

64-Channel 32-MHz Serial-to-Parallel Converter with Push-Pull Outputs

Features

- 5V CMOS Logic
- Up to +80V Output Voltage
- Low-Power Level Shifting
- 32 MHz Equivalent Data Rate
- Latched Data Outputs
- Forward and Reverse Shifting Options (DIR pin)
- Diode to V_{PP} allows Efficient Power Recovery
- Outputs may be Hot Switched

Applications

- Vacuum Fluorescent Display Driver
- Inkjet Driver
- 3D Printer Driver
- Microelectromechanical Systems Applications

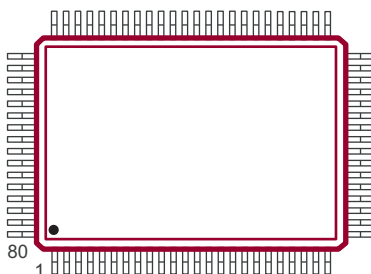
General Description

The HV57708 is a low-voltage to high-voltage serial-to-parallel converter with push-pull outputs. The device is designed as a driver for EL displays. It can also be used in any application requiring multiple-output high-voltage current sourcing and sinking capability such as driving plasma panels, vacuum fluorescent displays and large matrix LCD displays.

The device has four parallel 16-bit registers, permitting data rates four times the speed of the clock frequency. There are also 64 latches and a control logic to perform the polarity select and blanking of the outputs. The HV_{OUT1} is connected to the first stage of the first Shift register through the polarity and blanking logic. Data is shifted through the Shift registers on the logic low-to-high transition of the clock. The DIR pin causes counter-clockwise shifting when connected to GND and clockwise shifting when connected to V_{DD} . A data output buffer is provided for cascading devices. This output reflects the current status of the last bit of the Shift register, HV_{OUT64} . 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 registers to the latches occurs when the $\overline{LE}$ input is high. The data in the latches is stored when $\overline{LE}$ is low.

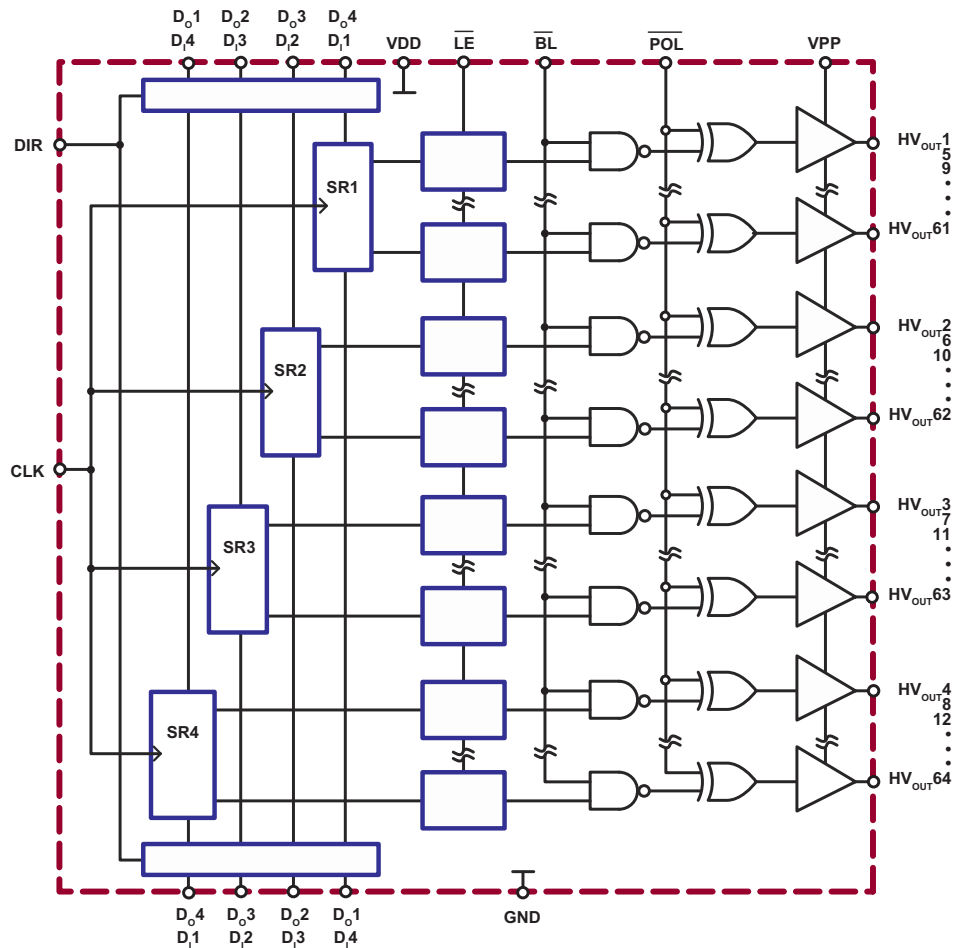
Package Type

80-lead PQFP
(Top view)



See [Table 2-1](#) for pin information.

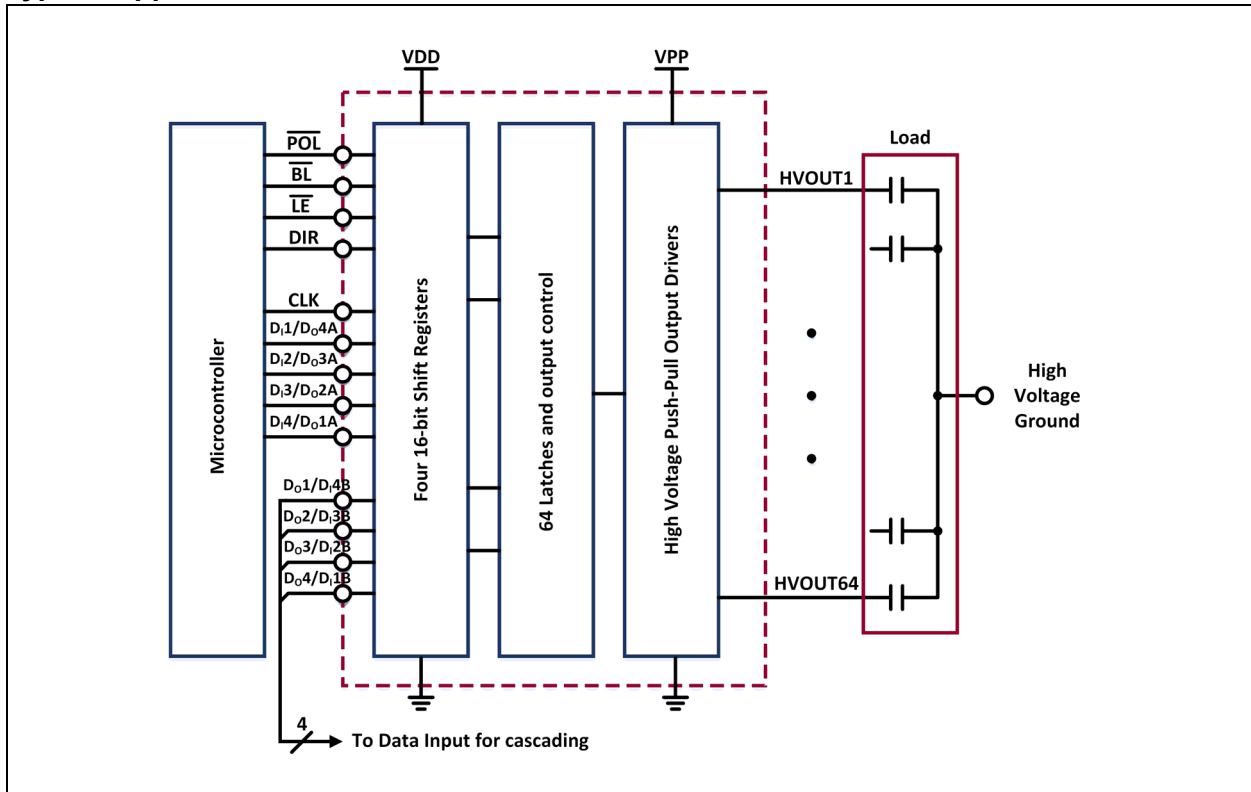
Functional Block Diagram



Note:

Each SR (shift register) provides 16 outputs. SR1 supplies every fourth output starting with 1; SR2 supplies every fourth output with 2, etc.

Typical Application Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Supply Voltage, V_{DD}	–0.5V to +7.5V
Output Voltage, V_{PP}	–0.5V to +90V
Logic Input Levels	–0.3V to $V_{DD} + 0.3V$
Ground Current (Note 1)	1.5A
Maximum Junction Temperature, $T_{J(MAX)}$	+125°C
Storage Temperature, T_S	–65°C to +150°C
Continuous Total Power Dissipation:	
80-lead PQFP (Note 2)	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: Limited by the total power dissipated in the package

Note 2: For operations above 25°C ambient, derate linearly to the maximum operating temperature at 20 mW/°C.

RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Logic Supply Voltage	V_{DD}	4.5	—	5.5	V	
Output Voltage	V_{PP}	8	—	80	V	
High-Level Input Voltage	V_{IH}	$V_{DD} - 0.5V$	—	—	V	
Low-Level Input Voltage	V_{IL}	0	—	0.5	V	
Clock Frequency per Register	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	V _{DD} = V _{DD} maximum, f _{CLK} = 8 MHz
High-Voltage Supply Current		I _{PP}	—	—	100	μA	Outputs high
			—	—	100	μA	Outputs low
Quiescent V _{DD} Supply Current		I _{DDQ}	—	—	100	μA	All V _{IN} = V _{DD}
High-Level Output	HV _{OUT}	V _{OH}	65	—	—	V	I _O = −15 mA, V _{PP} = +80V
	Data Out		V _{DD} −0.5V	—	—	V	I _O = −100 μA
Low-Level Output	HV _{OUT}	V _{OL}	—	—	7	V	I _O = 12 mA, V _{PP} = +80V
	Data Out		—	—	0.5	V	I _O = 100 μA
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-Voltage Clamp Diode		V _{OC}	—	—	1	V	I _{OC} = 1 mA

AC ELECTRICAL CHARACTERISTICS

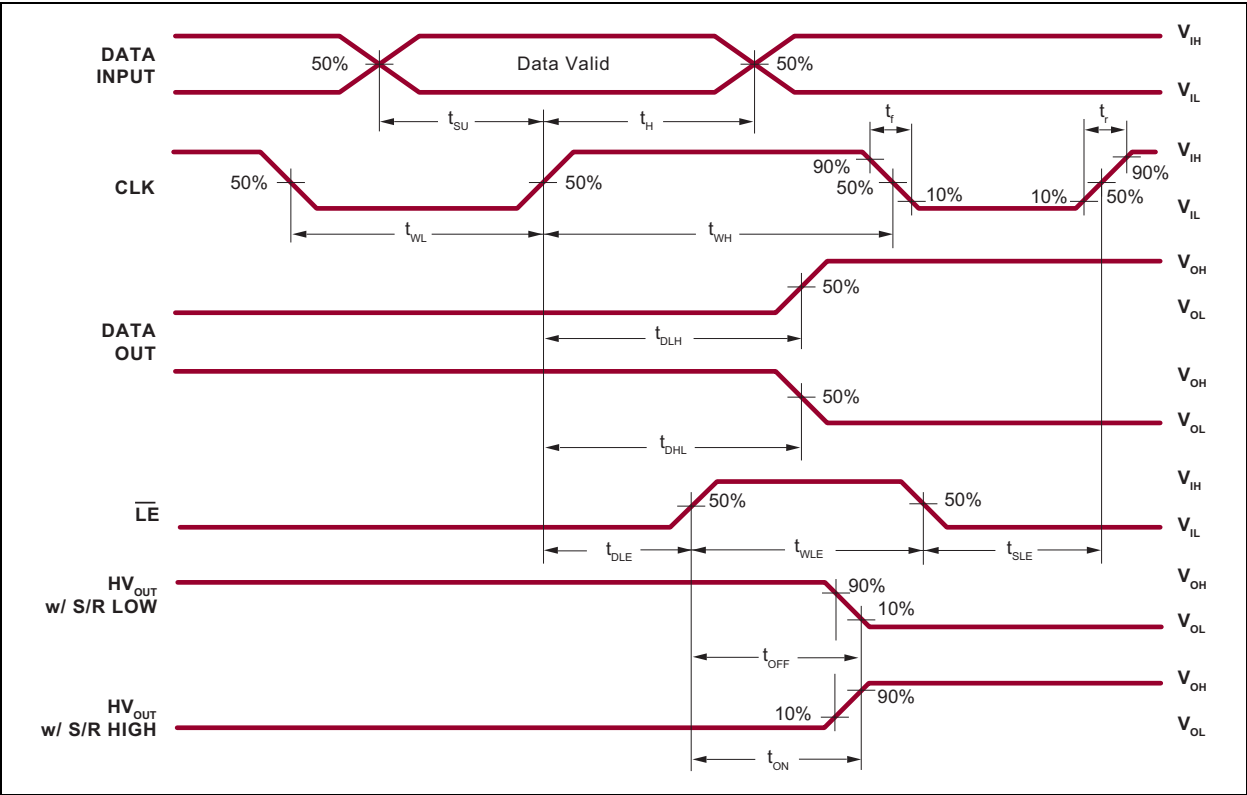
Electrical Specifications: T _A = 85°C maximum. Logic signal inputs and data inputs have t _r , t _f ≤ 5 ns (10% and 90% points).						
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Clock Frequency	f _{CLK}	—	—	8	MHz	Per register
Clock Width High or Low	t _{WL} , t _{WH}	62	—	—	ns	
Data Set-Up Time before Clock Rises	t _{SU}	10	—	—	ns	
Data Hold Time after Clock Rises	t _H	15	—	—	ns	
Time from Latch Enable to HV _{OUT}	t _{ON} , t _{OFF}	—	—	500	ns	C _L = 15 pF
Latch Enable Pulse Width	t _{WLE}	25	—	—	ns	
Delay Time Clock to Latch Enable Low to High	t _{DLE}	25	—	—	ns	Note 1
Latch Enable Set-Up Time before Clock Rises	t _{SLE}	0	—	—	ns	
Delay Time Clock to Data Low to High	t _{DLH}	—	—	70	ns	C _L = 15 pF
Delay Time Clock to Data High to Low	t _{DHL}	—	—	70	ns	C _L = 15 pF

Note 1: t_{DLE} is not required but recommended to produce stable high-voltage outputs and thus minimize power dissipation and current spikes. t_{DLE} allows internal SR output to stabilize.

TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
TEMPERATURE RANGE						
Operating Ambient Temperature	T _A	-40	—	+85	°C	
Maximum Junction Temperature	T _{J(MAX)}	—	—	+125	°C	
Storage Temperature	T _S	-65	—	+150	°C	
PACKAGE THERMAL RESISTANCE						
80-lead PQFP	θ _{JA}	—	37	—	°C/W	

Timing Waveforms



2.0 PIN DESCRIPTION

The details on the pins of HV57708 are listed on [Table 2-1](#). Refer to [Package Type](#) for the location of pins.

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	HVOUT24/41	High-voltage output
2	HVOUT23/42	High-voltage output
3	HVOUT22/43	High-voltage output
4	HVOUT21/44	High-voltage output
5	HVOUT20/45	High-voltage output
6	HVOUT19/46	High-voltage output
7	HVOUT18/47	High-voltage output
8	HVOUT17/48	High-voltage output
9	HVOUT16/49	High-voltage output
10	HVOUT15/50	High-voltage output
11	HVOUT14/51	High-voltage output
12	HVOUT13/52	High-voltage output
13	HVOUT12/53	High-voltage output
14	HVOUT11/54	High-voltage output
15	HVOUT10/55	High-voltage output
16	HVOUT9/56	High-voltage output
17	HVOUT8/57	High-voltage output
18	HVOUT7/58	High-voltage output
19	HVOUT6/59	High-voltage output
20	HVOUT5/60	High-voltage output
21	HVOUT4/61	High-voltage output
22	HVOUT3/62	High-voltage output
23	HVOUT2/63	High-voltage output
24	HVOUT1/64	High-voltage output
25	DIN1/DOUT4(A)	Data Input 1/Output 4 A pin
26	DIN2/DOUT3(A)	Data Input 2/Output 3 A pin
27	DIN3/DOUT2(A)	Data Input 3/Output 2 A pin
28	DIN4/DOUT1(A)	Data Input 4/Output 1 A pin
29	$\overline{LE}$	Latch enable pin
30	CLK	Clock pin
31	$\overline{BL}$	Blanking pin
32	VDD	Low-voltage supply voltage
33	DIR	Direction pin (Note)
34	GND	Ground

Note: Pin designation for DIR = H/L
 Example: For DIR = H, pin 41 is HVOUT6
 For DIR = L, pin 41 is HVOUT1
 For clockwise and counter-clockwise shifts, see [Table 3-2](#) $Q_N \rightarrow Q_{N+1}$.

TABLE 2-1: PIN FUNCTION TABLE (CONTINUED)

Pin Number	Pin Name	Description
35	$\overline{\text{POL}}$	Polarity pin
36	DOUT4/DIN1(B)	Data Output 4/Input 1 B pin
37	DOUT3/DIN2(B)	Data Output 3/Input 2 B pin
38	DOUT2/DIN3(B)	Data Output 2/Input 3 B pin
39	DOUT1/DIN4(B)	Data Output 1/Input 4 B pin
40	VPP	High-voltage supply voltage
41	HVOUT64/1	High-voltage output
42	HVOUT63/2	High-voltage output
43	HVOUT62/3	High-voltage output
44	HVOUT61/4	High-voltage output
45	HVOUT60/5	High-voltage output
46	HVOUT59/6	High-voltage output
47	HVOUT58/7	High-voltage output
48	HVOUT57/8	High-voltage output
49	HVOUT56/9	High-voltage output
50	HVOUT55/10	High-voltage output
51	HVOUT54/11	High-voltage output
52	HVOUT53/12	High-voltage output
53	HVOUT52/13	High-voltage output
54	HVOUT51/14	High-voltage output
55	HVOUT50/15	High-voltage output
56	HVOUT49/16	High-voltage output
57	HVOUT48/17	High-voltage output
58	HVOUT47/18	High-voltage output
59	HVOUT46/19	High-voltage output
60	HVOUT45/20	High-voltage output
61	HVOUT44/21	High-voltage output
62	HVOUT43/22	High-voltage output
63	HVOUT42/23	High-voltage output
64	HVOUT41/24	High-voltage output
65	HVOUT40/25	High-voltage output
66	HVOUT39/26	High-voltage output
67	HVOUT38/27	High-voltage output
68	HVOUT37/28	High-voltage output
69	HVOUT36/29	High-voltage output
70	HVOUT35/30	High-voltage output
71	HVOUT34/31	High-voltage output
72	HVOUT33/32	High-voltage output

Note: Pin designation for DIR = H/L

Example: For DIR = H, pin 41 is HVOUT6

For DIR = L, pin 41 is HVOUT1

For clockwise and counter-clockwise shifts, see [Table 3-2](#) $Q_N \rightarrow Q_{N+1}$.

TABLE 2-1: PIN FUNCTION TABLE (CONTINUED)

Pin Number	Pin Name	Description
73	HVOUT32/33	High-voltage output
74	HVOUT31/34	High-voltage output
75	HVOUT30/35	High-voltage output
76	HVOUT29/36	High-voltage output
77	HVOUT28/37	High-voltage output
78	HVOUT27/38	High-voltage output
79	HVOUT26/39	High-voltage output
80	HVOUT25/40	High-voltage output

Note: Pin designation for DIR = H/L
 Example: For DIR = H, pin 41 is HVOUT6
 For DIR = L, pin 41 is HVOUT1
 For clockwise and counter-clockwise shifts, see [Table 3-2](#) $Q_N \rightarrow Q_{N+1}$.

3.0 FUNCTIONAL DESCRIPTION

Follow the steps in [Table 3-1](#) to power up and power down the HV57708.

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

Power-Up		Power-Down	
Step	Description	Step	Description
1	Connect ground.	1	Remove V_{PP} . (Note 1)
2	Apply V_{DD} .	2	Remove all inputs.
3	Set all inputs (Data, CLK, Enable, etc.) to a known state.	3	Remove V_{DD} .
4	Apply V_{PP} . (Note 1)	4	Disconnect ground.

Note 1: The V_{PP} should not drop below V_{DD} or float during operation.

TABLE 3-2: TRUTH FUNCTION TABLE

Function	Inputs						Outputs		
	Data	CLK	$\overline{LE}$	$\overline{BL}$	$\overline{POL}$	DIR	Shift Register	High-Voltage Output	Data Out
All O/P High	X	X	X	L	L	X	—	H	—
All O/P Low	X	X	X	L	H	X	—	L	—
O/P Normal	X	X	X	H	H	X	—	No inversion	—
O/P Inverted	X	X	X	H	L	X	—	Inversion	—
Data falls through Transparent Latches	L	↑	H	H	H	X	L	L	—
	H	↑	H	H	H	X	H	H	—
	L	↑	H	H	L	X	L	H	—
	H	↑	H	H	L	X	H	L	—
Data Stored/ Latches Loaded	X	X	L	H	H	X	*	Stored data	—
	X	X	L	H	L	X	*	Inversion of stored data	—
I/O Relation	$D_{I/O1-4A}$	↑	H	H	H	H	$Q_N \rightarrow Q_{N+1}$	New H or L	$D_{I/O1-4B}$
	$D_{I/O1-4A}$	↑	L	H	H	H	$Q_N \rightarrow Q_{N+1}$	Previous H or L	$D_{I/O1-4B}$
	$D_{I/O1-4B}$	↑	L	H	H	L	$Q_N \rightarrow Q_{N-1}$	Previous H or L	$D_{I/O1-4A}$
	$D_{I/O1-4B}$	↑	H	H	H	L	$Q_N \rightarrow Q_{N-1}$	New H or L	$D_{I/O1-4A}$

Note: H = High-logic level

L = Low-logic level

X = Irrelevant

↑ = Low-to-high transition

* = Dependent on the previous stage's state. See [Table 2-1](#) for D_{IN} and D_{OUT} pin designation for clockwise and counter-clockwise shifts.

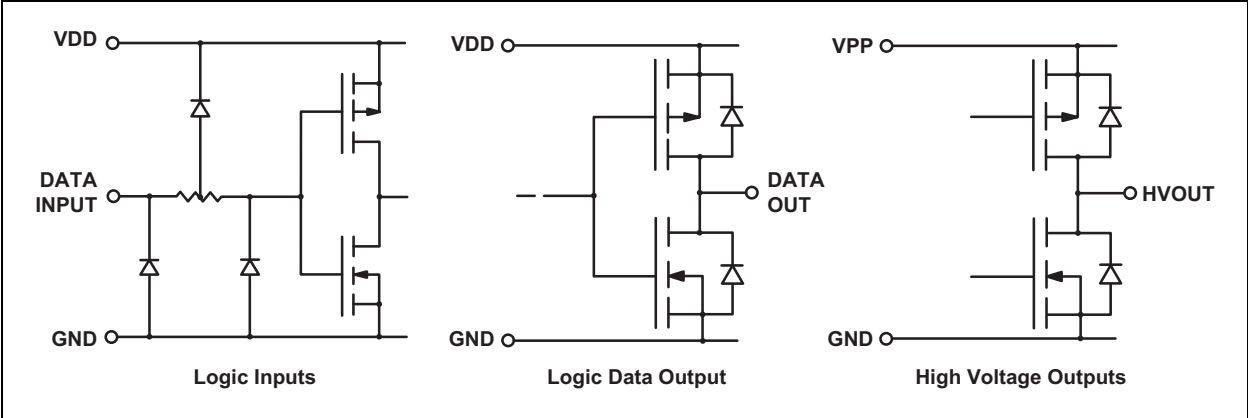


FIGURE 3-1: Input and Output Equivalent Circuits.

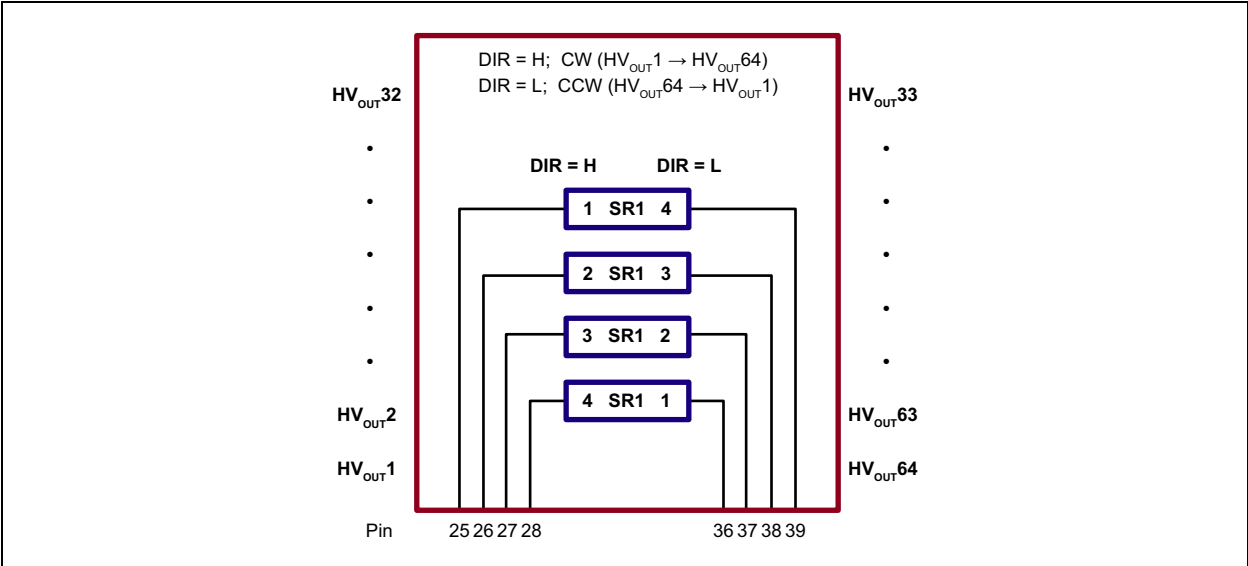
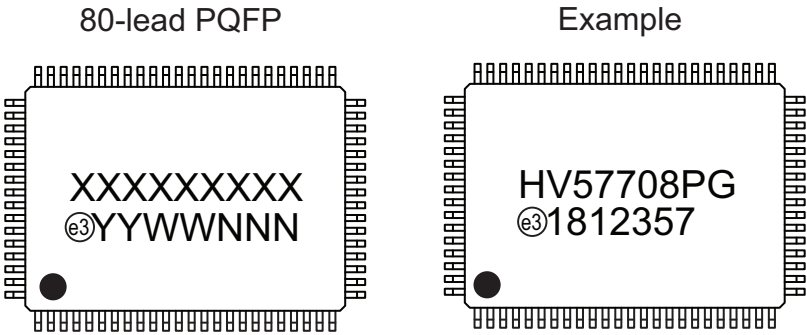


FIGURE 3-2: Shift Register Operation.

4.0 PACKAGE MARKING INFORMATION

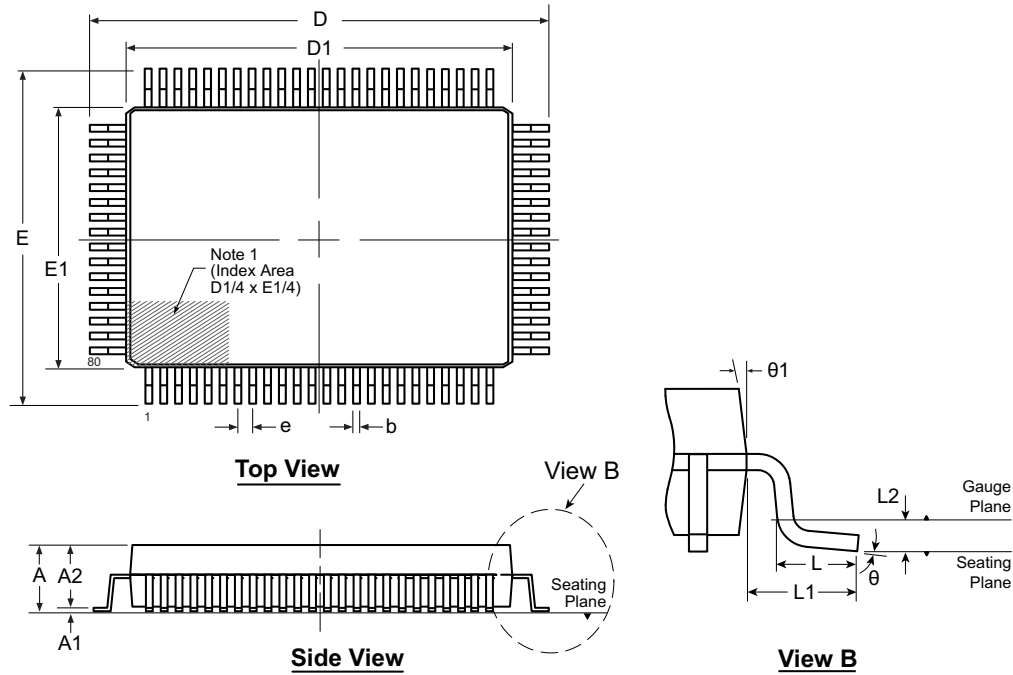
4.1 Packaging Information



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.	

80-Lead PQFP Package Outline (PG)

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



Note: For the most current package drawings, see the Microchip Packaging Specification at 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	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.

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (April 2018)

- Converted Supertex Doc # DSFP-HV57708 to Microchip DS20005861A
- Removed “HVCMOS[®] Technology” in the Features section
- Changed the package marking format
- Made minor changes throughout the document

HV57708

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:	HV57708	=	64-Channel 32 MHz Serial-to-Parallel Converter with Push-Pull Outputs		
Package:	PG	=	80-lead PQFP		
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package		
Media Type:	(blank)	=	66/Tray for a PG Package		

Example:

a) HV57708PG-G: 64-Channel 32 MHz Serial-to-Parallel Converter with Push-Pull Outputs, 80-lead PQFP, 66/Tray

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.

© 2018, Microchip Technology Incorporated, All Rights Reserved.
ISBN: 978-1-5224-2752-0

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

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

China - Beijing
Tel: 86-10-8569-7000

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

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

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

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

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

China - Hong Kong SAR
Tel: 852-2943-5100

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

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

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

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

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

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

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

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

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

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

India - Pune
Tel: 91-20-4121-0141

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

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

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

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

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

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

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

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

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

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

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

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