# 16-Channel Serial to Parallel Converter with High Voltage Backplane Driver and Push-Pull Outputs

## Features

- HVCMOS® technology
- Output voltage up to +200V
- Shift register speed 500kHz @ $V_{DD}$ = 1.7V
- 16 high voltage outputs
- High voltage backplane driver
- CMOS input levels

## Applications

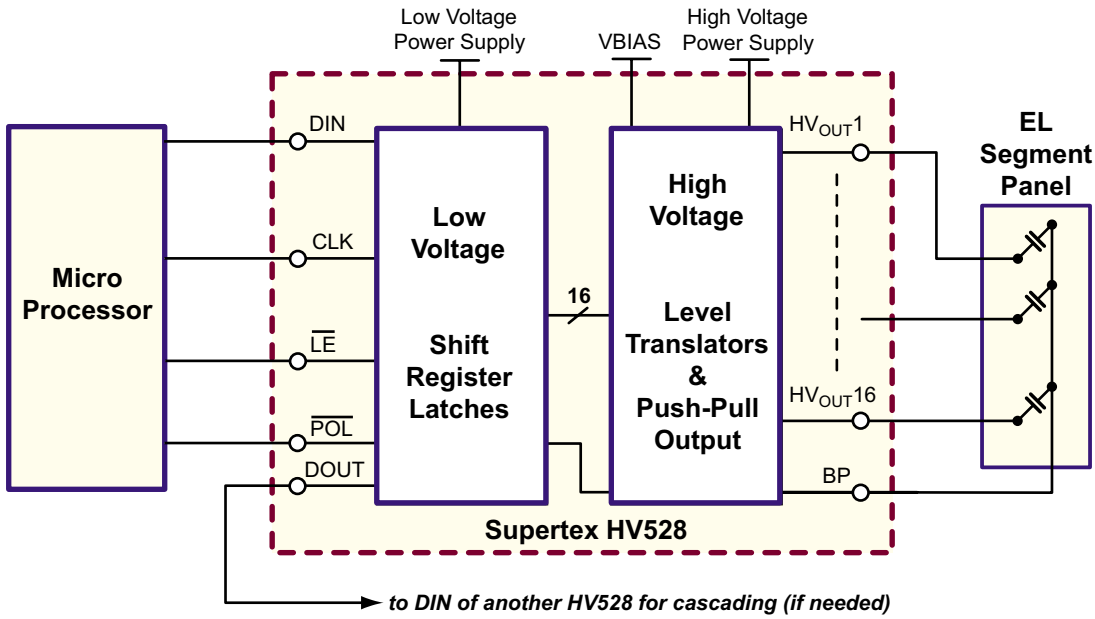
- Multiple segment EL display
- Piezoelectric transducer driver
- Braille driver

## General Description

The HV528 is a 200V, 16-channel serial to parallel converter. The high voltage outputs and the backplane driver are designed to source and sink ±1.0mA.

The high voltage outputs are controlled by a 16-bit serial shift register, followed by a 16-bit latch. Data is shifted through the shift registers during the low to high clock transition. A data output buffer is provided for cascading multiple devices. Data is transferred to the 16-bit latch when a logic level low is applied to the $\overline{LE}$ input. Data is stored in the latch when $\overline{LE}$ is high. Output states are controlled by the data in the latch and by the $\overline{POL}$ pin.

## Typical Application Circuit

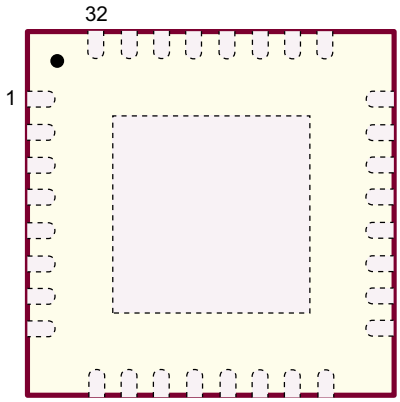


## Ordering Information

| Device | Package Option |
|---|---|
| | 32-Lead QFN<br>*5.00x5.00mm body*<br>*1.00mm height (max)*<br>*0.50mm pitch* |
| HV528 | HV528K6-G |

*-G indicates package is RoHS compliant ('Green')*

## Pin Configuration




**32-Lead QFN (K6)**
***(top view)***
***(Bottom side exposed center pad is at $V_{PP}$ potential)***

## Absolute Maximum Ratings

| Parameter | Value |
|---|---|
| Logic supply, $V_{DD}$ | -0.5V to 7.0V |
| High voltage supply, $V_{PP}$ | 215V |
| Translator supply voltage, $V_{BIAS}$ | -0.5V to 7.0V |
| Logic input levels | -0.5V to $V_{DD}$ +0.5V |
| Operating junction temperature | -40°C to +125°C |
| Storage temperature range | -65°C to +150°C |

*Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. Continuous operation of the device at the absolute rating level may affect device reliability. All voltages are referenced to device ground.*

## Product Marking

L = Lot Number
YY = Year Sealed
WW = Week Sealed
A = Assembler ID
C = Country of Origin
___ = "Green" Packaging

**32-Lead QFN (K6)**

## Operating Supply Voltages and Conditions

| Sym | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Logic supply voltage | 1.7 | 3.0 | 5.5 | V | --- |
| $V_{BIAS}$ | Level translator supply voltage | 5.4 | - | 6.6 | V | --- |
| $V_{PP}$ | Positive high voltage supply | 50 | - | 200 | V | --- |
| $V_{IH}$ | High-level input voltage | $0.9V_{DD}$ | - | $V_{DD}$ | V | --- |
| $V_{IL}$ | Low-level input voltage | 0 | - | | V | --- |
| $T_A$ | Operating temperature | 0 | - | +70 | °C | --- |

***Notes:***

1. *External ground noise reduction circuit will be provided by design upon characterization.*

***Power-up sequence should be the following*:***

1. Apply ground
2. Apply $V_{DD}$
3. Set all inputs ($D_{IN}$, CLK, $\overline{LE}$ , $\overline{POL}$) to a known state
4. Apply $V_{BIAS}$
5. Apply $V_{PP}$

***Power-down sequence should be the reverse of the above***

** This power up sequence requires an external high voltage diode between $V_{DD}$ and $V_{PP}$. Without the diode, power up $V_{PP}$ to a $V_{DD}$ level first to bias the silicon substrate. After all other signals are powered, finish raising the $V_{PP}$ to its final level.*

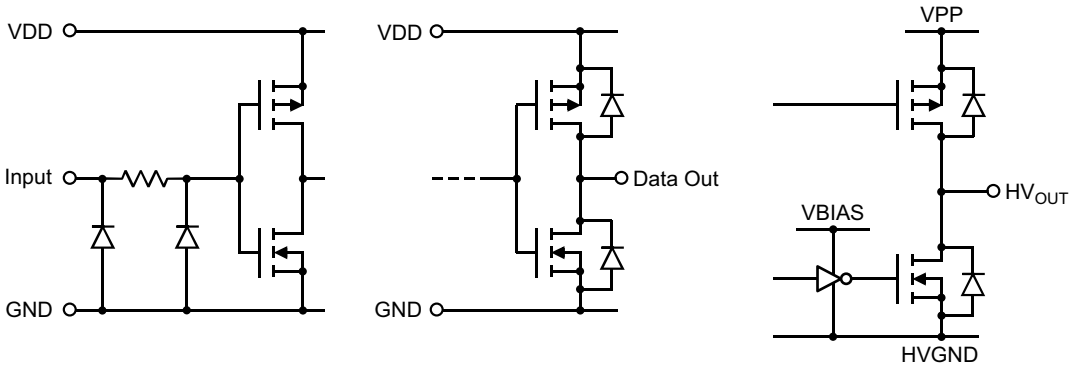
## DC Electrical Characteristics *(Over operating supply voltages and temperature, unless otherwise noted)*

| Sym | Parameter | | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|---|
| $I_{DD}$ | $V_{DD}$ supply current | | - | - | 1.0 | mA | $f_{CLK}$ = 500kHz |
| $I_{DDQ}$ | Quiescent $V_{DD}$ supply current | | - | - | 10 | µA | All logic inputs = $V_{DD}$ or 0V |
| $I_{BIAS}$ | $V_{BIAS}$ supply current | | - | - | 100 | µA | All $HV_{OUTS}$ switching at 1.0kHz. Peak $I_{BIAS}$ = 200mA with all channels switching |
| $I_{BIASQ}$ | Quiescent $V_{BIAS}$ current | | - | - | 10 | µA | No $HV_{OUT}$ switching |
| $I_{PPQ}$ | Quiescent $V_{PP}$ supply current | | - | - | 100 | µA | $V_{PP}$ = 200V, outputs are static |
| $I_{IH}$ | High-level logic input current | | - | - | 10 | µA | $V_{IH} = V_{DD}$ |
| $I_{IL}$ | Low-level logic input current | | - | - | -10 | µA | $V_{IL}$ = 0V |
| $V_{OH}$ | High level output | $HV_{OUT}$ & BP | $V_{PP}$ -30V | - | - | V | $IHV_{OUT}$ = -1.0mA, 50V ≤ $V_{PP}$ ≤ 100V |
| | | | $V_{PP}$ -16V | - | - | V | $IHV_{OUT}$ = -1.0mA, 100V < $V_{PP}$ ≤ 200V |
| | | $D_{OUT}$ | $V_{DD}$ -1.0V | - | - | V | $ID_{OUT}$ = -1.0mA |
| $V_{OL}$ | Low level output | $HV_{OUT}$ & BP | - | - | 6.0 | V | $IHV_{OUT}$ = 1.0mA |
| | | $D_{OUT}$ | - | - | 1.0 | V | $ID_{OUT}$ = 1.0mA |
| $C_{DIN}$ | Logic input capacitance | | - | - | 10 | pF | --- |
| $C_{DOUT}$ | Logic output capacitance | | - | - | 10 | pF | --- |

## AC Electrical Characteristics *(Over operating supply voltages and temperature, unless otherwise noted)*

| Sym | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $f_{CLK}$ | Clock frequency | 0 | - | 500 | kHz | --- |
| $t_C$ | Clock high / low pulse width | 1.0 | - | - | µs | --- |
| $t_{SU}$ | Data setup time before clock rises | 50 | - | - | ns | --- |
| $t_H$ | Data hold time after clock rises | 50 | - | - | ns | --- |
| $t_{CLE}$ | $\overline{LE}$ from CLK setup time | 15 | - | - | ns | --- |
| $t_{WLE}$ | $\overline{LE}$ pulse width | 100 | - | - | ns | --- |
| $t_{DD}$ | Clock negative edge to $D_{OUT}$ delay | - | - | 150 | ns | $C_{LDOUT}$ = 50pF, ($C_{LDOUT}$ includes $C_{DIN}$ and $C_{DOUT}$) |
| $t_{PHV}$ | Delay time from inputs for $HV_{OUT}$ / BP to start rise/fall | - | - | 500 | ns | $V_{PP}$ = 200V, $V_{BIAS}$ = 5.4V |
| $t_{OR}$ | $HV_{OUTPUT}$ / BP rise time | - | - | 300 | µs | $C_L$ = 1500pF, $V_{PP}$ = 200V |
| $t_{OF}$ | $HV_{OUTPUT}$ / BP fall time | - | - | 300 | µs | $C_L$ = 1500pF, $V_{BIAS}$ = 5.4V, $V_{PP}$ = 200V |
| $t_{OC}$ | Width of $\overline{POL}$ pulses | $t_{PHV} + t_{OR}/t_{OF}$ | - | - | µs | --- |

## Input and Output Equivalent Circuits




**Logic Inputs** **Logic Data Output** **High Voltage Outputs**

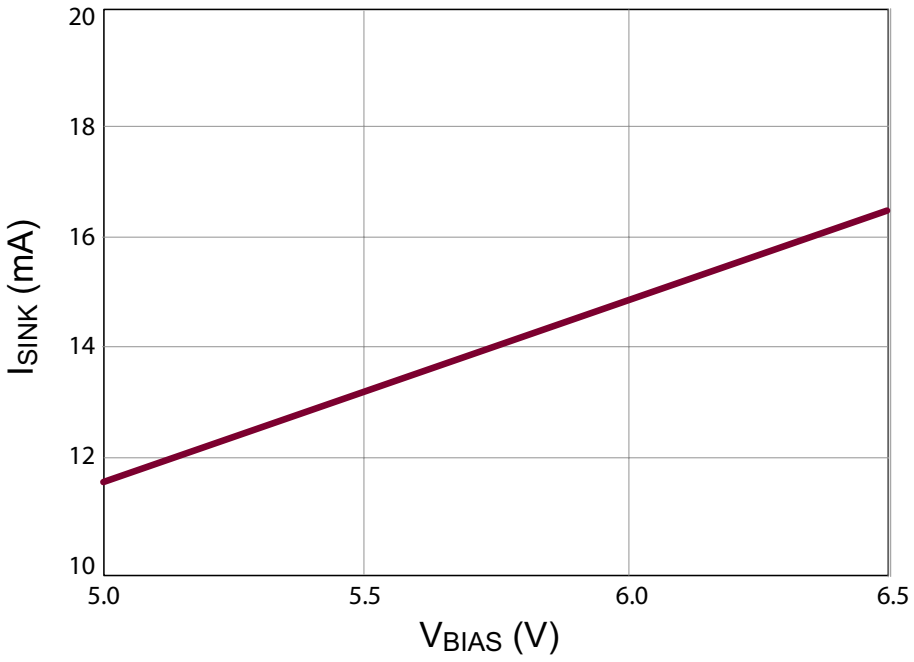
## $V_{BIAS}$ SUPPLY

The $V_{BIAS}$ supply operates from 5.4 to 6.6V. It is the gate drive voltage for all of the output N-channel MOSFETs. This allows the output peak current sink to be set by varying the $V_{BIAS}$ voltage. A higher $V_{BIAS}$ voltage will increase the current sinking capability.

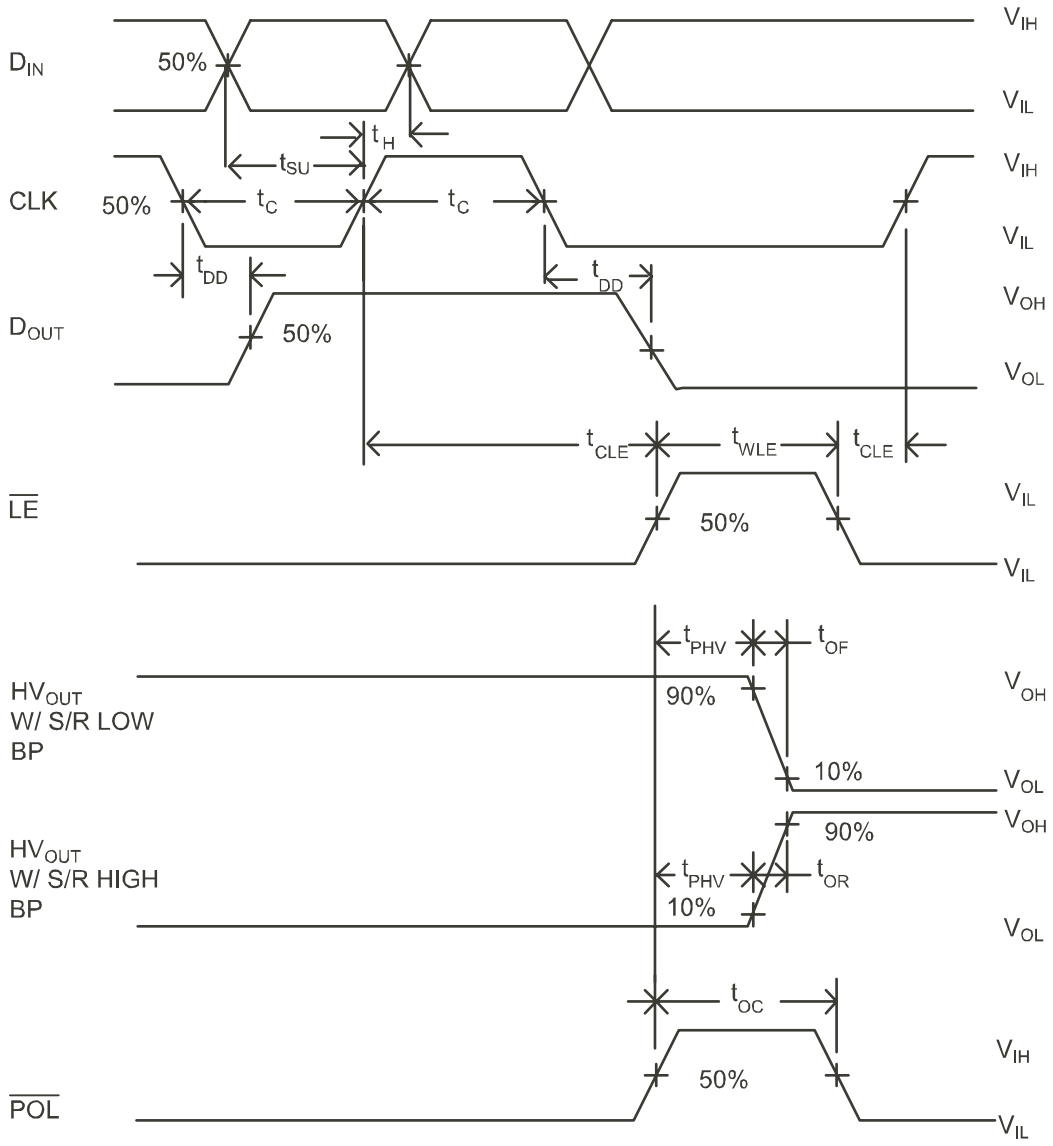
The operating $V_{DD}$ range is 1.7 to 5.5V. A plot showing the typical characteristics of $I_{SINK}$ vs $V_{BIAS}$ is shown below.

## Typical $HV_{OUT}$ $I_{SINK}$ vs $V_{BIAS}$

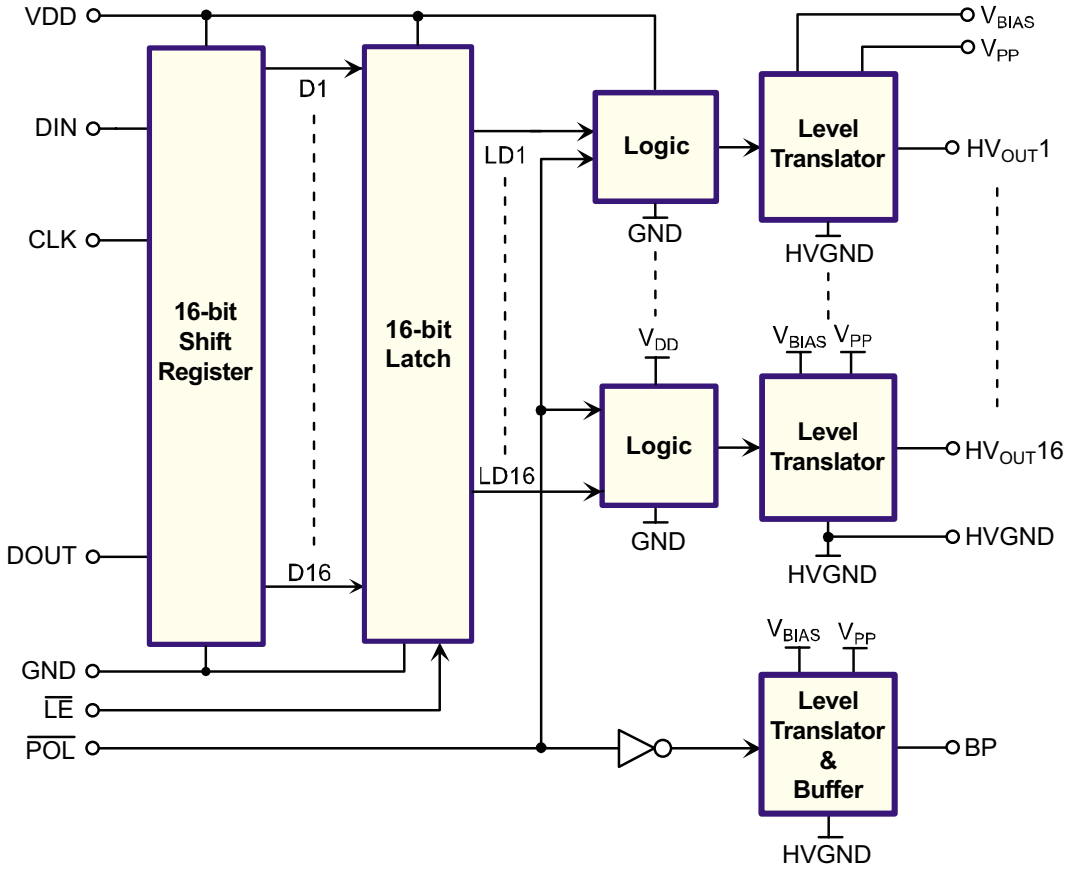
***($V_{PP}$ = 200V, $C_{LOAD}$ = 1.0nF)***



## Switching Waveforms



## Functional Block Diagram




## Function Table

| Function | Inputs | | | | Outputs | | | |
|---|---|---|---|---|---|---|---|---|
| | DIN | CLK | $\overline{LE}$ | $\overline{POL}$ | Shift Reg 1 2...16 | HV Outputs 1 2...16 | BP | DOUT |
| Load S/R | H OR L | ↑ | H | X | H or L ●...● | ● ●...● | X | ● |
| Transfer data in latch | X | L | L | H | * *.....* | * *.....* | L | ● |
| | X | L | L | L | * *.....* | * *.....* (b) | H | ● |
| Store data in latches | X | X | H | H | ● ●...● | ● ●...● | L | ● |
| | X | X | H | L | ● ●...● | ● ●...● (b) | H | ● |
| Transparent mode | L | ↑ | L | H | L ●...● | L ●...● | L | ● |
| | H | ↑ | L | H | H ●...● | H ●...● | L | ● |
| Invert mode | X | X | H | L | ● ●...● | ● ●...● (b) | H | X |
| | X | X | H | H | ● ●...● | ● ●...● | L | X |

***Notes:***

H = high level, L = low level, X = irrelevant, ↑ = low-to-high transition

● = dependent on previous stage's state before the last CLK or last $\overline{LE}$ low

* = data at the last CLK ↑

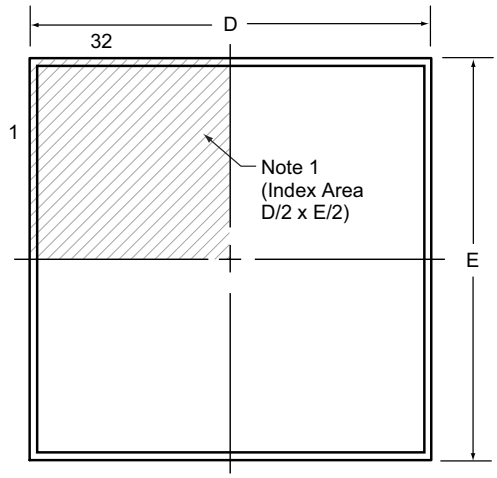
(b) = bar over all symbols

## Pin Description

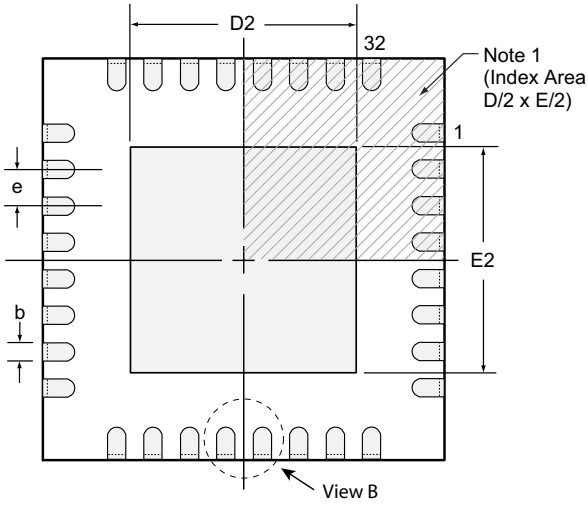
| Pin # | Function | Description |
|---|---|---|
| 1 | $HV_{OUT}12$ | High voltage push-pull output |
| 2 | $HV_{OUT}11$ | |
| 3 | $HV_{OUT}10$ | |
| 4 | $HV_{OUT}9$ | |
| 5 | $HV_{OUT}8$ | |
| 6 | $HV_{OUT}7$ | |
| 7 | $HV_{OUT}6$ | |
| 8 | $HV_{OUT}5$ | |
| 9 | $HV_{OUT}4$ | |
| 10 | $HV_{OUT}3$ | |
| 11 | $HV_{OUT}2$ | |
| 12 | $HV_{OUT}1$ | |
| 13 | NC | No connect |
| 14 | VPP | High voltage supply |
| 15 | GND | Logic ground |
| 16 | NC | No connect |
| 17 | DIN | Data in |
| 18 | NC | No connect |
| 19 | CLK | Clock input logic |
| 20 | VDD | Logic supply voltage |
| 21 | $\overline{POL}$ | Polarity bar input logic |
| 22 | $\overline{LE}$ | Latch enable bar input logic |
| 23 | NC | No connect |
| 24 | DOUT | Data out |
| 25 | NC | No connect |
| 26 | VBIAS | Level translator bias voltage |
| 27 | HVGND | High voltage ground |
| 28 | BP | High voltage backplane output |
| 29 | $HV_{OUT}16$ | High voltage push-pull output |
| 30 | $HV_{OUT}15$ | |
| 31 | $HV_{OUT}14$ | |
| 32 | $HV_{OUT}13$ | |
| Center Pad | | The center pad is at VPP potential. Leave floating or connect to VPP. Do not ground. |

# 32-Lead QFN Package Outline (K6)

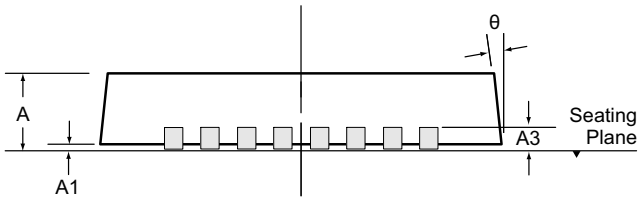
***5.00x5.00mm body, 1.00mm height (max), 0.50mm pitch***



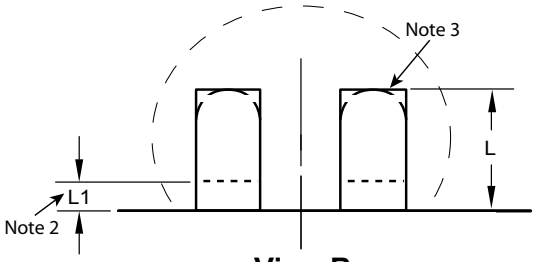

**Top View**




**Bottom View**




**Side View**




**View B**

***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. *Depending on the method of manufacturing, a maximum of 0.15mm pullback (L1) may be present.*
3. *The inner tip of the lead may be either rounded or square.*

| Symbol | | A | A1 | A3 | b | D | D2 | E | E2 | e | L | L1 | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimension (mm) | MIN | 0.80 | 0.00 | 0.20 REF | 0.18 | 4.85* | 1.05 | 4.85* | 1.05 | 0.50 BSC | 0.30† | 0.00 | 0° |
| | NOM | 0.90 | 0.02 | | 0.25 | 5.00 | - | 5.00 | - | | 0.40† | - | - |
| | MAX | 1.00 | 0.05 | | 0.30 | 5.15* | 3.55† | 5.15* | 3.55† | | 0.50† | 0.15 | 14° |

*JEDEC Registration MO-220, Variation VHHD-6, Issue K, June 2006.*
** This dimension is not specified in the original JEDEC drawing. The value listed is for reference only.*
*† This dimension is a non-JEDEC dimension.*
***Drawings not to scale.***
***Supertex Doc. #:** DSPD-32QFNK65X5P050, Version B090808.*

*(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to http://www.supertex.com/packaging.html.)*

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