RELIABILITY REPORT

FOR

MAX16141AAF+, MAX16141AAF+T

June 11, 2020

MAXIM INTEGRATED

160 RIO ROBLES

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Conclusion

The MAX16141 successfully meets the quality and reliability standards required of all Maxim Integrated products. In addition, Maxim Integrated's continuous reliability monitoring program ensures that all outgoing product will continue to meet Maxim Integrated's quality and reliability standards.

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I. Device Description

A. General

The MAX16141/MAX16141A, ideal diode controllers, provide system protection against a variety of system faults, such as reverse current, reverse voltage, overcurrent, input overvoltage/undervoltage, and overtemperature conditions. The wide operating voltage range of 3.5V to 36V, combined with 5µA (typ) of shutdown current, make the MAX16141/ MAX16141A ideal for automotive applications. An integrated charge pump drives the gate of the back-to-back external nFETs 9V above the source connection, minimizing power loss between the source and the load.

A fast-acting comparator allows the MAX16141/MAX16141A to block reverse-current flow within 1µs (max) of the input falling below the output voltage. An external current-sense resistor between RS and OUT provides overload monitoring capability. Two input pins, OVSET and UVSET, provide set points to protect against input overvoltage and undervoltage events using a simple resistive-divider.

During startup, the MAX16141/MAX16141A monitor the voltage drop across the external nFETs (VIN - VOUT) and the load current for overcurrent fault to ensure VOUT is greater than 0.9 x VIN. Once the startup event is complete, the MAX16141/MAX16141A are ready to protect against systems faults. During normal operation, some systems experience brownouts or short interruptions of power. To ensure smooth system recovery from these interruptions, the MAX16141/MAX16141A includes a secondary power input (VCC) to keep critical circuits alive. When the main input power recovers, the MAX16141/MAX16141A enable the gate in fast mode (70µs, typ) to charge the output capacitor.

Both devices feature a low power mode that is enabled with a logic input. In low power mode the devices allow limited current flow from source to the load. For the MAX16141, the low power mode is enabled using an active low logic input, SLEEP. For the MAX16141A, the lower power mode is activated using an active-high logic input (SLEEP).

Additional features include an internal switch that isolates the monitoring from the UVSET and OVSET resistive network in shutdown mode to help minimize system power loss.

II. Manufacturing Information

A. Description/Function:	3.5V to 36V Ideal Diode Controller with Voltage and Current Circuit Breaker
B. Process:	S4
C. Device Count:	17467
D. Fabrication Location:	Japan
E. Assembly Location:	Thailand, Taiwan
F. Date of Initial Production:	July 2018

III. Packaging Information

A. Package Type:	TQFN
B. Lead Frame:	CU194
C. Lead Finish:	Matte Tin
D. Die Attach:	AB8200T, EN4900G
E. Bondwire:	1 mil Au
F. Mold Material:	G770HCD, G700LA
G. Flammability Rating:	UL-94 (V-0 Rating)
H. Classification of Moisture Sensitivity per JEDEC standard J-STD-020-C	Level 1
I. Single Layer Theta Ja:	59.3 °C/W
J. Single Layer Theta Jc:	6 °C/W
K. Multi Layer Theta Ja:	40 °C/W
L. Multi Layer Theta Jc:	6 °C/W

IV. Die Information

A. Dimensions:	88x88 mils
B. Passivation:	SiN / SiO2

V. Quality Assurance Information

A. Quality Assurance Contacts:	Ryan Wall (Manager, Reliability) Michael Cairnes (Executive Director, Reliability) Bryan Preeshl (SVP of QA)
B. Outgoing Inspection Level:	0.1% for all electrical parameters guaranteed by the Datasheet. 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 125C biased (static) life test are shown in Table 1. Using these results, the Failure Rate λ is calculated as follows:

$$\lambda = \frac{1}{MTTF} = \frac{1.83}{192\ x\ 2454\ x\ 77\ x\ 2}$$ (Chi square value for MTTF upper limit)

(where 2454 = Temperature Acceleration factor assuming an activation energy of 0.8eV)

$$\lambda = 25.2\ x\ 10^{-9}$$

$$\lambda = 25.2\ FITs\ (60\%\ confidence\ level\ @25°C)$$

Maxim Integrated performs quarterly life test monitors on its processes. This data is published in the Reliability Report found at https://www.maximintegrated.com/en/support/qa-reliability/reliability/reliability-monitor-program.html.

S4 cumulative process data:

$$\lambda = 0.02\ FITs\ (60\%\ confidence\ level\ @25°C)$$
$$\lambda = 0.24\ FITs\ (60\%\ confidence\ level\ @55°C)$$

B. ESD and Latch-Up Testing

The MAX16141 has been found to have all pins able to withstand an HBM transient pulse of ±1500 V per JEDEC / ESDA JS-001. Latch-Up testing has shown that this device withstands ±100 mA current injection and supply overvoltage per JEDEC JESD78.

Table 1

Reliability Evaluation Test Results

MAX16141AAF/V+

TEST ITEM	TEST CONDITION	FAILURE IDENTIFICATION	SAMPLE SIZE	NUMBER OF FAILURES	COMMENTS
Static Life Test (Note 1)	Ta = 125°C Biased Time = 192 hrs.	DC parameters & functionality	77	0	

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