

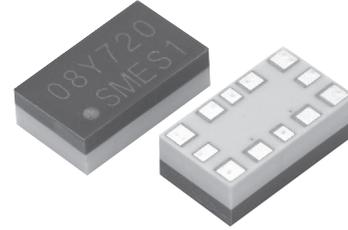
Surface-mounted, ultracompact SPDT MEMS switch usable up to 10-GHz band (typical).

- Exceptional high-frequency characteristics in a broad spectrum up to 10 GHz (typical)  
At 8 GHz (50Ω):

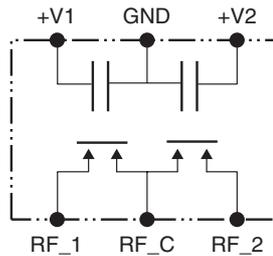
Isolation: 30 dB min.,  
Insertion loss: 1 dB max.

- Ultracompact size: 5.2×3.0×1.8 mm (L×W×H)
- Contact switching endurance of over 100 million cycles. (0.5 mA at 0.5 VDC, resistive load)
- Power consumption of 10 μW max.

**RoHS compliant**



### Equivalent Circuit Design



### Application Example

- Semiconductor testers
- High-frequency measurement devices
- RF components

### List of Models

#### Standard Models with Surface-mounting Terminals

Classification	Structure	Contact form	Model	Packaging	Package quantity	Model	Minimum order
Single-side stable	Plastic sealed	SPDT	2SMES-01	2" IC Pack	56/Tray	2SMES-01	1
				JEDEC Tray	250/Tray	2SMES-01CT	150

## Specifications

### ■ Contact Switching Ratings

Item	Load	Resistive load
Rated load		0.5 mA at 0.5 VDC
Rated carry current		100 mA at 10 VDC RF: 30 dBm*
Maximum switching voltage		0.5 VDC
Maximum switching current		0.5 mADC
Maximum switching capacity		0.25 mW

**Note:** Unless otherwise specified, initial values are based on a temperature of 23°C and a humidity of 65%.

\* These values are for a V.SWR of 1.2 or less at the load.

### ■ High-frequency Characteristics

Item	Frequency	2 GHz	8 GHz	10 GHz	12 GHz
Isolation		---	30 dB		---
Insertion Loss		---	1 dB	1 dB (Typ.)	3 dB
Return Loss		---	10 dB		---
Maximum peak power		36 dBm	---		---
Maximum carry power		30 dBm	---		---

**Note:** 1. The impedance of the measurement system is 50 Ω.

2. The above values are initial values.

3. These values are for a V.SWR of less than 1.2 at the load.

4. Unless otherwise specified, initial values are based on a temperature of 23°C and a humidity of 65%.

### ■ Input Ratings

Rated voltage (VDC)		Rated current (mA)	Must operate voltage (V)	Must release voltage (V)	Absolute maximum voltage (V)	Rated power consumption (μW)
DC	34±5%	---	90% max. of rated voltage	10% min. of rated voltage	40	10

**Note:** Unless otherwise specified, initial values are based on a temperature of 23°C and a humidity of 65%.

## Characteristics

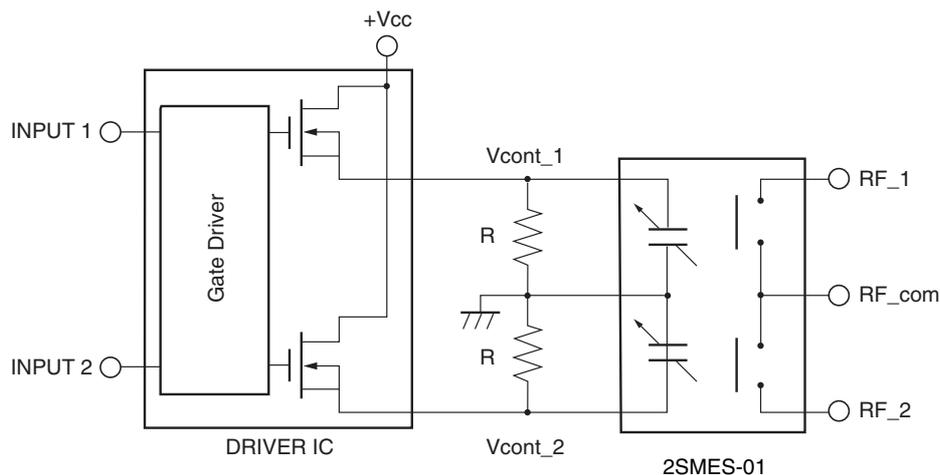
Item	Classification Model	Single-side stable model
		2SMES-01
Contact resistance		1,500 mΩ max. *
Operating time		100 μs max. (Depends on the rated voltage operation.)
Release time		100 μs max. (Depends on the rated voltage operation.)
Insulation resistance	V-GND	100 MΩ (at 40 VDC)
	others	100 MΩ (at 100 VDC)
Vibration resistance	Destruction	10 Hz to 500 Hz 10 G
	Malfunction	10 Hz to 500 Hz 10 G
Shock resistance	Destruction	1,000 m/s <sup>2</sup> (100 G)
	Malfunction	1,000 m/s <sup>2</sup> (100 G)
Life expectancy	Mechanical	100,000,000 Operations min.
	Electrical	100,000,000 Operations min.
ESD		100 V (Human body model)
Ambient temperature		Operating: -20°C to 85°C (with no icing or condensation)
Ambient humidity		Operating: 5% to 85%
Weight		Approx. 0.1 g

**Note:** 1. The above values are initial values.

2. Unless otherwise specified, initial values are based on a temperature of 23°C and a humidity of 65%.

\* The contact resistance was measured with 10 mA at 1 VDC with a voltage drop method.

## Typical Example of Drive Circuit for RF MEMS Switch

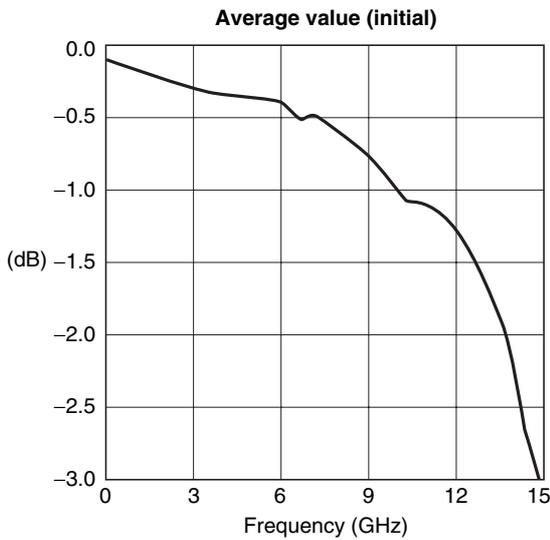


1. This Switch uses an integrated structure for the DC-GND on the input side and the RF-GND on the output side. For a relay drive circuit, first be sure to ground the GND pins and then use a high-side switch to turn the operating voltage ON and OFF.
2. This Switch uses an electrostatic drive relay. To turn OFF the relay, the charge accumulated on the primary side must be discharged. Install a discharge circuit in the relay drive circuit. The resistance value for discharge circuit must be 1 M $\Omega$  or less. If there is no discharge circuit, the relay will not turn OFF. This may result in contact sticking.
3. This Switch is designed so that the electrostatic actuator operates at a high speed. Because of this, the time constant of the drive waveform may affect the operating characteristics and life performance of the Switch. Therefore, the drive circuit must be designed so that the square wave time constant ( $\tau$ ) in the vicinity of the operating input pins (Vcont\_1 and Vcont\_2) is greater than 0.5  $\mu$ s and less than 10  $\mu$ s.

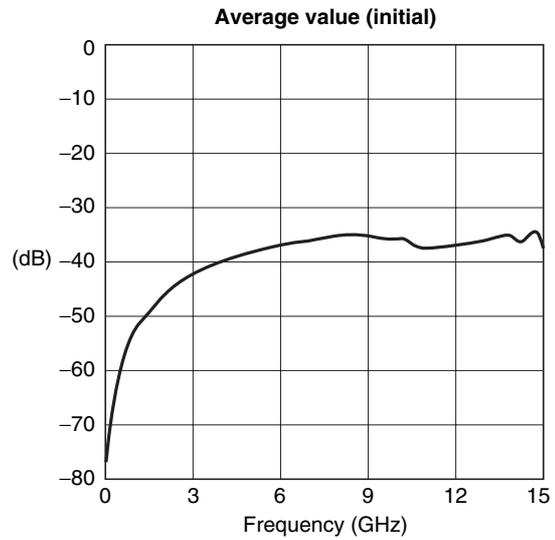
## Engineering Data (for reference)

### ■ High Frequency Characteristics

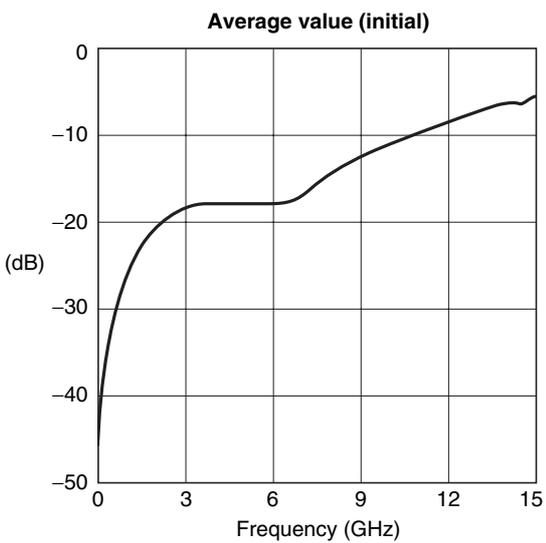
#### Insertion Loss



#### Isolation

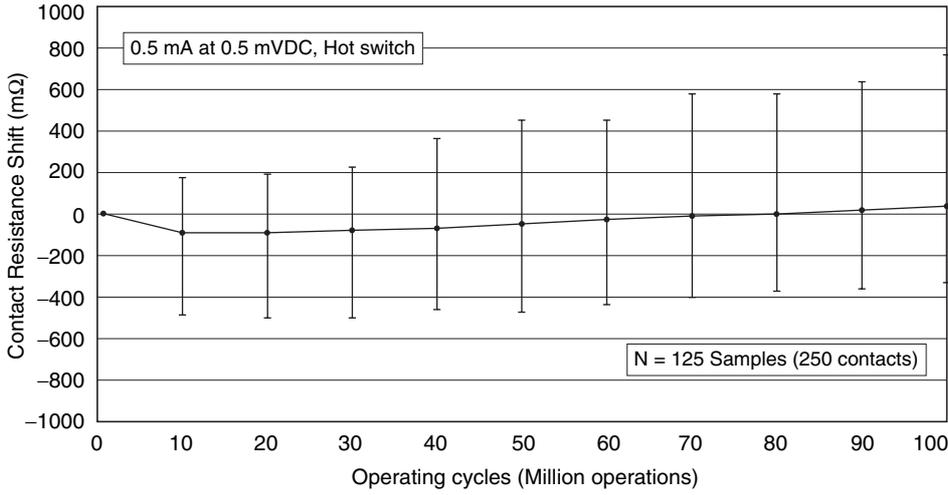


#### Return Loss

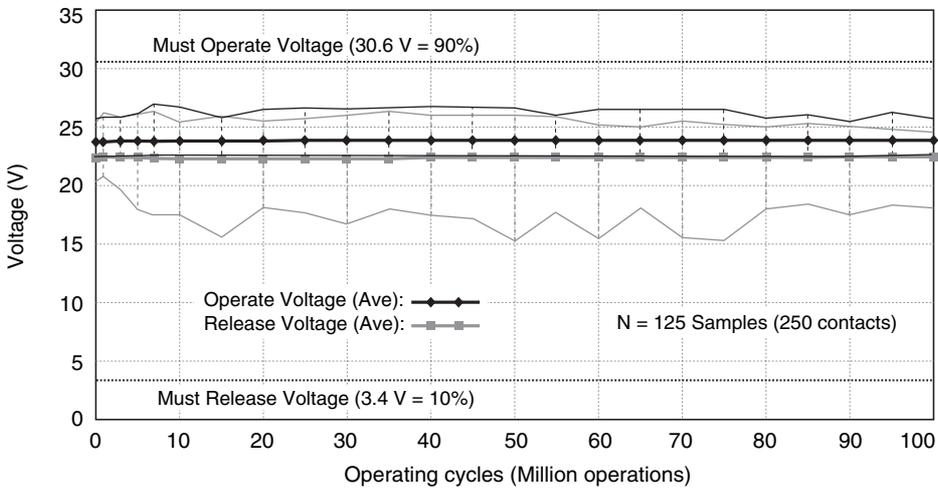


- Note:**
1. These measurement results are for an ambient temperature of 23°C.
  2. These high-frequency characteristics were measured with an RF probe (the Switch was not mounted to a PCB).
  3. These high-frequency characteristics are the initial measurement results.
  4. The high-frequency characteristics depend on the mounting board. Perform sufficient testing on the actual device, including durability tests, before actual use.

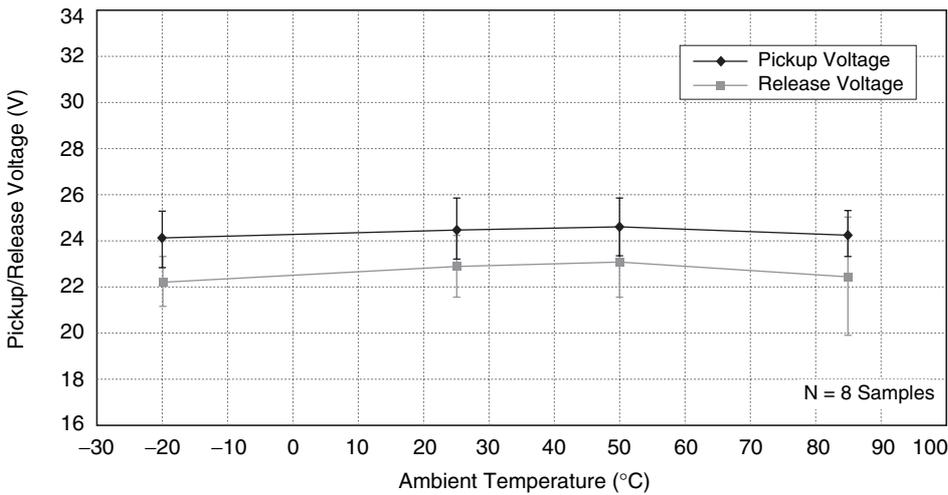
**Electrical Endurance (Contact Resistance Shift)**



**Electrical Endurance (Pickup Voltage/Release Voltage)**



**Ambient Temperature vs. Pickup voltage/Release Voltage**

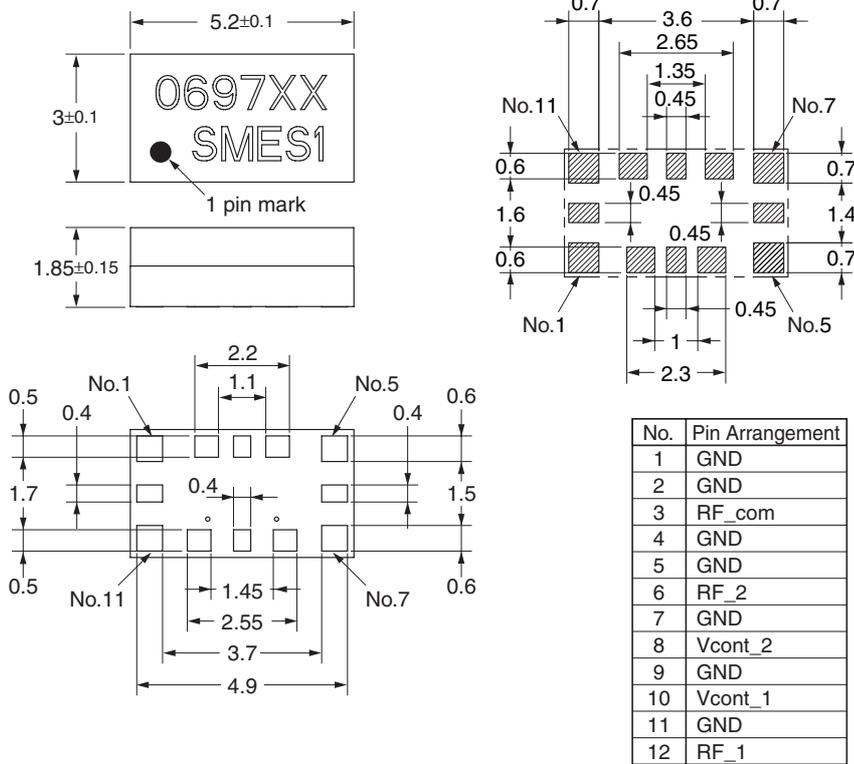


# Dimensions

**Note:** All units are in millimeters unless otherwise indicated.

## Mounting PAD Dimensions (Top View)

The dimensional tolerance for all measurements is  $\pm 0.1$  mm.

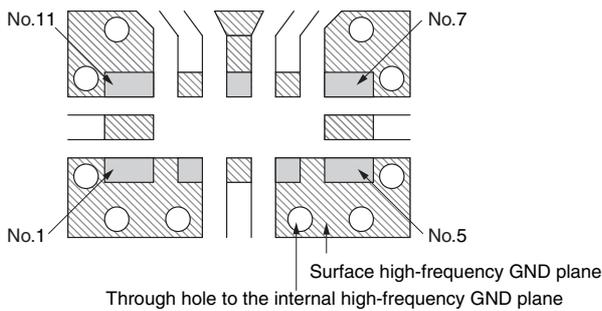


# Precautions for PCB Design

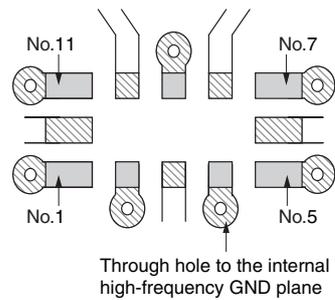
## High-frequency GND Pad and High-frequency GND Plane Connections

**Note:** indicates a high-frequency GND pad.

### In case of Coplanar Waveguide



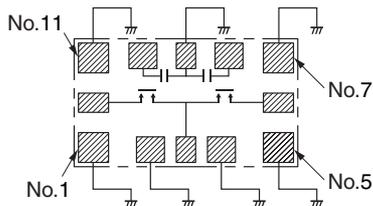
### In case of Microstrip Line



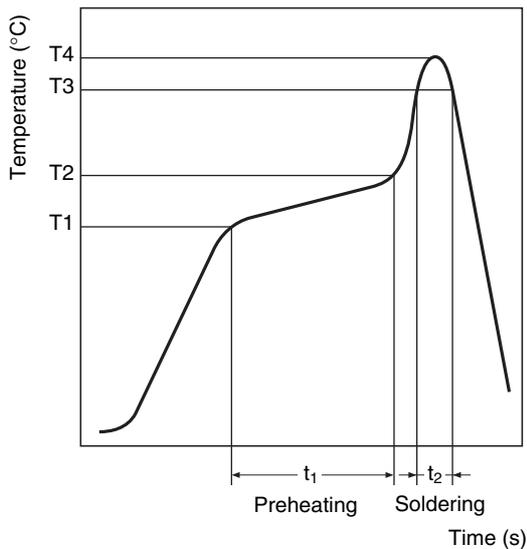
- Connect all high-frequency GND pads directly to the high-frequency GND plane.

- Connect each high-frequency GND pad to the internal high-frequency GND plane through the through holes.

### Internal Connection (Top View)



## Recommended Soldering Method



- We recommend a thickness of 150 to 200  $\mu\text{m}$  for the solder cream.
- We recommend that you use the recommended mounting PAD dimensions for the land pattern.
- IRS (Infrared Reflow Soldering) Temperature Profile Conditions During solder reflow, set the temperature conditions for the pins and top surface of the case so that they are at or below the conditions listed in the following table, and then confirm that the conditions are met on the actual device.
- Avoid rapid cooling when cleaning after solder mounting. Use an alcohol-based or water-based cleaning solution. Maintain a cleaning temperature of 60°C max.

Item	Preheating (T1 to T2, $t_1$ )	Soldering (T3, $t_2$ )	Peak value (T4)
Terminal	150°C to 180°C 120 s max.	230°C min. 30 s max.	250°C max.
Upper surface of case	---	---	255°C max.

## Safety Precautions

### Precautions for Correct Use

#### ● Handling the MEMS Switch

- Use the MEMS Switch as soon as possible and within one week after opening the moisture-proof packaging. If the MEMS Switch is left exposed for a long period of time after opening the moisture-proof packaging, this may negatively affect the external appearance and sealing performance of the Switch after it is mounted. If you must store the Switch after it has been removed from the moisture-proof packaging, place the Switch back into the moisture-proof packaging, seal the packaging with tape, and store in an environment of 10 to 30°C at 30% max. If baking is performed after the Switch is removed from the packaging again, do so at 80°C, 5% max. for 60 hours or less (one time only) and mount the switch within 72 hours after baking (MSL3).
- Avoid rapid cooling when cleaning after solder mounting. Use an alcohol-based or water-based cleaning solution. Also, maintain a cleaning temperature of 60°C max.
- Do not perform hot switching that exceeds the ratings. (The rated load is 0.5 mA at 0.5 VDC with a resistance load.)
- Do not use any ultrasonic cleaning methods.
- The MEMS Switch is extremely susceptible to static electricity. Take the necessary precautions to eliminate static electricity when handling the Switch (100 V max.). Implement measures to eliminate static electricity before you handle the MEMS Switch. Contact OMRON for additional guidelines.
- Do not drop the Switch or attempt to disassemble it.
- Do not apply force to the Switch that would result in the Switch deformation or changes in quality.

#### ● Usage, Storage, and Transportation Environments

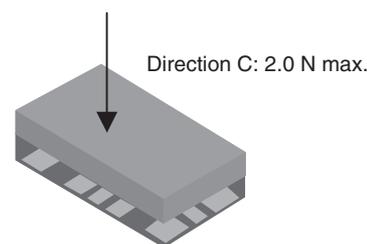
- Avoid contact with direct sunlight during use, storage, and transportation. Store the Switch at room temperature, normal humidity, and normal pressure.
- Avoid exposure to corrosive gases during usage, storage, and transportation.

#### ● Long-term Continuous ON Contacts

- Using the MEMS Switch in a circuit that is designed so that no switching is performed and current is applied to the Switch for a long period of time (more than 24 hours) may cause unstable contacts. If the MEMS Switch must be used in this kind of circuit, we recommend adding fail-safe circuits in case the contact fails.

#### ● Claw Securing Force During Automatic Mounting

- During automatic insertion of an MEMS Switch, be sure to set the securing force of each claw to the following value so that the RF MEMS Switch's characteristics will be maintained.



#### ● Precautions for Safe Usage

- Always turn OFF the power supply to the drive and load sides and conduct thorough safety checks before replacing the MEMS Switch or performing any wiring.
- Do not touch the MEMS Switch pins when power is being supplied. Doing so may result in electrical shock.

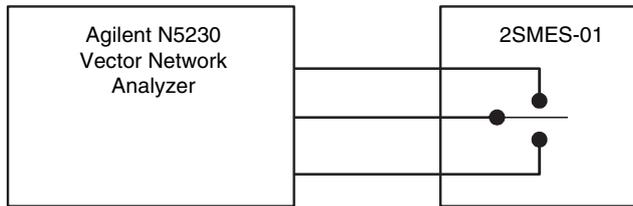
#### ● Coating

- Do not use a silicon-based coating when mounting the Switch to the PCB. Also, do not use any cleaning solutions that contain silicon when cleaning the PCB after the relay is mounted. The cleaning solution may remain as a coating on the relay surface.)

## For Reference Only

### High-frequency Characteristic Measurement Methods and Measurement PCBs

The high-frequency characteristics of the 2SMES-01 are measured as described below.

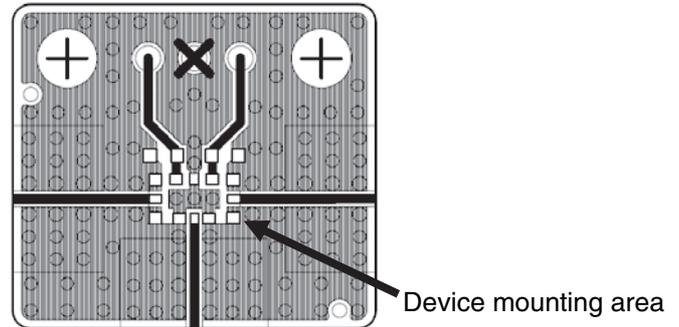


### PCB for High-frequency Evaluation

Board thickness  $t = 1.6$  mm

Material: MEGTRON6 (R5775, permittivity: 3.6)

Signal line width = 0.5 mm, Space = 0.2 mm (CPW)



**ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.**

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. A178-E1-03 **In the interest of product improvement, specifications are subject to change without notice.**

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