



RELIABILITY REPORT  
FOR  
MAX5404EUB+  
PLASTIC ENCAPSULATED DEVICES

October 20, 2009

**MAXIM INTEGRATED PRODUCTS**

120 SAN GABRIEL DR.  
SUNNYVALE, CA 94086

|                                   |
|-----------------------------------|
| <b>Approved by</b>                |
| Ken Wendel                        |
| Quality Assurance                 |
| Director, Reliability Engineering |

## Conclusion

The MAX5404EUB+ successfully meets the quality and reliability standards required of all Maxim products. In addition, Maxim's continuous reliability monitoring program ensures that all outgoing product will continue to meet Maxim's quality and reliability standards.

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## I. Device Description

### A. General

The MAX5403/MAX5404/MAX5405 is a family of dual linear taper digital potentiometers. Each device has one 3-terminal potentiometer and one 2-terminal variable resistor (Figure 1). The MAX5403/MAX5404/MAX5405 operate from +2.7V to +5.5V single-supply voltages and use an ultra-low supply current of 0.1 $\mu$ A. These devices also provide glitchless switching between resistors taps as well as a convenient power-on reset (POR) that sets the wiper to the midscale position at power-up. The potentiometer consists of a fixed resistor with a wiper contact that is digitally controlled through a 3-wire serial interface and has 256-tap points. It performs the same function as a discrete potentiometer or variable resistor. These parts are ideal for applications requiring digitally controlled resistors. Three resistance values are available: 10k (MAX5403), 50k (MAX5404), and 100k (MAX5405). A nominal resistor-temperature coefficient of 35ppm/ $^{\circ}$ C end-to-end and 5ppm/ $^{\circ}$ C ratiometric make the MAX5403/MAX5404/MAX5405 ideal for applications requiring low temperature-coefficient variable resistors, such as adjustable-gain circuit configurations. The MAX5403/MAX5404/MAX5405 are available in a 10-pin  $\mu$ MAX<sup>®</sup> package. Each device is guaranteed over the extended industrial temperature range (-40 $^{\circ}$ C to +85 $^{\circ}$ C).

## II. Manufacturing Information

|                                  |   |
|----------------------------------|---|
| A. Description/Function:         | Dual, 256-Tap, Low-Drift, Digital Potentiometers in 10- $\mu$ MAX |
| B. Process:                      | C6  |
| C. Number of Device Transistors: | 8689  |
| D. Fabrication Location:         | California  |
| E. Assembly Location:            | Thailand  |
| F. Date of Initial Production:   | January 27, 2001  |

## III. Packaging Information

|  |                          |
|--|--------------------------|
| A. Package Type:   | 10-pin uMAX              |
| B. Lead Frame:   | Copper Alloy             |
| C. Lead Finish:  | Matte Sn Plate           |
| D. Die Attach:   | Non-conductive Epoxy     |
| E. Bondwire:   | Gold (1 mil dia.)        |
| F. Mold Material:  | Epoxy with silica filler |
| G. Assembly Diagram:   | #05-7001-0487            |
| H. Flammability Rating:  | Class UL94-V0            |
| I. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C | Level 1                  |
| J. Single Layer Theta Ja:  | 180°C/W                  |
| K. Single Layer Theta Jc:  | 41.9°C/W                 |
| L. Multi Layer Theta Ja:   | 113.1°C/W                |
| M. Multi Layer Theta Jc:   | 41.9°C/W                 |

## IV. Die Information

|                            |   |
|----------------------------|---|
| A. Dimensions:             | 76 X 89 mils  |
| B. Passivation:            | Si <sub>3</sub> N <sub>4</sub> /SiO <sub>2</sub> (Silicon nitride/ Silicon dioxide) |
| C. Interconnect:           | Al/0.5%Cu with Ti/TiN Barrier   |
| D. Backside Metallization: | None  |
| E. Minimum Metal Width:    | 0.6 microns (as drawn)  |
| F. Minimum Metal Spacing:  | 0.6 microns (as drawn)  |
| G. Bondpad Dimensions:     | 5 mil. Sq.  |
| H. Isolation Dielectric:   | SiO <sub>2</sub>  |
| I. Die Separation Method:  | Wafer Saw   |

## V. Quality Assurance Information

|                                   |   |
|-----------------------------------|---|
| A. Quality Assurance Contacts:    | Ken Wendel (Director, Reliability Engineering)<br>Bryan Preeshl (Managing Director of QA)       |
| B. Outgoing Inspection Level:     | 0.1% for all electrical parameters guaranteed by the Datasheet.<br>0.1% For all Visual Defects. |
| C. Observed Outgoing Defect Rate: | < 50 ppm  |
| D. Sampling Plan:                 | Mil-Std-105D  |

## VI. Reliability Evaluation

### A. Accelerated Life Test

The results of the 135°C biased (static) life test are shown in Table 1. Using these results, the Failure Rate ( $\lambda$ ) is calculated as follows:

$$\lambda = \frac{1}{\text{MTTF}} = \frac{1.83}{192 \times 4340 \times 160 \times 2} \quad (\text{Chi square value for MTTF upper limit})$$

(where 4340 = Temperature Acceleration factor assuming an activation energy of 0.8eV)

$$\lambda = 6.71 \times 10^{-9}$$

$$\lambda = 6.71 \text{ F.I.T. (60\% confidence level @ 25°C)}$$

The following failure rate represents data collected from Maxim's reliability monitor program. Maxim performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at <http://www.maxim-ic.com/qa/reliability/monitor>. Cumulative monitor data for the C6 Process results in a FIT Rate of 0.43 @ 25C and 7.50 @ 55C (0.8 eV, 60% UCL)

### B. Moisture Resistance Tests

The industry standard 85°C/85%RH or HAST testing is monitored per device process once a quarter.

### C. E.S.D. and Latch-Up Testing

The DP03-1 die type has been found to have all pins able to withstand a HBM transient pulse of +/-1000 V per JEDEC JESD22-A114. Latch-Up testing has shown that this device withstands a current of +/-250 mA.

**Table 1**  
Reliability Evaluation Test Results

**MAX5404EUB+**

| TEST ITEM                         | TEST CONDITION                                    | FAILURE IDENTIFICATION           | SAMPLE SIZE | NUMBER OF FAILURES |
|-----------------------------------|---|----------------------------------|-------------|--------------------|
| <b>Static Life Test</b> (Note 1)  |   |                                  |             |                    |
|                                   | Ta = 135°C<br>Biased<br>Time = 192 hrs.           | DC Parameters<br>& functionality | 160         | 0                  |
| <b>Moisture Testing</b> (Note 2)  |   |                                  |             |                    |
| HAST                              | Ta = 130°C<br>RH = 85%<br>Biased<br>Time = 96hrs. | DC Parameters<br>& functionality | 77          | 0                  |
| <b>Mechanical Stress</b> (Note 2) |   |                                  |             |                    |
| Temperature<br>Cycle              | -65°C/150°C<br>1000 Cycles<br>Method 1010         | DC Parameters<br>& functionality | 77          | 0                  |

Note 1: Life Test Data may represent plastic DIP qualification lots.

Note 2: Generic Package/Process data