

## 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)

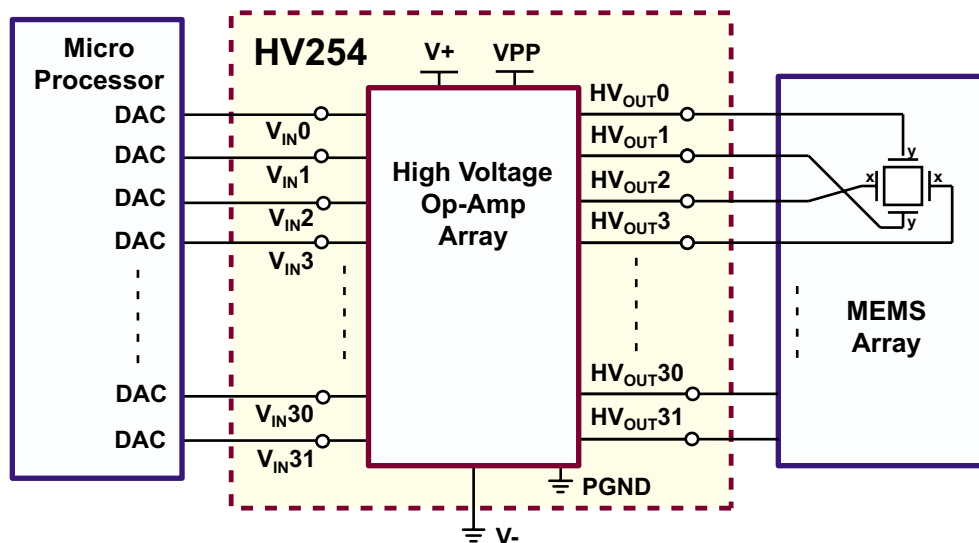
### General Description

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 3V/ $\mu$ 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 3V/ $\mu$ s. High value resistors are used for the gain setting to minimize current on the feedback path.

### Typical Application Circuit



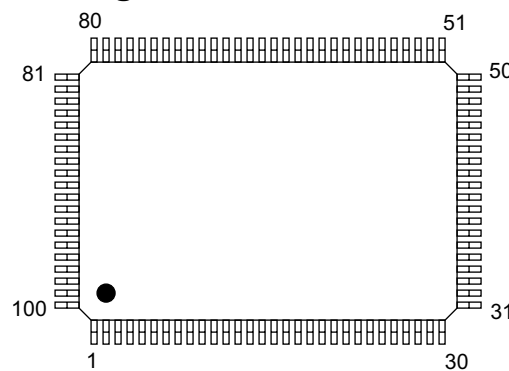
## Ordering Information

Device	<b>100-Lead MQFP</b> 20.00x14.00mm body 3.15mm height (max) 0.65mm pitch, 3.20mm footprint
HV254	HV254FG-G

-G indicates package is RoHS compliant ("Green")



## Pin Configuration



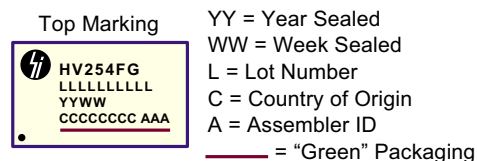
100-Lead MQFP (FG)

## 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.

## Product Marking



100-Lead MQFP (FG)

## 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	5.0	5.25	V	---
V-	Low voltage negative supply	-4.75	-5.0	-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)

Sym	Parameter	Min	Typ	Max	Units	Conditions
<b>High Voltage Amplifier Output</b>						
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	-	±1.5	±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>

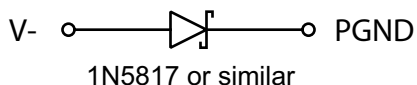
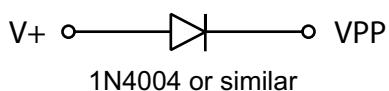
## Temperature Diode

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

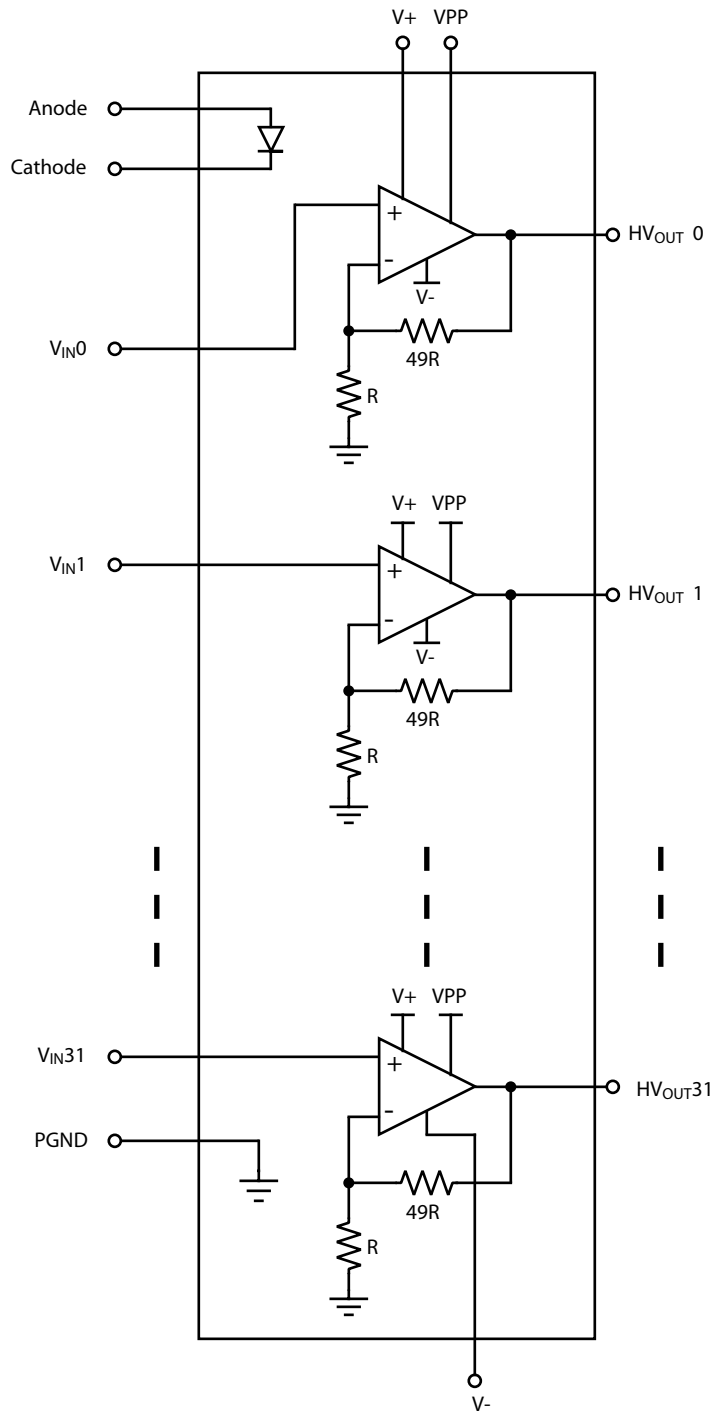
The HV254 can be powered down with any of the following sequences listed below.

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

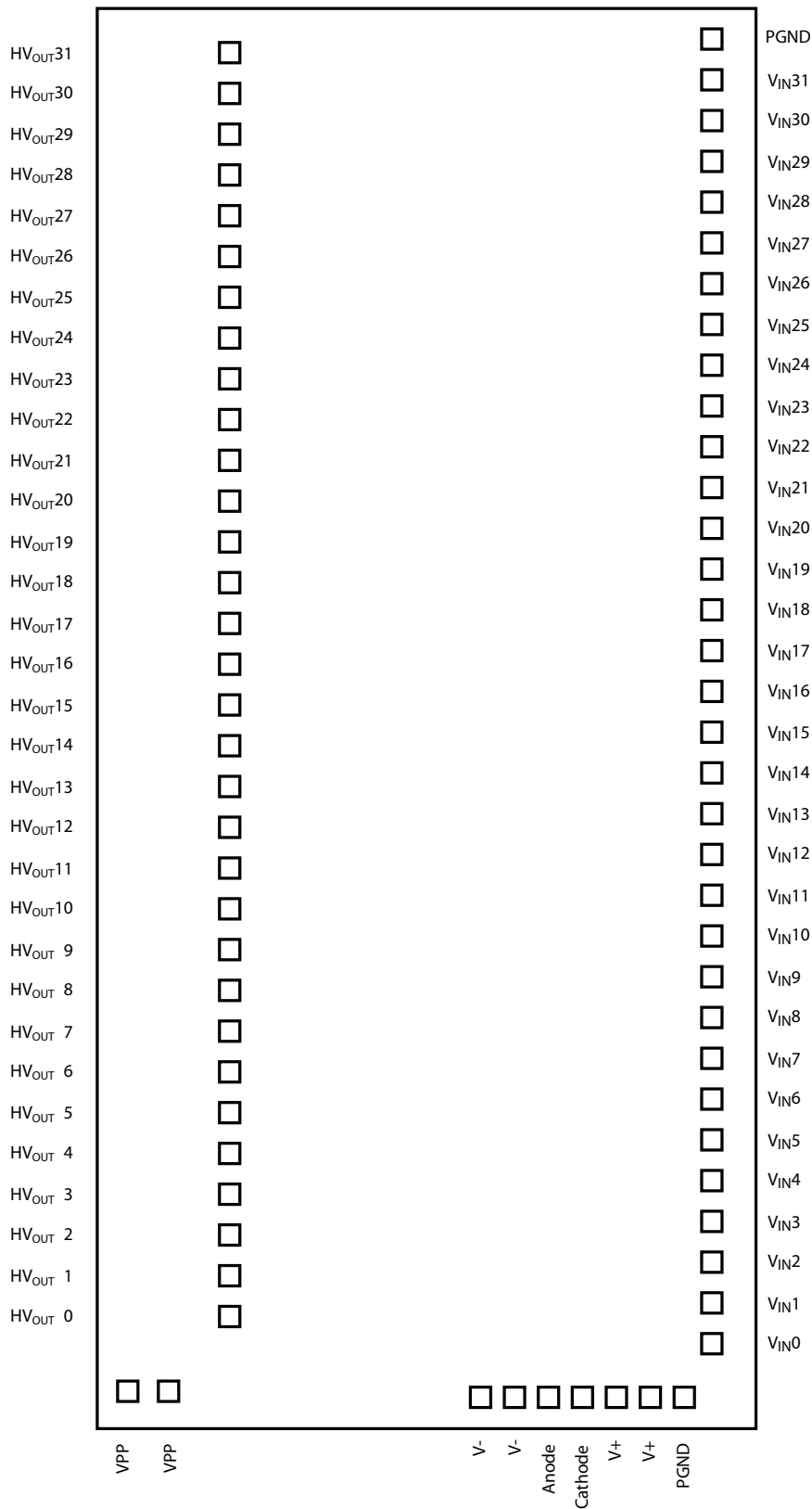
or

- 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 together.
49	$V_{IN0}$	Amplifier inputs.
50	$V_{IN1}$	
51	$V_{IN2}$	
52	$V_{IN3}$	
53	$V_{IN4}$	
54	$V_{IN5}$	
55	$V_{IN6}$	
56	$V_{IN7}$	
57	$V_{IN8}$	
58	$V_{IN9}$	
59	$V_{IN10}$	
60	$V_{IN11}$	
61	$V_{IN12}$	
62	$V_{IN13}$	
63	$V_{IN14}$	
64	$V_{IN15}$	
65	$V_{IN16}$	
66	$V_{IN17}$	
67	$V_{IN18}$	

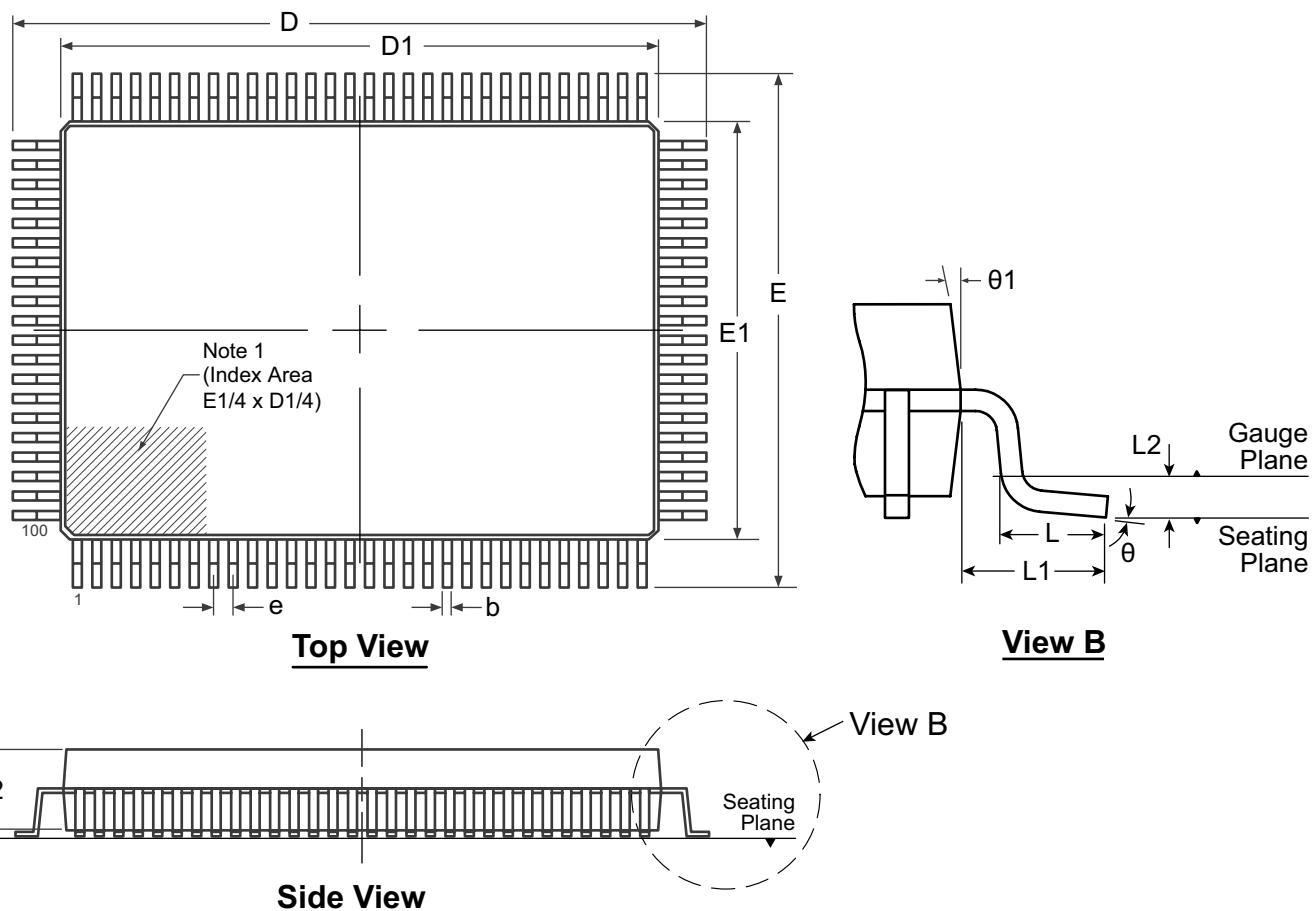


## Pin Description *(cont.)*

Pin #	Function	Description
68	$V_{IN\ 19}$	Amplifier inputs.
69	$V_{IN\ 20}$	
70	$V_{IN\ 21}$	
71	$V_{IN\ 22}$	
72	$V_{IN\ 23}$	
73	$V_{IN\ 24}$	
74	$V_{IN\ 25}$	
75	$V_{IN\ 26}$	
76	$V_{IN\ 27}$	
77	$V_{IN\ 28}$	
78	$V_{IN\ 29}$	
79	$V_{IN\ 30}$	
80	$V_{IN\ 31}$	
81	PGND	Power ground. Two PGND pads. Need to be externally connected together.
82	NC	No connect.
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99	$HV_{OUT\ 31}$	Amplifier outputs.
100	$HV_{OUT\ 30}$	

# 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 (mm)	MIN	2.50*	0.00	2.50	0.22	22.95*	19.80*	16.95*	13.80*	0.65 BSC	0.73	1.60 REF	0.25 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 original JEDEC drawing. The value listed is for reference only.

Drawings are not to scale.

Supertex Doc. #: DSPD-100MQFPFG, Version E101708.

(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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