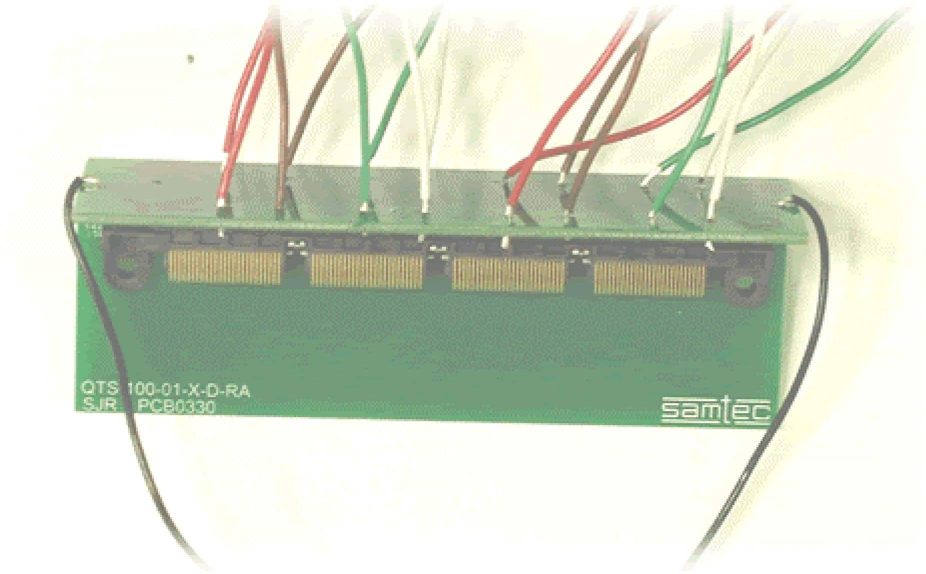
Project Number:	Tracking Code: 0217--0671		
Requested by: Danny Boesing	Date: 4/23/02	Product Rev: 4	
Part #: QTS-100-01-L-D-RA	Lot #: 01/02/02	Tech: Troy Cook	Eng: John Tozier
Part description: 0.635mm Double Row Right Angle HI Speed Terminal Strip		Qty to test: 2	
Test Start: 05/13/02	Test Completed: 7/22/02		



Solder Joint Reliability Lucent X-21301 Summary Report

PART DESCRIPTION

0.635mm Double Row Right Angle HI Speed Terminal Strip

Part #: QTS-100-01-L-D-RA	Tracking Code: 0217--0671
Test Completed: 7/22/02	

CERTIFICATION

All instruments and measuring equipment were calibrated to National Institute for Standards and Technology (NIST) traceable standards according to IS0 10012-l and ANSI/NCSL 2540-1, as applicable.
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SCOPE

To perform the following tests: Thermal Cycling to Detect Solder Joint Events and Failures for life calculations.

APPLICABLE DOCUMENTS

Lucent X-21301 for Thermal Cycling aspects

TEST SAMPLES AND PREPARATION

1) All materials were manufactured in accordance with the applicable product specification.
2) All test samples were identified and encoded to maintain traceability throughout the test sequences.
3) KEY Communication Services, experts in this field of expertise, performed soldering.
   *** Key Communication Services is not affiliated with Samtec.**

ATTRIBUTE DEFINITION

THERMAL CYCLING:

1) Lucent X-21301
   a) Thermal Limits: Low Temperature = 0° C ± 2° C; High Temperature = 100° C ± 2° C
   b) Dwell Time at Thermal Limits: Five (5) minutes
   c) Ramp Time to Thermal Limits: Ten (10) minutes

EVENT DETECTION:

1) Connectors are mated
   a) Signal Interruptions exceeding 300 Ω lasting for greater than 200 nanoSeconds

FAILURE CRITERIA:

1) Fifteen (15) EVENTS within 100 thermal cycles of one another.
   a) The FIRST EVENT is considered the FAILURE Cycle (Time)
2) Terminate Thermal Cycling when approximately 62% of the product fails
   a) Fifteen 300 Ω –200 nanoSeconds events within 100 thermal cycles of one another.

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STATISTICAL ANALYSIS

1) Use Weibull 2P, optimized on X, (CYCLES) to determine Alpha, α, and Beta, β
2) Plot, $\ln\left[\ln\left\langle\frac{1}{1-Fw(t)}\right\rangle\right]$ vs. $\ln(Cycles)$
    a) $Fw(t)= 1- e^{-\left(\frac{t}{\alpha}\right)^{\beta}}$
    b) Perform Linear Regression
        i) $\ln\left[\ln\left\langle\frac{1}{1-Fw(t)}\right\rangle\right] = \beta\ln(t) - \beta\ln(\alpha)$
            (1) Beta, β, corresponds to the slope
            (2) βln(α) corresponds to the intercept
            (3) Where Alpha is calculated, $\alpha=e^{-\left(\frac{Intercept}{\beta}\right)}$
    c) Use Benard's Median Rank, MR
    d) $MR=\frac{(i-0.3)}{(N+0.4)}$
        i) i = Item Number (e.g. 1,2,3, etc)
        ii) N = Total Number of Items

LIFE CALCULATIONS (Based on Samtec Test Conditions)

1) Use the modified Coffin-Manson Equation (Norris-Landzberg) and Alpha, α, and Beta, β
    a) Calculate the Acceleration Factor, AF, from laboratory conditions to field conditions
        i) Lab Temperature Extremes (e.g. 100 C°)
        ii) Field Temperature Extremes (Power ON to Power OFF, 15C°, Estimated)
        iii) Field Solder Joint Temp, Estimated 45° C or 318° K
        iv) Lab Solder Joint Temp, 100° C or 373° K
        v) In Use Cyclic Frequency per day … 6 minimum
        vi) Lab Cyclic Frequency per day … 48 for this test

SUPPLEMENTAL EXAMINATION:

1) Visual failure examination was performed

RESULTS

Failure Percentage for 32 Signal Channels 6%

Failure #	Channel #	Cycle #
1	216	2439
2	228	2943

Path Resistance at Board Level, Ohms

Channel	Before Test	After Test
216	1.2	4.3
228	1.2	5.4

Alpha---2852
Beta-- 6.779

Acceleration Factor using constants in ATTRIBUTES-----------------------35.4

Predicted Life using 1000 ppm failure rate-------------------- Exceeded the 20 year life expectancy

Supplemental Findings

- **Failure Analysis**
  - **Channel 198 (resistance change ≈ 0.6 Ohms) was evaluated as a 'cold solder joints' in the wiring and can be eliminated from the analysis.**
    - **Eliminate this failure point in the Weibull statistics.**
    - **Cold Solder Joint is defined as insufficient reflow of solder.**

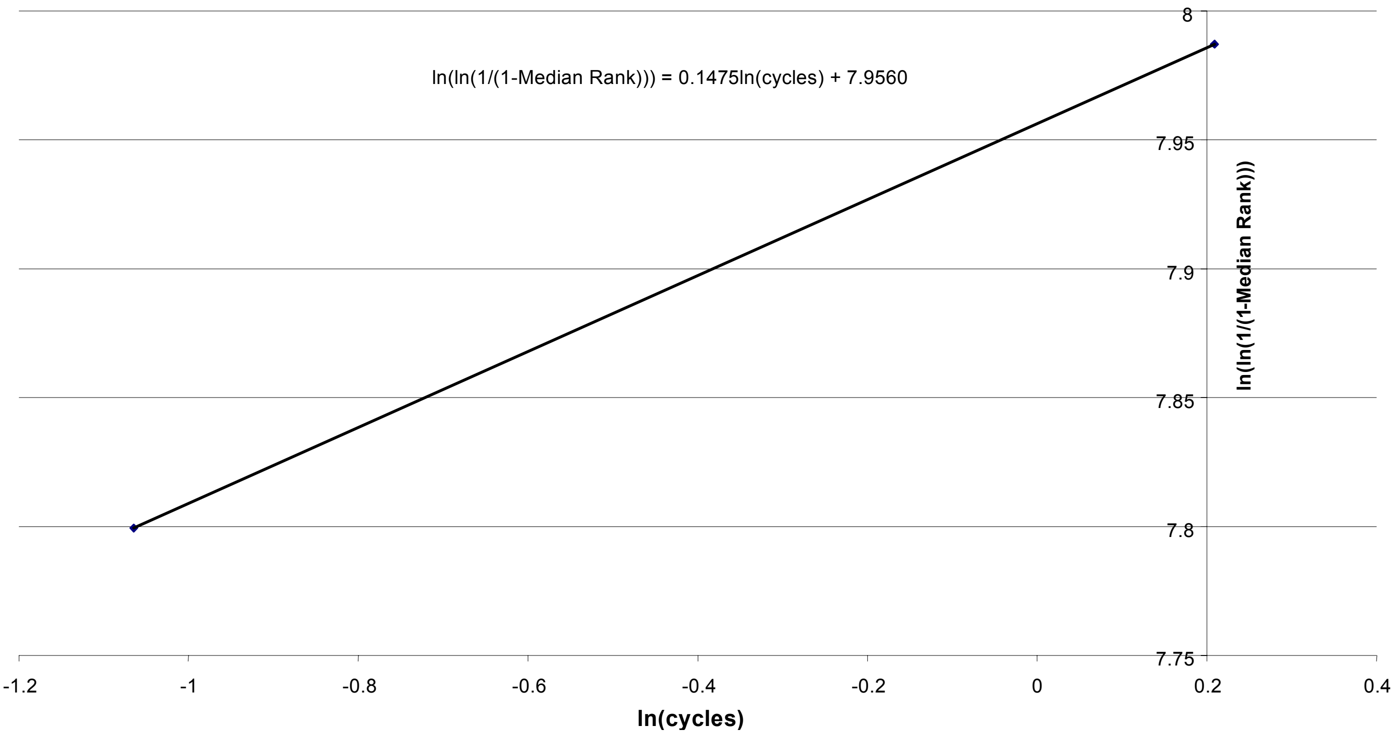
DATA

BENARD MEDIAN RANK

Item	Calculated Median Rank
1	0.291667
2	0.708333

Part #: QTS-100-01-L-D-RA	Tracking Code: 0217--0671
Test Completed: 7/22/02	

LINEAR GRAPH (transposed for regression on X and intercept calculations)



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EQUIPMENT AND CALIBRATION SCHEDULES

Equipment #: 25
Description: Temperature/Humidity Chamber
Manufacturer: Thermotron
Model: SE-1000-6-6
Serial #: 31808
Accuracy: See Manual
… Last Cal: 8/15/02, Next Cal: 8/15/03

Equipment #: 23
Description: STD Series Event Detector
Manufacturer: Analysis Tech
Model: 256
Serial #: 1010425
Accuracy: See manual
… Last Cal: 8/1/02, Next Cal: 8/1/03

Equipment #: 10
Description: True RMS Multimeter
Manufacturer: Fluke
Model: 87 III
Serial #: 74660176
Accuracy: See Manual
… Last Cal: 6/25/02, Next Cal: 6/25/03

Equipment #: 28
Description: 6"x6" Video Measuring Machine
Manufacturer: Micro-Vu
Model: M301
Serial #: V6815
Accuracy: See Manual
… Last Cal: 4/3/02, Next Cal: 4/3/03
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