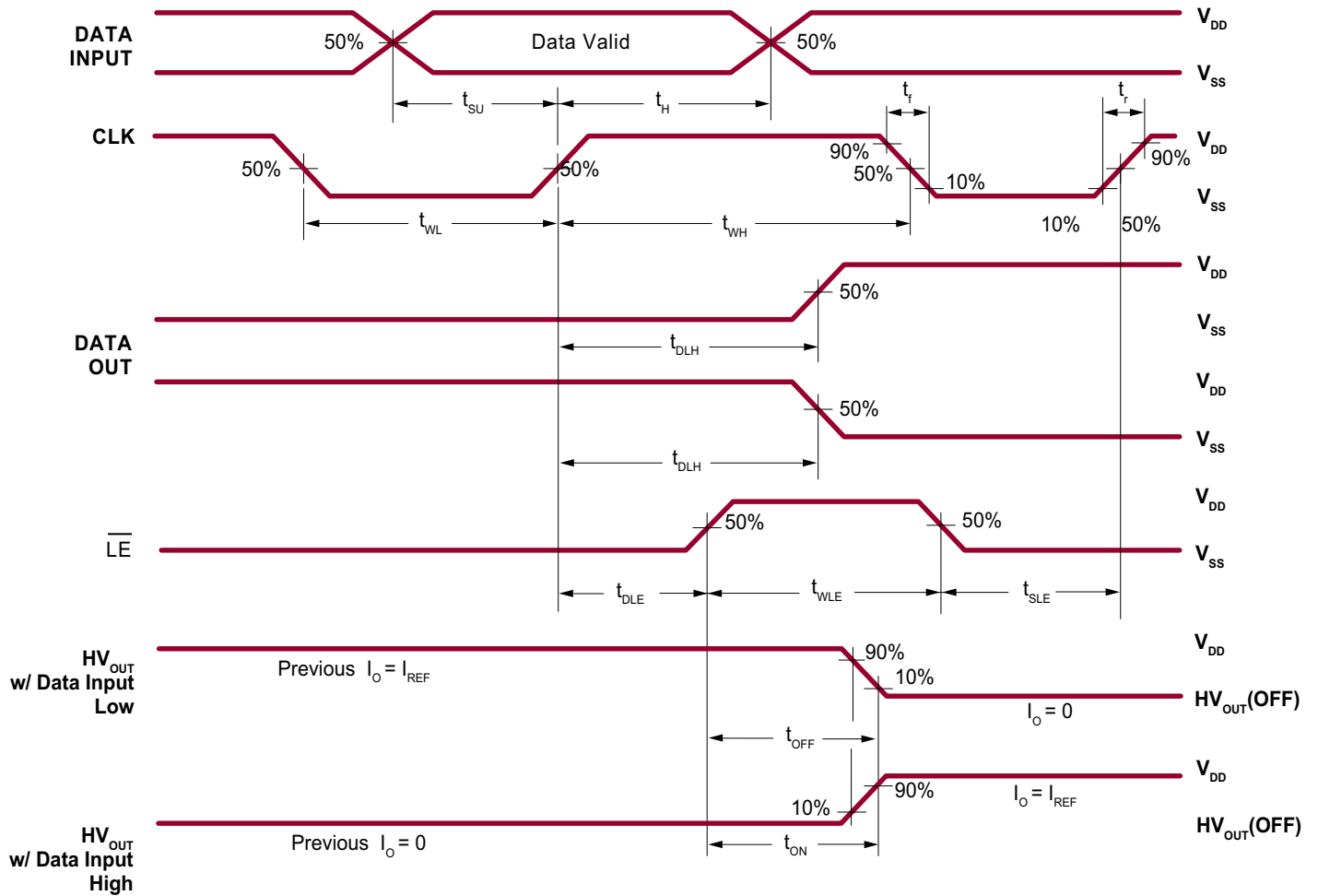


High Voltage Output

Shift Register Operation



Switching Waveforms



Function Table

Function	Inputs					Outputs		
	Data In	CLK	\overline{LE}	\overline{BL}	DIR	Shift Reg	HV Outputs	Data Out
All O/P high	X	X	X	L	X	*	ON	*
Data falls through (latches transparent)	L	$_ \uparrow _$	H	H	X	L.....L	ON	L
	H	$_ \uparrow _$	H	H	X	H.....H	OFF	H
Data stored in latches	X	X	L	H	X	*	Inversion of stored data	*
I/O relation	$D_{I/O}1-2A$	$_ \uparrow _$	H	H	H	$Q_n \rightarrow Q_{n+1}$	New ON or OFF	$D_{I/O}1-2B$
	$D_{I/O}1-2A$	$_ \uparrow _$	L	H	H	$Q_n \rightarrow Q_{n+1}$	Previous ON or OFF	$D_{I/O}1-2B$
	$D_{I/O}1-2B$	$_ \uparrow _$	L	H	L	$Q_n \rightarrow Q_{n-1}$	Previous ON or OFF	$D_{I/O}1-2A$
	$D_{I/O}1-2B$	$_ \uparrow _$	H	H	L	$Q_n \rightarrow Q_{n-1}$	New ON or OFF	$D_{I/O}1-2A$

Note:

* = dependent on previous stage's state. See Figure 7 for DIN and DOUT pin designation for CW and CCW shift.

H = V_{DD} (Logic)/ V_{NN} (HV Outputs)

L = V_{SS}

Typical Current Programing Circuits

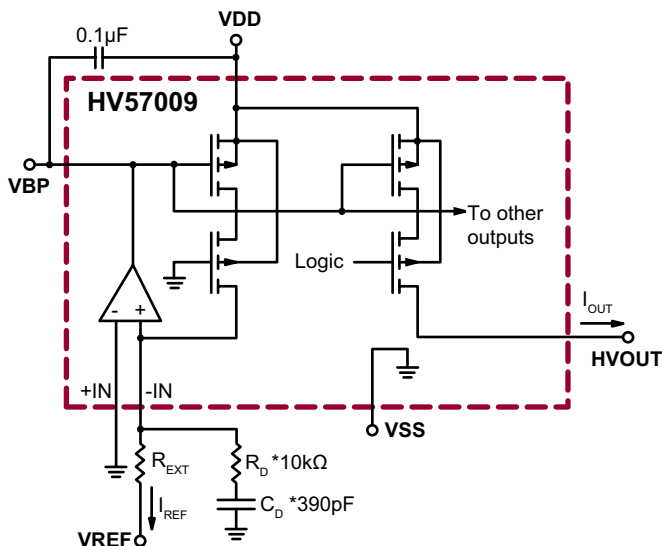


Figure 1a: Negative Control

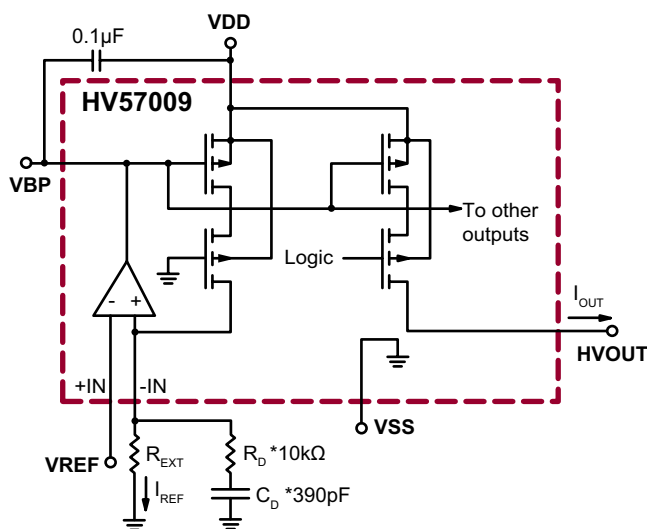


Figure 1b: Positive Control

*Required if $R_{EXT} > 10K\Omega$ or R_{EXT} is replaced by a constant current source.

Since:

$$I_{OUT} = I_{REF} = |V_{REF}| / R_{EXT}$$

Therefore:

If $I_{OUT} = 2.0mA$ and $V_{REF} = -5.0V \rightarrow R_{EXT} = 2.5K\Omega$.

If $I_{OUT} = 1.0mA$ and $R_{EXT} = 1.0K\Omega \rightarrow V_{REF} = -1.0V$.

If $R_{EXT} > 10K\Omega$, add series network R_D and C_D to ground for stability as shown.

This control method behaves linearly as long as the operational amplifier is not saturated. However, it requires a negative power source and needs to provide a current $I_{REF} = I_{OUT}$ for each HV570 chip being controlled.

If $HV_{OUT} \geq +1.0V$, the HV_{OUT} cascade may no longer operate as a perfect current source, and the output current will

diminish. This effect depends on the magnitude of the output current.

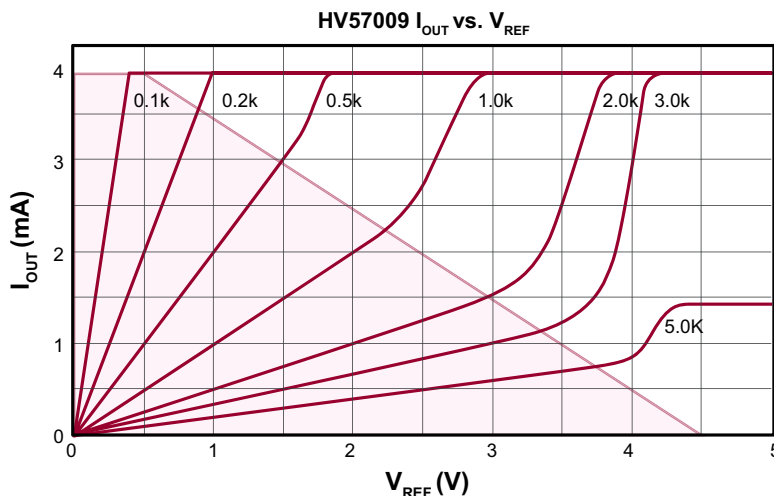
Given I_{OUT} and V_{REF} the R_{EXT} can be calculated by using:

$$R_{EXT} = V_{REF} / I_{REF} = V_{REF} / I_{OUT}$$

The intersection of a set of I_{OUT} and V_{REF} values can be located in the graph shown below. The value picked for R_{EXT} must always be in the shaded area for linear operation. This control method has the advantage that V_{REF} is positive, and draws only leakage current. If $R_{EXT} > 10K\Omega$, add series network R_D and C_D to ground for stability as shown.

Note:

Lower reference current I_{REF} results in higher distortion, ΔI_{CS} , on the output.



Pin Function

Pin #	Function
1	HV _{OUT} 24
2	HV _{OUT} 23
3	HV _{OUT} 22
4	HV _{OUT} 21
5	HV _{OUT} 20
6	HV _{OUT} 19
7	HV _{OUT} 18
8	HV _{OUT} 17
9	HV _{OUT} 16
10	HV _{OUT} 15
11	HV _{OUT} 14
12	HV _{OUT} 13
13	HV _{OUT} 12
14	HV _{OUT} 11
15	HV _{OUT} 10
16	HV _{OUT} 9
17	HV _{OUT} 8
18	HV _{OUT} 7
19	HV _{OUT} 6
20	HV _{OUT} 5

Pin #	Function
21	HV _{OUT} 4
22	HV _{OUT} 3
23	HV _{OUT} 2
24	HV _{OUT} 1
25	D _{I/O} 1A
26	D _{I/O} 2A
27	NC
28	NC
29	$\overline{\text{LE}}$
30	CLK
31	$\overline{\text{BL}}$
32	VSS
33	DIR
34	VDD
35	-IN
36	D _{I/O} 2B
37	D _{I/O} 1B
38	NC
39	+IN
40	VBP

Pin #	Function
41	HV _{OUT} 64
42	HV _{OUT} 63
43	HV _{OUT} 62
44	HV _{OUT} 61
45	HV _{OUT} 60
46	HV _{OUT} 59
47	HV _{OUT} 58
48	HV _{OUT} 57
49	HV _{OUT} 56
50	HV _{OUT} 55
51	HV _{OUT} 54
52	HV _{OUT} 53
53	HV _{OUT} 52
54	HV _{OUT} 51
55	HV _{OUT} 50
56	HV _{OUT} 49
57	HV _{OUT} 48
58	HV _{OUT} 47
59	HV _{OUT} 46
60	HV _{OUT} 45

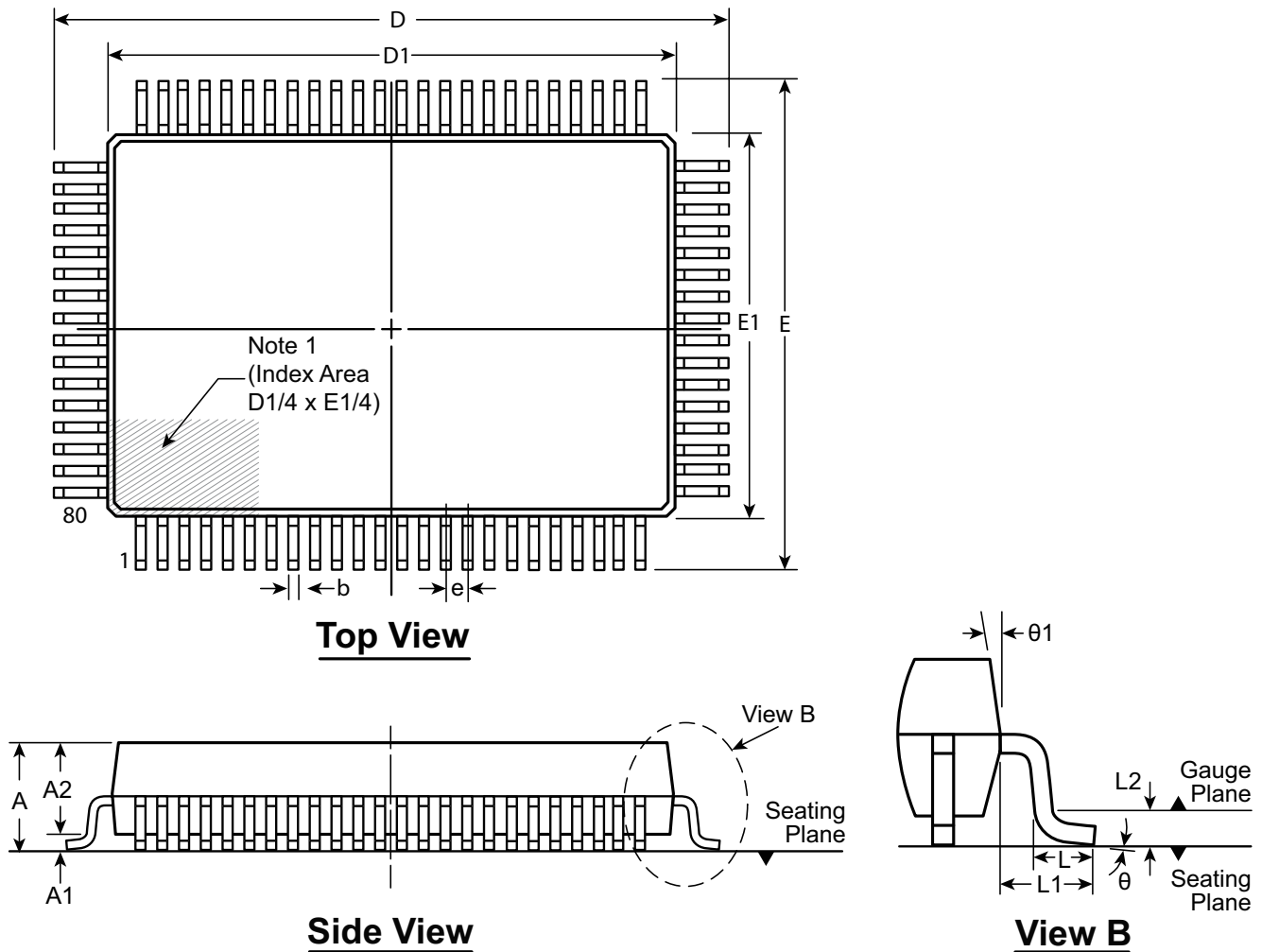
Pin #	Function
61	HV _{OUT} 44
62	HV _{OUT} 43
63	HV _{OUT} 42
64	HV _{OUT} 41
65	HV _{OUT} 40
66	HV _{OUT} 39
67	HV _{OUT} 38
68	HV _{OUT} 37
69	HV _{OUT} 36
70	HV _{OUT} 35
71	HV _{OUT} 34
72	HV _{OUT} 33
73	HV _{OUT} 32
74	HV _{OUT} 31
75	HV _{OUT} 30
76	HV _{OUT} 29
77	HV _{OUT} 28
78	HV _{OUT} 27
79	HV _{OUT} 26
80	HV _{OUT} 25

Notes:

1. Pin designation for DIR = VDD.
2. A 0.1 μ F capacitor is needed between VDD and VBP (pin 40) for better output current stability and to prevent transient cross-coupling between outputs. See Figures 1a and 1b.

80-Lead PQFP Package Outline (PG)

20.00x14.00mm body, 3.40mm height (max), 0.80mm pitch, 3.90mm footprint



- Note:**
1. A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.

Symbol	A	A1	A2	b	D	D1	E	E1	e	L	L1	L2	θ	θ1	
Dimension (mm)	MIN	2.80*	0.25	2.55	0.30	23.65*	19.80*	17.65*	13.80*	0.80 BSC	0.73	1.95 REF	0.25 BSC	0°	5°
	NOM	-	-	2.80	-	23.90	20.00	17.90	14.00		0.88			3.5°	-
	MAX	3.40	0.50*	3.05	0.45	24.15*	20.20*	18.15*	14.20*		1.03			7°	16°

JEDEC Registration MO-112, Variation CB-1, Issue B, Sept. 1995.

* This dimension is not specified in the JEDEC drawing.

Drawings not to scale.

Supertex Doc. #: DSPD-80PQFPPG, Version C041309.

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to <http://www.supertex.com/packaging.html>.)

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