



SGM48755

High Isolation and Low Leakage 4:1 CMOS Analog Signal Multiplexer

GENERAL DESCRIPTION

The SGM48755 is a CMOS analog switch configured as a 4:1 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 only 1nA (TYP) at +25°C.

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

The SGM48755 is available in Green MSOP-10 package. 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

FUNCTION TABLE

ENABLE INPUT	SELECT INPUTS		ON SWITCHES
	ADDB	ADDA	
1	X	X	NONE
0	0	0	COM-NO0
0	0	1	COM-NO1
0	1	0	COM-NO2
0	1	1	COM-NO3

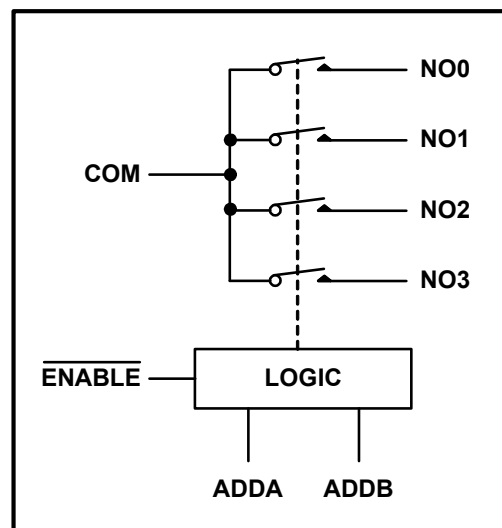
X = Don't care

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

FEATURES

- **Guaranteed On-Resistance**
24Ω (TYP) with +5V Supply
- **Guaranteed On-Resistance Match Between Channels**
- **“T” Type Switch**
- **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 ADDA and ADDB Control Pins to Reduce Clock Feedthrough Effect**
- **2.5V to 5.5V Single-Supply Operation**
- **1.8V Logic Compatible**
- **Low Distortion: 0.35% (R_L = 600Ω, f = 20Hz to 20kHz)**
- **High Off-Isolation: -80dB (R_L = 50Ω, f = 1MHz)**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green MSOP-10 Package**

FUNCTIONAL BLOCK DIAGRAM



PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM48755	MSOP-10	-40°C to +85°C	SGM48755YMS10G/TR	SGM48755 YMS10 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 ±20mA
 Peak Current
 (Pulsed at 1ms, 10% duty cycle) ±40mA
 Junction Temperature 150°C
 Storage Temperature Range -65°C to +150°C
 Lead Temperature (Soldering, 10s) 260°C
 ESD Susceptibility
 HBM 4000V
 MM 300V

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.

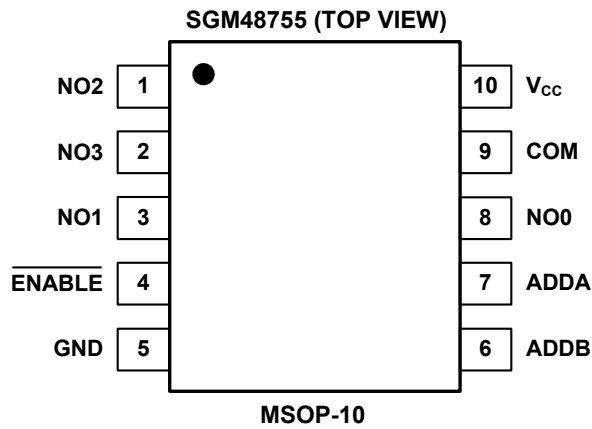
ESD SENSITIVITY CAUTION

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 CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	NO2	Analog Switch Normally Open Input 2.
2	NO3	Analog Switch Normally Open Input 3.
3	NO1	Analog Switch Normally Open Input 1.
4	$\overline{\text{ENABLE}}$	Inhibit. Drive $\overline{\text{ENABLE}}$ low or connect to GND for normal operation. Drive $\overline{\text{ENABLE}}$ high or connect to V_{CC} to turn all switches off.
5	GND	Ground.
6	ADDB	Logic-Level Address Input.
7	ADDA	Logic-Level Address Input.
8	NO0	Analog Switch Normally Open Input 0.
9	COM	Analog Switch Common.
10	V_{CC}	Positive Analog and Digital Supply Voltage.

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.)

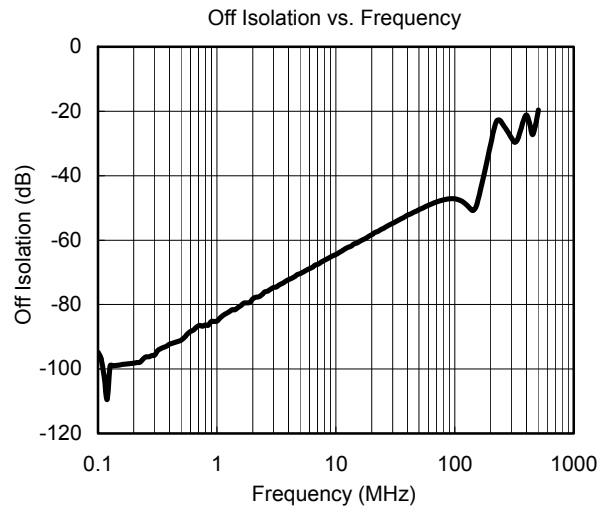
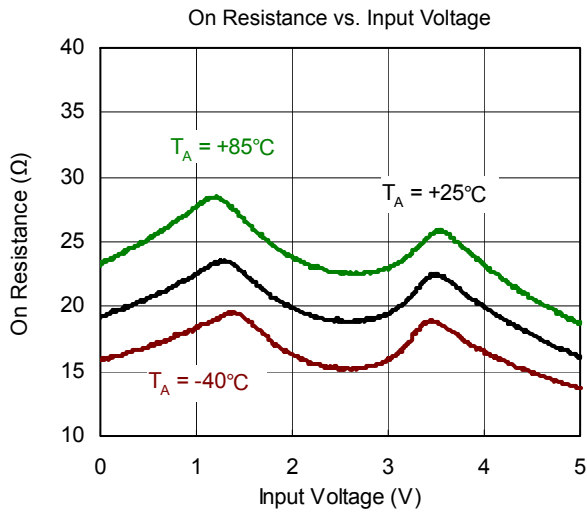
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{NO_} , V _{COM}		Full	GND		V _{CC}	V
On-Resistance	R _{ON}	I _{COM} = 1mA	+25°C		24	30	Ω
			Full			35	
On-Resistance Match Between Channels	ΔR _{ON}	I _{COM} = 1mA	+25°C		1	2.6	Ω
			Full			3.1	
On-Resistance Flatness	R _{FLAT(ON)}	I _{COM} = 1mA	+25°C		8	11	Ω
			Full			14	
Channel Off Leakage Current	I _{NO_(OFF)}	V _{NO_} = 4.5V or 0V, V _{COM} = 4.5V or 0V	+25°C		1	2000	nA
	I _{COM(OFF)}	V _{NO_} = 4.5V or 0V, V _{COM} = 4.5V or 0V	+25°C		1	1000	
Channel On Leakage Current	I _{NO_(ON)} , I _{COM(ON)}	V _{NO_} = 4.5V or 0V, V _{COM} = 4.5V or 0V	+25°C		1	1000	nA
DIGITAL I/O							
Logic Input Logic Threshold High	V _{ADDAH} , V _{ADDBH} , V _{ENABLEH}		+25°C	1.7			V
Logic Input Logic Threshold Low	V _{ADDAL} , V _{ADDBL} , V _{ENABLEL}		+25°C			0.5	V
Input-Current High	I _{ADDAH} , I _{ADDBH} , I _{ENABLEH}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = V _{CC}	+25°C		1		nA
Input-Current Low	I _{ADDAL} , I _{ADDBL} , I _{ENABLEL}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = 0V	+25°C		1		nA
DYNAMIC CHARACTERISTICS							
Address Transition Time	t _{TRANS}	V _{NO_} = ±3V, R _L = 300Ω, C _L = 35pF, Test Circuit 1	+25°C		65		ns
ENABLE Turn-On Time	t _{ON}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2	+25°C		50		ns
ENABLE Turn-Off Time	t _{OFF}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2	+25°C		85		ns
Input Transition Rise or Fall Rate	Δt/ΔV		+25°C			20	ns/V
Break-Before-Make Time Delay	t _D	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 3	+25°C		45		ns
Charge Injection	Q	R _S = 0Ω, C _L = 1nF, V _S = 0V, Test Circuit 4	+25°C		3		pC
Off Isolation	O _{ISO}	R _L = 50Ω, f = 1MHz, Test Circuit 5	+25°C		-80		dB
Input Off-Capacitance	C _{NO_(OFF)}	V _{NO_} = 0V, f = 1MHz, Test Circuit 6	+25°C		6		pF
Output Off-Capacitance	C _{COM(OFF)}	V _{NO_} = 0V, f = 1MHz, Test Circuit 6	+25°C		13		pF
Output On-Capacitance	C _{COM(ON)}	V _{NO_} = 0V, f = 1MHz, Test Circuit 6	+25°C		19		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		0.35		%
POWER SUPPLY							
Power Supply Range	V _{CC}		Full	2.5		5.5	V
Power Supply Current	I _{CC}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = V _{CC} or 0V	+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.)

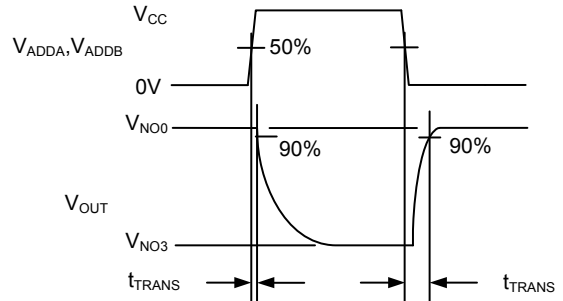
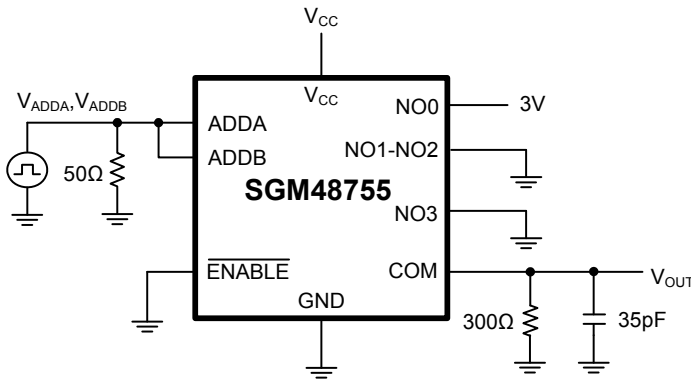
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{NO_} , V _{COM}		Full	GND		V _{CC}	V
On-Resistance	R _{ON}	I _{COM} = 1mA	+25°C		40	59	Ω
			Full			62	
Channel Off Leakage Current	I _{NO_(OFF)} , I _{COM(OFF)}	V _{NO_} = 1V or 3V, V _{COM} = 3V or 1V	+25°C		1	1000	nA
Channel On Leakage Current	I _{NO_(ON)} , I _{COM(ON)}	V _{NO_} = 1V or 3V, V _{COM} = 3V or 1V	+25°C		1	1000	nA
DIGITAL I/O							
Logic Input Logic Threshold High	V _{ADDAH} , V _{ADDBH} , V _{ENABLEH}		+25°C	1.7			V
Logic Input Logic Threshold Low	V _{ADDAL} , V _{ADDBL} , V _{ENABLEL}		+25°C			0.5	V
Input-Current High	I _{ADDAH} , I _{ADDBH} , I _{ENABLEH}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = V _{CC}	+25°C		1		nA
Input-Current Low	I _{ADDAL} , I _{ADDBL} , I _{ENABLEL}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = 0V	+25°C		1		nA
DYNAMIC CHARACTERISTICS							
Address Transition Time	t _{TRANS}	V _{NO_} = 3V/0V, R _L = 300Ω, C _L = 35pF, Test Circuit 1	+25°C		120		ns
$\overline{\text{ENABLE}}$ Turn-On Time	t _{ON}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2	+25°C		85		ns
$\overline{\text{ENABLE}}$ Turn-Off Time	t _{OFF}	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 2	+25°C		115		ns
Input Transition Rise or Fall Rate	Δt/ΔV		+25°C			100	ns/V
Break-Before-Make Time Delay	t _D	V _{NO_} = 3V, R _L = 300Ω, C _L = 35pF, Test Circuit 3	+25°C		65		ns
-3dB Bandwidth	BW	R _L = 50Ω	+25°C		180		MHz
Charge Injection	Q	R _S = 0Ω, C _L = 1nF, V _S = 0V, Test Circuit 4	+25°C		4		pC
POWER SUPPLY							
Power Supply Current	I _{CC}	V _{ADDA} , V _{ADDB} , V _{ENABLE} = V _{CC} or 0V	+25°C		0.001	3	μA

TYPICAL PERFORMANCE CHARACTERISTICS

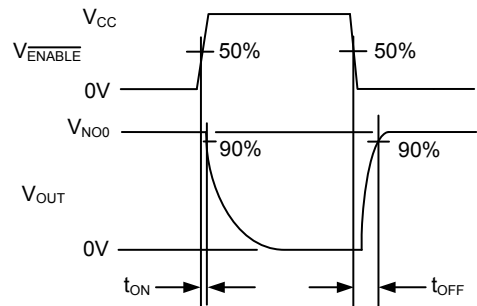
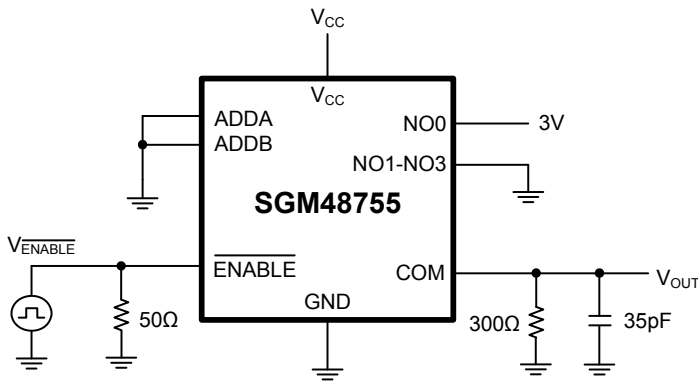
V_{CC} = 5.0V, unless otherwise noted.



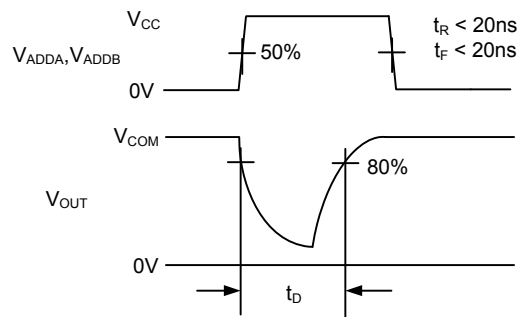
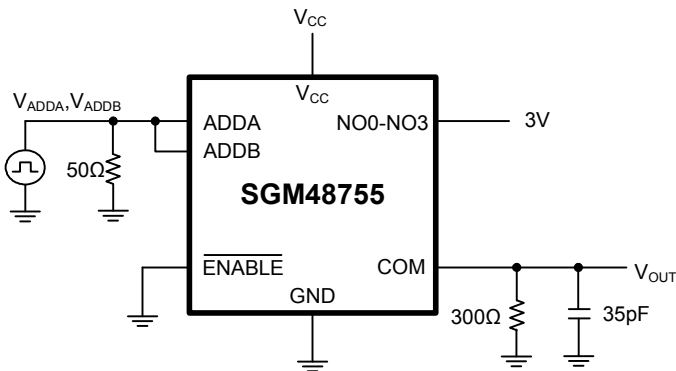
TEST CIRCUITS



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

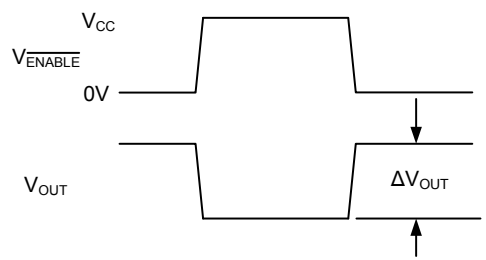
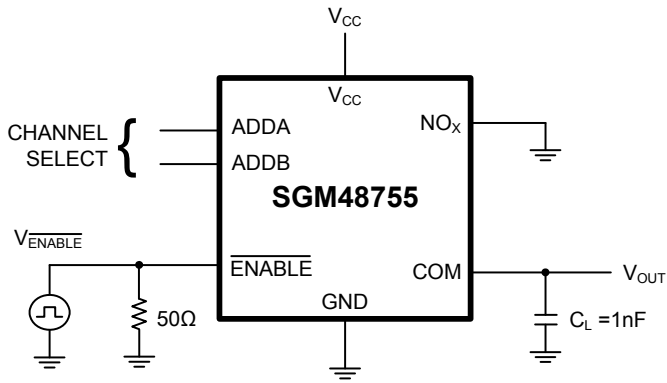


Test Circuit 2. Switching Times (t_{ON} , t_{OFF})



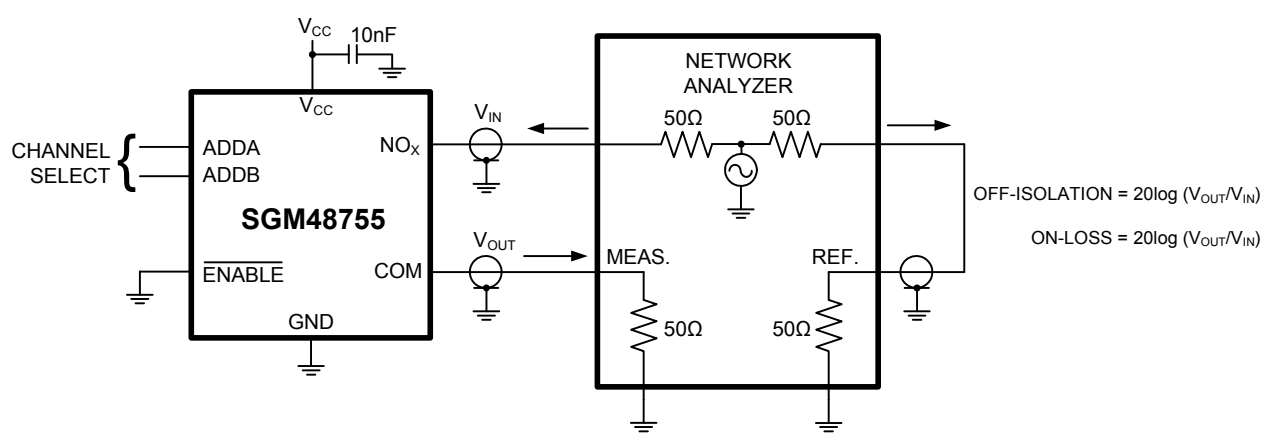
Test Circuit 3. Break-Before-Make Time Delay (t_D)

TEST CIRCUITS



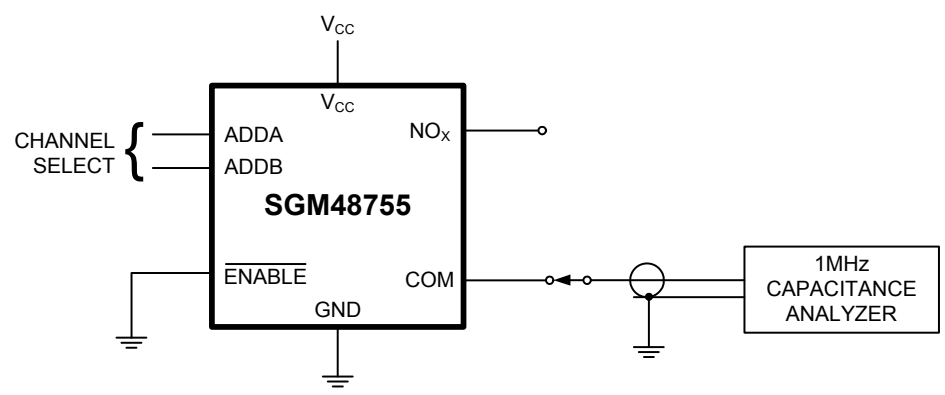
ΔV_{OUT} IS THE MEASURED VOLTAGE DUE TO CHARGE TRANSFER ERROR Q WHEN THE CHANNEL TURNS OFF.
 $Q = \Delta V_{OUT} \times C_L$

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 INFORMATION

Power-Supply Considerations

Overview

The SGM48755 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 100 Ω resistor in series with the supply V_{CC} pin for over-voltage protection (Figure 1).

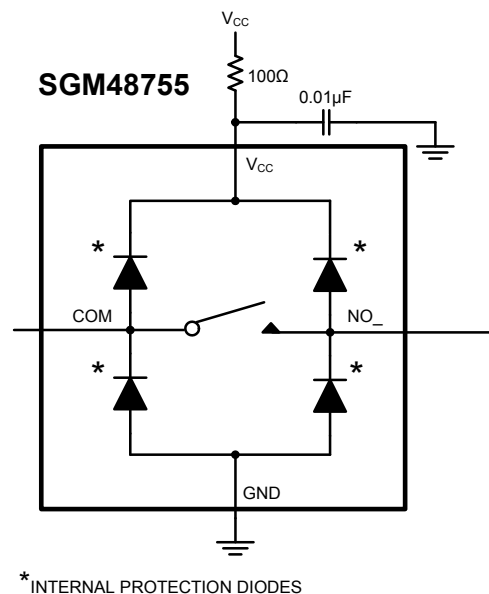
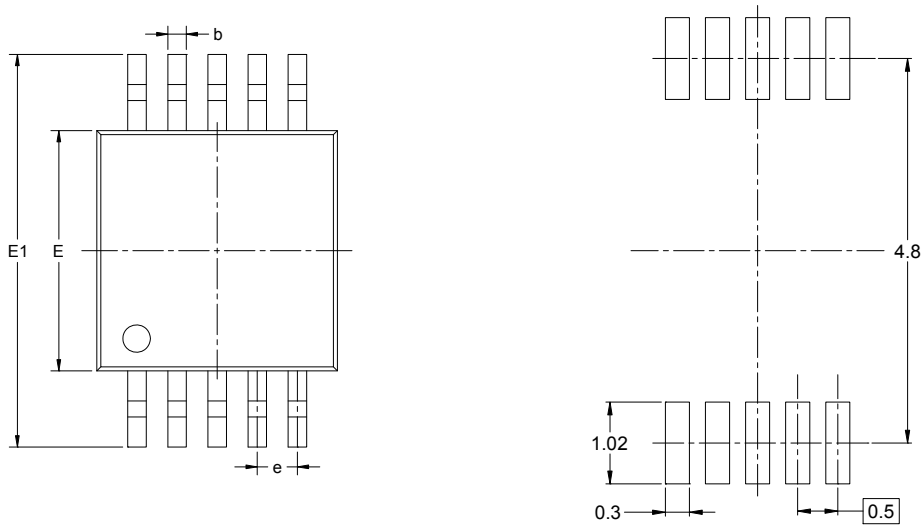


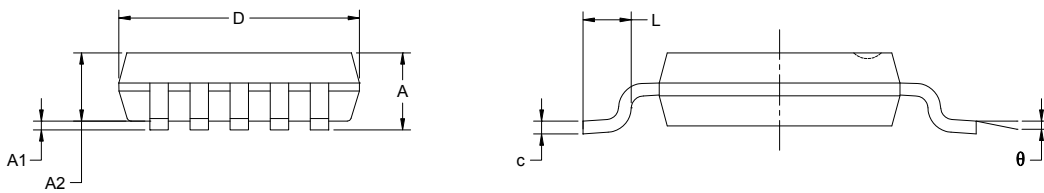
Figure 1. Over-Voltage Protection Using External Resistor

PACKAGE OUTLINE DIMENSIONS

MSOP-10



RECOMMENDED LAND PATTERN (Unit: mm)

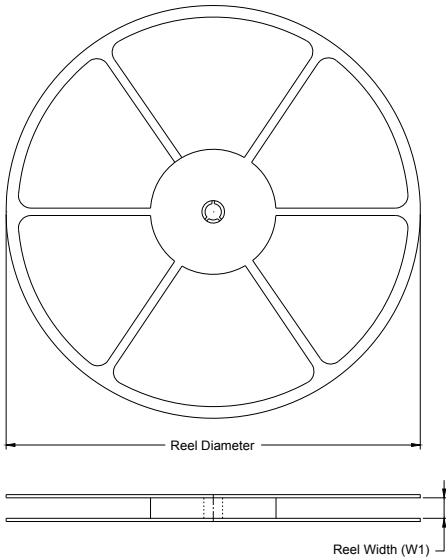


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

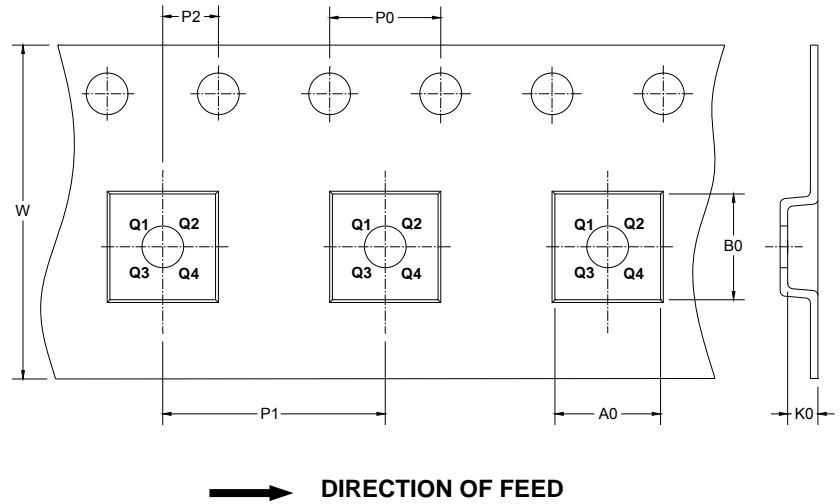
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

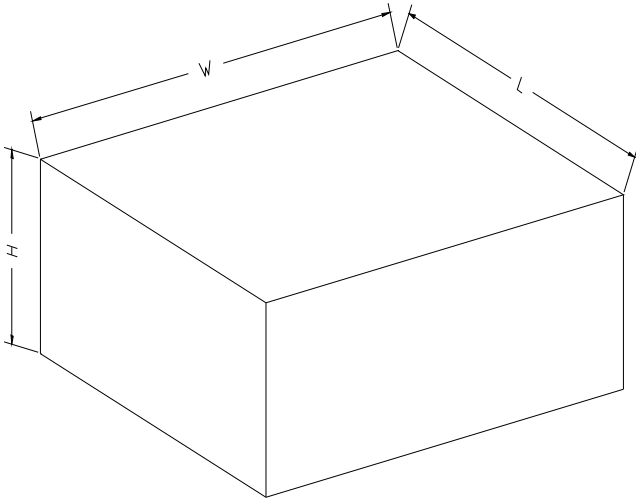
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP-10	13"	12.4	5.2	3.3	1.2	4.0	8.0	2.0	12.0	Q1

DD0001

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

DD0102