ELECTRICAL TEST SYSTEM GUIDE

Z-PACK TINMAN Customer System Kit
User's Guide

Report # 27GC004
06/21/07-Rev1

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I. INTRODUCTION

The Z-PACK TINMAN customer evaluation system has been constructed so that the user may directly test the performance of the Z-PACK TINMAN connector when designed into a variety of electrical system applications. The test system varies several system parameters in order to mimic typical system applications as closely as possible. Some of the permutations are as follows:

- Multiple system trace lengths
- Multiple adjacent pairs
- Various layer connections
- Optional Counterboring

The system was designed to examine system throughput, system noise, and system reflection/impedance. **Note:** The evaluation system is designed using standard plated through-hole technology and in some cases counter-bored plated through-holes.

The Z-PACK TINMAN customer evaluation system was designed with the intent to test and evaluate the performance of the Z-PACK TINMAN connector in typical applications. The connector is available in a 1.0" (25.40mm) or 0.8" (20.30mm) slot pitch version. The 1.0" pitch connector is provided with the customer evaluation system. The 1.0" pitch connector has 5 differential pairs per column, for a density of 66.8 pairs per inch and the 0.8" pitch connector has 4 pairs per column, for a density of 53.5 pairs per inch.

II. USAGE GUIDELINES

SMA connections are used as test points on the system evaluation kit. The SMA connectors provide high quality with repeatable measurements. The following guidelines facilitate successful use of the Z-PACK TINMAN customer system evaluation kit.

- **If an SMA connection is broken, contact Tyco immediately for a replacement kit. Do not attempt to de-solder or re-solder SMA connections.**
- **Do not apply excessive torque to SMA connections.**
- **Do not modify, rework, or disassemble any connectors.**
- **Remove and replace pin protectors as the various slots are tested on the backplane.**
- **Ensure that cards are fully mated to provide accurate data.**
- **Do not apply hazardous voltages to the Z-PACK TINMAN test cards.**
- **Do not subject to mechanical testing.**
- **Do not subject to environmental testing.**
- **In the event of damage return the unit to Tyco Electronics for repair.**

III. BACKPLANE DESCRIPTION

The Z-PACK TINMAN customer evaluation backplane is a combination of 5 different system lengths used to study the effects of system analysis. In order to test these different system lengths, the backplane must be fully mated with 2 line cards, within the same link. Also, included on the backplane are single-ended and differential traces that can be used for basic characterization.

The backplane, as shown in **Figure 1**, is a 16 layer board with 6 signal layers, 8 ground layers, and top and bottom pads-only layers. For the evaluation backplane PWB stackup, see **Figure 2**. All signal layers have counterbored and non-counterbored connections. Characterization traces exist on the top signal layer only.

Routing techniques were designed to reflect realistic high speed system performance. 1" (25.40mm), 4" (101.60mm), 8" (203.20mm), 16" (406.40mm), and 24" (609.60mm) of trace are routed through pinfields to mimic the effects of pinfield routing. All traces were length matched to within 1 mil (25 um) to eliminate skew. Each section on the backplane is labeled according to trace length and designated by a white arrow. All signals within a section are routed to identical pin locations from left connector to right connector. For example connection E4 on the left side of the link routes to connection E4 on the right side of the link. For the backplane trace geometries, see **Figure 3**.

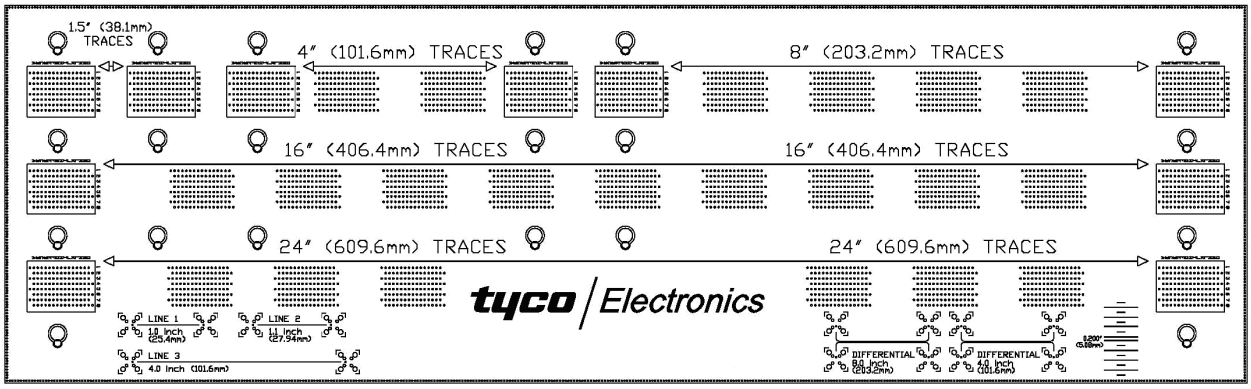

Figure 1: Z-PACK TINMAN Customer Evaluation Backplane

A. BACKPLANE PWB STACKUP

The backplane stackup is shown in **Figure 2**. The board is 200 mils (5.08mm) thick and has 16 copper layers. There are 6 signal layers, 8 ground plane layers, and 2 pads only layers. All signal layers contain counterbored and non-counterbored connections. The customer evaluation backplane is fabricated with Nelco 4000-13 (FR4) material.

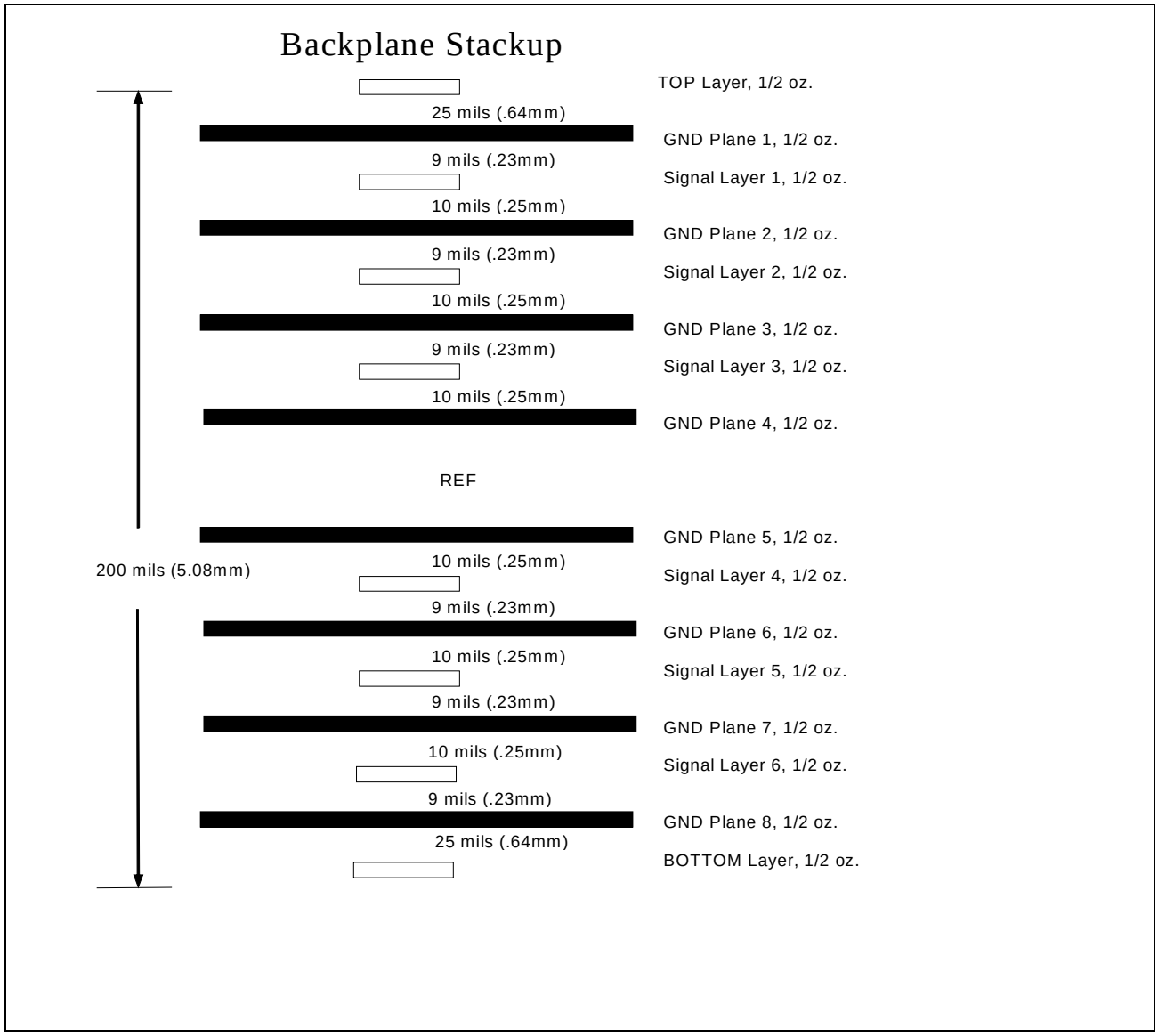

Figure 2: Z-PACK TINMAN Evaluation Backplane PWB Stackup

B. BACKPLANE TRACE GEOMETRY

The backplane trace geometry is shown in **Figure 3**. All signal layers consist of 7 mil (0.18mm) wide differential pairs with 10 mil (0.25mm) spaces within the pair. The 7-10-7 differential trace geometry was designed for a 100 Ohm differential impedance.

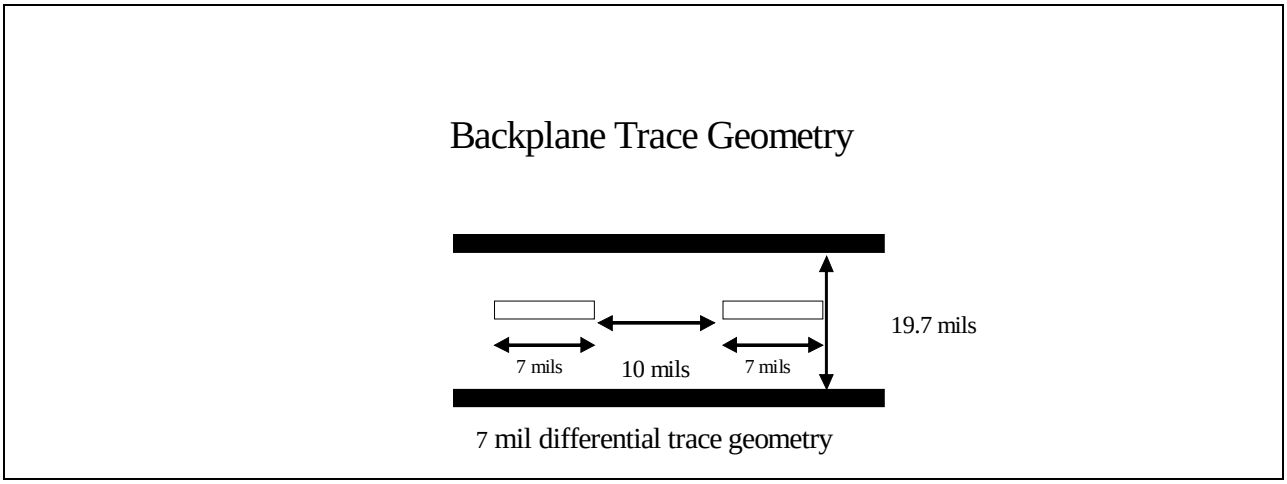

Figure 3: Z-PACK TINMAN Customer Evaluation Backplane Trace Geometry

C. Z-PACK TINMAN BACKPLANE PADSTACK

Shown below in **Table 1** is the padstack used in the fabrication of the backplane printed circuit board:

Description	Size
Drill	21.8mils (0.55mm)
External Pad	32.0mils (0.81mm)
Internal Pad	34.0mils (0.86mm)
Antipad	45 x 131mils (1.14 x 3.33mm)

Table 1: Z-PACK TINMAN Backplane Padstack

IV. LINE CARD DESCRIPTION

The Z-PACK TINMAN customer evaluation line card is shown in **Figure 4**. The line card is designed to mimic a typical application. Two line cards are needed to test any one of the system links. One daughtercard is used for transmitting while the other is used for receiving. Both line cards are identical so the transmit and receive locations can be used interchangeably. All test points on the line card are SMA connections.

The line card is a 14-layer board with 6 signal layers and 8 ground layers. For the evaluation line card PWB stackup, see **Figure 5**. All signals layers contain counterbored and non-counterbored connections. Columns 3 and 6 have counterboring while columns 4 and 5 are not counterbored. The columns that are counterbored on the daughtercard are also counterbored on the backplane.

Differential traces were routed from test point to connector plated through-hole with 5.0" (127mm) traces. All differential traces were routed to eliminate skew within the system caused by the connector. One leg of the connector pair is slightly longer than the other resulting in connector skew. By accounting for connector skew in the individual routed trace lengths a resultant skewless system is achieved. Differential traces are routed on the end columns of the connector, columns 1, 2, 7 and 8, to 50 ohm terminations. The line card also includes a 5.0" differential characterization trace. For the line card trace geometries, see **Figure 6**.

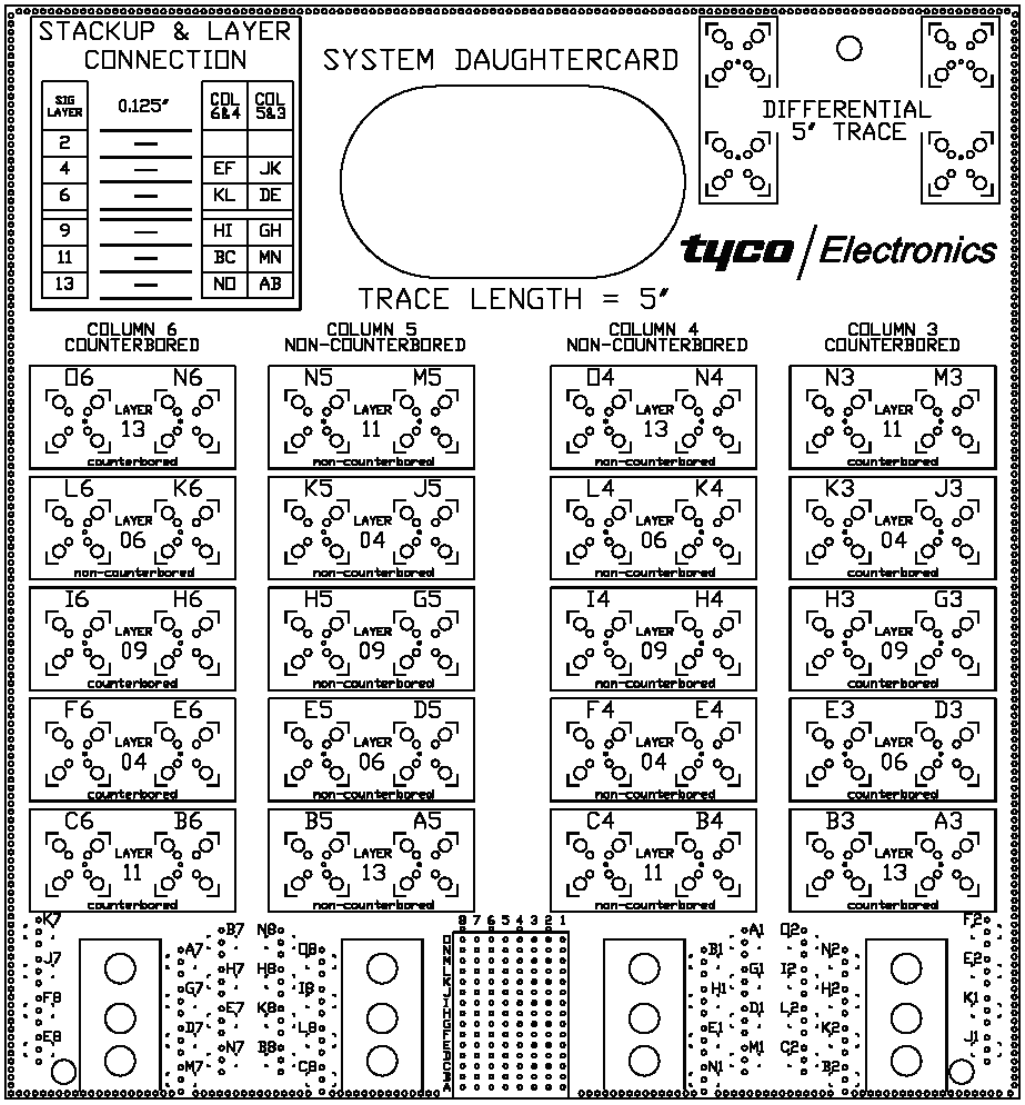

Figure 4: Z-PACK TINMAN Evaluation System Line Card

A. LINE CARD PWB STACKUP

The Z-PACK TINMAN customer evaluation line card stackup is shown in **Figure 5**. The board is 125 mils (3.18mm) thick and has 14 copper layers. There are 6 signal layers and 8 ground plane layers. All signal layers contain counterbored and non-counterbored connections. The evaluation line card is fabricated with Nelco 4000-6 (FR4) material.

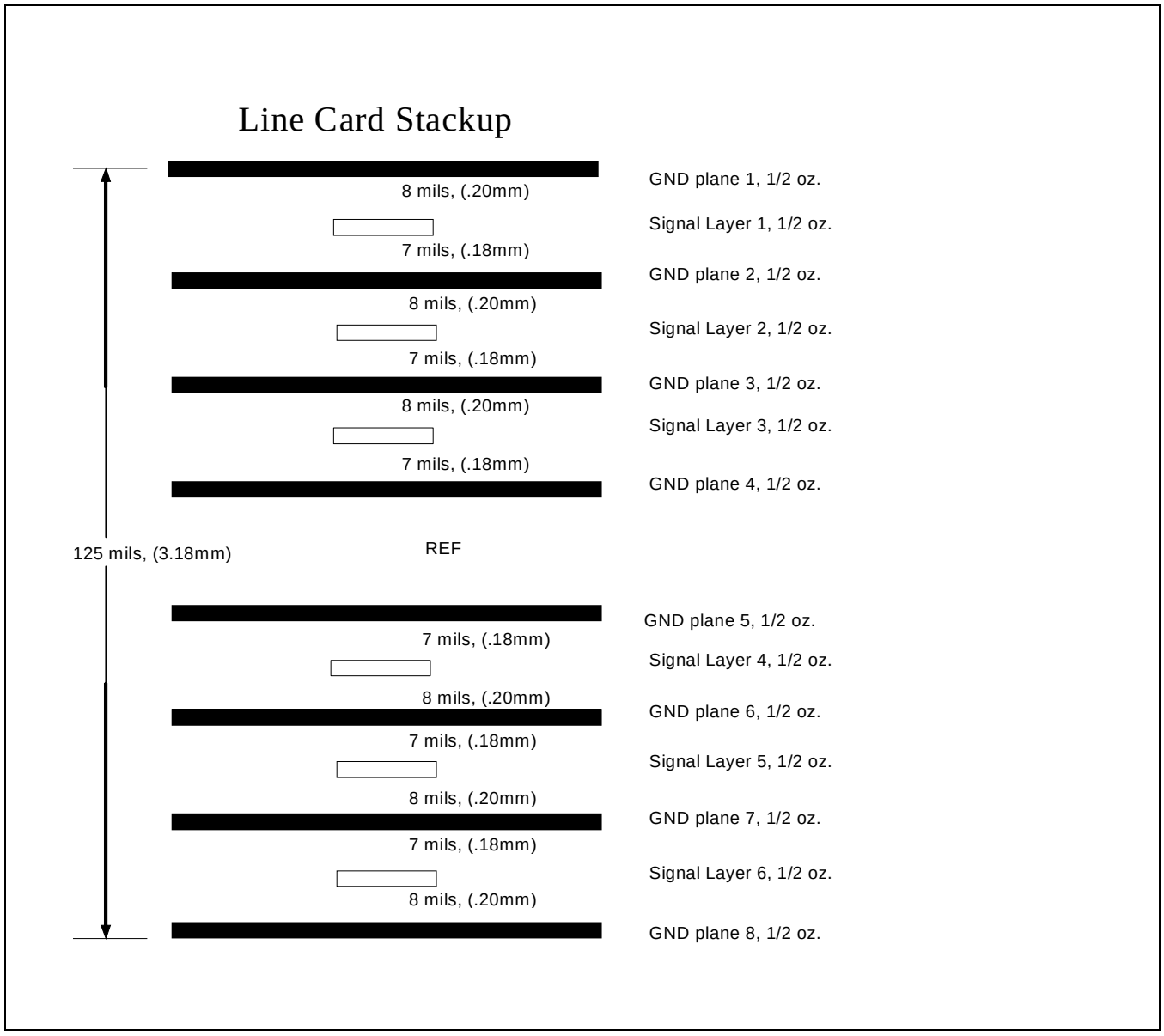

Figure 5: Z-PACK TINMAN Customer Evaluation Line Card PWB Stackup

B. LINE CARD TRACE GEOMETRY

The line card trace geometries are shown in **Figure 6**. All signal layers consist of 5 mil (0.13mm) wide differential traces with 9 mil (.23mm) spaces within the pair. The 5-9-5 differential trace geometry was designed for a 100 Ohm differential impedance.

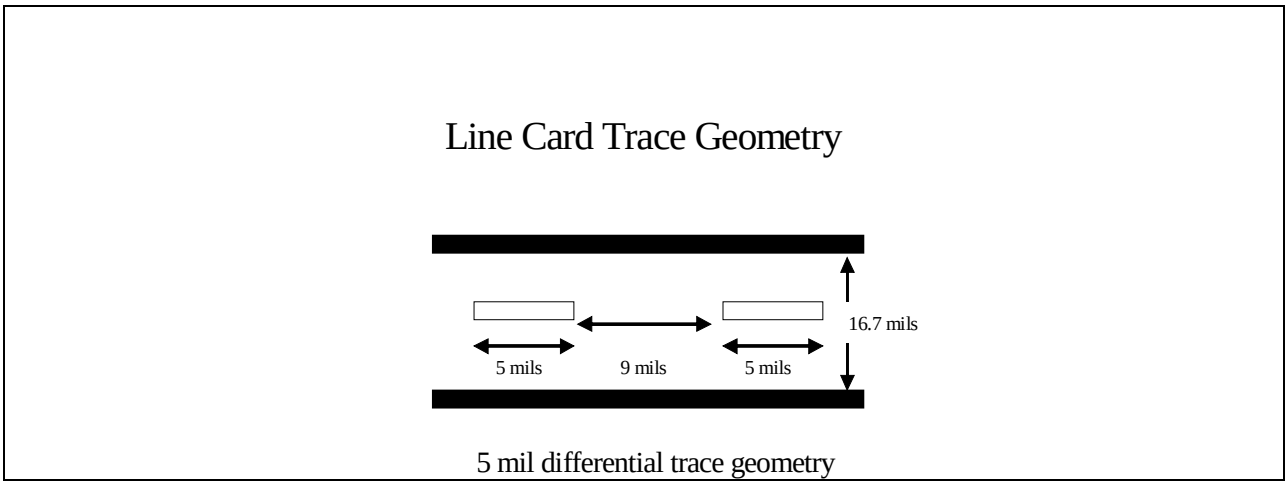

Figure 6: Z-PACK TINMAN Evaluation Line Card Trace Geometries

C. Z-PACK TINMAN DAUGHTERCARD PADSTACK

Shown below in **Table 2** is the padstack used in the fabrication of the daughtercard printed circuit board:

Description	Size
Drill	22.0mils (0.56mm)
External Pad	34.0mils (0.86mm)
Internal Pad	34.0mils (0.86mm)
Antipad	45 x 131mils (1.14 x 3.33mm)

Table 2: Z-PACK TINMAN Daughtercard Padstack

V. TEST PROCEDURES

The following electrical tests can be conducted with the Z-PACK TINMAN evaluation system: system impedance/reflection, system throughput, and system noise. The following permutations can be tested for each electrical test: various system trace lengths, layer connections, counterbored vs. non-counterbored and all rows of the connector.

A. SYSTEM LINKS

The Z-PACK TINMAN customer evaluation system is used to test a variety of real system applications. The Z-PACK TINMAN line cards can plug into various system links. All 5 system links are designed with differential traces routed through pinfields with counterbored and non-counterbored plated through-hole connections. The difference between each of the 5 links is the backplane trace length described below in **Table 3**.

Line Card (Transmit) Trace Length	Line Card (Receive) Trace Length	Backplane Trace Length	Total System Trace Length
5”	5”	1.5”	11.5”
5”	5”	4”	14”
5”	5”	8”	18”
5”	5”	16”	26”
5”	5”	24”	34”

Table 3: System Tests Trace Lengths

NOTE: The 11.5” system measurements require a unique line card for testing not typically supplied in the Z-PACK TINMAN customer evaluation set.

B. SYSTEM TESTING

Connections for system tests are designed to be intuitive. In order to test the system 2 daughtercards are required. One card will plug into the left side of the backplane system link and the other card will plug into the right side of the system link, each slot connection is marked with white arrows on each link. Connections will be identical on both cards to examine system throughput, ex. Signal E4F4 on the left side of the system connects to signal E4F4 on the right side of the system. Each test point is labeled with a designation routed to their respective pins on the Z-PACK TINMAN connector throughout the entire system link. **Figure 7** shows the connection locations for pair E4F4. The overall interconnect path is length matched to within 1 mil (25um), both inter- and intra- pair to eliminate skew and maximize comparability of test data from varying test scenarios.

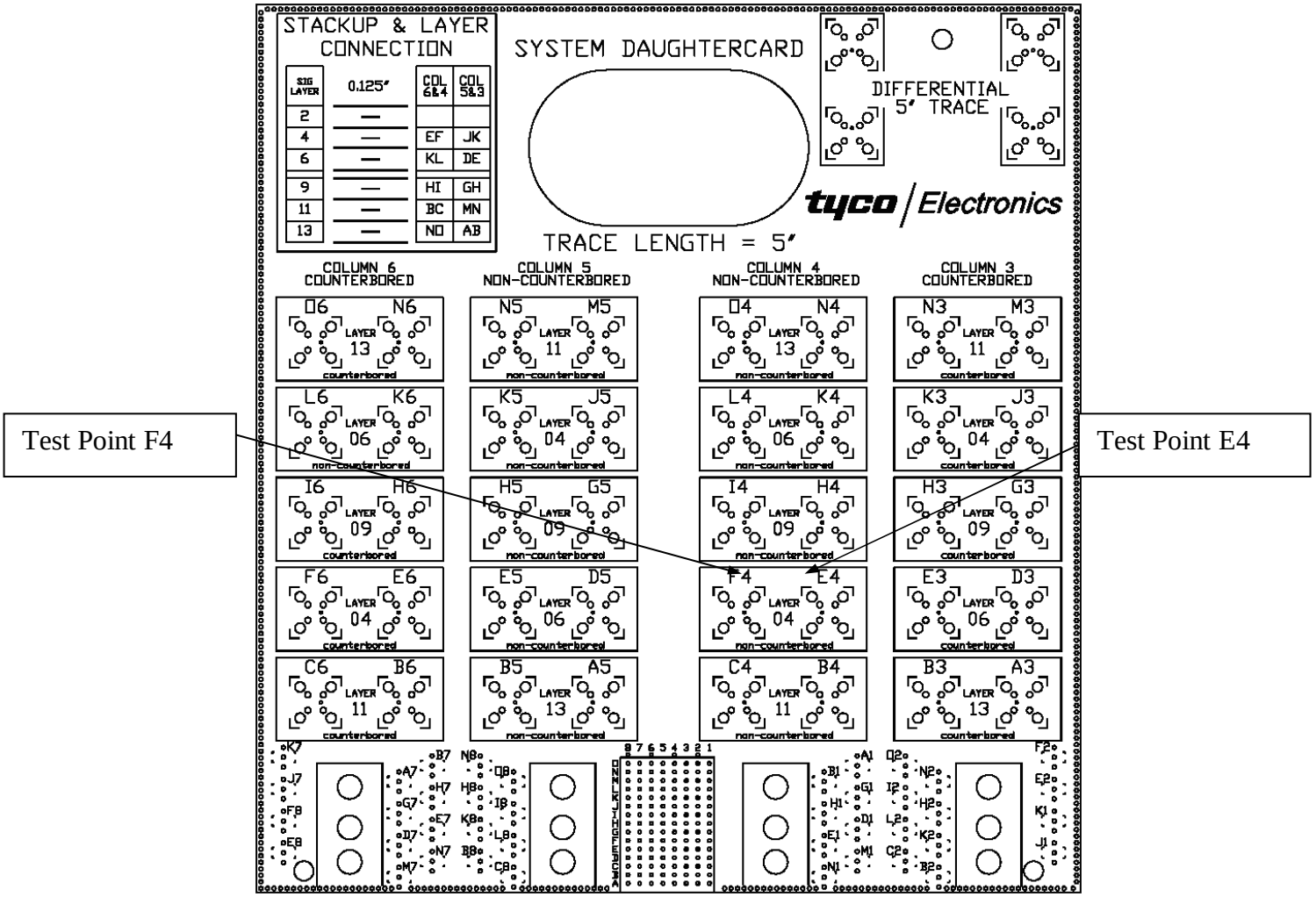

Figure 7: Connection Locations for Line Card Pairs

VI. EXAMPLE SYSTEM PERFORMANCE

Shown below are some examples of measurements taken with the Z-PACK TINMAN evaluation system.

A. EYE PATTERN RESULTS

A 2^7-1 PRBS 1.0 Volt differential swing was used for the eye pattern testing. The difference between each of the four measurements is system length and data rate.

1.25 Gbps

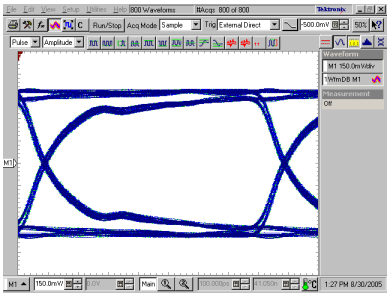

Figure 8: Pair AB5

Jitter = 26ps
Eye Opening = 831mV

14" SYTEM LENGTH

6.25 Gbps

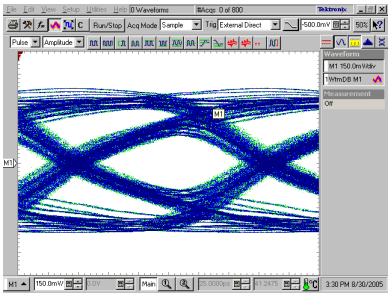

Figure 9: Pair AB5

Jitter = 44ps
Eye Opening = 357mV

1.25 Gbps

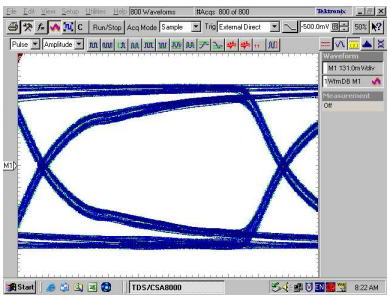

Figure 10: Pair AB5

Jitter = 40ps
Eye Opening = 740mV

26" SYSTEM LENGTH

6.25 Gbps

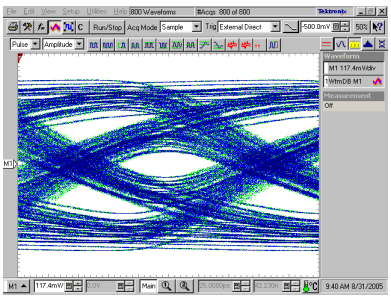

Figure 11: Pair AB5

Jitter = 80ps
Eye Opening = 127mV

B. INSERTION LOSS RESULTS

Shown below are frequency sweep plots for various system lengths. All measurements include end of the cable calibration.

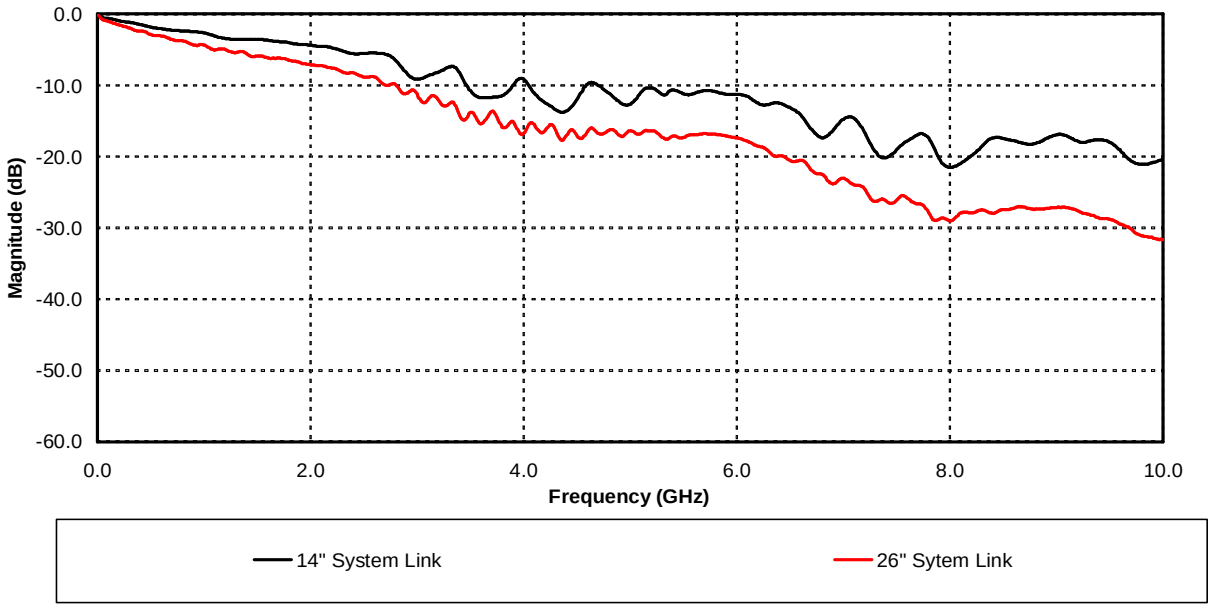

Figure 12: Pair AB5

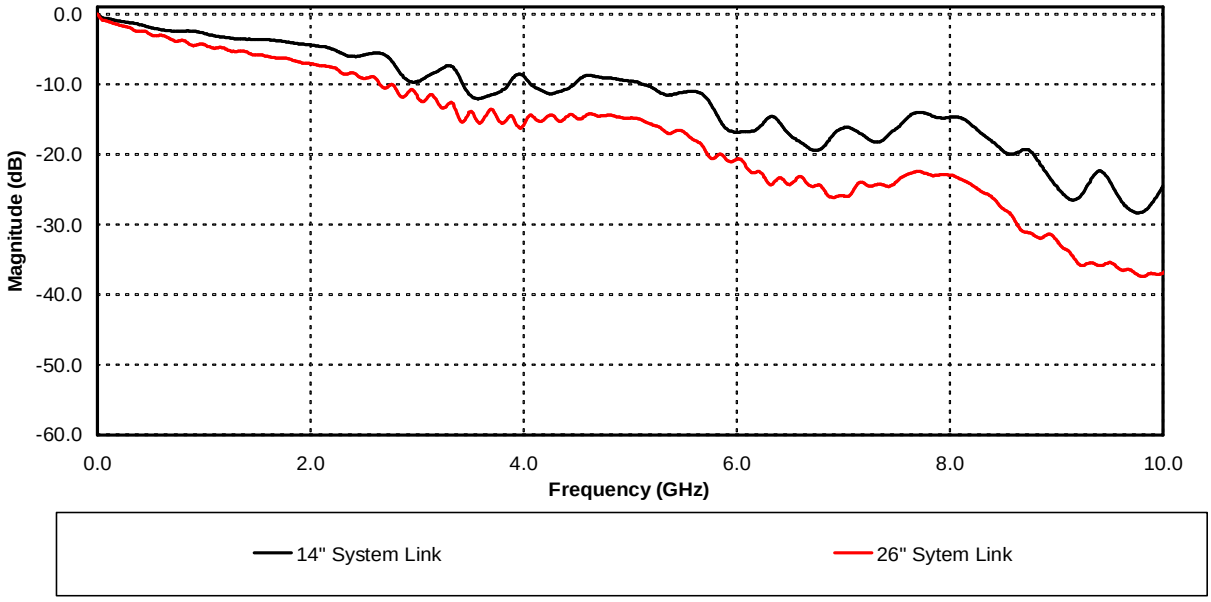

Figure 13: Pair BC4

VII. CONTACT INFORMATION

The following key contacts can be used to obtain additional information on the Z-PACK TINMAN product family.

Technical Support Center	1-800-522-6752	www.tycoelectronics.com/help
Bob Patterson Product Engineer	(717) 985-2810	rapatter@tycoelectronics.com
Bob Hnatuck, Product Manager	(717) 592-4168	rhnatuck@tycoelectronics.com

VIII. APPENDIX

A. CALIBRATION DESCRIPTION

Separated from the main line card is a calibration card. The calibration structure is shown below in Figure 14. This calibration coupon can be used for specific TRL calibration techniques. All of the traces are 6.4 mil single-ended top layer counterbored connections.

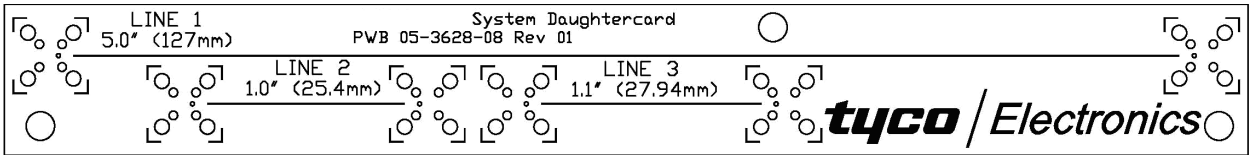

Figure 14: Z-PACK TINMAN Customer System Evaluation Calibration