

FEATURES

- Superior upgrade for MAX811/MAX812**
- Specified over temperature**
- Low power consumption: 5 μ A typical**
- Precision voltage monitor: 2.5 V, 3 V, 3.3 V, 5 V options**
- Reset assertion down to 1 V_{CC}**
- Power-on reset: 140 ms minimum**
- Logic low $\overline{\text{RESET}}$ output (ADM811)**
- Logic high RESET output (ADM812)**
- Built-in manual reset**

APPLICATIONS

- Microprocessor systems**
- Controllers**
- Intelligent instruments**
- Automotive systems**
- Safety systems**
- Portable instruments**

GENERAL DESCRIPTION

The ADM811/ADM812 are reliable voltage monitoring devices suitable for use in most voltage monitoring applications. The ADM811/ADM812 are designed to monitor six different voltages, each allowing a 5% or 10% degradation of standard PSU voltages before a reset occurs. These voltages have been selected for the effective monitoring of 2.5 V, 3 V, 3.3 V, and 5 V supply voltage levels.

Included in this circuit is a debounced manual reset input. Reset can be activated using an electrical switch (or an input from another digital device) or by a degradation of the supply voltage. The manual reset function is very useful, especially if the circuit in which the ADM811/ADM812 are operating enters into a state that can only be detected by the user. Allowing the user to reset a system manually can reduce the damage or danger that could otherwise be caused by an out-of-control or locked system.

FUNCTIONAL BLOCK DIAGRAM

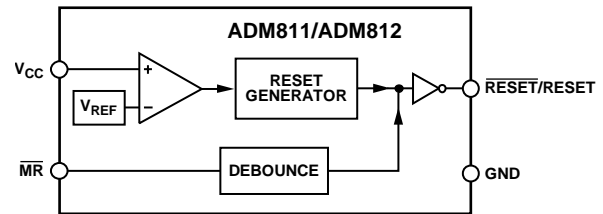


Figure 1.

00082-001

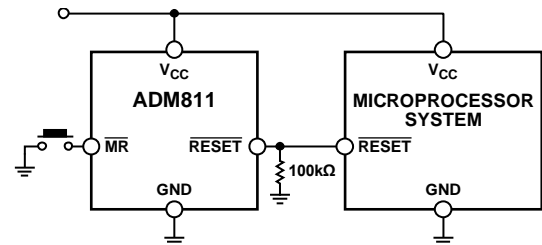


Figure 2. Typical ADM811 Operating Circuit

00082-002

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REVISION HISTORY

3/13—Rev. F to Rev. G

| | |
|---|----|
| Changes to Pin 4 Description; Table 3 | 5 |
| Updated Outline Dimensions | 9 |
| Changes to Ordering Guide | 10 |

8/09—Rev. E to Rev. F

| | |
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| Changes to Ordering Guide | 10 |
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5/08—Rev. D to Rev. E

| | |
|------------------------------------|----|
| Changes to Table 2..... | 4 |
| Changes to Outline Dimensions..... | 9 |
| Changes to Ordering Guide | 10 |

5/06—Rev. C to Rev. D

| | |
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| Changes to Ordering Guide | 9 |
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2/03—Rev. B to Rev. C

| | |
|---|---|
| Changes Features | 1 |
| Changes to General Description | 1 |
| Changes to Specifications | 2 |
| Removed Note 2 from Ordering Guide..... | 3 |
| Changes to Pin Function Descriptions..... | 4 |
| Removed Note from Table I | 6 |

1/03—Rev. A to Rev. B

| | |
|---|-----------|
| Added ADM812 | Universal |
| Changes to Specifications..... | 2 |
| Changes to Ordering Guide | 3 |
| Changes to Pin Configuration | 4 |
| Changes to Pin Function Description | 4 |
| Additions to Table I..... | 6 |
| Changes to Manual Reset section..... | 6 |

5/02—Rev. 0 to Rev. A

| | |
|-------------------------|-----------|
| Deletion of ADM812..... | Universal |
|-------------------------|-----------|

SPECIFICATIONS

V_{CC} = full operating range; T_A = T_{MIN} to T_{MAX} ; V_{CC} typical = 5 V for L/M models, 3.3 V for T/S models, 3 V for R model, 2.5 V for Z models, unless otherwise noted.

Table 1.

| Parameter | Min | Typ | Max | Unit | Test Conditions/Comments |
|---|---------------------|------|----------------------|-----------------------|---|
| SUPPLY | | | | | |
| Voltage | 1.0 | | 5.5 | V | $T_A = 0^\circ\text{C}$ to 70°C |
| | 1.2 | | | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| Current | | 8 | 15 | μA | $V_{CC} < 5.5\text{ V}$, ADM81xL/M, $I_{OUT} = 0\text{ mA}$ |
| | | 5 | 10 | μA | $V_{CC} < 3.6\text{ V}$, ADM81xR/S/T/Z, $I_{OUT} = 0\text{ mA}$ |
| RESET VOLTAGE THRESHOLD | | | | | |
| ADM81xL | 4.54 | 4.63 | 4.72 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xL | 4.50 | | 4.75 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| ADM81xM | 4.30 | 4.38 | 4.46 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xM | 4.25 | | 4.50 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| ADM81xT | 3.03 | 3.08 | 3.14 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xT | 3.00 | | 3.15 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| ADM81xS | 2.88 | 2.93 | 2.98 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xS | 2.85 | | 3.00 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| ADM81xR | 2.58 | 2.63 | 2.68 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xR | 2.55 | | 2.70 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| ADM81xZ | 2.28 | 2.32 | 2.35 | V | $T_A = 25^\circ\text{C}$ |
| ADM81xZ | 2.25 | | 2.38 | V | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |
| RESET THRESHOLD TEMPERATURE COEFFICIENT | | 30 | | ppm/ $^\circ\text{C}$ | |
| V_{CC} TO RESET/RESET DELAY | | 40 | | μs | $V_{OD} = 125\text{ mV}$, ADM81xL/M |
| | | 20 | | μs | $V_{OD} = 125\text{ mV}$, ADM81xR/S/T/Z |
| RESET ACTIVE TIMEOUT PERIOD | 140 | | 560 | ms | $V_{CC} = V_{TH(MAX)}$ |
| | 300 | | 700 | ms | ADM811-3T only |
| MANUAL RESET | | | | | |
| Minimum Pulse Width | 10 | | | μs | |
| Glitch Immunity | | 100 | | ns | |
| RESET/RESET Propagation Delay | | 0.5 | | μs | |
| Pull-Up Resistance | 10 | 20 | 30 | k Ω | |
| The Manual Reset Circuit Acts On | | | | | |
| An Input Rising Above | 2.3 | | | V | $V_{CC} > V_{TH(MAX)}$, ADM81xL/M |
| An Input Falling Below | | | 0.8 | V | $V_{CC} > V_{TH(MAX)}$, ADM81xL/M |
| An Input Rising Above | $0.7 \times V_{CC}$ | | | V | $V_{CC} > V_{TH(MAX)}$, ADM81xR/S/T/Z |
| An Input Falling Below | | | $0.25 \times V_{CC}$ | V | $V_{CC} > V_{TH(MAX)}$, ADM81xR/S/T/Z |
| RESET/RESET Output Voltage | | | | | |
| Low (ADM812R/S/T/Z) | | | 0.3 | V | $V_{CC} = V_{TH(MAX)}$, $I_{SINK} = 1.2\text{ mA}$ |
| Low (ADM812L/M) | | | 0.4 | V | $V_{CC} = V_{TH(MAX)}$, $I_{SINK} = 3.2\text{ mA}$ |
| High (ADM812R/S/T/Z/L/M) | $0.8 \times V_{CC}$ | | | V | $1.8\text{ V} < V_{CC} < V_{TH(MIN)}$, $I_{SOURCE} = 150\text{ }\mu\text{A}$ |
| Low (ADM811R/S/T/Z) | | | 0.3 | V | $V_{CC} = V_{TH(MIN)}$, $I_{SINK} = 1.2\text{ mA}$ |
| Low (ADM811L/M) | | | 0.4 | V | $V_{CC} = V_{TH(MIN)}$, $I_{SINK} = 3.2\text{ mA}$ |
| Low (ADM811R/S/T/Z/L/M) | | | 0.3 | V | $V_{CC} > 1.0\text{ V}$, $I_{SINK} = 50\text{ }\mu\text{A}$ |
| High (ADM811R/S/T/Z) | $0.8 \times V_{CC}$ | | | V | $V_{CC} > V_{TH(MAX)}$, $I_{SOURCE} = 500\text{ }\mu\text{A}$ |
| High (ADM811L/M) | $V_{CC} \times 1.5$ | | | V | $V_{CC} > V_{TH(MAX)}$, $I_{SOURCE} = 800\text{ }\mu\text{A}$ |

ABSOLUTE MAXIMUM RATINGS

Typical values are at $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 2.

| Parameter | Rating |
|---|---|
| Terminal Voltage (With Respect to Ground) | |
| V_{CC} | -0.3 V to +6 V |
| All Other Inputs | -0.3 V to $V_{CC} + 0.3$ V |
| Input Current | |
| V_{CC} | 20 mA |
| \overline{MR} | 20 mA |
| Output Current | |
| \overline{RESET} | 20 mA |
| Power Dissipation ($T_A = 70^\circ\text{C}$) | |
| RA-4 (SOT-143) | 200 mW |
| Derate by 4 mW/ $^\circ\text{C}$ Above 70°C | |
| θ_{JA} Thermal Impedance | 330 $^\circ\text{C}/\text{W}$ |
| Operating Temperature Range | -40 $^\circ\text{C}$ to +85 $^\circ\text{C}$ |
| Storage Temperature Range | -65 $^\circ\text{C}$ to +160 $^\circ\text{C}$ |
| Lead Temperature (Soldering, 10 sec) | 300 $^\circ\text{C}$ |
| Vapor Phase (60 sec) | 215 $^\circ\text{C}$ |
| Infrared (15 sec) | 220 $^\circ\text{C}$ |
| ESD Rating | 3 kV |

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

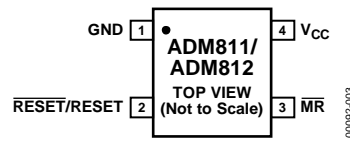


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|------------------------------------|--|
| 1 | GND | Ground Reference For All Signals, 0 V. |
| 2 | $\overline{\text{RESET}}$ (ADM811) | Active Low Logic Output. $\overline{\text{RESET}}$ remains low while V_{CC} is below the reset threshold or when $\overline{\text{MR}}$ is low; $\overline{\text{RESET}}$ then remains low for at least 140 ms (at least 300 ms for the ADM811-3T) after V_{CC} rises above the reset threshold. |
| | RESET (ADM812) | Active High Logic Output. RESET remains high while V_{CC} is below the reset threshold or when $\overline{\text{MR}}$ is low; RESET then remains high for 240 ms (typical) after V_{CC} rises above the reset threshold. |
| 3 | $\overline{\text{MR}}$ | Manual Reset. This active low debounced input ignores input pulses of 100 ns or less (typical) and is guaranteed to accept input pulses of greater than 10 μs . Leave floating when not used. |
| 4 | V_{CC} | Monitored Supply Voltage of 2.5 V, 3 V, 3.3 V, or 5 V. A 0.1 μF decoupling capacitor between V_{CC} and the GND pin is recommended. |

TYPICAL PERFORMANCE CHARACTERISTICS

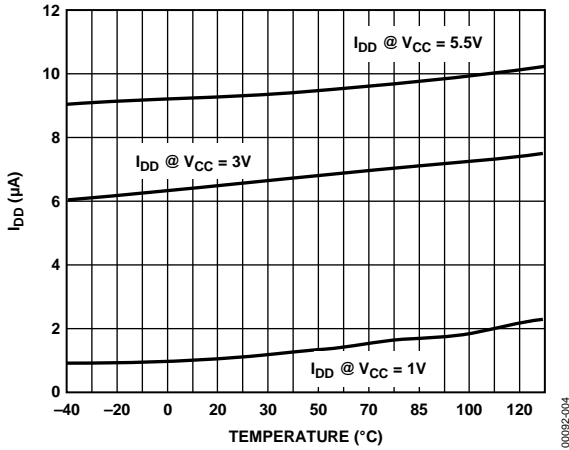


Figure 4. Supply Current vs. Temperature (ADM81xR/S/T/Z)

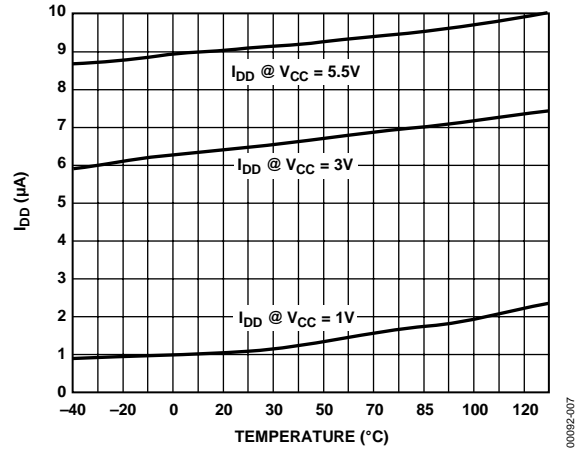


Figure 7. Supply Current vs. Temperature (ADM81xL/M)

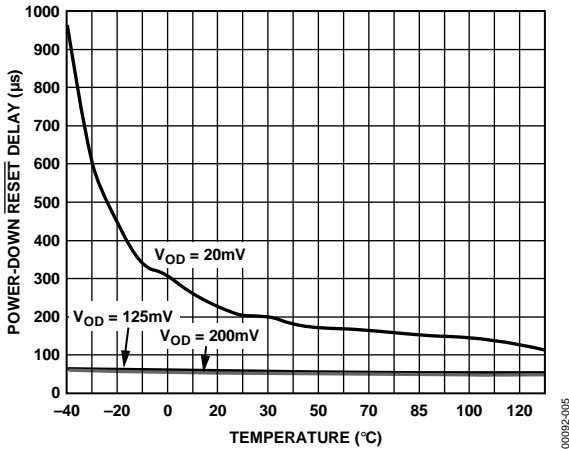


Figure 5. Power-Down $\overline{\text{RESET}}$ Delay vs. Temperature (ADM81xR/S/T/Z)

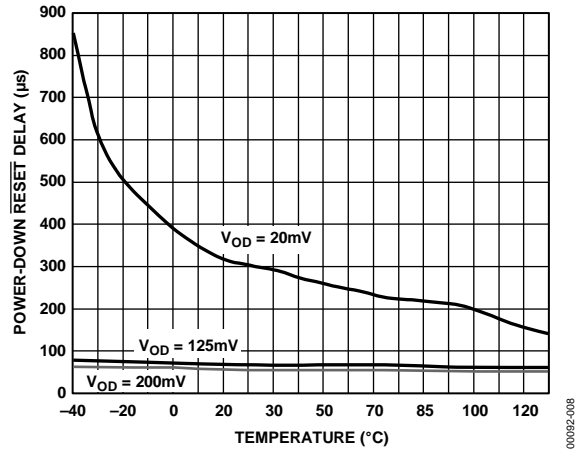


Figure 8. Power-Down $\overline{\text{RESET}}$ Delay vs. Temperature (ADM81xL/M)

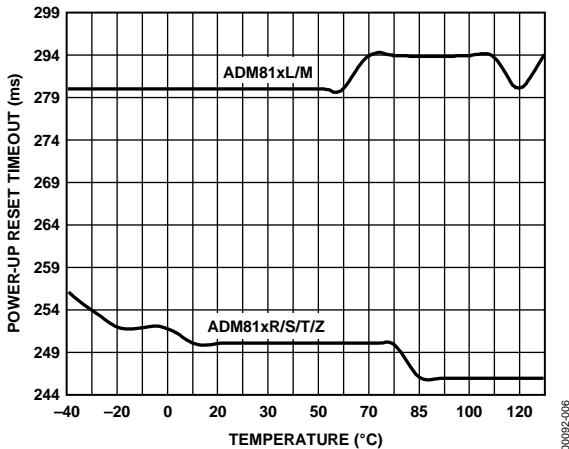


Figure 6. Power-Up $\overline{\text{RESET}}$ Timeout vs. Temperature

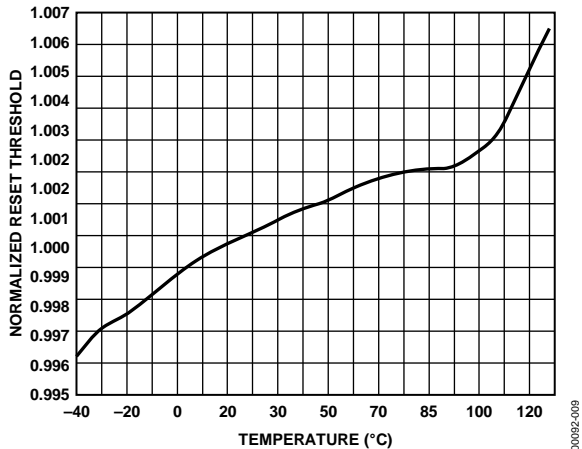


Figure 9. $\overline{\text{RESET}}$ Threshold Deviation vs. Temperature

CIRCUIT INFORMATION

RESET THRESHOLDS

A reset output is provided to the microprocessor whenever the V_{CC} input is below the reset threshold. The actual reset threshold depends on whether an L, M, T, S, R, or Z suffix is used (see Table 4).

Table 4. Reset Threshold Options

| Model | Reset Threshold (V) |
|--------------|---------------------|
| ADM811LART | 4.63 |
| ADM811MART | 4.38 |
| ADM811TART | 3.08 |
| ADM811-3TART | 3.08 |
| ADM811SART | 2.93 |
| ADM811RART | 2.63 |
| ADM811ZART | 2.32 |
| ADM812LART | 4.63 |
| ADM812MART | 4.38 |
| ADM812TART | 3.08 |
| ADM812SART | 2.93 |
| ADM812RART | 2.63 |
| ADM812ZART | 2.32 |

RESET OUTPUT

On power-up and after V_{CC} rises above the reset threshold, an internal timer holds the reset output active for 240 ms (typical). This is intended as a power-on reset signal for the processor. It allows time for both the power supply and the microprocessor to stabilize after power-up. If a power supply brownout or interruption occurs, the reset output is similarly activated and remains active for 240 ms (typical) after the supply recovers.

This allows time for the power supply and microprocessor to stabilize.

The ADM811 provides an active low reset output ($\overline{\text{RESET}}$) while the ADM812 provides an active high output (RESET).

During power-down of the ADM811, the $\overline{\text{RESET}}$ output remains valid (low) with V_{CC} as low as 1 V. This ensures that the microprocessor is held in a stable shutdown condition as the supply falls and also ensures that no spurious activity can occur via the microprocessor as it powers up.

MANUAL RESET

The ADM811/ADM812 are equipped with a manual reset input. This input is designed to operate in a noisy environment where unwanted glitches could be induced. These glitches could be produced by the bouncing action of a switch contact, or where a manual reset switch may be located some distance away from the circuit (the cabling of which can pick up noise).

The manual reset input is guaranteed to ignore logically valid inputs that are faster than 100 ns and to accept inputs longer in duration than 10 μs .

GLITCH IMMUNITY

The ADM811/ADM812 contain internal filtering circuitry providing glitch immunity from fast transient glitches on the power supply line.

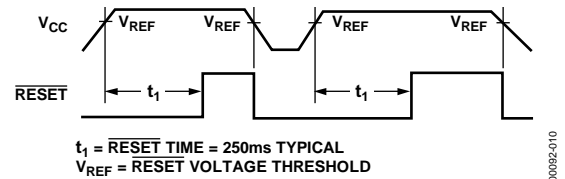


Figure 10. Power Fall $\overline{\text{RESET}}$ Timing

INTERFACING TO OTHER DEVICES

OUTPUT

The ADM811/ADM812 are designed to integrate with as many devices as possible. One feature of the ADM811/ADM812 is the reset output, which is directly proportional to V_{CC} (this is guaranteed only while V_{CC} is greater than 1 V). This enables the part to be used with both 3 V and 5 V, or any nominal voltage within the minimum and maximum specifications for V_{CC} .

BENEFITS OF A VERY ACCURATE RESET THRESHOLD

Because the ADM811/ADM812 can operate effectively even when there are large degradations of the supply voltages, the possibility of a malfunction during a power failure is greatly reduced. Another advantage of the ADM811/ADM812 is its very accurate internal voltage reference circuit. Combined, these benefits produce an exceptionally reliable microprocessor supervisory circuit.

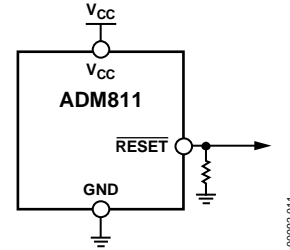
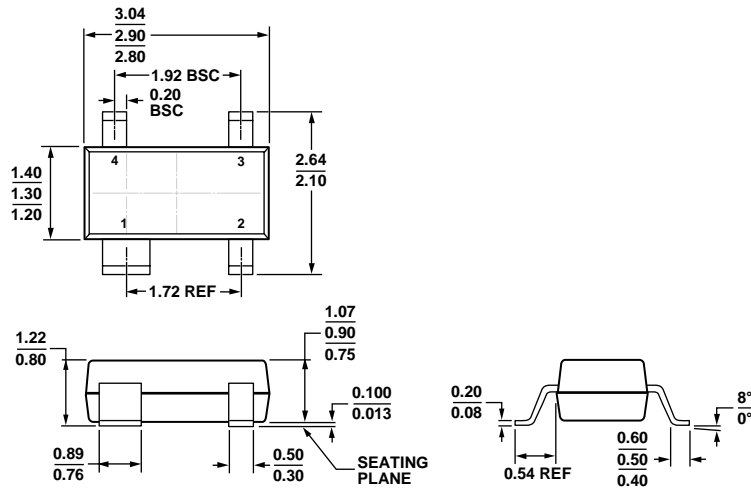


Figure 11. Ensuring a Valid $\overline{\text{RESET}}$ Output Down to $V_{CC} = 0\text{ V}$

ENSURING A VALID $\overline{\text{RESET}}$ /RESET OUTPUT DOWN TO $V_{CC} = 0\text{ V}$

When V_{CC} falls below 0.8 V, the $\overline{\text{RESET}}$ /RESET of the ADM811/ADM812 no longer sinks current. Therefore, a high impedance CMOS logic input connected to $\overline{\text{RESET}}$ /RESET can drift to undetermined logic levels. To eliminate this problem, a 100 k Ω resistor should be connected from $\overline{\text{RESET}}$ /RESET to ground.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS TO-253-AA

Figure 12. 4-Lead Small Outline Transistor Package [SOT-143] (RA-4)

Dimensions shown in millimeters

00-13-2012-B

ORDERING GUIDE

| Model ^{1, 2} | Reset Threshold (V) | Temperature Range | Ordering Quantity | Package Description | Package Option | Branding |
|-----------------------|---------------------|-------------------|-------------------|---------------------|----------------|----------|
| ADM811LART-REEL | 4.63 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBV |
| ADM811LART-REEL7 | 4.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBV |
| ADM811LARTZ-REEL | 4.63 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M4J |
| ADM811LARTZ-REEL7 | 4.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M4J |
| ADM811MART-REEL7 | 4.38 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBT |
| ADM811MARTZ-REEL | 4.38 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBT # |
| ADM811MARTZ-REEL7 | 4.38 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBT # |
| ADM811TART-REEL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBG |
| ADM811TARTZ-REEL | 3.08 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBG # |
| ADM811TARTZ-REEL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBG # |
| ADM811-3TART-REEL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MB3 |
| ADM811-3TARTZ-RL | 3.08 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M4E |
| ADM811-3TARTZ-RL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M4E |
| ADM811SART-REEL | 2.93 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBE |
| ADM811SART-REEL7 | 2.93 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBE |
| ADM811SARTZ-REEL | 2.93 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBE # |
| ADM811SARTZ-REEL7 | 2.93 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBE # |
| ADM811RART-REEL7 | 2.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBB |
| ADM811RARTZ-REEL | 2.63 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M4N |
| ADM811RARTZ-REEL7 | 2.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M4N |
| ADM811ZART-REEL | 2.32 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MBZ |
| ADM811ZART-REEL7 | 2.32 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MBZ |
| ADM811ZARTZ-REEL | 2.32 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M6G |
| ADM811ZARTZ-REEL7 | 2.32 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M6G |
| ADM812LART-REEL7 | 4.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCV |
| ADM812LARTZ-REEL | 4.63 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M5D |
| ADM812LARTZ-REEL7 | 4.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M5D |
| ADM812MART-REEL | 4.38 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MCT |
| ADM812MART-REEL7 | 4.38 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCT |
| ADM812MARTZ-REEL | 4.38 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M6D |
| ADM812MARTZ-REEL7 | 4.38 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M6D |
| ADM812TART-REEL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCG |
| ADM812TARTZ-REEL | 3.08 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M68 |
| ADM812TARTZ-REEL7 | 3.08 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M68 |
| ADM812SART-REEL | 2.93 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MCE |
| ADM812SART-REEL7 | 2.93 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCE |
| ADM812SARTZ-REEL | 2.93 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M67 |
| ADM812SARTZ-REEL7 | 2.93 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M67 |
| ADM812RART-REEL7 | 2.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCB |
| ADM812RARTZ-REEL | 2.63 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M6F |
| ADM812RARTZ-REEL7 | 2.63 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M6F |
| ADM812ZART-REEL | 2.32 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | MCZ |
| ADM812ZART-REEL7 | 2.32 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | MCZ |
| ADM812ZARTZ-REEL | 2.32 | -40°C to +85°C | 10,000 | 4-Lead SOT-143 | RA-4 | M69 |
| ADM812ZARTZ-REEL7 | 2.32 | -40°C to +85°C | 3,000 | 4-Lead SOT-143 | RA-4 | M69 |

¹ Available only in reels.² Z = RoHS Compliant Part. RoHS-compliant parts may have # branded on either the top or bottom of the device.

NOTES

NOTES

Данный компонент на территории Российской Федерации

Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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