

32-Channel Serial-to-Parallel Converter with Open Drain Outputs

Features

- 100 mA Minimum Sink Current
- 8 MHz Shift Register Speed
- Polarity and Blanking Inputs
- CMOS-compatible Inputs
- Forward and Reverse Shifting Options
- Diode to V_{PP} allows Efficient Power Recovery

Applications

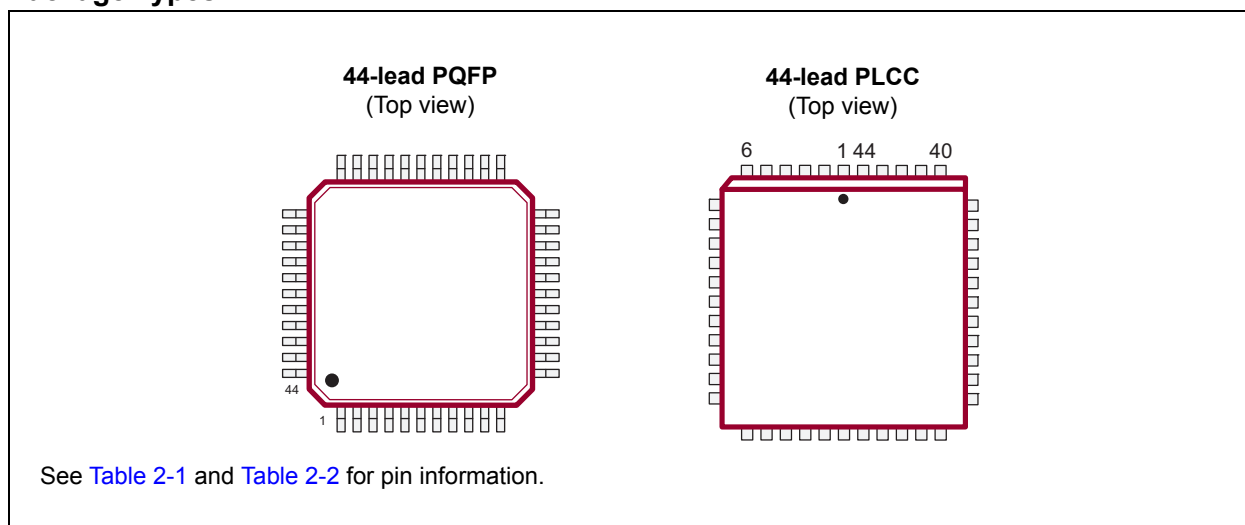
- Inkjet and Electrostatic Print Heads
- AC-electroluminescent Displays
- Microelectromechanical Systems Applications

General Description

The HV5522 is a low-voltage to high-voltage serial-to-parallel converter with open drain outputs. This device is designed as a driver for AC electroluminescent displays. It can also be used in any application requiring multiple-output high-voltage current sinking capabilities, such as driving inkjet and electrostatic print heads, plasma panels, vacuum fluorescent and large matrix LCD displays.

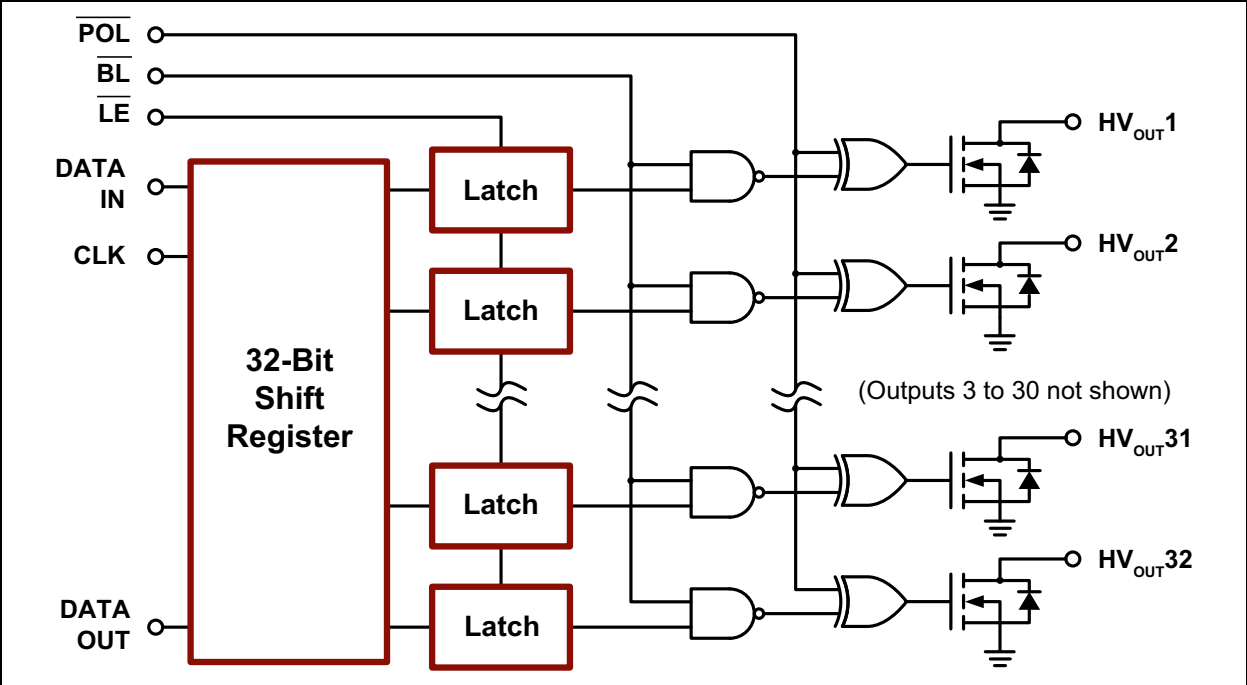
This device consists of a 32-bit Shift register, 32 latches and control logic to perform the polarity select and blanking of the outputs. Data is shifted through the Shift register on the high-to-low transition of the clock. The HV5522 shifts the data counter clockwise when viewed from the top of the package. A data output buffer is provided for cascading devices. This output reflects the current status of the last bit of the Shift register. The operation of the Shift register is not affected by the latch enable ($\overline{LE}$), blanking ($\overline{BL}$) and polarity ($\overline{POL}$) inputs. The transfer of data from the Shift register to the latch occurs when the $\overline{LE}$ input is high. The data in the latch is stored when $\overline{LE}$ is low.

Package Types

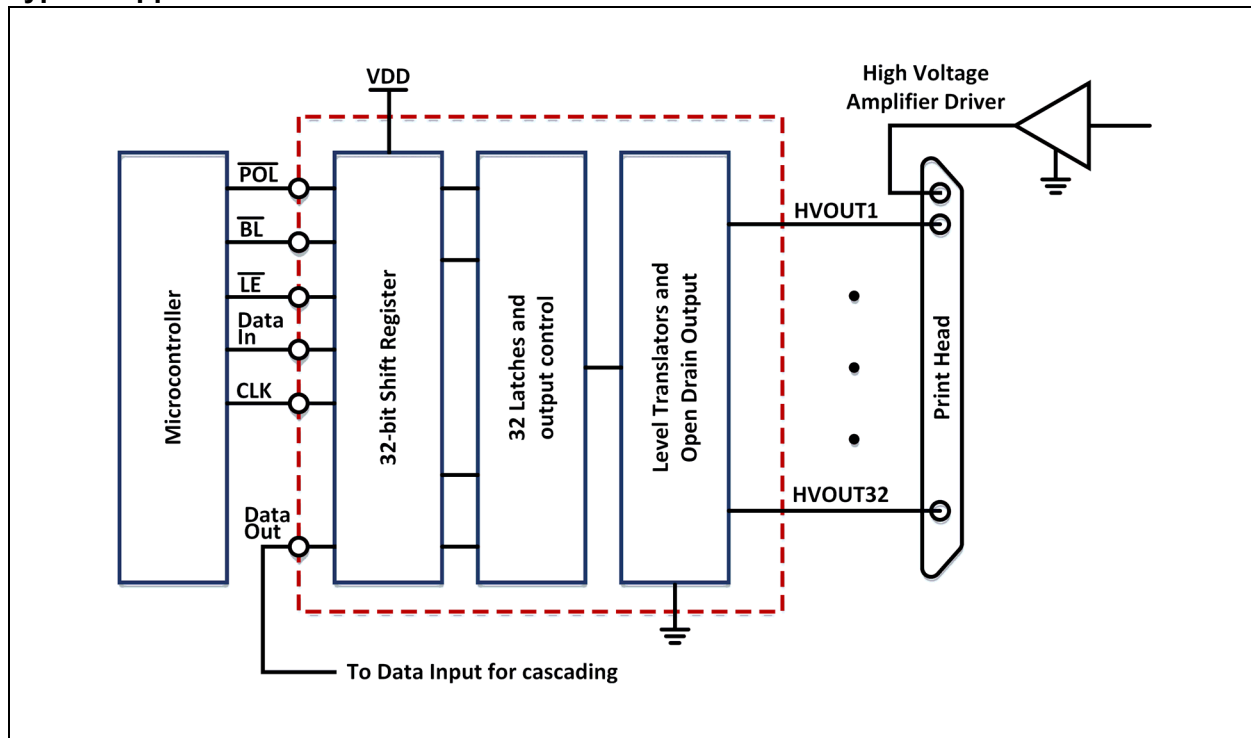


HV5522

Functional Block Diagram



Typical Application Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Supply Voltage, V_{DD} (Note 1)	–0.5V to +15V
Output Voltage, V_{PP} (Note 1)	–0.5V to +230V
Logic Input Levels (Note 1)	–0.5V to $V_{DD}+0.5V$
Ground Current (Note 2)	1.5A
Operating Ambient Temperature, T_A	–40°C to +85°C
Storage Temperature, T_S	–65°C to +150°C
Continuous Total Power Dissipation:	
44-lead PQFP (Note 3)	1200 mW
44-lead PLCC (Note 3)	1200 mW

† **Notice:** Stresses above those listed under “Absolute 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 sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

- Note 1:** All voltages are referenced to V_{SS} .
Note 2: Duty cycle is limited by the total power dissipated in the package.
Note 3: For operations above 25°C ambient, derate linearly to the maximum operating temperature of 20 mW/°C.

RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Logic Supply Voltage	V_{DD}	10.8	—	13.2	V	
High-voltage Output Voltage	HV_{OUT}	–0.3	—	220	V	
High-level Input Voltage	V_{IH}	$V_{DD}-2$	—	V_{DD}	V	
Low-level Input Voltage	V_{IL}	0	—	2	V	
Clock Frequency	f_{CLK}	—	—	8	MHz	
Operating Ambient Temperature	T_A	–40	—	+85	°C	

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over recommended operating conditions unless otherwise noted.							
Parameter		Sym.	Min.	Typ.	Max.	Unit	Conditions
V _{DD} Supply Current		I _{DD}	—	—	15	mA	f _{CLK} = 8 MHz, f _{DATA} = 4 MHz
Quiescent V _{DD} Supply Current		I _{DDQ}	—	—	100	μA	V _{IN} = 0V
Off State Output Current		I _{O(OFF)}	—	—	10	μA	All outputs high, all SWS parallel
High-level Logic Input Current		I _{IH}	—	—	1	μA	V _{IH} = V _{DD}
Low-level Logic Input Current		I _{IL}	—	—	−1	μA	V _{IL} = 0V
High-level Output Data Out		V _{OH}	V _{DD} −1V	—	—	V	I _{DOUT} = −100 μA
Low-level Output Voltage	HV _{OUT}	V _{OL}	—	—	15	V	I _{HVOUT} = 100 mA
	Data Out		—	—	1	V	I _{DOUT} = 100 μA
HV _{OUT} Clamp Voltage		V _{OC}	—	—	−1.5	V	I _{OL} = −100 mA

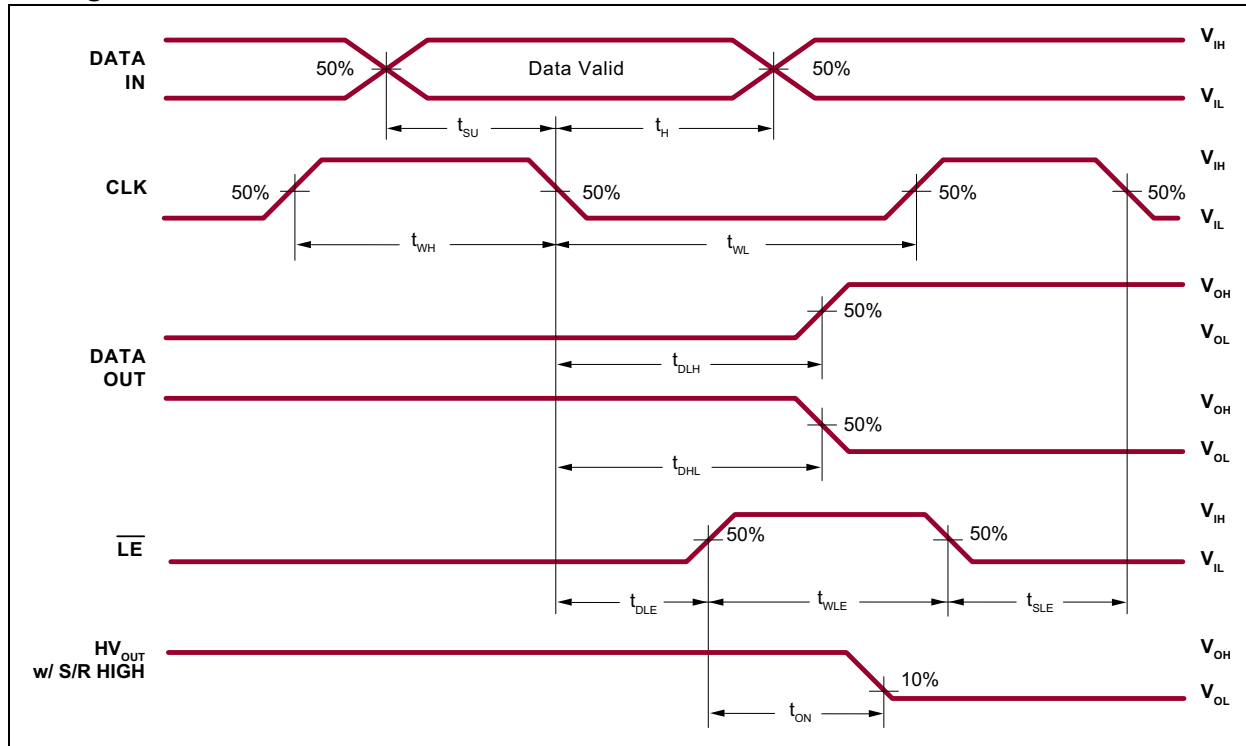
AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: V _{DD} = 12V, T _A = 25°C						
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Clock Frequency	f _{CLK}	—	—	8	MHz	
Clock Width, High or Low	t _{WL} , t _{WH}	62	—	—	ns	
Data Set-up Time before Clock Falls	t _{SU}	25	—	—	ns	
Data Hold Time after Clock Falls	t _H	10	—	—	ns	
Turn-on Time, HV _{OUT} from Enable	t _{ON}	—	—	500	ns	R _L = 2 kΩ to V _{PP} maximum
Delay Time Clock to Data High to Low	t _{DHL}	—	—	100	ns	C _L = 15 pF
Delay Time Clock to Data Low to High	t _{DLH}	—	—	100	ns	C _L = 15 pF
Delay Time Clock to Latch Enable Low to High	t _{DLE}	50	—	—	ns	
Latch Enable Pulse Width	t _{WLE}	50	—	—	ns	
Latch Enable Setup Time before Clock Falls	t _{SLE}	50	—	—	ns	

TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
TEMPERATURE RANGE						
Operating Ambient Temperature	T _A	-40	—	+85	°C	
Storage Temperature	T _S	-65	—	+150	°C	
PACKAGE THERMAL RESISTANCE						
44-lead PQFP	θ _{JA}	—	51	—	°C/W	
44-lead PLCC	θ _{JA}	—	37	—	°C/W	

Timing Waveforms



2.0 PIN DESCRIPTION

The details on the pins of HV5522 44-lead PQFP and 44-lead PLCC are listed on [Table 2-1](#) and [Table 2-2](#), respectively. Refer to [Package Types](#) for the location of pins.

TABLE 2-1: 44-LEAD PQFP PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	HVOUT11	High-voltage output
2	HVOUT12	High-voltage output
3	HVOUT13	High-voltage output
4	HVOUT14	High-voltage output
5	HVOUT15	High-voltage output
6	HVOUT16	High-voltage output
7	HVOUT17	High-voltage output
8	HVOUT18	High-voltage output
9	HVOUT19	High-voltage output
10	HVOUT20	High-voltage output
11	HVOUT21	High-voltage output
12	HVOUT22	High-voltage output
13	HVOUT23	High-voltage output
14	HVOUT24	High-voltage output
15	HVOUT25	High-voltage output
16	HVOUT26	High-voltage output
17	HVOUT27	High-voltage output
18	HVOUT28	High-voltage output
19	HVOUT29	High-voltage output
20	HVOUT30	High-voltage output
21	HVOUT31	High-voltage output
22	HVOUT32	High-voltage output
23	DATA OUT	Data output pin
24	NC	No connection
25	NC	No connection
26	NC	No connection
27	$\overline{\text{POL}}$	Inverts the polarity of the HVOUT pins
28	CLK	Clock pin. Shift registers shift data on the falling edge of input clock.
29	VSS	Reference voltage (usually ground)
30	VDD	Logic supply voltage
31	$\overline{\text{LE}}$	Latch enable pin. Data is shifted from the Shift register to the latches on logic input high.
32	DATA IN	Data input pin
33	$\overline{\text{BL}}$	This blanking pin sets all HVOUT pins low or high, depending on the state of polarity. See Table 3-2 .
34	NC	No connection

TABLE 2-1: 44-LEAD PQFP PIN FUNCTION TABLE (CONTINUED)

Pin Number	Pin Name	Description
35	HVOUT1	High-voltage output
36	HVOUT2	High-voltage output
37	HVOUT3	High-voltage output
38	HVOUT4	High-voltage output
39	HVOUT5	High-voltage output
40	HVOUT6	High-voltage output
41	HVOUT7	High-voltage output
42	HVOUT8	High-voltage output
43	HVOUT9	High-voltage output
44	HVOUT10	High-voltage output

TABLE 2-2: 44-LEAD PLCC PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	HVOUT16	High-voltage output
2	HVOUT17	High-voltage output
3	HVOUT18	High-voltage output
4	HVOUT19	High-voltage output
5	HVOUT20	High-voltage output
6	HVOUT21	High-voltage output
7	HVOUT22	High-voltage output
8	HVOUT23	High-voltage output
9	HVOUT24	High-voltage output
10	HVOUT25	High-voltage output
11	HVOUT26	High-voltage output
12	HVOUT27	High-voltage output
13	HVOUT28	High-voltage output
14	HVOUT29	High-voltage output
15	HVOUT30	High-voltage output
16	HVOUT31	High-voltage output
17	HVOUT32	High-voltage output
18	DATA OUT	Data output pin
19	NC	No connection
20	NC	No connection
21	NC	No connection
22	$\overline{\text{POL}}$	Inverts the polarity of the HVOUT pins
23	CLK	Clock pin. Shift registers shift data on the falling edge of the input clock.
24	VSS	Reference voltage (usually ground)
25	VDD	Logic supply voltage
26	$\overline{\text{LE}}$	Latch enable pin. Data is shifted from the Shift register to the latches on logic input high.

TABLE 2-2: 44-LEAD PLCC PIN FUNCTION TABLE (CONTINUED)

Pin Number	Pin Name	Description
27	DATA IN	Data input pin
28	$\overline{\text{BL}}$	This blanking pin sets all HVOUT pins low or high, depending on the state of polarity. See Table 3-2 .
29	NC	No connection
30	HVOUT1	High-voltage output
31	HVOUT2	High-voltage output
32	HVOUT3	High-voltage output
33	HVOUT4	High-voltage output
34	HVOUT5	High-voltage output
35	HVOUT6	High-voltage output
36	HVOUT7	High-voltage output
37	HVOUT8	High-voltage output
38	HVOUT9	High-voltage output
39	HVOUT10	High-voltage output
40	HVOUT11	High-voltage output
41	HVOUT12	High-voltage output
42	HVOUT13	High-voltage output
43	HVOUT14	High-voltage output
44	HVOUT15	High-voltage output

3.0 FUNCTIONAL DESCRIPTION

Follow the steps in Table 3-1 to power up and power down the HV5522.

TABLE 3-1: POWER-UP AND POWER-DOWN SEQUENCE

Power-up		Power-down	
Step	Description	Step	Description
1	Connect ground.	1	Remove all inputs.
2	Apply V _{DD} .	2	Remove V _{DD} .
3	Set all inputs to a known state.	3	Disconnect ground.

TABLE 3-2: TRUTH FUNCTION TABLE

Function	Inputs					Outputs								
	Data	CLK	$\overline{\text{LE}}$	$\overline{\text{BL}}$	$\overline{\text{POL}}$	Shift Register				High-voltage Output				Data Out
						1	2	...	32	1	2	...	32	
All On	X	X	X	L	L	p1	p2	...	p32	On	On	...	On	d
All Off	X	X	X	L	H	p1	p2	...	p32	Off	Off	...	Off	d
Invert Mode	X	X	L	H	L	p1	p2	...	p32	$\overline{\text{p1}}$	$\overline{\text{p2}}$	...	$\overline{\text{p32}}$	d
Load S/R	H or L	↓	L	H	H	H or L	p1	...	p31	p1	p2	...	p32	p32
Load Latches	X	H or L	↑	H	H	p1	p2	...	p32	p1	p2	...	p32	d
	X	H or L	↑	H	L	p1	p2	...	p32	$\overline{\text{p1}}$	$\overline{\text{p2}}$	...	$\overline{\text{p32}}$	d
Transparent Latch Mode	L	↓	H	H	H	L	p1	...	p31	Off	p1	...	p31	p32
	H	↓	H	H	H	H	p1	...	p31	On	p1	...	p31	p32

Note: H = High-logic level
L = Low-logic level
X = Irrelevant
↓ = High-to-low transition
↑ = Low-to-high transition
d = Current state of the data output
pn = “p” represents the current state of the Shift register output, and
“n” represents the channel order.

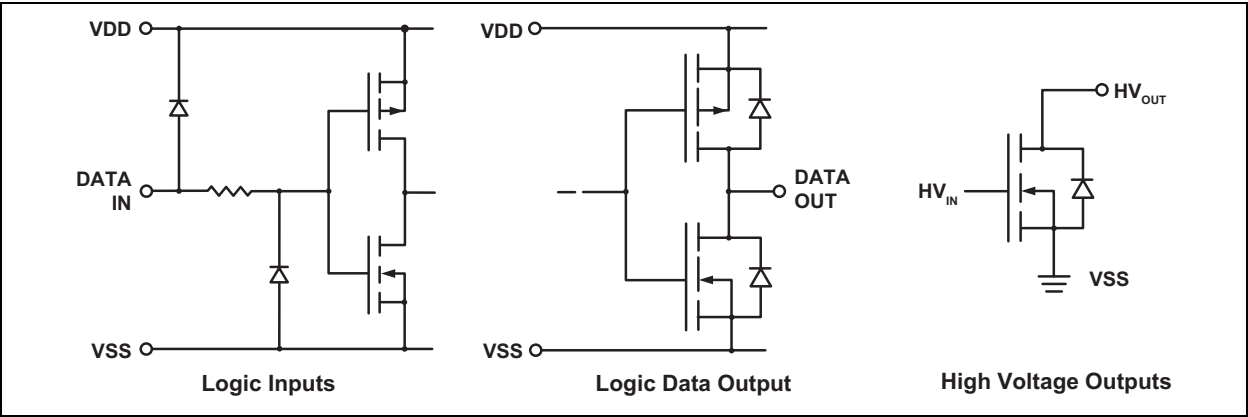
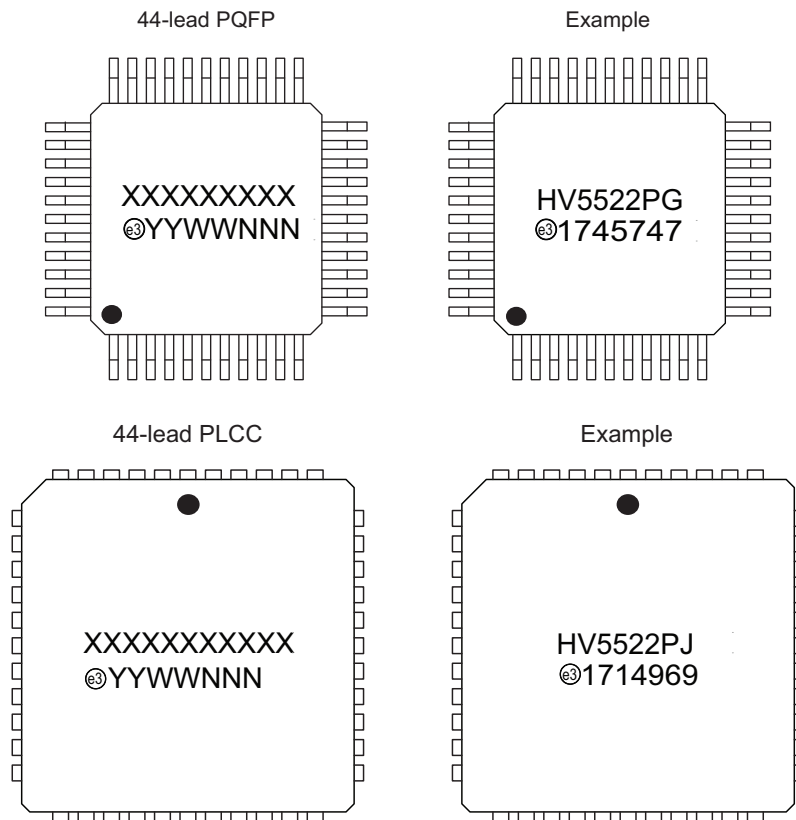


FIGURE 3-1: Input and Output Equivalent Circuits.

4.0 PACKAGE MARKING INFORMATION

4.1 Packaging Information

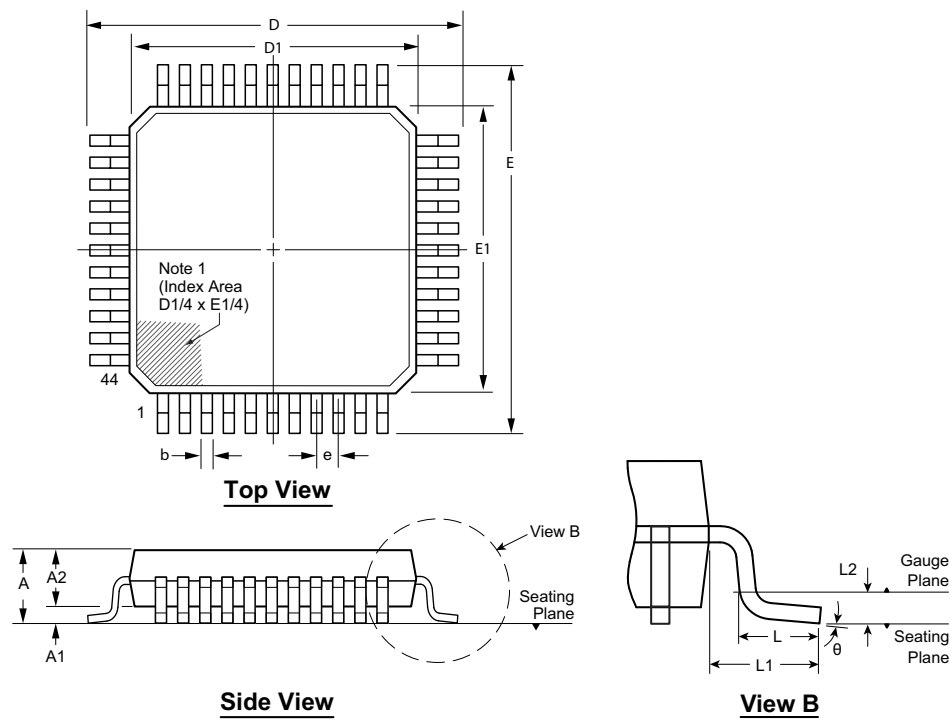


Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	e3	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

Note: 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.

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.

- Note:**
- 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
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.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (October 2017)

- Converted Supertex Doc# DSFP-HV5522 to Microchip DS20005699A
- Changed the package marking format
- Removed the 44-lead PQFP PG M919 and 44-lead PLCC PJ M903 media types
- Made minor changes throughout the document

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>PART NO.</u>	<u>XX</u>	-	<u>X</u>	-	<u>X</u>
Device	Package Options		Environmental		Media Type
Device:	HV5522	=	32-Channel Serial-to-Parallel Converter with Open Drain Outputs		
Packages:	PG	=	44-lead PQFP		
	PJ	=	44-lead PLCC		
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package		
Media Type:	(blank)	=	96/Tray for a PG Package		
	(blank)	=	27/Tube for a PJ Package		

Examples:

a) HV5522PG-G: 32-Channel Serial-to-Parallel Converter with Open Drain Outputs, 44-lead PQFP, 96/Tray

b) HV5522PJ-G: 32-Channel Serial-to-Parallel Converter with Open Drain Outputs, 44-lead PLCC, 27/Tube

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

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® MCUs and dsPIC® DSCs, KEELOQ® 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.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949 ==

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, AVR, AVR logo, AVR Freaks, BeaconThings, BitCloud, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, Helder, JukeBlox, KEELOQ, KEELOQ logo, Klear, LANCheck, LINK MD, maxStylus, maxTouch, MediaLB, megaAVR, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, Prochip Designer, QTouch, RightTouch, SAM-BA, SpyNIC, SST, SST Logo, SuperFlash, tinyAVR, UNI/O, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, EtherSynch, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and Quiet-Wire are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, CryptoAuthentication, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, Mindi, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PureSilicon, QMatrix, RightTouch logo, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2017, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-2256-3

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon

Hong Kong
Tel: 852-2943-5100
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115
Fax: 86-571-8792-8116

China - Hong Kong SAR
Tel: 852-2943-5100
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-3326-8000
Fax: 86-21-3326-8021

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8864-2200
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

ASIA/PACIFIC

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-3019-1500

Japan - Osaka
Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

Japan - Tokyo
Tel: 81-3-6880-3770
Fax: 81-3-6880-3771

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-67-3636

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7289-7561

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820