



## Reliability Qualification Report

### Device Qualification

Date: 10/16/2002

PCN:

**Laura Rivers**  
**Reliability Engineer**  
**602 244 5474**

**Scott Savage**  
**Reliability Manager**  
**602 244 4848**

#### 1) Introduction:

Qualification of NUF2221W1T2 series of devices designed for applications requiring Line Termination, EMI Filtering and ESD Protection. These are intended for use in upstream USB ports, Cellular phones, Wireless equipment and computer applications. Offering an integrated solution, offering better ESD protection than available from a discrete implementation because of reduced parasitic inductances, in a small package (SC88/SOT363) reducing PCB space and cost.

ESD Ratings: Jedec MM Class C, Jedec HBM 3B.  
 Compliant with IEC61000-4-2 (Level 4) 8KV (contact) 15KV (air)

#### 2) Device Description:

|                            |                                       |                                  |
|----------------------------|---------------------------------------|----------------------------------|
| <b>Qual ID</b> 1564        | <b>Wafer Fab Site</b> ISMF            | Seremban, Malaysia               |
| <b>Device</b> NUF2221W1T2  | <b>Assembly Site</b> SBN              | Seremban, Malaysia               |
| <b>Line Source</b> ZLU22N  | <b>Final Test Site</b> AIT BATAM, IDN | Batam, Indonesia                 |
| <b>Parent Tech</b> ZENER   | <b>Reliability Lab</b> SBN            | Seremban, Malaysia               |
| <b>Technology</b> ZENER    | <b>Max. Current</b> 100mA             | <b>Max. Voltage</b> 7V           |
| <b>Package</b> SC88/SOT363 | <b>Die Size</b> 670 X 500             | <b>Flag Size</b> 1.1mm X 0.625mm |
| <b>Polarity</b> PN         |                                       |                                  |

#### Related Qualification Report(s):

This series of devices is qualified by similarity based upon the NZMM7V04T4, rel report # 0450, for die technology and the NL27WZU04DFT2, rel report# 1242, for package technology. Full characterization of the NUF2221W1T2 has also been completed.



### 3) Qualification Results Analysis:

no anomalies were observed.

### 4) Conclusion:

The NUF2221W1T2 and NUF2xx1W1T2 series of devices have been found to meet or exceed all qualification requirements, by similarity, according to ON Semiconductor Product Qualification Process, 12MRB17722C.  
These devices are fully qualified.



## Reliability Customer Report

### Package Qualification

Date: 02/19/01

PCN: n/a

**Chuck Reed/Laura Rivers**  
**Reliability Engineer**  
**602 244 5474**

**Thomas Grzybowski**  
**Reliability Manager**  
**602-244-4331**

#### 1) Introduction:

This product is being developed for a Motorola cellular phone application. The device has 21 zener diodes and 9 resistors. The FAB facility is ISMF and assembly is Amkor.

#### 2) Device Descriptions:

**Qual ID** 0450

**Device** NZMM7V0T4

**Line Source** ZLDMC7V0

**Parent Tech** ZENER

**Technology** ZENER

**Package** 24 MLP2

**Polarity** PN

**Wafer Fab Site** ISMF

**Assembly Site** Amkor (ATP4)

**Final Test Site** Amkor (ATK1)

**Reliability Lab** FET TESTER

52nd St., Phoenix, AZ

**Max. Current**

**Max. Voltage**

**Die Size** 53 MILS X 53 MILS

**Flag Size**

**Qual ID** 0477

**Device** NZMM7V0T4

**Line Source** ZLDMC7V0

**Parent Tech** ZENER

**Technology** ZENER

**Package** 24 MLP2

**Polarity** PN

**Wafer Fab Site** ISMF

**Assembly Site** Amkor (ATP4)

**Final Test Site** Amkor (ATK1)

**Reliability Lab** FET TESTER

52nd St., Phoenix, AZ

**Max. Current**

**Max. Voltage**

**Die Size** 53 MILS X 53 MILS

**Flag Size**



## 2) Device Descriptions continued:

Qual ID 0668

Device NZMM7V0T4

Line Source ZLDMC7V0

Parent Tech ZENER

Technology ZENER

Package 24 MLP2

Polarity PN

Wafer Fab Site ISMF

Assembly Site Amkor (ATP4)

Final Test Site Amkor (ATK1)

Reliability Lab FET TESTER

52nd St., Phoenix, AZ

Max. Current

Max. Voltage

Die Size 53 MILS X 53 MILS

Flag Size

Qual ID 0669

Device NZMM7V0T4

Line Source ZLDMC7V0

Parent Tech ZENER

Technology ZENER

Package 24 MLP2

Polarity PN

Wafer Fab Site ISMF

Assembly Site Amkor (ATP4)

Final Test Site Amkor (ATK1)

Reliability Lab FET TESTER

52nd St., Phoenix, AZ

Max. Current

Max. Voltage

Die Size 53 MILS X 53 MILS

Flag Size

Qual ID n/a

Device

Line Source

Parent Tech

Technology

Package

Polarity

Wafer Fab Site

Assembly Site

Final Test Site

Reliability Lab

Max. Current

Max. Voltage

Die Size

Flag Size

Qual ID n/a

Device

Line Source

Parent Tech

Technology

Package

Polarity

Wafer Fab Site

Assembly Site

Final Test Site

Reliability Lab

Max. Current

Max. Voltage

Die Size

Flag Size

Qual ID n/a

Device

Line Source

Parent Tech

Technology

Package

Polarity

Wafer Fab Site

Assembly Site

Final Test Site

Reliability Lab

Max. Current

Max. Voltage

Die Size

Flag Size



### 3) Qualification Results Analysis:

Life and environmental tests passed with zero qualification related failures.

### 4) Conclusion:

The 24 pin EMI filter qualification of the NZMM7V0T4 product meets or exceeds reliability qualification test requirements per 12MSB17722C issue B. Zero devices in any subgroup experienced failure due to the standard testing. This qualifies other dice in the family such as: NZF220DFT1 and NZF220TT1.



## 5) Test Description & Condition:

|            |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto       | Autoclave                           | <b>AUTOCLAVE</b><br>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br><b>Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing                                          |
| Auto-PC    | Autoclave - PC                      | <b>AUTOCLAVE + MOISTURE LEVEL PRECONDITIONING</b><br>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br><b>Typical Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing |
| Bond Pull  | Bond Pull Strength                  | <b>BOND PULL STRENGTH</b><br>The purpose of this test is to determine bond pull strength of wire to die, substrate, or package header connections. The wires may be bonded by soldering, thermocompression, ultrasonic, or related bonding techniques.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Parametric shifts, open, and/or intermittent<br><b>Common Failure Mechanisms:</b> Corrosion or contaminants from foreign material within the package. Silicon or metalization defects.                                                       |
| Bond Shear | Bond Shear                          | <b>BOND SHEAR</b><br>The purpose of this test is to determine bond shear strength of wire to die, substrate, or package header connections. The wires may be bonded by soldering, thermocompression, ultrasonic, or related bonding techniques.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Parametric shifts, open, and/or intermittent<br><b>Common Failure Mechanisms:</b> Corrosion or contaminants from foreign material within the package. Silicon or metalization defects.                                                              |
| DPA        | Destructive Physical Analysis       | <b>DESTRUCTIVE PHYSICAL ANALYSIS</b><br>The purpose of this test is to determine conformance with applicable design and process requirements.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Electrical, mechanical and physical failures<br><b>Common Failure Mechanisms:</b> Various material and manufacturing defects.                                                                                                                                                                                                                         |
| DPA-H3TRB  | Destructive Physical Analysis H3TRB | <b>DESTRUCTIVE PHYSICAL ANALYSIS</b><br>The purpose of this test is to determine conformance with applicable design and process requirements.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Electrical, mechanical and physical failures<br><b>Common Failure Mechanisms:</b> Various material and manufacturing defects.                                                                                                                                                                                                                         |



## 5) Test Description & Condition continued:

|              |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DPA-H3TRB-PC | Destructive Physical Analysis<br>H3TRB-PC            | <b>DESTRUCTIVE PHYSICAL ANALYSIS</b><br>The purpose of this test is to determine conformance with applicable design and process requirements.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Electrical, mechanical and physical failures<br><b>Common Failure Mechanisms:</b> Various material and manufacturing defects.                                                                                                                                                                                                                                                                                   |
| DPA-TC-PC    | Destructive Physical Analysis<br>TC-PC               | <b>DESTRUCTIVE PHYSICAL ANALYSIS</b><br>The purpose of this test is to determine conformance with applicable design and process requirements.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Electrical, mechanical and physical failures<br><b>Common Failure Mechanisms:</b> Various material and manufacturing defects.                                                                                                                                                                                                                                                                                   |
| DPATC        | Destructive Physical Analysis<br>TC                  | <b>DESTRUCTIVE PHYSICAL ANALYSIS</b><br>The purpose of this test is to determine conformance with applicable design and process requirements.<br><b>Test Conditions:</b> TA = 25°C<br><b>Common Failure Modes:</b> Electrical, mechanical and physical failures<br><b>Common Failure Mechanisms:</b> Various material and manufacturing defects.                                                                                                                                                                                                                                                                                   |
| ESD          | Electrostatic Discharge                              | <b>ELECTROSTATIC DISCHARGE</b><br>The purpose of this test is to measure the relative ability of the part to withstand accidental electrostatic discharge. Both the Human Body Model and the Machine Model are used in testing. Devices are divided into groups and tested at specified increments across the ESD test range (per JEDEC). Data is recorded and devices are rated at the highest level at which they passed. If devices show no failures at the max increment, they are rated as being greater than (>) that voltage. If devices fail at some lower increment, they are rated as being equal (=) to that voltage.   |
| H3TRB        | High Humidity<br>High Temperature<br>Reverse Bias    | <b>HIGH HUMIDITY HIGH TEMPERATURE BIAS</b><br>This test designed to measure the moisture resistance of plastic encapsulated devices. A bias is applied to create an electrolytic cell necessary to accelerate corrosion of the die metallization. With time, this is a catastrophically destructive test.<br><b>Test Conditions:</b> TA = 85°C, rh = 85%<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing                                  |
| H3TRB-PC     | High Humidity<br>High Temperature<br>Reverse Bias-PC | <b>HIGH HUMIDITY HIGH TEMPERATURE BIAS + MOISTURE LEVEL PRECONDITIONING</b><br>This test designed to measure the moisture resistance of plastic encapsulated devices. A bias is applied to create an electrolytic cell necessary to accelerate corrosion of the die metallization. With time, this is a catastrophically destructive test.<br><b>Test Conditions:</b> TA = 85°C, rh = 85%<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing |



## 5) Test Description & Condition continued:

|        |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HTRB   | High Temperature Reverse Bias      | <b>HIGH TEMPERATURE REVERSE BIAS</b><br>The purpose of this test is to align mobile ions by means of temperature and voltage stress to form a high-current leakage path between two or more junctions.<br><b>Test Conditions:</b> TA = 150°C<br><b>Common Failure Modes:</b> Parametric shifts in leakage and gain<br><b>Common Failure Mechanisms:</b> Ionic contamination on the surface or under the metallization of the die                                                                                                      |
| IOL    | Intermittent Operational Life      | <b>INTERMITTENT OPERATIONAL LIFE</b><br>The purpose of this test is the same as Operating Life in addition to checking the integrity of both wire and die bonds by means of thermal stressing.<br><b>Test Conditions:</b> TA = 25°C, Ton = Toff = 2 minutes, delta Tj => 100°C<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Foreign material, crack and bulk die defects, metallization, wire and die bond defects                                                         |
| IOL-PC | Intermittent Operational Life - PC | <b>INTERMITTENT OPERATIONAL LIFE + MOISTURE LEVEL PRECONDITIONING</b><br>The purpose of this test is the same as Operating Life in addition to checking the integrity of both wire and die bonds by means of thermal stressing.<br><b>Test Conditions:</b> TA = 25°C, Ton = Toff = 2 minutes, delta Tj => 100°C<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Foreign material, crack and bulk die defects, metallization, wire and die bond defects                        |
| MSL 1  | Moisture Level 1                   | <b>MOISTURE LEVEL PRECONDITIONING</b><br>These tests are performed to simulate the board mounting process where parts are subjected to a high temperature for a short duration. These tests detect mold compound delamination from the die and leadframe. The failure mechanisms are corrosion, fractured wirebonds and passivation cracks.<br>10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@220°C + 1X Flux Immersion + DI Rinse                                                                                                       |
| TC     | Temperature Cycle                  | <b>TEMPERATURE CYCLING</b><br>The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and transitions between temperature extremes. This testing will also expose excessive thermal mismatch between materials.<br><b>Test Conditions:</b> TA = -65°C to 150°C, air to air<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Wire bond, cracked or lifted die and package failure                                  |
| TC-PC  | Temperature Cycle - PC             | <b>TEMPERATURE CYCLING + MOISTURE LEVEL PRECONDITIONING</b><br>The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and transitions between temperature extremes. This testing will also expose excessive thermal mismatch between materials.<br><b>Test Conditions:</b> TA = -65°C to 150°C, air to air<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Wire bond, cracked or lifted die and package failure |



# Test Summary

| Test Name    | Test Conditions & Bias                                                  | Lot ID | Interval | SS | Rej | Comment |
|--------------|-------------------------------------------------------------------------|--------|----------|----|-----|---------|
| Auto         | TA = +121°C, RH = 100%, PSIG = 15, N/A                                  | 0450A  | 0 Hr.    | 30 | 0   |         |
|              |                                                                         | 0450A  | 96 Hr.   | 30 | 0   |         |
|              |                                                                         | 0477B  | 0 Hr.    | 77 | 0   |         |
|              |                                                                         | 0477B  | 96 Hr.   | 77 | 0   |         |
|              |                                                                         | 0668A  | 0 Hr.    | 77 | 0   |         |
|              |                                                                         | 0668A  | 96 Hr.   | 77 | 0   |         |
|              |                                                                         | 0669A  | 0 Hr.    | 77 | 0   |         |
|              |                                                                         | 0669A  | 96 Hr.   | 77 | 0   |         |
| Auto-PC      | After MSL-1 pre-conditioning:<br>TA = +121°C, RH = 100%, PSIG = 15, N/A | 0477A  | 0 Hr.    | 76 | 0   |         |
|              |                                                                         | 0477A  | 96 Hr.   | 76 | 0   |         |
|              |                                                                         | 0668A  | 0 Hr.    | 77 | 0   |         |
|              |                                                                         | 0668A  | 96 Hr.   | 77 | 0   |         |
|              |                                                                         | 0669A  | 0 Hr.    | 68 | 0   |         |
|              |                                                                         | 0669A  | 96 Hr.   | 68 | 0   |         |
| Bond Pull    | Cond. C or D; pre- or post mold, N/A                                    | 0477A  | Results  | 5  | 0   |         |
| Bond Shear   | Cond. C or D; pre- or post mold, N/A                                    | 0477A  | Results  | 5  | 0   |         |
| DPA-H3TRB-PC | Random Sample of Good H3TRB devices per CDF-AEC-Q101-004 Section 4, N/A | 0477A  | Results  | 2  | 0   |         |
|              |                                                                         | 0668A  | Results  | 2  | 0   |         |
|              |                                                                         | 0669A  | Results  | 2  | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                                                                                    | Lot ID | Interval | SS | Rej | Comment |
|-----------|---------------------------------------------------------------------------------------------------------------------------|--------|----------|----|-----|---------|
| DPA-TC    | Random Sample of Good Temp Cycle devices per CDF-AEC-Q101-004 Section 4, N/A                                              | 0450A  | Results  | 2  | 0   |         |
|           |                                                                                                                           | 0477A  | Results  | 2  | 0   |         |
| DPA-TC-PC | Random Sample of Good Temp Cycle devices per CDF-AEC-Q101-004 Section 4, N/A                                              | 0477A  | Results  | 2  | 0   |         |
| Elect Dis | As Specified, N/A                                                                                                         | 0477A  | Results  | 20 | 0   |         |
| ESD       | MM, N/A                                                                                                                   | 0477A  | Results  | 5  | 0   |         |
| H3TRB     | TA = +85°C, RH = 85%, +4.8 volts to pins 1-24 in parallel, to ground connection. Note: pin 1 = pin 24 and pin 3 = pin 22. | 0450A  | 0 Hr.    | 29 | 0   |         |
|           |                                                                                                                           | 0450A  | 504 Hr.  | 29 | 0   |         |
|           |                                                                                                                           | 0450A  | 1008 Hr. | 29 | 0   |         |
|           |                                                                                                                           | 0477A  | 0 Hr.    | 71 | 0   |         |
|           |                                                                                                                           | 0477A  | 504 Hr.  | 71 | 0   |         |
|           |                                                                                                                           | 0477A  | 1008 Hr. | 71 | 0   |         |
|           |                                                                                                                           | 0668A  | 0 Hr.    | 77 | 0   |         |
|           |                                                                                                                           | 0668A  | 504 Hr.  | 77 | 0   |         |
|           |                                                                                                                           | 0668A  | 1008 Hr. | 77 | 0   |         |
|           |                                                                                                                           | 0669A  | 0 Hr.    | 77 | 0   |         |
|           |                                                                                                                           | 0669A  | 504 Hr.  | 77 | 0   |         |
|           |                                                                                                                           | 0669A  | 1008 Hr. | 77 | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                                                                            | Lot ID | Interval        | SS | Rej | Comment |
|-----------|-------------------------------------------------------------------------------------------------------------------|--------|-----------------|----|-----|---------|
| H3TRB-PC  | After MSL-1 pre-conditioning:<br>TA = +85°C; RH = 85%, +4.8 volts to pins 1-24 in parallel, to ground connection. | 0477A  | 0 Hr.           | 59 | 0   |         |
|           |                                                                                                                   | 0477A  | 504 Hr.         | 59 | 0   |         |
|           |                                                                                                                   | 0477A  | <b>1008 Hr.</b> | 59 | 0   |         |
|           |                                                                                                                   | 0668A  | 0 Hr.           | 77 | 0   |         |
|           |                                                                                                                   | 0668A  | 1008 Hr.        | 77 | 0   |         |
|           |                                                                                                                   | 0669A  | 0 Hr.           | 77 | 0   |         |
| HTRB      | TA = +150°C, +4.8 volts to pins 1-24 in parallel, to ground connection.                                           | 0669A  | 504 Hr.         | 77 | 0   |         |
|           |                                                                                                                   | 0450A  | 0 Hr.           | 28 | 0   |         |
|           |                                                                                                                   | 0450A  | 504 Hr.         | 28 | 0   |         |
|           |                                                                                                                   | 0450A  | <b>1008 Hr.</b> | 28 | 0   |         |
|           |                                                                                                                   | 0477A  | 0 Hr.           | 77 | 0   |         |
|           |                                                                                                                   | 0477A  | 504 Hr.         | 77 | 0   |         |
|           |                                                                                                                   | 0477A  | <b>1008 Hr.</b> | 77 | 0   |         |
|           |                                                                                                                   | 0668A  | 0 Hr.           | 77 | 0   |         |
|           |                                                                                                                   | 0668A  | 504 Hr.         | 77 | 0   |         |
|           |                                                                                                                   | 0668A  | <b>1008 Hr.</b> | 77 | 0   |         |
|           |                                                                                                                   | 0669A  | 0 Hr.           | 77 | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                                                | Lot ID | Interval          | SS  | Rej | Comment |
|-----------|---------------------------------------------------------------------------------------|--------|-------------------|-----|-----|---------|
| IOL       | TA = +25°C, delta Tj => 100°C, 2 minutes on/off, Delta Tj of 100C                     | 0669A  | 504 Hr.           | 77  | 0   |         |
|           |                                                                                       | 0669A  | <b>1008 Hr.</b>   | 77  | 0   |         |
|           |                                                                                       | 0450A  | 0 Cyc.            | 29  | 0   |         |
|           |                                                                                       | 0450A  | 7500 Cyc.         | 29  | 0   |         |
|           |                                                                                       | 0450A  | <b>15000 Cyc.</b> | 20  | 0   |         |
|           |                                                                                       | 0477B  | 0 Cyc.            | 72  | 0   |         |
|           |                                                                                       | 0477B  | 7500 Cyc.         | 72  | 0   |         |
|           |                                                                                       | 0477B  | <b>15000 Cyc.</b> | 72  | 0   |         |
| IOL-PC    | By similarity with MMUN1001LT1, 3 lots.                                               |        | 0 Cyc.            | 249 | 0   |         |
|           | By similarity with MMUN1001LT1, 3 lots.                                               |        | <b>10000 Cyc.</b> | 249 | 0   |         |
|           | After MSL-1 pre-conditioning:<br>TA = +25°C, delta Tj => 100°C, 2 minutes on/off,     | 0477A  | 0 Cyc.            | 75  | 0   |         |
|           |                                                                                       | 0477A  | 7500 Cyc.         | 75  | 0   |         |
|           |                                                                                       | 0477A  | <b>15000 Cyc.</b> | 75  | 0   |         |
| MSL 1     | 10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@220°C + 1X Flux Immersion + DI Rinse, N/A | 0477A  | 0 Hr.             | 307 | 0   |         |
|           |                                                                                       | 0477A  | Readout           | 307 | 0   |         |
|           |                                                                                       | 0668A  | 0 Hr.             | 320 | 0   |         |
|           |                                                                                       | 0668A  | Readout           | 320 | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                            | Lot ID | Interval  | SS  | Rej | Comment |
|-----------|-------------------------------------------------------------------|--------|-----------|-----|-----|---------|
| TC        | Air to Air; -65°C to +150°C, N/A                                  | 0669A  | 0 Hr.     | 320 | 0   |         |
|           |                                                                   | 0669A  | Readout   | 320 | 0   |         |
|           |                                                                   | 0450A  | 0 Cyc.    | 30  | 0   |         |
|           |                                                                   | 0450A  | 500 Cyc.  | 30  | 0   |         |
|           |                                                                   | 0450A  | 1000 Cyc. | 30  | 0   |         |
|           |                                                                   | 0477A  | 0 Cyc.    | 77  | 0   |         |
|           |                                                                   | 0477A  | 500 Cyc.  | 77  | 0   |         |
|           |                                                                   | 0477A  | 1000 Cyc. | 77  | 0   |         |
|           |                                                                   | 0668A  | 0 Cyc.    | 77  | 0   |         |
|           |                                                                   | 0668A  | 500 Cyc.  | 77  | 0   |         |
|           |                                                                   | 0668A  | 1000 Cyc. | 77  | 0   |         |
|           |                                                                   | 0669A  | 0 Cyc.    | 77  | 0   |         |
|           |                                                                   | 0669A  | 500 Cyc.  | 77  | 0   |         |
|           |                                                                   | 0669A  | 1000 Cyc. | 77  | 0   |         |
| TC-PC     | After MSL-1 pre-conditioning:<br>Air to Air; -65°C to +150°C, N/A | 0477A  | 0 Cyc.    | 77  | 0   |         |
|           |                                                                   | 0477A  | 500 Cyc.  | 77  | 0   |         |
|           |                                                                   | 0477A  | 1000 Cyc. | 77  | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias | Lot ID | Interval  | SS | Rej | Comment |
|-----------|------------------------|--------|-----------|----|-----|---------|
| TC-PC     | CONTINUED              | 0668A  | 0 Cyc.    | 76 | 0   |         |
|           |                        | 0668A  | 500 Cyc.  | 76 | 0   |         |
|           |                        | 0668A  | 1000 Cyc. | 76 | 0   |         |
|           |                        | 0669A  | 0 Cyc.    | 77 | 0   |         |
|           |                        | 0669A  | 500 Cyc.  | 77 | 0   |         |
|           |                        | 0669A  | 1000 Cyc. | 77 | 0   |         |



\*Note: No parametric limits have been negotiated for low/high (-55C/+150C) temperatures.

| Parameter                    | Spec Min | Max  | Reading Min | Max      | X Bar    | Sigma    | Cp   | Cpk  |
|------------------------------|----------|------|-------------|----------|----------|----------|------|------|
| 25 Degrees C initial         |          |      |             |          |          |          |      |      |
| Vz @ 1mA, (Volts)            | 6 V      | 8 V  | 6.68        | 6.78     | 6.74     | 0.0163   | 82   | 15.1 |
| Ir @ 3V, (Amperes)           | n/a      | 1 UA | -1.45E-10   | 1.59E-09 | 3.61E-10 | 1.15E-10 | 2909 | 2907 |
| 25 Degrees C final           |          |      |             |          |          |          |      |      |
| Vz @ 1mA, (Volts)            | 6 V      | 8V   | 6.69        | 6.78     | 6.74     | 0.0152   | 88   | 16.4 |
| Ir @ 3V, (Amperes)           | n/a      | 1 UA | 1.92E-10    | 4.68E-08 | 1.14E-09 | 2.70E-09 | 123  | 123  |
| High Spec Temp Extreme +150C |          |      |             |          |          |          |      |      |
| Vz @ 1mA                     | -        | -    | -           | -        | -        | -        | -    | -    |
| Ir @ 3V                      | -        | -    | -           | -        | -        | -        | -    | -    |

8x20 surge to destruction study with all diodes in parallel. The highest peak power survived [by all units] was 251W.  
The highest current survived [by all units] was 18.3A.

1. 290.70 W
2. 251.37 W
3. 262.60 W
4. 260.24 W
5. 254.33 W

## Wire bond tests

- Visual 45 pcs Pass
- Wire pull 45 wires 1.72 Cpk
- Ball shear 45 balls 1.69 Cpk

## Reliability Summary

Date: 11/15/2000 Motorola Part # NZMM7V0T4

Supplier: ON Semiconductor

| TEST         | CONDITIONS                                                                   | Samples/Fail |
|--------------|------------------------------------------------------------------------------|--------------|
| PTH          | 121C @ 2 atmospheres, saturated (100% RH), t = 96 hours.                     | 231/0        |
| PTH-PC       | Ditto PTH after MSL-1 preconditioning.                                       | 221/0        |
| H3TRB        | Ta=85°C; RH=85%; +4.8 volts to pins 1-24 in parallel to ground; t=500 hours. | 231/0        |
| H3TRB-PC     | Ditto H3TRB after MSL-1 preconditioning.                                     | 219/0        |
| H3TRB-PC-DPA | H3TRB-PC survivors.                                                          | 6/0          |
| HTRB         | Ta=150°C; +4.8 volts to pins 1-24 in parallel to ground, t=500 hours.        | 231/0        |
| TC           | Air to Air; -65°C to +150°C, 500 cycles                                      | 231/0        |
| TC-PC        | Ditto TC after MSL-1 preconditioning.                                        | 231/0        |
| TC-PC-DPA    | TC-PC survivors                                                              | 6/0          |
| IOL          | Delta Tj>=100C, 7500 cycles, Ton=Toff=2 minutes.                             | 231/0        |
| ESD          | Machine Model, >2KV (units passed >30KV)                                     | 5/0          |
| SURGE        | >50W (units passed >250W)                                                    | 5/0          |
| BOND SHEAR   | 10 bonds from at least 5 units. (45 bonds were sheared.)                     | 5/0          |
| WIRE PULL    | 10 wires from at least 5 units. (45 wires were pulled.)                      | 5/0          |

**REL ID:= 450**  
**LOT ID:= a**  
**Rel Test:= AC**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 9.24     | 9.33     | 9.302     | 0.020069 | -154.5015 | 9.23       | 9.32     | 9.296     | 0.021909 | -141.4341 |
| 12          | VZ(pin 12)       | 9.25     | 9.33     | 9.304333  | 0.01888  | -164.2755 | 9.24       | 9.32     | 9.297333  | 0.020998 | -147.5902 |
| 13          | VZ(pin 13)       | 9.25     | 9.33     | 9.306667  | 0.020229 | -153.3584 | 9.25       | 9.33     | 9.3       | 0.020172 | -153.6808 |
| 22          | Delta Vz(T4-T13) | -0.0128  | 0.004    | -0.003773 | 0.00417  | 0.301638  | -0.0124    | 0.0028   | -0.00368  | 0.004141 | 0.296189  |
| 33          | IR(pin 4)        | 1.02E-11 | 4.35E-11 | 2.43E-11  | 8.8E-12  | -0.920435 | -3.29E-10  | 4.86E-11 | -1.02E-10 | 8.82E-11 | 0.38447   |
| 41          | IR(pin 12)       | 1.54E-11 | 5.11E-11 | 3.48E-11  | 8.21E-12 | -1.410966 | -3.58E-11  | 6.52E-11 | 2.53E-11  | 2.59E-11 | -0.325931 |
| 45          | VF(pin 4)        | 2.1764   | 2.4092   | 2.294667  | 0.068845 | -11.11025 | 2.1744     | 2.4188   | 2.295053  | 0.071759 | -10.66094 |
| 53          | VF(pin 12)       | 2.1652   | 2.4208   | 2.29708   | 0.075097 | -10.19601 | 2.1572     | 2.4244   | 2.29784   | 0.078145 | -9.801632 |
| 63          | Vres(pins 12-13) | 0.99344  | 1.048    | 1.012629  | 0.012391 | -27.24093 | 0.99096    | 1.0472   | 1.011417  | 0.012507 | -26.95707 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | -0.01     | -0.01     | -0.006     | -0.108225    | -0.107181    | -0.064502     |
| 12          | VZ(pin 12)       | -0.01     | -0.01     | -0.007     | -0.108108    | -0.107181    | -0.075234     |
| 13          | VZ(pin 13)       | 0         | 0         | -0.006667  | 0            | 0            | -0.071633     |
| 22          | Delta Vz(T4-T13) | 0.0004    | -0.0012   | 9.33E-05   | -3.125       | -30          | -2.472637     |
| 33          | IR(pin 4)        | -3.39E-10 | 5.12E-12  | -1.26E-10  | -3315.234    | 11.76471     | -518.5159     |
| 41          | IR(pin 12)       | -5.12E-11 | 1.41E-11  | -9.44E-12  | -333.3333    | 27.5646      | -27.16741     |
| 45          | VF(pin 4)        | -0.002    | 0.0096    | 0.000387   | -0.091895    | 0.398473     | 0.016851      |
| 53          | VF(pin 12)       | -0.008    | 0.0036    | 0.00076    | -0.369481    | 0.148711     | 0.033085      |
| 63          | Vres(pins 12-13) | -0.00248  | -0.0008   | -0.001212  | -0.249638    | -0.076336    | -0.119688     |

**REL ID:= 450**  
**LOT ID:= a**  
**Rel Test:= H3TRB**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 9.21     | 9.31     | 9.276333  | 0.025795 | -119.8707 | 9.21       | 9.31     | 9.273793  | 0.025272 | -122.3201 |
| 12          | VZ(pin 12)       | 9.23     | 9.31     | 9.279667  | 0.022967 | -134.6827 | 9.23       | 9.31     | 9.277586  | 0.022465 | -137.6594 |
| 13          | VZ(pin 13)       | 9.23     | 9.31     | 9.281667  | 0.022296 | -138.7622 | 9.23       | 9.3      | 9.27931   | 0.023289 | -132.8155 |
| 22          | Delta Vz(T4-T13) | -0.0224  | 0.0084   | -0.004467 | 0.006739 | 0.220954  | -0.0228    | 0.0084   | -0.004648 | 0.006853 | 0.226092  |
| 33          | IR(pin 4)        | -6.4E-12 | 4.99E-11 | 2.14E-11  | 1.24E-11 | -0.575756 | -6.66E-11  | 1.98E-11 | -1.11E-11 | 2E-11    | 0.185157  |
| 41          | IR(pin 12)       | 2.56E-12 | 5.12E-11 | 2.49E-11  | 1.05E-11 | -0.791943 | 0          | 9.47E-11 | 1.63E-11  | 1.82E-11 | -0.298078 |
| 45          | VF(pin 4)        | 2.0788   | 2.4008   | 2.277827  | 0.07161  | -10.60286 | 2.0696     | 2.3644   | 2.260587  | 0.072301 | -10.42209 |
| 53          | VF(pin 12)       | 2.1088   | 2.4172   | 2.279627  | 0.069401 | -10.94899 | 2.0992     | 2.3692   | 2.262747  | 0.067454 | -11.18169 |
| 63          | Vres(pins 12-13) | 1.0036   | 1.0488   | 1.028547  | 0.012898 | -26.58221 | 1.0028     | 1.0476   | 1.027347  | 0.012714 | -26.93449 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | -0.00254   | 0            | 0            | -0.027384     |
| 12          | VZ(pin 12)       | 0         | 0         | -0.00208   | 0            | 0            | -0.02242      |
| 13          | VZ(pin 13)       | 0         | -0.01     | -0.002356  | 0            | -0.107411    | -0.025387     |
| 22          | Delta Vz(T4-T13) | -0.0004   | 0         | -0.000182  | 1.785714     | 0            | 4.065101      |
| 33          | IR(pin 4)        | -6.02E-11 | -3.01E-11 | -3.25E-11  | 940.625      | -60.25641    | -151.8821     |
| 41          | IR(pin 12)       | -2.56E-12 | 4.35E-11  | -8.63E-12  | -100         | 85           | -34.58783     |
| 45          | VF(pin 4)        | -0.0092   | -0.0364   | -0.01724   | -0.442563    | -1.516161    | -0.756863     |
| 53          | VF(pin 12)       | -0.0096   | -0.048    | -0.01688   | -0.455235    | -1.985769    | -0.740474     |
| 63          | Vres(pins 12-13) | -0.0008   | -0.0012   | -0.0012    | -0.079713    | -0.114416    | -0.116666     |

**REL ID:= 450**  
**LOT ID:= a**  
**Rel Test:= HTRB**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 9.23     | 9.31     | 9.283667 | 0.018473 | -167.5147 | 9.23       | 9.72     | 9.323793  | 0.113528 | -27.37583 |
| 12          | VZ(pin 12)       | 9.23     | 9.31     | 9.285    | 0.019783 | -156.445  | 9.23       | 9.73     | 9.325517  | 0.109564 | -28.3717  |
| 13          | VZ(pin 13)       | 9.24     | 9.31     | 9.286333 | 0.018659 | -165.8949 | 9.24       | 9.73     | 9.327931  | 0.10887  | -28.55981 |
| 22          | Delta Vz(T4-T13) | -0.0116  | 0.012    | -0.00384 | 0.005467 | 0.234132  | -0.0152    | 0.0416   | -0.002855 | 0.01011  | 0.094135  |
| 33          | IR(pin 4)        | 6E-13    | 5.63E-11 | 2.39E-11 | 1.26E-11 | -0.632669 | 6E-13      | 5.63E-11 | 2.39E-11  | 1.26E-11 | -0.632669 |
| 41          | IR(pin 12)       | 1.28E-12 | 5.38E-11 | 2.76E-11 | 1.24E-11 | -0.742245 | 1.28E-12   | 5.38E-11 | 2.76E-11  | 1.24E-11 | -0.742245 |
| 45          | VF(pin 4)        | 2.124    | 2.3784   | 2.281067 | 0.069591 | -10.92604 | 2.124      | 2.3784   | 2.281067  | 0.069591 | -10.92604 |
| 53          | VF(pin 12)       | 2.1016   | 2.4048   | 2.291387 | 0.073276 | -10.42357 | 2.1016     | 2.4048   | 2.291387  | 0.073276 | -10.42357 |
| 63          | Vres(pins 12-13) | 1.0012   | 1.0456   | 1.021973 | 0.014083 | -24.1899  | 1.0012     | 1.0456   | 1.021973  | 0.014083 | -24.1899  |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0.41      | 0.040126   | 0            | 4.403867     | 0.432226      |
| 12          | VZ(pin 12)       | 0         | 0.42      | 0.040517   | 0            | 4.511278     | 0.436373      |
| 13          | VZ(pin 13)       | 0         | 0.42      | 0.041598   | 0            | 4.511278     | 0.447945      |
| 22          | Delta Vz(T4-T13) | -0.0036   | 0.0296    | 0.000985   | 31.03448     | 246.6667     | -25.64745     |
| 33          | IR(pin 4)        | 0         | 0         | 0          | 0            | 0            | 0             |
| 41          | IR(pin 12)       | 0         | 0         | 0          | 0            | 0            | 0             |
| 45          | VF(pin 4)        | 0         | 0         | 0          | 0            | 0            | 0             |
| 53          | VF(pin 12)       | 0         | 0         | 0          | 0            | 0            | 0             |
| 63          | Vres(pins 12-13) | 0         | 0         | 0          | 0            | 0            | 0             |

**REL ID:= 477**  
**LOT ID:= a**  
**Rel Test:= AC\_PC**

| Test Number | Test Name        | Initial   |          |          |          |           | Qual Point |          |           |          |           |
|-------------|------------------|-----------|----------|----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min       | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.8       | 6.88     | 6.848571 | 0.019447 | -117.3872 | 6.8        | 6.88     | 6.848158  | 0.019981 | -114.2463 |
| 12          | VZ(pin 12)       | 6.8       | 6.88     | 6.851299 | 0.017041 | -134.0158 | 6.8        | 6.89     | 6.850789  | 0.017871 | -127.7831 |
| 13          | VZ(pin 13)       | 6.8       | 6.89     | 6.852468 | 0.018221 | -125.3614 | 6.8        | 6.89     | 6.852632  | 0.018502 | -123.459  |
| 22          | Delta Vz(T4-T13) | -0.0492   | 0.0464   | -0.00439 | 0.018799 | 0.077836  | -0.0492    | 0.0464   | -0.004653 | 0.019005 | 0.081602  |
| 33          | IR(pin 4)        | 1.48E-10  | 5.58E-10 | 2.44E-10 | 9.14E-11 | -0.889065 | 6.56E-11   | 2.99E-08 | 6.37E-10  | 3.41E-09 | -0.062288 |
| 41          | IR(pin 12)       | -3.07E-11 | 7.16E-10 | 2.6E-10  | 1.1E-10  | -0.787276 | 1.43E-10   | 3.05E-08 | 1.04E-09  | 3.85E-09 | -0.090468 |
| 45          | VF(pin 4)        | 1.0288    | 1.174    | 1.080836 | 0.034189 | -10.53773 | 1.0252     | 1.1828   | 1.080626  | 0.03778  | -9.534486 |
| 53          | VF(pin 12)       | 1.028     | 1.1912   | 1.085631 | 0.039899 | -9.069914 | 1.0252     | 1.197199 | 1.088095  | 0.04275  | -8.484259 |
| 63          | Vres(pins 12-13) | 0.92316   | 1.0304   | 0.960121 | 0.023109 | -13.84929 | 0.9222     | 1.0308   | 0.960104  | 0.023168 | -13.81377 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | -0.000414  | 0            | 0            | -0.006038     |
| 12          | VZ(pin 12)       | 0         | 0.01      | -0.000509  | 0            | 0.145349     | -0.007433     |
| 13          | VZ(pin 13)       | 0         | 0         | 0.000164   | 0            | 0            | 0.002394      |
| 22          | Delta Vz(T4-T13) | 0         | 0         | -0.000263  | 0            | 0            | 5.991903      |
| 33          | IR(pin 4)        | -8.28E-11 | 2.94E-08  | 3.93E-10   | -55.79203    | 5265.207     | 161.0864      |
| 41          | IR(pin 12)       | 1.74E-10  | 2.97E-08  | 7.84E-10   | -566.5365    | 4155.688     | 302.1515      |
| 45          | VF(pin 4)        | -0.0036   | 0.0088    | -0.00021   | -0.349922    | 0.749574     | -0.019439     |
| 53          | VF(pin 12)       | -0.0028   | 0.005999  | 0.002464   | -0.272374    | 0.50361      | 0.22692       |
| 63          | Vres(pins 12-13) | -0.00096  | 0.0004    | -1.68E-05  | -0.103991    | 0.03882      | -0.001753     |

**REL ID:= 477**  
**LOT ID:= a**  
**Rel Test:= H3TRB**

| Test Number | Test Name        | Initial   |          |           |          |              | Qual Point |          |          |          |           |
|-------------|------------------|-----------|----------|-----------|----------|--------------|------------|----------|----------|----------|-----------|
|             |                  | Min       | Max      | Mean      | StDev    | Cpk          | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.79      | 6.89     | 6.844935  | 0.020237 | -112.7463417 | 6.79       | 6.88     | 6.841948 | 0.019402 | -117.5501 |
| 12          | VZ(pin 12)       | 6.78      | 6.9      | 6.845584  | 0.019091 | -119.527096  | 5.8        | 6.89     | 6.828701 | 0.12031  | -18.91967 |
| 13          | VZ(pin 13)       | 6.79      | 6.9      | 6.847143  | 0.019253 | -118.5469801 | 5.67       | 6.9      | 6.829351 | 0.135388 | -16.8143  |
| 22          | Delta Vz(T4-T13) | -0.0588   | 0.0424   | -0.002197 | 0.018272 | 0.040086516  | -0.0592    | 1.18     | 0.013132 | 0.135971 | -0.032194 |
| 33          | IR(pin 4)        | 1.2E-10   | 4.02E-10 | 2.13E-10  | 5.7E-11  | -1.242642362 | -1.29E-10  | 3.51E-07 | 7.48E-09 | 4.63E-08 | -0.05386  |
| 41          | IR(pin 12)       | -3.33E-11 | 4.86E-10 | 2.34E-10  | 6.76E-11 | -1.155301238 | 4.86E-11   | 4.41E-07 | 1.04E-08 | 6.27E-08 | -0.055224 |
| 45          | VF(pin 4)        | 1.0424    | 1.2108   | 1.089667  | 0.035242 | -10.30640601 | 1.0424     | 1.2148   | 1.090847 | 0.036195 | -10.04589 |
| 53          | VF(pin 12)       | 1.039199  | 1.225999 | 1.087626  | 0.036306 | -9.985752589 | 1.039199   | 1.23     | 1.089236 | 0.037067 | -9.795209 |
| 63          | Vres(pins 12-13) | 0.9354    | 1.035599 | 0.987463  | 0.026466 | -12.43670901 | 0.93484    | 1.0352   | 0.987165 | 0.026228 | -12.54579 |

| Test Number | Test Name        | Delta Min | Delta Max | Delta     | Delta(%)  | Delta(%) Max | Delta(%)  |
|-------------|------------------|-----------|-----------|-----------|-----------|--------------|-----------|
|             |                  |           |           | Mean      | Min       |              | Mean      |
| 4           | VZ(pin 4)        | 0         | -0.01     | -0.002987 | 0         | -0.145137881 | -0.043638 |
| 12          | VZ(pin 12)       | -0.98     | -0.01     | -0.016883 | -14.45428 | -0.144927536 | -0.246628 |
| 13          | VZ(pin 13)       | -1.12     | 0         | -0.017792 | -16.49485 | 0            | -0.259849 |
| 22          | Delta Vz(T4-T13) | -0.0004   | 1.1376    | 0.01533   | 0.680272  | 2683.018868  | -697.6359 |
| 33          | IR(pin 4)        | -2.49E-10 | 3.51E-07  | 7.27E-09  | -206.9884 | 87311.61239  | 3418.209  |
| 41          | IR(pin 12)       | 8.19E-11  | 4.41E-07  | 1.02E-08  | -245.8583 | 90664.80263  | 4332.455  |
| 45          | VF(pin 4)        | 0         | 0.004     | 0.001179  | 0         | 0.330360093  | 0.108221  |
| 53          | VF(pin 12)       | 0         | 0.004001  | 0.00161   | 0         | 0.326346106  | 0.148062  |
| 63          | Vres(pins 12-13) | -0.00056  | -0.000399 | -0.000298 | -0.059867 | -0.038528427 | -0.030197 |

**REL ID:= 477**  
**LOT ID:= a**  
**Rel Test:= HTRB**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.8      | 6.88     | 6.845065  | 0.017519 | -130.2433 | 6.8        | 6.89     | 6.846234  | 0.017399 | -131.1595 |
| 12          | VZ(pin 12)       | 6.8      | 6.89     | 6.843117  | 0.016957 | -134.5223 | 6.8        | 6.89     | 6.844286  | 0.017504 | -130.3374 |
| 13          | VZ(pin 13)       | 6.79     | 6.88     | 6.845455  | 0.018104 | -126.0401 | 6.79       | 6.89     | 6.846234  | 0.018781 | -121.5085 |
| 22          | Delta Vz(T4-T13) | -0.0428  | 0.044    | -0.000192 | 0.018241 | 0.003512  | -0.0428    | 0.0428   | -0.000405 | 0.018244 | 0.007403  |
| 33          | IR(pin 4)        | 1.3E-10  | 3.98E-10 | 2.14E-10  | 5.71E-11 | -1.2469   | 1.63E-10   | 3.12E-09 | 3.52E-10  | 4.33E-10 | -0.270652 |
| 41          | IR(pin 12)       | 1.28E-11 | 1.02E-09 | 2.45E-10  | 1.24E-10 | -0.660285 | 5.42E-11   | 2.81E-09 | 3.43E-10  | 3.22E-10 | -0.354583 |
| 45          | VF(pin 4)        | 1.0324   | 1.1628   | 1.082     | 0.027192 | -13.26372 | 1.0336     | 1.184    | 1.093792  | 0.034187 | -10.66489 |
| 53          | VF(pin 12)       | 1.0108   | 1.154    | 1.079766  | 0.026294 | -13.68842 | 1.0172     | 1.172    | 1.090519  | 0.03221  | -11.2855  |
| 63          | Vres(pins 12-13) | 0.947    | 1.035599 | 0.988604  | 0.022346 | -14.74688 | 0.95584    | 1.0436   | 0.997156  | 0.022172 | -14.99104 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0.01      | 0.001169   | 0            | 0.145349     | 0.017076      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.001169   | 0            | 0            | 0.01708       |
| 13          | VZ(pin 13)       | 0         | 0.01      | 0.000779   | 0            | 0.145349     | 0.011383      |
| 22          | Delta Vz(T4-T13) | 0         | -0.0012   | -0.000213  | 0            | -2.727273    | 110.8108      |
| 33          | IR(pin 4)        | 3.21E-11  | 2.72E-09  | 1.38E-10   | 24.62435     | 682.98       | 64.7697       |
| 41          | IR(pin 12)       | 4.14E-11  | 1.79E-09  | 9.72E-11   | 323.75       | 176.1071     | 39.57765      |
| 45          | VF(pin 4)        | 0.0012    | 0.0212    | 0.011792   | 0.116234     | 1.823185     | 1.089853      |
| 53          | VF(pin 12)       | 0.0064    | 0.018     | 0.010753   | 0.633162     | 1.559792     | 0.995888      |
| 63          | Vres(pins 12-13) | 0.00884   | 0.008001  | 0.008552   | 0.933474     | 0.772596     | 0.865031      |

**REL ID:= 477**  
**LOT ID:= a**  
**Rel Test:= TC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.8      | 6.87     | 6.843636 | 0.015467 | -147.487  | 6.79       | 6.87     | 6.841429 | 0.017525 | -130.1234 |
| 12          | VZ(pin 12)       | 6.79     | 6.87     | 6.841429 | 0.018261 | -124.8834 | 6.78       | 6.87     | 6.84039  | 0.018669 | -122.1347 |
| 13          | VZ(pin 13)       | 6.79     | 6.88     | 6.838831 | 0.020454 | -111.4524 | 6.79       | 6.88     | 6.837662 | 0.020384 | -111.813  |
| 22          | Delta Vz(T4-T13) | -0.0356  | 0.0432   | 0.004244 | 0.01852  | -0.076389 | -0.0352    | 0.0436   | 0.004281 | 0.018702 | -0.076294 |
| 33          | IR(pin 4)        | 1.36E-10 | 4.56E-10 | 2.03E-10 | 5.98E-11 | -1.131223 | -1.03E-09  | 4.71E-10 | 1.82E-10 | 1.57E-10 | -0.386148 |
| 41          | IR(pin 12)       | 2.81E-11 | 6.24E-10 | 2.23E-10 | 7.84E-11 | -0.94718  | 1.56E-10   | 6.44E-10 | 2.3E-10  | 7.53E-11 | -1.018398 |
| 45          | VF(pin 4)        | 1.0384   | 1.1192   | 1.076026 | 0.019544 | -18.35251 | 1.0568     | 1.146    | 1.098415 | 0.022575 | -16.21855 |
| 53          | VF(pin 12)       | 1.0324   | 1.126    | 1.076473 | 0.020987 | -17.09762 | 1.0496     | 1.1508   | 1.098483 | 0.026699 | -13.7143  |
| 63          | Vres(pins 12-13) | 0.951    | 1.0352   | 0.990563 | 0.021335 | -15.4766  | 0.95328    | 1.0364   | 0.99219  | 0.021391 | -15.46139 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | -0.01     | 0         | -0.002208  | -0.147059    | 0            | -0.032261     |
| 12          | VZ(pin 12)       | -0.01     | 0         | -0.001039  | -0.147275    | 0            | -0.015186     |
| 13          | VZ(pin 13)       | 0         | 0         | -0.001169  | 0            | 0            | -0.017091     |
| 22          | Delta Vz(T4-T13) | 0.0004    | 0.0004    | 3.64E-05   | -1.123596    | 0.925926     | 0.856793      |
| 33          | IR(pin 4)        | -1.17E-09 | 1.55E-11  | -2.12E-11  | -859.434     | 3.398016     | -10.46064     |
| 41          | IR(pin 12)       | 1.27E-10  | 1.94E-11  | 7.16E-12   | 453.2006     | 3.100775     | 3.210569      |
| 45          | VF(pin 4)        | 0.0184    | 0.0268    | 0.022389   | 1.771957     | 2.394568     | 2.080754      |
| 53          | VF(pin 12)       | 0.0172    | 0.0248    | 0.02201    | 1.666021     | 2.202487     | 2.044678      |
| 63          | Vres(pins 12-13) | 0.00228   | 0.0012    | 0.001627   | 0.239748     | 0.11592      | 0.164251      |

**REL ID:= 477**  
**LOT ID:= a**  
**Rel Test:= TC\_PC**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.81     | 6.89     | 6.856104  | 0.018364 | -124.4454 | 6.81       | 6.89     | 6.857273  | 0.018399 | -124.2339 |
| 12          | VZ(pin 12)       | 6.82     | 6.9      | 6.860649  | 0.015839 | -144.3788 | 6.82       | 6.9      | 6.861818  | 0.01502  | -152.2826 |
| 13          | VZ(pin 13)       | 6.82     | 6.89     | 6.861039  | 0.016826 | -135.9207 | 6.82       | 6.89     | 6.861818  | 0.01668  | -137.1249 |
| 22          | Delta Vz(T4-T13) | -0.0484  | 0.0448   | -0.004421 | 0.015996 | 0.092122  | -0.046     | 0.0444   | -0.004223 | 0.016112 | 0.087374  |
| 33          | IR(pin 4)        | 7.67E-11 | 4.94E-10 | 2.42E-10  | 7.37E-11 | -1.093926 | -1.51E-09  | 1.46E-09 | 2.47E-10  | 2.59E-10 | -0.317362 |
| 41          | IR(pin 12)       | 3.6E-13  | 6.88E-10 | 2.58E-10  | 8.94E-11 | -0.963143 | -1.04E-10  | 9.4E-10  | 2.62E-10  | 1.18E-10 | -0.737936 |
| 45          | VF(pin 4)        | 1.0412   | 1.2104   | 1.106099  | 0.041869 | -8.805941 | 1.0516     | 1.22     | 1.122592  | 0.038166 | -9.804461 |
| 53          | VF(pin 12)       | 1.03     | 1.23     | 1.113839  | 0.044017 | -8.434987 | 1.0376     | 1.2316   | 1.132208  | 0.044275 | -8.523996 |
| 63          | Vres(pins 12-13) | 0.92528  | 1.031999 | 0.96239   | 0.021807 | -14.71091 | 0.92612    | 1.034    | 0.963589  | 0.021929 | -14.64689 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.001169   | 0            | 0            | 0.017048      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.001169   | 0            | 0            | 0.017037      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.000779   | 0            | 0            | 0.011357      |
| 22          | Delta Vz(T4-T13) | 0.0024    | -0.0004   | 0.000197   | -4.958678    | -0.892857    | -4.465335     |
| 33          | IR(pin 4)        | -1.59E-09 | 9.65E-10  | 4.9E-12    | -2069.744    | 195.4085     | 2.024822      |
| 41          | IR(pin 12)       | -1.04E-10 | 2.51E-10  | 3.73E-12   | -28877.78    | 36.5502      | 1.444238      |
| 45          | VF(pin 4)        | 0.0104    | 0.0096    | 0.016494   | 0.998847     | 0.793126     | 1.491147      |
| 53          | VF(pin 12)       | 0.0076    | 0.0016    | 0.018369   | 0.737864     | 0.130081     | 1.649151      |
| 63          | Vres(pins 12-13) | 0.00084   | 0.002001  | 0.0012     | 0.090783     | 0.193896     | 0.124638      |

**REL ID:= 477**  
**LOT ID:= b**  
**Rel Test:= AUTO**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.78     | 6.88     | 6.844935 | 0.017368 | -131.3721 | 6.78       | 6.88     | 6.846494  | 0.017974 | -126.9695 |
| 12          | VZ(pin 12)       | 6.78     | 6.88     | 6.846494 | 0.016604 | -137.4447 | 6.78       | 6.88     | 6.847403  | 0.016336 | -139.7243 |
| 13          | VZ(pin 13)       | 6.79     | 6.87     | 6.847143 | 0.014406 | -158.438  | 6.79       | 6.87     | 6.848571  | 0.014022 | -162.8054 |
| 22          | Delta Vz(T4-T13) | -0.068   | 0.0448   | -0.00241 | 0.014075 | 0.057086  | -0.0688    | 0.0452   | -0.002192 | 0.013951 | 0.05238   |
| 33          | IR(pin 4)        | 1.33E-10 | 4.58E-10 | 2.05E-10 | 6.78E-11 | -1.004847 | 1.52E-10   | 1.62E-07 | 1.02E-08  | 2.64E-08 | -0.129376 |
| 41          | IR(pin 12)       | 1.6E-10  | 6.28E-10 | 2.24E-10 | 7.83E-11 | -0.953507 | 1.75E-10   | 1.91E-06 | 1.95E-07  | 3.55E-07 | -0.182605 |
| 45          | VF(pin 4)        | 1.0348   | 1.1984   | 1.077823 | 0.030987 | -11.59433 | 1.0328     | 1.2012   | 1.078176  | 0.030025 | -11.96978 |
| 53          | VF(pin 12)       | 1.0348   | 1.1496   | 1.076961 | 0.025729 | -13.95269 | 1.0332     | 1.1708   | 1.078815  | 0.028103 | -12.79578 |
| 63          | Vres(pins 12-13) | 0.95124  | 1.024799 | 0.982684 | 0.021911 | -14.9495  | 0.95184    | 1.024799 | 0.982702  | 0.021837 | -15.00088 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.001558   | 0            | 0            | 0.022768      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.000909   | 0            | 0            | 0.013278      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.001429   | 0            | 0            | 0.020864      |
| 22          | Delta Vz(T4-T13) | -0.0008   | 0.0004    | 0.000218   | 1.176471     | 0.892857     | -9.051724     |
| 33          | IR(pin 4)        | 1.98E-11  | 1.62E-07  | 1E-08      | 14.91096     | 35335.41     | 4908.524      |
| 41          | IR(pin 12)       | 1.57E-11  | 1.91E-06  | 1.94E-07   | 9.842224     | 303489.6     | 86749.98      |
| 45          | VF(pin 4)        | -0.002    | 0.0028    | 0.000353   | -0.193274    | 0.233645     | 0.032767      |
| 53          | VF(pin 12)       | -0.0016   | 0.0212    | 0.001855   | -0.154619    | 1.84412      | 0.172201      |
| 63          | Vres(pins 12-13) | 0.0006    | 0         | 1.82E-05   | 0.063076     | 0            | 0.001857      |

**REL ID:= 477**  
**LOT ID:= b**  
**Rel Test:= IOL**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.79     | 6.88     | 6.844416 | 0.017282 | -132.0144 | 6.79       | 15       | 7.052987 | 1.306374 | -1.799634 |
| 12          | VZ(pin 12)       | 6.78     | 6.88     | 6.846104 | 0.016635 | -137.1821 | 6.78       | 15       | 7.053766 | 1.306226 | -1.800037 |
| 13          | VZ(pin 13)       | 6.8      | 6.88     | 6.843506 | 0.017454 | -130.6948 | 6.8        | 15       | 7.052078 | 1.306539 | -1.799176 |
| 22          | Delta Vz(T4-T13) | -0.0636  | 0.0428   | 0.00093  | 0.018618 | -0.016648 | -0.0632    | 0.0408   | 0.000358 | 0.018468 | -0.00647  |
| 33          | IR(pin 4)        | 1.18E-10 | 3.78E-10 | 2.42E-10 | 5.15E-11 | -1.564351 | 2.28E-12   | 1.73E-09 | 4.19E-10 | 3.5E-10  | -0.399531 |
| 41          | IR(pin 12)       | 1.58E-10 | 4.1E-10  | 2.62E-10 | 5.6E-11  | -1.560668 | -1.4E-12   | 3.73E-09 | 5.32E-10 | 7.05E-10 | -0.25157  |
| 45          | VF(pin 4)        | 1.042    | 1.2256   | 1.091745 | 0.026822 | -13.56778 | 0.9804     | 5.0008   | 1.335521 | 0.972988 | -0.457533 |
| 53          | VF(pin 12)       | 1.0516   | 1.198    | 1.091075 | 0.022968 | -15.83442 | 0.97936    | 5.0016   | 1.288207 | 0.875381 | -0.490532 |
| 63          | Vres(pins 12-13) | 0.94888  | 1.021199 | 0.978807 | 0.017955 | -18.17141 | 0.94912    | 2.5016   | 1.019571 | 0.244248 | -1.391443 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 8.12      | 0.208571   | 0            | 118.0233     | 3.047323      |
| 12          | VZ(pin 12)       | 0         | 8.12      | 0.207662   | 0            | 118.0233     | 3.033292      |
| 13          | VZ(pin 13)       | 0         | 8.12      | 0.208571   | 0            | 118.0233     | 3.047727      |
| 22          | Delta Vz(T4-T13) | 0.0004    | -0.002    | -0.000571  | -0.628931    | -4.672897    | -61.45251     |
| 33          | IR(pin 4)        | -1.15E-10 | 1.35E-09  | 1.77E-10   | -98.06386    | 356.4504     | 73.36256      |
| 41          | IR(pin 12)       | -1.6E-10  | 3.32E-09  | 2.69E-10   | -100.8836    | 809.4727     | 102.6866      |
| 45          | VF(pin 4)        | -0.0616   | 3.7752    | 0.243776   | -5.911708    | 308.0287     | 22.32902      |
| 53          | VF(pin 12)       | -0.07224  | 3.8036    | 0.197131   | -6.869532    | 317.4958     | 18.06764      |
| 63          | Vres(pins 12-13) | 0.00024   | 1.480401  | 0.040764   | 0.025293     | 144.9669     | 4.164625      |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= AC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.74     | 6.82     | 6.778875 | 0.018623 | -121.3346 | 6.74       | 6.82     | 6.78     | 0.018759 | -120.4757 |
| 12          | VZ(pin 12)       | 6.74     | 6.82     | 6.77925  | 0.017413 | -129.7705 | 6.73       | 6.82     | 6.779875 | 0.018106 | -124.8172 |
| 13          | VZ(pin 13)       | 6.74     | 6.81     | 6.77825  | 0.018878 | -119.6829 | 6.74       | 6.81     | 6.779375 | 0.019509 | -115.8309 |
| 22          | Delta Vz(T4-T13) | -0.034   | 0.0412   | 0.000415 | 0.015505 | -0.008922 | -0.034     | 0.0476   | 0.000585 | 0.015782 | -0.012356 |
| 33          | IR(pin 4)        | 1.38E-10 | 6.57E-10 | 3.02E-10 | 9.42E-11 | -1.069431 | 3.83E-11   | 1.27E-07 | 2.07E-09 | 1.42E-08 | -0.048614 |
| 41          | IR(pin 12)       | 1.68E-10 | 6.55E-10 | 3.27E-10 | 1.09E-10 | -1.003264 | 1.59E-10   | 0.000102 | 1.27E-06 | 1.14E-05 | -0.037305 |
| 45          | VF(pin 4)        | 1.0684   | 1.178    | 1.118755 | 0.019124 | -19.49977 | 1.0676     | 1.1804   | 1.11806  | 0.019711 | -18.90734 |
| 53          | VF(pin 12)       | 1.0748   | 1.1628   | 1.11657  | 0.016028 | -23.22135 | 1.0748     | 1.1624   | 1.115845 | 0.016539 | -22.48904 |
| 63          | Vres(pins 12-13) | 0.93336  | 1.0156   | 0.968793 | 0.019054 | -16.94778 | 0.93312    | 1.0156   | 0.968843 | 0.018935 | -17.05579 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.001125   | 0            | 0            | 0.016596      |
| 12          | VZ(pin 12)       | -0.01     | 0         | 0.000625   | -0.148368    | 0            | 0.009219      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.001125   | 0            | 0            | 0.016597      |
| 22          | Delta Vz(T4-T13) | 0         | 0.0064    | 0.00017    | 0            | 15.53398     | 40.96386      |
| 33          | IR(pin 4)        | -1E-10    | 1.26E-07  | 1.76E-09   | -72.30903    | 19207.87     | 583.1368      |
| 41          | IR(pin 12)       | -8.96E-12 | 0.000102  | 1.27E-06   | -5.343511    | 15518425     | 388997.3      |
| 45          | VF(pin 4)        | -0.0008   | 0.0024    | -0.000695  | -0.074878    | 0.203735     | -0.062119     |
| 53          | VF(pin 12)       | 0         | -0.0004   | -0.000725  | 0            | -0.0344      | -0.064925     |
| 63          | Vres(pins 12-13) | -0.00024  | 0         | 5.1E-05    | -0.025714    | 0            | 0.005263      |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= AC-PC**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.76     | 6.81     | 6.79025   | 0.009933 | -227.861  | 6.76       | 6.82     | 6.791625 | 0.010607 | -213.4252 |
| 12          | VZ(pin 12)       | 6.77     | 6.82     | 6.7925    | 0.009209 | -245.8581 | 6.77       | 6.85     | 6.793625 | 0.01139  | -198.8192 |
| 13          | VZ(pin 13)       | 6.77     | 6.81     | 6.791125  | 0.009139 | -247.687  | 6.76       | 6.83     | 6.791375 | 0.01188  | -190.5623 |
| 22          | Delta Vz(T4-T13) | -0.0316  | 0.0352   | -0.000145 | 0.013781 | 0.003507  | -0.0312    | 0.0352   | 4.5E-05  | 0.013841 | -0.001084 |
| 33          | IR(pin 4)        | 1.83E-10 | 6.23E-10 | 3.09E-10  | 9.41E-11 | -1.093937 | -4.84E-09  | 0.002266 | 2.83E-05 | 0.000253 | -0.037279 |
| 41          | IR(pin 12)       | 1.77E-10 | 7.85E-10 | 3.35E-10  | 1.08E-10 | -1.031747 | 2.09E-10   | 0.005155 | 6.45E-05 | 0.000576 | -0.037327 |
| 45          | VF(pin 4)        | 1.1      | 1.183599 | 1.124765  | 0.016396 | -22.8663  | 1.1028     | 1.5444   | 1.181585 | 0.098522 | -3.997692 |
| 53          | VF(pin 12)       | 1.088799 | 1.1672   | 1.124215  | 0.015543 | -24.11016 | 1.0948     | 1.5452   | 1.18137  | 0.101048 | -3.897051 |
| 63          | Vres(pins 12-13) | 0.93416  | 1.008    | 0.973483  | 0.017875 | -18.1532  | 0.93332    | 1.0068   | 0.972797 | 0.017847 | -18.16895 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0.01      | 0.001375   | 0            | 0.146843     | 0.02025       |
| 12          | VZ(pin 12)       | 0         | 0.03      | 0.001125   | 0            | 0.439883     | 0.016562      |
| 13          | VZ(pin 13)       | -0.01     | 0.02      | 0.00025    | -0.14771     | 0.293686     | 0.003681      |
| 22          | Delta Vz(T4-T13) | 0.0004    | 0         | 0.00019    | -1.265823    | 0            | -131.0345     |
| 33          | IR(pin 4)        | -5.02E-09 | 0.002266  | 2.83E-05   | -2744.872    | 3.64E+08     | 9174734       |
| 41          | IR(pin 12)       | 3.24E-11  | 0.005155  | 6.45E-05   | 18.34239     | 6.57E+08     | 19287794      |
| 45          | VF(pin 4)        | 0.0028    | 0.360801  | 0.05682    | 0.254545     | 30.48338     | 5.05172       |
| 53          | VF(pin 12)       | 0.006001  | 0.378     | 0.057155   | 0.551158     | 32.3852      | 5.083995      |
| 63          | Vres(pins 12-13) | -0.00084  | -0.0012   | -0.000686  | -0.08992     | -0.119048    | -0.07052      |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= H3TRB**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.75     | 6.81     | 6.7875   | 0.012579 | -179.8652 | 6.75       | 6.81     | 6.787875  | 0.013187 | -171.5744 |
| 12          | VZ(pin 12)       | 6.75     | 6.82     | 6.7875   | 0.012779 | -177.0546 | 6.75       | 6.82     | 6.787375  | 0.012703 | -178.0985 |
| 13          | VZ(pin 13)       | 6.75     | 6.81     | 6.786375 | 0.01139  | -198.6071 | 6.75       | 6.81     | 6.78625   | 0.011515 | -196.4469 |
| 22          | Delta Vz(T4-T13) | -0.0348  | 0.0268   | 0.00101  | 0.011813 | -0.028499 | -0.0348    | 0.0264   | 0.001185  | 0.011902 | -0.033186 |
| 33          | IR(pin 4)        | 1.72E-10 | 9.29E-10 | 3.21E-10 | 1.09E-10 | -0.981853 | -6.68E-08  | 2.55E-07 | -1.14E-08 | 3.72E-08 | 0.101837  |
| 41          | IR(pin 12)       | 2.03E-10 | 7.74E-10 | 3.39E-10 | 1.02E-10 | -1.112583 | -5.99E-08  | 2.71E-07 | 6.56E-09  | 4.47E-08 | -0.048942 |
| 45          | VF(pin 4)        | 1.0836   | 1.174    | 1.120415 | 0.019008 | -19.64817 | 1.0836     | 1.1744   | 1.119745  | 0.019755 | -18.89408 |
| 53          | VF(pin 12)       | 1.076    | 1.1784   | 1.1174   | 0.02044  | -18.22215 | 1.074      | 1.1952   | 1.11695   | 0.021846 | -17.04257 |
| 63          | Vres(pins 12-13) | 0.93716  | 1.0024   | 0.973321 | 0.014222 | -22.8128  | 0.93536    | 0.99744  | 0.971776  | 0.014114 | -22.94998 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.000375   | 0            | 0            | 0.005525      |
| 12          | VZ(pin 12)       | 0         | 0         | -0.000125  | 0            | 0            | -0.001842     |
| 13          | VZ(pin 13)       | 0         | 0         | -0.000125  | 0            | 0            | -0.001842     |
| 22          | Delta Vz(T4-T13) | 0         | -0.0004   | 0.000175   | 0            | -1.492537    | 17.32673      |
| 33          | IR(pin 4)        | -6.7E-08  | 2.54E-07  | -1.17E-08  | -39052.89    | 27326.58     | -3637.962     |
| 41          | IR(pin 12)       | -6.01E-08 | 2.71E-07  | 6.22E-09   | -29568.71    | 34936.16     | 1832.248      |
| 45          | VF(pin 4)        | 0         | 0.0004    | -0.00067   | 0            | 0.034072     | -0.059799     |
| 53          | VF(pin 12)       | -0.002    | 0.0168    | -0.00045   | -0.185874    | 1.425662     | -0.040263     |
| 63          | Vres(pins 12-13) | -0.0018   | -0.00496  | -0.001545  | -0.19207     | -0.494812    | -0.158735     |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= H3TRB\_PC**

| Test Number | Test Name        | Initial  |          |           |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|-----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean      | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.76     | 6.81     | 6.78925   | 0.010527 | -214.974  | 6.76       | 6.81     | 6.789625 | 0.010487 | -215.804  |
| 12          | VZ(pin 12)       | 6.76     | 6.81     | 6.788625  | 0.010156 | -222.8069 | 6.76       | 6.81     | 6.789375 | 0.010354 | -218.581  |
| 13          | VZ(pin 13)       | 6.77     | 6.81     | 6.78825   | 0.008827 | -256.3516 | 6.77       | 6.81     | 6.788875 | 0.009    | -251.4447 |
| 22          | Delta Vz(T4-T13) | -0.0244  | 0.0248   | -0.000145 | 0.011539 | 0.004189  | -0.0248    | 0.0272   | 0.00029  | 0.012036 | -0.008031 |
| 33          | IR(pin 4)        | 8.19E-11 | 6.75E-10 | 2.99E-10  | 1.01E-10 | -0.983935 | 1.95E-10   | 4.47E-07 | 5.98E-09 | 5E-08    | -0.039868 |
| 41          | IR(pin 12)       | 1.52E-10 | 7.17E-10 | 3.28E-10  | 1.11E-10 | -0.987966 | 2.33E-10   | 4.22E-07 | 9.91E-09 | 5.93E-08 | -0.055683 |
| 45          | VF(pin 4)        | 1.0748   | 1.1768   | 1.12252   | 0.020148 | -18.57146 | 1.0736     | 1.1884   | 1.12275  | 0.021873 | -17.11032 |
| 53          | VF(pin 12)       | 1.074    | 1.1624   | 1.114545  | 0.017158 | -21.6531  | 1.072      | 1.1632   | 1.11462  | 0.018195 | -20.41985 |
| 63          | Vres(pins 12-13) | 0.94952  | 1.0092   | 0.98607   | 0.014711 | -22.34333 | 0.9488     | 1.007599 | 0.985216 | 0.014574 | -22.53382 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.000375   | 0            | 0            | 0.005523      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.00075    | 0            | 0            | 0.011048      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.000625   | 0            | 0            | 0.009207      |
| 22          | Delta Vz(T4-T13) | -0.0004   | 0.0024    | 0.000435   | 1.639344     | 9.677419     | -300          |
| 33          | IR(pin 4)        | 1.13E-10  | 4.47E-07  | 5.68E-09   | 137.5        | 66149.93     | 1899.515      |
| 41          | IR(pin 12)       | 8.08E-11  | 4.21E-07  | 9.58E-09   | 53.06176     | 58770.47     | 2920.678      |
| 45          | VF(pin 4)        | -0.0012   | 0.0116    | 0.00023    | -0.111649    | 0.985724     | 0.020491      |
| 53          | VF(pin 12)       | -0.002    | 0.0008    | 7.51E-05   | -0.18622     | 0.068823     | 0.006735      |
| 63          | Vres(pins 12-13) | -0.00072  | -0.001601 | -0.000854  | -0.075828    | -0.158641    | -0.086557     |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= HTRB**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.74     | 6.81     | 6.77275  | 0.017573 | -128.4715 | 6.74       | 6.81     | 6.772625 | 0.017983 | -125.5349 |
| 12          | VZ(pin 12)       | 6.73     | 6.81     | 6.768625 | 0.0177   | -127.4724 | 6.73       | 6.81     | 6.768875 | 0.017062 | -132.2381 |
| 13          | VZ(pin 13)       | 6.74     | 6.82     | 6.769875 | 0.018315 | -123.2141 | 6.74       | 6.82     | 6.77025  | 0.018279 | -123.4628 |
| 22          | Delta Vz(T4-T13) | -0.0344  | 0.0508   | 0.003075 | 0.015854 | -0.064654 | -0.0344    | 0.05     | 0.002865 | 0.015882 | -0.060129 |
| 33          | IR(pin 4)        | 3.57E-11 | 4.55E-09 | 2.93E-10 | 4.97E-10 | -0.196674 | 1.65E-10   | 4.45E-09 | 7.36E-10 | 8.16E-10 | -0.300719 |
| 41          | IR(pin 12)       | 1.2E-10  | 2.06E-09 | 2.79E-10 | 2.19E-10 | -0.425061 | 2.33E-10   | 4.02E-09 | 7.79E-10 | 7.49E-10 | -0.346691 |
| 45          | VF(pin 4)        | 1.064    | 1.168    | 1.114555 | 0.020069 | -18.51233 | 1.0548     | 1.1724   | 1.10612  | 0.021897 | -16.83807 |
| 53          | VF(pin 12)       | 1.0628   | 1.1788   | 1.11491  | 0.021085 | -17.62599 | 1.056      | 1.1896   | 1.108495 | 0.024772 | -14.91571 |
| 63          | Vres(pins 12-13) | 0.93228  | 0.99188  | 0.968517 | 0.01351  | -23.89552 | 0.93876    | 1.0008   | 0.975996 | 0.01397  | -23.28827 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | -0.000125  | 0            | 0            | -0.001846     |
| 12          | VZ(pin 12)       | 0         | 0         | 0.00025    | 0            | 0            | 0.003694      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.000375   | 0            | 0            | 0.005539      |
| 22          | Delta Vz(T4-T13) | 0         | -0.0008   | -0.00021   | 0            | -1.574803    | -6.829268     |
| 33          | IR(pin 4)        | 1.3E-10   | -1.02E-10 | 4.42E-10   | 363.7892     | -2.250945    | 150.731       |
| 41          | IR(pin 12)       | 1.13E-10  | 1.96E-09  | 5E-10      | 93.61702     | 94.85736     | 179.2179      |
| 45          | VF(pin 4)        | -0.0092   | 0.0044    | -0.008435  | -0.864662    | 0.376712     | -0.75681      |
| 53          | VF(pin 12)       | -0.0068   | 0.0108    | -0.006415  | -0.639819    | 0.916186     | -0.575383     |
| 63          | Vres(pins 12-13) | 0.00648   | 0.00892   | 0.007479   | 0.69507      | 0.899302     | 0.772262      |

**REL ID:= 668**  
**LOT ID:= a**  
**Rel Test:= TC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.73     | 6.81     | 6.765625 | 0.020429 | -110.3949 | 6.73       | 6.82     | 6.769125 | 0.020635 | -109.3465 |
| 12          | VZ(pin 12)       | 6.73     | 6.84     | 6.765375 | 0.01728  | -130.5064 | 6.73       | 6.84     | 6.766625 | 0.01757  | -128.3718 |
| 13          | VZ(pin 13)       | 6.74     | 6.82     | 6.765    | 0.015508 | -145.4063 | 6.74       | 6.82     | 6.7665   | 0.015598 | -144.6038 |
| 22          | Delta Vz(T4-T13) | -0.0516  | 0.0452   | 0.00124  | 0.018192 | -0.022721 | -0.0528    | 0.0496   | 0.003    | 0.018486 | -0.054094 |
| 33          | IR(pin 4)        | 1.35E-11 | 4.71E-10 | 2.22E-10 | 8.02E-11 | -0.922248 | 3.33E-11   | 1.08E-08 | 3.92E-10 | 1.19E-09 | -0.109596 |
| 41          | IR(pin 12)       | 1.15E-10 | 7.92E-10 | 2.61E-10 | 1.05E-10 | -0.825086 | 1.21E-10   | 7.94E-10 | 2.78E-10 | 1.13E-10 | -0.816229 |
| 45          | VF(pin 4)        | 1.0644   | 1.16     | 1.11698  | 0.018991 | -19.60557 | 1.0748     | 1.4456   | 1.1418   | 0.058428 | -6.514034 |
| 53          | VF(pin 12)       | 1.0792   | 1.1848   | 1.119775 | 0.021966 | -16.99245 | 1.0812     | 1.1952   | 1.12423  | 0.02652  | -14.13056 |
| 63          | Vres(pins 12-13) | 0.91952  | 0.9846   | 0.957155 | 0.017681 | -18.04443 | 0.92036    | 0.9854   | 0.959148 | 0.017087 | -18.71122 |

| Test Number | Test Name        |           |           | Delta    | Delta(%) | Delta(%) | Delta(%) |
|-------------|------------------|-----------|-----------|----------|----------|----------|----------|
|             |                  | Delta Min | Delta Max | Mean     | Min      | Max      | Mean     |
| 4           | VZ(pin 4)        | 0         | 0.01      | 0.0035   | 0        | 0.146843 | 0.051732 |
| 12          | VZ(pin 12)       | 0         | 0         | 0.00125  | 0        | 0        | 0.018476 |
| 13          | VZ(pin 13)       | 0         | 0         | 0.0015   | 0        | 0        | 0.022173 |
| 22          | Delta Vz(T4-T13) | -0.0012   | 0.0044    | 0.00176  | 2.325581 | 9.734513 | 141.9355 |
| 33          | IR(pin 4)        | 1.98E-11  | 1.03E-08  | 1.7E-10  | 146.8843 | 2197.045 | 76.76788 |
| 41          | IR(pin 12)       | 5.84E-12  | 1.92E-12  | 1.7E-11  | 5.071205 | 0.242522 | 6.525481 |
| 45          | VF(pin 4)        | 0.0104    | 0.2856    | 0.02482  | 0.977076 | 24.62069 | 2.222068 |
| 53          | VF(pin 12)       | 0.002     | 0.0104    | 0.004455 | 0.185322 | 0.877785 | 0.397842 |
| 63          | Vres(pins 12-13) | 0.00084   | 0.0008    | 0.001993 | 0.091352 | 0.081251 | 0.208221 |

REL ID:= 668  
 LOT ID:= a  
 Rel Test:= TC\_PC

| Test Number | Test Name        | Initial  |          |          |          | Cpk       | Qual Point |          |           |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|-----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    |           | Min        | Max      | Mean      | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.77     | 6.81     | 6.788875 | 0.009678 | -233.8358 | 6.77       | 6.83     | 6.799125  | 0.011821 | -191.7279 |
| 12          | VZ(pin 12)       | 6.77     | 6.8      | 6.789    | 0.00773  | -292.7704 | 6.77       | 6.84     | 6.79625   | 0.01226  | -184.7757 |
| 13          | VZ(pin 13)       | 6.76     | 6.81     | 6.788625 | 0.009513 | -237.8806 | 6.76       | 6.84     | 6.795875  | 0.013187 | -171.7766 |
| 22          | Delta Vz(T4-T13) | -0.028   | 0.032    | 0.00011  | 0.01221  | -0.003003 | -0.024     | 0.0352   | 0.00279   | 0.011925 | -0.077989 |
| 33          | IR(pin 4)        | 1.64E-10 | 9.13E-10 | 3.09E-10 | 1.12E-10 | -0.91428  | 1.95E-10   | 1.99E-07 | 7.58E-09  | 2.92E-08 | -0.086544 |
| 41          | IR(pin 12)       | 2.05E-10 | 7.58E-10 | 3.22E-10 | 1.04E-10 | -1.03603  | -6.86E-08  | 2.91E-08 | -5.23E-10 | 1.08E-08 | 0.016101  |
| 45          | VF(pin 4)        | 1.0924   | 1.1816   | 1.12113  | 0.016216 | -23.04541 | 1.1136     | 1.5332   | 1.22038   | 0.107541 | -3.782691 |
| 53          | VF(pin 12)       | 1.0848   | 1.1608   | 1.11578  | 0.016298 | -22.82078 | 1.0976     | 1.494    | 1.19764   | 0.102401 | -3.898525 |
| 63          | Vres(pins 12-13) | 0.94028  | 1.0136   | 0.976649 | 0.016666 | -19.53377 | 0.94208    | 1.0144   | 0.978392  | 0.016507 | -19.75652 |

| Test Number | Test Name        | Delta     |           | Delta(%)  |           | Delta(%) |           |
|-------------|------------------|-----------|-----------|-----------|-----------|----------|-----------|
|             |                  | Delta Min | Delta Max | Mean      | Min       | Max      | Mean      |
| 4           | VZ(pin 4)        | 0         | 0.02      | 0.01025   | 0         | 0.293686 | 0.150982  |
| 12          | VZ(pin 12)       | 0         | 0.04      | 0.00725   | 0         | 0.588235 | 0.10679   |
| 13          | VZ(pin 13)       | 0         | 0.03      | 0.00725   | 0         | 0.440529 | 0.106796  |
| 22          | Delta Vz(T4-T13) | 0.004     | 0.0032    | 0.00268   | -14.28571 | 10       | 2436.364  |
| 33          | IR(pin 4)        | 3.07E-11  | 1.98E-07  | 7.27E-09  | 18.72559  | 21689.2  | 2357.426  |
| 41          | IR(pin 12)       | -6.88E-08 | 2.83E-08  | -8.45E-10 | -33600    | 3734.987 | -262.6112 |
| 45          | VF(pin 4)        | 0.0212    | 0.3516    | 0.09925   | 1.940681  | 29.75626 | 8.852679  |
| 53          | VF(pin 12)       | 0.0128    | 0.3332    | 0.08186   | 1.179941  | 28.70434 | 7.336574  |
| 63          | Vres(pins 12-13) | 0.0018    | 0.0008    | 0.001742  | 0.191432  | 0.078927 | 0.178416  |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= AC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.71     | 6.76     | 6.742875 | 0.011605 | -193.6833 | 6.71       | 6.76     | 6.743375 | 0.011577 | -194.1544 |
| 12          | VZ(pin 12)       | 6.72     | 6.77     | 6.7425   | 0.01085  | -207.1437 | 6.72       | 6.77     | 6.744    | 0.010978 | -204.7818 |
| 13          | VZ(pin 13)       | 6.72     | 6.77     | 6.742875 | 0.011046 | -203.4825 | 6.72       | 6.77     | 6.74375  | 0.010952 | -205.2599 |
| 22          | Delta Vz(T4-T13) | -0.038   | 0.0296   | -0.00012 | 0.013637 | 0.002933  | -0.0372    | 0.0296   | -0.00061 | 0.013978 | 0.014547  |
| 33          | IR(pin 4)        | 1.94E-10 | 1.08E-09 | 3.77E-10 | 1.45E-10 | -0.865921 | 1.22E-10   | 1.74E-08 | 8.5E-10  | 2.29E-09 | -0.124024 |
| 41          | IR(pin 12)       | 2.39E-10 | 8.86E-10 | 3.84E-10 | 1.25E-10 | -1.025702 | 2.05E-10   | 1.24E-07 | 8.1E-09  | 2.06E-08 | -0.131319 |
| 45          | VF(pin 4)        | 1.0528   | 1.1496   | 1.08193  | 0.019775 | -18.23732 | 1.052      | 1.602    | 1.089245 | 0.061636 | -5.890751 |
| 53          | VF(pin 12)       | 1.0532   | 1.1844   | 1.084235 | 0.025808 | -14.00403 | 1.0528     | 1.6212   | 1.09201  | 0.065776 | -5.534017 |
| 63          | Vres(pins 12-13) | 0.95388  | 1.0168   | 0.986099 | 0.017154 | -19.16204 | 0.9534     | 1.0168   | 0.986073 | 0.017236 | -19.07025 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0         | 0.0005     | 0            | 0            | 0.007415      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.0015     | 0            | 0            | 0.022247      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.000875   | 0            | 0            | 0.012977      |
| 22          | Delta Vz(T4-T13) | 0.0008    | 0         | -0.00049   | -2.105263    | 0            | 408.3333      |
| 33          | IR(pin 4)        | -7.17E-11 | 1.63E-08  | 4.73E-10   | -36.95607    | 1519.048     | 125.4237      |
| 41          | IR(pin 12)       | -3.43E-11 | 1.23E-07  | 7.72E-09   | -14.3383     | 13937.31     | 2013.002      |
| 45          | VF(pin 4)        | -0.0008   | 0.4524    | 0.007315   | -0.075988    | 39.35282     | 0.676109      |
| 53          | VF(pin 12)       | -0.0004   | 0.4368    | 0.007775   | -0.037979    | 36.87943     | 0.717092      |
| 63          | Vres(pins 12-13) | -0.00048  | 0         | -2.65E-05  | -0.050321    | 0            | -0.00269      |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= AC\_PC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.7      | 6.77     | 6.739875 | 0.014275 | -157.3795 | 6.7        | 15       | 7.168734 | 1.820281 | -1.312752 |
| 12          | VZ(pin 12)       | 6.7      | 6.77     | 6.738625 | 0.014473 | -155.1962 | 6.7        | 15       | 7.477975 | 2.36048  | -1.055996 |
| 13          | VZ(pin 13)       | 6.7      | 6.78     | 6.73825  | 0.015733 | -142.7613 | 6.7        | 15       | 7.164177 | 1.821307 | -1.311179 |
| 22          | Delta Vz(T4-T13) | -0.04    | 0.0348   | 0.001815 | 0.016889 | -0.035823 | -0.0316    | 0.0592   | 0.004294 | 0.018002 | -0.079501 |
| 33          | IR(pin 4)        | 1.84E-10 | 2.71E-09 | 3.54E-10 | 2.81E-10 | -0.419642 | -1.16E-09  | 1.98E-07 | 4.69E-09 | 2.49E-08 | -0.062809 |
| 41          | IR(pin 12)       | 2.2E-10  | 1.15E-09 | 3.91E-10 | 1.49E-10 | -0.873124 | -1.14E-10  | 5.16E-07 | 1.32E-08 | 6.28E-08 | -0.070159 |
| 45          | VF(pin 4)        | 1.0452   | 1.1508   | 1.08689  | 0.025625 | -14.13864 | 1.048      | 5.0012   | 1.767555 | 1.435462 | -0.41045  |
| 53          | VF(pin 12)       | 1.0496   | 1.1496   | 1.09448  | 0.023324 | -15.64144 | 1.0616     | 5.0016   | 1.877095 | 1.513495 | -0.413413 |
| 63          | Vres(pins 12-13) | 0.9528   | 1.0164   | 0.983239 | 0.01648  | -19.88796 | 0.957      | 2.5016   | 1.125558 | 0.433597 | -0.865287 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 8.23      | 0.428859   | 0            | 121.5657     | 6.363014      |
| 12          | VZ(pin 12)       | 0         | 8.23      | 0.73935    | 0            | 121.5657     | 10.97182      |
| 13          | VZ(pin 13)       | 0         | 8.22      | 0.425927   | 0            | 121.2389     | 6.321036      |
| 22          | Delta Vz(T4-T13) | 0.0084    | 0.0244    | 0.002479   | -21          | 70.11494     | 136.5659      |
| 33          | IR(pin 4)        | -1.35E-09 | 1.95E-07  | 4.34E-09   | -731.0547    | 7190.285     | 1224.681      |
| 41          | IR(pin 12)       | -3.33E-10 | 5.15E-07  | 1.28E-08   | -151.6464    | 44814.72     | 3284.183      |
| 45          | VF(pin 4)        | 0.0028    | 3.8504    | 0.680665   | 0.267891     | 334.5846     | 62.62503      |
| 53          | VF(pin 12)       | 0.012     | 3.852     | 0.782615   | 1.143293     | 335.0731     | 71.50567      |
| 63          | Vres(pins 12-13) | 0.0042    | 1.4852    | 0.142319   | 0.440806     | 146.1236     | 14.4745       |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= H3TRB**

| Test Number | Test Name        | Initial   |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|-----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min       | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.69      | 6.78     | 6.74475  | 0.013499 | -166.5529 | 6.7        | 6.78     | 6.745875 | 0.012798 | -175.7051 |
| 12          | VZ(pin 12)       | 6.71      | 6.78     | 6.742875 | 0.010814 | -207.8408 | 6.71       | 6.78     | 6.743625 | 0.011052 | -203.3996 |
| 13          | VZ(pin 13)       | 6.71      | 6.78     | 6.744    | 0.011092 | -202.6641 | 6.71       | 6.78     | 6.74475  | 0.010905 | -206.1625 |
| 22          | Delta Vz(T4-T13) | -0.026    | 0.0416   | 0.0016   | 0.014501 | -0.036778 | -0.0264    | 0.0412   | 0.00158  | 0.014529 | -0.03625  |
| 33          | IR(pin 4)        | -5.63E-11 | 7.85E-10 | 3.29E-10 | 1.1E-10  | -0.991364 | -1.78E-10  | 9.51E-10 | 3.36E-10 | 1.43E-10 | -0.784415 |
| 41          | IR(pin 12)       | 2.23E-10  | 7.12E-10 | 3.56E-10 | 1.13E-10 | -1.053806 | 2.25E-10   | 3.43E-09 | 4.29E-10 | 3.87E-10 | -0.369426 |
| 45          | VF(pin 4)        | 1.0472    | 1.1312   | 1.077286 | 0.019451 | -18.46156 | 1.0444     | 1.13     | 1.07608  | 0.020226 | -17.73454 |
| 53          | VF(pin 12)       | 1.0412    | 1.1528   | 1.081772 | 0.025143 | -14.34165 | 1.0384     | 1.1532   | 1.08091  | 0.025901 | -13.91072 |
| 63          | Vres(pins 12-13) | 0.94732   | 1.0108   | 0.980615 | 0.015704 | -20.81513 | 0.94592    | 1.0092   | 0.979238 | 0.015559 | -20.97971 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0.01      | 0         | 0.001125   | 0.149477     | 0            | 0.01668       |
| 12          | VZ(pin 12)       | 0         | 0         | 0.00075    | 0            | 0            | 0.011123      |
| 13          | VZ(pin 13)       | 0         | 0         | 0.00075    | 0            | 0            | 0.011121      |
| 22          | Delta Vz(T4-T13) | -0.0004   | -0.0004   | -2E-05     | 1.538462     | -0.961538    | -1.25         |
| 33          | IR(pin 4)        | -1.21E-10 | 1.66E-10  | 7.21E-12   | 215.2699     | 21.16532     | 2.193106      |
| 41          | IR(pin 12)       | 1.88E-12  | 2.72E-09  | 7.32E-11   | 0.84154      | 382.0415     | 20.56914      |
| 45          | VF(pin 4)        | -0.0028   | -0.0012   | -0.001206  | -0.26738     | -0.106082    | -0.111948     |
| 53          | VF(pin 12)       | -0.0028   | 0.0004    | -0.000862  | -0.26892     | 0.034698     | -0.079697     |
| 63          | Vres(pins 12-13) | -0.0014   | -0.0016   | -0.001376  | -0.147785    | -0.15829     | -0.14034      |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= H3TRB\_PC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.72     | 6.77     | 6.74175  | 0.010765 | -208.7545 | 6.72       | 6.79     | 6.744    | 0.012788 | -175.7837 |
| 12          | VZ(pin 12)       | 6.72     | 6.77     | 6.742875 | 0.009704 | -231.6261 | 6.72       | 6.79     | 6.744625 | 0.011577 | -194.1904 |
| 13          | VZ(pin 13)       | 6.72     | 6.76     | 6.742625 | 0.010403 | -216.0578 | 6.72       | 6.79     | 6.745    | 0.012013 | -187.1638 |
| 22          | Delta Vz(T4-T13) | -0.0276  | 0.0268   | -0.00086 | 0.012697 | 0.022578  | -0.0276    | 0.0272   | -0.00062 | 0.012581 | 0.016427  |
| 33          | IR(pin 4)        | 2.01E-10 | 7.78E-10 | 3.59E-10 | 1.15E-10 | -1.043961 | -1.54E-10  | 1.5E-08  | 6.3E-10  | 1.67E-09 | -0.125896 |
| 41          | IR(pin 12)       | 1.77E-10 | 1.45E-09 | 3.86E-10 | 1.69E-10 | -0.762313 | -3.58E-11  | 4.14E-09 | 6.03E-10 | 6.18E-10 | -0.324959 |
| 45          | VF(pin 4)        | 1.0456   | 1.123999 | 1.07629  | 0.017109 | -20.96963 | 1.0444     | 1.3024   | 1.076705 | 0.0311   | -11.5403  |
| 53          | VF(pin 12)       | 1.049999 | 1.1348   | 1.082115 | 0.018055 | -19.97845 | 1.0476     | 1.3296   | 1.082765 | 0.03391  | -10.64358 |
| 63          | Vres(pins 12-13) | 0.95308  | 1.008    | 0.98566  | 0.016036 | -20.48868 | 0.95184    | 1.0072   | 0.98504  | 0.016109 | -20.38271 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0.02      | 0.00225    | 0            | 0.295421     | 0.033374      |
| 12          | VZ(pin 12)       | 0         | 0.02      | 0.00175    | 0            | 0.295421     | 0.025953      |
| 13          | VZ(pin 13)       | 0         | 0.03      | 0.002375   | 0            | 0.443787     | 0.035224      |
| 22          | Delta Vz(T4-T13) | 0         | 0.0004    | 0.00024    | 0            | 1.492537     | -27.90698     |
| 33          | IR(pin 4)        | -3.55E-10 | 1.42E-08  | 2.71E-10   | -176.5572    | 1824.342     | 75.50342      |
| 41          | IR(pin 12)       | -2.13E-10 | 2.69E-09  | 2.17E-10   | -120.212     | 185.0496     | 56.04542      |
| 45          | VF(pin 4)        | -0.0012   | 0.178401  | 0.000415   | -0.114767    | 15.87199     | 0.038563      |
| 53          | VF(pin 12)       | -0.002399 | 0.1948    | 0.00065    | -0.228476    | 17.16602     | 0.060071      |
| 63          | Vres(pins 12-13) | -0.00124  | -0.0008   | -0.00062   | -0.130105    | -0.079365    | -0.062949     |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= HTRB**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.68     | 6.77     | 6.737875 | 0.015483 | -145.0573 | 6.7        | 6.77     | 6.7385   | 0.014504 | -154.8603 |
| 12          | VZ(pin 12)       | 6.68     | 6.77     | 6.74025  | 0.017573 | -127.855  | 6.7        | 6.77     | 6.74075  | 0.016209 | -138.6242 |
| 13          | VZ(pin 13)       | 6.68     | 6.77     | 6.739375 | 0.016939 | -132.6167 | 6.7        | 6.77     | 6.74025  | 0.015909 | -141.2237 |
| 22          | Delta Vz(T4-T13) | -0.0392  | 0.0224   | -0.00159 | 0.011923 | 0.044453  | -0.0392    | 0.0208   | -0.00184 | 0.011915 | 0.051478  |
| 33          | IR(pin 4)        | 2.29E-10 | 5.53E-10 | 3.4E-10  | 7.42E-11 | -1.526148 | 2.15E-10   | 4.68E-08 | 1.53E-09 | 5.38E-09 | -0.09496  |
| 41          | IR(pin 12)       | 2.32E-10 | 7.17E-10 | 3.81E-10 | 1.04E-10 | -1.220833 | 2.76E-10   | 6.32E-09 | 1.01E-09 | 1.18E-09 | -0.284882 |
| 45          | VF(pin 4)        | 1.0512   | 1.1456   | 1.086795 | 0.021038 | -17.21977 | 1.0488     | 1.1476   | 1.086095 | 0.022405 | -16.15848 |
| 53          | VF(pin 12)       | 1.0512   | 1.1696   | 1.087225 | 0.024419 | -14.84121 | 1.0492     | 1.1828   | 1.0871   | 0.026753 | -13.54495 |
| 63          | Vres(pins 12-13) | 0.95144  | 1.007599 | 0.980061 | 0.012795 | -25.53203 | 0.95944    | 1.0156   | 0.988561 | 0.013319 | -24.74067 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0.02      | 0         | 0.000625   | 0.299401     | 0            | 0.009276      |
| 12          | VZ(pin 12)       | 0.02      | 0         | 0.0005     | 0.299401     | 0            | 0.007418      |
| 13          | VZ(pin 13)       | 0.02      | 0         | 0.000875   | 0.299401     | 0            | 0.012983      |
| 22          | Delta Vz(T4-T13) | 0         | -0.0016   | -0.00025   | 0            | -7.142857    | 15.72327      |
| 33          | IR(pin 4)        | -1.39E-11 | 4.62E-08  | 1.19E-09   | -6.079665    | 8361.372     | 351.2007      |
| 41          | IR(pin 12)       | 4.43E-11  | 5.61E-09  | 6.32E-10   | 19.10016     | 782.1231     | 165.922       |
| 45          | VF(pin 4)        | -0.0024   | 0.002     | -0.0007    | -0.228311    | 0.174581     | -0.064407     |
| 53          | VF(pin 12)       | -0.002    | 0.0132    | -0.000125  | -0.190259    | 1.128591     | -0.011491     |
| 63          | Vres(pins 12-13) | 0.008     | 0.008001  | 0.0085     | 0.840831     | 0.794066     | 0.867292      |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= TC**

| Test Number | Test Name        | Initial  |          |          |          |           | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    | Cpk       | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.7      | 6.77     | 6.729625 | 0.016493 | -136.0121 | 6.7        | 6.78     | 6.732    | 0.017459 | -128.5311 |
| 12          | VZ(pin 12)       | 6.7      | 6.76     | 6.727875 | 0.016512 | -135.8188 | 6.7        | 6.76     | 6.729375 | 0.017455 | -128.511  |
| 13          | VZ(pin 13)       | 6.7      | 6.75     | 6.72825  | 0.014476 | -154.928  | 6.7        | 6.77     | 6.72925  | 0.015076 | -148.7874 |
| 22          | Delta Vz(T4-T13) | -0.0232  | 0.0284   | 0.001075 | 0.011861 | -0.030211 | -0.022     | 0.0308   | 0.002585 | 0.011683 | -0.073755 |
| 33          | IR(pin 4)        | 2.27E-10 | 8.78E-10 | 3.79E-10 | 1.24E-10 | -1.018684 | 2.17E-10   | 8.72E-10 | 3.79E-10 | 1.28E-10 | -0.986782 |
| 41          | IR(pin 12)       | 2.46E-10 | 1.15E-09 | 4.11E-10 | 1.47E-10 | -0.930786 | 2.05E-11   | 1.63E-09 | 4.24E-10 | 2.04E-10 | -0.693545 |
| 45          | VF(pin 4)        | 1.049999 | 1.158    | 1.101345 | 0.027077 | -13.55797 | 1.0556     | 1.388    | 1.12994  | 0.052922 | -7.117051 |
| 53          | VF(pin 12)       | 1.0488   | 1.1452   | 1.098505 | 0.025394 | -14.41927 | 1.0524     | 1.4464   | 1.11386  | 0.04997  | -7.430143 |
| 63          | Vres(pins 12-13) | 0.95696  | 1.0144   | 0.989678 | 0.011996 | -27.50083 | 0.95876    | 1.0424   | 0.992059 | 0.013497 | -24.50026 |

| Test Number | Test Name        | Delta     |           |            |              |              |               |
|-------------|------------------|-----------|-----------|------------|--------------|--------------|---------------|
|             |                  | Delta Min | Delta Max | Delta Mean | Delta(%) Min | Delta(%) Max | Delta(%) Mean |
| 4           | VZ(pin 4)        | 0         | 0.01      | 0.002375   | 0            | 0.14771      | 0.035292      |
| 12          | VZ(pin 12)       | 0         | 0         | 0.0015     | 0            | 0            | 0.022295      |
| 13          | VZ(pin 13)       | 0         | 0.02      | 0.001      | 0            | 0.296296     | 0.014863      |
| 22          | Delta Vz(T4-T13) | 0.0012    | 0.0024    | 0.00151    | -5.172414    | 8.450704     | 140.4651      |
| 33          | IR(pin 4)        | -9.64E-12 | -6.4E-12  | 2.7E-13    | -4.247444    | -0.728863    | 0.071208      |
| 41          | IR(pin 12)       | -2.25E-10 | 4.77E-10  | 1.3E-11    | -91.66667    | 41.42361     | 3.152952      |
| 45          | VF(pin 4)        | 0.005601  | 0.23      | 0.028595   | 0.533429     | 19.86183     | 2.596375      |
| 53          | VF(pin 12)       | 0.0036    | 0.3012    | 0.015355   | 0.343249     | 26.30108     | 1.397803      |
| 63          | Vres(pins 12-13) | 0.0018    | 0.028     | 0.002381   | 0.188096     | 2.760252     | 0.240582      |

**REL ID:= 669**  
**LOT ID:= a**  
**Rel Test:= TC\_PC**

| Test Number | Test Name        | Initial  |          |          |          | Cpk       | Qual Point |          |          |          |           |
|-------------|------------------|----------|----------|----------|----------|-----------|------------|----------|----------|----------|-----------|
|             |                  | Min      | Max      | Mean     | StDev    |           | Min        | Max      | Mean     | StDev    | Cpk       |
| 4           | VZ(pin 4)        | 6.69     | 6.75     | 6.719875 | 0.014007 | -159.9209 | 6.69       | 6.75     | 6.72175  | 0.01385  | -161.7695 |
| 12          | VZ(pin 12)       | 6.69     | 6.76     | 6.718375 | 0.015298 | -146.3871 | 6.69       | 6.76     | 6.72     | 0.015261 | -146.7752 |
| 13          | VZ(pin 13)       | 6.7      | 6.76     | 6.718    | 0.013632 | -164.2742 | 6.7        | 6.76     | 6.719875 | 0.013547 | -165.3439 |
| 22          | Delta Vz(T4-T13) | -0.0404  | 0.0428   | 0.00196  | 0.015251 | -0.042838 | -0.0404    | 0.0432   | 0.002625 | 0.015223 | -0.05748  |
| 33          | IR(pin 4)        | 2.46E-10 | 9.32E-10 | 4.11E-10 | 1.25E-10 | -1.091899 | -1.2E-13   | 1.33E-09 | 4.48E-10 | 1.83E-10 | -0.815688 |
| 41          | IR(pin 12)       | 2.44E-10 | 1.13E-09 | 4.38E-10 | 1.42E-10 | -1.026467 | 8.96E-12   | 1.23E-09 | 4.8E-10  | 1.94E-10 | -0.824766 |
| 45          | VF(pin 4)        | 1.068    | 1.1488   | 1.10646  | 0.018962 | -19.45068 | 1.0668     | 1.398399 | 1.11853  | 0.045741 | -8.151217 |
| 53          | VF(pin 12)       | 1.072    | 1.155599 | 1.11297  | 0.019108 | -19.41545 | 1.07       | 1.4596   | 1.12083  | 0.053264 | -7.014251 |
| 63          | Vres(pins 12-13) | 0.9538   | 1.007599 | 0.990317 | 0.011942 | -27.64191 | 0.95456    | 1.0084   | 0.990465 | 0.011927 | -27.68046 |

| Test Number | Test Name        | Delta     |           | Delta(%) |           | Delta(%) |          |
|-------------|------------------|-----------|-----------|----------|-----------|----------|----------|
|             |                  | Delta Min | Delta Max | Mean     | Min       | Max      | Mean     |
| 4           | VZ(pin 4)        | 0         | 0         | 0.001875 | 0         | 0        | 0.027902 |
| 12          | VZ(pin 12)       | 0         | 0         | 0.001625 | 0         | 0        | 0.024187 |
| 13          | VZ(pin 13)       | 0         | 0         | 0.001875 | 0         | 0        | 0.02791  |
| 22          | Delta Vz(T4-T13) | 0         | 0.0004    | 0.000665 | 0         | 0.934579 | 33.92857 |
| 33          | IR(pin 4)        | -2.46E-10 | 3.97E-10  | 3.72E-11 | -100.0488 | 42.55666 | 9.045965 |
| 41          | IR(pin 12)       | -2.35E-10 | 1.02E-10  | 4.15E-11 | -96.32907 | 9.090909 | 9.471669 |
| 45          | VF(pin 4)        | -0.0012   | 0.249599  | 0.01207  | -0.11236  | 21.72693 | 1.090869 |
| 53          | VF(pin 12)       | -0.002    | 0.304001  | 0.00786  | -0.186567 | 26.30679 | 0.706222 |
| 63          | Vres(pins 12-13) | 0.00076   | 0.000801  | 0.000148 | 0.079681  | 0.079496 | 0.014898 |



## Reliability Customer Report Family Qualification

Date: 10/31/2001

PCN:

**Ken Fergus**  
Reliability Engineer  
602-244-7079

**Mark Wasilewski**  
Reliability Manager  
602-244-5114

### 1) Introduction:

This report is a summary of reliability data for the Logic Two-Gate and Analog Switch devices in the SC88 package. Also included is 260 deg C IR preconditioning test results which will allow this package to utilize lead free plating in the future.

Data References:

### 2) Device Description:

|                                    |                                         |                     |
|------------------------------------|-----------------------------------------|---------------------|
| <b>Qual ID</b> 1242                | <b>Wafer Fab Site</b> Chartered         | Singapore           |
| <b>Device</b> NL27WZU04DFT2        | <b>Assembly Site</b> Sbn                | Malaysia            |
| <b>Line Source</b> n/a             | <b>Final Test Site</b> Sbn              | Malaysia            |
| <b>Parent Tech</b> 0.6 micron Cmos | <b>Reliability Lab</b> T.5 3rd. D Bldg. | Phoenix, Az         |
| <b>Technology</b> Cmos             | <b>Max. Current</b>                     | <b>Max. Voltage</b> |
| <b>Package</b> SC-88               | <b>Die Size</b> 451 um X 911 um         | <b>Flag Size</b>    |
| <b>Polarity</b> n/a                |                                         |                     |

#### Related Qualification Report(s):

The following Standard Logic devices are qualified by similarity based on the data in this report:  
NL27WZ04DFT2, NL27WZ06DFT2, NL27WZ07DFT2, NL27WZ14DFT2, NL27WZ16DFT2, NL27WZU04DFT2,  
NLA4599DFT2/4, NLA4599DFT2/4.



### 3) Qualification Results Analysis:

See attached reliability reports

### 4) Conclusion:

Full qualification is granted for Logic Two-Gate and Analog Switches in the SC88 package.



# SBN ON SEMICONDUCTOR RELIABILITY REPORT

**DEVICE:** NL27WZU04DFT2      **PACKAGE:** Case: 419B , **Style:** 0537  
**ASSEM. LINE:** N/A      **FAB SITE:** N/A  
**WAFER LINE:** N/A      **ASSY. SITE:** SBN site-1  
**MFG. DATE:** 0130      **REQUESTOR:** TS Teo  
**Reference no.** 48ON04308D

**TRACKING NUMBER:** ZQ013001A-C

## PURPOSE:

This qualification is to qualify New Product Introduction of SC88 Logic which transferred from HANA to be assembled and tested in SBN.

## TEST PERFORMED:

### Environmental Tests

Autoclave  
Temp Cycle  
Solder Heat  
HTS

Note: with pre-cond process

### Life Tests

N/A

## TEST RESULTS:

Full reliability testing (without Preconditioning) of SC88 package qualification meets or exceeds the requirement set forth in the ON Semiconductor's Production Reliability Qualification Process (12MSB17722C).

**REVIEWED BY:** \_\_\_\_\_

TK Yew  
RELIABILITY ENGINEER

**APPROVED BY:** \_\_\_\_\_

Abdul Razak  
R & QA Manager

**DATE:** August 24, 2001

\*Test results contained herein are for information only. This report does not alter  
**ON Semiconductor's** standard warranty or product specifications.

# ENVIRONMENTAL & LIFE TEST

## ACCEPTANCE CRITERIA

Target device: NL27WZU04DFT2

| PARAMETER | MEASUREMENT CONDITIONS            | FAILURE DEFINITION |                    |       |              |         |
|-----------|-----------------------------------|--------------------|--------------------|-------|--------------|---------|
|           |                                   | INITIAL-ENDPOINTS  |                    |       | DELTA LIMITS |         |
|           |                                   | MIN                | MAX                | UNITS | MAX          | BASE    |
| VIH       | V <sub>cc</sub> =2.3V to 5.5V     | 0.8V <sub>cc</sub> |                    | V     | -            | Initial |
| VIL       | V <sub>cc</sub> =2.3V to 5.5V     |                    | 0.2V <sub>cc</sub> | V     | -            | Initial |
| VOH       | VOH=VIN=VIL, VCC=2.3, IOH = 100uA | 2.1                |                    | V     | -            | Initial |
|           | VOH=VIN=VIL, VCC=2.7, IOH = 100uA | 2.4                |                    | V     | -            | Initial |
|           | VOH=VIN=VIL, VCC=3.0, IOH = 100uA | 2.7                |                    | V     | -            | Initial |
|           | VOH=VIN=VIL, VCC=4.5, IOH = 100uA | 4.0                |                    | V     | -            | Initial |
|           | VOH=VIN=GND, VCC=2.3, IOH= - 8mA  | 1.9                |                    | V     | -            | Initial |
|           | VOH=VIN=GND, VCC=2.7, IOH= - 12mA | 2.2                |                    | V     | -            | Initial |
|           | VOH=VIN=GND, VCC=3.0, IOH=-16mA   | 2.4                |                    | V     | -            | Initial |
|           | VOH=VIN=GND, VCC=3.0, IOH= -24mA  | 2.3                |                    | V     | -            | Initial |
|           | VOH=VIN=GND, VCC=4.5, IOH= -32mA  | 3.8                |                    | V     | -            | Initial |
|           |                                   |                    |                    |       |              |         |
| VOL       | VOL=VIN=VIH, VCC=2.3, IOL= 100uA  |                    | 0.2                | V     | -            | Initial |
|           | VOL=VIN=VIH, VCC=2.7, IOL= 100uA  |                    | 0.3                | V     | -            | Initial |
|           | VOL=VIN=VIH, VCC=3.0, IOL= 100uA  |                    | 0.3                | V     | -            | Initial |
|           | VOL=VIN=VIH, VCC=4.5, IOL= 100uA  |                    | 0.5                | V     | -            | Initial |
|           | VOL=VIN=VCC, VCC=2.3, IOL= 8mA    |                    | 0.3                | V     | -            | Initial |
|           | VOL=VIN=VCC, VCC=2.7, IOL= 12mA   |                    | 0.4                | V     | -            | Initial |
|           | VOL=VIN=VCC, VCC=3.0, IOL= 16mA   |                    | 0.4                | V     | -            | Initial |
|           | VOL=VIN=VCC, VCC=3.0, IOL=24mA    |                    | 0.55               | V     | -            | Initial |

## ENVIRONMENTAL & LIFE TEST ACCEPTANCE CRITERIA

Target device: NL27WZU04DFT2

| PARAMETER | MEASUREMENT CONDITIONS           | FAILURE DEFINITION |       |       |              |            |
|-----------|----------------------------------|--------------------|-------|-------|--------------|------------|
|           |                                  | INITIAL-ENDPOINTS  |       |       | DELTA LIMITS |            |
|           |                                  | MIN                | MAX   | UNITS | MAX          | BASE       |
| VOL       | VOL=VIN=VCC, VCC=4.5, IOL = 32mA |                    | 0.55  | V     | -            | Initial    |
| IIN       | VIN=VCC or GND, VCC=5.5,         |                    | ± 0.1 | uA    | -            | Spec Width |
| ICC       | VIN=VCC or GND,VCC=5.5,          |                    | 1     | uA    | -            | Spec Width |

# ENVIRONMENTAL TEST SUMMARY

NL27WZU04DFT2

Note: without Precond Process

# RELIABILITY REPORT\*

## REJECT SUMMARY

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### ENVIRONMENTAL:

No Reject found.

### CONCLUSION:

Full reliability testing (without preconditioning) of SC88 package qualification meets or exceeds the requirement set forth in the ON Semiconductor's Product Reliability Qualification Process (12MSB17722C)



## Reliability Customer Report Site Qualification

Date: 02/16/01

PCN: N/A

Lyle Stewart/Carolyn Anitllon  
Reliability Engineer  
602-244-7519

Mark Wasilewski  
Reliability Manager  
602-244-5114

### 1) Introduction:

Qualification of HANA SC88 Assembly and Test Process For NLAST4599 New Product Design

NOTE: The “**bold lettering**” in the interval column of the test summary indicates the qualification points.

### 2) Device Description:

**Qual ID** 0831

**Device** NLAST4599DF

**Line Source** AST4599

**Parent Tech** C-MOS

**Technology** 0.6 um CMOS

**Package** SC-88

**Polarity** INTEGRATED

**Wafer Fab Site** Chartered

**Assembly Site** Hana (B)

**Final Test Site** Hana (B)

**Reliability Lab** T.5 3rd. B Bldg.

**Max. Current** 20mA

**Max. Voltage** 7V

**Die Size** 451 um X 911 um

**Flag Size** 1113 um X 610 um

#### Related Qualification Report(s):

The following **Standard Logic Devices** are qualified by similarity based on the data in this report:

NL27WZ04DFT2, NL27WZ06DFT2, NL27WZ07DFT2, NL27WZ14DFT2, NL27WZ16DFT2, NL27WZU04DFT2, NLAS4599DFT2



### 3) Qualification Results Analysis:

Zero qualification related failures were observed during reliability testing.

### 4) Conclusion:

By successfully completing all reliability testing under the terms of ON Semiconductor Reliability Document 12MSB17722C, HANA has been granted full qualification to assemble and test Standard Logic SC88 product.



## 5) Test Description & Condition:

|            |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Auto       | Autoclave                           | <p><b>AUTOCLAVE</b><br/>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br/><b>Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br/><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br/><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing</p>                                                   |
| Auto-PC    | Autoclave - PC                      | <p><b>AUTOCLAVE + MOISTURE LEVEL PRECONDITIONING</b><br/>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br/><b>Typical Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br/><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br/><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing</p>          |
| Bond Pull  | Bond Pull Strength                  | <p><b>BOND PULL STRENGTH</b><br/>The purpose of this test is to determine bond pull strength of wire to die, substrate, or package header connections. The wires may be bonded by soldering, thermocompression, ultrasonic, or related bonding techniques.<br/><b>Test Conditions:</b> TA = 25°C<br/><b>Common Failure Modes:</b> Parametric shifts, open, and/or intermittent<br/><b>Common Failure Mechanisms:</b> Corrosion or contaminants from foreign material within the package. Silicon or metalization defects.</p>                                                                |
| Bond Shear | Bond Shear                          | <p><b>BOND SHEAR</b><br/>The purpose of this test is to determine bond shear strength of wire to die, substrate, or package header connections. The wires may be bonded by soldering, thermocompression, ultrasonic, or related bonding techniques.<br/><b>Test Conditions:</b> TA = 25°C<br/><b>Common Failure Modes:</b> Parametric shifts, open, and/or intermittent<br/><b>Common Failure Mechanisms:</b> Corrosion or contaminants from foreign material within the package. Silicon or metalization defects.</p>                                                                       |
| HAST       | Highly Accelerated Stress Test      | <p><b>HIGHLY ACCELERATED STRESS TEST</b><br/>HAST uses a pressurized environment to produce extremely severe temperature, humidity and bias conditions. HAST accelerates the same failure mechanisms as High Humidity High Temperature Bias.<br/><b>Test Conditions:</b> TA = 130°C, rh = 85%, p = 18.8 psig<br/><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br/><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing</p>                                  |
| HAST-PC    | Highly Accelerated Stress Test - PC | <p><b>HIGHLY ACCELERATED STRESS TEST + MOISTURE LEVEL PRECONDITIONING</b><br/>HAST uses a pressurized environment to produce extremely severe temperature, humidity and bias conditions. HAST accelerates the same failure mechanisms as High Humidity High Temperature Bias.<br/><b>Test Conditions:</b> TA = 130°C, rh = 85%, p = 18.8 psig<br/><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br/><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing</p> |



## 5) Test Description & Condition continued:

|          |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HT Bake  | High Temperature Bake           | <b>HIGH TEMPERATURE BAKE</b><br>High temperature storage life testing is performed to accelerate failure mechanisms which are thermally activated through the application of extreme temperatures.<br><b>Test Conditions:</b> TA = 150°C<br><b>Common Failure Modes:</b> Parametric shifts in leakage and gain<br><b>Common Failure Mechanisms:</b> Bulk die and diffusion defects                                                                                        |
| HTB      | High Temperature Bake           | <b>HIGH TEMPERATURE BAKE</b><br>High temperature storage life testing is performed to accelerate failure mechanisms which are thermally activated through the application of extreme temperatures.<br><b>Test Conditions:</b> TA = 175°C<br><b>Common Failure Modes:</b> Parametric shifts in leakage and gain<br><b>Common Failure Mechanisms:</b> Bulk die and diffusion defects                                                                                        |
| HTOL     | High Temperature Operating Life | <b>HIGH TEMPERATURE OPERATING LIFE</b><br>The purpose of this test is to evaluate the bulk stability of the die and to generate defects resulting from manufacturing aberrations that are manifested as time and stress-dependent failures.<br><b>Test Conditions:</b> TA = 145°C<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Foreign material, crack die, bulk die, metallization, wire and die bond defects |
| MSL 1    | Moisture Level 1                | <b>MOISTURE LEVEL PRECONDITIONING</b><br>These tests are performed to simulate the board mounting process where parts are subjected to a high temperature for a short duration. These tests detect mold compound delamination from the die and leadframe. The failure mechanisms are corrosion, fractured wirebonds and passivation cracks.<br>10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@235°C + 1X Flux Immersion + DI Rinse                                           |
| Phys Dim | Physical Dimensions             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Solder   | Solderability                   | <b>SOLDERABILITY</b><br>The purpose of this test is to measure the ability of device leads/terminals to be soldered after an extended period of storage or shelf life.<br><b>Test Conditions:</b> Steam aging = 8 hours<br><b>Common Failure Modes:</b> Pin holes, dewetting, non-wetting<br><b>Common Failure Mechanisms:</b> Poor plating, contaminated leads                                                                                                           |



## 5) Test Description & Condition continued:

|       |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TC    | Temperature Cycle      | <b>TEMPERATURE CYCLING</b><br>The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and transitions between temperature extremes. This testing will also expose excessive thermal mismatch between materials.<br><b>Test Conditions:</b> TA = -65°C to 150°C, air to air<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Wire bond, cracked or lifted die and package failure                                  |
| TC-PC | Temperature Cycle - PC | <b>TEMPERATURE CYCLING + MOISTURE LEVEL PRECONDITIONING</b><br>The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and transitions between temperature extremes. This testing will also expose excessive thermal mismatch between materials.<br><b>Test Conditions:</b> TA = -65°C to 150°C, air to air<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Wire bond, cracked or lifted die and package failure |



# Test Summary

| Test Name | Test Conditions & Bias                                  | Lot ID | Interval | SS | Rej | Comment |
|-----------|---------------------------------------------------------|--------|----------|----|-----|---------|
| HT Bake   | TA = +150°C, N/A                                        | 0831A  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 168 Hr.  | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
| HT Bake   | TA = +150°C, Use High Temp Solder per best Lab practice | 0831B  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 168 Hr.  | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
| HT Bake   | TA = +150°C, Use High Temp Solder per best Lab practice | 0831C  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 168 Hr.  | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
| HTOL      | TA = +145°C, Vcc = 5.0V                                 | 0831A  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
|           |                                                         | 0831B  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
|           |                                                         | 0831C  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 504 Hr.  | 84 | 0   |         |
| HAST      | TA = +130°C, RH = 85%, PSIG = 18.8, Vcc = 5.0V          | 0831A  | 0 Hr.    | 84 | 0   |         |
|           |                                                         |        | 96 Hr.   | 84 | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                                                         | Lot ID | Interval | SS  | Rej | Comment |
|-----------|------------------------------------------------------------------------------------------------|--------|----------|-----|-----|---------|
| HAST      | TA = +130°C, RH = 85%, PSIG = 18.8, N/A                                                        | 0831B  | 0 Hr.    | 84  | 0   |         |
|           |                                                                                                |        | 96 Hr.   | 84  | 0   |         |
|           |                                                                                                | 0831C  | 0 Hr.    | 84  | 0   |         |
|           |                                                                                                |        | 96 Hr.   | 84  | 0   |         |
| HAST-PC   | TA = +130°C, RH = 85%, PSIG = 18.8, Vcc = 5.0V                                                 | 0831A  | 0 Hr.    | 84  | 0   |         |
|           |                                                                                                |        | 96 Hr.   | 73  | 0   |         |
|           |                                                                                                | 0831B  | 0 Hr.    | 84  | 0   |         |
|           |                                                                                                |        | 96 Hr.   | 84  | 0   |         |
|           |                                                                                                | 0831C  | 0 Hr.    | 84  | 0   |         |
|           |                                                                                                |        | 96 Hr.   | 84  | 0   |         |
| MSL 1     | 10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@235°C + 1X Flux Immersion + DI Rinse + Visual, N/A | 0831A  | 0 Hr.    | 252 | 0   |         |
|           |                                                                                                |        | Readout  | 252 | 0   |         |
|           |                                                                                                |        | Readout  | 252 | 0   |         |
|           |                                                                                                | 0831B  | 0 Hr.    | 252 | 0   |         |
|           |                                                                                                |        | Readout  | 252 | 0   |         |
|           |                                                                                                |        | Readout  | 252 | 0   |         |
|           |                                                                                                | 0831C  | 0 Hr.    | 252 | 0   |         |



# Test Summary

| Test Name | Test Conditions & Bias                                              | Lot ID | Interval | SS  | Rej | Comment |
|-----------|---------------------------------------------------------------------|--------|----------|-----|-----|---------|
| Phys Dim  | Case Outline, N/A                                                   | 0831A  | Readout  | 252 | 0   |         |
|           |                                                                     |        | Readout  | 252 | 0   |         |
|           |                                                                     |        | Results  | 10  | 0   |         |
| Solder    | 8 Hours steam aging prior to testing; 1 hour gold plated leads, N/A | 0831A  | Results  | 10  | 0   |         |
| TC        | Air to Air; -65°C to +150°C, N/A                                    | 0831A  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 75  | 0   |         |
|           |                                                                     | 0831B  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 84  | 0   |         |
|           |                                                                     | 0831C  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 84  | 0   |         |
| TC-PC     | Air to Air; -65°C to +150°C, N/A                                    | 0831A  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 74  | 0   |         |
|           |                                                                     | 0831B  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 84  | 0   |         |
|           |                                                                     | 0831C  | 0 Cyc.   | 84  | 0   |         |
|           |                                                                     |        | 500 Cyc. | 84  | 0   |         |



## Reliability Customer Report Package Qualification

Date: 10/08/2001

PCN:

**Laura Rivers**  
Reliability Engineer

**Mark Wasilewski**  
Reliability Manager  
602-244-5114

### 1) Introduction:

Qualification of Pb-Free Solder for the SC88 and SC88A packages with 100% Sn plating. Solder used was Sn/Ag/Cu.

The data for this report was used to qualify the SC88 because the metal to pkg ratio is at it worst case in the SC88A. Therefore the delamination, etc will be less in the SC88. This also qualifies the SC70 packages. This is for all technologies.

### 2) Device Description:

**Qual ID** 1008

**Device** MSQA6V1W5T2

**Line Source** ZK6V1QA

**Parent Tech** ZENER

**Technology** Zener

**Package** SC-88A

**Polarity** PN

**Wafer Fab Site**

**Assembly Site** SBN

**Final Test Site** Sbn

**Reliability Lab** FET TESTER

**Max. Current**

**Die Size** 27 X 26

Seremban Malaysia

Seremban Malaysia

Phoenix, AZ, USA

**Max. Voltage**

**Flag Size**

#### **Related Qualification Report(s):**

Packages qualified for Pb-free based upon this report are;  
SC70, SC88, SC88A for all technologies.



### 3) Qualification Results Analysis:

no anomalies observed.

### 4) Conclusion:

All testing was successfully performed in accordance with ON Semiconductor qualification specification 12MSB17722C and a 260 C MSL 1 preconditioning profile for Pb-free products. SC70, SC88 and SC88A are now considered fully qualified for Pb-free processing per the qualification process shown in this report.



## 5) Test Description & Condition:

|         |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MSL 1   | Moisture Level 1                        | <b>MOISTURE LEVEL PRECONDITIONING</b><br>These tests are performed to simulate the board mounting process where parts are subjected to a high temperature for a short duration. These tests detect mold compound delamination from the die and leadframe. The failure mechanisms are corrosion, fractured wirebonds and passivation cracks.<br>10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@260°C + 1X Flux Immersion + DI Rinse                                                                                                                                           |
| Auto-PC | Autoclave - PC                          | <b>AUTOCCLAVE + MOISTURE LEVEL PRECONDITIONING</b><br>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br><b>Typical Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing |
| TC-PC   | Temperature Cycle - PC                  | <b>TEMPERATURE CYCLING + MOISTURE LEVEL PRECONDITIONING</b><br>The purpose of this test is to evaluate the ability of the device to withstand both exposure to extreme temperatures and transitions between temperature extremes. This testing will also expose excessive thermal mismatch between materials.<br><b>Test Conditions:</b> TA = -65°C to 150°C, air to air<br><b>Common Failure Modes:</b> Parametric shifts and catastrophic<br><b>Common Failure Mechanisms:</b> Wire bond, cracked or lifted die and package failure                                     |
| Solder  | Solderability                           | <b>SOLDERABILITY</b><br>The purpose of this test is to measure the ability of device leads/terminals to be soldered after an extended period of storage or shelf life.<br><b>Test Conditions:</b> Steam aging = 8 hours<br><b>Common Failure Modes:</b> Pin holes, dewetting, non-wetting<br><b>Common Failure Mechanisms:</b> Poor plating, contaminated leads                                                                                                                                                                                                           |
| SAT-PC  | Scanning Acoustic Tomography (SAT) - PC | <b>SOLDERABILITY</b><br>The purpose of this test is to measure the ability of device leads/terminals to be soldered after an extended period of storage or shelf life.<br><b>Test Conditions:</b> Steam aging = 8 hours<br><b>Common Failure Modes:</b> Pin holes, dewetting, non-wetting<br><b>Common Failure Mechanisms:</b> Poor plating, contaminated leads                                                                                                                                                                                                           |
| SAT-PC  | Scanning Acoustic Tomography (SAT) - PC | <b>AUTOCCLAVE + MOISTURE LEVEL PRECONDITIONING</b><br>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br><b>Typical Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing |



## 5) Test Description & Condition continued:

|        |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SAT-PC | Scanning Acoustic Tomography (SAT) - PC | <b>AUTOCLAVE + MOISTURE LEVEL PRECONDITIONING</b><br>Autoclave is an environmental test which measures device resistance to moisture penetration and the resultant effects of galvanic corrosion. Autoclave is a highly accelerated and destructive test.<br><b>Typical Test Conditions:</b> TA = 121°C, rh = 100%, p = 15 psig<br><b>Common Failure Modes:</b> Parametric shifts, high leakage and/or catastrophic<br><b>Common Failure Mechanisms:</b> Die corrosion or contaminants such as foreign material on or within the package materials. Poor package sealing |
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# Test Summary

| Test Name   | Test Conditions & Bias                                                                                               | Lot ID    | Interval  | SS  | Rej | Comment |
|-------------|----------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----|-----|---------|
| MSL1        | 10TC + 24Hr Bake@125°C + 168Hr 85/85 + 3 IR@260°C + 1X Flux Immersion + DI Rinse - amount for pre conditioned tests. | 1008A,B,C | Results   | all | 0   |         |
| Auto-PC     | TA = +121°C, RH = 100%, PSIG = 15, N/A                                                                               | 1008A,B,C | 0 Hr.     | 240 | 0   |         |
|             |                                                                                                                      |           | 96 Hr.    | 240 | 0   |         |
| SAT         | SAT shall be performed on 7 units from each group at Zero hours processing                                           | 1008A,B,C | Results   | 21  | 0   |         |
| SAT         | SAT shall be performed on 7 units from each group after 3X IR reflow                                                 | 1008A,B,C | Results   | 21  | 0   |         |
| SAT         | SAT shall be performed on 7 units from each group after 500 cycles Temp cycle                                        | 1008A,B,C | Results   | 21  | 0   |         |
| SAT         | SAT shall be performed on 7 units from each group after 1000 cycles Temp cycle                                       | 1008A,B,C | Results   | 21  | 0   |         |
| Solder      | 8 Hours steam aging prior to testing; solderability shall be tested at 260 C using Sn/Ag/Cu solder                   | 1008A,B,C | Results   | 30  | 0   |         |
| TC-PC       | Air to Air; -65°C to +150°C, N/A<br>(ss includes samples for SAT)                                                    | 1008A,B,C | 0 Cyc.    | 324 | 0   |         |
|             |                                                                                                                      |           | 500 Cyc.  | 324 | 0   |         |
|             |                                                                                                                      |           | 1000 Cyc. | 324 | 0   |         |
| Solder Heat | All groups, A,B,C shall be tested at 260 C.                                                                          | 1008A,B,C | Results   | 90  | 0   |         |