

## PROTECTION PRODUCTS

### Description

The SMS series of TVS arrays are designed to protect sensitive electronics from damage or latch-up due to ESD and other voltage-induced transient events. Each device will protect up to five lines. They are available with operating voltages of 5V, 12V, 15V and 24V. They are unidirectional devices and may be used on lines where the signal polarities are above ground.

TVS diodes are solid-state devices designed specifically for transient suppression. They feature large cross-sectional area junctions for conducting high transient currents. They offer desirable characteristics for board level protection including fast response time, low operating and clamping voltage and no device degradation.

The SMS series devices may be used to meet the immunity requirements of IEC 61000-4-2, level 4. The low cost SOT23-6L package makes them ideal for use in portable electronics such as cell phones, PDA's, and notebook computers.

### Features

- ◆ Transient protection for data lines to **IEC 61000-4-2 (ESD)  $\pm 15\text{kV}$  (air),  $\pm 8\text{kV}$  (contact)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ **IEC 61000-4-5 (Lightning) 24A (8/20 $\mu$ s)**
- ◆ Small package for use in portable electronics
- ◆ Protects five I/O lines
- ◆ Working voltages: 5V, 12V, 15V and 24V
- ◆ Low leakage current
- ◆ Low operating and clamping voltages
- ◆ Solid-state silicon avalanche technology

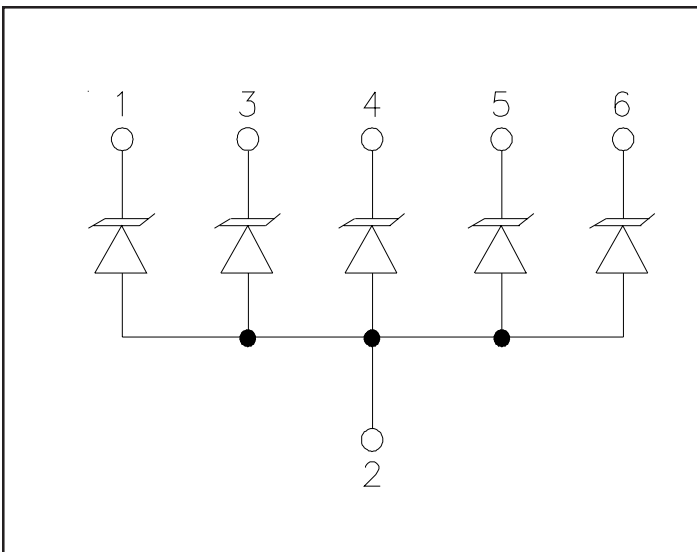
### Mechanical Characteristics

- ◆ EIAJ SOT23-6L package
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking Code
- ◆ Packaging : Tape and Reel per EIA 481

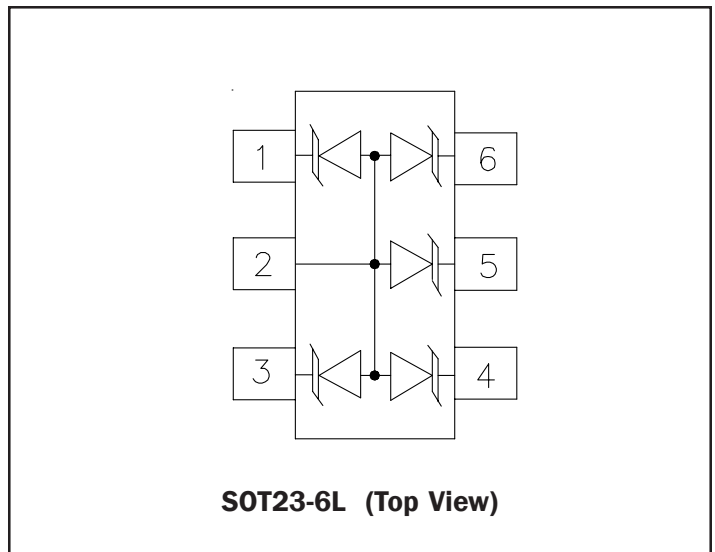
### Applications

- ◆ Cell phone Handsets and Accessories
- ◆ Microprocessor Based Equipment
- ◆ Personal Digital Assistants (PDA's)
- ◆ Notebooks, Desktops, and Servers
- ◆ Portable Instrumentation
- ◆ Set Top Box
- ◆ Peripherals
- ◆ MP3 Players
- ◆ Cordless Phones

### Circuit Diagram



### Schematic & PIN Configuration



**PROTECTION PRODUCTS**
**Absolute Maximum Rating**

| Rating   | Symbol    | Value         | Units |
|--|-----------|---------------|-------|
| Peak Pulse Power ( $t_p = 8/20\mu s$ )               | $P_{pk}$  | 300           | Watts |
| Peak Forward Voltage ( $I_F = 1A, t_p = 8/20\mu s$ ) | $V_{FP}$  | 1.5           | V     |
| Lead Soldering Temperature                           | $T_L$     | 260 (10 sec.) | °C    |
| Operating Temperature                                | $T_J$     | -55 to +125   | °C    |
| Storage Temperature                                  | $T_{STG}$ | -55 to +150   | °C    |

**Electrical Characteristics**

| <b>SMS05C</b>             |           |   |         |         |         |         |
|---------------------------|-----------|---|---------|---------|---------|---------|
| Parameter                 | Symbol    | Conditions  | Minimum | Typical | Maximum | Units   |
| Reverse Stand-Off Voltage | $V_{RWM}$ |   |         |         | 5       | V       |
| Reverse Breakdown Voltage | $V_{BR}$  | $I_t = 1mA$   | 6       |         |         | V       |
| Reverse Leakage Current   | $I_R$     | $V_{RWM} = 5V, T = 25^\circ C$                      |         |         | 20      | $\mu A$ |
| Clamping Voltage          | $V_C$     | $I_{PP} = 5A, t_p = 8/20\mu s$                      |         |         | 9.8     | V       |
| Clamping Voltage          | $V_C$     | $I_{PP} = 24A, t_p = 8/20\mu s$                     |         |         | 14.5    | V       |
| Peak Pulse Current        | $I_{PP}$  | $t_p = 8/20\mu s$                                   |         |         | 24      | A       |
| Junction Capacitance      | $C_J$     | Between I/O Pins and Ground<br>$V_R = 0V, f = 1MHz$ |         | 325     | 400     | pF      |

| <b>SMS12C</b>             |           |   |         |         |         |         |
|---------------------------|-----------|---|---------|---------|---------|---------|
| Parameter                 | Symbol    | Conditions  | Minimum | Typical | Maximum | Units   |
| Reverse Stand-Off Voltage | $V_{RWM}$ |   |         |         | 12      | V       |
| Reverse Breakdown Voltage | $V_{BR}$  | $I_t = 1mA$   | 13.3    |         |         | V       |
| Reverse Leakage Current   | $I_R$     | $V_{RWM} = 12V, T = 25^\circ C$                     |         |         | 1       | $\mu A$ |
| Clamping Voltage          | $V_C$     | $I_{PP} = 5A, t_p = 8/20\mu s$                      |         |         | 19      | V       |
| Clamping Voltage          | $V_C$     | $I_{PP} = 15A, t_p = 8/20\mu s$                     |         |         | 23      | V       |
| Peak Pulse Current        | $I_{PP}$  | $t_p = 8/20\mu s$                                   |         |         | 15      | A       |
| Junction Capacitance      | $C_J$     | Between I/O Pins and Ground<br>$V_R = 0V, f = 1MHz$ |         | 135     | 150     | pF      |

## PROTECTION PRODUCTS

### Electrical Characteristics (Continued)

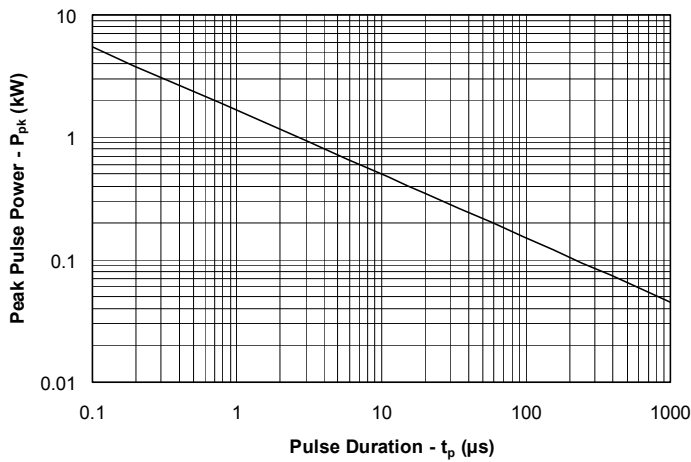
| SMS15C                    |           |   |         |         |         |         |
|---------------------------|-----------|---|---------|---------|---------|---------|
| Parameter                 | Symbol    | Conditions  | Minimum | Typical | Maximum | Units   |
| Reverse Stand-Off Voltage | $V_{RWM}$ |   |         |         | 15      | V       |
| Reverse Breakdown Voltage | $V_{BR}$  | $I_t = 1mA$   | 16.7    |         |         | V       |
| Reverse Leakage Current   | $I_R$     | $V_{RWM} = 15V, T=25^\circ C$                       |         |         | 1       | $\mu A$ |
| Clamping Voltage          | $V_C$     | $I_{PP} = 5A, t_p = 8/20\mu s$                      |         |         | 24      | V       |
| Clamping Voltage          | $V_C$     | $I_{PP} = 12A, t_p = 8/20\mu s$                     |         |         | 29      | V       |
| Peak Pulse Current        | $I_{PP}$  | $t_p = 8/20\mu s$                                   |         |         | 12      | A       |
| Junction Capacitance      | $C_J$     | Between I/O Pins and Ground<br>$V_R = 0V, f = 1MHz$ |         | 100     | 125     | pF      |

| SMS24C                    |           |   |         |         |         |         |
|---------------------------|-----------|---|---------|---------|---------|---------|
| Parameter                 | Symbol    | Conditions  | Minimum | Typical | Maximum | Units   |
| Reverse Stand-Off Voltage | $V_{RWM}$ |   |         |         | 24      | V       |
| Reverse Breakdown Voltage | $V_{BR}$  | $I_t = 1mA$   | 26.7    |         |         | V       |
| Reverse Leakage Current   | $I_R$     | $V_{RWM} = 24V, T=25^\circ C$                       |         |         | 1       | $\mu A$ |
| Clamping Voltage          | $V_C$     | $I_{PP} = 5A, t_p = 8/20\mu s$                      |         |         | 40      | V       |
| Clamping Voltage          | $V_C$     | $I_{PP} = 8A, t_p = 8/20\mu s$                      |         |         | 44      | V       |
| Peak Pulse Current        | $I_{PP}$  | $t_p = 8/20\mu s$                                   |         |         | 8       | A       |
| Junction Capacitance      | $C_J$     | Between I/O Pins and Ground<br>$V_R = 0V, f = 1MHz$ |         | 60      | 75      | pF      |

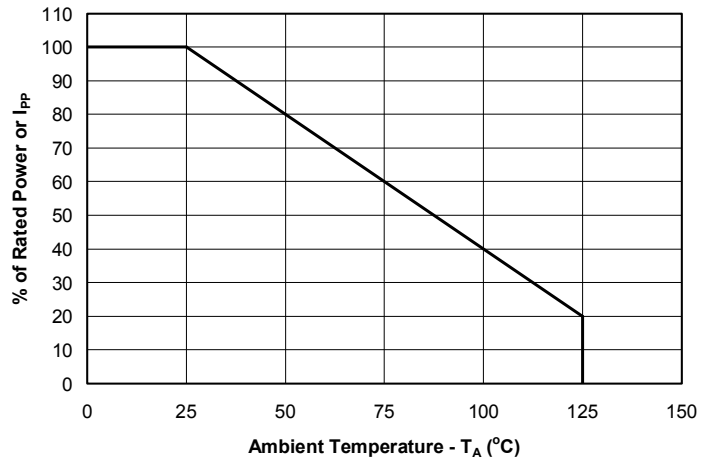
## PROTECTION PRODUCTS

### Typical Characteristics

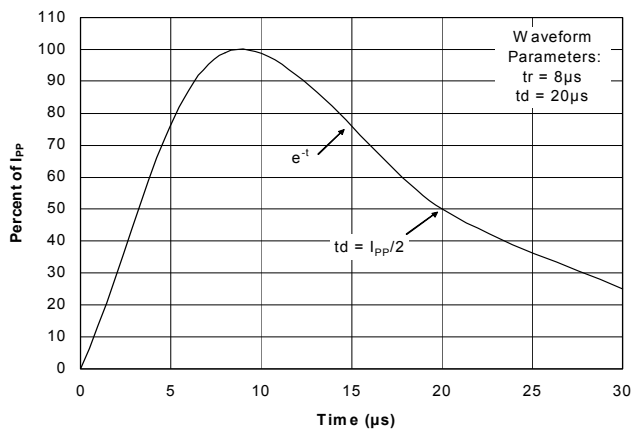
#### Non-Repetitive Peak Pulse Power vs. Pulse Time



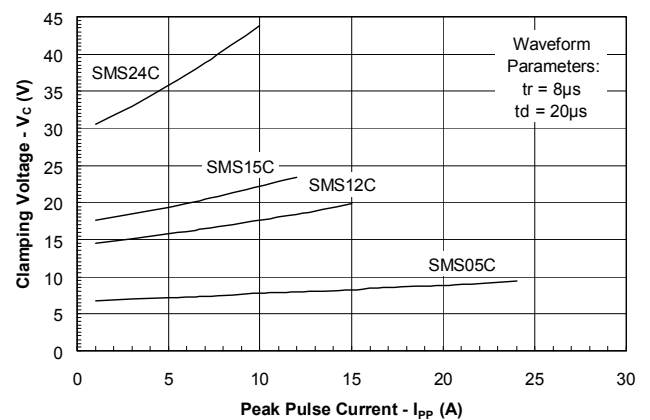
#### Power Derating Curve



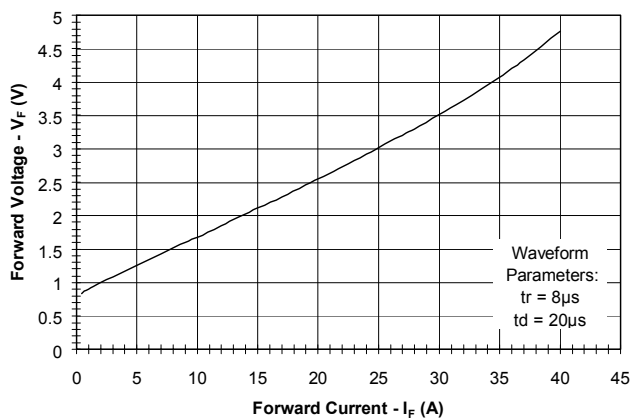
#### Pulse Waveform



#### Clamping Voltage vs. Peak Pulse Current



#### Forward Voltage vs. Forward Current



## PROTECTION PRODUCTS

### Applications Information

#### Device Connection for Protection of Five Data Lines

The SMSxxC is designed to protect up to five unidirectional data lines. The device is connected as follows:

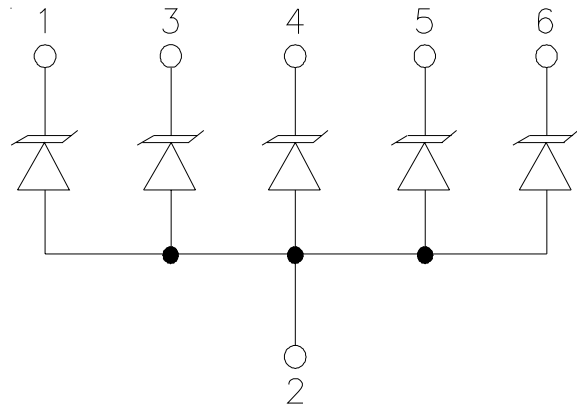
1. Unidirectional protection of five I/O lines is achieved by connecting pins 1, 3, 4, 5 and 6 to the data lines. Pin 2 is connected to ground. The ground connection should be made directly to the ground plane for best results. The path length is kept as short as possible to reduce the effects of parasitic inductance in the board traces.

#### Circuit Board Layout Recommendations for Suppression of ESD.

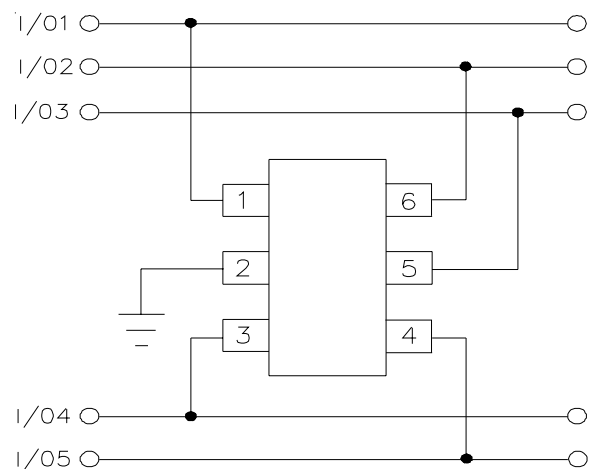
Good circuit board layout is critical for the suppression of ESD induced transients. The following guidelines are recommended:

- Place the SMSxxC near the input terminals or connectors to restrict transient coupling.
- Minimize the path length between the SMSxxC and the protected line.
- Minimize all conductive loops including power and ground loops.
- The ESD transient return path to ground should be kept as short as possible.
- Never run critical signals near board edges.
- Use ground planes whenever possible.

SMSxxC Circuit Diagram

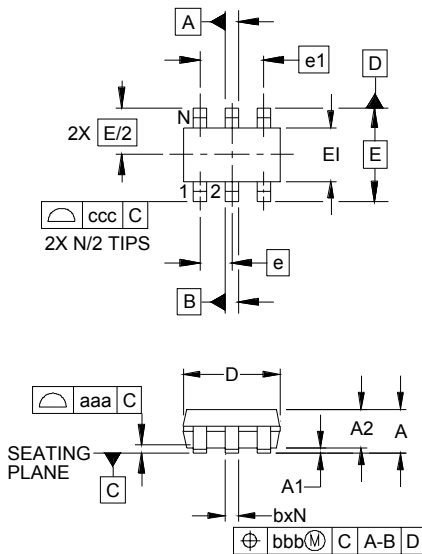


Protection of Five Unidirectional Lines



## PROTECTION PRODUCTS

### Outline Drawing

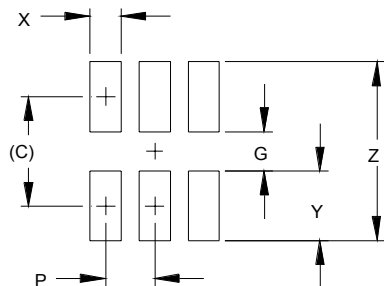


| DIM    | INCHES   |      |      | MILLIMETERS |      |      |
|--------|----------|------|------|-------------|------|------|
|        | MIN      | NOM  | MAX  | MIN         | NOM  | MAX  |
| A      | .035     | -    | .057 | 0.90        | -    | 1.45 |
| A1     | .000     | -    | .006 | 0.00        | -    | 0.15 |
| A2     | .035     | .045 | .051 | .90         | 1.15 | 1.30 |
| b      | .010     | -    | .020 | 0.25        | -    | 0.50 |
| c      | .003     | -    | .009 | 0.08        | -    | 0.22 |
| D      | .110     | .114 | .118 | 2.80        | 2.90 | 3.00 |
| E1     | .060     | .063 | .069 | 1.50        | 1.60 | 1.75 |
| E      | .110 BSC |      |      | 2.80 BSC    |      |      |
| e      | .037 BSC |      |      | 0.95 BSC    |      |      |
| e1     | .075 BSC |      |      | 1.90 BSC    |      |      |
| L      | .012     | .018 | .024 | 0.30        | 0.45 | 0.60 |
| L1     | (0.24)   |      |      | (0.60)      |      |      |
| N      | 6        |      |      | 6           |      |      |
| theta1 | 0°       | -    | 10°  | 0°          | -    | 10°  |
| aaa    | .004     |      |      | 0.10        |      |      |
| bbb    | .008     |      |      | 0.20        |      |      |
| ccc    | .008     |      |      | 0.20        |      |      |

**NOTES:**

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS **-A-** AND **-B-** TO BE DETERMINED AT DATUM PLANE **-H-**
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

### Land Pattern



| DIMENSIONS |        |             |
|------------|--------|-------------|
| DIM        | INCHES | MILLIMETERS |
| C          | (.098) | (2.50)      |
| G          | .055   | 1.40        |
| P          | .037   | 0.95        |
| X          | .024   | 0.60        |
| Y          | .043   | 1.10        |
| Z          | .141   | 3.60        |

**NOTES:**

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

## PROTECTION PRODUCTS

### Marking Codes

| Part Number | Marking Code |
|-------------|--------------|
| SMS05C      | C05          |
| SMS12C      | C12          |
| SMS15C      | C15          |
| SMS24C      | C24          |

Note:

Pin 1 Identified with a dot.

### Ordering Information

| Part Number | Working Voltage | Qty per Reel | Reel Size |
|-------------|-----------------|--------------|-----------|
| SMS05C.TC   | SnPb            | 3,000        | 7 Inch    |
| SMS12C.TC   | SnPb            | 3,000        | 7 Inch    |
| SMS15C.TC   | SnPb            | 3,000        | 7 Inch    |
| SMS24C.TC   | SnPb            | 3,000        | 7 Inch    |
| SMS05C.TCT  | Pb Free         | 3,000        | 7 Inch    |
| SMS12C.TCT  | Pb Free         | 3,000        | 7 Inch    |
| SMS15C.TCT  | Pb Free         | 3,000        | 7 Inch    |
| SMS24C.TCT  | Pb Free         | 3,000        | 7 Inch    |

Note:

(1) No suffix indicates tube pack.