



SGM48752

CMOS Analog Multiplexer

GENERAL DESCRIPTION

The SGM48752 is a CMOS analog IC configured as two 4-channel multiplexers. 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 only 1nA (TYP) at +25°C.

All digital inputs can support 1.8V logic control I/O.

The SGM48752 is available in Green SOIC-16, SSOP-16, TSSOP-16 and TQFN-3×3-16L packages. It operates over an ambient temperature range of -40°C to +85°C.

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**
- **Low Off-Leakage Current 1nA (TYP) at +25°C**
- **Low On-Leakage Current 1nA (TYP) at +25°C**
- **Optimized Rise Time and Fall Time of A, B Control Pins to Reduce Clock Feedthrough Effect**
- **2.5V to 5.5V Single-Supply Operation**
- **1.8V Logic Compatible**
- **Low Distortion: 0.7% ($R_L = 600\Omega$, $f = 20\text{Hz}$ to 20kHz)**
- **High Off-Isolation: -83dB ($R_L = 50\Omega$, $f = 1\text{MHz}$)**
- **Low Crosstalk: -110dB ($f = 1\text{MHz}$)**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green SOIC-16, SSOP-16, TSSOP-16 and TQFN-3×3-16L Packages**

PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|----------|---------------------|-----------------------------|-------------------|----------------------------|---------------------|
| SGM48752 | SOIC-16 | -40°C to +85°C | SGM48752YS16G/TR | SGM48752YS16 XXXXX | Tape and Reel, 2500 |
| | SSOP-16 | -40°C to +85°C | SGM48752YQS16G/TR | SGM48752 YQS16 XXXXX | Tape and Reel, 3000 |
| | TSSOP-16 | -40°C to +85°C | SGM48752YTS16G/TR | SGM48752 YTS16 XXXXX | Tape and Reel, 4000 |
| | TQFN-3x3-16L | -40°C to +85°C | SGM48752YTQ16G/TR | 48752TQ XXXXX | Tape and Reel, 4000 |

NOTE: XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND -0.3V to 6V
Voltage into Any Terminal ⁽¹⁾ -0.3V to (V_{CC} + 0.3V)
Continuous Current into Any Terminal ± 20 mA
Peak Current, X_{-} , Y_{-}
(Pulsed at 1ms, 10% duty cycle) ± 40 mA
Junction Temperature 150°C
Storage Temperature Range -65°C to +150°C
Lead Temperature (Soldering, 10s) 260°C
ESD Susceptibility
HBM 3000V
MM 200V

NOTE:

1. Voltages exceeding V_{CC} or GND on any signal terminal are clamped by internal diodes. Limit forward-diode current to maximum current rating.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range 2.5V to 5.5V
Operating Temperature Range -40°C to +85°C

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

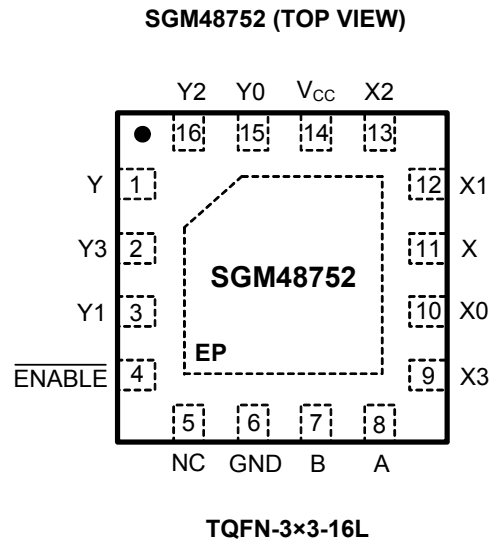
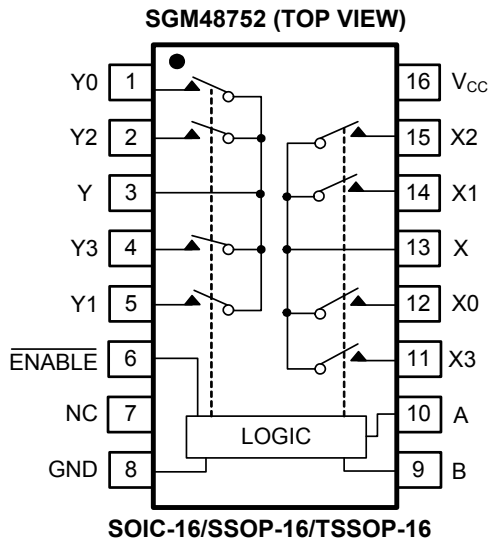
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO 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.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

PIN CONFIGURATIONS



PIN DESCRIPTION

| PIN | | NAME | FUNCTION |
|--------------------------|---------------|-----------------|---|
| SOIC-16/SSOP-16/TSSOP-16 | TQFN-3x3-16L | | |
| 1, 5, 2, 4 | 15, 3, 16, 2 | Y0, Y1, Y2, Y3 | Analog Switch "Y" Inputs 0-3. |
| 3 | 1 | Y | Analog Switch "Y" Output. |
| 6 | 4 | ENABLE | Digital Enable Input. Normally connected to GND. |
| 7 | 5 | NC | No Connect. |
| 8 | 6 | GND | Ground. Connect to digital ground. |
| 9 | 7 | B | Digital Address "B" Input. |
| 10 | 8 | A | Digital Address "A" Input. |
| 12, 14, 15, 11 | 10, 12, 13, 9 | X0, X1, X2, X3 | Analog Switch "X" Inputs 0-3. |
| 13 | 11 | X | Analog Switch "X" Output. |
| 16 | 14 | V _{CC} | Positive Analog and Digital Supply Voltage Input. |
| — | Exposed Pad | EP | Exposed Pad. Connect EP to GND. |

FUNCTION TABLE

| ENABLE INPUT | SELECT INPUTS | | ON SWITCHES |
|--------------|---------------|---|-------------------|
| | B | A | |
| H | X | X | All Switches Open |
| L | L | L | X-X0, Y-Y0 |
| L | L | H | X-X1, Y-Y1 |
| L | H | L | X-X2, Y-Y2 |
| L | H | H | X-X3, Y-Y3 |

X = Don't care

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

ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V, Full = -40°C to +85°C, typical values are at T_A = +25°C, unless otherwise noted.)

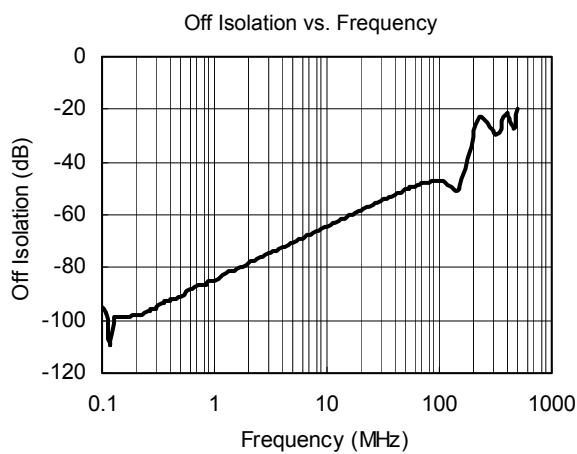
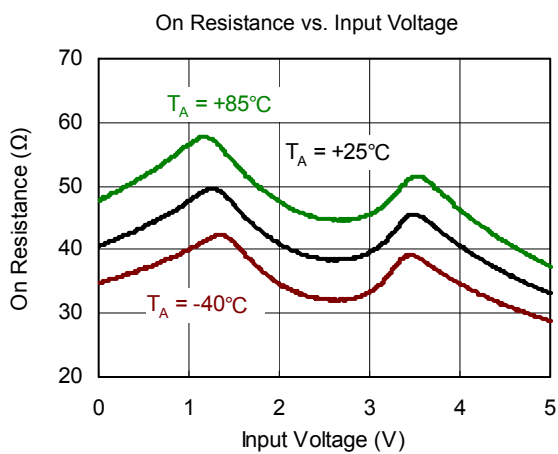
| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|--|--|-------|-----|-------|-----------------|-------|
| ANALOG SWITCH | | | | | | | |
| Analog Signal Range | V _{X-} , V _{Y-} , V _X , V _Y | | Full | GND | | V _{CC} | V |
| On-Resistance | R _{ON} | V _{CC} = 5.0V, I _X , I _Y = 1mA | +25°C | | 48 | 58 | Ω |
| | | | Full | | | 67 | |
| On-Resistance Match Between Channels | ΔR _{ON} | V _{CC} = 5.0V, I _X , I _Y = 1mA | +25°C | | 1.5 | 5 | Ω |
| | | | Full | | | 5.3 | |
| On-Resistance Flatness | R _{FLAT(ON)} | V _{CC} = 5.0V, I _X = 1mA | +25°C | | 17 | 25 | Ω |
| | | | Full | | | 28 | |
| X ₋ , Y ₋ Off Leakage Current | I _{X(OFF)} , I _{Y(OFF)} | V _{CC} = 5.0V, V _{X-} , V _{Y-} = 1V, 4.5V, V _X , V _Y = 4.5V, 1V | +25°C | | 1 | 1000 | nA |
| X, Y Off Leakage Current | I _{X(OFF)} , I _{Y(OFF)} | V _{CC} = 5.0V, V _{X-} , V _{Y-} = 1V, 4.5V, V _X , V _Y = 4.5V, 1V | +25°C | | 1 | 1000 | nA |
| X, Y On Leakage Current | I _{X(ON)} , I _{Y(ON)} | V _{CC} = 5.0V, V _X , V _Y = 4.5V, 1V | +25°C | | 1 | 1000 | nA |
| DIGITAL I/O | | | | | | | |
| Logic Input Logic Threshold High | V _{AH} , V _{BH} , V _{ENABLE} | | +25°C | 1.7 | | | V |
| Logic Input Logic Threshold Low | V _{AL} , V _{BL} , V _{ENABLE} | | +25°C | | | 0.5 | V |
| Input-Current High | I _{AH} , I _{BH} , I _{ENABLE} | V _A , V _B , V _{ENABLE} = V _{CC} | +25°C | | 1 | 1000 | nA |
| Input-Current Low | I _{AL} , I _{BL} , I _{ENABLE} | V _A , V _B , V _{ENABLE} = 0V | +25°C | | 1 | 1000 | nA |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Address Transition Time | t _{TRANS} | V _{X-} , V _{Y-} = 3V/0V, R _L = 300Ω, C _L = 35pF, Test Circuit 1 | +25°C | | 85 | | ns |
| ENABLE Turn-On Time | t _{ON} | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2 | +25°C | | 60 | | ns |
| ENABLE Turn-Off Time | t _{OFF} | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2 | +25°C | | 70 | | ns |
| Internal A, B Rise Time | t _R | | +25°C | | 45 | | ns |
| Internal A, B Fall Time | t _F | | +25°C | | 50 | | ns |
| Break-Before-Make Time | t _D | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 3 | +25°C | | 50 | | ns |
| Charge Injection | Q | R _S = 0Ω, C _L = 1nF, Test Circuit 4 | +25°C | | 3 | | pC |
| Off Isolation | O _{ISO} | R _L = 50Ω, f = 1MHz, Test Circuit 5 | +25°C | | -83 | | dB |
| Crosstalk | X _{TALK} | f = 1MHz, Test Circuit 5 | +25°C | | -110 | | dB |
| Input Off-Capacitance | C _{X(OFF)} , C _{Y(OFF)} | f = 1MHz, Test Circuit 6 | +25°C | | 5 | | pF |
| Output Off-Capacitance | C _{X(OFF)} , C _{Y(OFF)} | f = 1MHz, Test Circuit 6 | +25°C | | 9 | | pF |
| Output On-Capacitance | C _{X(ON)} , C _{Y(ON)} | f = 1MHz, Test Circuit 6 | +25°C | | 13 | | pF |
| -3dB Bandwidth | BW | R _L = 50Ω | +25°C | | 180 | | MHz |
| Total Harmonic Distortion | THD | R _L = 600Ω, 5V _{P-P} , f = 20Hz to 20kHz | +25°C | | 0.7 | | % |
| POWER SUPPLY | | | | | | | |
| Power Supply Range | V _{CC} | | Full | 2.5 | | 5.5 | V |
| Power Supply Current | I _{CC} | V _{CC} = 5.5V, V _A , V _B , V _{ENABLE} = V _{CC} or 0 | +25°C | | 0.001 | 6 | μA |

ELECTRICAL CHARACTERISTICS(V_{CC} = 3.3V, Full = -40°C to +85°C, typical values are at T_A = +25°C, unless otherwise noted.)

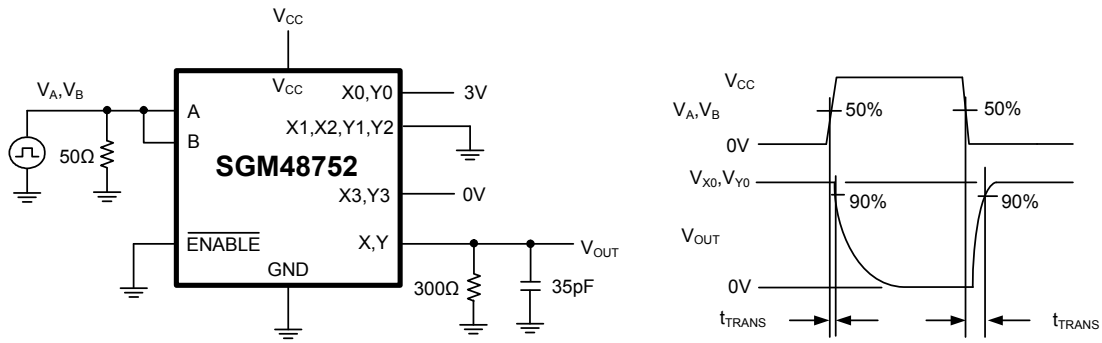
| PARAMETER | SYMBOL | CONDITIONS | TEMP | MIN | TYP | MAX | UNITS |
|---|---|---|-------|-----|-------|-----------------|-------|
| ANALOG SWITCH | | | | | | | |
| Analog Signal Range | $V_{X-}, V_{Y-}, V_{X+}, V_{Y+}$ | | Full | GND | | V _{CC} | V |
| On-Resistance | R _{ON} | I _X , I _Y = 1mA | +25°C | | 80 | 110 | Ω |
| | | | Full | | | 116 | |
| X ₋ , Y ₋ Off Leakage Current | $I_{X(OFF)}, I_{Y(OFF)}$ | V _{X-} , V _{Y-} = 1V, 3V, V _{X+} , V _{Y+} = 3V, 1V | +25°C | | 1 | 1000 | nA |
| X, Y Off Leakage Current | I _{X(OFF)} , I _{Y(OFF)} | V _{X-} , V _{Y-} = 1V, 3V, V _{X+} , V _{Y+} = 3V, 1V | +25°C | | 1 | 1000 | nA |
| X, Y On Leakage Current | I _{X(ON)} , I _{Y(ON)} | V _{X+} , V _{Y+} = 3V, 1V | +25°C | | 1 | 1000 | nA |
| DIGITAL I/O | | | | | | | |
| Logic Input Logic Threshold High | $V_{AH}, V_{BH}, V_{ENABLE}$ | | +25°C | 1.7 | | | V |
| Logic Input Logic Threshold Low | $V_{AL}, V_{BL}, V_{ENABLE}$ | | +25°C | | | 0.5 | V |
| Input-Current High | $I_{AH}, I_{BH}, I_{ENABLE}$ | V _A , V _B , V _{ENABLE} = V _{CC} | +25°C | | 1 | 1000 | nA |
| Input-Current Low | $I_{AL}, I_{BL}, I_{ENABLE}$ | V _A , V _B , V _{ENABLE} = 0V | +25°C | | 1 | 1000 | nA |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Address Transition Time | t _{TRANS} | V _{X-} , V _{Y-} = 3V/0V, R _L = 300Ω, C _L = 35pF, Test Circuit 1 | +25°C | | 150 | | ns |
| ENABLE Turn-On Time | t _{ON} | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2 | +25°C | | 110 | | ns |
| ENABLE Turn-Off Time | t _{OFF} | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2 | +25°C | | 100 | | ns |
| Internal A, B Rise Time | t _R | | +25°C | | 80 | | ns |
| Internal A, B Fall Time | t _F | | +25°C | | 85 | | ns |
| Break-Before-Make Time | t _D | V _{X-} , V _{Y-} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 3 | +25°C | | 80 | | ns |
| -3dB Bandwidth | BW | R _L = 50Ω | +25°C | | 180 | | MHz |
| Charge Injection | Q | R _S = 0Ω, C = 1nF, V _S = 2.5V, Test Circuit 4 | +25°C | | 3 | | pC |
| POWER SUPPLY | | | | | | | |
| Power Supply Current | I _{CC} | V _{CC} = 3.6V, V _A , V _B , V _{ENABLE} = V _{CC} or 0 | +25°C | | 0.001 | 3 | μA |

TYPICAL PERFORMANCE CHARACTERISTICS

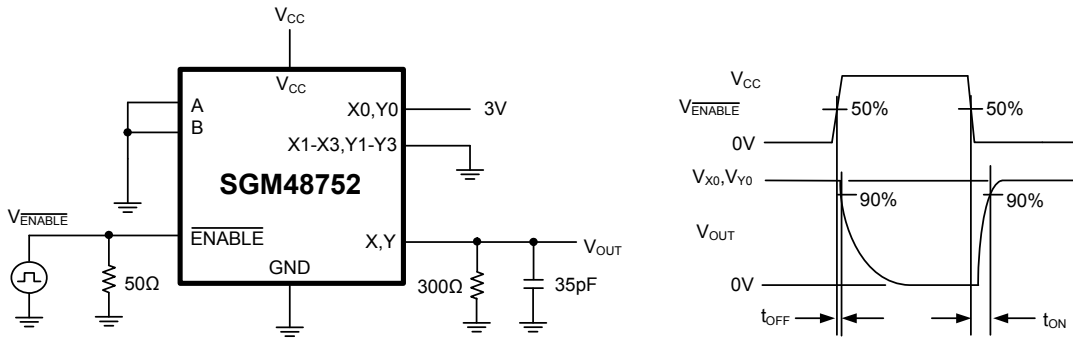
V_{CC} = 5.0V, unless otherwise noted.



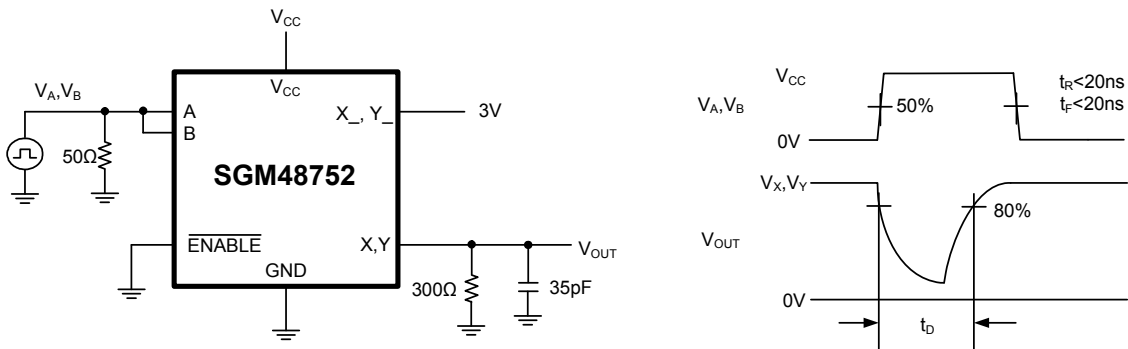
TEST CIRCUITS



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

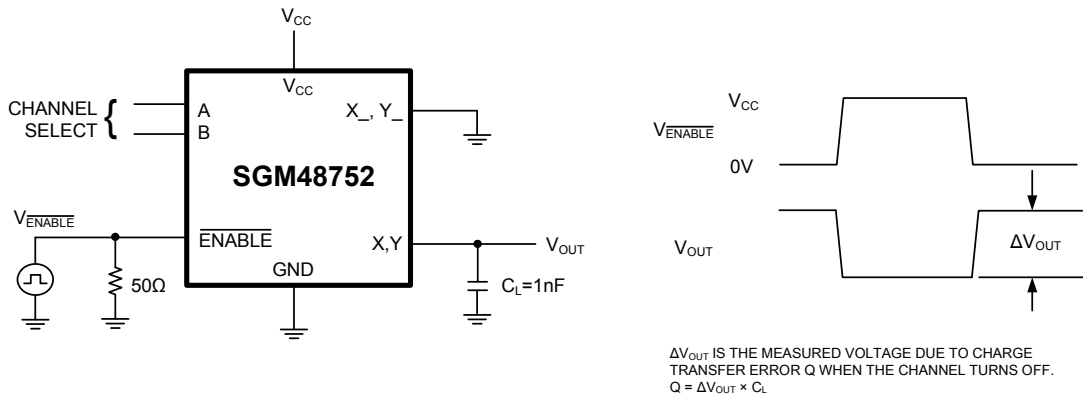


Test Circuit 2. Switching Times (t_{ON} , t_{OFF})

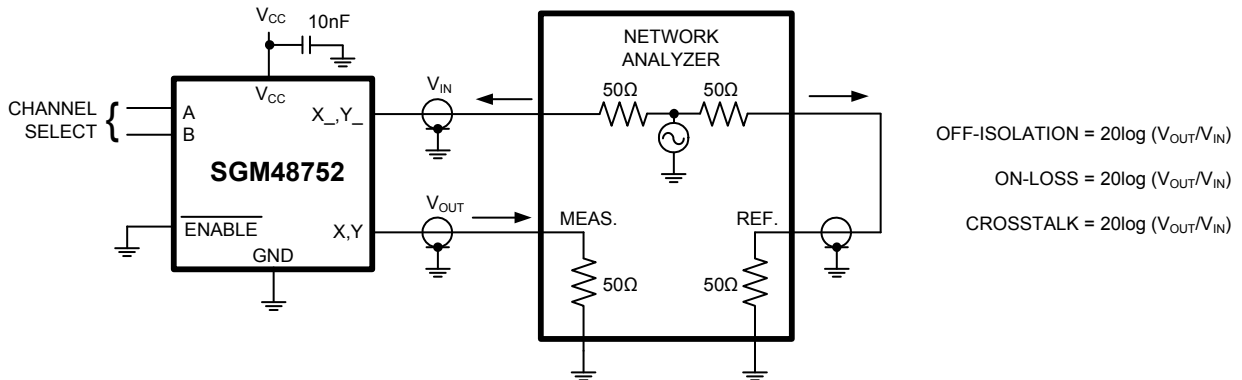


Test Circuit 3. Break-Before-Make Time (t_D)

TEST CIRCUITS

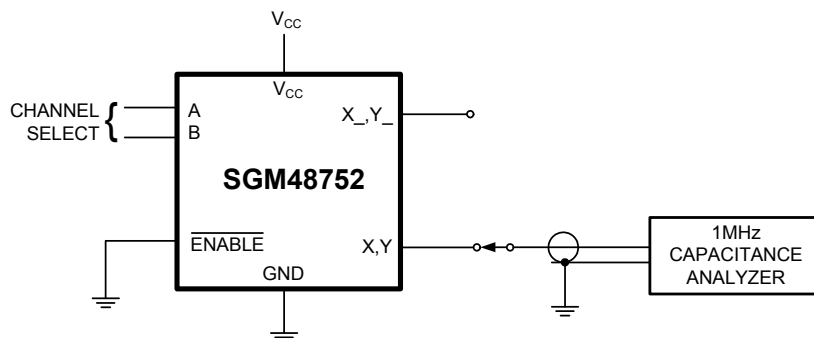


Test Circuit 4. Charge Injection (Q)



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.
 CROSSTALK IS MEASURED FROM ONE CHANNEL (A, B) TO ALL OTHER CHANNELS.
 SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

Test Circuit 5. Off Isolation, On Loss and Crosstalk



Test Circuit 6. Capacitance

APPLICATION INFORMATION

Power-Supply Considerations

Overview

The SGM48752 construction is typical of most CMOS analog switch. It supports single power supply. V_{CC} and GND are used to drive the internal CMOS switches and set the limits of the analog voltage on any switch. Reverse 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 and 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 100Ω resistor in series with the supply V_{CC} pin for over-voltage protection (Figure 1).

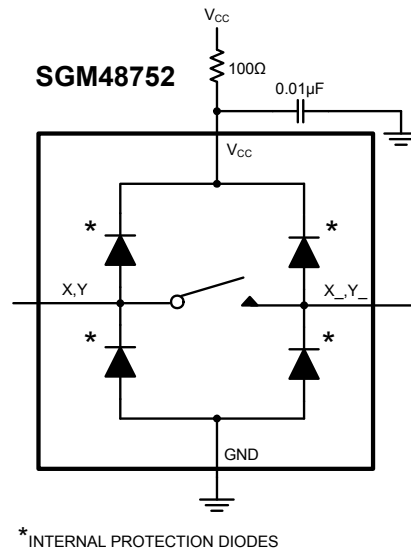
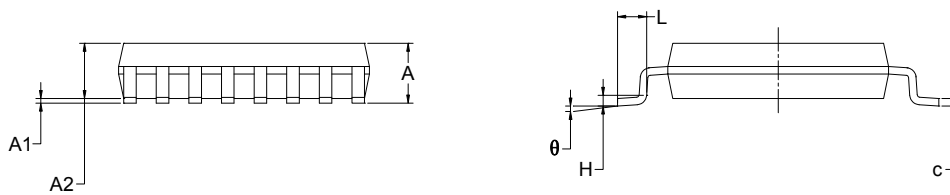
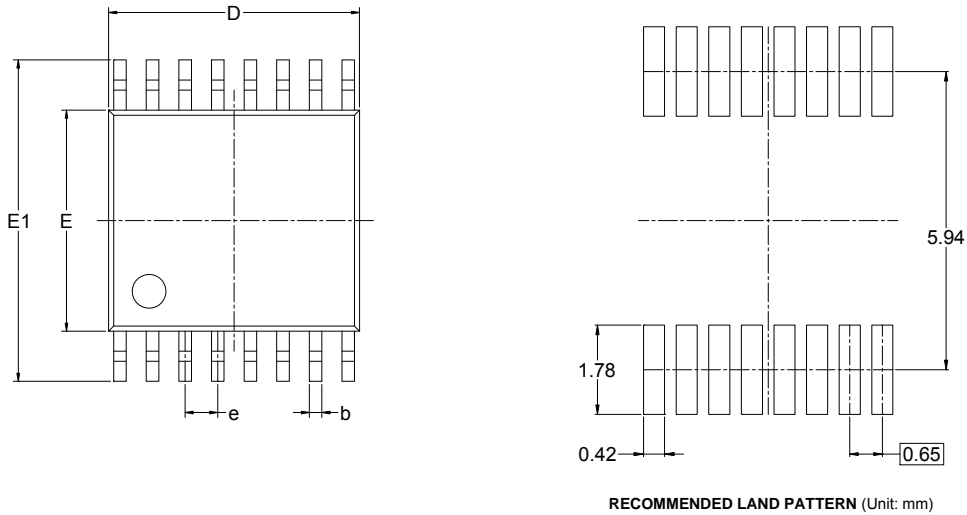


Figure 1. Over-Voltage Protection Using External Resistor

PACKAGE OUTLINE DIMENSIONS

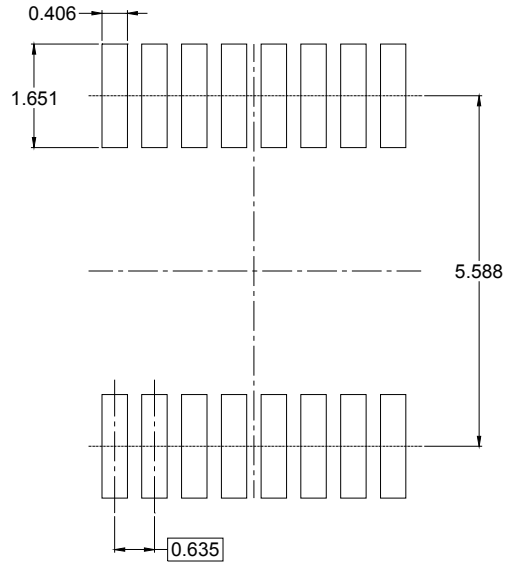
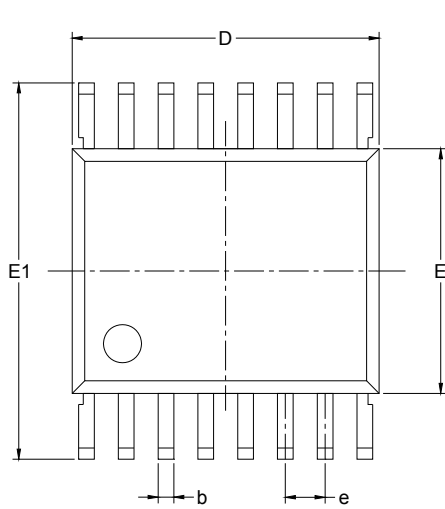
TSSOP-16



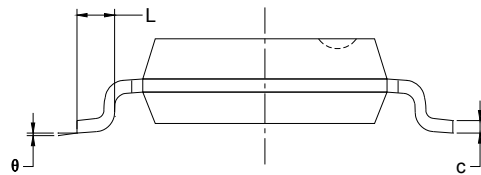
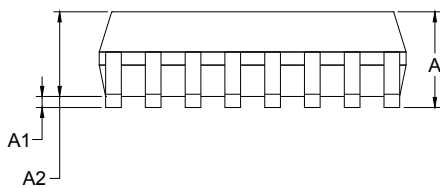
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | | 1.100 | | 0.043 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.000 | 0.031 | 0.039 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 4.900 | 5.100 | 0.193 | 0.201 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.500 | 0.700 | 0.02 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

PACKAGE OUTLINE DIMENSIONS

SSOP-16



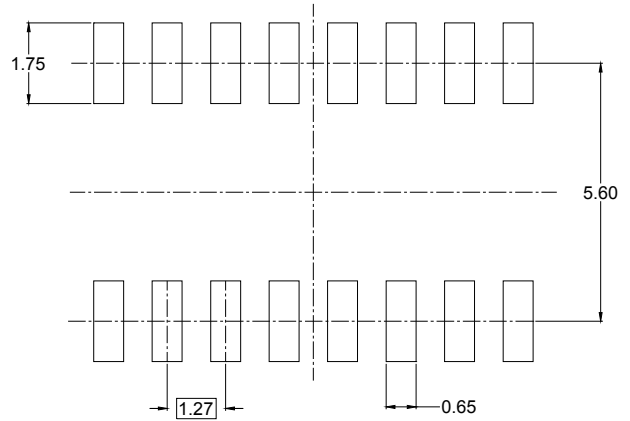
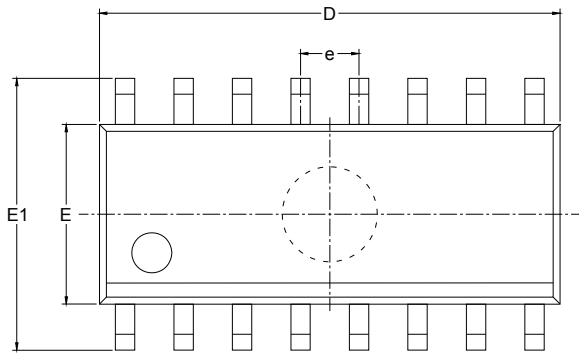
RECOMMENDED LAND PATTERN (Unit: mm)



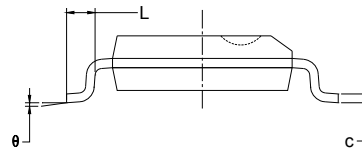
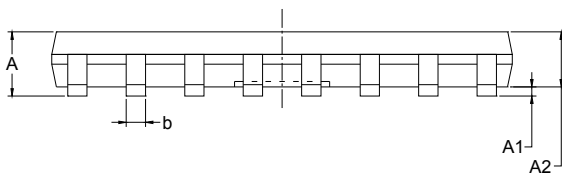
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.200 | 0.300 | 0.008 | 0.012 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.700 | 5.100 | 0.185 | 0.200 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 0.635 BSC | | 0.025 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

PACKAGE OUTLINE DIMENSIONS

SOIC-16



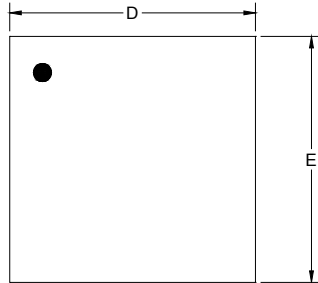
RECOMMENDED LAND PATTERN (Unit: mm)



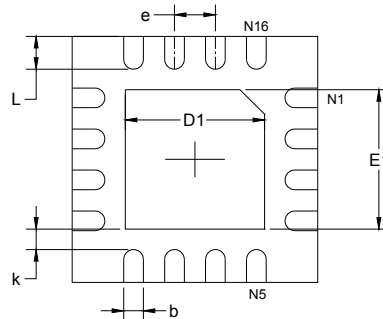
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|--------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.006 | 0.010 |
| D | 9.800 | 10.200 | 0.386 | 0.402 |
| E | 3.800 | 4.000 | 0.150 | 0.157 |
| E1 | 5.800 | 6.200 | 0.228 | 0.244 |
| e | 1.27 BSC | | 0.050 BSC | |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

PACKAGE OUTLINE DIMENSIONS

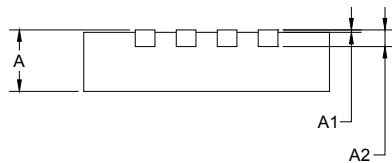
TQFN-3x3-16L



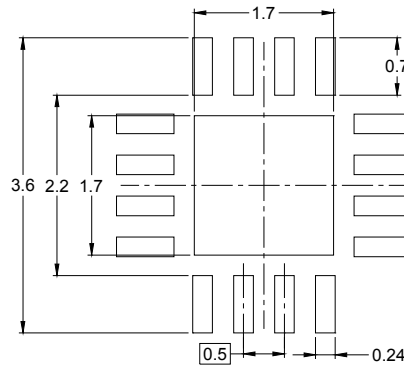
TOP VIEW



BOTTOM VIEW



SIDE VIEW

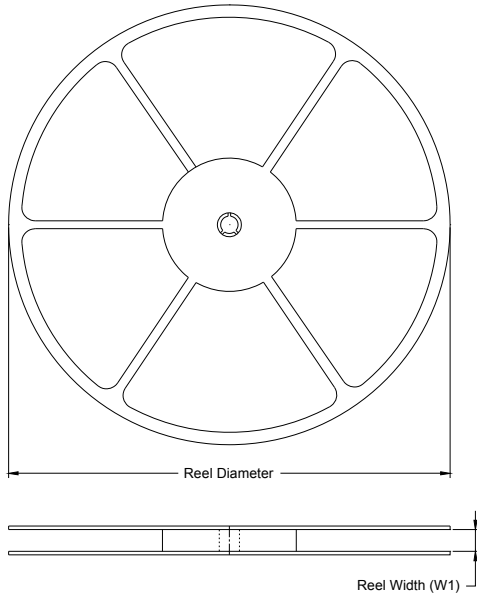


RECOMMENDED LAND PATTERN (Unit: mm)

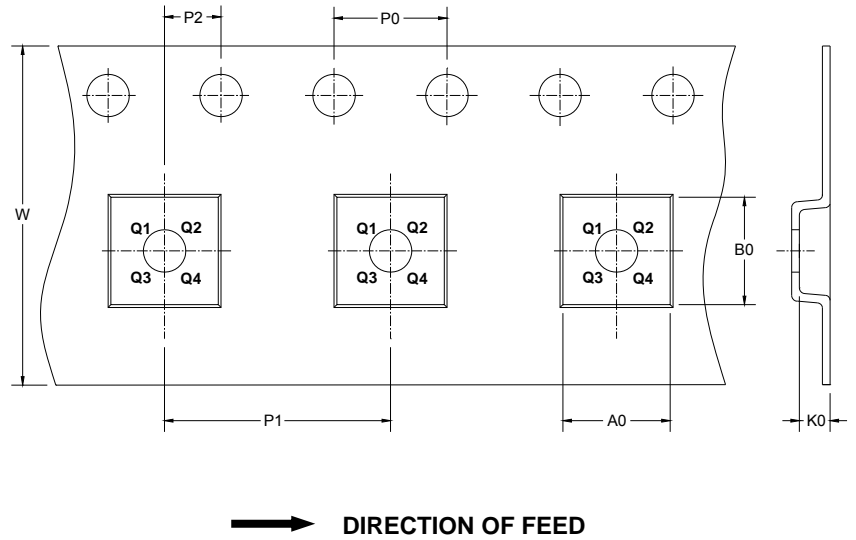
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|------------------------------|-------|-------------------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 REF | | 0.008 REF | |
| D | 2.900 | 3.100 | 0.114 | 0.122 |
| D1 | 1.600 | 1.800 | 0.063 | 0.071 |
| E | 2.900 | 3.100 | 0.114 | 0.122 |
| E1 | 1.600 | 1.800 | 0.063 | 0.071 |
| k | 0.200 MIN | | 0.008 MIN | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| e | 0.500 TYP | | 0.020 TYP | |
| L | 0.300 | 0.500 | 0.012 | 0.020 |

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

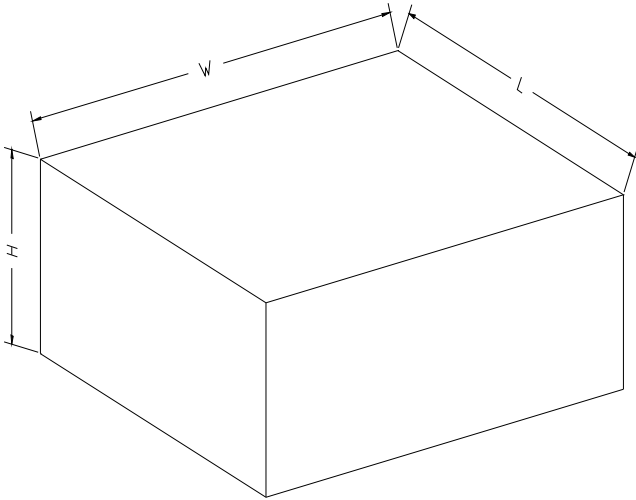
KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|--------------|---------------|--------------------|---------|---------|---------|---------|---------|---------|--------|---------------|
| SOIC-16 | 13" | 16.4 | 6.5 | 10.3 | 2.1 | 4.0 | 8.0 | 2.0 | 16.0 | Q1 |
| SSOP-16 | 13" | 12.4 | 6.4 | 5.4 | 2.1 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| TSSOP-16 | 13" | 12.4 | 6.9 | 5.6 | 1.2 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| TQFN-3×3-16L | 13" | 12.40 | 3.35 | 3.35 | 1.13 | 4.00 | 4.00 | 2.00 | 12.00 | Q1 |

D00001

PACKAGE INFORMATION

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|-----------|-------------|------------|-------------|--------------|
| 13" | 386 | 280 | 370 | 5 |

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