

# 16-Channel High Voltage Analog Switch With Bleed Resistors

## Features

- ▶ HVCMOS® technology for high performance
- ▶ 220V operating conditions
- ▶ Output on-resistance typically 22Ω
- ▶ Integrated bleed resistors on the outputs
- ▶ 5.0 and 12.0V CMOS logic compatibility
- ▶ Very low quiescent power dissipation (-10μA)
- ▶ -45dB min off isolation at 7.5MHz
- ▶ Low parasitic capacitance
- ▶ Excellent noise immunity
- ▶ Flexible operating supply voltages

## Applications

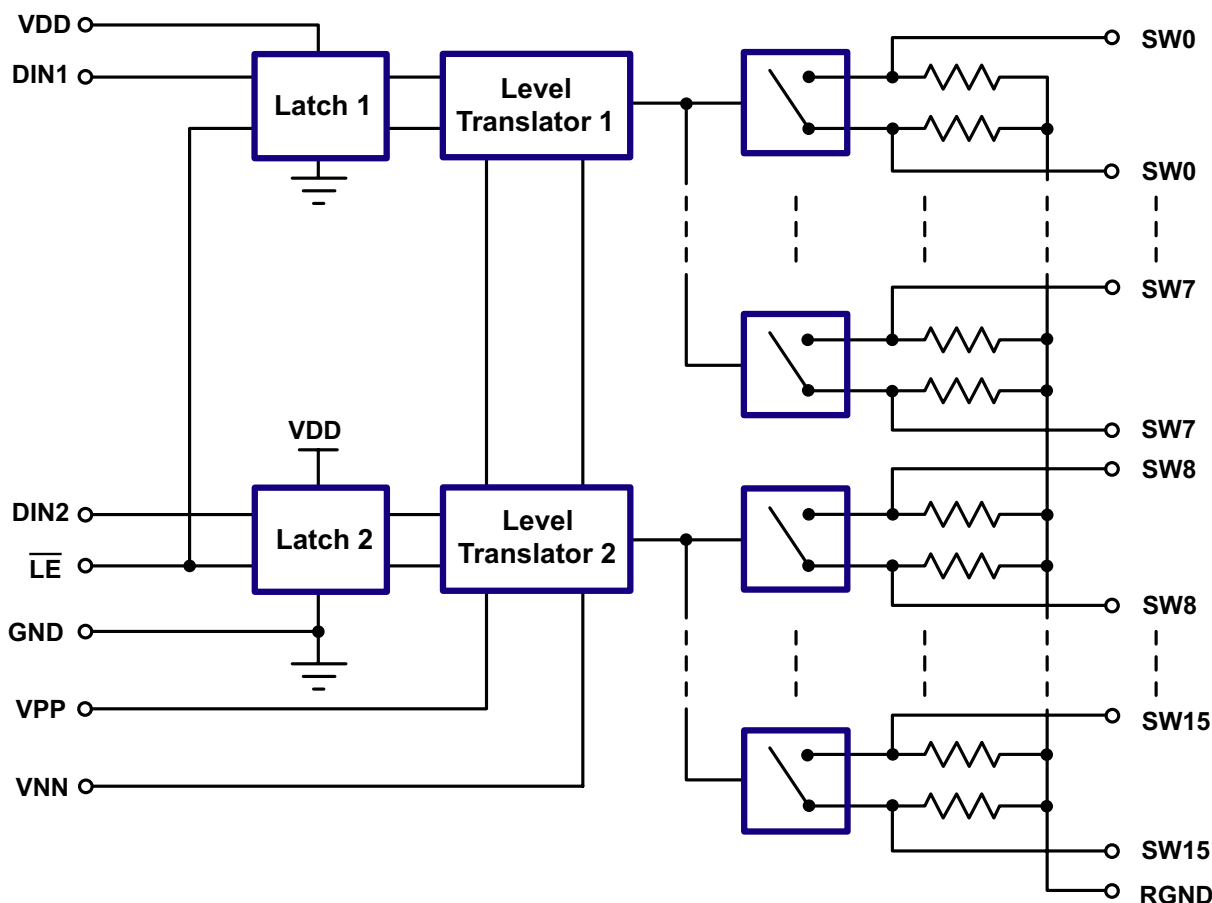
- ▶ Medical ultrasound imaging
- ▶ Non-destructive evaluation

## General Description

The Supertex HV238 is a 220V, 16-channel, high voltage analog switch integrated circuit (IC) with output bleed resistors ( $R_{INT}$ ). The output switches are configured as 2 sets of 8 single pole single throw analog switches. It is intended to be used in applications requiring high voltage switching controlled by low voltage control signals such as ultrasound imaging.

The 2 sets of 8 analog switches are controlled by 2 input logic controls,  $D_{IN1}$  and  $D_{IN2}$ . A logic high on  $D_{IN1}$  will turn on switches 0 to 7 and a logic high on  $D_{IN2}$  will turn on switches 8 to 15. The bleed resistors help to significantly reduce voltage built up on capacitive loads such as piezoelectric transducers connected to the outputs.

## Block Diagram



## Ordering Information

Part Number	Package Option	Packing
HV238FG-G	48-Lead LQFP	250/Tray
HV238FG-G M931		1000/Reel

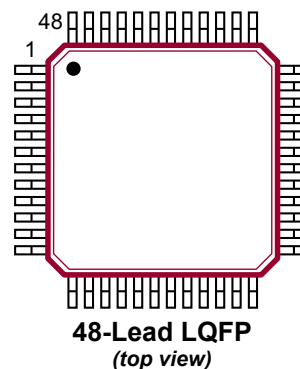
-G denotes a lead (Pb)-free / RoHS compliant package

## Absolute Maximum Ratings

Parameter	Value
$V_{DD}$ logic power supply voltage	-0.5V to +15V
$V_{PP} - V_{NN}$ supply voltage	225V
$V_{PP}$ positive high voltage supply	-0.5V to $V_{NN} + 225V$
$V_{NN}$ negative high voltage supply	+0.5V to -225V
Logic input voltages	-0.5V to $V_{DD} + 0.3V$
Analog signal range	$V_{NN}$ to $V_{PP}$
Peak analog signal current/channel	3.0A
Storage temperature	-65°C to +150°C
Power dissipation	1.0W

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



## Product Marking

Top Marking



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

Bottom Marking



\*May be part of top marking

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

48-Lead LQFP

## Typical Thermal Resistance

Package	$\theta_{ja}$
48-Lead LQFP	52°C/W

## Operating Conditions

Sym	Parameter	Value
$V_{DD}$	Logic power supply voltage	4.75V to 12.6V
$V_{PP}$	Positive high voltage supply	50V to 110V
$V_{NN}$	Negative high voltage supply	-10V to $V_{PP} - 220V$
$V_{IH}$	High level input voltage	$V_{DD} - 1.0V$ to $V_{DD}$
$V_{IL}$	Low-level input voltage	0V to 1.0V
$V_{SIG}$	Analog signal voltage peak-to-peak	$V_{NN} + 10V$ to $V_{PP} - 10V$
$T_A$	Operating free air temperature	0°C to 70°C

### Notes:

- Power up/down sequence is arbitrary except GND must be powered -up first and powered-down last.
- $V_{SIG}$  must be  $V_{NN} \leq V_{SIG} \leq V_{PP}$  or floating during power up/down transition.
- Rise and fall times of power supplies  $V_{DD}$ ,  $V_{PP}$  and  $V_{NN}$  should not be less than 1.0msec.

## DC Electrical Characteristics (Over operating conditions unless otherwise specified)

Sym	Parameter	0°C		+25°C			+70°C		Units	Conditions
		Min	Max	Min	Typ	Max	Min	Max		
R <sub>ONS</sub>	Small signal switch on-resistance	-	30	-	26	32	-	40	Ω	V <sub>SIG</sub> = 0V, I <sub>SIG</sub> = 5.0mA V <sub>PP</sub> = +50V V <sub>NN</sub> = -170V
		-	25	-	22	27	-	35		
		-	25	-	22	27	-	30		V <sub>SIG</sub> = 0V, I <sub>SIG</sub> = 5.0mA V <sub>PP</sub> = +110V V <sub>NN</sub> = -110V
		-	20	-	18	22	-	25		V <sub>SIG</sub> = 0V, I <sub>SIG</sub> = 200mA
ΔR <sub>ONS</sub>	Small signal switch on-resistance matching	-	20	-	5.0	20	-	20	%	V <sub>SIG</sub> = 0V, I <sub>SIG</sub> = 5.0mA, V <sub>PP</sub> = +110V, V <sub>NN</sub> = -110V
R <sub>ONL</sub>	Large signal switch on-resistance	-	-	-	15	-	-	-	Ω	V <sub>SIG</sub> = 0V, I <sub>SIG</sub> = 1.0A
R <sub>INT</sub>	Output switch shunt resistance	-	-	20	35	50	-	-	KΩ	Output switch to R <sub>GND</sub> , I <sub>RINT</sub> = 0.5mA
I <sub>SOL</sub>	Switch off leakage per switch	-	5.0	-	1.0	10	-	15	μA	V <sub>SIG</sub> = V <sub>PP</sub> -10V, V <sub>NN</sub> = +10V
V <sub>OS</sub>	DC offset switch off	-	300	-	100	300	-	300	mV	No Load
	DC offset switch on	-	500	-	100	500	-	500		
I <sub>PPQ</sub>	Quiescent V <sub>PP</sub> supply current	-	-	-	10	50	-	-	μA	All switches off
I <sub>NNQ</sub>	Quiescent V <sub>NN</sub> supply current	-	-	-	-10	-50	-	-		
I <sub>PPQ</sub>	Quiescent V <sub>PP</sub> supply current	-	-	-	10	50	-	-	μA	All switches on, I <sub>SW</sub> = 5.0mA
I <sub>NNQ</sub>	Quiescent V <sub>NN</sub> supply current	-	-	-	-10	-50	-	-		
I <sub>SW</sub>	Switch output peak current	-	3.0	-	3.0	2.0	-	2.0	A	V <sub>SIG</sub> duty cyclcy < 0.1%
f <sub>SW</sub>	Output switching frequency	-	-	-	-	50	-	-	kHz	Duty cycle = 50%
I <sub>PP</sub>	Average V <sub>PP</sub> supply current	-	6.5	-	-	8.8	-	10	mA	V <sub>PP</sub> = +50V, V <sub>NN</sub> = -170V All output switches are turning on and off at 50kHz
I <sub>NN</sub>	Average V <sub>NN</sub> supply current	-	8.1	-	-	-8.8	-	-10		
I <sub>PP</sub>	Average V <sub>PP</sub> supply current	-	-8.1	-	-	6.3	-	6.9	mA	V <sub>PP</sub> = +110V, V <sub>NN</sub> = -110V All output switches are turning on and off at 50kHz
I <sub>NN</sub>	Average V <sub>NN</sub> supply current	-	5.0	-	-	-6.3	-	-6.9		
I <sub>DDQ</sub>	Logic supply quiescent current	-	10	-	-	10	-	10	μA	All logic inputs are static.
I <sub>DD</sub>	Logic supply average current	-	2.0	-	-	2.0	-	2.0	mA	D <sub>IN1</sub> = D <sub>IN2</sub> = 3.0MHz, $\overline{LE}$ is high
C <sub>IN</sub>	Logic input capacitance	-	10	-	-	10	-	10	pF	---

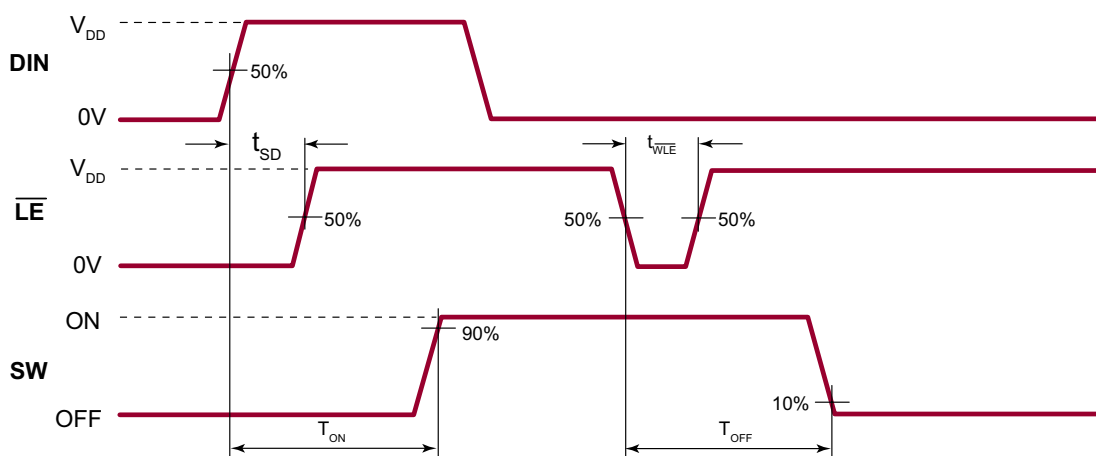
## AC Electrical Characteristics (Over recommended operating conditions, V<sub>DD</sub> = 5.0V, unless otherwise specified)

t <sub>WLE</sub>	Time width of $\overline{LE}$	150	-	150	-	-	150	-	ns	---
t <sub>WDIN</sub>	Time width of D <sub>IN</sub>	150	-	150	-	-	150	-	ns	---
t <sub>SD</sub>	Set up time before $\overline{LE}$ rises	150	-	150	-	-	150	-	ns	---
t <sub>ON</sub>	Turn on time	-	5.0	-	-	5.0	-	5.0	μs	V <sub>SIG</sub> = V <sub>PP</sub> -10V, R <sub>LOAD</sub> = 10kΩ
t <sub>OFF</sub>	Turn off time	-	5.0	-	-	5.0	-	5.0	μs	V <sub>SIG</sub> = V <sub>PP</sub> -10V, R <sub>LOAD</sub> = 10kΩ
dv/dt	Maximun V <sub>SIG</sub> slew rate	-	20	-	-	20	-	20	V/ns	---

## AC Electrical Characteristics (Over recommended operating conditions, $V_{DD} = 5.0V$ , unless otherwise specified)

Sym	Parameter	0°C		+25°C			+70°C		Units	Conditions
		Min	Max	Min	Typ	Max	Min	Max		
$K_O$	Off isolation	-30	-	-30	-33	-	-30	-	dB	f = 5.0MHz, 1.0k $\Omega$ /15pF load
		-45	-	-45	-50	-	-45	-		f = 7.5MHz, $R_{LOAD} = 50\Omega$ load
$K_{CR}$	Switch crosstalk	-45	-	-45	-	-	-45	-	dB	f = 5.0MHz, 50 $\Omega$ load
$I_{ID}$	Output switch isolation diode current	-	300	-	-	300	-	300	mA	300ns pulse width, 2.0% duty cycle
$C_{SG(OFF)}$	Off capacitance SW to GND	5.0	17	5.0	12	17	5.0	17	pF	$V_{SIG} = 0V$ , f = 1.0MHz
$C_{SG(ON)}$	On capacitance SW to GND	25	50	25	38	50	25	50	pF	$V_{SIG} = 0V$ , f = 1.0MHz
$+V_{SPK}$	Output voltage spike	-	-	-	4.0	-	-	-	V	$R_{LOAD} = 50\Omega$
$-V_{SPK}$		-	-	-	-4.0	-	-	-		

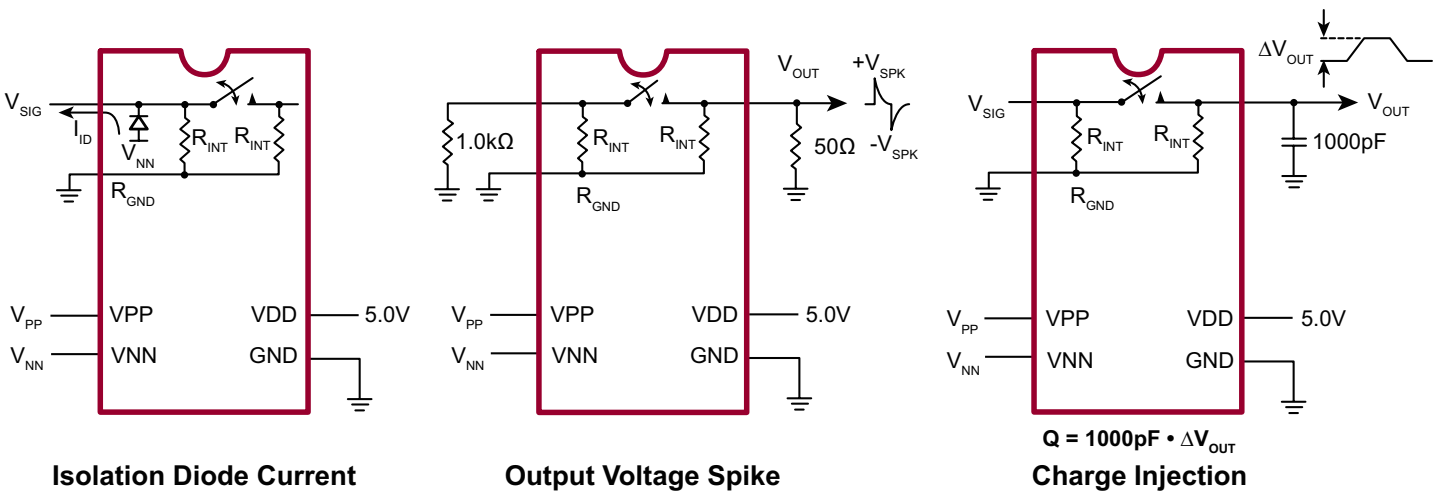
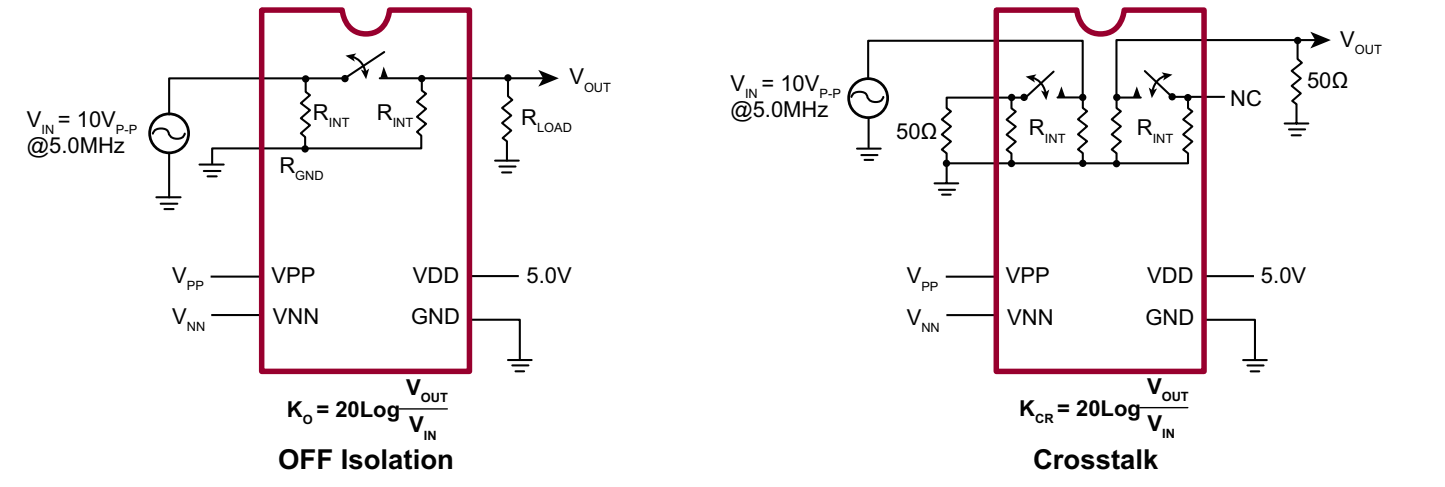
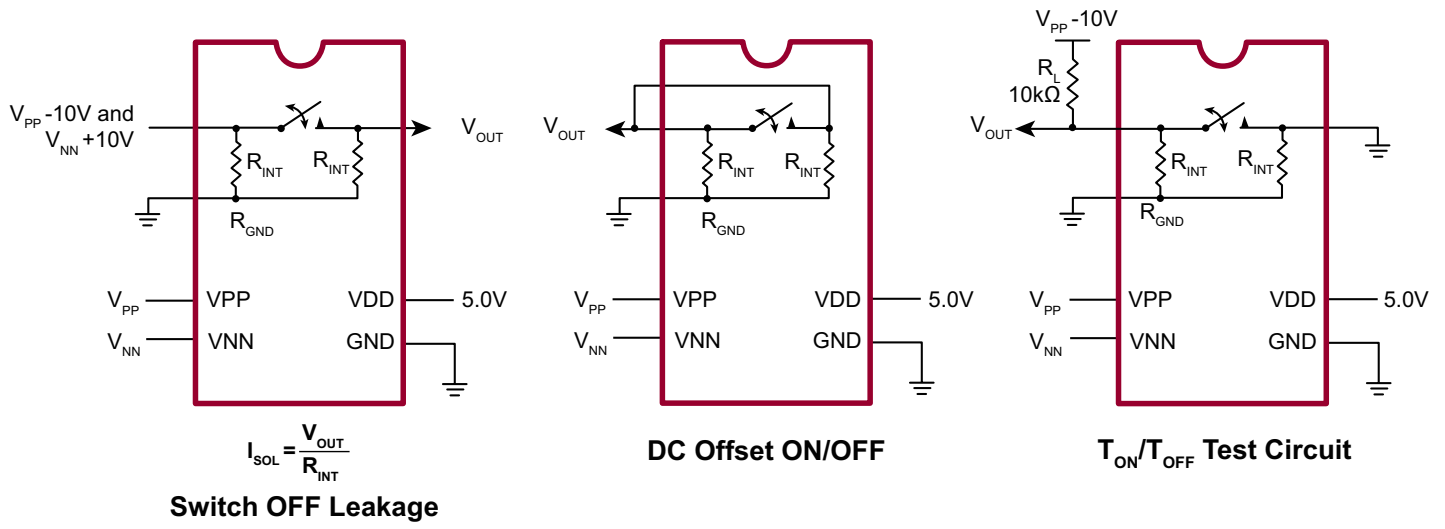
## Logic Timing Diagram



## Truth Table

$D_{IN2}$	$D_{IN1}$	$\overline{LE}$	SW0 to SW7	SW8 to SW15
L	L	L	OFF	OFF
L	H	L	ON	OFF
H	L	L	OFF	ON
H	H	L	ON	ON
X	X	H	Hold Previous State	

Test Circuits

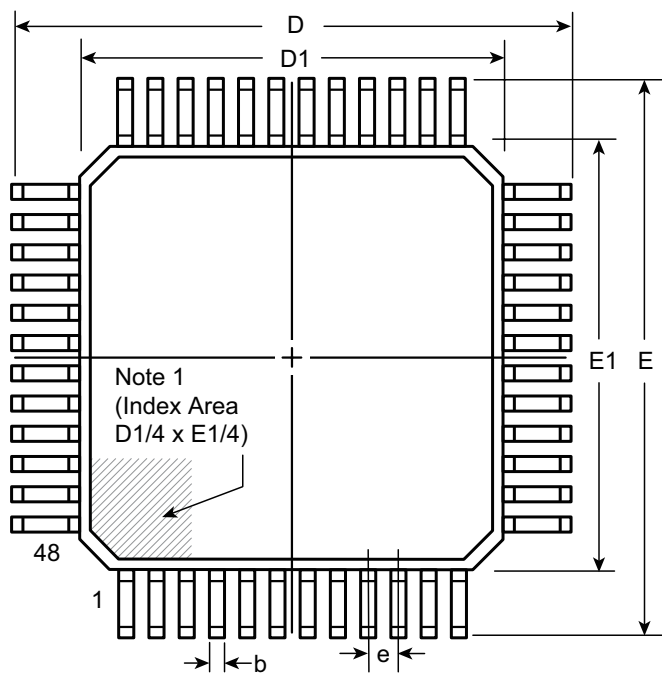


## Pin Description

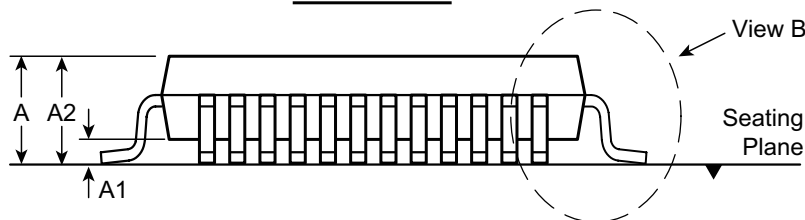
Pin	Function	Pin	Function
1	VNN	25	SW10
2	N/C	26	SW10
3	VPP	27	SW9
4	N/C	28	SW9
5	DIN1	29	SW8
6	$\overline{LE}$	30	SW8
7	DIN2	31	SW7
8	N/C	32	SW7
9	N/C	33	SW6
10	VDD	34	SW6
11	GND	35	SW5
12	N/C	36	SW5
13	RGND	37	SW4
14	SW15	38	N/C
15	SW15	39	SW4
16	SW14	40	N/C
17	SW14	41	SW3
18	SW13	42	SW3
19	SW13	43	SW2
20	SW12	44	SW2
21	SW12	45	SW1
22	SW11	46	SW1
23	SW11	47	SW0
24	N/C	48	SW0

# 48-Lead LQFP Package Outline (FG)

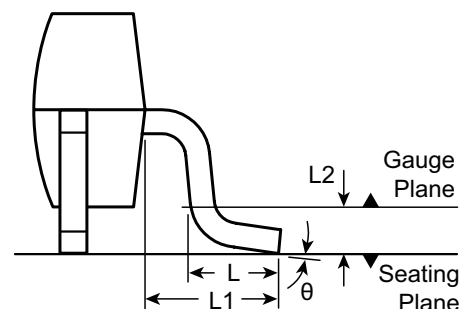
7.00x7.00mm body, 1.60mm height (max), 0.50mm pitch



**Top View**



**Side View**



**View B**

**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
Dimension (mm)	MIN	1.40*	0.05	1.35	0.17	8.80*	6.80*	8.80*	6.80*	0.50 BSC	0.45	1.00 REF	0.25 BSC	0°
	NOM	-	-	1.40	0.22	9.00	7.00	9.00	7.00		0.60			3.5°
	MAX	1.60	0.15	1.45	0.27	9.20*	7.20*	9.20*	7.20*		0.75			7°

JEDEC Registration MS-026, Variation BBC, Issue D, Jan. 2001.  
\* This dimension is not specified in the JEDEC drawing.

Drawings are not to scale.  
Supertex Doc. #: DSPD-48LQFPFG Version, D041309.

(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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