

## 32-Channel High Voltage Amplifier Array

### Features

- ▶ 32 independent high voltage amplifiers
- ▶ Up to 250V output voltage
- ▶ 3.0V/ $\mu$ s typical output slew rate
- ▶ Very low operating current (typically 45 $\mu$ A per channel)
- ▶ High value internal feedback resistors
- ▶ Fixed gain of 50V/V
- ▶ Integrated silicon diode for temperature sensing

### Applications

- ▶ MEMS (microelectromechanical systems) driver
- ▶ Piezoelectric transducer driver
- ▶ Optical crosspoint switches (using MEMS technology)

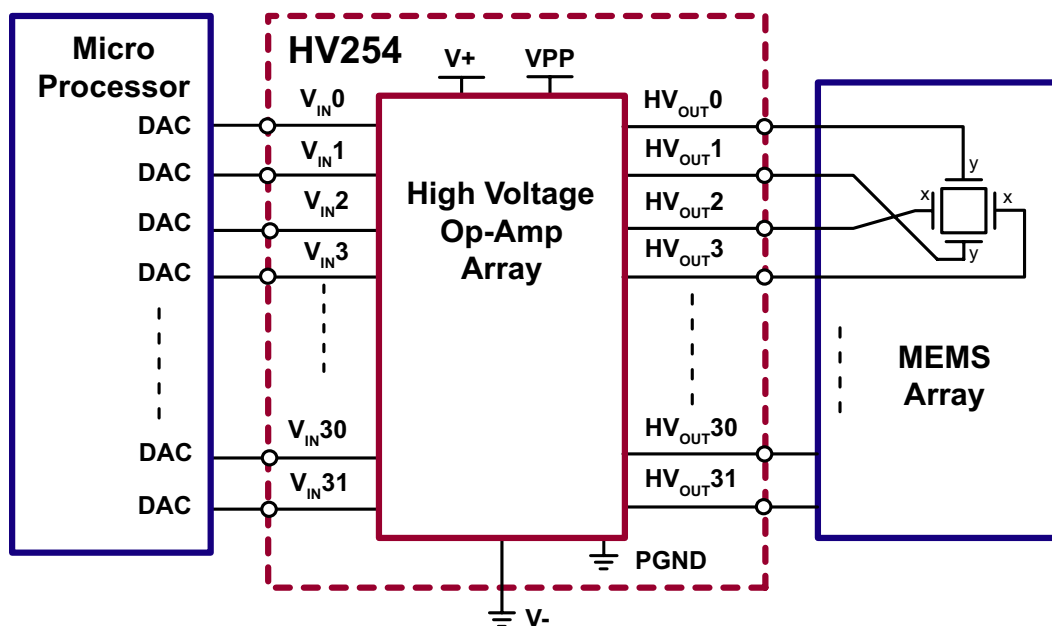
### General Description

The Supertex HV254 is a 32-channel, high voltage, amplifier array integrated circuit. It operates on a 275V high voltage supply and two low voltage supplies: +5.0V and -5.0V. Each channel has its own input and output. An integrated diode is included to help monitor die temperature.

The input voltage can be from a DAC (Digital to Analog Converter) with a voltage range of 0V to the low voltage supply, V+. The output of the HV254 will swing from 7.0 to 250V. It cannot swing to ground. With the internal gain set at 50V/V, a minimum input signal of 140mV will still maintain linearity. Input voltages below 140mV can be applied without damage to the device. However, the amplifier will be saturated. Typical output load is equivalent to a 125M $\Omega$  resistor in parallel with a 100pF capacitor. The outputs have a guaranteed slew rate of at least 3.0V/ $\mu$ s. The internal closed loop gain is set at a nominal value of 34.0dB (50V/V).

The HV254 is designed to operate with minimal power consumption while maintaining a guaranteed slew rate of 3.0V/ $\mu$ s. High value resistors are used for the gain setting to minimize current on the feedback path.

### Typical Application Circuit



## Ordering Information

| Part Number | Package Option | Packing |
|-------------|----------------|---------|
| HV254FG-G   | 100-Lead MQFP  | 66/Tray |

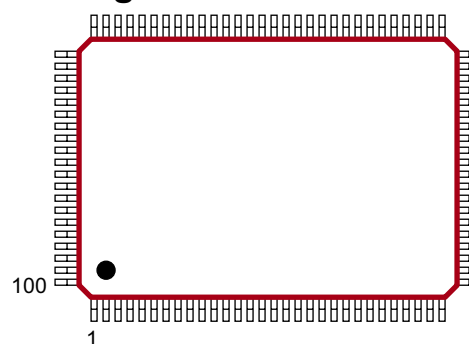
-G denotes a lead (Pb)-free / RoHS compliant package

## Absolute Maximum Ratings

| Parameter                           | Value          |
|-------------------------------------|----------------|
| $V_{PP}$ , High voltage supply      | 275V           |
| $V_+$ , Low voltage positive supply | 7.0V           |
| $V_-$ , Low voltage negative supply | -7.0V          |
| $HV_{OUT}$ , Output voltage         | 0V to 275V     |
| $V_{IN}$ , Analog input signal      | 0V to 5.0V     |
| Storage temperature range           | -65°C to 150°C |
| Maximum junction temperature        | 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.

## Pin Configuration



**100-Lead MQFP**  
(top view)

## Product Marking

|             |                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------|
| Top Marking | YY = Year Sealed<br>WW = Week Sealed<br>L = Lot Number<br>C = Country of Origin<br>A = Assembler ID<br>— = "Green" Packaging |
|             |                                                                                                                              |

Package may or may not include the following marks: Si or

**100-Lead MQFP**

## Typical Thermal Resistance

| Package       | $\theta_{ja}$ |
|---------------|---------------|
| 100-Lead MQFP | 39°C/W        |

## Operating Conditions

| Sym      | Parameter                    | Min   | Typ   | Max   | Units | Conditions                                                             |
|----------|------------------------------|-------|-------|-------|-------|------------------------------------------------------------------------|
| $V_{PP}$ | High voltage positive supply | 50    | -     | 275   | V     | ---                                                                    |
| $V_+$    | Low voltage positive supply  | 4.75  | 5.00  | 5.25  | V     | ---                                                                    |
| $V_-$    | Low voltage negative supply  | -4.75 | -5.00 | -5.25 | V     | ---                                                                    |
| $I_{PP}$ | $V_{PP}$ supply current      | 1.0   | -     | 2.5   | mA    | $V_{PP} = 275V$ . All inputs set at 140mV. Typically 45μA per channel. |
| $I_+$    | $V_+$ supply current         | -     | -     | 1.0   | mA    | $V_+ = 5.25V$                                                          |
| $I_-$    | $V_-$ supply current         | -     | -     | -3.0  | mA    | $V_- = -5.25V$                                                         |
| $T_A$    | Ambient temperature range    | -10   | -     | 70    | °C    | ---                                                                    |
| $T_J$    | Operating temperature range  | -10   | -     | 125   | °C    | ---                                                                    |

## Electrical Characteristics (over operating conditions, unless otherwise specified)

### High Voltage Amplifier Output

| Sym               | Parameter                                | Min  | Typ   | Max   | Units | Conditions                                  |
|-------------------|------------------------------------------|------|-------|-------|-------|---------------------------------------------|
| HV <sub>OUT</sub> | HV <sub>OUT</sub> voltage swing          | 7.0  | -     | 250   | V     | V <sub>PP</sub> = 275V, Load = 125MΩ//100pF |
| V <sub>IN</sub>   | Input voltage range                      | 0.14 | -     | V+    | V     | ---                                         |
| HV <sub>OS</sub>  | HV <sub>OUT</sub> DC offset              | -    | ±1.50 | ±1.52 | V     | V <sub>PP</sub> = 275V, 30mV input offset   |
| SR                | HV <sub>OUT</sub> slew rate              | 3.0  | -     | -     | V/μs  | V <sub>PP</sub> = 275V, load = 125MΩ//100pF |
| R <sub>FB</sub>   | Feedback impedance                       | 8.0  | 12    | -     | MΩ    | ---                                         |
| A <sub>V</sub>    | Closed loop gain                         | 47.5 | 50.0  | 52.5  | V/V   | ---                                         |
| BW                | HV <sub>OUT</sub> -3dB channel bandwidth | 5.0  | -     | -     | KHz   | V <sub>PP</sub> = 275V                      |
| C <sub>LOAD</sub> | HV <sub>OUT</sub> capacitive load        | 0    | -     | 100   | pF    | ---                                         |
|                   | Stability (max drift)                    | -    | -     | 500   | mV    | Measured at HV <sub>OUT</sub>               |

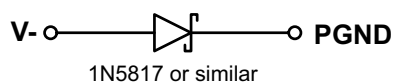
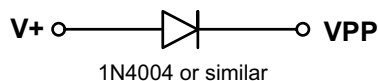
### Temperature Diode

| Sym            | Parameter                              | Min | Typ  | Max | Units | Conditions                               |
|----------------|----------------------------------------|-----|------|-----|-------|------------------------------------------|
| PIV            | Peak inverse voltage                   | -   | -    | 5.0 | V     | cathode to anode                         |
| V <sub>F</sub> | Forward diode drop                     | -   | -    | 0.8 | V     | I <sub>F</sub> = 100μA, anode to cathode |
| I <sub>F</sub> | Forward diode current                  | -   | -    | 100 | μA    | anode to cathode                         |
| T <sub>C</sub> | V <sub>F</sub> temperature coefficient | -   | -2.2 | -   | mV/°C | anode to cathode                         |

## Power Up/Down Sequence

### External Diode Protection

The device can be damaged due to improper power up/down sequence. To prevent damage, please follow the acceptable power up/down sequences and add two external diodes as shown in the diagram below. The first diode is a high voltage diode across VPP and V+ where the anode of the diode is connected to V+ and the cathode of the diode is connected to VPP. Any low current high voltage diode such as a 1N4004 will be adequate. The second diode is a schottky diode across V- and DGND where the anode of the schottky diode is connected to V- and the cathode is connected to DGND. Any low current schottky diode such as a 1N5817 will be adequate.



### Acceptable Power Up Sequences

The HV254 can be powered up with any of the following sequences listed below.

- 1) VPP 2) V- 3) V+ 4) Inputs and Anode

or

- 1) V- 2) V+ 3) VPP 4) Inputs and Anode

### Acceptable Power Down Sequences

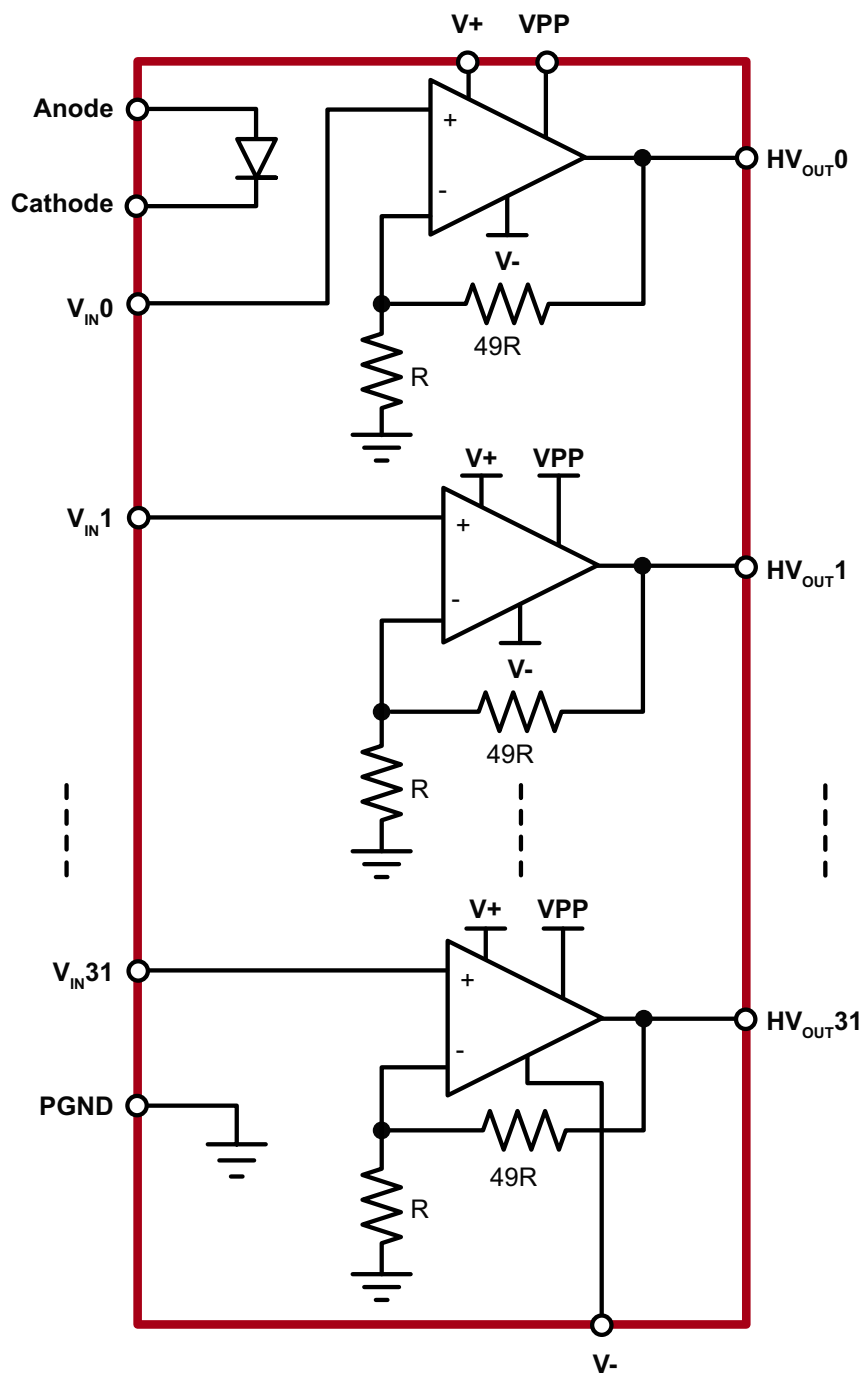
The HV254 can be powered down with any of the following sequences listed below.

- 1) Inputs and Anode 2) V+ 3) V- 4) VPP

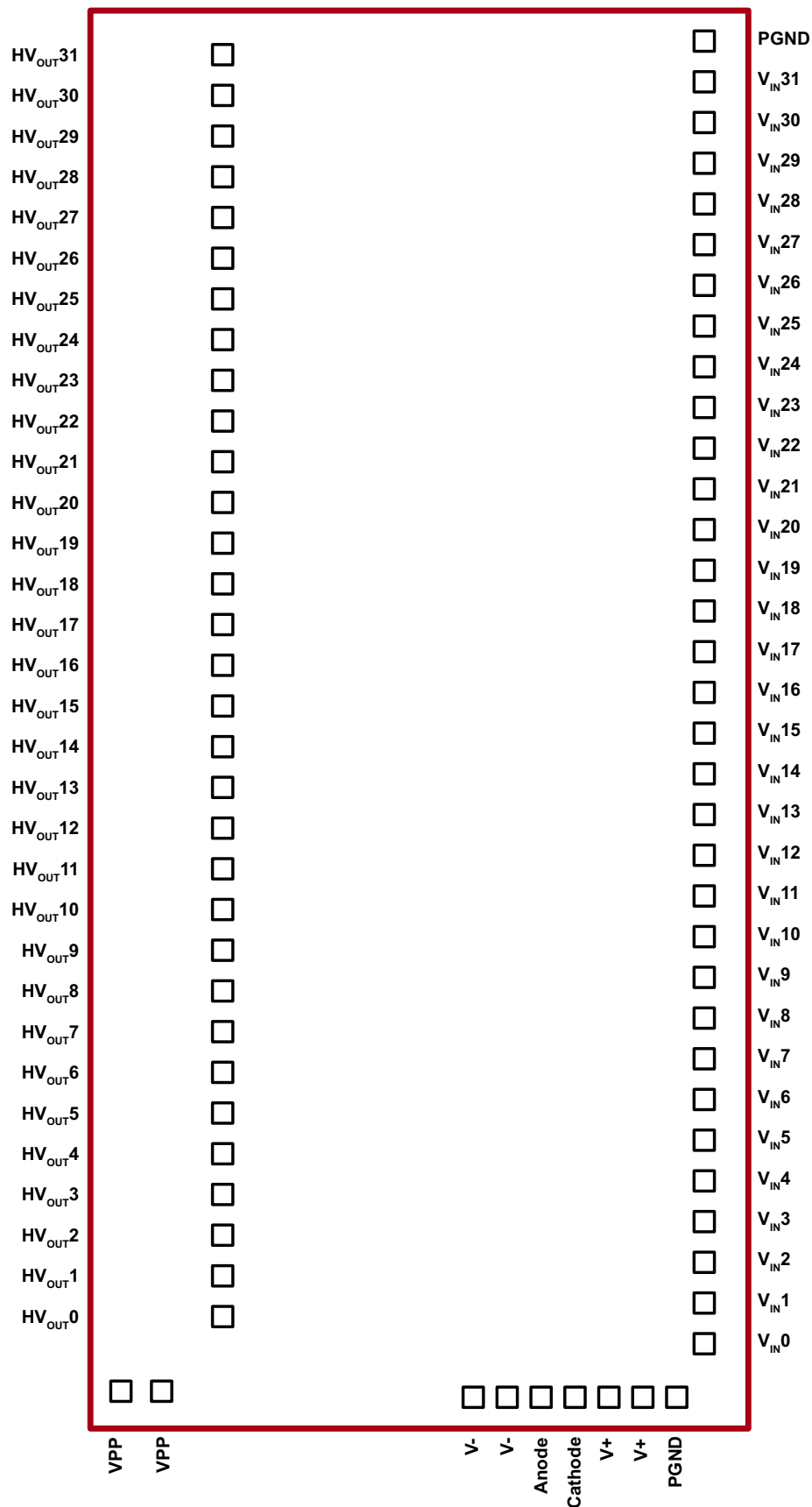
or

- 1) Inputs and Anode 2) VPP 3) V+ 4) V-

## HV254 Block Diagram



# Pad Configuration *(not drawn to scale)*



## Pad Coordinates

Chip size: 4800 $\mu$ m x 11180 $\mu$ m

Center of die is (0,0)

| Pad Name             | X ( $\mu$ m) | Y ( $\mu$ m) |
|----------------------|--------------|--------------|
| HV <sub>OUT</sub> 31 | -1447.5      | 5244.0       |
| HV <sub>OUT</sub> 30 | -1447.5      | 4926.5       |
| HV <sub>OUT</sub> 29 | -1447.5      | 4609.0       |
| HV <sub>OUT</sub> 28 | -1447.5      | 4291.5       |
| HV <sub>OUT</sub> 27 | -1447.5      | 3974.0       |
| HV <sub>OUT</sub> 26 | -1447.5      | 3656.5       |
| HV <sub>OUT</sub> 25 | -1447.5      | 3339.0       |
| HV <sub>OUT</sub> 24 | -1447.5      | 3021.5       |
| HV <sub>OUT</sub> 23 | -1447.5      | 2704.0       |
| HV <sub>OUT</sub> 22 | -1447.5      | 2386.5       |
| HV <sub>OUT</sub> 21 | -1447.5      | 2069.0       |
| HV <sub>OUT</sub> 20 | -1447.5      | 1751.5       |
| HV <sub>OUT</sub> 19 | -1447.5      | 1434.0       |
| HV <sub>OUT</sub> 18 | -1447.5      | 1116.5       |
| HV <sub>OUT</sub> 17 | -1447.5      | 799.0        |
| HV <sub>OUT</sub> 16 | -1447.5      | 481.5        |
| HV <sub>OUT</sub> 15 | -1447.5      | 164.0        |
| HV <sub>OUT</sub> 14 | -1447.5      | -153.5       |
| HV <sub>OUT</sub> 13 | -1447.5      | -471.0       |
| HV <sub>OUT</sub> 12 | -1447.5      | -788.5       |
| HV <sub>OUT</sub> 11 | -1447.5      | -1106.0      |
| HV <sub>OUT</sub> 10 | -1447.5      | -1423.5      |
| HV <sub>OUT</sub> 9  | -1447.5      | -1741.0      |
| HV <sub>OUT</sub> 8  | -1447.5      | -2058.5      |
| HV <sub>OUT</sub> 7  | -1447.5      | -2376.0      |
| HV <sub>OUT</sub> 6  | -1447.5      | -2693.5      |

| Pad Name            | X ( $\mu$ m) | Y ( $\mu$ m) |
|---------------------|--------------|--------------|
| HV <sub>OUT</sub> 5 | -1447.5      | -3011.0      |
| HV <sub>OUT</sub> 4 | -1447.5      | -3328.5      |
| HV <sub>OUT</sub> 3 | -1447.5      | -3646.0      |
| HV <sub>OUT</sub> 2 | -1447.5      | -3963.5      |
| HV <sub>OUT</sub> 1 | -1447.5      | -4281.0      |
| HV <sub>OUT</sub> 0 | -1447.5      | -4598.5      |
| VPP                 | -2057.0      | -4985.0      |
| VPP                 | -1897.0      | -4985.0      |
| V-                  | 1030.5       | -5018.0      |
| V-                  | 1190.5       | -5018.0      |
| ANODE               | 1350.5       | -5018.0      |
| CATHODE             | 1550.5       | -5018.0      |
| V+                  | 1710.5       | -5018.0      |
| V+                  | 1870.5       | -5018.0      |
| PGND                | 2034.5       | -5018.0      |
| V <sub>IN</sub> 0   | 2156.5       | -4725.0      |
| V <sub>IN</sub> 1   | 2156.5       | -4411.0      |
| V <sub>IN</sub> 2   | 2156.5       | -4097.0      |
| V <sub>IN</sub> 3   | 2156.5       | -3783.0      |
| V <sub>IN</sub> 4   | 2156.5       | -3469.0      |
| V <sub>IN</sub> 5   | 2156.5       | -3155.0      |
| V <sub>IN</sub> 6   | 2156.5       | -2841.0      |
| V <sub>IN</sub> 7   | 2156.5       | -2527.0      |
| V <sub>IN</sub> 8   | 2156.5       | -2213.0      |
| V <sub>IN</sub> 9   | 2156.5       | -1899.0      |
| V <sub>IN</sub> 10  | 2156.5       | -1585.0      |

| Pad Name           | X ( $\mu$ m) | Y ( $\mu$ m) |
|--------------------|--------------|--------------|
| V <sub>IN</sub> 11 | 2156.5       | -1271.0      |
| V <sub>IN</sub> 12 | 2156.5       | -957.0       |
| V <sub>IN</sub> 13 | 2156.5       | -643.0       |
| V <sub>IN</sub> 14 | 2156.5       | -329.0       |
| V <sub>IN</sub> 15 | 2156.5       | -15.0        |
| V <sub>IN</sub> 16 | 2156.5       | 299.0        |
| V <sub>IN</sub> 17 | 2156.5       | 613.0        |
| V <sub>IN</sub> 18 | 2156.5       | 927.0        |
| V <sub>IN</sub> 19 | 2156.5       | 1241.0       |
| V <sub>IN</sub> 20 | 2156.5       | 1555.0       |
| V <sub>IN</sub> 21 | 2156.5       | 1869.0       |
| V <sub>IN</sub> 22 | 2156.5       | 2183.0       |
| V <sub>IN</sub> 23 | 2156.5       | 2497.0       |
| V <sub>IN</sub> 24 | 2156.5       | 2811.0       |
| V <sub>IN</sub> 25 | 2156.5       | 3125.0       |
| V <sub>IN</sub> 26 | 2156.5       | 3439.0       |
| V <sub>IN</sub> 27 | 2156.5       | 3753.0       |
| V <sub>IN</sub> 28 | 2156.5       | 4067.0       |
| V <sub>IN</sub> 29 | 2156.5       | 4381.0       |
| V <sub>IN</sub> 30 | 2156.5       | 4695.0       |
| V <sub>IN</sub> 31 | 2156.5       | 5009.0       |
| PGND               | 2156.5       | 5315.5       |

### Notes:

1. The two PGND pads are not electrically connected.
2. The two VPP pads, V+ pads, and V- pads are electrically connected.
3. Backside potential is VPP. Leave floating or connect to VPP.
4. Anode and Cathode are connected to the P and N terminals (respectively) of a silicon diode which can be used to measure temperature.

## Pin Description

| Pin # | Function             | Description        |
|-------|----------------------|--------------------|
| 1     | HV <sub>OUT</sub> 29 | Amplifier outputs. |
| 2     | HV <sub>OUT</sub> 28 |                    |
| 3     | HV <sub>OUT</sub> 27 |                    |
| 4     | HV <sub>OUT</sub> 26 |                    |
| 5     | HV <sub>OUT</sub> 25 |                    |
| 6     | HV <sub>OUT</sub> 24 |                    |
| 7     | HV <sub>OUT</sub> 23 |                    |
| 8     | HV <sub>OUT</sub> 22 |                    |
| 9     | HV <sub>OUT</sub> 21 |                    |
| 10    | HV <sub>OUT</sub> 20 |                    |
| 11    | HV <sub>OUT</sub> 19 |                    |
| 12    | HV <sub>OUT</sub> 18 |                    |
| 13    | HV <sub>OUT</sub> 17 |                    |
| 14    | HV <sub>OUT</sub> 16 |                    |
| 15    | HV <sub>OUT</sub> 15 |                    |
| 16    | HV <sub>OUT</sub> 14 |                    |
| 17    | HV <sub>OUT</sub> 13 |                    |
| 18    | HV <sub>OUT</sub> 12 |                    |
| 19    | HV <sub>OUT</sub> 11 |                    |
| 20    | HV <sub>OUT</sub> 10 |                    |
| 21    | HV <sub>OUT</sub> 09 |                    |
| 22    | HV <sub>OUT</sub> 08 |                    |
| 23    | HV <sub>OUT</sub> 07 |                    |
| 24    | HV <sub>OUT</sub> 06 |                    |
| 25    | HV <sub>OUT</sub> 05 |                    |
| 26    | HV <sub>OUT</sub> 04 |                    |
| 27    | HV <sub>OUT</sub> 03 |                    |
| 28    | HV <sub>OUT</sub> 02 |                    |
| 29    | HV <sub>OUT</sub> 01 |                    |
| 30    | HV <sub>OUT</sub> 0  |                    |
| 31    | NC                   | No connect.        |
| 32    |                      |                    |
| 33    |                      |                    |
| 34    |                      |                    |
| 35    |                      |                    |

## Pin Description (cont.)

| Pin # | Function           | Description                                                                                 |
|-------|--------------------|---------------------------------------------------------------------------------------------|
| 36    | VPP                | High voltage positive supply.                                                               |
| 37    |                    |                                                                                             |
| 38    | NC                 | No connect.                                                                                 |
| 39    | IBIAS              | For internal testing only. Leave floating.                                                  |
| 40    | NC                 | No connect.                                                                                 |
| 41    | V-                 | Low voltage negative supply.                                                                |
| 42    |                    |                                                                                             |
| 43    | ANODE              | Anode side of of a low voltage silicon diode that can be used to monitor die temperature.   |
| 44    | CATHODE            | Cathode side of of a low voltage silicon diode that can be used to monitor die temperature. |
| 45    | V+                 | Low voltage positive supply.                                                                |
| 46    |                    |                                                                                             |
| 47    | NC                 | No connect.                                                                                 |
| 48    | PGND               | Power ground. Two PGND pads. Need to be externally connected.                               |
| 49    | V <sub>IN</sub> 0  | Amplifier inputs.                                                                           |
| 50    | V <sub>IN</sub> 1  |                                                                                             |
| 51    | V <sub>IN</sub> 2  |                                                                                             |
| 52    | V <sub>IN</sub> 3  |                                                                                             |
| 53    | V <sub>IN</sub> 4  |                                                                                             |
| 54    | V <sub>IN</sub> 5  |                                                                                             |
| 55    | V <sub>IN</sub> 6  |                                                                                             |
| 56    | V <sub>IN</sub> 7  |                                                                                             |
| 57    | V <sub>IN</sub> 8  |                                                                                             |
| 58    | V <sub>IN</sub> 9  |                                                                                             |
| 59    | V <sub>IN</sub> 10 |                                                                                             |
| 60    | V <sub>IN</sub> 11 |                                                                                             |
| 61    | V <sub>IN</sub> 12 |                                                                                             |
| 62    | V <sub>IN</sub> 13 |                                                                                             |
| 63    | V <sub>IN</sub> 14 |                                                                                             |
| 64    | V <sub>IN</sub> 15 |                                                                                             |
| 65    | V <sub>IN</sub> 16 |                                                                                             |
| 66    | V <sub>IN</sub> 17 |                                                                                             |
| 67    | V <sub>IN</sub> 18 |                                                                                             |

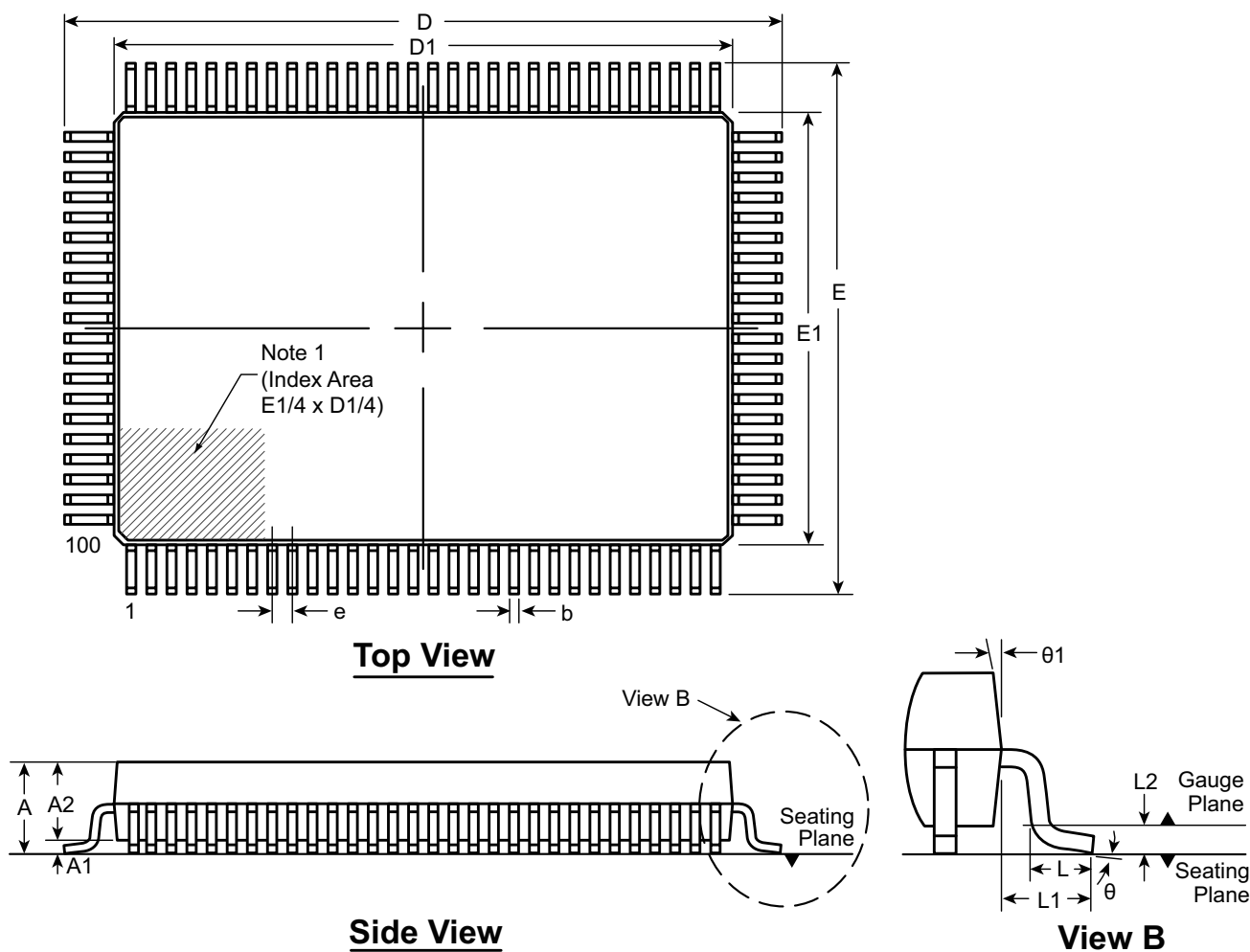


## Pin Description (cont.)

| Pin # | Function     | Description                                                   |
|-------|--------------|---------------------------------------------------------------|
| 68    | $V_{IN19}$   | Amplifier inputs.                                             |
| 69    | $V_{IN20}$   |                                                               |
| 70    | $V_{IN21}$   |                                                               |
| 71    | $V_{IN22}$   |                                                               |
| 72    | $V_{IN23}$   |                                                               |
| 73    | $V_{IN24}$   |                                                               |
| 74    | $V_{IN25}$   |                                                               |
| 75    | $V_{IN26}$   |                                                               |
| 76    | $V_{IN27}$   |                                                               |
| 77    | $V_{IN28}$   |                                                               |
| 78    | $V_{IN29}$   |                                                               |
| 79    | $V_{IN30}$   |                                                               |
| 80    | $V_{IN31}$   |                                                               |
| 81    | PGND         | Power ground. Two PGND pads. Need to be externally connected. |
| 82    | NC           | No connect.                                                   |
| 83    |              |                                                               |
| 84    |              |                                                               |
| 85    |              |                                                               |
| 86    |              |                                                               |
| 87    |              |                                                               |
| 88    |              |                                                               |
| 89    |              |                                                               |
| 90    |              |                                                               |
| 91    |              |                                                               |
| 92    |              |                                                               |
| 93    |              |                                                               |
| 94    |              |                                                               |
| 95    |              |                                                               |
| 96    |              |                                                               |
| 97    |              |                                                               |
| 98    |              |                                                               |
| 99    | $HV_{OUT31}$ | Amplifier outputs.                                            |
| 100   | $HV_{OUT30}$ |                                                               |

# 100-Lead MQFP Package Outline (FG)

20.00x14.00mm body, 3.15mm height (max), 0.65mm pitch, 3.20mm footprint



## 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<br>(mm) | MIN | 2.50* | 0.00 | 2.50 | 0.22 | 22.95* | 19.80* | 16.95* | 13.80* | 0.65<br>BSC | 0.73 | 1.60<br>REF | 0.25<br>BSC | 0° | 5°  |
|                   | NOM | -     | -    | 2.70 | -    | 23.20  | 20.00  | 17.20  | 14.00  |             | 0.88 |             |             | -  | -   |
|                   | MAX | 3.15  | 0.25 | 2.90 | 0.40 | 23.45* | 20.20* | 17.45* | 14.20* |             | 1.03 |             |             | 7° | 16° |

JEDEC Registration MS-022, Variation GC-2, Issue B, Dec. 1996.

\* This dimension is not specified in the JEDEC drawing.

**Drawings are not to scale.**

**Supertex Doc. #:** DSPD-100MQFPFG, Version F041309.

(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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