Reliability Report Update Plastic Chip Carrier (PCC) Package

National Semiconductor
PCC
July 1986

National Semiconductor continues to conduct reliability tests on our complete line of surface mount components to assure you of the highest level of reliability performance possible.

This Reliability Report Update presents additional data recently gathered on National's family of plastic chip carrier packages with leadcounts of 20, 28, 44, and 68.

The data demonstrates that the reliability performance of products assembled in National's plastic chip carrier package is excellent and is comparable to the reliability performance of product assembled in National's standard dual-in-line package (DIP).

INTRODUCTION

The PCC (Plastic Chip Carrier) package has been developed to meet customer demand for ever-increasing miniaturization component density, and surface mounting requirements. These devices occupy only 25–35% of the PC board area required for conventional DIP packages.

These small packages mount directly on the surface of a PC board or substrate. Users should note that boards for PCC devices have different design considerations from those typically used for traditional insertion-mounted DIPs. Several techniques for ''high density surface mounting'' have been developed, as well as new board and substrate materials.

National's Reliability Department has performed a series of accelerated environmental tests to determine the reliability of this package. Descriptions of these tests and results follow. Thermal resistance characteristics for the PCC appear at the end of this report.

TEST DESCRIPTIONS

High Temperature Bias—Continuous operation at rated supply voltage; $T_A = 125°C$.

High Temperature Bias is the most generally accepted accelerated life test. The elevated temperature along with the applied voltage stress accelerates many failure mechanisms associated with the die in the packaging system. As with all accelerated environmental tests, all failures are analyzed for package related failure mechanisms.

Temperature Humidity Bias—Continuous operation at rated supply voltage; $T_A = 85°C$, RH = 85%.

Temperature Humidity Bias is the standard test for plastic package integrity with respect to moisture and external contaminant penetration. The combination of temperature, humidity and bias accelerates any failure mechanisms that would occur if moisture penetrates the package. The primary failure mechanism is corrosion due to electrolysis of the device metallization or bonding wires.

Autoclave—Unbiased at $T_A = 121°C$, RH = 100%, 15 psi.

Autoclave is designed to accelerate the penetration of moisture into the package in order to determine the resistance of the die and packaging system to moisture and external contaminants.

Temperature Cycle—Unbiased at $T_A = -65°C$ to $+150°C$, 20 minutes per cycle.

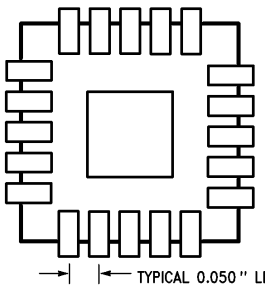
Temperature cycle tests the thermal expansion coefficient compatibility of the materials used and design of the packaging systems at alternating temperature extremes. The expected failure mechanisms include cracking at encapsulation-leadframe interfaces and fractured or lifted bond wires. In addition, moisture and contaminants tend to be driven into the cracks and openings of seals and seams as the package expands and contracts.

Thermal Shock—Unbiased at $-65°C$ to $+150°C$ liquid, 5 minutes immersion, 5 seconds transfer time per cycle.

This test, while similar to Temperature cycle, is designed to examine how the different rates of thermal conductivity for package materials affect the integrity of the package materials when exposed to alternating temperature extremes.

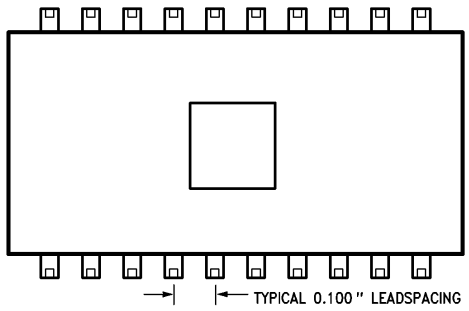
Component Size Comparison

Plastic Chip Carrier



TL/HH/8671–1

Dual-in-Line Package



TL/HH/8671–2

High Temperature Bias*: $T_A = 125°C$

Device	Package	168 Hrs.	500 Hrs.	1000 Hrs.
DS75451	8-DIP	0/60	0/60	0/60
DS75451	20-PCC	0/60	0/60	0/60
DS75451	28-PCC	0/60	0/60	0/60
DS75451	44-PCC	0/47	0/47	0/47
LM324	14-DIP	0/24	0/24	0/24
LM324A	20-PCC	0/96	0/96	0/96
LM324A	28-PCC	0/49	0/49	0/49
LM324A	44-PCC	0/50	0/50	0/50
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
87S181	24-DIP	0/77	0/77	0/77
87S181	28-PCC	0/77	0/77	0/77
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
DMPAL16L8	20-DIP	0/77	0/77	0/77
DMPAL16L8	20-PCC	0/77	0/77	0/77
DMPAL16R4	20-DIP	0/77	0/77	0/77
DMPAL16R4	20-PCC	0/77	0/77	0/77
DMPAL16R8	20-DIP	0/77	0/77	0/77
DMPAL16R8	20-PCC	1/77(1)	1/76(2)	0/75
INS8250A	40-DIP	0/84	0/84	0/84
INS8250A	44-PCC	0/75	0/75	0/75
INS8250A	40-DIP	0/84	0/84	0/84
INS8250A	44-PCC	0/77	0/77	0/77
INS8250A	40-DIP	0/75	0/75	0/75
INS8250A	44-PCC	0/77	0/77	1/77(3)
SCX6324	48-DIP	1/80(4)	0/80	1/80(5)
SCX6324	68-PCC	0/80	0/80	0/80
SCX6234	68-PCC	0/60	0/60	0/60
SCX6234	68-PCC	2/75(4)	0/73	0/73
SCX6234	68-PCC	0/45	0/45	0/45
	DIP	1/869	0/866	1/865
	PCC	3/1264	1/1261	1/1260

Note 1: Functional

Note 2: Leakage at pin 14, bake recoverable

Note 3: Functional

Note 4: Marginal I_{SS} (Parametric)

Note 5: Functional

*All PCC packages board mounted (Vapor-phase soldering.)

Temperature Humidity Bias*: 85°C, 85% RH

Device	Package	168 Hrs.	500 Hrs.	1000 Hrs.
DS75451	8-DIP	0/43	0/43	1/43(1)
DS75451	20-PCC	0/59	0/59	0/59
DS75451	28-PCC	0/59	0/59	0/59
LM324	14-DIP	0/50	0/50	0/50
LM324A	20-PCC	0/97	0/97	0/97
LM324A	28-PCC	0/46	0/46	1/46(2)
LM324A	44-PCC	0/50	0/50	0/50
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
87S181	24-DIP	0/77	0/77	0/77
87S181	28-PCC	0/77	0/77	0/77
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
DMPAL16L8	20-DIP	0/77	0/77	0/77
DMPAL16L8	20-PCC	0/77	0/77	0/77
DMPAL16R4	20-DIP	0/77	0/77	0/77
DMPAL16R4	20-PCC	0/77	0/77	0/77
DMPAL16R8	20-DIP	0/77	0/77	0/77
DMPAL16R8	20-PCC	0/77	0/77	0/77
INS8250A	40-DIP	0/90	0/90	0/90
INS8250A	44-PCC	0/74	0/74	0/74
INS8250A	40-DIP	1/70(3)	0/69	0/69
INS8250A	44-PCC	0/77	0/77	0/77
INS8250A	40-DIP	0/77	0/77	0/77
INS8250A	44-PCC	0/77	†	0/77
SCX6324	48-DIP	0/80	1/80(4)	0/80
SCX6324	68-PCC	1/80(5)	0/80	0/80
	DIP	1/872	1/871	1/871
	PCC	1/1081	0/1004	1/1081

Note 1: ECR

Note 2: Parametric

Note 3: Parametric, Input leakage

Note 4: Functional, I_{IL}

Note 5: Marginal I_{SS} (Parametric)

†No Measurements

*All PCC packages board mounted (Vapor-phase soldering.)

Autoclave: 121°C, 15 PSI and 100% RH

Device	Package	48 Hrs.	96 Hrs.	168 Hrs.
LM324	14-DIP	0/50	0/50	0/50
LM324A	20-PCC	0/300	0/300	0/300
LM324A	28-PCC	0/100	0/100	0/100
LM324A	44-PCC	0/100	0/100	0/100
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
87S181	24-DIP	0/77	0/77	0/77
87S181	28-PCC	0/77	0/77	0/77
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
DMPAL16L8	20-DIP	0/77	0/77	0/77
DMPAL16L8	20-PCC	0/77	0/77	0/77
DMPAL16R4	20-DIP	0/77	0/77	0/77
DMPAL16R4	20-PCC	0/77	0/77	0/77
DMPAL16R8	20-DIP	0/77	0/77	0/77
DMPAL16R8	20-PCC	0/77	0/77	0/77
INS8250A	40-DIP	1/55(1)	1/54(2)	0/53
INS8250A	40-DIP	0/55	0/55	0/55
INS8250A	44-PCC	0/50	0/50	0/50
INS8250A	40-DIP	0/55	0/55	0/55
INS8250A	44-PCC	0/55	0/55	0/55
SCX6234	68-PCC	0/55	0/55	0/55
SCX6234	68-PCC	1/55(3)	0/55	0/55
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/55	0/55	0/55
SCX6234	68-PCC	0/55	0/55	1/55(4)
SCX6234	68-PCC	1/55(4)	0/55	0/55
	DIP	1/677	1/676	0/675
	PCC	2/1387	0/1387	1/1387

Note 1: Marginal V_{IH}

Note 2: Marginal V_{IH}

Note 3: Marginal I_{SS} (Parametric)

Note 4: Parametric

Temperature Cycle*: $T_A = -65°C$ to $+150°C$

Device	Package	500 Cycles	1000 Cycles	2000 Cycles
DS75451	20-PCC	0/100	0/100	0/100
DS75451	20-PCC	0/196	0/196	0/196
DS75451	28-PCC	0/50	0/50	0/50
DS75451	28-PCC	0/250	0/250	0/250
DS75451	44-PCC	0/45	0/45	0/45
DS75451	44-PCC	0/250	0/250	0/250
LM324A	20-PCC	0/199	0/199	0/199
LM324A	28-PCC	0/50	0/50	0/50
LM324A	44-PCC	0/50	0/50	0/50
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
87S181	24-DIP	0/77	0/77	0/77
87S181	28-PCC	0/77	0/77	0/77
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
DMPAL16L8	20-DIP	0/77	0/77	0/77
DMPAL16L8	20-PCC	0/77	0/77	0/77
DMPAL16R4	20-DIP	0/77	0/77	0/77
DMPAL16R4	20-PCC	0/77	0/77	0/77
DMPAL16R8	20-DIP	0/77	0/77	0/77
DMPAL16R8	20-PCC	0/77	0/77	0/77
INS8250A	40-DIP	0/55	0/55	0/55
INS8250A	40-DIP	0/55	0/55	0/55
INS8250A	44-PCC	0/40	0/40	0/40
INS8250A	40-DIP	0/45	0/45	0/45
INS8250A	44-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	2/45(1)	0/43
	DIP	0/617	0/617	0/617
	PCC	0/1827	2/1827	0/1825

Note 1: I_{SS} Rampup—intermetal oxide short

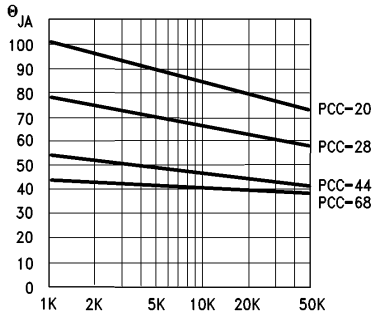
*All PCC packages board mounted (Vapor-phase soldering.)

Thermal Shock*: $T_A = -65°C$ to $+150°C$

Device	Package	15 Cycles	30 Cycles	60 Cycles
DS75451	8-DIP	0/100	0/100	0/100
DS75451	20-PCC	0/100	0/100	0/100
DS75451	28-PCC	0/100	0/100	0/100
DS75451	44-PCC	0/100	0/100	0/100
LM324	14-DIP	0/49	0/49	0/49
LM324A	20-PCC	0/50	0/50	0/50
LM324A	28-PCC	0/50	0/50	0/50
LM324A	44-PCC	0/50	0/50	0/50
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
87S181	24-DIP	0/77	0/77	0/77
87S181	28-PCC	0/77	0/77	0/77
87S191	24-DIP	0/77	0/77	0/77
87S191	28-PCC	0/77	0/77	0/77
DMPAL16L8	20-DIP	0/77	0/77	0/77
DMPAL16L8	20-PCC	0/77	0/77	0/77
DMPAL16R4	20-DIP	0/77	0/77	0/77
DMPAL16R4	20-PCC	0/77	0/77	0/77
DMPAL16R8	20-DIP	0/77	0/77	0/77
DMPAL16R8	20-PCC	0/77	0/77	0/77
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	0/45	0/45
SCX6234	68-PCC	0/45	0/45	1/45
	DIP	0/611	0/611	0/611
	PCC	0/1137	0/1137	1/1137

Note 1: Parametric, Input leakage

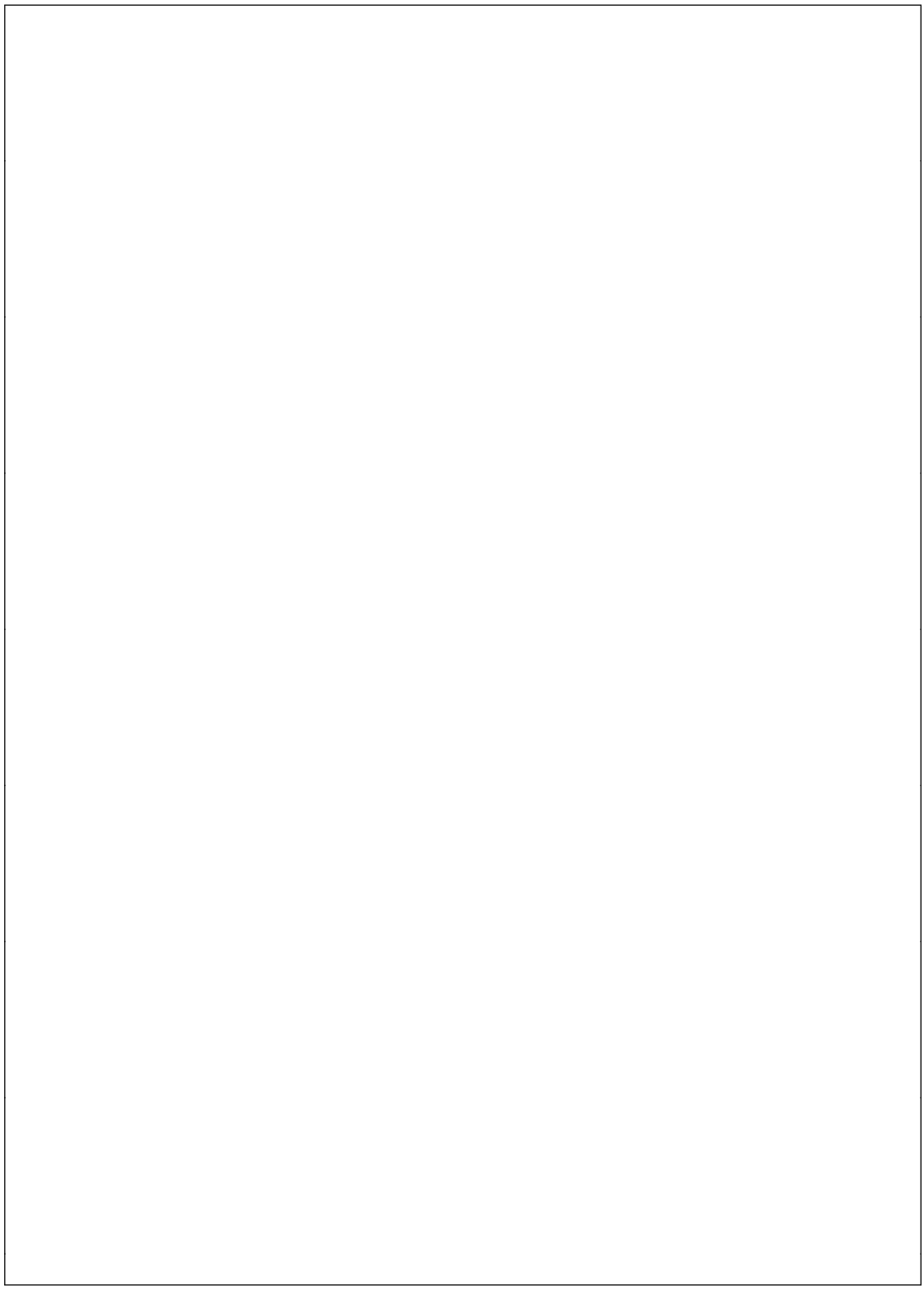
*All PCC packages board mounted (Vapor-phase reflow soldering.)



TL/HH/8671–3

CONCLUSION

Data presented in this report demonstrate that the reliability performance of product assembled in National's Plastic Chip Carrier (PCC) package is excellent and comparable to the reliability performance of product assembled in National's standard dual-in-line (DIP) package.



Reliability Report Update Plastic Chip Carrier (PCC) Package

Lit. #980040

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408