

# BCT48751

## 8:1 CMOS Analog Signal Multiplexer

### GENERAL DESCRIPTION

The BCT48751 is a CMOS analog IC configured as an 8-channel multiplexer. This CMOS device can operate from 2.5V to 5.5V single supplies. Each switch can handle rail-to-rail analog signals. The off-leakage current is less than 1uA at 25°C. All digital inputs can support 1.8V logic control I/O.






### APPLICATIONS

Battery-Operated Equipment  
Audio and Video Signal Routing  
Low-Voltage Data-Acquisition Systems  
Communications Circuits  
Automotive

### FEATURES

- Guaranteed On-Resistance
  - 48Ω (TYP) with +5V Supply
- Guaranteed On-Resistance Match Between Channels
  - 1.5Ω (TYP) with +5V Supply
- High -3dB Bandwidth: 300MHz
- Low Off-Leakage Current 1uA (MAX) at 25°C
- Low On-Leakage Current 1uA (MAX) at 25°C
- 2.5V to 5.5V Single-Supply Operation
- 1.8V Logic Compatible
- High Off-Isolation: -83dB(RL=50Ω, f=1MHz)
- -40°C to 85°C Operating Temperature Range
- Available in Green QFN-3x3-16L , SOP16 , SSOP16 or TSSOP16 Packages

### ORDERING INFORMATION

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
BCT48751EGE-TR	QFN3x3-16L	-40°C to +85°C	 48751 XXXXXX	3000
BCT48751EOE-TU	SOP16	-40°C to +85°C	 48751 XXXXXX	--
BCT48751EOE-TR	SOP16	-40°C to +85°C	 48751 XXXXXX	3000
BCT48751ESE-TU	SSOP16	-40°C to +85°C	 48751 XXXXXX	--
BCT48751ECE-TR	TSSOP16	-40°C to +85°C	 48751 XXXXXX	3000

Note: "XXXXXX" in Marking will be appeared as the batch code.



# BCT48751

## 8:1 CMOS Analog Signal Multiplexer

### ABSOLUTE MAXIMUM RATINGS

V <sub>CC</sub> to GND .....	-0.3V to +6.0V
Voltage into Any Terminal .....	-0.3V to (V <sub>CC</sub> + 0.3V)
Continuous Current into Any Terminal.....	±20mA
Peak Current, X <sub>L</sub> (Pulsed at 1ms, 10% duty cycle).....	±40mA
Storage Temperature Range.....	-65°C to +150°C
Junction Temperature.....	150°C
Operating Temperature Range.....	-40°C to +85°C
Lead Temperature (Soldering, 10 sec).....	260°C
ESD Susceptibility	
HBM.....	2000V
MM.....	200V

#### NOTE:

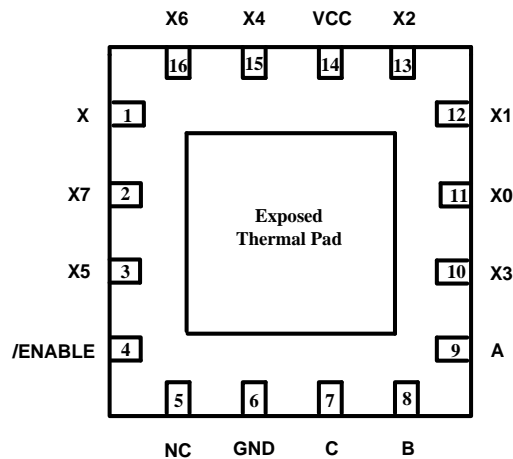
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### CAUTION

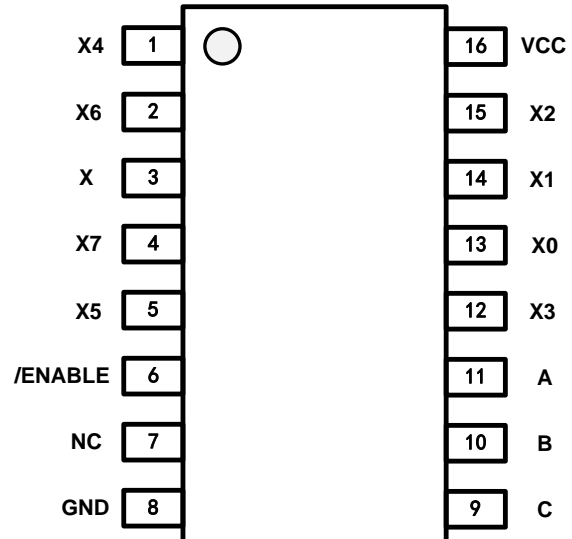
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. Broadchip recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

### PIN CONFIGURATION (TOP VIEW)



QFN3x3-16L



SOP16/SSOP16/TSSOP16

### PIN DESCRIPTION

PIN		NAME	FUNCTION
QFN3x3-16L	SOP16 SSOP16 TSSOP16		
11,12,13,10, 15,3,16,2	13,14,15,12 ,1,5,2,4	X0-X7	Analog Switch Inputs X0-X7.
1	3	X	Analog Switch "X" Output.
14	16	V <sub>CC</sub>	Positive Analog and Digital Supply Voltage Input.
9	11	A	Digital Address "A" Input.
8	10	B	Digital Address "B" Input.
7	9	C	Digital Address "C" Input.
6	8	GND	Ground. Connect to digital ground.
5	7	NC	No Connect.
4	6	/ENABLE	Digital Enable Input. Normally connected to GND.
Exposed Pad	-	EP	Exposed Pad. Connect EP to GND.

### FUNCTION TABLE

/ENABLE INPUT	SELECT INPUTS			ON SWITCHES
	C	B	A	
H	X	X	X	All Switches Open.
L	L	L	L	X-X0
L	L	L	H	X-X1
L	L	H	L	X-X2
L	L	H	H	X-X3
L	H	L	L	X-X4
L	H	L	H	X-X5
L	H	H	L	X-X6
L	H	H	H	X-X7

X=Don't care

NOTE: Input and output pins are identical and interchangeable. Either maybe considered an input or output; signals pass equally will in either direction.

### ELECTRICAL CHARACTERISTICS

( $V_{CC}=5.0V$ , typical values are at  $T_A=+25^{\circ}C$ , unless otherwise specified.)

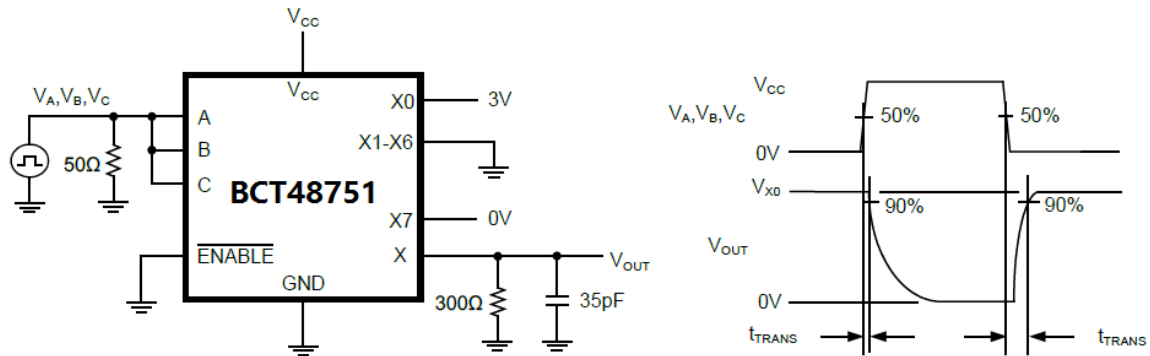
PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>						
Analog Signal Range	$V_{X-}, V_X$		GND		$V_{CC}$	mV
On-Resistance	$R_{ON}$	$I_X=1mA$		48	58	$\Omega$
On-Resistance Match Between Channels	$\Delta R_{ON}$	$I_X=1mA$		1.5	5	$\Omega$
On-Resistance Flatness	$R_{FLAT(ON)}$	$I_X=1mA$		17	25	$\Omega$
X_ Off Leakage Current	$I_{X(OFF)}$	$V_X=4.5V$ or $0V$			1	$\mu A$
X Off Leakage Current	$I_{X(OFF)}$	$V_X=4.5V$ or $0V$			1	$\mu A$
X On Leakage Current	$I_{X(ON)}$	$V_X=4.5V$ or $0V$			1	$\mu A$
<b>DIGITAL I/O</b>						
Input Voltage High	$V_{IH}$	A,B,C,/ENABLE Pin	1.7			V
Input Voltage Low	$V_{IL}$	A,B,C,/ENABLE Pin			0.5	V
Input Current High	$I_{IH}$	$V_A, V_B, V_C, V_{ENABLE}=V_{CC}$			1	$\mu A$
Input Current Low	$I_{IL}$	$V_A, V_B, V_C, V_{ENABLE}=0V$			1	$\mu A$
<b>DYNAMIC CHARACTERISTICS</b>						
Address Transition Time	$t_{TRANS}$	$V_X=3V, R_L=300\Omega, C_L=35pF$		85		ns
/ENABLE Turn-On Time	$t_{ON}$	$V_X=3V, R_L=300\Omega, C_L=35pF$		60		ns
/ENABLE Turn-Off Time	$t_{OFF}$	$V_X=3V, R_L=300\Omega, C_L=35pF$		70		ns
Internal A, B, C Rise Time	$t_R$	$V_X=3V, R_L=300\Omega, C_L=35pF$		45		ns
Internal A, B, C Fall Time	$t_F$	$V_X=3V, R_L=300\Omega, C_L=35pF$		50		ns
Break-Before-Make Time Delay	$t_D$	$V_X=3V, R_L=300\Omega, C_L=35pF$		50		ns
Charge Injection	Q	$R_S=0\Omega, C_L=1nF$		6		pC
<b>ANALOG SWITCH</b>						
Input Off-Capacitance	$C_{X(OFF)}$	$V_X=0V, f=1MHz$		4.7		pF
Output Off-Capacitance	$C_{X(OFF)}$	$V_X=0V, f=1MHz$		12.7		pF
Output On-Capacitance	$C_{X(ON)}$	$V_X=0V, f=1MHz$		16		pF
-3dB Bandwidth	BW	$R_L=50\Omega$		300		MHz
Off Isolation	$O_{ISO}$	$R_L=50\Omega, f=1MHz$		-83		dB
Total Harmonic Distortion	THD	$R_L=600\Omega, 5V_{P-P}, f=20Hz$ to $20kHz$		0.7		%
<b>Power Supply</b>						
Power Supply Range	$V_{CC}$		2.5		5.5	V
Power Supply Current	$I_{CC}$	$V_{CC}=5V, V_A, V_B, V_C, V_{ENABLE}=V_{CC}$ or $0$		0.001	6	$\mu A$

### ELECTRICAL CHARACTERISTICS

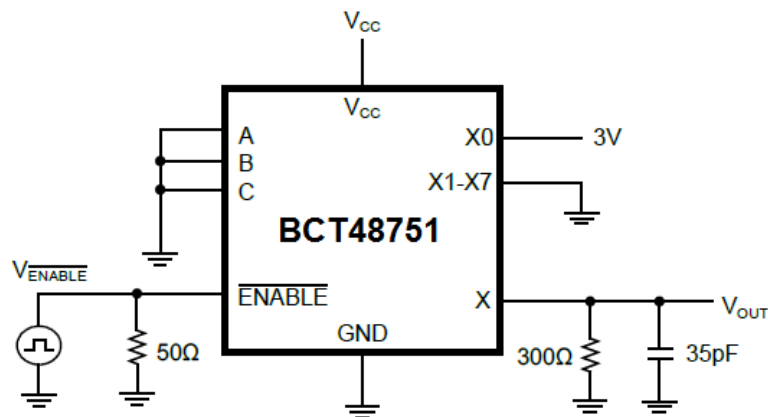
( $V_{CC} = 3.3V$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise specified.)

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>						
Analog Signal Range	$V_{X-}, V_X$		GND		$V_{CC}$	mV
On-Resistance	$R_{ON}$	$I_X = 1mA$		80	110	$\Omega$
X_ Off Leakage Current	$I_{X(OFF)}$	$V_X = 1V, 3V$			1	$\mu A$
X Off Leakage Current	$I_{X(OFF)}$	$V_X = 1V, 3V$			1	$\mu A$
X On Leakage Current	$I_{X(ON)}$	$V_X = 1V, 3V$			1	$\mu A$
<b>DIGITAL I/O</b>						
Input Voltage High	$V_{IH}$		1.7			V
Input Voltage Low	$V_{IL}$				0.5	V
Input Current High	$I_{IH}$	$V_A, V_B, V_C, V_{ENABLE} = V_{CC}$		1	1000	nA
Input Current Low	$I_{IL}$	$V_A, V_B, V_C, V_{ENABLE} = 0V$		1	1000	nA
<b>DYNAMIC CHARACTERISTICS</b>						
Address Transition Time	$t_{TRANS}$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		150		ns
/ENABLE Turn-On Time	$t_{ON}$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		110		ns
/ENABLE Turn-Off Time	$t_{OFF}$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		100		ns
Internal A, B, C Rise Time	$t_R$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		80		ns
Internal A, B, C Fall Time	$t_F$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		85		ns
Break-Before-Make Time Delay	$t_D$	$V_X = 3V, R_L = 300\Omega, C_L = 35pF$		80		ns
<b>ANALOG SWITCH</b>						
-3dB Bandwidth	BW	$R_L = 50\Omega$		300		MHz
Charge Injection	Q	$R_S = 0\Omega, C_L = 1nF$		6		pC
<b>POWER SUPPLY</b>						
Power Supply Current	$I_{CC}$	$V_{CC} = 5V, V_A, V_B, V_C, V_{ENABLE} = V_{CC} \text{ or } 0$		0.001	3	$\mu A$

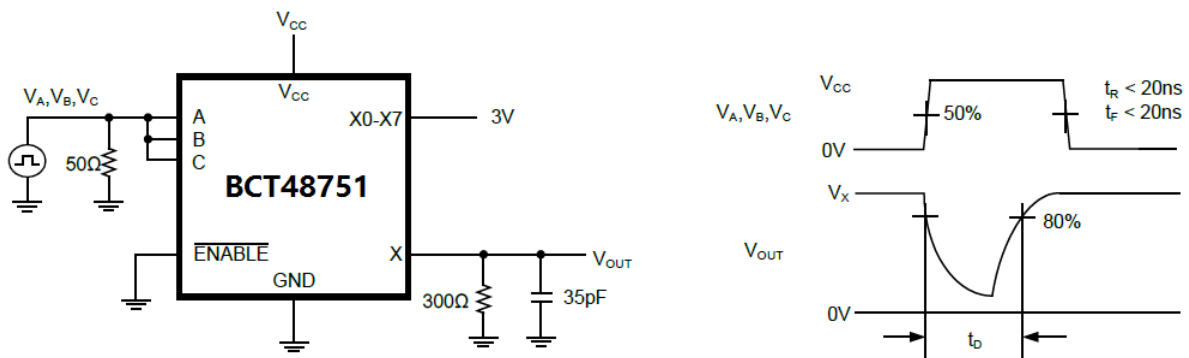
### TEST CIRCUITS



Test Circuit 1. Address Transition Times ( $t_{\text{TRANS}}$ )

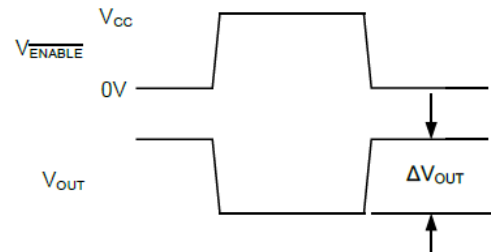
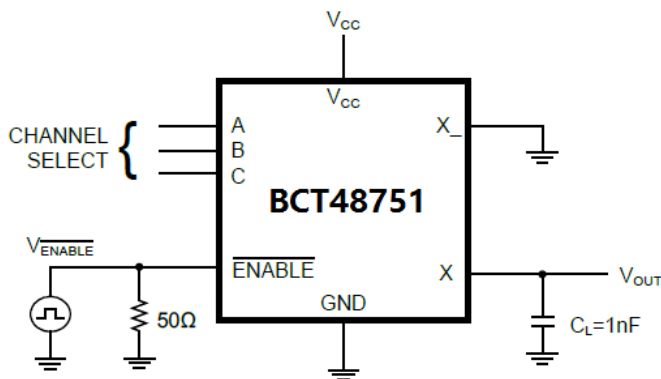


Test Circuit 2. Switching Times ( $t_{\text{ON}}$ ,  $t_{\text{OFF}}$ )



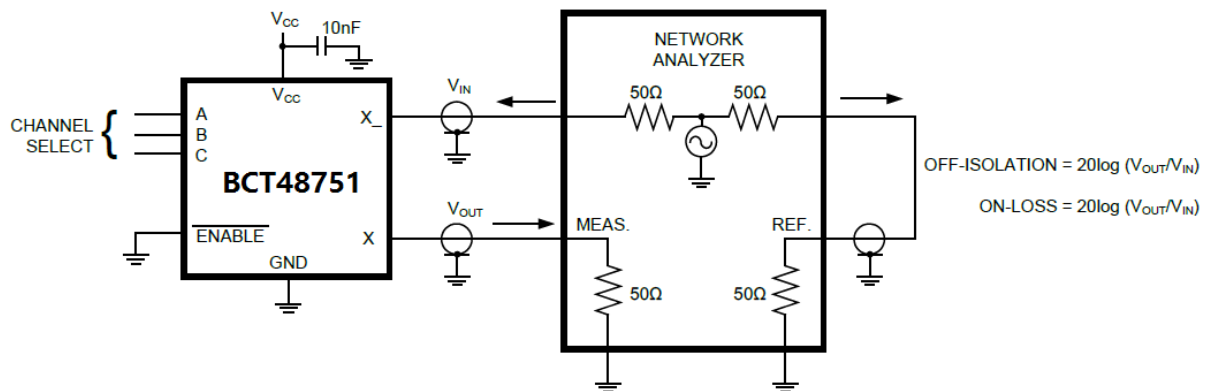
Test Circuit 3. Break-Before-Make Time Delay ( $t_D$ )

### TEST CIRCUITS



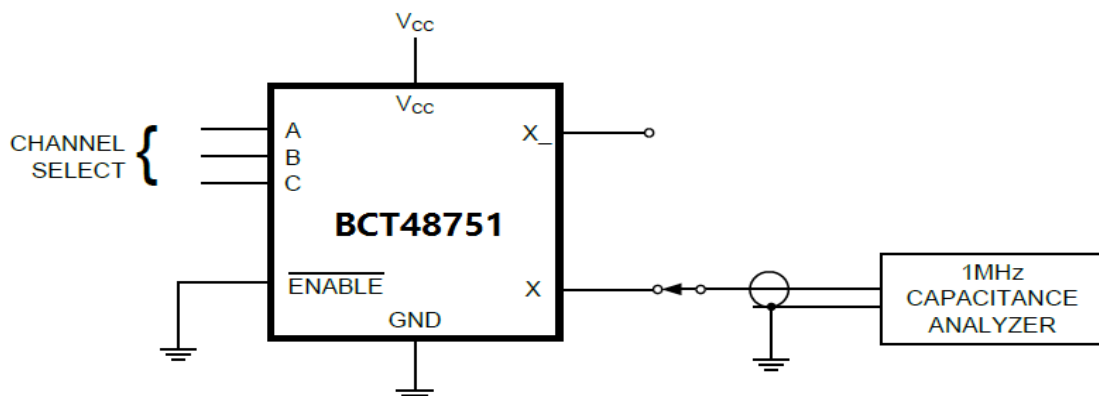
$\Delta V_{OUT}$  IS THE MEASURED VOLTAGE DUE TO CHARGE TRANSFER ERROR Q WHEN THE CHANNEL TURNS OFF.  
 $Q = \Delta V_{OUT} \times C_L$

#### Test Circuit 4. Charge Injection (Q)



MEASUREMENTS ARE STANDARDIZED AGAINST SHORT AT SOCKET TERMINALS.  
 OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH.  
 ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH.  
 SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

#### Test Circuit 5. Off Isolation, On Loss



#### Test Circuit 6. Capacitance



### APPLICATION NOTES

#### Power-Supply Considerations

##### Overview

The BCT48751 construction is typical of most CMOS analog switch. It supports single power supply.  $V_{CC}$  and GND used to drive the internal CMOS switches and set the limits of the analog voltage on any switch. Reserve ESD protection diodes are internally connected between each analog-signal pin and both  $V_{CC}$  and GND. If any analog signal exceeds  $V_{CC}$  or GND, one of these diodes will conduct. During normal operation, these and other reverse-biased ESD diodes leak, forming the only current drawn from  $V_{CC}$  or GND.

Virtually all the analog leakage current comes from the ESD diodes. Although the ESD diodes on a given signal pin are identical and therefore fairly well balanced, they are reverse biased differently. Each is biased by either  $V_{CC}$  or GND and the analog signal. This means their leakages will vary as the signal varies. The difference in the two diode leakages to the  $V_{CC}$  and GND pins constitutes the analog-signal-path leakage current. All analog leakage current flows between each pin one of the supply terminals, not to the other switch terminal. This is why both sides of a given switch can show leakage currents of either the same or opposite polarity.

#### Over-Voltage Protection

Proper power-supply sequencing is recommended for the CMOS device. Do not

exceed the absolute maximum ratings because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence  $V_{CC}$  on first, followed by the logic inputs and analog signals. If power-supply sequencing is not possible, add one 100 resistor in series with the supply  $V_{CC}$  pin for over-voltage protection (Figure 1).

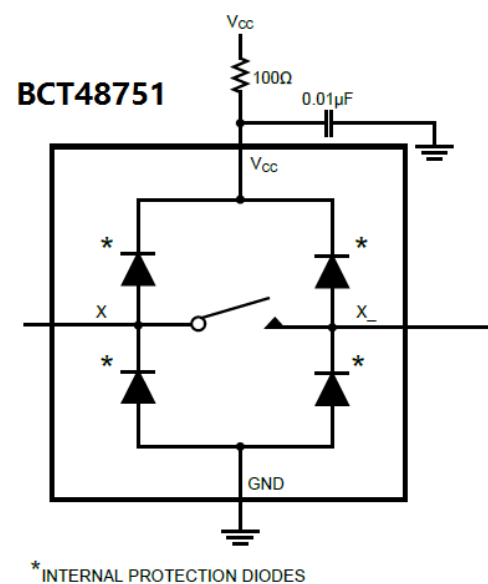
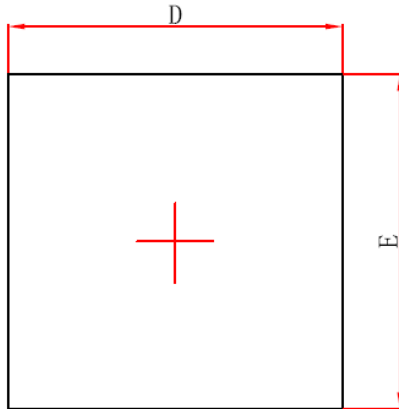


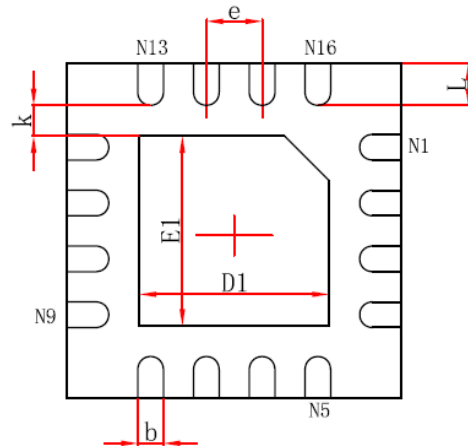
Figure 1. Over-Voltage Protection Using External Resistor

### PACKAGE OUTLINE DIMENSIONS

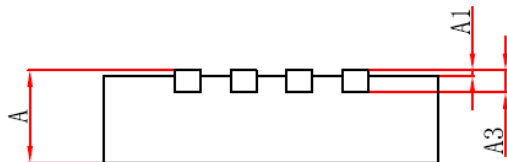
#### QFN3x3-16L



Top View



Bottom View



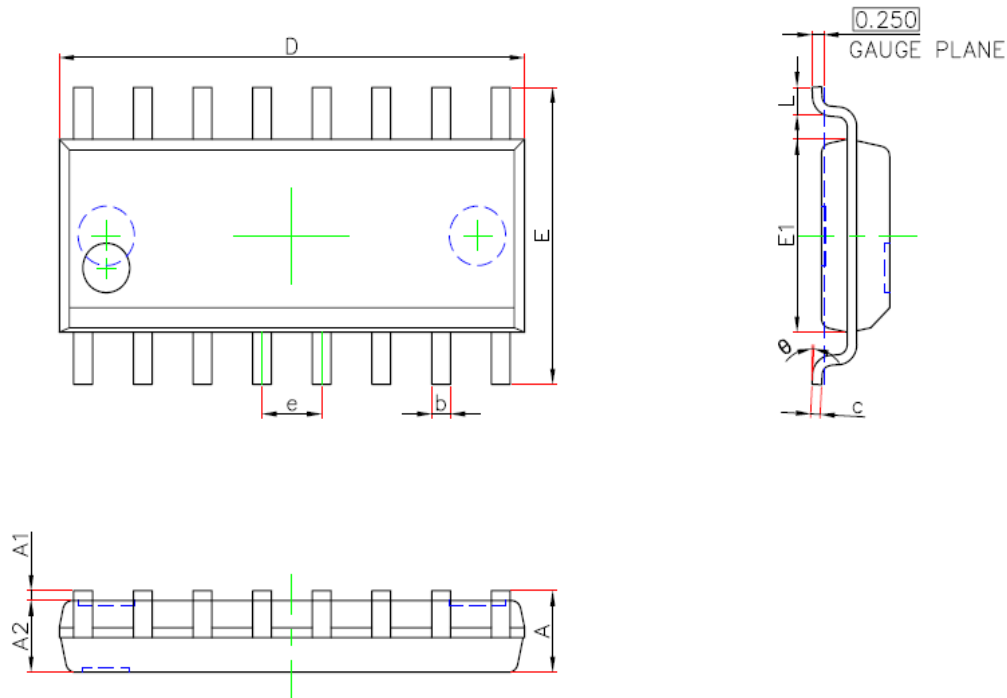
Side View

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700/0.800	0.800/0.900	0.028/0.031	0.031/0.035
A1	0.000	0.050	0.000	0.002
A3	0.203REF		0.008REF	
D	2.924	3.076	0.115	0.121
E	2.924	3.076	0.115	0.121
D1	1.600	1.800	0.063	0.071
E1	1.600	1.800	0.063	0.071
k	0.200MIN.		0.008MIN.	
b	0.180	0.280	0.007	0.011
e	0.500TYP.		0.020TYP.	
L	0.324	0.476	0.013	0.019

QFN3X3-16L Surface Mount Package

### PACKAGE OUTLINE DIMENSIONS

#### SOP16

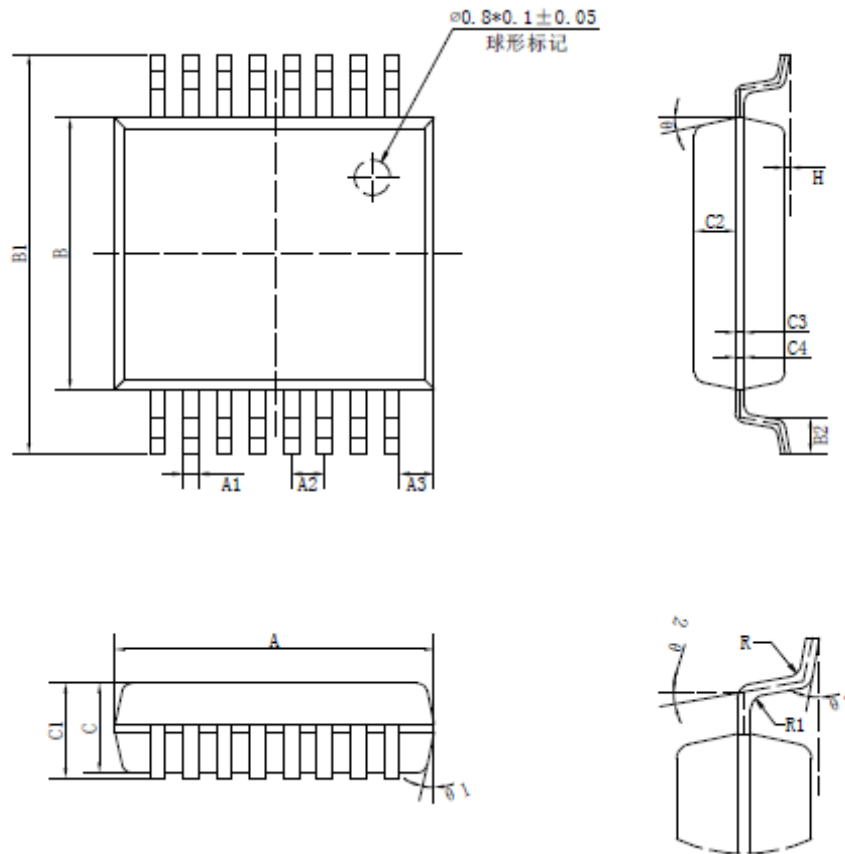


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.750		0.069
A1	0.150	0.250	0.006	0.010
A2	1.400	1.500	0.055	0.059
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.000	0.386	0.394
e	1.270(BSC)		0.050(BSC)	
E	5.900	6.100	0.232	0.240
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP16 Surface Mount Package

### PACKAGE OUTLINE DIMENSIONS

#### SSOP16

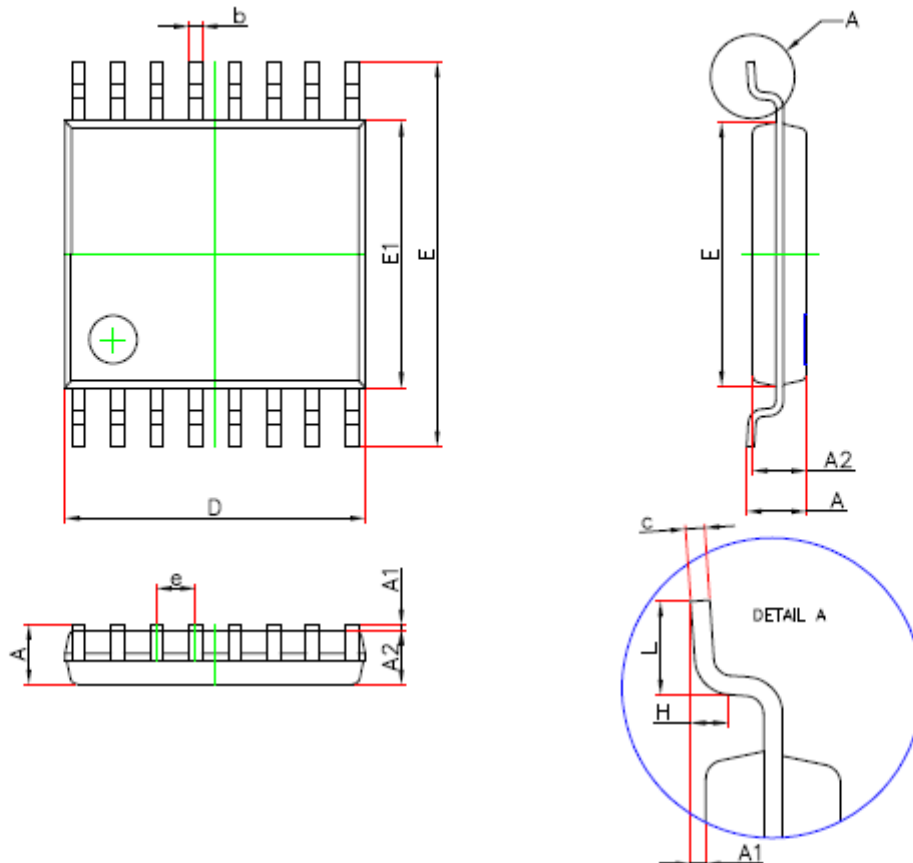


Symbol	Min	Max	Symbol	Min	Max
A	6.15	6.25	C3	0.152 TYP	
A1	0.30 TYP		C4	0.172 TYP	
A2	0.65 TYP		H	0.05	0.06
A3	0.675 TYP		$\theta$	12° TYP	
B	5.25	5.35	$\theta 1$	12° TYP	
B1	7.65	7.95	$\theta 2$	10° TYP	
B2	0.60	0.80	$\theta 3$	0°	8°
C	1.70	1.80	R	0.20 TYP	
C1	1.75	1.95	R1	0.15 TYP	
C2	0.799 TYP				

SSOP16 Surface Mount Package (unit: mm)

### PACKAGE OUTLINE DIMENSIONS

#### TSSOP16



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	—	1.200	—	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	6.250	6.550	0.246	0.258
E1	4.300	4.500	0.169	0.177
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.250(TYP)		0.010(TYP)	
θ	1°	7°	1°	7°

TSSOP16 Surface Mount Package