



# HV5308 / HV5408

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## 32-Channel, Serial-to-Parallel Converter with High-Voltage Push-Pull Outputs

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### Features

- Processed with High-Voltage CMOS technology
- Low power-level shifting
- Source/sink current minimum 20mA
- Shift register speed 8.0 MHz
- Latched data outputs
- CMOS compatible inputs
- Forward and reverse shifting options
- Diode to  $V_{PP}$  allows efficient power recovery

### Description

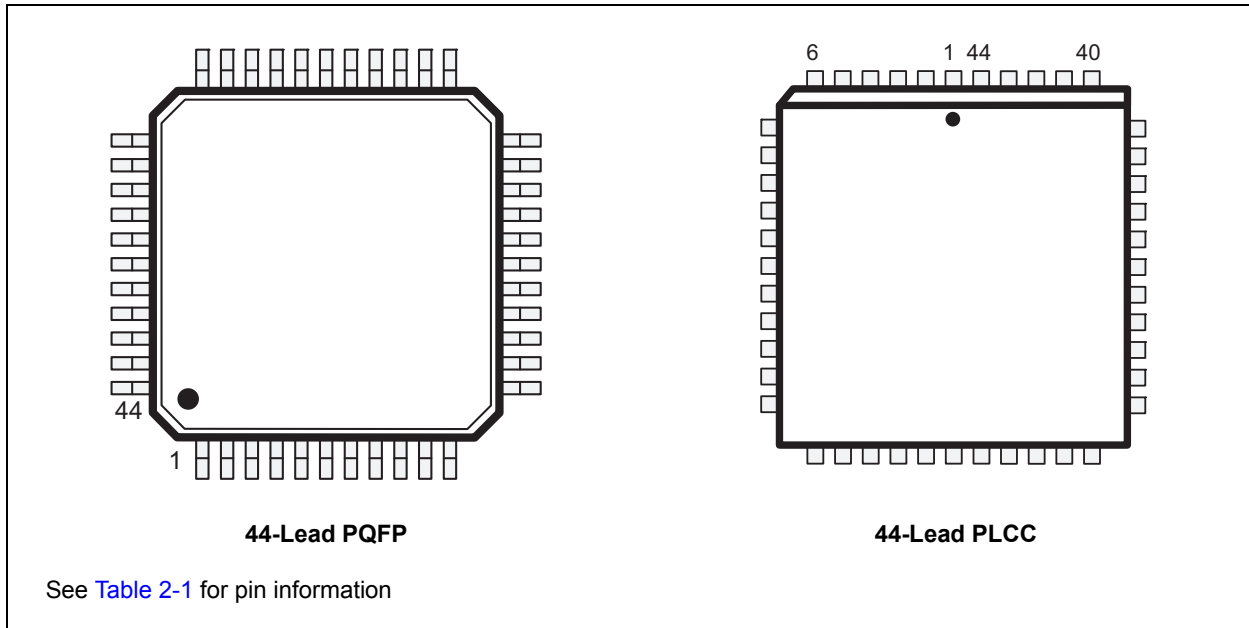
HV5308 and HV5408 are low-voltage serial to high-voltage parallel converters with push-pull outputs. These devices have been designed for use as a driver for AC-electroluminescent displays. HV5308 / HV5408 can also be used in any application requiring multiple output high-voltage, current sourcing, and sinking capabilities such as driving plasma panels, vacuum fluorescent, or large matrix LCD displays.

These devices consist of a 32-bit shift register, 32 latches, and control logic to enable outputs. Data is shifted through the shift register on the low-to-high transition of the clock. HV5308 shifts in the clockwise direction, when viewed from the top of the package, and HV5408 shifts in the counter-clockwise direction.

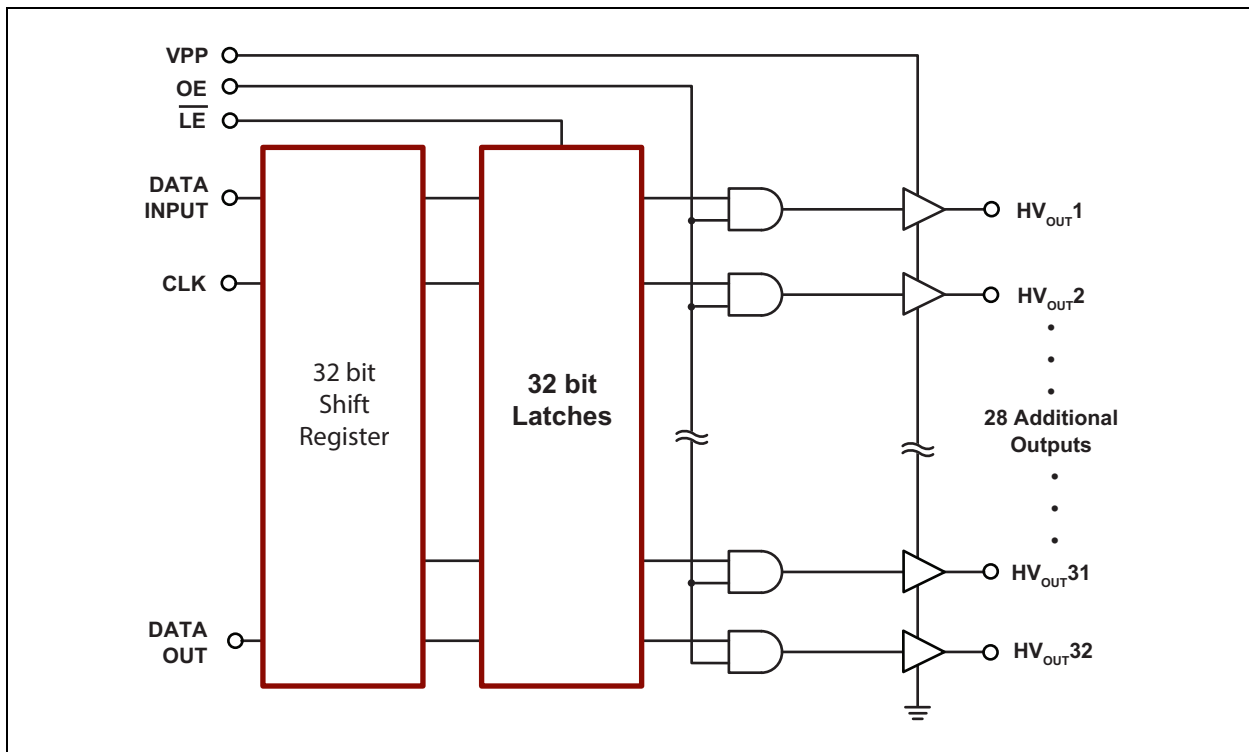
A data output buffer is provided for cascading devices. This output reflects the current status of the last bit of the shift register (32). Operation of the shift register is not affected by the  $\overline{LE}$  (latch enable) or the OE (output enable) inputs. Transfer of data from the shift register to the latch occurs when the  $\overline{LE}$  input is high. The data in the latch is retained when LE is low.

# HV5308 / HV5408

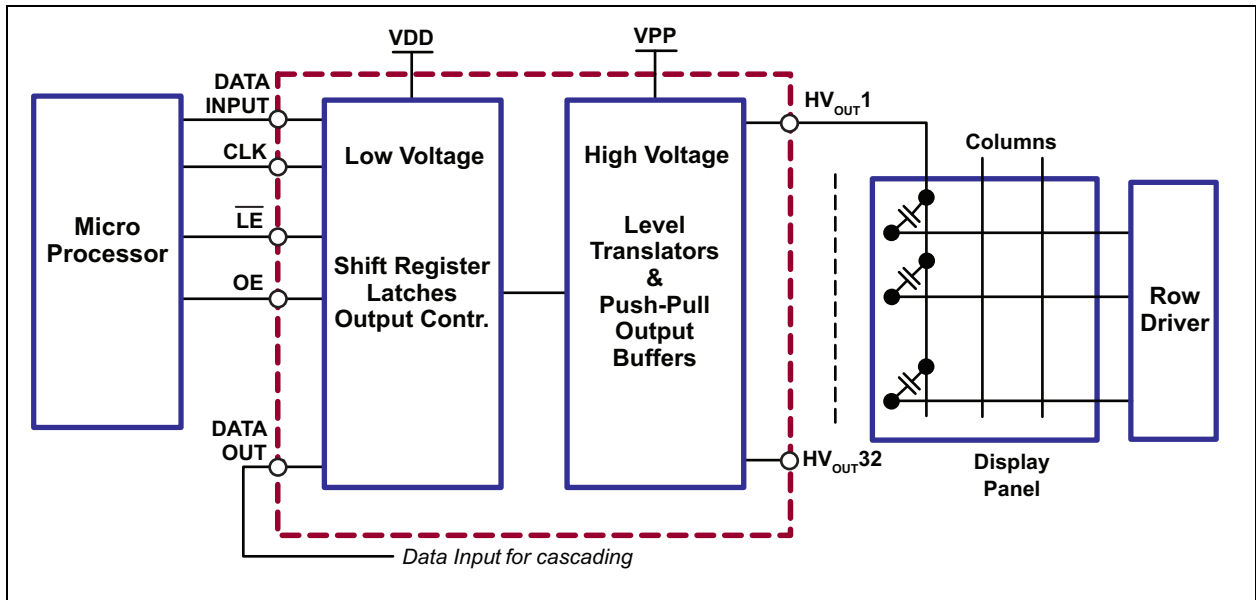
## Package Type



## Functional Block Diagram



## Typical Application Circuit



# HV5308 / HV5408

## 1.0 ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS†

Supply voltage, $V_{DD}$ .....	-0.5V to +16V
Supply voltage, $V_{PP}$ .....	-0.5V to +90V
Logic input levels .....	-0.5V to $V_{DD}+0.5V$
Ground current <sup>1</sup> .....	1.5A
Continuous total power dissipation <sup>2</sup> .....	1200mW
Operating temperature range .....	-40°C to +85°C
Storage temperature range .....	-65°C to +150°C

† **Notice:** Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

- 1: Duty cycle is limited by the total power dissipated in the package.
- 2: For operation above 25°C ambient derate linearly to maximum operating temperature at 20mW/°C.

### ELECTRICAL CHARACTERISTICS

Electrical Specifications: $V_{PP} = 60V$ , $V_{DD} = 12V$ , $T_A = 25^\circ C$						
Parameter	Symbol	Min	Max	Units	Conditions	
<b>DC Characteristics</b>						
$V_{PP}$ supply current	$I_{PP}$	-	0.5	mA	HV <sub>OUTPUTS</sub> high to low	
$I_{DD}$ supply current (quiescent)	$I_{DDQ}$	-	100	μA	All inputs = $V_{DD}$ or GND	
$I_{DD}$ supply current (operating)	$I_{DD}$	-	15	mA	$V_{DD} = V_{DD} \text{ max}$ , $f_{CLK} = 8.0\text{MHz}$	
High level logic input current	$I_{IH}$	-	1.0	μA	$V_{IN} = V_{DD}$	
Low level logic input current	$I_{IL}$	-	-1.0	μA	$V_{IN} = 0$	
High level output voltage	HV <sub>OUT</sub>	$V_{OH}$	52	-	V	$I_{OH} = -20\text{mA}$ , -40 to 85°C $I_{OH} = -15\text{mA}$ , -55 to 125°C
	Data out		10.5	-	V	$I_O = -100\mu A$
Low level output voltage	HV <sub>OUT</sub>	$V_{OL}$	-	8.0	V	$I_{OL} = 20\text{mA}$ , -40 to 85°C $I_{OL} = 15\text{mA}$ , -55 to 125°C
	Data out		-	1.0	V	$I_O = 100\mu A$
HV output clamp diode voltage	$V_{OC}$	-	-1.5	V	$I_{OL} = -100\text{mA}$	
<b>AC Characteristics</b>						
Clock frequency	$f_{CLK}$	-	8.0	MHz	---	
Clock width, High or Low	$t_{WL}$ or $t_{WH}$	62	-	ns	---	
Setup time before CLK rises	$t_{SU}$	25	-	ns	---	
Hold time after CLK rises	$t_H$	10	-	ns	---	
Data output delay after L to H CLK	$t_{DLH}$ (Data)	-	110	ns	$C_L = 15\text{pF}$ , (Note 1)	
Data output delay after H to L CLK	$t_{DHL}$ (Data)	-	110	ns	$C_L = 15\text{pF}$ , (Note 1)	
$\overline{LE}$ delay after L to H CLK	$t_{DLE}$	50	-	ns	(Note 1)	
Width of $\overline{LE}$ pulse	$t_{WLE}$	50	-	ns	---	
$\overline{LE}$ setup time before L to H CLK	$t_{SLE}$	50	-	ns	(Note 1)	
Delay from $\overline{LE}$ to HV <sub>OUT</sub> , L to H	$t_{ON}$	-	500	ns	(Note 1)	
Delay from $\overline{LE}$ to HV <sub>OUT</sub> , H to L	$t_{OFF}$	-	500	ns	(Note 1)	

**Note 1:** L to H = Low to High; H to L = High to Low.

## TEMPERATURE SPECIFICATIONS

Electrical Specifications: Unless otherwise specified, for all specifications $T_A = T_J = +25^\circ\text{C}$						
Parameter	Symbol	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Operating Temperature		-40	–	85	$^\circ\text{C}$	
Storage Temperature		-65	–	150	$^\circ\text{C}$	
<b>Package Thermal Resistances</b>						
Thermal Resistance, 44-Lead PQFP	$\theta_{ja}$	–	51	–	$^\circ\text{C/W}$	
Thermal Resistance, 44-Lead PLCC	$\theta_{ja}$	–	37	–	$^\circ\text{C/W}$	

# HV5308 / HV5408

## 2.0 PIN DESCRIPTION

The locations of the pins are listed in [Package Type](#).

**TABLE 2-1: PIN DESCRIPTION PQFP**

Pin #	HV5308	HV5408	Description
1	HV <sub>OUT22</sub>	HV <sub>OUT11</sub>	High voltage outputs. High voltage push-pull outputs, which, depending on controlling low voltage data, can drive loads either to GND, or to V <sub>PP</sub> rail levels.
2	HV <sub>OUT21</sub>	HV <sub>OUT12</sub>	
3	HV <sub>OUT20</sub>	HV <sub>OUT13</sub>	
4	HV <sub>OUT19</sub>	HV <sub>OUT14</sub>	
5	HV <sub>OUT18</sub>	HV <sub>OUT15</sub>	
6	HV <sub>OUT17</sub>	HV <sub>OUT16</sub>	
7	HV <sub>OUT16</sub>	HV <sub>OUT17</sub>	
8	HV <sub>OUT15</sub>	HV <sub>OUT18</sub>	
9	HV <sub>OUT14</sub>	HV <sub>OUT19</sub>	
10	HV <sub>OUT13</sub>	HV <sub>OUT20</sub>	
11	HV <sub>OUT12</sub>	HV <sub>OUT21</sub>	
12	HV <sub>OUT11</sub>	HV <sub>OUT22</sub>	
13	HV <sub>OUT10</sub>	HV <sub>OUT23</sub>	
14	HV <sub>OUT9</sub>	HV <sub>OUT24</sub>	
15	HV <sub>OUT8</sub>	HV <sub>OUT25</sub>	
16	HV <sub>OUT7</sub>	HV <sub>OUT26</sub>	
17	HV <sub>OUT6</sub>	HV <sub>OUT27</sub>	
18	HV <sub>OUT5</sub>	HV <sub>OUT28</sub>	
19	HV <sub>OUT4</sub>	HV <sub>OUT29</sub>	
20	HV <sub>OUT3</sub>	HV <sub>OUT30</sub>	
21	HV <sub>OUT2</sub>	HV <sub>OUT31</sub>	
22	HV <sub>OUT1</sub>	HV <sub>OUT32</sub>	
23	DATA OUT	DATA OUT	Serial data output. Data output for cascading to the data input of the next device.
24	N/C	N/C	No connect.
25			
26			
27	CLK	CLK	Data shift register clock Input are shifted into the shift register on the positive edge of the clock.
28	GND	GND	Logic and high voltage ground
29	VPP	VPP	High voltage power rail.
30	VDD	VDD	Low voltage logic power rail.
31	$\overline{LE}$	$\overline{LE}$	Latch enable input. When $\overline{LE}$ is High, shift register data is transferred into a data latch. When $\overline{LE}$ is Low, data is latched, and new data can be clocked into the shift register.
32	DATA IN	DATA IN	Serial data input. Data needs to be present before each rising edge of the clock.
33	OE	OE	Output enable input. When OE is Low, all HV outputs are forced into a Low state, regardless of data in each channel. When OE is High, all HV outputs reflect data latched.
34	N/C	N/C	No connect.

# HV5308 / HV5408

**TABLE 2-1: PIN DESCRIPTION PQFP (CONTINUED)**

Pin #	HV5308	HV5408	Description
35	HV <sub>OUT</sub> 32	HV <sub>OUT</sub> 1	High voltage outputs. High voltage push-pull outputs, which, depending on controlling low voltage data, can drive loads either to GND, or to V <sub>PP</sub> rail levels.
36	HV <sub>OUT</sub> 31	HV <sub>OUT</sub> 2	
37	HV <sub>OUT</sub> 30	HV <sub>OUT</sub> 3	
38	HV <sub>OUT</sub> 29	HV <sub>OUT</sub> 4	
39	HV <sub>OUT</sub> 28	HV <sub>OUT</sub> 5	
40	HV <sub>OUT</sub> 27	HV <sub>OUT</sub> 6	
41	HV <sub>OUT</sub> 26	HV <sub>OUT</sub> 7	
42	HV <sub>OUT</sub> 25	HV <sub>OUT</sub> 8	
43	HV <sub>OUT</sub> 24	HV <sub>OUT</sub> 9	
44	HV <sub>OUT</sub> 23	HV <sub>OUT</sub> 10	

**TABLE 2-2: PIN DESCRIPTION PLCC**

Pin #	HV5308	HV5408	Description
1	HV <sub>OUT</sub> 17	HV <sub>OUT</sub> 16	High voltage outputs. High voltage push-pull outputs, which, depending on controlling low voltage data, can drive loads either to GND, or to V <sub>PP</sub> rail levels.
2	HV <sub>OUT</sub> 16	HV <sub>OUT</sub> 17	
3	HV <sub>OUT</sub> 15	HV <sub>OUT</sub> 18	
4	HV <sub>OUT</sub> 14	HV <sub>OUT</sub> 19	
5	HV <sub>OUT</sub> 13	HV <sub>OUT</sub> 20	
6	HV <sub>OUT</sub> 12	HV <sub>OUT</sub> 21	
7	HV <sub>OUT</sub> 11	HV <sub>OUT</sub> 22	
8	HV <sub>OUT</sub> 10	HV <sub>OUT</sub> 23	
9	HV <sub>OUT</sub> 9	HV <sub>OUT</sub> 24	
10	HV <sub>OUT</sub> 8	HV <sub>OUT</sub> 25	
11	HV <sub>OUT</sub> 7	HV <sub>OUT</sub> 26	
12	HV <sub>OUT</sub> 6	HV <sub>OUT</sub> 27	
13	HV <sub>OUT</sub> 5	HV <sub>OUT</sub> 28	
14	HV <sub>OUT</sub> 4	HV <sub>OUT</sub> 29	
15	HV <sub>OUT</sub> 3	HV <sub>OUT</sub> 30	
16	HV <sub>OUT</sub> 2	HV <sub>OUT</sub> 31	
17	HV <sub>OUT</sub> 1	HV <sub>OUT</sub> 32	
18	DATA OUT	DATA OUT	Serial data output. Data output for cascading to the data input of the next device.
19	N/C	N/C	No connect.
20			
21			
22	CLK	CLK	Data shift register clock Input are shifted into the shift register on the positive edge of the clock.
23	GND	GND	Logic and high voltage ground
24	V <sub>PP</sub>	V <sub>PP</sub>	High voltage power rail.
25	V <sub>DD</sub>	V <sub>DD</sub>	Low voltage logic power rail.
26	LE	LE	Latch enable input. When $\overline{LE}$ is High, shift register data is transferred into a data latch. When $\overline{LE}$ is Low, data is latched, and new data can be clocked into the shift register.

# HV5308 / HV5408

**TABLE 2-2: PIN DESCRIPTION PLCC (CONTINUED)**

Pin #	HV5308	HV5408	Description
27	DATA IN	DATA IN	Serial data input. Data needs to be present before each rising edge of the clock.
28	OE	OE	Output enable input. When OE is Low, all HV outputs are forced into a LOW state, regardless of data in each channel. When OE is High, all HV outputs reflect data latched.
29	N/C	N/C	No connect.
30	HVOUT32	HV <sub>OUT1</sub>	High voltage outputs. High voltage push-pull outputs, which, depending on controlling low voltage data, can drive loads either to GND, or to V <sub>PP</sub> rail levels.
31	HVOUT31	HV <sub>OUT2</sub>	
32	HVOUT30	HV <sub>OUT3</sub>	
33	HVOUT29	HV <sub>OUT4</sub>	
34	HVOUT28	HV <sub>OUT5</sub>	
35	HVOUT27	HV <sub>OUT6</sub>	
36	HVOUT26	HV <sub>OUT7</sub>	
37	HVOUT25	HV <sub>OUT8</sub>	
38	HVOUT24	HV <sub>OUT9</sub>	
39	HVOUT23	HV <sub>OUT10</sub>	
40	HVOUT22	HV <sub>OUT11</sub>	
41	HVOUT21	HV <sub>OUT12</sub>	
42	HVOUT20	HV <sub>OUT13</sub>	
43	HVOUT19	HV <sub>OUT14</sub>	
44	HVOUT18	HV <sub>OUT15</sub>	



## 3.0 FUNCTIONAL DESCRIPTION

Table 3-1 provides functional information about HV5308 / HV5408.

**TABLE 3-1: FUNCTIONAL TABLE CLK**

DATA IN	CLK	DATA OUT
H	↑	H
L	↑	L
X	No ↑	No change

**Note:** H = High level, L = Low level, ↑ = Low-to-High transition

**TABLE 3-2: FUNCTIONAL TABLE  $\overline{LE}$ , OE**

DATA IN	$\overline{LE}$	OE	HV <sub>OUT</sub>
X	X	L	All HV <sub>OUT</sub> = Low
X	L	H	Previous latched data
H	H	H	H
L	H	H	L

**Note:** H = High level, L = Low level, X= Don't Care

**TABLE 3-3: RECOMMENDED OPERATING CONDITIONS (-40°C to 85°C)**

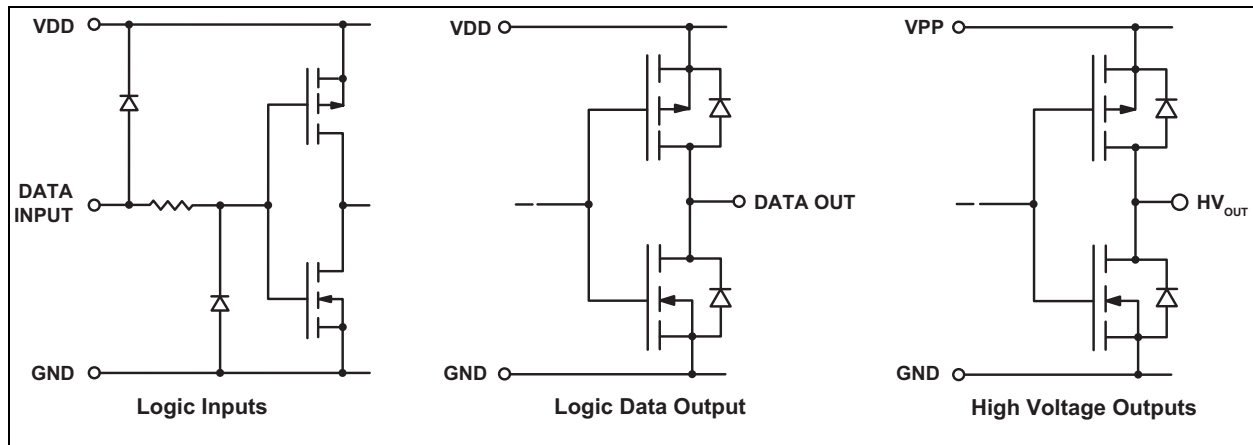
Symbol	Parameter	Min	Max	Units
V <sub>DD</sub>	Logic voltage supply	10.8	13.2	V
V <sub>PP</sub>	High voltage supply	8.0	80	V
V <sub>IH</sub>	Input high voltage	V <sub>DD</sub> - 2.0	V <sub>DD</sub>	V
V <sub>IL</sub>	Input low voltage	0	2.0	V
f <sub>CLK</sub>	Clock frequency	0	8.0	MHz

## 3.1 Power-Up and Recommended Operating Conditions

To power-up HV5308 / HV5408, perform the following power-up sequence:

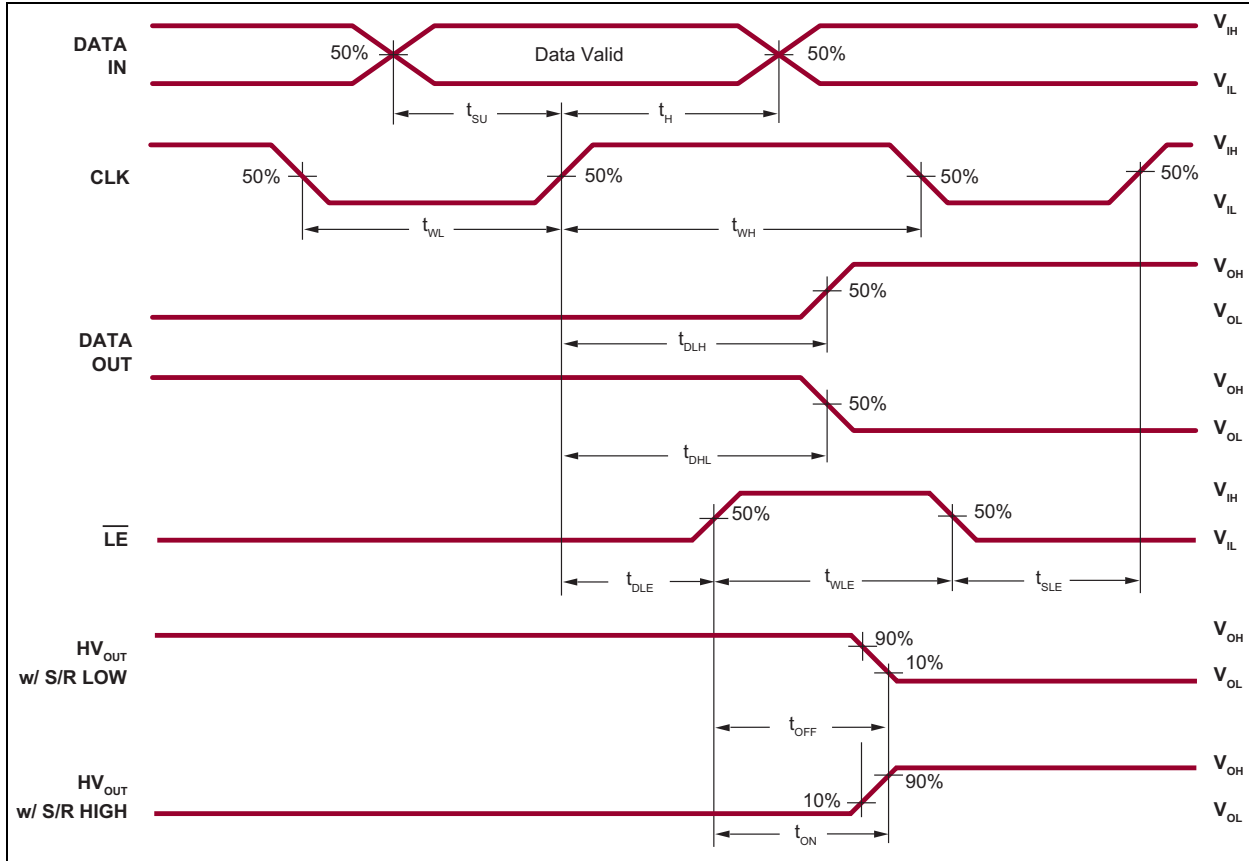
1. Connect ground
2. Apply V<sub>DD</sub>
3. Set all inputs (Data, CLK,  $\overline{LE}$ , etc.) to a known state
4. Apply V<sub>PP</sub>
5. The V<sub>PP</sub> should not fall below V<sub>DD</sub> or float during operation.

To power-down the device, reverse the steps above.



**FIGURE 3-1:** Input and Output Equivalent Circuits

# HV5308 / HV5408

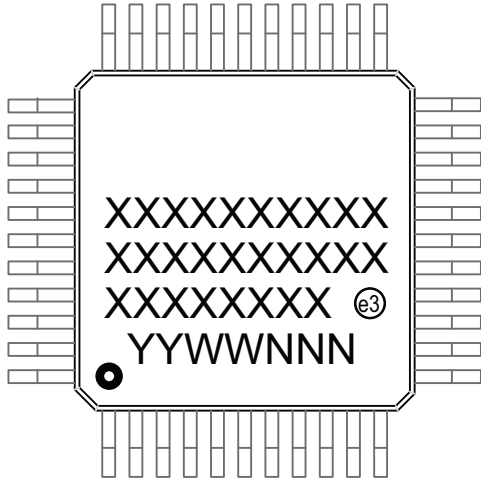


**FIGURE 3-2:** Switching Waveforms

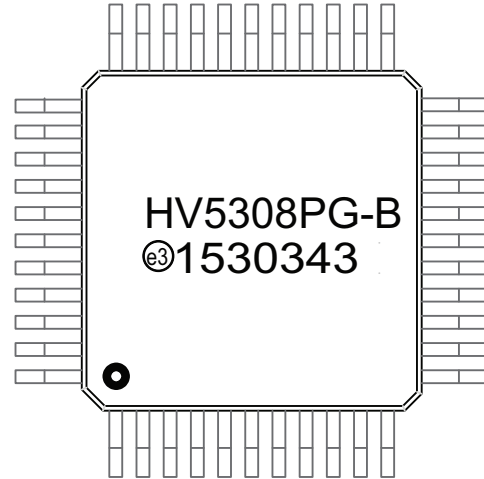
## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

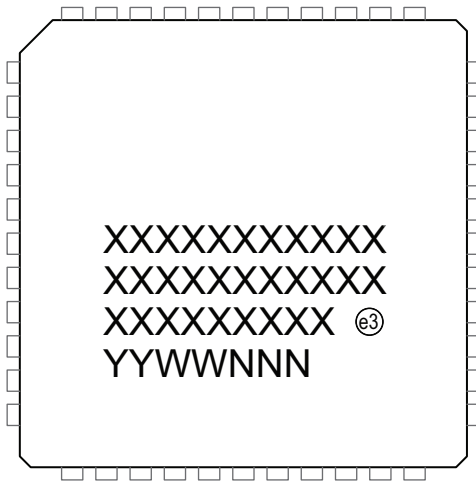
44-lead PQFP



Example



44-lead PLCC



Example

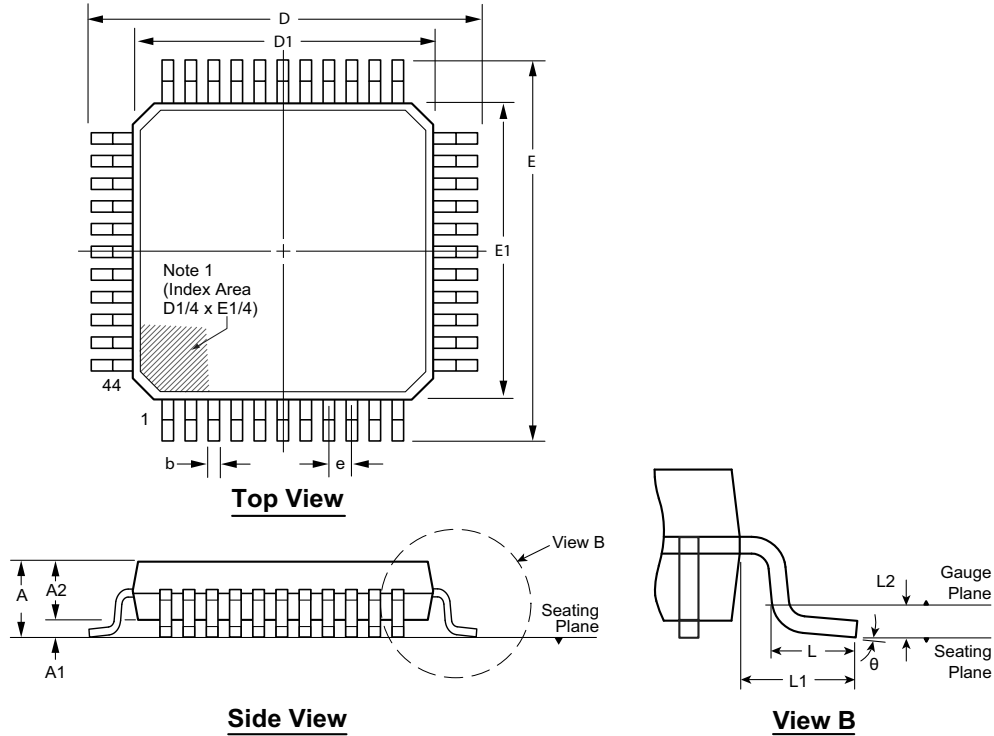


<b>Legend:</b>	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.
<b>Note:</b> In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.		

# HV5308 / HV5408

## 44-Lead PQFP Package Outline (PG)

10.00x10.00mm body, 2.35mm height (max), 0.80mm pitch



Note: For the most current package drawings, see the Microchip Packaging Specification at [www.microchip.com/packaging](http://www.microchip.com/packaging).

**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.

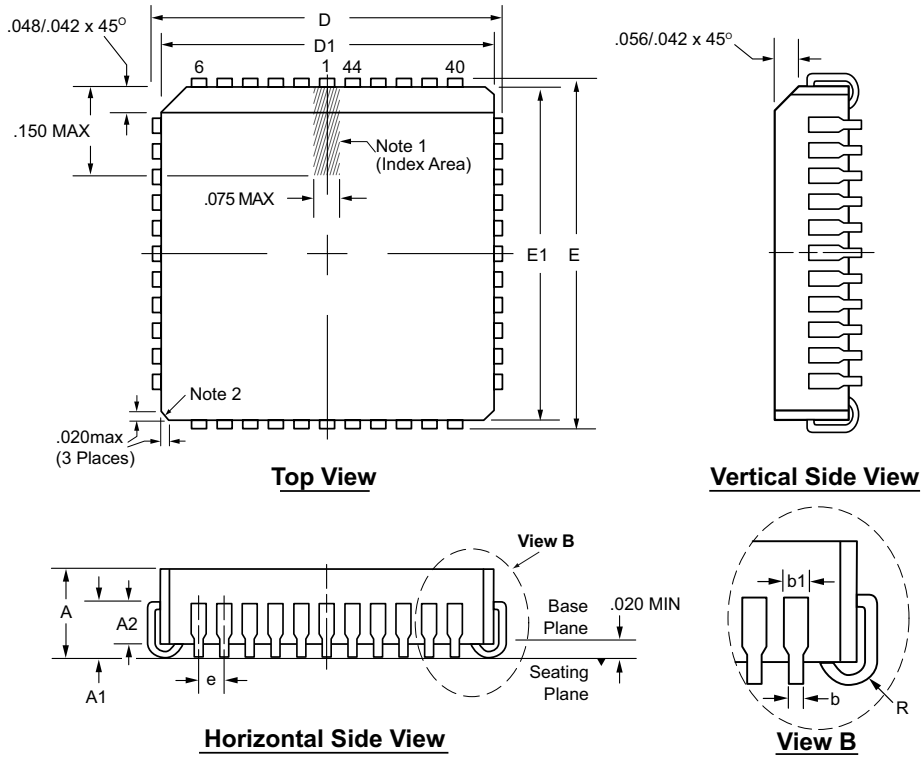
Symbol	A	A1	A2	b	D	D1	E	E1	e	L	L1	L2	$\theta$	
Dimension (mm)	MIN	1.95*	0.00	1.95	0.30	13.65*	9.80*	13.65*	9.80*	0.80 BSC	0.73	1.95 REF	0.25 BSC	0°
	NOM	-	-	2.00	-	13.90	10.00	13.90	10.00		0.88		3.5°	
	MAX	2.35	0.25	2.10	0.45	14.15*	10.20*	14.15*	10.20*		1.03		7°	

JEDEC Registration MO-112, Variation AA-2, Issue B, Sep.1995.

\* This dimension is not specified in the JEDEC drawing.

Drawings not to scale.

## 44-Lead PLCC Package Outline (PJ) .653x.653in body, .180in height (max), .050in pitch



Note: For the most current package drawings, see the Microchip Packaging Specification at [www.microchip.com/packaging](http://www.microchip.com/packaging).

**Notes:**

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.
2. Actual shape of this feature may vary.

Symbol	A	A1	A2	b	b1	D	D1	E	E1	e	R
Dimension (inches)	MIN	.165	.090	.062	.013	.685	.650	.685	.650	.050 BSC	.025
	NOM	.172	.105	-	-	.690	.653	.690	.653		.035
	MAX	.180	.120	.083	.021	.695	.656	.695	.656		.045

JEDEC Registration MS-018, Variation AC, Issue A, June, 1993.

† This dimension differs from the JEDEC drawing.

Drawings not to scale.

# HV5308 / HV5408

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## APPENDIX A: REVISION HISTORY

### Revision A (December 2015)

- Updated file to Microchip format

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>XX</u> -	<u>X</u>	-	<u>X</u>	-	<u>X</u>
Device	Package Options	Version		Environmental		Media Type
<p>Device:</p> <p>HV5308 = 32-Channel Serial to Parallel Converter, with High-voltage Push-pull Outputs data shifts in clockwise direction</p> <p>HV5408 = 32-Channel Serial to Parallel Converter, with High-voltage Push-pull Outputs data shifts in counter-clockwise direction</p> <p>Package:</p> <p>PG = 44-Lead PQFP</p> <p>PJ = 44-Lead PLCC</p> <p>Version</p> <p>B = Revision B</p> <p>Environmental</p> <p>G = Lead (Pb)-free/ROHS-compliant package</p> <p>Media Type:</p> <p>(blank) = 96/Tray for PG package</p> <p>= 27/Tube for PJ package</p> <p>M903 = 500/Reel for PG package</p> <p>M919 = 500/Reel for PJ package</p>	<p><b>Examples:</b></p> <p>a) HV5308PG-B-G Clockwise data shift, 44-Lead PQFP package, 96/Tray</p> <p>b) HV5308PG-B-G-M919 Clockwise data shift, 44-Lead PQFP package, 500/Reel</p> <p>c) HV5308PJ-B-G Clockwise data shift, 44-Lead PLCC package, 27/Tube</p> <p>d) HV5308PJ-B-G-M903 Clockwise data shift, 44-Lead PLCC package, 500/Reel</p> <p>e) HV5408PG-B-G Counter-clockwise data shift, 44-Lead PQFP package, 96/Tray</p> <p>f) HV5408PJ-B-G Counter-clockwise data shift, 44-Lead PLCC package, 27/Tube</p>					

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*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC<sup>®</sup> MCUs and dsPIC<sup>®</sup> DSCs, KEELOQ<sup>®</sup> code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*





# MICROCHIP

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