HV2662 / HV2762

Low Harmonic Distortion, 24-Channel SPST High Voltage Analog Switch

Features

- 24 Channels of high voltage analog switch
- 3.3 or 5.0V CMOS input logic level
- 24 Channel SPST configuration
- 20 MHz data shift clock frequency
- HVCMOS technology for high performance
- Very low quiescent power dissipation-10µA
- Low parasitic capacitance
- DC to 50 MHz analog signal frequency
- -60dB typical OFF-isolation at 5.0 MHz
- CMOS logic circuitry for low power
- Excellent noise immunity
- Cascadable serial data register with latches
- Flexible operating supply voltages
- Integrated bleed resistors on outputs (HV2762 only)

Applications

- Medical ultrasound imaging
- Piezoelectric transducer drivers
- Inkjet printer heads
- Optical MEMS modules

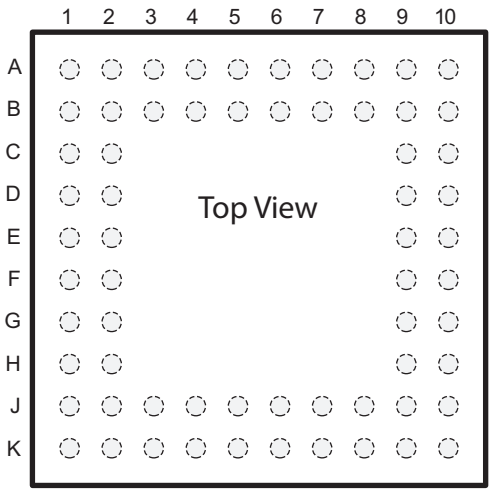
Description

HV2662/HV2762 are low-charge injection, 24-channel, high-voltage analog switch integrated circuits (ICs). These ICs excel in applications requiring high-voltage switching controlled by low-voltage control signals such as medical ultrasound imaging, piezoelectric transducer driver, and printers. HV2762 provides integrated bleed resistors that eliminate voltage build-up on capacitive loads such as piezoelectric transducers. HV2662 does not have integrated bleed resistors.

HV2662/HV2762 shift input data into a 24-bit shift register that can then be retained in a 24-bit latch. To reduce any possible clock feed through noise, the latch-enable bar should be left high until all bits are clocked in during the rising edge of the clock. Using High Voltage CMOS technology, these ICs combine high-voltage, bilateral DMOS switches and low-power CMOS logic to provide efficient control of high voltage analog signals.

The device is suitable for various combinations of high voltage supplies, e.g., V_{PP}/V_{NN}: +40V/-160V, +100V/-100V, and +160V/-40V.

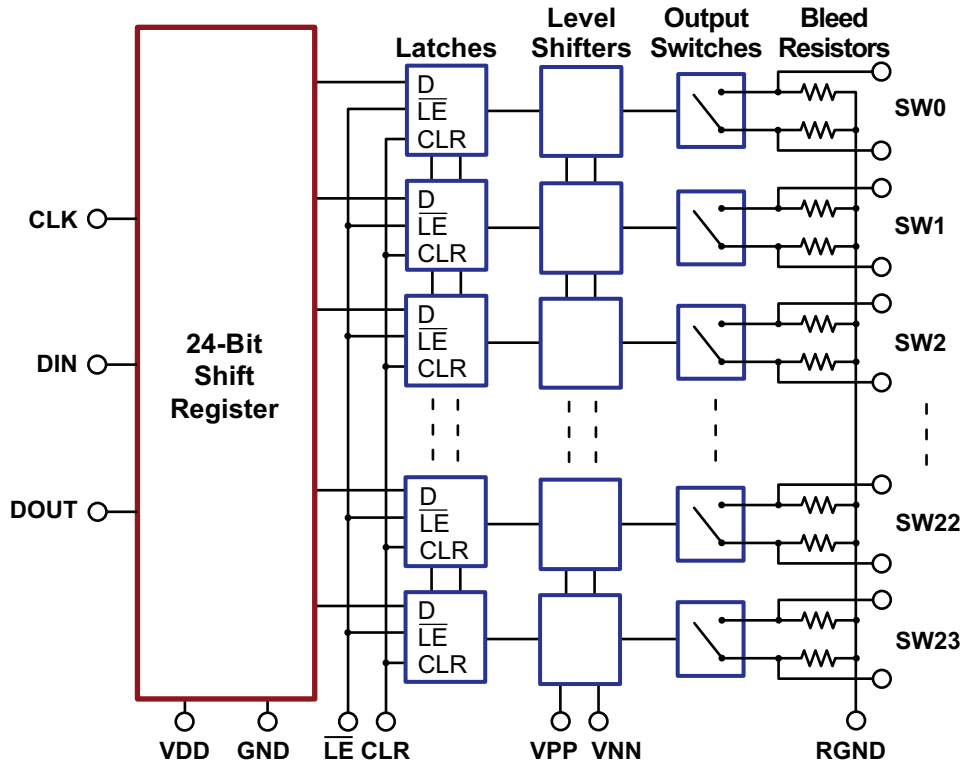
Package Types



64-ball VFBGA

See Table 2-1 for pin information

Block Diagram



Note: Bleed resistors and RGND only apply to HV2762.

1.0 ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS†

V_{DD} logic supply ..... -0.50 to +6.5V
V_{PP} - V_{NN} differential supply 220V
V_{PP} positive supply ..... -0.5 to V_{NN} + 200V
V_{NN} negative supply ..... +0.5 to -200V
Logic input voltage ..... -0.5V to V_{DD} +0.3V
Analog signal range ..... V_{NN} to V_{PP}
Peak analog signal current/channel 2.0A
Storage temperature ..... -65°C to +150°C
Power dissipation 1.0W

† 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.

RECOMMENDED OPERATING CONDITIONS (Notes 1– 3)

Symbol	Parameter	Value
V_{DD}	Logic power supply voltage	3.0V to 5.5V (**Note 2**)
V_{PP}	Positive high voltage supply	+40V to V_{NN} +200V (**Note 2**)
V_{NN}	Negative high voltage supply	-40V to -160V (**Note 2**)
V_{IH}	High level input voltage	0.9V_{DD} to V_{DD}
V_{IL}	Low level input voltage	0V to 0.1 V_{DD}
V_{SIG}	Analog signal voltage peak-to-peak	V_{NN} +10V to V_{PP} -10V (**Note 3**)
T_A	Operating free air temperature	0°C to 70°C

Note 1: Power up/down sequence is arbitrary except GND must be powered-up first and powered-down last.

2: Rise and fall times of power supplies V_{DD}, V_{PP}, and V_{NN} should not be less than 1.0msec.

3: V_{SIG} must be $V_{NN} \le V_{SIG} \le V_{PP}$ or floating during power up/down transition.

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over recommended operating conditions unless otherwise specified.
See test circuits Figure 3-2

Parameter	Symbol	0°C		25°C			70°C		Units	Conditions	
		Min	Max	Min	Typ	Max	Min	Max			
Small signal switch ON-resistance	R_{ONS}	-	-	-	26	-	-	-	Ω	I_{SIG} = 5.0mA	V_{PP} = +40V, V_{NN} = -160V
		-	-	-	22	-	-	-		I_{SIG} = 200mA	
		-	-	-	22	-	-	-		I_{SIG} = 5.0mA	V_{PP} = +100V, V_{NN} = -100V
		-	-	-	18	-	-	-		I_{SIG} = 200mA	
		-	-	-	20	-	-	-		I_{SIG} = 5.0mA	V_{PP} = +160V, V_{NN} = -40V
		-	-	-	16	-	-	-		I_{SIG} = 200mA	
Small signal switch ON-resistance matching	ΔR_{ONS}	-	20	-	5.0	20	-	20	%	I_{SIG} = 5.0mA, V_{PP} = +100V, V_{NN} = -100V	
Large signal switch ON-resistance	R_{ONL}	-	-	-	30	-	-	-	Ω	V_{SIG} = V_{PP} -10V, I_{SIG} = 1A (Note 1)	
Output-switch shunt resistance (HV2762 only)	R_{INT}	-	-	20	35	50	-	-	KΩ	Output switch to R_{GND}, I_{RINT} =0.5 mA	

DC ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Specifications: Over recommended operating conditions unless otherwise specified.
See test circuits Figure 3-2

Parameter	Symbol	0°C		25°C			70°C		Units	Conditions	
		Min	Max	Min	Typ	Max	Min	Max			
Switch OFF-leakage per switch	I_{SOL}	-	5.0	-	1.0	10	-	15	µA	V_{SIG} = V_{PP} -10V, V_{NN} +10V	
DC offset switch OFF	V_{OS}	-	300	-	100	300	-	300	mV	No load for HV2762. R_{LOAD} = 100 KΩ for HV2662	
DC offset switch ON		-	500	-	100	500	-	500			
Quiescent V_{PP} supply current	I_{PPQ}	-	-	-	10	50	-	-	µA	All switches OFF	
Quiescent V_{NN} supply current	I_{NNQ}	-	-	-	-10	-50	-	-			
Quiescent V_{PP} supply current	I_{PPQ}	-	-	-	10	50	-	-	µA	All switches ON, I_{SW} = 5.0mA	
Quiescent V_{NN} supply current	I_{NNQ}	-	-	-	-10	-50	-	-			
Switch output peak current	I_{SW}	-	-	-	2.0	1.3	-	-	A	V_{SIG} duty cycle < 0.1% (Note 1)	
Output switching frequency	f_{SW}	-	-	-	-	50	-	-	kHz	Duty cycle = 50% (Note 1)	
Average VPP supply current	I_{PP}	-	4.0	-	-	4.5	-	5.0	mA	V_{PP}= +40V, V_{NN} = -160V	All output switches are turning ON and OFF at 50 kHz with no load
		-	4.0	-	-	4.5	-	5.0		V_{PP}= +100V, V_{NN} = -100V	
		-	4.0	-	-	4.5	-	5.0		V_{PP}= +160V, V_{NN} = -40V	
Average V_{NN} supply current	I_{NN}	-	4.0	-	-	4.5	-	5.0	mA	V_{PP} = +40V, V_{NN} = -160V	All output switches are turning ON and OFF at 50 kHz with no load
		-	4.0	-	-	4.5	-	5.0		V_{PP}= +100V, V_{NN} = -100V	
		-	4.0	-	-	4.5	-	5.0		V_{PP}= +160V, V_{NN} = -40V	
Average V_{DD} supply current	I_{DD}	-	8.0	-	-	8.0	-	8.0	mA	f_{CLK} = 5.0MHz, V_{DD} = 5.0V	
Quiescent V_{DD} supply current	I_{DDQ}	-	10	-	-	10	-	10	µA	All logic inputs are static	
Data out source current	I_{SOR}	0.45	-	0.45	0.70	-	0.40	-	mA	V_{OUT} = V_{DD} -0.7V	
Data out sink current	I_{SINK}	0.45	-	0.45	0.70	-	0.40	-	mA	V_{OUT} = 0.7V	
Logic input capacitance	C_{IN}	-	10	-	-	10	-	10	pF	(Note 2)	

Note 1: Specification is obtained by characterization and is not 100% tested.

2: Design guidance only

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over recommended operating conditions unless otherwise specified.
See test circuits Figure 3-2

Parameter	Symbol	0°C		25°C			70°C		Units	Conditions
		Min	Max	Min	Typ	Max	Min	Max		
Set up time before $\overline{LE}$ rises	t_{SD}	25	-	25	-	-	25	-	ns	(Note 1)
Time width of $\overline{LE}$	t_{WLE}	56	-	56	-	-	56	-	ns	V_{DD} = 3.0V (Note 1)
		12	-	12	-	-	12	-		V_{DD} = 5.0V (Note 1)
Clock delay time to data out	t_{DO}	9.0	40	9.0	-	40	9.0	40	ns	V_{DD} = 3.0V (Note 1)
		8.0	30	8.0	-	30	8.0	30		V_{DD} = 5.0V (Note 1)
Time width of CLR	t_{WCLR}	55	-	55	-	-	55	-	ns	(Note 1)
Set up time data to clock	t_{SU}	21	-	21	-	-	21	-	ns	V_{DD} = 3.0V (Note 1)
		7.0	-	7.0	-	-	7.0	-		V_{DD} = 5.0V (Note 1)
Hold time data from clock	t_H	5.0	-	5.0	-	-	5.0	-	ns	V_{DD} = 3.0V (Note 1)
		5.0	-	5.0	-	-	5.0	-		V_{DD} = 5.0V (Note 1)
Clock frequency	f_{CLK}	-	8	-	-	8	-	8	MHz	V_{DD} = 3.0V
		-	20	-	-	20	-	20		V_{DD} = 5.0V (Note 1)
Clock rise and fall times	t_R, t_F	-	50	-	-	50	-	50	ns	(Note 1)
Turn ON time	t_{ON}	-	5.0	-	-	5.0	-	5.0	µs	V_{SIG} = V_{PP} -10V, R_{LOAD} = 10kΩ
Turn OFF time	t_{OFF}	-	5.0	-	-	5.0	-	5.0		
Maximum V_{SIG} slew rate	dv/dt	-	20	-	-	20	-	20	V/ns	V_{PP} = +40V, V_{NN} = -160V (Note 1)
		-	20	-	-	20	-	20		V_{PP} = +100V, V_{NN} = -100V (Note 1)
		-	20	-	-	20	-	20		V_{PP} = +160V, V_{NN} = -40V (Note 1)
OFF isolation	K_O	-30	-	-30	-33	-	-30	-	dB	f = 5.0 MHz, 1.0 KΩ//15 pF load (Note 1)
		-58	-	-58	-60	-	-58	-		f = 5.0 MHz, 50Ω load (Note 1)
Switch crosstalk	K_{CR}	-60	-	-60	-70	-	-60	-	dB	f = 5.0 MHz, 50Ω load (Note 1)
Output switch isolation diode current	I_{ID}	-	300	-	-	300	-	300	mA	300 ns pulse width, 2.0% duty cycle (Note 1)
OFF capacitance SW to GND	$C_{SG(OFF)}$	-	14	-	9.0	14	-	14	pF	V_{SIG} = 0V, f = 1.0 MHz (Note 1)
ON capacitance SW to GND	$C_{SG(ON)}$	-	17	-	12	17	-	17		
Output voltage spike (per switch)	$+V_{SPK}$	-	-	-	-	150	-	-	mV	V_{PP} = +40V, V_{NN} = -160V R_{LOAD} = 50Ω (Note 1)
	$-V_{SPK}$	-	-	-	-	150	-	-		
	$+V_{SPK}$	-	-	-	-	150	-	-		V_{PP} = +100V, V_{NN} = -100V R_{LOAD} = 50Ω (Note 1)
	$-V_{SPK}$	-	-	-	-	150	-	-		
	$+V_{SPK}$	-	-	-	-	150	-	-		V_{PP} = +160V, V_{NN} = -40V R_{LOAD} = 50Ω (Note 1)
	$-V_{SPK}$	-	-	-	-	150	-	-		
Charge injection (per switch)	QC	-	-	-	820	-	-	-	pC	V_{PP} = +40V, V_{NN} = -160V (Note 1)
		-	-	-	600	-	-	-		V_{PP} = +100V, V_{NN} = -100V (Note 1)
		-	-	-	350	-	-	-		V_{PP} = +160V, V_{NN} = -40V (Note 1)

Note 1: Specification is obtained by characterization and is not 100% tested.

TEMPERATURE SPECIFICATIONS

Electrical Specifications: Unless otherwise specified, for all specifications $T_A = T_J$ = +25°C						
Parameter	**Symbol**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Temperature Ranges						
Storage Temperature	T_A	-65	–	150	°C	
Package Thermal Resistances						
Thermal Resistance, 64-Ball VFBGA	θ_{ja}	–	36	–	°C/W	

2.0 PIN DESCRIPTION

The locations of the balls are listed in Package Types.

TABLE 2-1: BALL DESCRIPTION 64-BALL VFBGA

Pin #	HV2662	HV2762	Description
A1	SW22B	SW22B	Analog switch 22 terminal B
A2	V_{NN}	V_{NN}	Negative supply voltage
A3	SW21B	SW21B	Analog switch 21 terminal B
A4	SW20B	SW20B	Analog switch 20 terminal B
A5	SW19B	SW19B	Analog switch 19 terminal B
A6	SW18B	SW18B	Analog switch 18 terminal B
A7	SW17B	SW17B	Analog switch 17 terminal B
A8	SW16B	SW16B	Analog switch 16 terminal B
A9	SW15B	SW15B	Analog switch 15 terminal B
A10	SW15A	SW15A	Analog switch 15 terminal A
B1	SW23B	SW23B	Analog switch 23 terminal B
B2	SW23A	SW23A	Analog switch 23 terminal A
B3	SW22A	SW22A	Analog switch 22 terminal A
B4	SW21A	SW21A	Analog switch 21 terminal A
B5	SW20A	SW20A	Analog switch 20 terminal A
B6	SW19A	SW19A	Analog switch 19 terminal A
B7	SW18A	SW18A	Analog switch 18 terminal A
B8	SW17A	SW17A	Analog switch 17 terminal A
B9	SW16A	SW16A	Analog switch 16 terminal A
B10	SW14B	SW14B	Analog switch 14 terminal B
C1	NC	NC	No connect
C2	V_{PP}	V_{PP}	Positive supply voltage
C9	SW14A	SW14A	Analog switch 14 terminal A
C10	SW13B	SW13B	Analog switch 13 terminal B
D1	CLR	CLR	Latch clear logic input
D2	NC	RGND	No connect/ Ground for bleed resistor
D9	V_{NN}	V_{NN}	Negative supply voltage
D10	SW13A	SW13A	Analog switch 13 terminal A
E1	$\overline{LE}$	$\overline{LE}$	Latch-enable logic input, low active
E2	CLK	CLK	Clock logic input for shift register
E9	SW12B	SW12B	Analog switch 12 terminal B
E10	SW12A	SW12A	Analog switch 12 terminal A
F1	V_{DD}	V_{DD}	Logic supply voltage
F2	GND	GND	Ground
F9	SW11B	SW11B	Analog switch 11 terminal B
F10	SW11A	SW11A	Analog switch 11 terminal A
G1	D_{IN}	D_{IN}	Data-in logic input
G2	D_{OUT}	D_{OUT}	Data-out logic output
G9	SW10B	SW10B	Analog switch 10 terminal B
G10	V_{NN}	V_{NN}	Negative supply voltage
H1	NC	RGND	No connect/ Ground for bleed resistor
H2	V_{PP}	V_{PP}	Positive supply voltage

TABLE 2-1: BALL DESCRIPTION 64-BALL VFBGA (CONTINUED)

Pin #	HV2662	HV2762	Description
H9	SW10A	SW10A	Analog switch 10 terminal A
H10	SW9B	SW9B	Analog switch 9 terminal B
J1	SW0A	SW0A	Analog switch 0 terminal A
J2	SW0B	SW0B	Analog switch 0 terminal B
J3	SW1B	SW1B	Analog switch 1 terminal B
J4	SW2B	SW2B	Analog switch 2 terminal B
J5	SW3B	SW3B	Analog switch 3 terminal B
J6	SW4B	SW4B	Analog switch 4 terminal B
J7	SW5B	SW5B	Analog switch 5 terminal B
J8	SW6B	SW6B	Analog switch 6 terminal B
J9	SW7B	SW7B	Analog switch 7 terminal B
J10	SW9A	SW9A	Analog switch 9 terminal A
K1	SW1A	SW1A	Analog switch 1 terminal A
K2	V_{NN}	V_{NN}	Negative supply voltage
K3	SW2A	SW2A	Analog switch 2 terminal A
K4	SW3A	SW3A	Analog switch 3 terminal A
K5	SW4A	SW4A	Analog switch 4 terminal A
K6	SW5A	SW5A	Analog switch 5 terminal A
K7	SW6A	SW6A	Analog switch 6 terminal A
K8	SW7A	SW7A	Analog switch 7 terminal A
K9	SW8A	SW8A	Analog switch 8 terminal A
K10	SW8B	SW8B	Analog switch 8 terminal B

3.0 FUNCTIONAL DESCRIPTION

FIGURE 3-1: LOGIC TIMING WAVEFORMS

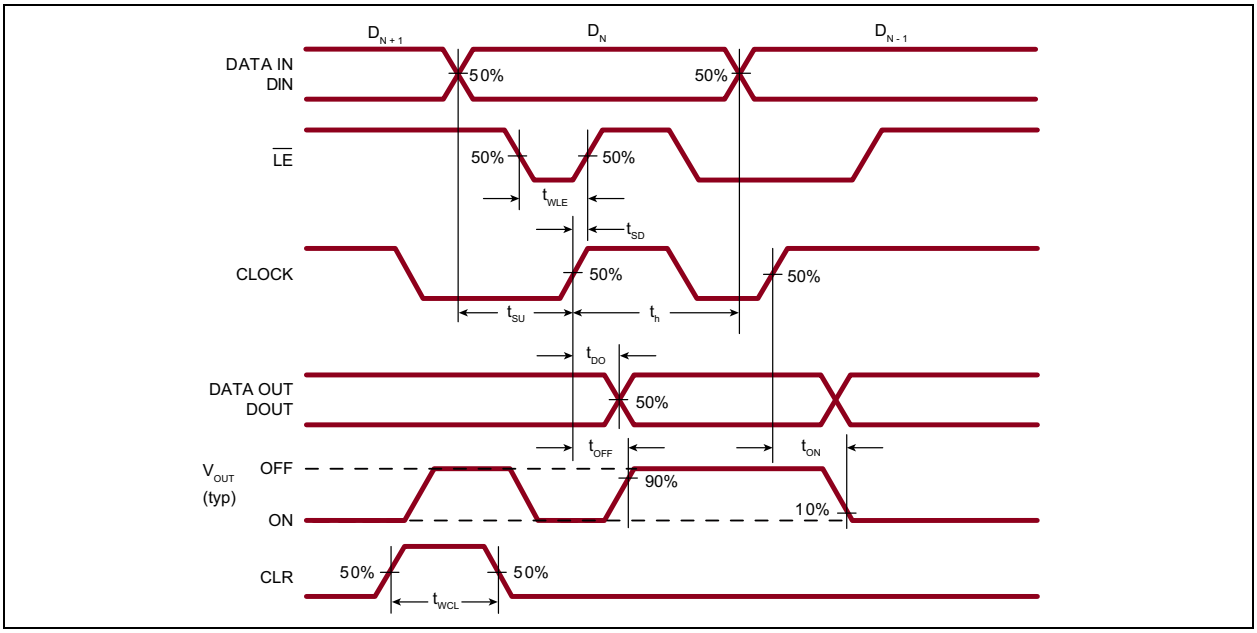


TABLE 3-1: TRUTH TABLE

D0[1]	D1	...	D15	D16	...	D23[2]	$\overline{LE}$[3]	CLR[4]	SW0[5,6]	SW1	...	SW15	SW16	...	SW23
L	-		-	-		-	L	L	OFF	-		-	-		-
H	-		-	-		-	L	L	ON	-		-	-		-
-	L		-	-		-	L	L	-	OFF		-	-		-
-	H		-	-		-	L	L	-	ON		-	-		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		L	-		-	L	L	-	-		OFF	-		-
-	-		H	-		-	L	L	-	-		ON	-		-
-	-	...	-	L	...	-	L	L	-	-	...	-	OFF	...	-
-	-		-	H		-	L	L	-	-		-	ON		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		-	-		-	L	L	-	-		-	-		-
-	-		-	-		L	L	L	-	-		-	-		OFF
-	-		-	-		H	L	L	-	-		-	-		ON
X	X	X	X	X	X	X	H	L	HOLD PREVIOUS STATE						
X	X	X	X	X	X	X	X	H	ALL SWITCHES OFF						

Note 1: Serial data is clocked in on the L to H transition of the CLK

2: DOUT is high when data in the register 23 is high.

3: Shift registers clocking has no effect on the switch states if LE is high.

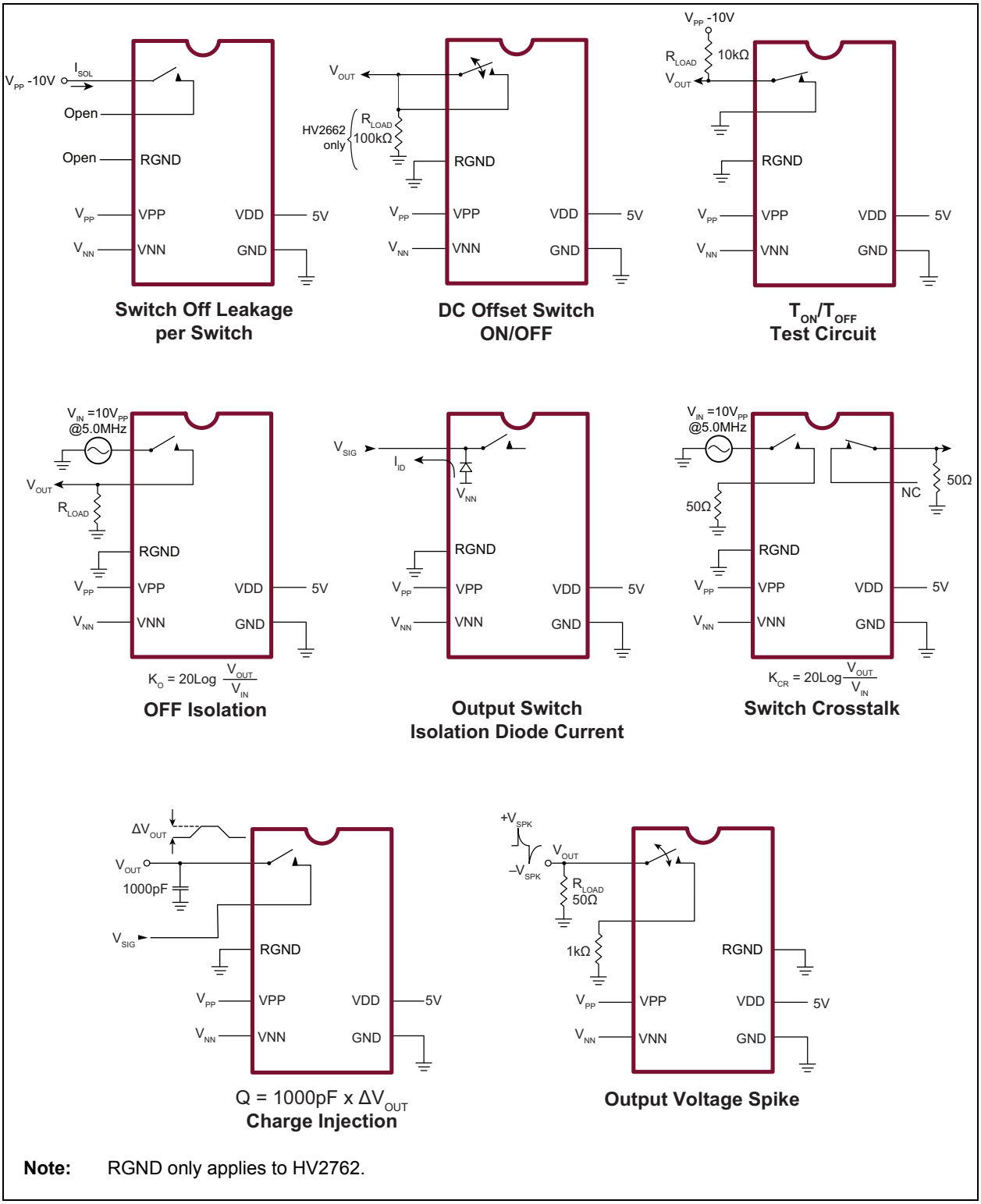
4: The CLR clear input overrides all other inputs.

5: The 24 switches operate independently.

6: All 24 switches go to a state retaining their latched condition at the rising edge of $\overline{LE}$. When $\overline{LE}$ is low, the shift registers data flow through the latch.

3.1 Application Information

FIGURE 3-2: TEST CIRCUITS

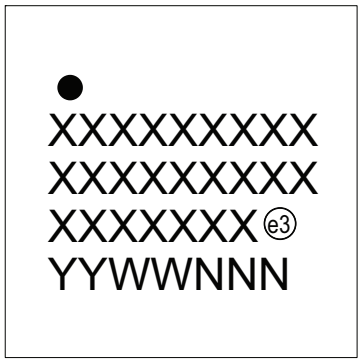


Note: RGND only applies to HV2762.

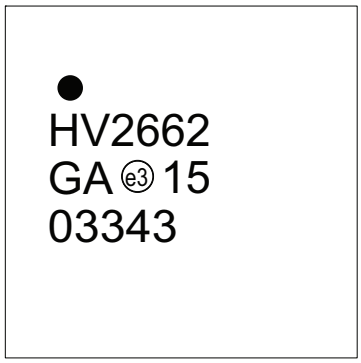
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

64-Ball VFBGA



Example

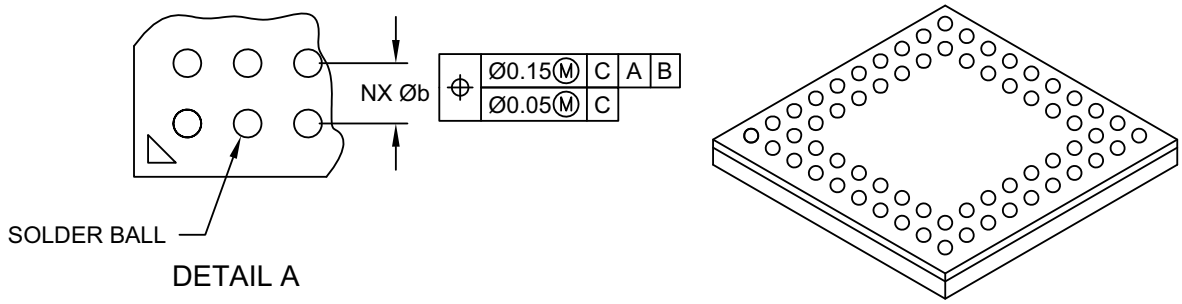


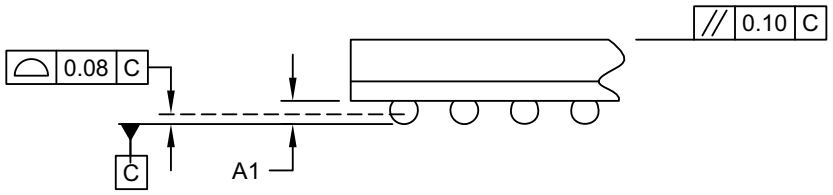
Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package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

64-Ball Very Thin Fine Pitch Ball Grid Array (GA) - 7x7x1.0 mm Body [VFBGA]
Supertex Legacy

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging





Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		64	
Pitch	e		0.65 BSC	
Overall Height	A	-	-	1.00
Standoff	A1	0.16	-	0.25
Molded Cap Thickness	A3		0.45 REF	
Overall Width	E		7.00 BSC	
Overall Ball Pitch	E1		5.85 BSC	
Overall Length	D		7.00 BSC	
Overall Ball Pitch	D1		5.85 BSC	
Ball Diameter	Øb	0.25	0.30	0.35

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-370-GA Rev A Sheet 2 of 2

APPENDIX A: REVISION HISTORY

Revision A (May 2016)

- Converted Supertex Docs #'s DSFP-2662 and DSFP-HV2762 to Microchip DS20005372A.
- Merged HV2662 and HV2762 into one document.
- Updated **"Product Identification System"**. Removed parts with a package code of "LA"; Added package "GA".
- EOL of 64-Ball LFGA package (LB).per PCN JAON-20WQKC840.
- Added information for 64-Ball VFBGA (GA) throughout.
- Minor text changes throughout.

PRODUCT IDENTIFICATION SYSTEM

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

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

Device:	HV2662 =	24-Channel, HV Analog Switch
	HV2762 =	24-Channel, HV Analog Switch with Bleed Resistors
Package:	GA =	64-ball VFBGA
Environmental	G =	Lead (Pb)-free/RoHS-compliant package
Media Type:	(blank) =	120/Tray for GA package

Examples:

a) HV2662GA-G: 64-ball VFBGA package, 120/Tray

b) HV2762GA-G: 64-ball VFBGA package, 120/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.
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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® 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.

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