chanhvinh.com

HV513

8-Channel Serial-to-Parallel Converter with High-Voltage Push-Pull Outputs, Polarity, Hi-Z and Short-Circuit Detect

Features

- Up to 250V Output Voltage
- Low-Power Level Shifting from 5V to 250V
- Shift Register Speed:
  - 8 MHz at V_{DD} = 5V
- Latched Data Outputs
- Output Polarity and Blanking
- Output Short-Circuit Detect
- Output High-Z (Hi-Z) Control
- CMOS-Compatible Inputs

Applications

- Piezoelectric Transducer Driver
- Braille Driver
- Weaving Applications
- Printer Drivers
- Microelectromechanical Systems Applications
- Displays

General Description

The HV513 is a low-voltage-to-high-voltage serial-to-parallel converter with eight high-voltage push-pull outputs. This device is designed to drive small capacitive loads such as piezoelectric transducers. It can also be used in any application requiring multiple high-voltage outputs with medium-current source-and-sink capabilities.

The device consists of an 8-bit Shift register, eight latches and control logic to perform the polarity select and blanking of the outputs. Data is shifted through the Shift register on the low-to-high transition of the clock. A data output buffer is provided for cascading devices. The operation of the Shift register is not affected by the latch enable ($\overline{LE}$), blanking ($\overline{BL}$), polarity ($\overline{POL}$) and $\overline{Hi\text{-}Z}$ control inputs. The transfer of data from the Shift register to the latch occurs when the $\overline{LE}$ is high. The data in the latch is stored when $\overline{LE}$ is low. A $\overline{Hi\text{-}Z}$ pin is provided to set all the outputs in a High-Z state.

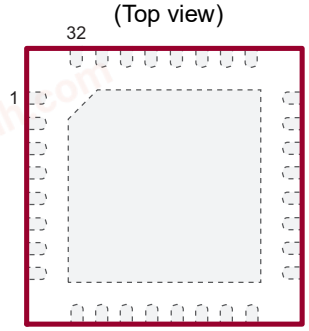
All outputs have short-circuit protection that detects if the outputs have reached the required output state. If an output does not track the required state, then the $\overline{SHORT}$ pin will be low. This output will pulse low during the output transition period under normal operation. See Figure 3-2 for details.

All outputs will have a break-before-make circuitry to reduce crossover current during output state changes.

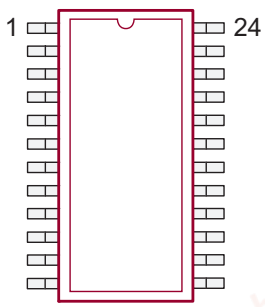
The $\overline{POL}$, $\overline{BL}$, $\overline{LE}$ and $\overline{Hi\text{-}Z}$ inputs have an internal pull-up resistor.

Package Types

32-lead QFN
(Top view)



24-lead SOW
(Top view)



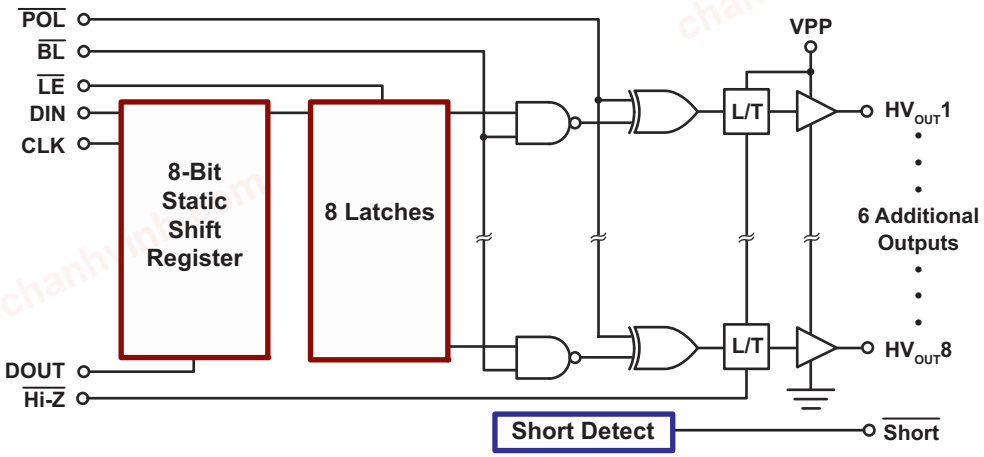
See Table 2-1 and Table 2-2 for pin information.

© 2019 Microchip Technology Inc.

chanhvinh.com

HV513

Functional Block Diagram

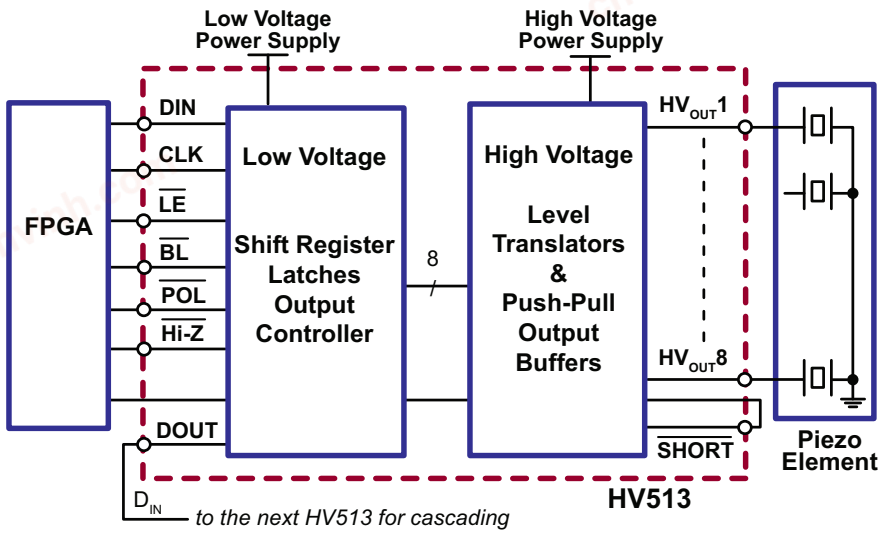


Note 1: $\overline{POL}$, $\overline{BL}$, $\overline{LE}$ and $\overline{Hi\text{-}Z}$ have internal 20 kΩ pull-up resistors.

© 2019 Microchip Technology Inc.

chanhvinh.com

Typical Application Circuit



chanhvinh.com

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Logic Supply Voltage, V_{DD} ..... –0.5V to +6V
High-Voltage Supply, V_{PP} ..... V_{DD} to +275V
Logic Input Levels ..... –0.5V to V_{DD} +0.5V
Ground Current (**Note 1**) 0.3A
High-Voltage Supply Current (**Note 1**) 0.25A
Maximum Junction Temperature, $T_{J(MAX)}$ ..... +125°C
Storage Temperature, T_S ..... –65°C to +150°C
Continuous Total Power Dissipation:
32-lead QFN (**Note 2**) ..... 750 mW
24-lead SOW (**Note 2**) ..... 750 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: Connection to all power and ground pads is required. Duty cycle is limited by the total power dissipated in the package.
2: For operations above 25°C ambient, derate linearly to 85°C at 12 mW/°C.

RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Logic Supply Voltage	V_{DD}	4.5	5	5.5	V	
High-Voltage Supply Voltage	V_{PP}	50	—	250	V	**Note 1**
High-Level Input Voltage	V_{IH}	V_{DD}–0.9V	—	V_{DD}	V	
Low-Level Input Voltage	V_{IL}	0	—	0.9	V	
Operating Junction Temperature	T_J	–40	—	+85	°C	

Note 1: The output may not switch below the minimum V_{PP}.

© 2019 Microchip Technology Inc.

chanhvinh.com

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over typical operating conditions unless otherwise specified, T_J = 25°C.							
Parameter		**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
V_{DD} Supply Current		I_{DD}	—	—	4	mA	f_{CLK} = 8 MHz, $\overline{LE}$ = Low
Quiescent V_{DD} Supply Current		I_{DDQ}	—	—	0.1	mA	All V_{IN} = V_{DD}
			—	—	2	mA	All V_{IN} = 0V
High-Voltage Supply Current		I_{PP}	—	—	100	µA	V_{PP} = 250V, f_{OUT} = 300 Hz, no load
Quiescent V_{PP} Supply Voltage		I_{PPQ}	—	—	100	µA	V_{PP} = 240V, outputs are static
High-Level Logic Input Current		I_{IH}	—	—	10	µA	V_{IH} = V_{DD}
Low-Level Logic Input Current		I_{IL}	—	—	–10	µA	V_{IL} = 0V
			—	—	–350	µA	V_{IL} = 0V, for inputs with pull-up resistors
High-Level Output	HV_{OUT}	V_{OH}	140	—	—	V	V_{PP} = 200V, I_{HVOUT} = –20 mA
	Data Out		V_{DD} –1V	—	—	V	I_{DOUT} = –0.1 mA
Low-Level Output	HV_{OUT}	V_{OL}	—	—	60	V	V_{DD} = 4.5V, I_{HVOUT} = 20 mA
	Data Out		—	—	1	V	I_{DOUT} = –0.1 mA

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over typical operating conditions unless otherwise specified, T_J = 25°C.						
Parameter	**Sym.**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Clock Frequency	f_{CLK}	0	—	8	MHz	
Output Switching Frequency (SOA Limited)	f_{OUT}	—	300	—	Hz	C_L = 50 nF, V_{PP} = 200V
Clock Width High and Low	t_{WL}, t_{WH}	62	—	—	ns	
Data Set-Up Time before Clock Rises	t_{SU}	15	—	—	ns	
Data Hold Time after Clock Rises	t_H	30	—	—	ns	
Latch Enable Pulse Width	t_{WLE}	80	—	—	ns	
Latch Enable Delay Time after Rising Edge of Clock	t_{DLE}	35	—	—	ns	
Latch Enable Set-Up Time before Clock Rises	t_{SLE}	40	—	—	ns	
HV_{OUT} Rise/Fall Time	t_{OR}, t_{OF}	—	—	1000	µs	C_L = 100 nF, V_{PP} = 200V
Delay Time for Output to Start Rise/Fall	$t_{dON/OFF}$	—	—	500	ns	
Delay Time Clock to Data Low to High	t_{DLH}	—	—	110	ns	C_L = 15 pF
Delay Time Clock to Data High to Low	t_{DHL}	—	—	110	ns	C_L = 15 pF
All Logic Inputs	t_r, t_f	—	—	5	ns	
Output Short-Circuit Detection	t_{SD}	—	—	500	ns	C_L = 15 pF, short to output fall of $\overline{SHORT}$
Output Short-Circuit Clear	t_{SC}	—	—	3000	ns	$\overline{Short}$ clear to output rise of $\overline{SHORT}$
Output High-Z State	t_{HI-Z}	—	—	500	ns	

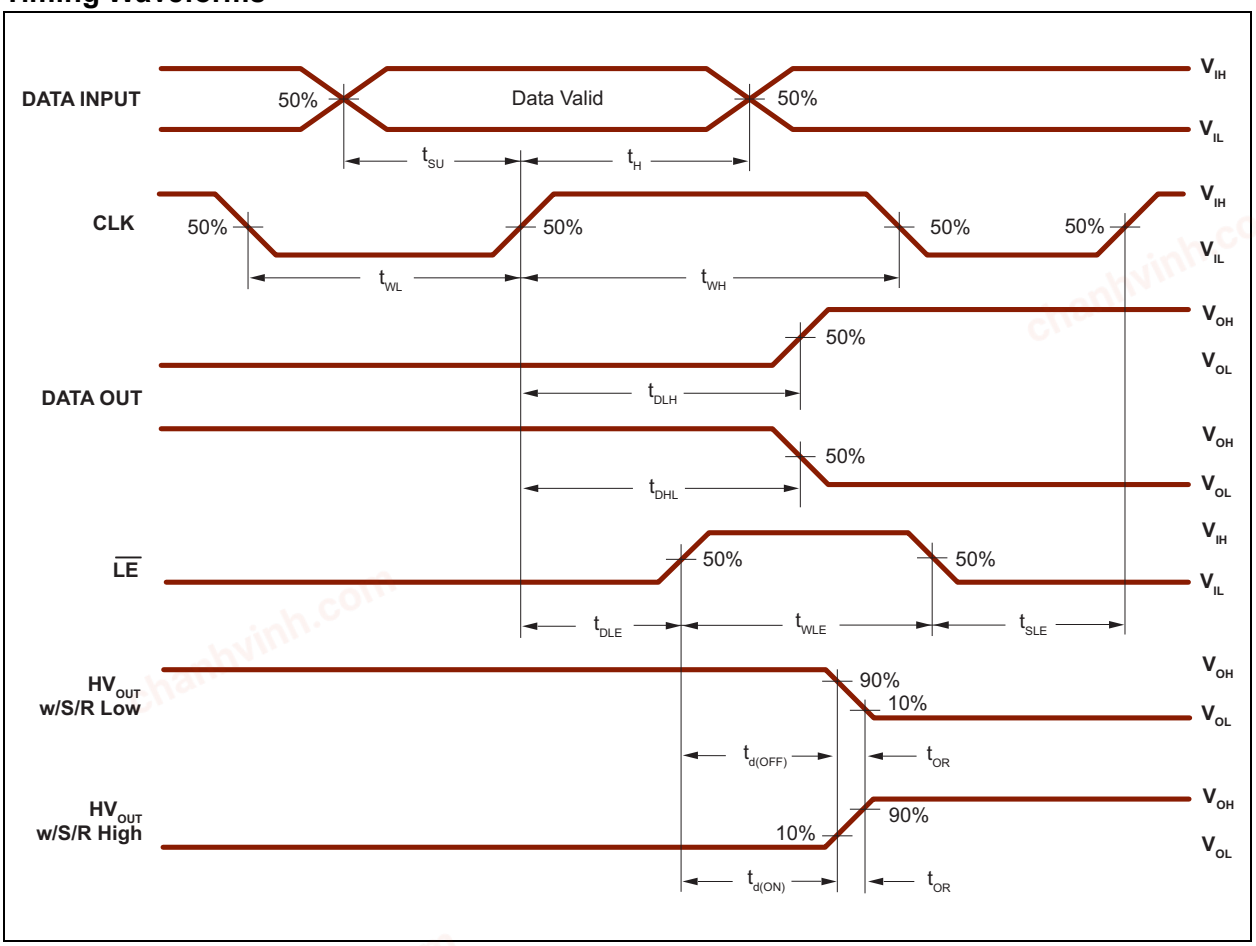
© 2019 Microchip Technology Inc.

chanhvinh.com

TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
TEMPERATURE RANGE						
Operating Junction Temperature	T_J	–40	—	+85	°C	
Maximum Junction Temperature	$T_{J(MAX)}$	—	—	+125	°C	
Storage Temperature	T_S	–65	—	+150	°C	
PACKAGE THERMAL RESISTANCE						
32-lead QFN	θ_{JA}	—	22	—	°C/W	
24-lead SOW	θ_{JA}	—	44	—	°C/W	

Timing Waveforms



© 2019 Microchip Technology Inc.

chanhvinh.com

2.0 PIN DESCRIPTION

The details on the pins of HV513 32-lead QFN and 24-lead SOW packages are listed in Table 2-1 and Table 2-2, respectively. Refer to **Package Types** for the location of pins.

TABLE 2-1: 32-LEAD QFN PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	NC	No connection
2	NC	No connection
3	NC	No connection
4	LGND	Low-voltage ground
5	HVGND	High-voltage ground
6	HVGND	High-voltage ground
7	NC	No connection
8	NC	No connection
9	HVOUT1	High-voltage push-pull output
10	HVOUT2	High-voltage push-pull output
11	HVOUT3	High-voltage push-pull output
12	HVOUT4	High-voltage push-pull output
13	HVOUT5	High-voltage push-pull output
14	HVOUT6	High-voltage push-pull output
15	HVOUT7	High-voltage push-pull output
16	HVOUT8	High-voltage push-pull output
17	NC	No connection
18	NC	No connection
19	VPP	High-voltage supply
20	VPP	High-voltage supply
21	VDD	Logic supply voltage
22	DOUT	Data output
23	NC	No connection
24	NC	No connection
25	$\overline{BL}$	Blanking. A logic input low sets all HVOUTs low.
26	NC	No connection
27	$\overline{POL}$	Polarity bar input logic
28	CLK	Clock. Shift registers shift data on the rising edge of input clock.
29	$\overline{LE}$	Latch enable bar input logic
30	$\overline{SHORT}$	If output does not reach its required state, a logic '0' will be asserted at the $\overline{SHORT}$ pin.
31	$\overline{Hi\text{-}Z}$	High-impedance pin. Logic input low sets all outputs in a High-impedance state.
32	DIN	Data input
Center Pad		Center Pad is at V_{PP} potential. Connect to VPP or leave floating.

chanhvinh.com

TABLE 2-2: 24-LEAD SOW PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	NC	No connection
2	VDD	Logic supply voltage
3	DOUT	Data output
4	$\overline{BL}$	Blanking. A logic input low sets all HVOUTs low.
5	$\overline{POL}$	Polarity bar input logic
6	CLK	Clock. Shift registers shift data on the rising edge of input clock.
7	$\overline{LE}$	Latch enable bar input logic
8	$\overline{SHORT}$	If output does not reach its required state, a logic '0' will be asserted at the $\overline{SHORT}$ pin.
9	$\overline{Hi\text{-}Z}$	High-impedance pin. Logic input low sets all outputs in a high-impedance state.
10	DIN	Data input
11	LGND	Low-voltage ground
12	NC	No connection
13	HVGND	High-voltage ground
14	HVGND	High-voltage ground
15	HVOUT1	High-voltage push-pull output
16	HVOUT2	High-voltage push-pull output
17	HVOUT3	High-voltage push-pull output
18	HVOUT4	High-voltage push-pull output
19	HVOUT5	High-voltage push-pull output
20	HVOUT6	High-voltage push-pull output
21	HVOUT7	High-voltage push-pull output
22	HVOUT8	High-voltage push-pull output
23	VPP	High-voltage supply
24	VPP	High-voltage supply

© 2019 Microchip Technology Inc.

chanhvinh.com

3.0 FUNCTIONAL DESCRIPTION

Follow the steps in Table 3-1 to power up and power down the HV513.

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

Power-up		Power-down	
Step	**Description**	**Step**	**Description**
1	Connect ground.	1	Remove V_{PP}.
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}.	4	Disconnect ground.

TABLE 3-2: TRUTH FUNCTION TABLE

Function	Inputs						Outputs				
							Shift Register		High-Voltage Output		Data Out
	Data	CLK	$\overline{LE}$	$\overline{BL}$	$\overline{POL}$	$\overline{Hi\text{-}Z}$	1	2...8	1	2...8	*
All On	X	X	X	L	L	H	*	*...*	H	H...H	*
All Off	X	X	X	L	H	H	*	*...*	L	L...L	*
Invert Mode	X	X	L	H	L	H	*	*...*	$\overline{*}$	$\overline{*}$...$\overline{*}$	*
Load S/R	H or L	↑	L	H	H	H	H or L	*...*	*	*...*	*
Store Data in Latches	X	X	L	H	H	H	*	*...*	*	*...*	*
	X	X	L	H	L	H	*	*...*	$\overline{*}$	$\overline{*}$...$\overline{*}$	*
Transparent Latch Mode	L	↑	H	H	H	H	L	*...*	L	*...*	*
	H	↑	H	H	H	H	H	*...*	H	*...*	*
Outputs Hi-Z	X	X	X	X	X	L	*	*...*	High-impedance outputs		*
Outputs On	X	X	X	X	X	H	*	*...*	*	*...*	*

Note: H = High-logic level
L = Low-logic level
X = Irrelevant
↑ = Low-to-high transition
* = Dependent on the previous stage's state before the last CLK or last $\overline{LE}$ high

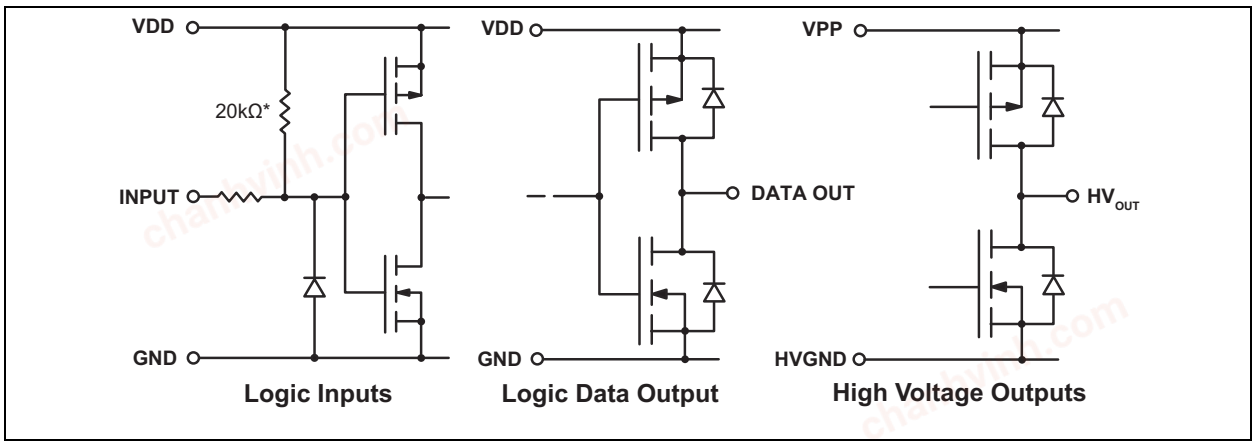
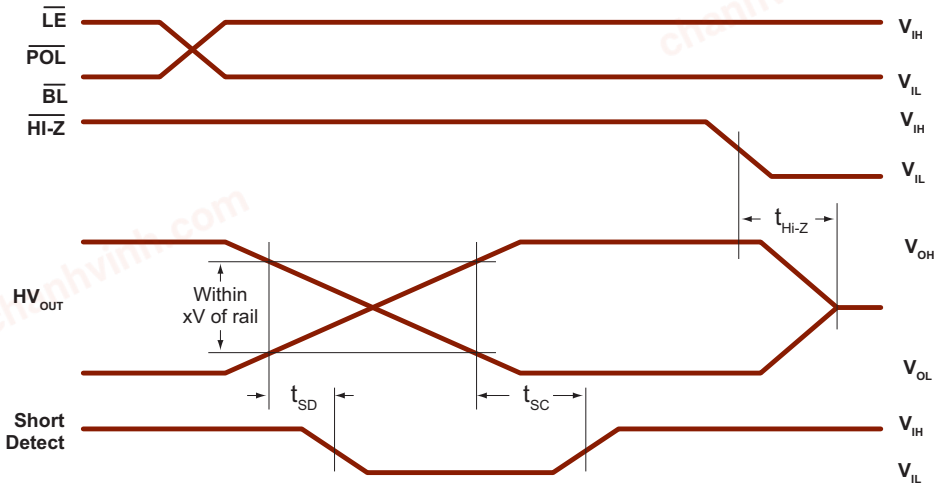


FIGURE 3-1: *Input and Output Equivalent Circuits.*

chanhvinh.com



Note 1: For V_{PP} greater than 150V, the short detect output will flag short conditions. There are two possibilities:
Case 1: HV_{OUT} is higher than 10V when expected low.
Case 2: H_{VOUT} is lower than V_P–100V when expected high.

2: For V_{PP} greater than 150V, the short detect output will stay clear. There are two possibilities:
Case 1: HV_{OUT} is lower than 2V when expected low.
Case 2: HV_{OUT} is higher than V_{PP}–60V when expected high.

FIGURE 3-2: *Short-Circuit Detect Detail Timing.*

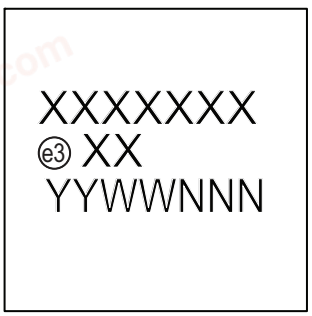
© 2019 Microchip Technology Inc.

chanhvinh.com

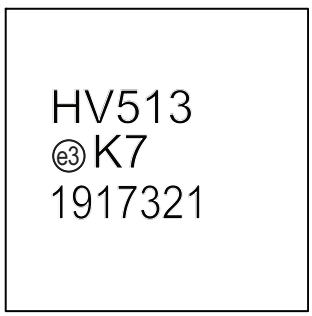
4.0 PACKAGE MARKING INFORMATION

4.1 Packaging Information

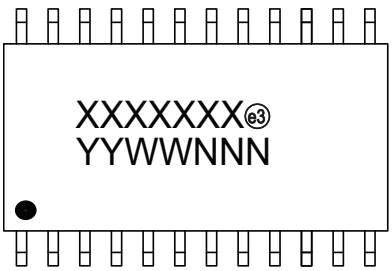
32-lead QFN



Example



24-lead SOW



Example



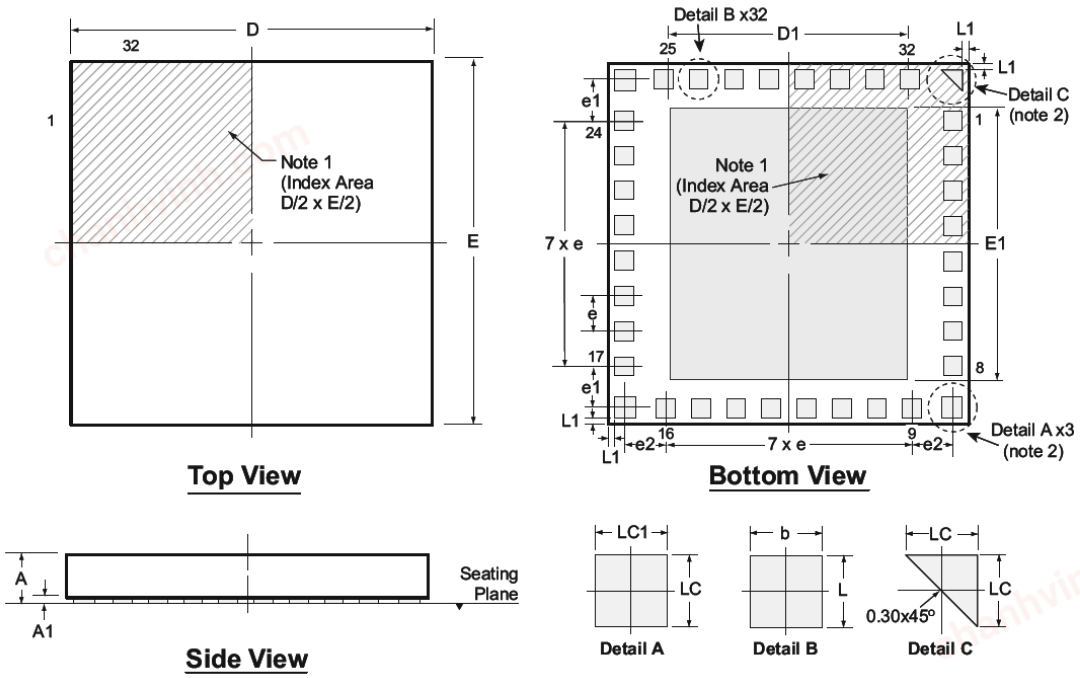
Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package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

chanhvinh.com

32-Lead QFN Package Outline (K7)

6.00x6.00mm body, 0.80mm height (max), 0.50mm pitch



Note: For the most current package drawings, see the Microchip Packaging Specification at 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. *The 4 corner pads are for mechanical placement only, they are not internally connected.*

Symbol		A	A1	b	D	D1	E	E1	e	e1	e2	L	L1	LC	LC1
Dimension (mm)	MIN	0.70	0.00	0.20	5.90	3.20	5.90	4.30	0.50 BSC	1.00 REF	0.975 REF	0.20	0.10 REF	0.20	0.25
	NOM	0.75	-	0.30	6.00	3.30	6.00	4.40				0.30		0.30	0.35
	MAX	0.80	0.05	0.40	6.10	3.40	6.10	4.50				0.40		0.40	0.45

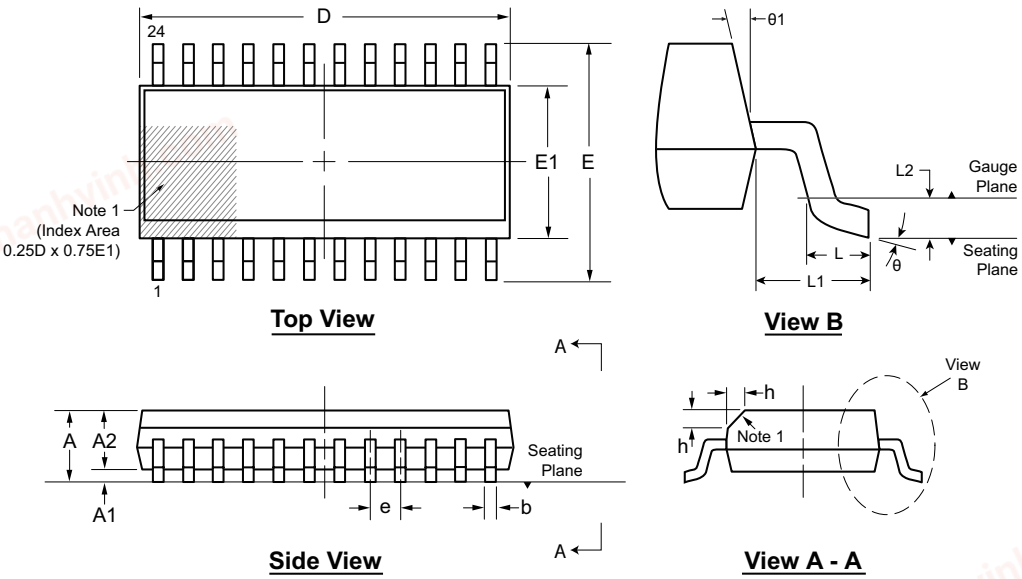
Drawings not to scale.

© 2019 Microchip Technology Inc.

chanhvinh.com

24-Lead SOW (Wide Body) Package Outline (WG)

15.40x7.50 body, 2.65mm height (max), 1.27mm pitch



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	E	E1	e	h	L	L1	L2	θ	θ1
Dimension (mm)	MIN	2.15*	0.10	2.05	0.31	15.20*	9.97*	7.40*	1.27 BSC	0.25	0.40	1.40 REF	0.25 BSC	0°	5°
	NOM	-	-	-	-	15.40	10.30	7.50		-	-			-	-
	MAX	2.65	0.30	2.55*	0.51	15.60*	10.63*	7.60*		0.75	1.27			8°	15°

JEDEC Registration MS-013, Variation AD, Issue E, Sep. 2005.
** This dimension is not specified in the JEDEC drawing.*
Drawings are not to scale.

© 2019 Microchip Technology Inc.

chanhvinh.com

NOTES:

chanhvinh.com

© 2019 Microchip Technology Inc.

chanhvinh.com

APPENDIX A: REVISION HISTORY

Revision A (October 2017)

- Converted Supertex Doc # DSFP-HV513 to Microchip DS20005846B
- Removed “HVCMOS® Technology” in the Features section
- Changed the package marking format
- Removed the 32-lead (6 x 6) WQFN K7 M935 media type
- Changed the quantity of the 32-lead (6 x 6) WQFN K7 package from 400/Tray to 490/Tray
- Made minor changes throughout the document

Revision B (June 2019)

- Added Center Pad details to Table 2-1.

chanhvinh.com

chanhvinh.com

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.	XX	-	X	-	X
Device	Package Options		Environmental		Media Type

Device:	HV513	=	8-Channel Serial-to-Parallel Converter with High-Voltage Push-Pull Outputs, Polarity, Hi-Z and Short-Circuit Detect
Packages:	K7	=	32-lead (6 x 6) WQFN
	WG	=	24-lead SOW
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Types:	(blank)	=	490/Tray for a K7 package
		=	1000/Reel for a WG package

Examples:

a) HV513K7-G: 8-Channel Serial-to-Parallel Converter with High-Voltage Push-Pull Outputs, Polarity, Hi-Z and Short-Circuit Detect, 32-lead (6 x 6) WQFN, 490/Tray

b) HV513WG-G: 8-Channel Serial-to-Parallel Converter with High-Voltage Push-Pull Outputs, Polarity, Hi-Z and Short-Circuit Detect, 24-lead SOW, 1000/Reel

© 2019 Microchip Technology Inc.

chanhvinh.com

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.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TempTrackr, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, Vite, WinPath, and ZL 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, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KleerNet, KleerNet logo, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, 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.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks 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.

© 2019, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-4693-4

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

chanhvinh.com

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: 49-7131-72400

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: 47-7288-4388

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

© 2019 Microchip Technology Inc.