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

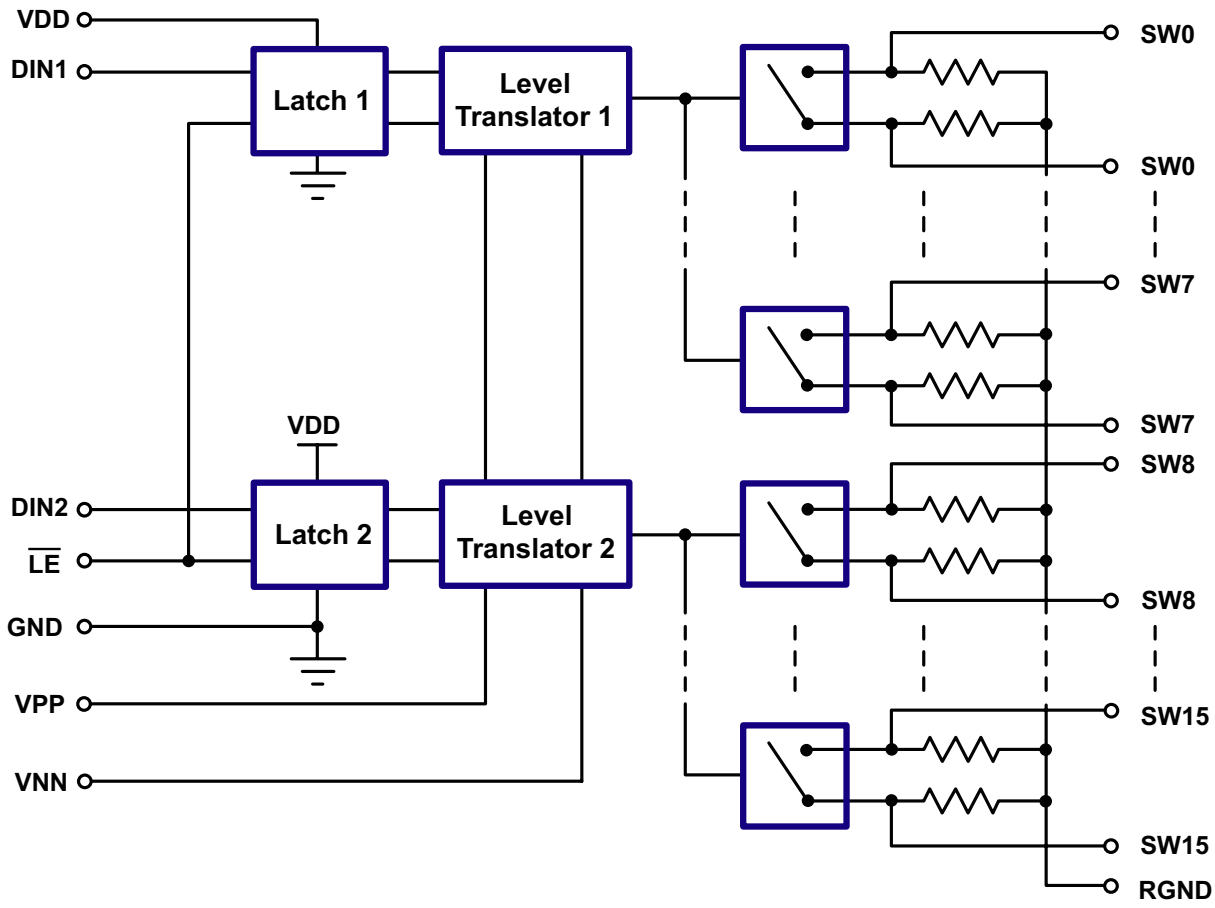
- Medical ultrasound imaging
- Non-destructive evaluation

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, $D_{IN}1$ and $D_{IN}2$. A logic high on $D_{IN}1$ will turn on switches 0 to 7 and a logic high on $D_{IN}2$ 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

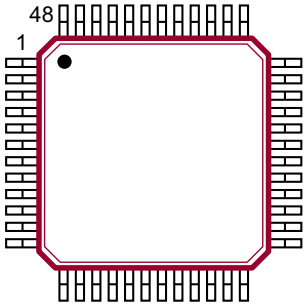
-G denotes a lead (Pb)-free / RoHS compliant package

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.

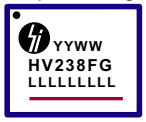
Pin Configuration



48-Lead LQFP
(top view)

Product Marking

Top Marking



Bottom Marking



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

**May be part of top marking*

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

48-Lead LQFP

Typical Thermal Resistance

Package	θ_{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:

1. *Power up/down sequence is arbtrary except GND must be powered -up first and powered-down last.*
2. *V_{SIG} must be $V_{NN} \le V_{SIG} \le V_{PP}$ or floating during power up/down transition.*
3. *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_{ONS}	Small signal switch on-resistance	-	30	-	26	32	-	40	Ω	V_{SIG} = 0V, I_{SIG} = 5.0mA	V_{PP} = +50V V_{NN} = -170V
		-	25	-	22	27	-	35		V_{SIG} = 0V, I_{SIG} = 200mA	
		-	25	-	22	27	-	30		V_{SIG} = 0V, I_{SIG} = 5.0mA	V_{PP} = +110V V_{NN} = -110V
		-	20	-	18	22	-	25		V_{SIG} = 0V, I_{SIG} = 200mA	
ΔR_{ONS}	Small signal switch on-resistance matching	-	20	-	5.0	20	-	20	%	V_{SIG} = 0V, I_{SIG} = 5.0mA, V_{PP} = +110V, V_{NN} = -110V	
R_{ONL}	Large signal switch on-resistance	-	-	-	15	-	-	-	Ω	V_{SIG} = 0V, I_{SIG} = 1.0A	
R_{INT}	Output switch shunt resistance	-	-	20	35	50	-	-	KΩ	Output switch to R_{GND}, I_{RINT} = 0.5mA	
I_{SOL}	Switch off leakage per switch	-	5.0	-	1.0	10	-	15	µA	V_{SIG} = V_{PP} -10V, V_{NN} = +10V	
V_{OS}	DC offset switch off	-	300	-	100	300	-	300	mV	No Load	
	DC offset switch on	-	500	-	100	500	-	500			
I_{PPQ}	Quiescent V_{PP} supply current	-	-	-	10	50	-	-	µA	All switches off	
I_{NNQ}	Quiescent V_{NN} supply current	-	-	-	-10	-50	-	-			
I_{PPQ}	Quiescent V_{PP} supply current	-	-	-	10	50	-	-	µA	All switches on, I_{SW} = 5.0mA	
I_{NNQ}	Quiescent V_{NN} supply current	-	-	-	-10	-50	-	-			
I_{SW}	Switch output peak current	-	3.0	-	3.0	2.0	-	2.0	A	V_{SIG} duty cycly < 0.1%	
f_{SW}	Output switching frequency	-	-	-	-	50	-	-	kHz	Duty cycle = 50%	
I_{PP}	Average V_{PP} supply current	-	6.5	-	-	8.8	-	10	mA	V_{PP} = +50V, V_{NN} = -170V All output switches are turning on and off at 50kHz	
I_{NN}	Average V_{NN} supply current	-	8.1	-	-	-8.8	-	-10			
I_{PP}	Average V_{PP} supply current	-	-8.1	-	-	6.3	-	6.9	mA	V_{PP} = +110V, V_{NN} = -110V All output switches are turning on and off at 50kHz	
I_{NN}	Average V_{NN} supply current	-	5.0	-	-	-6.3	-	-6.9			
I_{DDQ}	Logic supply quiescent current	-	10	-	-	10	-	10	µA	All logic inputs are static.	
I_{DD}	Logic supply average current	-	2.0	-	-	2.0	-	2.0	mA	$D_{IN}1$ = $D_{IN}2$ = 3.0MHz, $\overline{LE}$ is high	
C_{IN}	Logic input capacitance	-	10	-	-	10	-	10	pF	---	

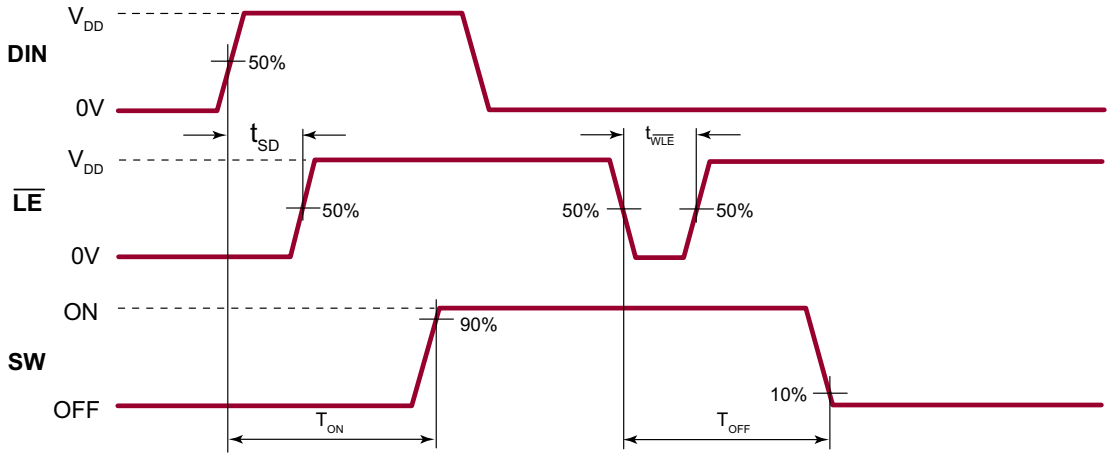
AC Electrical Characteristics *(Over recommended operating conditions, V_{DD} = 5.0V, unless otherwise specified)*

t_{WLE}	Time width of $\overline{LE}$	150	-	150	-	-	150	-	ns	---
t_{WDIN}	Time width of D_{IN}	150	-	150	-	-	150	-	ns	---
t_{SD}	Set up time before $\overline{LE}$ rises	150	-	150	-	-	150	-	ns	---
t_{ON}	Turn on time	-	5.0	-	-	5.0	-	5.0	µs	V_{SIG} = V_{PP} -10V, R_{LOAD} = 10kΩ
t_{OFF}	Turn off time	-	5.0	-	-	5.0	-	5.0	µs	V_{SIG} = V_{PP} -10V, R_{LOAD} = 10kΩ
dv/dt	Maximun V_{SIG} 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, 1.0kΩ/15pF load
		-45	-	-45	-50	-	-45	-		f = 7.5MHz, R_{LOAD} = 50Ω load
K_{CR}	Switch crosstalk	-45	-	-45	-	-	-45	-	dB	f = 5.0MHz, 50Ω 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} = 50Ω
$-V_{SPK}$		-	-	-	-4.0	-	-	-		

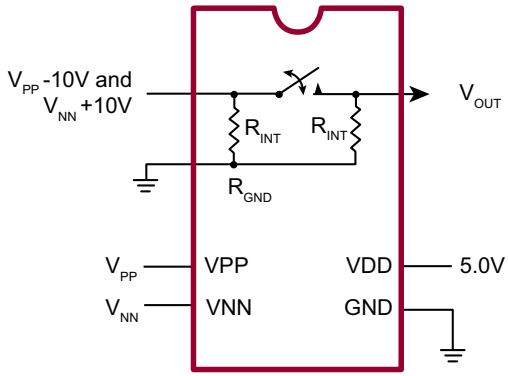
Logic Timing Diagram



Truth Table

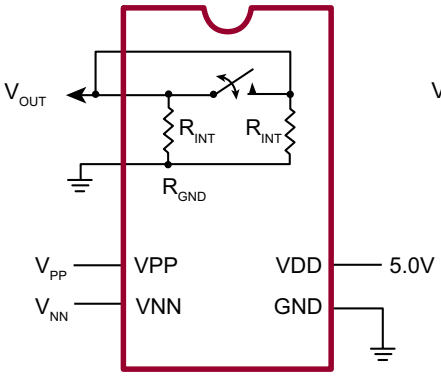
$D_{IN}2$	$D_{IN}1$	$\overline{LE}$	SW0 to SW7	SW8 to SW15
L	L	L	OFF	OFF
L	H	L	ON	OFF
H	L	L	OFF	ON
H	H	L	ON	ON
X	X	H	Hold Previous State	

Test Circuits

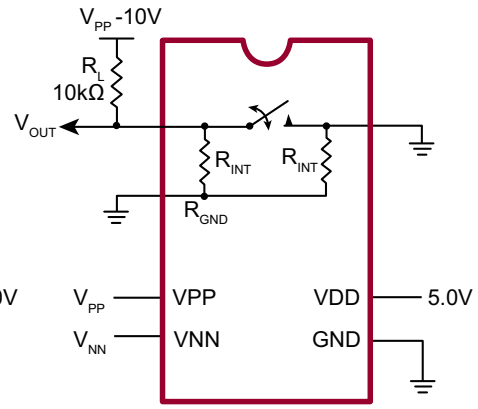


$I_{SOL} = \frac{V_{OUT}}{R_{INT}}$

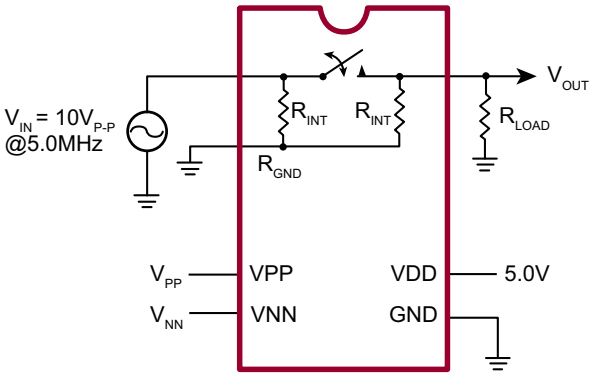
Switch OFF Leakage



DC Offset ON/OFF

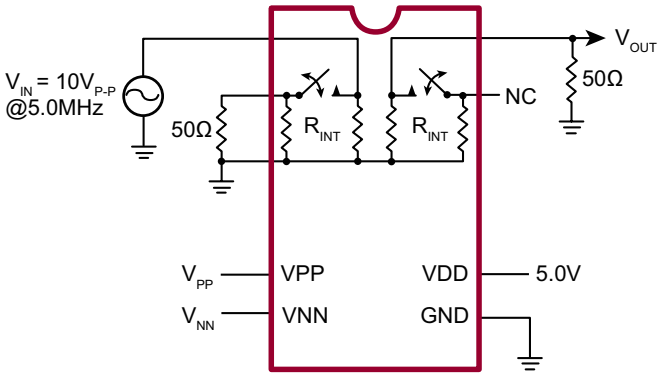


T_{ON}/T_{OFF} Test Circuit



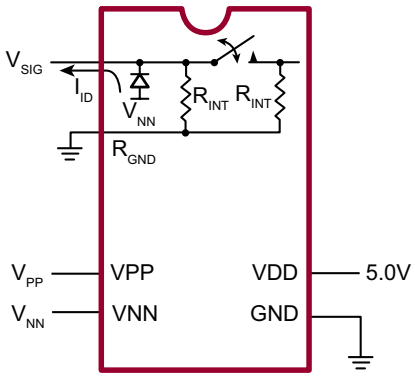
$K_O = 20Log\frac{V_{OUT}}{V_{IN}}$

OFF Isolation

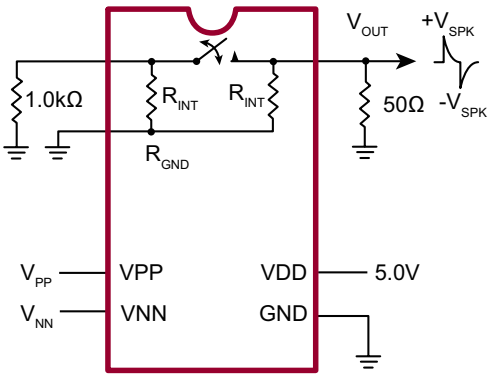


$K_{CR} = 20Log\frac{V_{OUT}}{V_{IN}}$

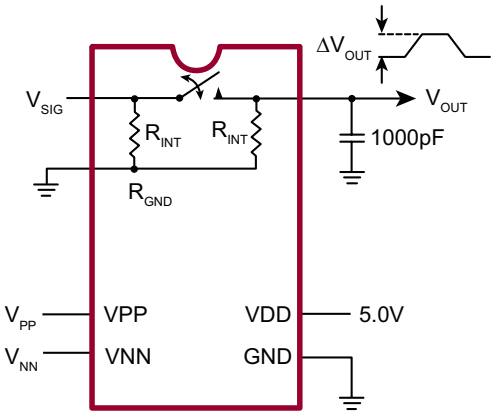
Crosstalk



Isolation Diode Current



Output Voltage Spike



$Q = 1000pF \bullet \Delta V_{OUT}$

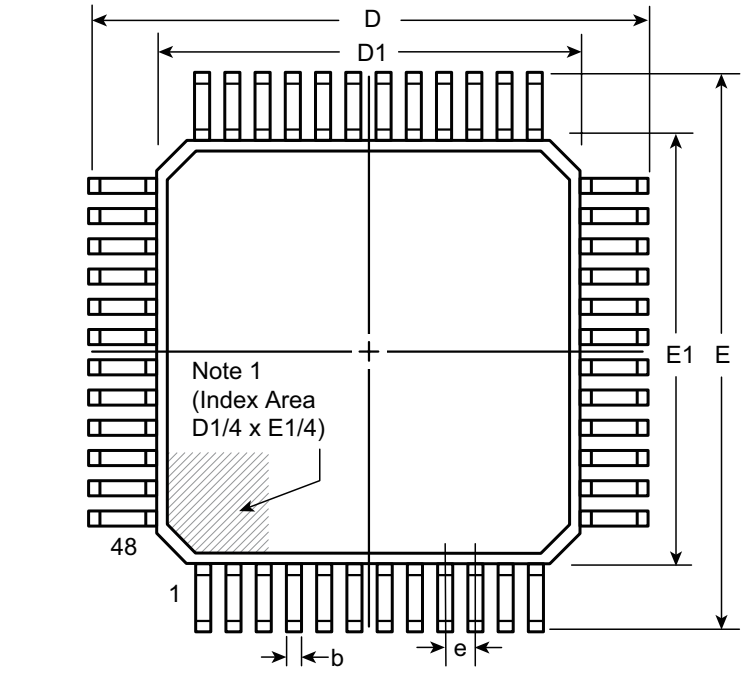
Charge Injection

Pin Description

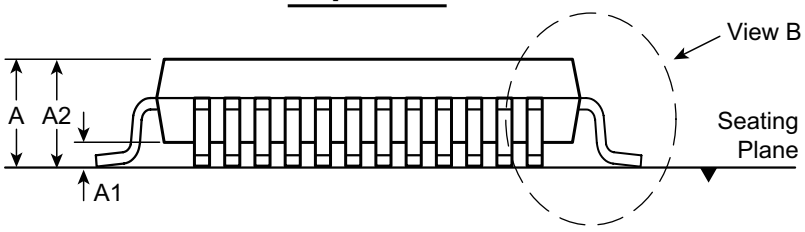
Pin	Function	Pin	Function
1	VNN	25	SW10
2	N/C	26	SW10
3	VPP	27	SW9
4	N/C	28	SW9
5	DIN1	29	SW8
6	$\overline{LE}$	30	SW8
7	DIN2	31	SW7
8	N/C	32	SW7
9	N/C	33	SW6
10	VDD	34	SW6
11	GND	35	SW5
12	N/C	36	SW5
13	RGND	37	SW4
14	SW15	38	N/C
15	SW15	39	SW4
16	SW14	40	N/C
17	SW14	41	SW3
18	SW13	42	SW3
19	SW13	43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

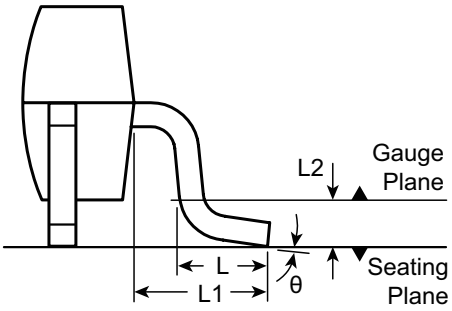
7.00x7.00mm body, 1.60mm height (max), 0.50mm pitch



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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