

TVS Diodes

Transient Voltage Suppression Diodes

ASMC Series



Description

Transient Voltage Suppressor (TVS) is a circuit protection component that either attenuates (reduces) or filters a transient voltage spike (overvoltage), TVS diodes provide critical protection by going into avalanche breakdown within no more than a few nanoseconds after a strike, clamping the transient voltage, and routing its current to the ground.

Applications

- Communication Equipment
- Security & Protection
- Industrial Control Equipment
- Power Supply
- Automotive Electronics
- New Energy
- Lightning Protection

Functional Diagram



Uni-Directional



Bi-Directional

Features

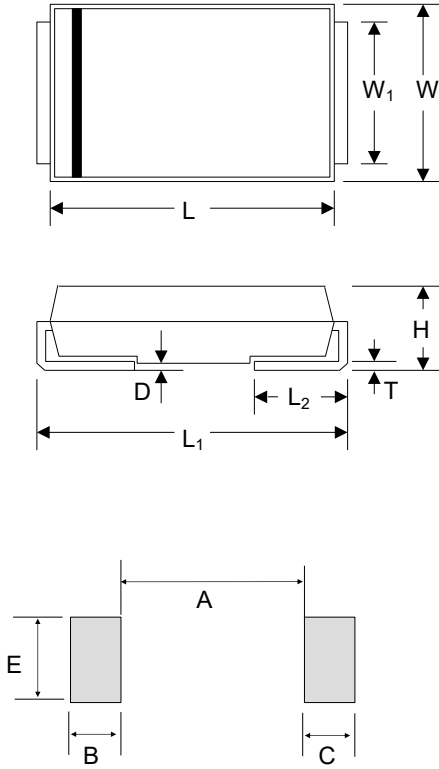
- AEC-Q101 Qualified
- Low incremental surge resistance
- Excellent clamping capability
- Low profile package with built-in strain relief
- Typical I_R less than 1.0 μA above 12 V
- 1500 W peak pulse power capability with a 10/1000 μs Waveform, repetition rate (duty cycle): 0.01%
- For surface mounted applications to optimize board space
- Typical failure mode is short from over-specified voltage or current
- IEC 61000-4-2 ESD 30 kV (Air), 30 kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Very fast response time
- Glass passivated chip junction
- High temperature to reflow soldering guaranteed: 260 $^{\circ}C/30sec$
- $V_{BR} @ T_J = V_{BR@25^{\circ}C} \times (1 + \alpha T \times (T_J - 25))$
(αT : Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Meet MSL level1, per J-STD-020
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

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Package Outline Dimensions (DO-214AB)



Mounting Pad Layout

| Symbol | Millimeters | | Inches | |
|----------------|-------------|-------|--------|-------|
| | Min. | Max. | Min. | Max. |
| L | 6.60 | 7.11 | 0.260 | 0.280 |
| W | 5.59 | 6.22 | 0.220 | 0.245 |
| W ₁ | 2.90 | 3.20 | 0.114 | 0.126 |
| H | 2.06 | 2.62 | 0.079 | 0.103 |
| T | 0.152 | 0.305 | 0.006 | 0.012 |
| L ₁ | 7.75 | 8.13 | 0.305 | 0.320 |
| L ₂ | 0.76 | 1.52 | 0.030 | 0.060 |
| D | - | 0.203 | - | 0.008 |
| A | - | 4.20 | - | 0.165 |
| B | 2.40 | - | 0.094 | - |
| C | 2.40 | - | 0.094 | - |
| E | 3.30 | - | 0.129 | - |

Maximum Ratings and Characteristics

(Ratings at 25 °C ambient temperature unless otherwise specified.)

| Parameter | Symbol | Value | Unit |
|---|------------------------------------|------------|--------|
| Peak Pulse Power Dissipation (Fig.2)- with a 10/1000 μ s Test waveform ⁽¹⁾⁽²⁾ (Fig.4)-Single Die Parts | P _{PPM} | 1500 | W |
| Peak Pulse Power Dissipation (Fig.2)- with a 10/1000 μ s Test waveform ⁽¹⁾⁽²⁾ (Fig.4)-Stacked Die Parts ⁽⁵⁾ | P _{PPM} | 2000 | W |
| Peak Power Dissipation on Infinite Heat Sink at T _L =50 °C | P _D | 6.5 | W |
| Peak Forward Surge Current,8.3ms single half sinewave superimposed on rated load (JEDEC Method) ⁽³⁾ | I _{FSM} | 200 | A |
| Maximum Instantaneous Forward Voltage at 100 A for Unidirectional Only ⁽⁴⁾ | V _F | 3.5/5.0 | V |
| Operating Temperature Range | T _J | -65 to 150 | °C |
| Storage Temperature Range | T _{STG} | -65 to 175 | °C |
| Typical Thermal Resistance Junction to Lead | R _{θJL} | 15 | °C / W |
| Typical Thermal Resistance Junction to Ambient | R _{θJA} | 75 | °C / W |

Notes:

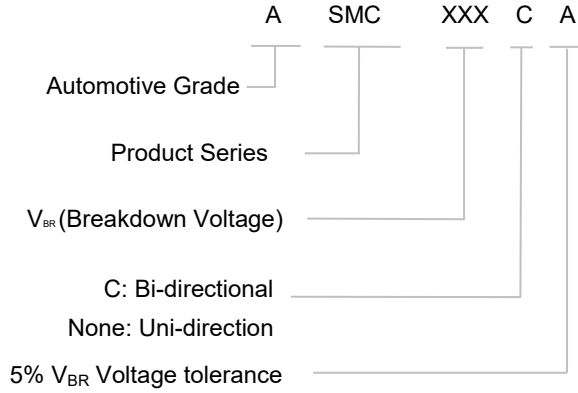
1. Non-repetitive current pulse, per Fig. 4 and derated above T_J(initial)=25 °C per Fig. 3.
2. Mounted on 8.0 mm² (.013 mm thick) land areas.
3. Measured of 8.3 ms single half sine-wave or equivalent square wave, duty cycle=4 pulses per minute maximum.
4. V_F < 3.5 V for single die parts and V_F < 5.0V for stacked-die parts.
5. For stacked die component details, please refer to models marked with * in electrical characteristics table.

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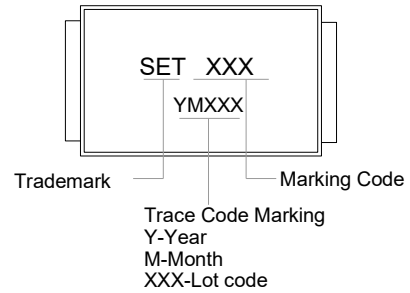
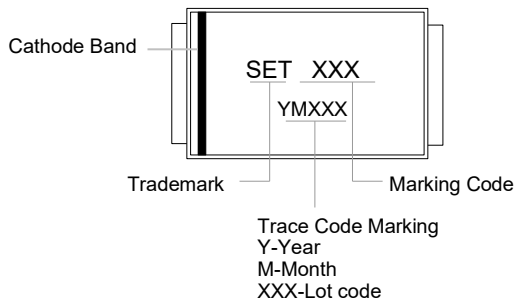
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ASMC Series

Part Numbering System



Marking



TVS Diodes

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Electrical Characteristics (T_A=25 °C unless otherwise noted)Table 1

| Part Number | | Device Marking Code | | Breakdown Voltage V _{BR} @I _T | | Test Current I _T | Reverse Stand-off Voltage V _R | Max. Reverse Leakage I _R @V _R | Max. Peak Pulse Current I _{PPM} | Max. Clamping Voltage V _C @I _{PPM} |
|-------------|-----------|---------------------|-------|---|-------|-----------------------------|--|---|--|--|
| | | | | Min | Max | | | | | |
| Uni | Bi | Uni | Bi | (V) | | (mA) | (V) | (μA) | (A) | (V) |
| ASMC6.8A | ASMC6.8CA | A6V8A | A6V8C | 6.45 | 7.14 | 10 | 5.80 | 600.00 | 144.80 | 10.50 |
| ASMC7.5A | ASMC7.5CA | A7V5A | A7V5C | 7.13 | 7.88 | 10 | 6.40 | 300.00 | 134.50 | 11.30 |
| ASMC8.2A | ASMC8.2CA | A8V2A | A8V2C | 7.79 | 8.61 | 10 | 7.02 | 200.00 | 125.60 | 12.10 |
| ASMC9.1A | ASMC9.1CA | A9V1A | A9V1C | 8.65 | 9.50 | 1 | 7.78 | 50.00 | 113.40 | 13.40 |
| ASMC10A | ASMC10CA | A10A | A10C | 9.50 | 10.50 | 1 | 8.55 | 10.00 | 104.80 | 14.50 |
| ASMC11A | ASMC11CA | A11A | A11C | 10.50 | 11.60 | 1 | 9.40 | 5.00 | 97.40 | 15.60 |
| ASMC12A | ASMC12CA | A12A | A12C | 11.40 | 12.60 | 1 | 10.20 | 5.00 | 91.00 | 16.70 |
| ASMC13A | ASMC13CA | A13A | A13C | 12.40 | 13.70 | 1 | 11.10 | 1.00 | 83.50 | 18.20 |
| ASMC15A | ASMC15CA | A15A | A15C | 14.30 | 15.80 | 1 | 12.80 | 1.00 | 71.70 | 21.20 |
| ASMC16A | ASMC16CA | A16A | A16C | 15.20 | 16.80 | 1 | 13.60 | 1.00 | 67.60 | 22.50 |
| ASMC18A | ASMC18CA | A18A | A18C | 17.10 | 18.90 | 1 | 15.30 | 1.00 | 60.30 | 25.20 |
| ASMC20A | ASMC20CA | A20A | A20C | 19.00 | 21.00 | 1 | 17.10 | 1.00 | 54.90 | 27.70 |
| ASMC22A | ASMC22CA | A22A | A22C | 20.90 | 23.10 | 1 | 18.80 | 1.00 | 49.70 | 30.60 |
| ASMC24A | ASMC24CA | A24A | A24C | 22.80 | 25.20 | 1 | 20.50 | 1.00 | 45.80 | 33.20 |
| ASMC27A | ASMC27CA | A27A | A27C | 25.70 | 28.40 | 1 | 23.10 | 1.00 | 40.50 | 37.50 |
| ASMC30A | ASMC30CA | A30A | A30C | 28.50 | 31.50 | 1 | 25.60 | 1.00 | 36.70 | 41.40 |
| ASMC33A | ASMC33CA | A33A | A33C | 31.40 | 34.70 | 1 | 28.20 | 1.00 | 33.30 | 45.70 |
| ASMC36A | ASMC36CA | A36A | A36C | 34.20 | 37.80 | 1 | 30.80 | 1.00 | 30.50 | 49.90 |
| ASMC39A | ASMC39CA | A39A | A39C | 37.10 | 41.00 | 1 | 33.30 | 1.00 | 28.20 | 53.90 |
| ASMC43A | ASMC43CA | A43A | A43C | 40.90 | 45.20 | 1 | 36.80 | 1.00 | 25.60 | 59.30 |
| ASMC47A | ASMC47CA | A47A | A47C | 44.70 | 49.40 | 1 | 40.20 | 1.00 | 23.50 | 64.80 |
| ASMC51A | ASMC51CA | A51A | A51C | 48.50 | 53.60 | 1 | 43.60 | 1.00 | 21.70 | 70.10 |
| ASMC56A | ASMC56CA | A56A | A56C | 53.20 | 58.80 | 1 | 47.80 | 1.00 | 19.70 | 77.00 |
| ASMC62A | ASMC62CA | A62A | A62C | 58.90 | 65.10 | 1 | 53.00 | 1.00 | 17.90 | 85.00 |
| ASMC68A | ASMC68CA | A68A | A68C | 64.60 | 71.40 | 1 | 58.10 | 1.00 | 16.50 | 92.00 |

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| Part Number | | Device Marking Code | | Breakdown Voltage $V_{BR}@I_T$ | | Test Current I_T | Reverse Stand-off Voltage V_R | Max. Reverse Leakage $I_R@V_R$ | Max. Peak Pulse Current I_{PPM} | Max. Clamping Voltage $V_C@I_{PPM}$ |
|-------------|------------|---------------------|-------|--------------------------------|--------|--------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|
| | | | | Min | Max | | | | | |
| Uni | Bi | Uni | Bi | (V) | | (mA) | (V) | (μ A) | (A) | (V) |
| ASMC75A | ASMC75CA | A75A | A75C | 71.30 | 78.80 | 1 | 64.10 | 1.00 | 14.80 | 103.00 |
| ASMC82A | ASMC82CA | A82A | A82C | 77.90 | 86.10 | 1 | 70.10 | 1.00 | 13.50 | 113.00 |
| ASMC91A | ASMC91CA | A91A | A91C | 86.50 | 95.50 | 1 | 77.80 | 1.00 | 12.20 | 125.00 |
| ASMC100A | ASMC100CA | A100A | A100C | 95.00 | 105.00 | 1 | 85.50 | 1.00 | 11.10 | 137.00 |
| ASMC110A | ASMC110CA | A110A | A110C | 105.00 | 116.00 | 1 | 94.00 | 1.00 | 10.00 | 152.00 |
| ASMC120A | ASMC120CA | A120A | A120C | 114.00 | 126.00 | 1 | 102.00 | 1.00 | 9.20 | 165.00 |
| ASMC130A | ASMC130CA | A130A | A130C | 124.00 | 137.00 | 1 | 111.00 | 1.00 | 8.50 | 179.00 |
| ASMC150A | ASMC150CA | A150A | A150C | 143.00 | 158.00 | 1 | 128.00 | 1.00 | 7.30 | 207.00 |
| ASMC160A | ASMC160CA | A160A | A160C | 152.00 | 168.00 | 1 | 136.00 | 1.00 | 6.90 | 219.00 |
| ASMC170A | ASMC170CA | A170A | A170C | 162.00 | 179.00 | 1 | 145.00 | 1.00 | 6.50 | 234.00 |
| ASMC180A | ASMC180CA | A180A | A180C | 171.00 | 189.00 | 1 | 154.00 | 1.00 | 6.20 | 246.00 |
| ASMC200A | ASMC200CA | A200A | A200C | 190.00 | 210.00 | 1 | 171.00 | 1.00 | 5.50 | 274.00 |
| ASMC220A | ASMC220CA | A220A | A220C | 209.00 | 231.00 | 1 | 185.00 | 1.00 | 4.60 | 328.00 |
| ASMC250A | ASMC250CA | A250A | A250C | 237.00 | 263.00 | 1 | 214.00 | 1.00 | 4.40 | 344.00 |
| ASMC300A | ASMC300CA | A300A | A300C | 285.00 | 315.00 | 1 | 256.00 | 1.00 | 3.70 | 414.00 |
| ASMC350A* | ASMC350CA* | A350A | A350C | 332.00 | 368.00 | 1 | 300.00 | 1.00 | 3.20 | 482.00 |
| ASMC400A* | ASMC400CA* | A400A | A400C | 380.00 | 420.00 | 1 | 342.00 | 1.00 | 2.50 | 548.00 |
| ASMC440A* | ASMC440CA* | A440A | A440C | 418.00 | 462.00 | 1 | 376.00 | 1.00 | 2.30 | 602.00 |
| ASMC480A* | ASMC480CA* | A480A | A480C | 456.00 | 504.00 | 1 | 408.00 | 1.00 | 3.10 | 658.00 |
| ASMC510A* | ASMC510CA* | A510A | A510C | 485.00 | 535.00 | 1 | 434.00 | 1.00 | 2.10 | 698.00 |
| ASMC530A* | ASMC530CA* | A530A | A530C | 503.50 | 556.50 | 1 | 451.00 | 1.00 | 2.10 | 725.00 |
| ASMC540A* | ASMC540CA* | A540A | A540C | 513.00 | 567.00 | 1 | 460.00 | 1.00 | 2.00 | 740.00 |
| ASMC550A* | ASMC550CA* | A550A | A550C | 522.50 | 577.50 | 1 | 468.00 | 1.00 | 2.00 | 760.00 |
| ASMC600A* | ASMC600CA* | A600A | A600C | 570.00 | 630.00 | 1 | 512.00 | 1.00 | 1.80 | 828.00 |

Notes:

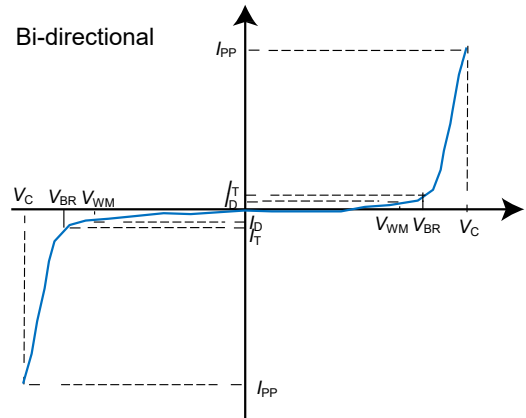
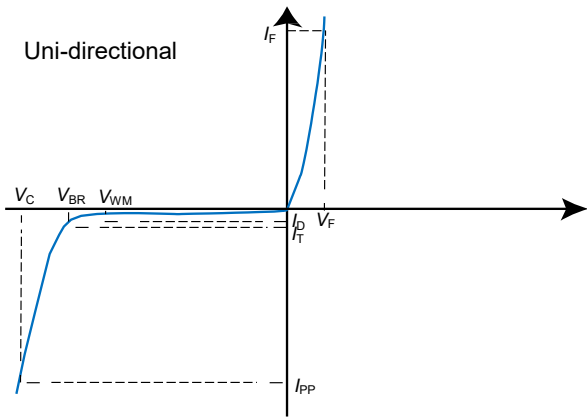
- For bidirectional type having V_R of 10 volts and less, the I_R should be doubled.
- For parts without A in the PN, the V_{BR} tolerance is $\pm 10\%$ and V_C is 5% higher than parts with A. The parts without A are currently available, but not recommended for new designs. The parts with A are preferred.
- For stacked die component details, please refer to models marked with * in electrical characteristics table.

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I-V Curve Characteristics



Performance Curve for Reference ($T_A=25^\circ\text{C}$ unless otherwise noted)

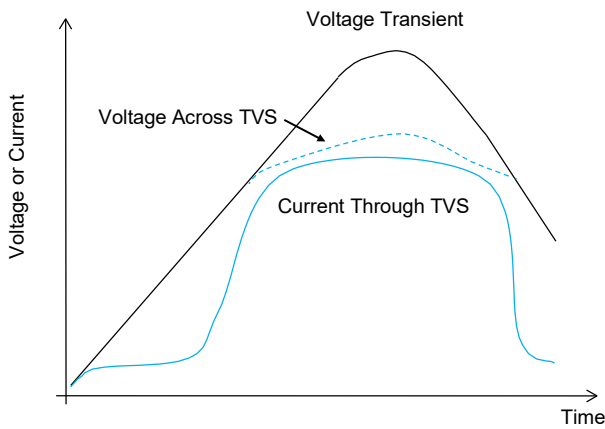


FIGURE 1 TVS Transients Clamping Waveform

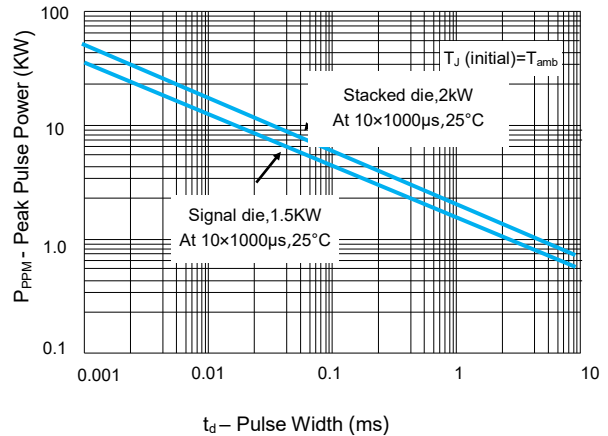


FIGURE 2 Peak Pulse Power Rating Curve

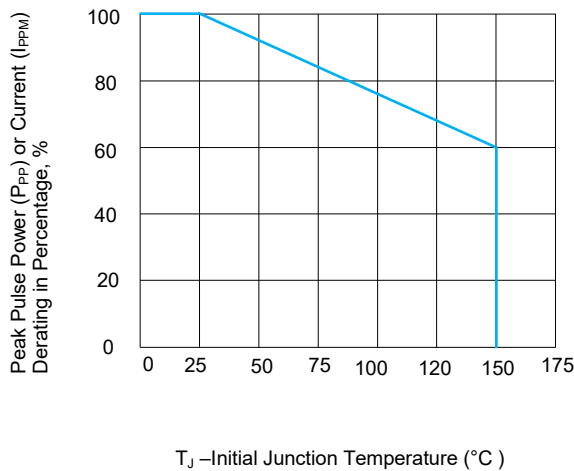


FIGURE 3 Peak Pulse Power Derating Curve

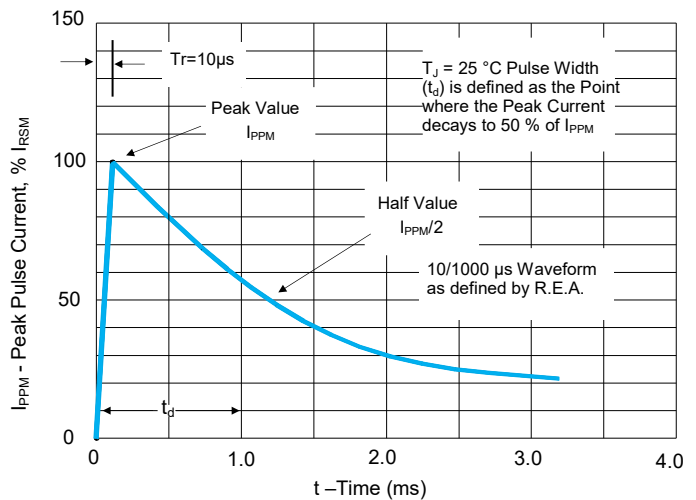


FIGURE 4 Pulse Waveform

TVS Diodes

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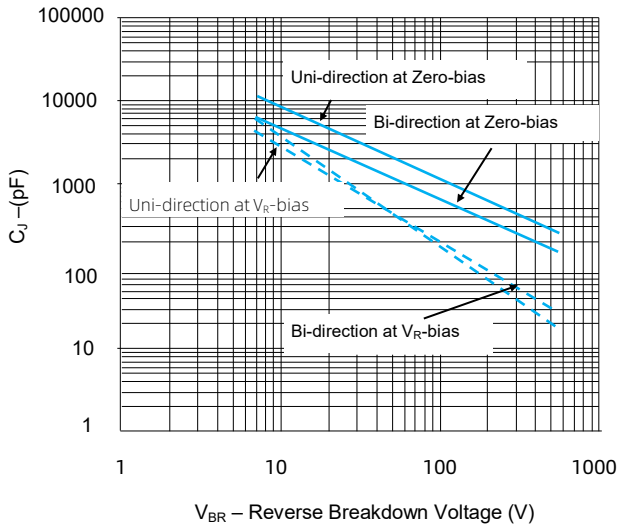


FIGURE 5 Typical Junction Capacitance

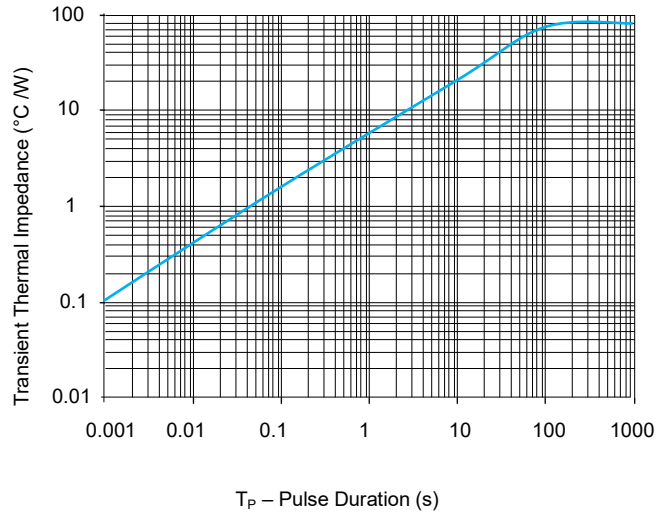


FIGURE 6 Typical Transient Thermal Impedance

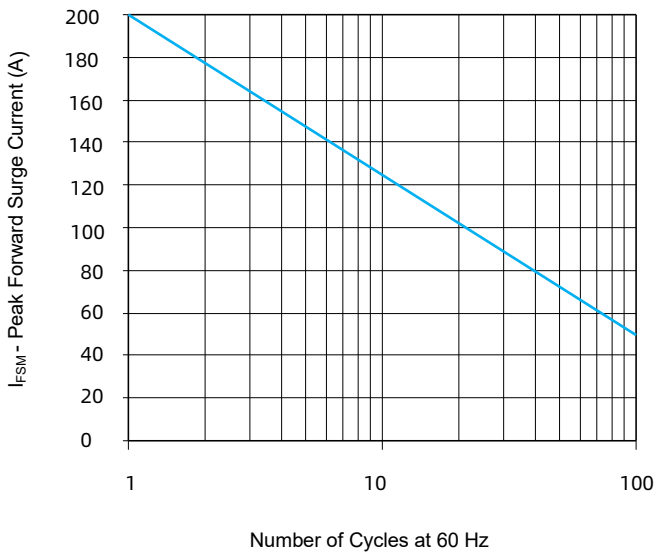


FIGURE 7 Maximum Non-Repetitive Forward Surge Current Uni-Directional only

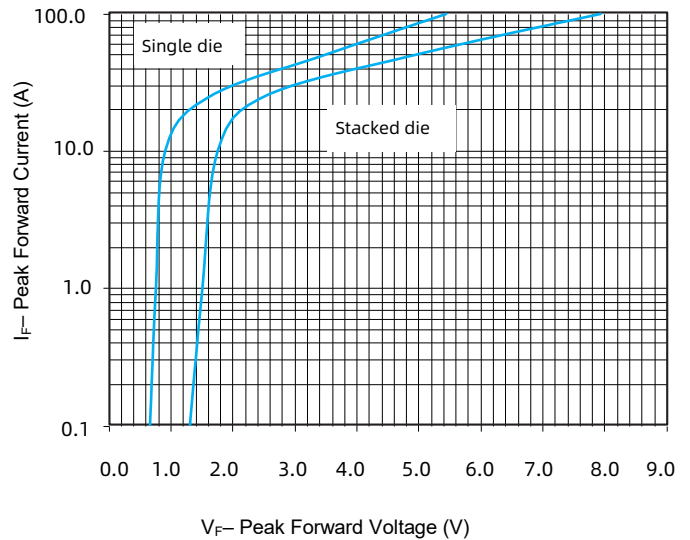


FIGURE 8 Peak Forward Drop vs Peak Forward Current (Typical Values)

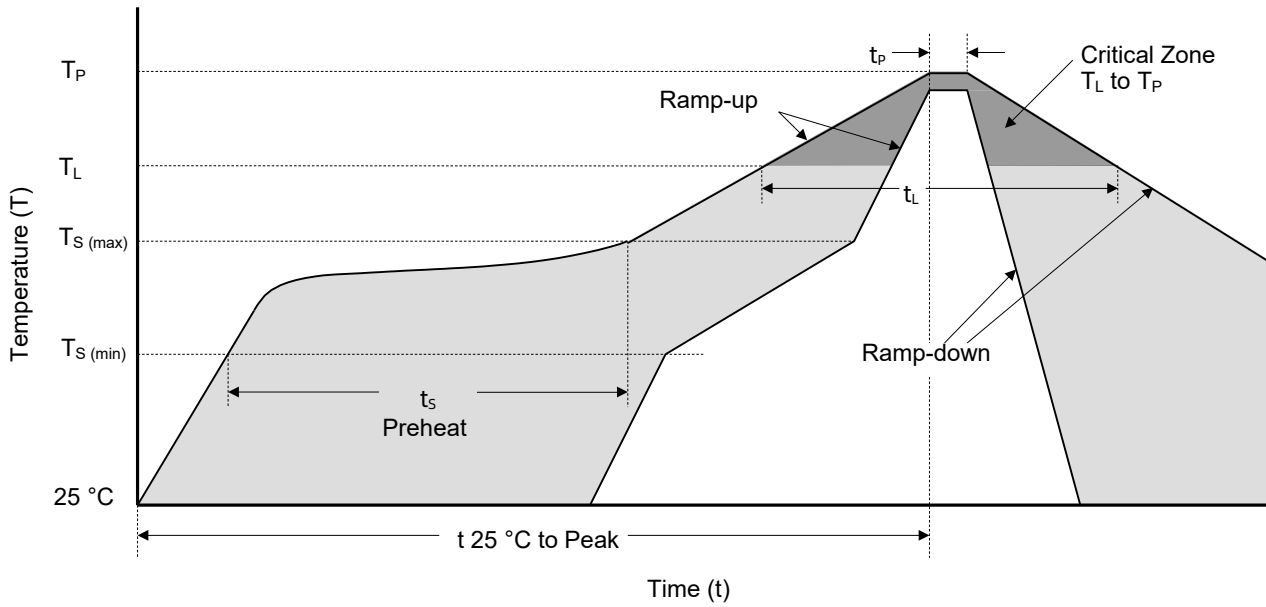
Environmental Specifications

| | |
|---------------------|---------------------------|
| High Temp. Storage | JESD22-A103 |
| HTRB | JESD22-A108 |
| Temperature Cycling | JESD22-A104 |
| MSL | JESDEC-J-STD-020, Level 1 |
| H3TRB | JESD22-A101 |
| RSH | JESD22-A111 |

Physical Specifications

| | |
|----------|---|
| Weight | 0.007 ounce, 0.21 grams |
| Case | JESD22D0214AB. Molded plastic body over glass passivated junction |
| Polarity | Color band denotes positive end (cathode) except Bidirectional |
| Terminal | Matte Tin-plated leads, Solderability per JESD22-B102 |

Soldering Parameters



Reflowing Condition

| Reflow Soldering Parameters | | Lead-Free Assembly |
|--|-----------------------------------|-------------------------|
| Pre-heat | Temperature Min ($T_{S (min)}$) | 150 °C |
| | Temperature Max ($T_{S (max)}$) | 200 °C |
| | Time (min to max) (t_s) | 60 ~ 120 seconds |
| Average Ramp Up Rate (Liquidus Temp (T_L) to Peak) | | 3 °C / second max. |
| $T_{S (max)}$ to T_L Ramp-up Rate | | 3 °C / second max. |
| Reflow | Temperature (T_L) (Liquidus) | 217 °C |
| | Time (min to max) (t_L) | 60 ~ 150 seconds |
| Peak Temperature (T_P) | | 260 ^{+0/-5} °C |
| Time of within 5 °C of Actual Peak Temperature (t_p) | | 20 ~ 40 seconds |
| Ramp-down Rate | | 6 °C / second max. |
| Time from 25 °C to Peak Temperature | | 8 Minutes max. |
| Do Not Exceed | | 260 °C |

Packaging Information

| Tape | Symbol | Dimension (mm) |
|------|----------------|---------------------|
| | W | 16.0 + 0.30 / -0.10 |
| | P ₀ | 4.00 ± 0.10 |
| | P ₁ | 8.00 ± 0.10 |
| | P ₂ | 2.00 ± 0.10 |
| | D ₀ | 1.55 ± 0.05 |
| | D ₁ | 1.55 ± 0.05 |
| | E | 1.75 ± 0.10 |
| | F | 7.50 ± 0.10 |
| | A ₀ | 6.15 ± 0.10 |
| | B ₀ | 8.30 ± 0.10 |
| | K ₀ | 2.48 ± 0.10 |
| | T | 0.30 ± 0.05 |

| Reel Size | 13" Reel | |
|-----------|----------------|---------|
| | A | 330 mm |
| | C | 13.2 mm |
| | W ₁ | 16.4 mm |

| Part Number | Package | QTY (Reel) | Packaging Option | Packaging Specification |
|-------------|----------|------------|-----------------------------------|-------------------------|
| ASMCxxx | DO-214AB | 3000 PCS | Tape & Reel – 16 mm tape/13" reel | EIA STD RS-481 |

Glossary

| Item | Description |
|------------------|--|
| V_C | Clamping Voltage Voltage across TVS in a region of low differential resistance that serves to limit the voltage across the device terminals. |
| V_R | Reverse Stand-off Voltage Maximum voltage that can be applied to the TVS without operation. NOTE : It is also shown as V_{WM} (maximum working voltage (maximum d.c. voltage)) and known as rated stand-off voltage (V_{SO}). |
| I_R | Reverse Leakage Current Current measured at V_R . NOTE : Also shown as I_D for stand-by current. |
| V_{BR} | Breakdown Voltage Voltage across TVS at a specified current I_T in the breakdown region. |
| I_{PPM} | Rated Random Recurring Peak Impulse Current Maximum-rated value of random recurring peak impulse current that may be applied to a device. |
| $P_{M(AV)}$ | Rated Average Power Dissipation Maximum-rated value of power dissipation resulting from all sources, including transients and standby current, averaged over a short period of time. |
| P_{PPM} | Rated Random Recurring Peak Impulse Power Dissipation Maximum-rated value of the product of rated random recurring peak impulse current (I_{PPM}) multiplies by specified maximum clamping voltage (V_C). |
| C_J | Capacitance Capacitance across the TVS measured at a specified frequency and voltage. |
| V_{FS} | Peak Forward Surge Voltage Peak voltage across an TVS for a specified forward surge current (I_{FS}) and time duration. NOTE : Also shown as V_F . |
| I_{FS} | Forward Surge Current Pulsed current through TVS in the forward conducting region. NOTE : Also shown as I_F . |
| $\alpha_{V(BR)}$ | Temperature Coefficient of Breakdown Voltage The change of breakdown voltage divided by the change of temperature. |
| I_{PP} | Peak pulse Current Peak pulse current value applied across the TVS to determine the clamping voltage V_C for a specified wave shape. |
| I_T | Pulsed D.C. Test Current Test current for measurement of the breakdown voltage V_{BR} . This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms. NOTE : Also shown as I_{BR} . |

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)



ATTENTION

Usage

1. TVS must be operated in the specified ambient temp.
2. Do not clean the TVS with strong polar solvent such as ketone, esters, benzene and halogenated hydrocarbon, to avoid damaging the encapsulating layer.
3. Please do not apply severe vibration, shock or pressure to TVS, to avoid element cracking.

Replacement

1. If TVS is visually damaged, please replace it.
2. TVS is a non-repairable product. For safety sake, please use equivalent TVS for replacement.

Storage

1. Storage Temp. Range: (-55 to 150) °C.
2. Do not store the TVS at the high temp., high humidity or corrosive gas environment, to avoid influencing the solder-ability of the lead wires. The product shall be used up within 1 year after receiving the goods.

Environmental Conditions

1. TVS should not be exposed to the open air, nor direct sunshine.
2. TVS should avoid rain, water vapor or other condition of high temp. and high humidity.
3. TVS should avoid sand dust, salt mist, or other harmful gases.

Max. Typical Capacitance of TVS

The typical capacitance of TVS is listed in the specifications. Designers may refer to it when designing TVS in High frequency circuit.

Installation Mechanical Stress

1. Do not knock TVS when installing, to avoid mechanical damage.
2. Please do not apply severe vibration, shock or pressure to TVS, to avoid surface resin or element cracking.

Automotive TVS Diodes (Surface Mount) Feature Overview

| Package Type | Series | | | | | | | | | | | | | |
|---|-------------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-------------|-------------|-------------|-------------|-------------|----------|
| | DO-214AA | DO-214AB | DO-214AC | DO-218AB | ASMB | ASMB-VR | ASMC | ASMC-VR | ASMD | A5.0SMD | SM8SxxA | SM8SxxCA | SM8TxxA | SM8TxxCA |
| Product Outline (mm) | | | | | | | | | | | | | | |
| V_R / V_{WM} (V) Reverse Stand-off Voltage | 5.8 ~ 468 | 5.0 ~ 440 | 5.8 ~ 553 | 5.0 ~ 440 | 5.8 ~ 553 | 5.0 ~ 440 | 5.8 ~ 51 | 5.0 ~ 440 | 12.0 ~ 170 | 10.0 ~ 43.0 | 12.0 ~ 43.0 | 20.0 ~ 43.0 | 33.0 ~ 36.0 | |
| P_{PPM} (W) (10/1000 μ s) Rated Peak Impulse Power Dissipation | 400 | 600 | 1500 | 3000 | 5000 | 6600 | 8000 | | | | | | | |
| Operating Temperature (°C) | -55 to +150 | | | | | | | | -55 to +175 | | | | | |