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EFFECT OF DESIGN FACTORS ON MICROVIA RELIABILITY OF
FLIPCHIP SUBSTRATES

A Thesis

Presented to

The Faculty of the Department of Chemical and Materials Engineering

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Dennis Chi Pong Leung

December 2007

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FLIPCHIP SUBSTRATES
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ABSTRACT

EFFECT OF DESIGN FACTORS ON MICROVIA RELIABILITY OF FLIPCHIP SUBSTRATES

By Dennis C.P. Leung

The objective of this investigation was to determine the relationship between reliability and design factors of the microvias in flipchip polymeric substrates. A 10-layer substrate was used to investigate these contrasting design factors: "Stack-on-core" vs. "Non-stack-on-core," "High" vs. "Low" aspect ratio, "Stacked" vs. "Staggered," and "Fillet" vs. "Non-fillet." Temperature cycling was used to generate stresses on the microvias. Electrical resistance was measured and analyzed, using design of experiment (DOE), to determine the effects of these design factors on microvia reliability. The significant single factors for a robust microvia were "Non-stack-on-core" and "Staggered." "Non-fillet" was significant when interacting with "Non-stack-on-core" and "Staggered." Cross-sectioning was employed to understand the failure pattern. Cracks occurred on "Stack-on-core" and "Stacked" designs only. All the cracks were located at the interface between the capture pad and the bottom of the microvia where stress is the highest due to the CTE mismatch of different materials.

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CHAPTER ONE

INTRODUCTION

Ever since the first Integrated Circuit (IC) was packaged in the 1960s, the microelectronics packaging industry has never stopped creating new IC packages to meet numerous demands from the ever evolving electronic products. For the past seven years the Flip Chip Ball Grid Array (FCBGA), an advanced microelectronic package, has been developed to package high density and high frequency chips such as microprocessors, high end memories, Application-Specific ICs (ASICs), and Field Programmable Gate Arrays (FPGAs). A cross section of a FCBGA showing the major components is shown in Figure 1. The top view, the side view, and the bottom view of a 35 x 35 mm FCBGA are shown in Figure 2. In Figure 2, the heat spreader was intentionally removed so that the silicon chip is visible in the top view.

Figure 1. Cross section of a typical Flip Chip Ball Grid Array (FCBGA).

1.1 The Main Drivers for the Development of FCBGA

Density and frequency are two of the major drivers for IC packaging development. The year 2005 marked the 40th anniversary of Moore's prediction, commonly known as

Moore's Law, which states that "the number of transistors on a chip roughly doubles every two years [1]." As the feature size has shrunk to 65 nm and the physical gate length has dropped to 35 nm, the microelectronics packaging industry has attempted to follow the trend and develop packages that handle and offer more and more Input/Output (I/O) counts within an acceptable size. For instance, the latest Intel Itanium-2 processor, which is packaged in a 42.5 mm x 42.5 mm FCBGA, contains 592 million transistors [1]. Another example can be found in a Xilinx Vertex 4 FPGA device that has more than 8,000 die pads^{*}. The same 42.5 mm x 42.5 mm FCBGA is used to route all the die pads of the device to 1760 package pins[†]. A quarter of the die pad layout and a quarter of the package pin layout of this device are shown side-by-side in Figure 3.

Figure 2. Top view, side view, and bottom view of a 35 mm x 35 mm FCBGA.

The development of worldwide information technology requires the electronic products to manipulate a very large number of data in a relatively short time. As the

^{*} A die pad is an elevated pad on the surface of a chip. A die pad is interconnected to a ground, a power, or an I/O of the chip.

[†] A package pin is a ball, pin or lead coming out from a package. A package pin is routed to a die pad (or die pads) of the chip inside the package and, therefore, is interconnected to a ground, a power, or an I/O of the chip.

optical networking technology has evolved from megabits per second to gigabits per second, the microelectronics packaging industry also had to follow the trend and develop packages that offer faster and faster clock speeds. Today the latest Intel Pentium-4 processor, which uses similar Flip Chip Pin Grid Array (FCPGA) packaging technology, can provide clock speeds of up to 3.73 GHz. The Xilinx Vertex-4 FPGA family is another example. The Vertex-4 FPGAs, which are packaged in FCBGAs, provide channels of Multi-Gigabit serial Transceiver (MGT) capable of running up to 10 Gigabits per second.

Figure 3. A quarter of the die pad layout and a quarter of the package pin layout in a Xilinx Vertex 4 device.

1.2 Changes in Microelectronic Packaging for the Development of FCBGA

Traditional leaded packages, which have leads on their sides, can no longer meet the density requirements. The largest leaded package, having an envelope size of about 35 mm x 35 mm and a lead pitch of 0.5 mm, only provides 240 package pins. In contrast,

a ball grid array (BGA) package of similar size provides 1156 package pins. The main advantage of the BGA package is that arrays of solder balls are laid out over the entire bottom area for package pins. Today the largest BGA package has a body size of 50 mm x 50 mm. With a ball pitch* of 1 mm, up to 2400 package pins can be provided.

Wire bonding, an interconnect technology that uses gold wire to join a chip I/O to a package lead, has been facing limitations in terms of density and speed. Density-wise, since wire bond pads can only be placed on the four sides of a chip, even with the most advanced technology that reduces the effective bond pad pitch to 30 μm , a maximum of only 2,600 die pads can be placed on a 20 mm x 20 mm silicon. Flip chip technology, or Controlled Collapse Chip Connection (C4) technology, conversely, makes use of the entire area of the chip to place arrays of solder bumps for die pads. The same 20 mm x 20 mm die can provide more than 8,000 die pads with a 200 μm solder bump pitch. Speed-wise, most I/Os of a wire-bond package have unavoidably long interconnect paths. First, the gold wire itself can be very long and is also very inductive. Second, a long redistribution path is needed inside the die to bring an I/O to the periphery of a chip. Thus wire bond interconnection can hardly meet the frequency and performance requirements of an advanced IC chip. On the contrary, almost all I/Os of a flip chip package have the most direct interconnect path. Therefore, flip chip technology is extensively chosen for packaging high speed and high performance chips.

* Ball pitch is the nominal distance between the center lines of two adjacent rows of balls. Nowadays, the commonly used ball pitches are 0.8 mm, 1 mm, and 1.27 mm for FCBGAs in the industry.

1.3 Challenges Facing FCBGA Development

FCBGA utilizes a polymeric substrate as the IC carrier and interconnection of die pads and package pins. Although ceramic substrates are more robust, polymeric substrates are chosen for commercial and industrial usage mainly because of their low cost. However, the cost of a FCBGA polymeric substrate ranges from 35% to 70% of the total assembly cost. (For example, the cost of an 8-layer 35 mm x 35 mm FCBGA polymeric substrate is \$12 each, the cost of the assembly is \$8 each, and so the total assembly cost is \$20 each.) But the cost of a leadframe is less than 20% of the total assembly cost of a leaded package. (The total assembly cost of a 240 pin PBGA, which has about 35 mm x 35 mm envelope size, is only about \$3 each.) In some cases, the cost of the polymeric substrate is even higher than the cost of the silicon. Consequently, many companies have started to put a lot of effort into improving the yield and lowering the cost of FCBGA polymeric substrates.

Unlike leadframes that normally offer a “one size fits all” solution, FCBGA polymeric substrates are custom designed for each IC-package combination according to the die pad layout, package pin layout, netlist*, and signal integrity requirements. The structure of a polymeric substrate is similar to that of a printed wiring board (PWB). But, every feature in it is in miniature size. For example, the minimum trace width and gap used are 20 μm and 25 μm , respectively, and the minimum blind laser via diameter is 50 μm [2].

* A netlist is a list of all the electrical “nets” inside a package. Each net is an interconnection of a die pad (or die pads) and a package pin (or package pins).

A common FCBGA polymeric substrate requires six to twelve copper layers for I/O routing and power and ground planes. Laser vias and core vias are used to interconnect I/Os, powers, and grounds in the copper layers according to the netlist and the signal integrity requirements of a microelectronic package. Up to 50,000 vias may exist in a 50 mm x 50 mm 12-layers FCBGA polymeric substrate. A failure in one via will cause a complete failure of the device. A cross section displaying the layers and the vias of a FCBGA polymeric substrate is shown in Figure 4.

Figure 4. Cross section of a 10-layer FCBGA polymeric substrate.

High yield loss, as much as 50%, is common in the manufacture of FCBGA polymeric substrates. The causes of yield loss include over/under etching of metal patterns, warping, delamination of layers, presence of plating impurities, and laser blind via failure, among others. Out of all failures, via failure due to micro-cracks is particularly difficult to be noticed and tested for [3]. Sometimes the minuscule micro-cracks remain unnoticed and the substrate is passed on to the IC assembly and packaging

operations. A photograph showing the crack in a micro-via of a 10-layer FCBGA polymeric substrate is shown in Figure 5.

Figure 5. A micro-via crack in a 10-layer FCBGA polymeric substrate.

After packaging, due to coefficient of thermal expansion (CTE) mismatch of the silicon and the substrate and of the copper and the polymeric materials, the substrate is unavoidably subjected to thermal stresses [4-6]. Micro-cracks due to manufacturing defects may become wider or propagate in length. In addition, new micro-cracks may also be created. Intermittent failure due to laser via micro-cracks is one of the major failures when the chip is tested or even when it is in service [7]. The economic impact on the users and the chip manufacturers is incredibly large. Therefore there is a need to investigate causes of via failure.

1.4 The Focus of this Research

The first phase of this investigation focused on the study of the causes of via micro-cracks of the microelectronic packages in current usage, including the effect of via

structures, via diameters, substrate materials, manufacturing processes, thermal stress and fatigue, and fracture mechanisms. The second phase focused on identifying the major design factors contributing to via cracks in an assembled FCBGA. Existing commonly used via structures, patterns, sizes, and features were analyzed to locate the potential factors. The types of experiment, measurement data and techniques, and design of experiment (DOE) were then developed to achieve the goal. A test vehicle containing the combinations of all the potential factors was designed. A sufficient number of test vehicles, for statistical significance, were fabricated and fully assembled for the experiment. The next phase of the research focused on setting up the experiment series, carrying them out, and analyzing the results and data. All the test vehicles were subjected to thermal stress cycles, and electrical resistances were measured and analyzed. After that, cross-sectioning and failure analyses were performed on selected test vehicles to obtain further information on failure modes. All of the experimental data and the results were analyzed and evaluated to understand the effect of design factors on laser via reliability of a FCBGA.

In Chapter 2, the background of laser via reliability and a general outline of the current design factors which are the possible causes of reliability concerns are presented. In Chapter 3, the objective and the parameters of the investigation are described. In Chapter 4, the experimental approach is explained. Chapter 5 and Chapter 6 contain the results and discussions of the results, respectively. The conclusions of this investigation are presented in Chapter 7, and recommendations for future work in Chapter 8.

CHAPTER TWO

LITERATURE REVIEW

Before the Ball Grid Array (BGA) and Pin Grid Array (PGA) packages emerged as the mainstream microelectronic packages in the 1990's, vias were not commonly known to the first level packaging industry as being part of the packaging interconnect structures. In the last 17 years, numerous articles, journals, and papers have discussed practically every aspect of vias. Many of these also identified via crack or via delamination as a potential issue in the development of reliable packages. Nevertheless, due to the competitive nature of the packaging industry, publications with detailed studies on via cracks are relatively few. The purpose of this chapter is to review and discuss the valuable works that have been done by other researchers. Table 1 is a summary of these works and the main features of the studies.

2.1 Road Map and Future Developments of Micro-via Technology

Every two years, the Semiconductor Industry Association (SIA), which consists of a group of semiconductor companies, assembles and updates a technology roadmap known as the International Technology Roadmap for Semiconductors (ITRS) to assure the growth of the semiconductor industry up to 10-15 years ahead. As reported by Sundaram et al. in 2004 [8], the 2002 ITRS roadmap required much finer vias than the current micro-vias of 50 μm diameter to match the 100 μm array die pad pitch and data rates of 10 Gigabits per second in 2010. By then, the micro-via diameter would be decreased to 10-30 μm , and the line and space, conductor thickness, and dielectric

thickness would also be decreased. A comparison of the general design rules for four consecutive generations of micro-via technologies is shown in Table 2. Currently the industry has reached the second generation.

Table 1. Main features of the previous research on via cracks.

	Studies	Main Features of the studies
1	Road map and future developments of micro-via technology	The need of decreasing micro-via diameter
		Reliability assessment of 25 μm micro-vias in a C-SiC composite board
2	Reliability assessments	Micro-vias in a flip chip package
		Photo-defined micro-vias of different sizes in PCB based test vehicles
		Mechanical drilled vias of different sizes, features, and pre-conditioning processes in a land grid array package
3	Thermo-mechanical formations of micro-via cracks	Use of FEA for thermal-stress analyses and fatigue-life prediction on mechanical drilled vias and high density interconnect vias
		Comparing the FEA results with the experimental data
4	Analyses of design factors	Micro via location with respect to a core via
		Aspect ratio
		Micro via location among each other
		Fillet

Table 2. General design rules of each generation of micro-via technology [2].

	First Generation Build-up	Co-Lamination Technology	Second Generation Build-up	Future SOP Interposer Substrate
Line /Spacing (μm)	75/75 - 100/100	50/50 - 75/75	10/10 - 30/30	3/3 - 10/10
Via/Land/Pitch (μm)	150-200/300-400/400-500	70-100/170-300/210-300	30-50/60-80/100-150	10-30/20-50/30-100
Layer Counts	2+n+2	6-20	3+n+3	3-5
Conductor Thickness (μm)	70-100	50-100	3-10	3-10
Dielectric Thickness (μm)	70-100	50-100	10-15	10-15

Sundaram's research pointed out that the current substrates and dielectric materials would not meet future requirements, and thus, development of the next generation micro-via and global wiring technologies would be needed. Several sets of substrate and dielectric materials were then identified as potential candidates. However, methods on how small and reliable micro-vias would be developed were not included.

The research was continued by Kumbhat et al., including Sundaram, in 2005 [9]. A new substrate set of carbon-silicon carbide (C-SiC) based composite board material was identified as a promising candidate substrate material for the next-generation micro-systems. One of the main reasons that C-SiC was selected as the basic board material was due to its minimal via-pad misalignment, which is a significant advantage for the multilayer built-up structure required to achieve very high wiring density. However, the authors also indicated that the use of C-SiC could potentially cause delamination and cracking in the interlayer dielectric due to its high CTE mismatch with the dielectric material and copper. On the whole, the authors indicated that the achievement of high density package wiring depended greatly on the reliability of micro-via interconnects.

The reliability of a 25 μm micro-via, based on finite element modeling and coupon testing, was then presented. Some test vehicles were designed, built and subjected to air-to-air thermal shock tests from -55°C to 125°C. The result was that the 25 μm micro-via structure survived 1,200 cycles without any failures. Measurement data and detailed procedures of how the conclusions were drawn were not included in the paper. Nevertheless, the roadmap and the future development needs of micro-via

technology presented in these two papers confirm the need and the importance for continued research on micro-vias.

2.2 Reliability Assessments of Vias

Accelerated thermal stress tests such as thermal cycling and thermal shock are commonly used for the reliability assessments of micro-electronic packages. Similar tests are also used for the reliability assessments of polymeric substrates. Because via failure is a major problem in the development of microelectronic packages, some investigations have been done specifically on the vias.

2.2.1 Micro-vias in a Flip Chip Package

The reliability assessment of flip chip on built-up laminate based multi-chip package with emphasis on micro-via interconnection reliability was investigated by Chai et al. in 2002 [10]. The reliability of micro-vias was assessed in three different test vehicles: (i) a 2 built-up layers daisy chain test coupon with 740 micro-vias, (ii) a comb pattern with line and space of 50 μm each, and (iii) a bare substrate. The test coupon and the bare substrate were tested in thermal shock from -55°C to 125°C up to 2,000 cycles, and the comb pattern was tested in 5 V bias in a hot air stress test at 131°C and 85% RH. After the thermal shock and biased hot air stress tests, the resistance values of the daisy chain patterns were measured. Not a single failure was found in these samples because the resistance change of the daisy chain pattern was within $\pm 3\%$ of the original value. The samples were also checked by visual inspection followed by C-Scan Acoustic Microscopy (CSAM) inspection. No delamination or visual abnormalities were found on

the test coupons. The conclusion was that the substrate technology that was used to build the micro-via and fine metal line interconnection demonstrated good reliability.

Although a cross-section of the test coupon was included in the paper, the important information of the test vehicles such as the size and the structure of the micro-vias, and the dielectric thickness were not mentioned. Moreover, the conditions of the thermal shock experiment such as cycle time and pre-conditioning level were not provided. The sample size of the experiment was unknown. The resistance measurement data and the statistical analysis were not given. The process and criteria used for visual inspection of abnormalities on the micro-vias was also not clear. These data and information are essential to support the results and the conclusion drawn. They would also be beneficial for further investigation.

2.2.2 Photo-defined Micro-vias in a Printed Circuit Board

Micro-via reliability issues for photo dielectric epoxy materials and processes were evaluated by Liu et al. in 2002 [11]. Two test vehicles designed by the Interconnect Technology Research Institute (ITRI) were used for the study. The ITRI-2.4 test sample had a 50 μm thick dielectric film with micro-vias of 50, 75, 100, and 125 μm . The ITRI HDI Fine Line 1A test sample had a 25 μm thick dielectric film with micro-vias of 25, 50, 75, and 100 μm . The numbers of vias and daisy chains and all the main features of the test vehicles were given in detail. The samples were tested in liquid-to-liquid thermal shock cycling from -55°C to 125°C using an EPSEC Thermal Shock Chamber TSB-5 up to 2,000 cycles. The cycle time was 10 minutes and the liquid-to-liquid transfer time was

10 seconds maximum. Resistance measurements were taken at every 100 cycles, and a 10% increase in resistance was considered a failure.

The first failure was found at 1,000 cycles for the 50 μm micro-vias in the ITRI-2.4 test vehicle, and the 25% failure rate was reached at 2,000 cycles. All the micro-vias of 75, 100, and 125 μm in the ITRI-2.4 test vehicle passed 2,000 cycles. The cross-section of a failed 50 μm micro-via after 2,000 cycles is shown in Figure 6. As can be seen in Figure 6, a crack occurred at the foot of the via. All the 25, 50, 75, and 100 μm micro-vias in the ITRI HDI Fine Line 1A test vehicle passed 2,000 cycles. The cross-section of a 25 μm micro-via that survived 2,000 cycles is shown in Figure 7.

Figure 6. A failed 50 μm micro-via in the ITRI-2.4 sample [11].

It was summarized that the cracks were a result of CTE mismatch between the copper and the dielectric epoxy layer. A high aspect ratio (dielectric thickness to via diameter) was the cause since it resulted in the copper plating at the foot of the vias being thin. This small micro-via metallization was not strong enough to withstand the stresses caused by the CTE mismatch.

Figure 7. A 25 μm micro-via survived 2000 thermal shock cycles in the ITRI HDI Fine Line 1A sample [11].

The authors stated that process-related defects such as inefficient control of dielectric roughening and copper plating processes, insufficient copper thickness on via walls, incomplete polymer curing, etc, might be the main causes of failures. However, details of the process related defects were not discussed.

Throughout the paper, the sample size used for the experiment was not given. If the sample size of each test vehicle were one, then the total number of vias tested would be merely a few hundreds for each via diameter. Since one flip chip package may contain as many as 70,000 laser micro-vias, the sample size of the experiments from this paper would be considered small. Moreover, resistance measurement data and statistical analysis are not provided in the paper. These data and information would be beneficial for further investigation.

2.2.3 Mechanically Drilled Vias in a Land Grid Array Package

The substrate via reliability of the mechanically drilled vias in a Land Grid Array (LGA) package was examined by Darveaux et al. in 2003 [12]. Nine different laminate

constructions were used as test vehicles in this experiment. All the nine test vehicles had the same outline of 10 mm x 10 mm 34 LGA package with two daisy chains that consisted of drill vias of 250 μm and 300 μm , respectively. The variables of the nine test vehicles are summarized in Table 3. The cross sections of the vias are shown in Figure 8.

Table 3. Experimental matrix for mechanically drilled vias [12].

Leg	1a	2a/b	3a	4a/b	5a/b	6a	7a	8a	9a
Total Thickness (μm)	470	490	451	471	290	490	290	490	378
Dielectric Thickness (μm)	387	392	355	362	213	408	209	411	212
Trace Thickness (μm)	28	40	28	35	26	26	24	33	67
Via Cap Thickness (μm)	18	18	17	19	N/A	N/A	N/A	20	18
Via Wall Thickness (μm)	60	51	65	60	28	28	22	62	63
# of Metal Layers	2	2	4	4	2	2	2	2	2
Inner Layer Thickness (μm)	N/A	N/A	18	18	N/A	N/A	N/A	N/A	N/A

Figure 8. Cross-sections of mechanically drilled vias [12].

The number of samples used was twenty-two for each test vehicle. All the samples were subjected to temperature cycling from -55°C to 125°C with a cycle time of

30 minutes. Resistance measurements were taken every 200 cycles on the two daisy chains of all the samples. The initial resistances of all the daisy chains were between 600 m Ω to 900 m Ω . A 200 m Ω increase in resistance was considered a failure.

The first failure was found at 600 cycles. Fourteen samples out of forty-four of Leg 1a had failures due to cracks. At 800 cycles, twenty cumulative samples of Leg 1a had failure, and one out of the forty-four samples in Leg 5b had failure. At 1,200 cycles, thirty-seven cumulative samples of Leg 1a had failure, three cumulative samples of Leg 5b had failure and one sample of Leg 8a had failure. All other samples survived the temperature cycling test. It was identified that the construction for Leg 1a used a less robust manufacturing process during the fabrication of the substrates at the supplier's premises. However, via cracking of Leg 5b could not be verified in cross-sectional photos. The experiment was continued up to 1,300 cycles, but no resistance measurements were recorded. In each leg, cross-section analyses were made on five units which had the greatest increase in resistance. The results of the cross-section are shown in Table 4. As can be seen from Table 4, all of the vias examined in Leg 1a were cracked. But cracks were also found in Legs 2a, 3a, 8a, 2b, and 4b. All of the vias of these legs had caps on them. The only capped via without cracks was Leg 9 which had the thickest via wall and the thickest copper layer among the nine constructions. None of the non-capped vias was found to have cracks. Also, the 300 μ m drills had more cracks than the 250 μ m drills did, and the legs that were pre-conditioned at 260°C had more cracks than the legs that were pre-conditioned at 240°C did.

Table 4. Cracks found in five worst case units from each leg after 1,300 temperature cycles [12].

Leg	Pre-conditioning	250 μm via	300 μm via
		# of cracks / # inspected	# of cracks / # inspected
1a	L3-240°C	5 / 5	5 / 5
2a	L3-240°C	0 / 5	5 / 5
3a	L3-240°C	2 / 5	2 / 5
4a	L3-240°C	0 / 5	0 / 5
5a	L3-240°C	0 / 5	0 / 5
6a	L3-240°C	0 / 5	0 / 5
7a	L3-240°C	0 / 5	0 / 5
8a	L3-240°C	0 / 5	5 / 5
9a	L3-240°C	0 / 5	0 / 5
2b	L3-260°C	3 / 5	5 / 5
4b	L3-260°C	0 / 5	5 / 5
5b	L3-260°C	0 / 5	0 / 5

The cross-section of a cracked via from Leg 2b, after 1,300 cycles, is shown in Figure 9. As can be seen in Figure 9, the crack most probably initiated from the inside of the knee at the intersection between the via wall and the via cap where a stress concentration point is clearly seen. The cross-section of a failed via from Leg 1a after 1,000 cycles is shown in Figure 10. It is thought that the crack started at the same stress concentration point at the intersection between the via wall and the via cap, and then propagated along the interface, and finally split open the interface.

From the experimental results, the following observations were made:

- Only one of the nine constructions failed before 1,000 temperature cycles.

This construction was identified having a substrate manufacturing process error.

- All the cracks were found between the via cap and the via wall. Thus, the samples without via caps were better than those with caps. The authors indicated that a

thin via wall might be a factor in avoiding cracks. Compared to other capped parts, the non-via-capped parts had a much thinner wall thickness. However, this finding contradicts with the conclusion of “insufficient copper thickness on via walls” as one of the process related defects for via crack proposed by Liu et al [11], as described in Section 2.2.2.

Figure 9. Crack initiation from inside of knee [12].

Figure 10. A completely failed mechanically drilled via [12].

- Legs with 260°C pre-conditioning reflow temperature showed more cracking than legs with 240°C pre-conditioning reflow temperature do. No explanation was given in the report.

- Legs with 300 µm drilled vias showed more cracking than legs with 250 µm drilled vias do. Again, no explanation was given in the report.

2.3 Thermo-mechanical Formations of Micro-via Cracks

Finite Element Analysis (FEA) is commonly used for the analysis of thermo-mechanically induced cracks on micro-vias. Stress concentration points of a via at the highest and the lowest temperatures of a temperature cycling test can be pin-pointed. Fatigue lives of a via under different situations can also be predicted.

2.3.1 Mechanically Drilled Vias in a LGA Package

Darveaux et al. [13] went on to study the mechanically drilled vias reviewed in Section 2.2.3 to understand the experimental results. The fatigue lives of the vias were predicted using the results obtained in FEA and were compared with the experimental data.

Finite element models were created for all the different via constructions shown in Figure 8 in Section 2.2.3. The materials were setup as follows in the FEA model:

- The laminate core materials were modeled with orthotropic properties.
- All other materials were modeled with isotropic properties.
- Copper was modeled in its elastic-plastic region.
- All other materials were modeled in the linear elastic region.

- Temperature dependent material properties were not used in the FEA because the data were not available for all the materials.

The structure was assumed to be stress free at 35°C. The stress and strain distribution was calculated using the following three load steps:

1. Ramped up to 125°C
2. Ramped down to -55°C
3. Ramped back up to 125°C

Both kinematic hardening and isotropic hardening* rules were applied for simulating fatigue loading. The stress-strain hysteresis loops of a via are shown in Figure 11. Kinematic hardening was chosen to obtain the total strain range. After that, the fatigue life, N , of a via was estimated based on Equation 1. The 1st term of the Equation is the strain in the plastic region and the 2nd term is the strain in the elastic region.

$$\epsilon_T = N^{-0.6} \epsilon_u + (0.9/E) \sigma_u [\exp (\epsilon_u)/0.36]^{0.1785 \log_{10}(100000/N)} \quad \text{Equation 1}$$

Where

- N = Fatigue life
- ϵ_T = Total strain range
- ϵ_u = Ultimate ductility
- E = Elastic modulus
- σ_u = Ultimate tensile strength

The total equivalent strain distributions of the vias were obtained for the different legs during the temperature cycling. The total equivalent strains in Leg 1 at -55°C and at 125°C are shown in Figure 12 and Figure 13, respectively. As can be seen in Figure 12

* Assuming the elastic domain and the shape remain unchanged in general multi-axial stress state, isotropic hardening only expands uniformly in sizes, and kinematic hardening translates in the stress space.

and Figure 13, the highest strain in both situations happens in the lower outer knee of the via.

Figure 11. Stress-strain hysteresis loops for worst case element in substrate via [13].

The predicted fatigue lives for the vias in all the legs are shown in Figure 14. In each via the fatigue life was calculated in the sections of the bottom inner, bottom outer, top inner, and top outer corners because one of these four sections contains the worst case element. The non-capped vias in Legs 5-7 exhibit about a 2 times longer fatigue life than the vias in the other legs. This finding correlates with the experimental results. However, as can be seen in Figure 14, at 1,200 cycles all of the vias except those in Leg 7 would fail in one corner or the other. Since there are twelve legs in the experiment, the total failure rate would be about 92%. But in the experiment a total of only 5% of the daisy chains failed at 1,200 cycles in the resistance tests, and about 30% of the vias were found

to have cracks at 1,300 cycles in the cross-section analyses. So, the predicted fatigue lives are significantly conservative.

Figure 12. Total equivalent strain in via of Leg 1 at -55°C [13].

2.3.2 Thermo-mechanical Fatigue Analysis of High Density Interconnect Vias

A detailed thermo-mechanical fatigue analysis of high density interconnected (HDI) vias was undertaken by Prabhu et al. in 1995 [4]. FEA analysis was done on the HDI via structure to determine the effect of temperature cycling. The results were then used to determine the fatigue life of the via structure based on the extreme levels of

Figure 14. Predicted fatigue life of vias for Leg 1 to Leg 9 [13].

Thermo-mechanical analyses were run for three different temperature cycles:

1. Between -65°C and 150°C (ΔT of 215°C)
2. Between -40°C and 125°C (ΔT of 165°C)
3. Between 3°C and 43°C (ΔT of 40°C)

Three load steps were used for each temperature cycle. The cycle was repeated until the stress was stabilized. A stress-strain hysteresis loop for the temperature cycling of ΔT 215°C is shown in Figure 16. The total strain range, ϵ_T , of 0.006 was obtained from Figure 16 for the calculation of the fatigue life. A stress contour plot of the via at 150 °C is shown in Figure 17.

Figure 15. The schematic of the high density interconnect [4].

Figure 16. The hysteresis loop for the temperature cycle with a temperature rise of 215°C [4].

Figure 17. Stress (Vonmises) contour plot over via at 150 °C [4].

The fatigue life, N , of a via was estimated based on Equation 2.

$$\epsilon_T = N^{-0.6} D_f^{0.75} + (0.9/E) S_u [\exp (D_f)/0.36]^{0.1785 \log_{10}(100000/N)} \quad \text{Equation 2}$$

Where

- N = Fatigue life
- ϵ_T = Total equivalent strain range
- D_f = Fatigue ductility coefficient
- E = Elastic modulus
- S_u = Tensile strength

Compared to Equation 1 discussed in Section 2.3.1, Equation 2 uses the fatigue ductility coefficient and tensile strength instead of the ultimate ductility and ultimate tensile strength. Since it is difficult to obtain the exact value of the fatigue ductility

coefficient* (D_f) of the plated copper, two extreme values were used. $D_f = 10\%$ indicates a brittle material whereas $D_f = 30\%$ indicates a relatively ductile material.

The number of cycles to failure for the via in Layer 2 is shown in Figure 18. This plot was used to predict the fatigue life of the via. For example, the via could fail at about 10 cycles in a temperature cycle test with a ΔT of 215°C , with copper having a 10% fatigue ductility coefficient.

Figure 18. Results of the finite element analysis for via in the 2nd layer [4].

* Fatigue ductility coefficient is the amount of strain that causes a material to fracture at the first reversal of cyclic loading.

Test samples from Texas Instruments (TI) and General Electric (GE) were built and subjected to five different accelerated thermal stress tests including the three temperature cycling conditions used for the FEA. The experiments were still in progress when the paper was published. The literature was searched to find the results published upon completion of the experiment. Unfortunately, these could not be found. The preliminary experimental results are shown in Table 5. In the temperature cycle test of $\Delta T = 215^{\circ}\text{C}$ (-65°C to 150°C), an average of 56% increase in resistance was found on the two TI samples after 250 cycles, and three out of the four GE parts showed intermittent opens after 110-200 cycles. But in a lower ΔT temperature cycle test of $\Delta T = 180^{\circ}\text{C}$ (-55°C to 125°C), an average of 34% increase in resistance was found on the three TI samples after 250 cycles, and none of the four GE parts failed after 150 cycles. This clearly shows that the higher the ΔT , the greater the increase in via resistance and the higher the failure rate.

The authors pointed out that the early failure analysis results from the experiments supported the predictions obtained in the FEA models. However, the paper indicated that the amount of data from the experiment was inadequate to fully develop predictive capability. The authors concluded that the predictions by the model could represent the lower bound of the life of the vias, and that the model might be conservative in predicting the number of cycles to failure.

2.4 Design Factors

Several factors need to be taken into account in the design and development of FCBGAs. These include the geometrical relationship between a laser via and a core via,

the ratio of dielectric thickness to laser via diameter, the geometrical relationship between two laser vias, and the existence of a fillet between a via pad and a trace. According to Xilinx and a substrate manufacturer, some combinations of these design factors could potentially result in via crack formation [14, 15].

Table 5. Summary of HDI test results [4].

Test	Conditions	Source	Test Results
Thermal Shock (Mil-std-883 M1011)	-65°C to 150°C	TI	5 parts tested to 300-500 cycles. No observed opens at room temperature. Via resistance increase averages 58% after 250 cycles.
		GE	5 parts tested to 70-200 cycles. Intermittent opens on at least one part.
Temperature Cycle (Mil-std-883 M1010)	-65°C to 150°C	TI	2 parts tested to 450 cycles. No observed opens at room temperature. Via resistance increase averages 56% after 250 cycles.
		GE	4 parts tested to 110 - 200 cycles. Intermittent opens on 3 parts.
Thermal Shock (Mil-std-883 M1011)	-55°C to 125°C	GE	4 parts tested to 200 cycles. No failures.
Temperature Cycle (Mil-std-883 M1010)	-55°C to 125°C	TI	9 parts tested to 150-300 cycles. No opens observed at room temperature. Via resistance increase averages 34% after 250 cycles.
		GE	4 parts tested to 150 cycles. No failures.
Power Temperature Cycle	-40°C to 125°C	GE	6 parts tested to 1000-1500 cycles. One failure at 1000 cycles.

2.4.1 Non-stack-on-core vs. Stack-on-core

A stack-on-core via, which resembles a through-hole drill, has its center-line in line with the center-line of a plated through hole (PTH) which is also known as a “core via”. On the other hand, a non-stack-on-core via has its center-line offset from the center-line of a core via. A stack-on-core via is shown in Figure 19(a), while a non-

stack-on-core via is shown in Figure 19(b). The amount of the offset equals to, or is larger than, the sum of the via capture pad radii of the laser via and the core via. For example, a 60 μm laser via may have a capture pad diameter ranging from 100 μm to 135 μm , and a 200 μm core via may require a capture pad diameter ranging from 300 μm to 350 μm , depending on the process capability of the substrate manufacturers. So, the offset can range from 200 μm to 243 μm .

Figure 19. Illustration of stack-on-core via and non-stack-on-core via

The total percentage of metal content and the metal distribution are different in each of the copper layers of a FCBGA substrate because the circuit design in each layer is different. Some layers may have more traces and less metal content while some may have more solid planes and more metal content. Because of the unevenness of metal content in each layer, warpage is induced to a substrate during lamination processes. However, substrate warpage should be kept at a minimum because it is one of the major causes of yield loss in the assembly process. As a result, almost all of the FCPBG polymeric substrates employ a thick core layer to provide the mechanical strength

required to keep the warpage within an acceptable level. As shown in Figure 4 and Figure 5, a core layer is much thicker than the other built-up layers. The core thickness, depending on the size of the package, ranges from 400 μm to 800 μm . The larger the package, the thicker the core thickness.

As shown in Figure 19(a), the stack-on-core via requires only one core via capture pad on the core copper layers (L5 and L6) while the non-stack-on-core via needs an extra laser via capture pad. The main advantage of a stack-on-core via is that it requires less space on a substrate, and thus allows more space for routing more I/Os as well as increasing the power/ground plane density. But, in substrate manufacturing, a stack-on-core via structure requires a few more manufacturing steps than a non-stack-on-core substrate does. These extra processes may leave some residues on the copper surface, and these residues in turn weaken the adhesion between the core layer and its adjacent built-up layer [14].

2.4.2 Aspect Ratio

The aspect ratio is the ratio of dielectric thickness to via diameter. An aspect ratio of 0.7 is shown in Figure 20(a) while a ratio of 0.5 is shown in Figure 20(b). For a fixed dielectric thickness, a higher aspect ratio suggests a smaller via and a via capture pad which in turn saves space in a substrate and increases I/O routing and power/ground plane density. However, according to Liu et al. [11] in Section 2.2.2, a high aspect ratio results in thin copper plating at the foot of the via, which in turn causes small micro-via metallization. If the metallization of the via is not strong enough to withstand the stresses

caused by CTE mismatch, the via will crack. This finding suggests that the chance of via failure is greater when the aspect ratio is higher.

Figure 20. Via aspect ratios.

2.4.3 Staggered Via vs. Stacked Via

In a stacked via design, which resembles a through-hole drill design, two or more vias are stacked on one another along the same axis. In a staggered via design the two vias of the neighboring layers interconnect to each other along two different axes. A stacked via design is shown in Figure 21(a), while a staggered via design is shown in Figure 21(b). In the staggered via design, the distance between the axes is equal to or larger than the via capture pad diameter. For a 60 μm via diameter, the via capture pad diameter ranges from 100 μm to 135 μm , depending on the process capability of the substrate manufacturers.

As shown in Figure 21, the middle layer has only one via capture pad in the stacked via design, while it has two capture pads in the staggered via design. The main advantage of the stacked via design is that it saves space in the substrate, and thus increases I/O routing and power/ground plane density. However, some manufacturers do not accept vias that are stacked in three layers or more because the chance of micro-crack occurrence can be increased [14]. Generally, a staggered via design is believed to be more robust in terms of resisting thermal stresses.

Figure 21. Stacked via design vs. staggered via design.

2.4.4 Fillet vs. Non-fillet

In the wire bond package designs, a fillet, also known as a “teardrop”, is commonly used to strengthen every intersection of the trace-via capture pad and the trace-BGA ball pad because it removes the stress concentration points. A design without fillets is shown in Figure 22(a), and a fillet of $R\ 50\ \mu\text{m}$ added between the $30\ \mu\text{m}$ traces and the via capture pads is shown in Figure 22(b). The main reason for adding fillets is

to minimize the chance of trace cracks at the intersection. However, fillets are seldom used in flip chip substrate designs due to technical problems associated with computer aided design and manufacturing, the details of which are beyond the scope of this thesis. However, the emerging issue of laser via micro-cracks has made some substrate manufacturers consider using fillets on flip chip substrate designs [14].

Figure 22. An illustration of a fillet between a trace and a via capture pad.

2.5 Summary of Literature Review

The literature search confirmed that research on, and study of, laser via micro-cracking is important in the development of future micro-electronic packages. There are several factors that affect via reliability. For design related factors, a via of high aspect ratio such as 1:1 has thinner plating at the foot of the via when compared to other vias of relatively low aspect ratio such as 0.67:1 and lower. The thinner the plating, the higher the chance of cracking. A via structure with fewer stress concentration points, such as the uncapped vias, exhibited longer thermal fatigue life when compared to a via structure

with more stress concentration points, such as the capped vias. From the experiences shared by a manufacturer and the packaging process engineering department of Xilinx, the non-stack-on-core via and the staggered via are more robust in terms of resisting thermal stresses when compared to the stack-on-core via and the stacked via [15]. Because the laser stacked via design and the stack-on-core via design are relatively new in the substrate manufacturing industry, research papers were not found.

Two of the papers reviewed cover the use of FEA on the mechanically drilled vias and the HDI via structure to analyze stresses and predict fatigue lives of the vias. The intent of reviewing the papers was to understand the causes of via failure mechanism which may alleviate the study of the laser micro-via cracks because these via structures have many similarities to the laser via structure used in the FCBGA substrates. However, due to the fact that many variables are involved in the analysis, both of these FEA results tend to be very conservative when compared with experimental data.

CHAPTER THREE

RESEARCH OBJECTIVE

From the literature review, it was found that laser via micro-cracks can originate from many different sources such as substrate manufacturing process parameters, laser technologies, and via design. The overall objective of this investigation was to determine if there is a relationship between via design and laser via micro-crack formation.

To minimize the “noises” that might come from the substrate manufacturing processes, only one test vehicle design that contained all the different via design parameters was used for the experiment. Furthermore, to minimize the “noises” that might come from the laser technologies, all the vias of the test samples were made by only one laser technology in one machine. In this experiment, CO₂ laser, which is still the most commonly used laser via technology in manufacturing FCBGA substrates, was selected.

In this research, four design parameters were studied: (i) stack-on-core via design vs. non-stack-on-core via design, (ii) aspect ratio, (iii) stacked via design vs. staggered via design, and (iv) fillet between via capture pad and trace vs. non-fillet. To reduce the chances of laser via crack, lowering aspect ratio and restricting the use of stack-on-core and stacked via structures have been proposed by some substrate manufacturers, without valid theoretical or experimental bases. However, more space is needed in the substrate when larger vias, non-stack-on-core, and staggered via designs are used, and thus I/O routing and power/ground plane density will be decreased. Although adding a fillet does not decrease the I/O routing density significantly, it requires more time in the design

process, which is already quite lengthy. This investigation was aimed at determining the extent to which these parameters, individually and in combination, are actually related to the causes of laser via micro-crack. A Design of Experiment (DOE) approach was used in the investigation to check the effects of the main factors and the interactions among them on micro-via reliability of FCBGA substrates.

CHAPTER FOUR

EXPERIMENTAL APPROACH

The investigation was divided into the following seven steps: (i) design of the test vehicle, (ii) ordering and fabricating of the test vehicle, (iii) packaging and assembling the test vehicle, (iv) temperature cycling testing with periodic measurement of resistance of each daisy chain, (v) analyzing the measured data, and (vi) cross-sectioning and analyzing the failed vias. The investigation process is shown schematically, in the form of a flow chart, in Figure 23.

Figure 23. Investigation flow chart.

4.1 Test Vehicle Design

The Xilinx Virtex 4vlx200 die of about 24 mm x 21 mm and a 40 mm x 40 mm 4+2+4* built-up FCBGA substrate with 1513 balls was selected by Xilinx as the test vehicle. Sixteen daisy chains were designed in the test vehicle, with each daisy chain occupying one sixteenth of the total substrate area. Each of these sixteen daisy chains contained a total of 768 laser vias and 96 plated through holes. Details of the design are presented in Figure 24(a) through Figure 24(f). The electrical resistance of the daisy chains, depending on the trace length, via diameter, and via structure, was in the range of 5.2 ohm to 11.0 ohm.

The experimental matrix of the daisy chains is shown in Table 6. All the laser vias in Daisy Chain 01 have the design factors of stack-on-core, low aspect ratio (or large via/pad size), stacked via (except Layer 3 and Layer 8), and fillet. All the laser vias in Daisy Chain 16 have the design factors of non-stack-on-core, high aspect ratio (or small via/pad size), staggered via, and non-fillet.

At present most of the substrate vendors do not recommend and support three laser vias being stacked on each other along the same axis, because of the concern of via crack or reliability, not because of their capabilities. For a 10-layer design, staggered vias are still required on Layer 3 and on Layer 8 so that only two stacked vias can be in-line on three metal layers. But in this test vehicle, Daisy Chain 02 and Daisy Chain 06 were designed in such a way that all of the laser vias and the plated through hole (PTH)

* A 4+2+4 substrate is a ten copper-layer substrate having two copper layers built on the two sides of a core structure, four copper build-up layers above the core, and another four copper build-up layers below it.

were stacked together along the same axis in order to test the extreme condition of having eight laser vias and a PTH stacked along the same axis.

Figure 24(a). The overall view of the test vehicle.

Figure 24(c). The upper left quarter design showing the bottom layer of Daisy Chains 01, 16, 05, and 12.

Figure 24(b). The upper left quarter design showing the top layer of Daisy Chains 01, 16, 05, and 12.

Figure 24(d). A zoom-in view at the package center with the ball pads and die pins omitted showing part of all 16 daisy chains.

Figure 24(e). A zoom-in view of Daisy Chain 06 (red) and Daisy Chain 11 (blue) with the ball pads omitted showing stack-on-core (Daisy 06) and non-stack-on-core (Daisy 11).

Figure 24(f). A zoom-in view of Daisy Chain 06 (red) and Daisy Chain 11 (blue) with the ball pads, die pins, and core vias omitted showing Daisy 06 of high aspect ratio, stacked via, and non-fillet, and Daisy 11 of low aspect ratio, staggered via, and fillet.

Figure 24. Detailed design of the test vehicle.

Table 6. Experimental design matrix of the daisy chains.

	Stack on core	Via/Pad Size	Stacked vs Staggered	Fillet
Daisy Chain 01	Yes	80/140	Stacked	Yes
Daisy Chain 02	Yes	80/140	Stacked	No
Daisy Chain 03	Yes	80/140	Staggered	Yes
Daisy Chain 04	Yes	80/140	Staggered	No
Daisy Chain 05	Yes	50/110	Stacked	Yes
Daisy Chain 06	Yes	50/110	Stacked	No
Daisy Chain 07	Yes	50/110	Staggered	Yes
Daisy Chain 08	Yes	50/110	Staggered	No
Daisy Chain 09	No	80/140	Stacked	Yes
Daisy Chain 10	No	80/140	Stacked	No
Daisy Chain 11	No	80/140	Staggered	Yes
Daisy Chain 12	No	80/140	Staggered	No
Daisy Chain 13	No	50/110	Stacked	Yes
Daisy Chain 14	No	50/110	Stacked	No
Daisy Chain 15	No	50/110	Staggered	Yes
Daisy Chain 16	No	50/110	Staggered	No

There are two advantages of having all sixteen combinations of the four factors in a test vehicle. First, the tooling cost can be kept to a minimum because only one substrate is needed. Second, the noises, or unwanted effects, from substrate manufacturing processes, assembly and temperature cycling test can be assumed to be identical for all the daisy chains and their vias in the same package.

The total time spent in the design from conceptual design to final approval was about 8 weeks. Cadence Advanced Packaging Designer v14.2 was used to design the test vehicle and Autodesk AutoCAD R15 was used for documentation.

4.2 Substrate Manufacturing

After the design was completed and verified, the substrates were fabricated by a substrate manufacturer in Taiwan. The price was about \$25.00 each with a minimum order quantity of 300 and a non-recurrent engineering cost of \$3,500. The total manufacturing cost was \$11,000. The lead time for manufacturing and testing of the substrates was 10 weeks. After the testing was done, the substrates were delivered to the appointed package assembly plant which was also located in Taiwan.

4.3 Packaging and Assembly

The substrates were assembled with the Virtex 4vlx200 ink dies, heat spreaders, and solder balls in the package assembly plant. The assembly cost per piece was \$10.00 with a minimum assembly cost of \$600. Sixty pieces of the test vehicle were assembled. The total assembly time taken was about four weeks. The test vehicles were fully

assembled and delivered to Xilinx for the temperature cycling tests and resistance measurements.

4.4 Temperature Cycling Tests and Resistance Measurements

Similar to the experiments described in Sections 2.2.1 to 2.2.3, this experiment was also designed to measure the resistance increase so that cracks would be detected. If there are cracks in the vias, the resistance of the daisy chains will increase. The greater the number of cracked vias, the higher the resistance increase. In addition, the longer and larger the crack, the higher the resistance increase. Temperature cycling was used to induce mechanical stresses on the test samples until at least a 10%* increase in resistance was detected in one or more daisy chains.

Fifty assembled parts, out of the total of sixty, were randomly selected for the experiment. First, the electrical resistance value of each daisy chain in each of these fifty parts was measured and recorded. Then the parts were submitted to the Temperature Cycling B (TCB) test. The temperature range was from -55°C to 125°C, according to Condition B of the Joint Electron Device Engineering Council (JEDEC) standard JESD22-A104C [17]. Each cycle time of the test took about thirty minutes. At 100-300 cycle intervals, the parts were removed from the temperature cycling chamber and left in an open area to cool down. After the parts were completely cooled down for about an hour, resistance values of the daisy chains were measured and recorded. Then the parts

* In the field of microelectronics packaging, there has not been any industrial specification that defines via failure by the extent of resistance increase. In commercial usage, if the electrical resistance of a via does not increase by 10% or more after TCB 1000 cycles, the via is still not counted as a failure by many companies [16].

were put back into the temperature cycling chamber for another round of cycles before the next resistance measurements were taken.

In the TCB temperature cycling test, the parts were removed for measurement at the 238th, 457th, 643rd, 875th, 1016th, 1200th, 1492nd, 1724th, and 2012th cycles. After the TCB 2,012th temperature cycle, maximum increase in resistance was still far from the 10% target. Therefore, the Temperature Cycling C (TCC) test was used in order to accelerate the failures. The range of temperatures of TCC is from -65°C to 150 °C, according to Condition C of the Joint Electron Device Engineering Council (JEDEC) standard JESD22-A104C [15]. The required cycle time of the TCC test was also thirty minutes. A subcontracting test house located in Fremont, CA was selected for the TCC test. The cost of each TCC cycle was \$2.50. Every 100 cycles, the parts were removed from the temperature cycling chamber and sent back to Xilinx for resistance measurements. In the TCC temperature cycling test, the parts were pulled out for measurement at the 100th, 200th, 300th, 400th, and 500th cycles. At the TCC 400th cycle, the maximum increase in resistance in two daisy chains had passed the 10% target. The similar measurement data were obtained in the same daisy chains at the TCC 500th cycle. Hence, the experiment was stopped at the TCC 500th cycle.

A Ransco dual-zone temperature cycle chamber was used to perform the TCB temperature cycling tests. A photograph of the temperature cycle chamber is shown in Figure 25. A Checksum open-short tester equipped with a programmable resistance measurement fixture, as shown in Figure 26, was used for carrying out the resistance

measurements. The total time spent for both TCB and TCC temperature cycling tests and resistance measurement was 20 weeks.

Figure 25. Ransco dual-zone temperature cycle chamber.

Figure 26. Checksum open-short tester.

4.5 Data Analysis

The net resistance change of all the daisy chains in these fifty packages was computed and recorded at the TCB 238th, 457th, 643rd, 875th, 1016th, 1200th, 1492nd,

1724th, 2012th cycles and at the TCC 100th, 200th, 300th, 400th, and 500th cycles. The data were statistically analyzed to verify that the data were reliable, to locate the daisy chains that had the highest net resistance increases and decreases, and to locate the daisy chains that had the abnormal trends of net resistance changes.

A 2-level 4-factor full factorial (2^4) DOE, as shown in Table 7, was used to estimate the effects of the resistance change from all the factors and interactions in every measured cycle. Further analysis was done to find the top contributing factors and interactions. Analysis of variance (ANOVA) was performed on the estimated effects at the TCB1200th, TCB2012th, TCC300th, and TCC500th cycles to determine the significant contributing factors and the interactions. These significant contributing factors and the interactions were cross examined and analyzed to filter out the ones that were actually irrelevant. Microsoft EXCEL was used for the data analysis.

4.6 Failure Analysis

If a complete open in electrical resistance is measured in a daisy chain, then that daisy chain is considered a failure and a full crack of at least one via is expected. However, throughout the experiment, a complete open was not found. Since it was not possible to cross-section all the vias of all the daisy chains in all the packages due to time and cost constraints, only some daisy chains were selected. The daisy chains selected for cross-sectioning either showed extreme net resistance change, displayed an abnormal trend of net resistance change, or had the extreme stacked via structure. Also, each of the chosen daisy chains was cross-sectioned in two areas: 1) at the outer package periphery;

and 2) under the die. The results enabled the investigators to have a better idea of which of these two areas had a greater chance of containing failed vias.

Table 7. DOE for each resistance measurement process.

	1	2	3	4	12	13	14	23	24	34	123	124	134	234	1234
DAISY06	-	-	-	-	+	+	+	+	+	+	-	-	-	-	+
DAISY14	+	-	-	-	-	-	-	+	+	+	+	+	+	-	-
DAISY02	-	+	-	-	-	+	+	-	-	+	+	+	-	+	-
DAISY10	+	+	-	-	+	-	-	-	-	+	-	-	+	+	+
DAISY08	-	-	+	-	+	-	+	-	+	-	+	-	+	+	-
DAISY16	+	-	+	-	-	+	-	-	+	-	-	+	-	+	+
DAISY04	-	+	+	-	-	-	+	+	-	-	-	+	+	-	+
DAISY12	+	+	+	-	+	+	-	+	-	-	+	-	-	-	-
DAISY05	-	-	-	+	+	+	-	+	-	-	-	+	+	+	-
DAISY13	+	-	-	+	-	-	+	+	-	-	+	-	-	+	+
DAISY01	-	+	-	+	-	+	-	-	+	-	+	-	+	-	+
DAISY09	+	+	-	+	+	-	+	-	+	-	-	+	-	-	-
DAISY07	-	-	+	+	+	-	-	-	-	+	+	+	-	-	+
DAISY15	+	-	+	+	-	+	+	-	-	+	-	-	+	-	-
DAISY03	-	+	+	+	-	-	-	+	+	+	-	-	-	+	-
DAISY11	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Single factor Effect	Description	+	-
1	Stack on core	no	yes
2	Aspect Ratio	low	high
3	Stacked v Staggered	staggered	stacked
4	Fillet	yes	no

After cross-sectioning, a Scanning Electron Microscope (SEM) was used to find the failed vias, to identify the location of the crack in each failed via, and to understand the failure mechanism. A JEOL JSM-6360LV low vacuum scanning electron microscope, as shown in Figure 27, was used for failure analysis. The total time spent in cross-sectioning and failure analysis was about 6 weeks.

Figure 27. JEOL JSM-6360LV low vacuum scanning electron microscope.

CHAPTER FIVE

RESULTS

The results of the resistance measurements and the resistance changes, the DOE analyses, and the failure analyses are presented in this chapter.

5.1 Electrical Resistance at the 0th Cycle

Before the temperature cycling tests were begun, the electrical resistances of all sixteen daisy chains in the fifty packages were measured. These data are referred as the 0th cycle resistances. During the data analysis, it was found that Package 33 and Package 34 had the same resistance values in all the daisy chains, and Package 34 consistently had the highest resistance decrease in all the measured cycles. It was concluded that the 0th resistances of all the sixteen daisy chains in Package 34 were mistaken. Thus, all the data from Package 34 was removed from the experiment.

The design features and the statistical analyses (average, standard deviation, maximum, minimum, and range) of the electrical resistances of all the daisy chains at 0th cycle are shown in Table 8(a) through Table 8(c). The detailed measurement data are included in Appendix A. Among all the sixteen daisy chains, Daisy 06 had the minimum average resistance of 5.20 ohm, a fairly small difference between the maximum and the minimum resistance data, and a fairly small standard deviation. Daisy 16 had the maximum average resistance of 11.06 ohm, the largest difference between the maximum and the minimum resistance data, and the largest standard deviation. All of these data are within the expected range for this test vehicle.

Table 8(a). Design features of daisy chains #01 – 06 and their statistical resistance data at the 0th cycle.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06
Conductor length	204 mm	148 mm	295 mm	243 mm	234 mm	114 mm
Stack on core	yes	yes	yes	yes	yes	yes
Via/Pad size	large	large	large	large	small	small
Stacked / Staggered	stacked	stacked	staggered	staggered	stacked	stacked
Fillet	yes	no	yes	no	yes	no
Mean	6.27	6.05	7.61	6.4	7.76	5.2
SD	0.3	0.35	0.29	0.4	0.45	0.32
Max	7.01	7.15	8.36	7.6	9.29	6.2
Min	5.7	5.41	6.98	5.59	6.9	4.61
Range	20.90%	28.75%	18.11%	31.52%	30.74%	30.45%

The electrical resistance of a daisy chain depends on the design as well as how it is manufactured. The accuracy of the electrical resistance measurements depends on the measurement equipment. From the perspective of design, the total trace length in a daisy chain is the predominant contributory factor to resistance: the longer the trace, the higher the resistance. Since the “total trace length” includes the additional length in the staggered via and the non-stack-on-core via designs, then whether the design is Non-stack-on-core or Stack-on-core, and Staggered Via or Stacked Via has no effect on electrical resistance. The other contributing factors are the via diameter and the fillet. The smaller the via diameter, the higher the resistance. Also, resistance is higher if a fillet is not incorporated between the traces and via pads. As can be seen in Table 8(a) through Table 8(c), Daisy chain 06 had the lowest average resistance of 5.20 ohm, mainly

because it had the shortest total length of 114 mm. Daisy chain 16 had the highest average resistance of 11.2 ohm because it had a fairly long total trace length of 372 mm, and its via diameter was small and there was no fillet incorporated between the traces and the via pads.

Table 8(b). Design features of daisy chains #07 – 12 and their statistical resistance data at the 0th cycle.

	DAISY07	DAISY08	DAISY09	DAISY10	DAISY11	DAISY12
Conductor length	285 mm	255 mm	398 mm	271 mm	478 mm	316 mm
Stack on core	yes	yes	no	no	no	no
Via/Pad size	small	small	large	large	large	large
Stacked / Staggered	staggered	staggered	stacked	stacked	staggered	staggered
Fillet	yes	no	yes	no	yes	no
Mean	9.35	7.98	7.76	8.28	8.92	8.44
SD	0.4	0.54	0.46	0.38	0.45	0.38
Max	10.61	9.62	8.86	9.22	10.53	9.53
Min	8.55	7.04	6.92	7.48	8.15	7.78
Range	22.03%	32.33%	25.06%	20.93%	26.62%	20.68%

From the manufacturing end, resistance is mainly determined by the etching process. Over etching results in a thinner trace width and thus the resistance is higher. On the other hand, under etching leaves a wider trace which in turn decreases the resistance. Other factors such as the manufacturing variance in the diameter of the laser vias and the core drills, and the variances in the electro-plating thicknesses of the vias and drills also affect the variation of the electrical resistance.

Table 8(c). Design features of daisy chains #13 – 16 and their statistical resistance data at the 0th cycle.

	DAISY13	DAISY14	DAISY15	DAISY16
Conductor length	364 mm	266 mm	427 mm	372 mm
Stack on core	no	no	no	no
Via/Pad size	small	small	small	small
Stacked / Staggered	stacked	stacked	staggered	staggered
Fillet	yes	no	Yes	no
Mean	8.77	8.2	10.26	11.06
SD	0.42	0.39	0.51	0.57
Max	9.75	9.13	11.71	12.9
Min	7.87	7.47	9.11	9.86
Range	21.49%	20.27%	25.32%	27.53%

In this investigation, a Checksum open-short tester equipped with a programmable resistance measurement fixture was used for electrical resistance measurements. Although the data are more reliable than if the data were obtained from manual measurements with an ohm-meter, measurement errors may still come from the calibration of the equipment, the cleanliness of the contact pins and the parts, and human error.

The maximum, minimum, and standard deviation in Table 8(a) through Table 8 (c) reveal how much variation of the electrical resistance values comes from manufacturing and measurements. In the 0th cycle data, Daisy Chain 16 had the highest standard deviation of 0.56 ohm, and the daisy chains #04, 05, 06, and 08 had a range of 30 % or more. These variances are not uncommon in FCBGA substrate manufacturing,

A one-way ANOVA was used to compare the variability between the means to the inherent variability. The hypothesis was that the mean of the electrical resistance is the same for all the daisy chains. The results of this analysis showed that the hypothesis was rejected because the mean is not same for all sixteen daisy chains at the 95% confidence level. Detailed calculations of ANOVA are shown in Appendix B.

5.2 Resistance Changes from Temperature Cycling Tests

Throughout the TCB and TCC temperature cycling tests, the actual electrical resistances of all the daisy chains in all the fifty packages were measured at the TCB 238th, 457th, 643rd, 875th, 1016th, 1200th, 1492nd, 1724th, 2012th cycles and at the TCC 100th, 200th, 300th, 400th, and 500th cycles. The measured data are contained in Appendix C-1. These data were used to derive the net resistance change and the resistance change as a percentage by using Equation 3 and Equation 4, respectively.

$$\text{Net resistance change} = \text{Measured resistance} - \text{Resistance in the 0}^{\text{th}} \text{ cycle} \quad \text{Equation 3}$$

$$\% \text{ Resistance change} = \frac{\text{Net resistance change}}{\text{Resistance from the 0}^{\text{th}} \text{ cycle}} \times 100\% \quad \text{Equation 4}$$

The average resistance change for each daisy chain and each measured cycle are shown in Table 9(a) and Table 9(b). The detailed data of resistance change and the statistical values, including average, standard deviation, maximum, and minimum are shown in Appendix C-2. As can be seen in Table 9(a) and Table 9(b), the average resistance shift did not go beyond 9% before the TCC 400th cycle in any of the daisy

chains. At and after the TCC 400th cycle, the average resistance shift of Daisy chain 04 and Daisy chain 06 went up to more than 16% while Daisy chain 14 fell to -5%.

Table 9(a). Average resistance changes of daisy chains #01 – 08 at all the measured cycles.

	Daisy 01	Daisy 02	Daisy 03	Daisy 04	Daisy 05	Daisy 06	Daisy 07	Daisy 08
TCB 238	-0.55%	1.71%	0.57%	0.01%	-0.39%	2.20%	0.56%	2.21%
TCB 457	0.25%	2.95%	0.81%	1.40%	0.00%	2.25%	1.62%	0.07%
TCB 643	1.06%	1.61%	-0.51%	-0.61%	0.27%	1.16%	0.45%	-1.73%
TCB 875	1.17%	2.45%	0.10%	-0.39%	0.38%	4.70%	0.81%	-0.39%
TCB 1016	5.81%	3.17%	0.50%	-0.19%	-0.45%	3.02%	1.30%	-0.08%
TCB 1200	2.14%	3.13%	0.00%	-0.31%	-0.50%	4.74%	1.58%	0.47%
TCB 1492	0.33%	2.19%	-0.16%	-0.39%	-0.74%	5.09%	1.57%	0.42%
TCB 1724	3.69%	2.87%	0.67%	0.54%	0.79%	5.36%	2.41%	-0.61%
TCB 2012	3.07%	2.94%	0.28%	-0.20%	0.13%	5.47%	1.50%	0.08%
TCC 100	1.07%	2.40%	0.24%	-0.01%	-0.02%	5.63%	1.14%	-0.81%
TCC 200	1.77%	2.58%	0.26%	0.07%	-0.92%	8.06%	1.29%	-0.31%
TCC 300	6.68%	3.75%	1.60%	1.25%	0.62%	8.65%	3.59%	1.95%
TCC 400	3.44%	4.77%	0.72%	16.81%	-0.15%	19.56%	1.83%	8.33%
TCC 500	2.38%	4.77%	-0.22%	17.03%	-0.17%	19.12%	1.87%	8.55%

The purpose of temperature cycling tests is to induce mechanical stresses on the vias. It is expected that the higher the ΔT and the greater the number of cycles, the higher the increase in via resistance. Also, the higher the resistance increase, the longer and larger the via crack.

As shown in Equation 4, the resistance change is normalized by its original resistance value and is used throughout the data analysis in this experiment. The resistance changes have been statistically analyzed and presented based on two testing methods: 1) by the temperature cycling tests, and 2) by the daisy chains.

Table 9(b). Average resistance changes of daisy chains #09 – 16 at all the measured cycles.

	Daisy 09	Daisy 10	Daisy 11	Daisy 12	Daisy 13	Daisy 14	Daisy 15	Daisy 16
TCB 238	0.63%	2.11%	1.53%	-1.30%	-0.23%	-0.44%	0.82%	-0.33%
TCB 457	1.88%	4.30%	1.75%	-1.40%	-0.20%	0.04%	1.68%	0.84%
TCB 643	0.55%	0.31%	-0.12%	-2.19%	-0.84%	-1.01%	0.01%	-0.31%
TCB 875	0.71%	0.41%	1.03%	-1.68%	-0.15%	0.03%	0.34%	0.57%
TCB 1016	1.18%	1.35%	1.84%	-1.87%	-0.33%	0.68%	2.39%	0.63%
TCB 1200	1.43%	0.43%	0.70%	-1.24%	-0.10%	-0.11%	0.41%	0.28%
TCB 1492	0.65%	0.52%	0.51%	-1.71%	-0.33%	-0.12%	0.08%	-0.13%
TCB 1724	1.26%	0.14%	0.82%	-1.33%	0.08%	0.74%	0.33%	0.14%
TCB 2012	1.07%	1.43%	1.17%	-1.85%	-0.64%	0.03%	0.36%	-0.20%
TCC 100	0.50%	0.11%	1.01%	-2.01%	-0.72%	0.49%	0.07%	-0.24%
TCC 200	0.45%	-0.04%	0.26%	-1.63%	-1.22%	-0.27%	1.35%	-0.52%
TCC 300	2.71%	2.02%	1.23%	-1.69%	0.28%	2.88%	2.07%	0.75%
TCC 400	-0.61%	1.03%	2.86%	-0.33%	0.32%	-5.45%	2.55%	1.27%
TCC 500	-1.43%	0.58%	2.40%	0.00%	-0.01%	-5.17%	2.91%	1.17%

5.2.1 Results Based on Temperature Cycling Tests

The mean, standard deviation, maximum increase, maximum decrease, and the range of the average resistance changes in the fourteen measured cycles are tabulated in Table 10 and plotted in Figure 28. A graph showing all the average resistance changes for each temperature cycling test is included in Appendix D.

Throughout the TCB tests the maximum increase in resistance gradually rose from 2.21% to 5.47% with the exceptions at TCB 643 and TCB 1016 where it dipped to 1.61% and ascended to 5.81%, respectively. However, the average change in resistance fluctuated within a narrow margin, between -0.12% and 1.18%. There is no strong evidence indicating that the via resistance increased with an increase in the number of cycles.

Table 10. Statistical analysis of resistance changes in the measured cycles.

	Mean	SD	Max. Increase	Max. Decrease	Range
TCB 238	0.57%	1.11%	2.21%	-1.30%	3.51%
TCB 457	1.14%	1.39%	4.30%	-1.40%	5.71%
TCB 643	-0.12%	1.03%	1.61%	-2.19%	3.80%
TCB 875	0.63%	1.40%	4.70%	-1.68%	6.38%
TCB 1016	1.18%	1.82%	5.81%	-1.87%	7.68%
TCB 1200	0.82%	1.50%	4.74%	-1.24%	5.99%
TCB 1492	0.49%	1.52%	5.09%	-1.71%	6.80%
TCB 1724	1.12%	1.69%	5.36%	-1.33%	6.69%
TCB 2012	0.92%	1.74%	5.47%	-1.85%	7.32%
TCC 100	0.55%	1.67%	5.63%	-2.01%	7.64%
TCC 200	0.70%	2.25%	8.06%	-1.63%	9.69%
TCC 300	2.40%	2.48%	8.65%	-1.69%	10.35%
TCC 400	3.56%	6.42%	19.56%	-5.45%	25.02%
TCC 500	3.36%	6.45%	19.12%	-5.17%	24.29%

Figure 28. Statistical analysis of resistance changes in the measured cycles.

In the TCC tests, the average change in resistance increased from 0.55 % at the TCC 100th cycle to 3.56% at the TCC 400th cycle, but slipped slightly back to 3.36% at the TCC 500th cycle. Since the TCC had a higher ΔT compared to the TCB tests, it is thought that the increase in via resistance is higher when ΔT is higher. Also, it is indicated that the resistance increased with an increase in the number of cycles, but only up to the TCC 400th cycle.

Throughout the TCB tests and up to the TCC 300th cycle, the maximum resistance change did not go beyond the 10% target, and the maximum resistance decrease barely went below -2.2%. But at the TCC 400th cycle and the TCC 500th cycle, some daisy chains exhibited a sudden rise in resistance to 16.8% or higher while some showed a sudden drop in resistance down to -5 %. These phenomena in the last two temperature cycling tests were unexpected. It is suggested that, on the one hand, some cracks might have occurred rapidly, driving the resistance upward, while on the other hand, some inter-layer contacts might have improved because of the higher TCC temperature, and thus drove the resistance downward.

As can be seen in Appendix D, the average resistance changes of all the daisy chains do not show a regular pattern at and before the TCB 643rd cycle. Between the TCB 875th cycle and the TCC 300th cycle, the resistance changes of all the daisy chains showed a regular pattern, except Daisy Chain 01. At and after the TCC 400th cycle, the resistance changes of several daisy chains exhibited irregular jumps or dips. These findings were used to establish the scope of further investigations using DOE and ANOVA.

5.2.2 Results Based on Daisy Chains

The mean, standard deviation, maximum increase, maximum decrease, and the range of the average resistance changes of the sixteen daisy chains are tabulated in Table 11(a) through Table 11(c) and plotted in Figure 29. A graph showing all the average resistance changes for each daisy chain is included in Appendix E.

Table 11(a). Statistical analysis of resistance changes of daisy chains #01 – 06.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06
Mean	2.31%	2.95%	0.35%	2.50%	-0.08%	6.79%
SD	2.08%	0.96%	0.53%	6.14%	0.50%	5.71%
Max Increase	6.68%	4.77%	1.60%	17.03%	0.79%	19.56%
Max Decrease	-0.55%	1.61%	-0.51%	-0.61%	-0.92%	1.16%
Range	7.23%	3.16%	2.11%	17.65%	1.71%	18.41%

Table 11(b). Statistical analysis of resistance changes of daisy chains #07 – 12.

	DAISY07	DAISY08	DAISY09	DAISY10	DAISY11	DAISY12
Mean	1.54%	1.30%	0.78%	1.05%	1.21%	-1.45%
SD	0.79%	3.19%	1.00%	1.17%	0.81%	0.61%
Max Increase	3.59%	8.55%	2.71%	4.30%	2.86%	0.00%
Max Decrease	0.45%	-1.73%	-1.43%	-0.04%	-0.12%	-2.19%
Range	3.15%	10.28%	4.14%	4.35%	2.98%	2.19%

Table 11(c). Statistical analysis of resistance changes of daisy chains #13 – 16.

	DAISY13	DAISY14	DAISY15	DAISY16
Mean	-0.29%	-0.55%	1.10%	0.28%
SD	0.43%	2.20%	1.04%	0.59%
Max Increase	0.32%	2.88%	2.91%	1.27%
Max Decrease	-1.22%	-5.45%	0.01%	-0.52%
Range	1.54%	8.34%	2.90%	1.79%

Figure 29. Statistical analysis of resistance changes of all daisy chains.

As can be seen from Table 11(a) through 11(c), Daisy Chain 06 had the highest mean resistance change of 6.79 % while Daisy Chain 02 had the 2nd highest mean resistance change of 2.95 %. Daisy Chain 02 and Daisy Chain 06 were the two daisy chains designed to test the extreme condition of having all vias stacked on each other. Daisy Chain 02 had a smaller aspect ratio, or a larger via diameter, whereas Daisy Chain 06 had a smaller via diameter. It is clearly seen that the risk of via crack is high when all vias are stacked on each other. Among these two daisy chains, the via set that has the smaller via diameter had the highest risk.

As can be seen from Figure 29, the standard deviations for Daisy Chains 09 to 16, excluding Daisy Chain 14, are more stable than those for Daisy Chains 01 to 08. Daisy

Chains 09 to 16 consist of Non-stack-on-core vias while Daisy Chains 01 to 08 consist of Stack-on-core vias. Therefore, it is suggested that Non-stack-on-core vias are more stable and robust than Stack-on-core vias.

From Appendix E it is seen that the average resistance changes of eleven daisy chains (Daisy Chains 02, 03, 05, 07, 09, 10, 11, 12, 13, 15, and 16) stayed within a range of 5 % throughout the fourteen temperature cycling tests. However, the TCC 400th and TCC 500th cycles produced irregular data that were not fully explicable in some daisy chains. Daisy chain 04 stayed below 0% before the TCC 200th cycle and jumped from 1.25% at the TCC 300th cycle up to 16.81% or more at the TCC 400th and 500th cycles. Daisy chain 06 had a gradual increase of resistance from 4.74% at the TCB 1200th cycle to 8.65% at the TCC 300th cycle, and jumped to more than 19.12% at the TCC 400th and 500th cycles. Daisy Chain 08 stayed below 1.95% before the TCC 300th cycle and jumped to 8.33% or more at the TCC 400th and 500th cycles. These three daisy chains had the same irregular pattern. On the other hand, Daisy Chain 14 dropped from 2.88% at the TCC 300th cycle to -5.17% or more at the TCC 400th and TCC 500th cycles. These findings were used to establish the scope of the cross-sectioning and failure analyses.

5.3 DOE Results

In the 2-level 4-factor full factorial (2^4) DOE, the average resistance changes were used to calculate the effects of the factors and the interactions in all the measured cycles. The ranking of the effects are listed in Table 12(a) through Table 12(c). The detailed effect calculations of all the measured cycles are shown in Appendix F-1.

Table 12(a). The rankings of the effects for the measured cycles TCB238 – TCB1016.

Rank	TCB 238		TCB 457		TCB 643		TCB 875		TCB 1016	
1	34	1.13%	34	1.57%	3	1.02%	34	1.21%	23	1.57%
2	14	1.08%	23	1.12%	23	0.73%	3	1.16%	13	1.27%
3	12	0.75%	123	1.01%	34	0.71%	13	0.98%	3	1.24%
4	234	0.65%	1234	0.77%	1	0.66%	1	0.95%	34	1.19%
5	23	0.65%	2	0.71%	13	0.61%	14	0.81%	24	1.02%
6	1	0.44%	14	0.67%	1234	0.51%	1234	0.77%	1234	0.99%
7	4	0.41%	3	0.59%	4	0.45%	24	0.72%	1	0.90%
8	124	0.32%	234	0.35%	123	0.45%	134	0.62%	12	0.80%
9	24	0.31%	124	0.34%	124	0.44%	123	0.44%	234	0.71%
10	123	0.27%	12	0.34%	2	0.26%	2	0.31%	4	0.69%
11	13	0.22%	4	0.33%	14	0.24%	23	0.26%	2	0.58%
12	134	0.19%	24	0.31%	134	0.22%	12	0.23%	134	0.47%
13	1234	0.19%	13	0.20%	234	0.09%	234	0.16%	14	0.38%
14	3	0.12%	134	0.09%	12	0.09%	4	0.16%	124	0.33%
15	2	0.04%	1	0.06%	24	0.01%	124	0.13%	123	0.26%

Table 12(b). The rankings of the effects for the measured cycles TCB1200 – TCB2012.

Rank	TCB 1200		TCB 1492		TCB 1724		TCB 2012	
1	1	1.18%	34	1.45%	1	1.69%	3	1.54%
2	3	1.16%	1	1.10%	3	1.50%	1	1.49%
3	34	1.09%	14	1.08%	34	1.10%	34	1.47%
4	14	0.99%	3	0.92%	1234	1.06%	1234	1.07%
5	23	0.83%	134	0.82%	234	1.01%	13	0.94%
6	134	0.82%	1234	0.82%	13	0.93%	24	0.92%
7	13	0.78%	24	0.68%	24	0.78%	14	0.73%
8	24	0.78%	12	0.60%	134	0.63%	23	0.73%
9	1234	0.73%	4	0.50%	14	0.43%	234	0.53%
10	234	0.53%	2	0.49%	23	0.32%	12	0.42%
11	12	0.27%	13	0.43%	4	0.28%	134	0.31%
12	4	0.22%	23	0.43%	124	0.15%	123	0.26%
13	124	0.08%	234	0.40%	2	0.07%	124	0.22%
14	2	0.06%	123	0.26%	123	0.07%	2	0.15%
15	123	0.01%	124	0.08%	12	0.03%	4	0.10%

Table 12(c). The rankings of the effects for the measured cycles TCC100 – TCC500.

Rank	TCC 100		TCC 200		TCC 300		TCC 400		TCC 500	
1	34	1.67%	34	1.97%	1	2.23%	1	6.71%	14	6.61%
2	1	1.30%	1	1.80%	3	2.10%	14	6.53%	1	6.61%
3	3	1.26%	14	1.41%	24	1.82%	1234	4.66%	4	4.79%
4	14	0.91%	234	1.38%	234	1.74%	4	4.38%	1234	4.41%
5	1234	0.89%	13	1.34%	34	1.66%	123	3.18%	123	3.02%
6	13	0.87%	3	1.21%	1234	1.32%	234	2.33%	234	2.45%
7	24	0.86%	24	1.03%	23	1.09%	124	1.79%	3	1.70%
8	134	0.63%	1234	1.02%	13	0.72%	23	1.46%	124	1.61%
9	234	0.61%	134	0.92%	14	0.68%	3	1.39%	23	1.52%
10	123	0.46%	123	0.78%	124	0.60%	13	1.37%	13	1.42%
11	4	0.28%	124	0.66%	2	0.41%	12	1.01%	12	1.01%
12	12	0.28%	4	0.59%	123	0.13%	24	0.41%	134	0.41%
13	2	0.28%	2	0.47%	134	0.12%	134	0.23%	2	0.35%
14	124	0.21%	12	0.39%	4	0.10%	34	0.15%	34	0.16%
15	23	0.05%	23	0.24%	12	0.02%	2	0.05%	24	0.02%

The TCB1200th, TCB2012th, TCC300th, and TCC500th cycles were chosen for the detailed 2⁴ DOE analyses. In each of these analyses, all the raw data of resistance changes were used to derive contrast, effect and sum of square (SS). The detailed DOE calculations are shown in Appendix F-2. In order to find the major contributing factors and the interactions of resistance changes, analysis of variance (ANOVA) was used to evaluate the significance of the effects. The ANOVA results are shown in Table 13(a) through Table 13(d). Among the 15 main factors and interactions, Factor 1 (Stack-on-core), Factor 3 (Stacked Via) and Interaction 34 (Stacked Via and Fillet) were found to be the three most significant factors contributing to resistance changes. Detailed DOE analyses are presented in Section 6.1.

Table 13(a). ANOVA: DOE for the TCB 1200th cycle.

Factor	Effect	SS	% contri- bution	DOF	MS	F0	P-value	Conclusion
1	-0.0118	0.0275	5.83	1	0.0275	69.12	4.2E-16	Significant
2	-0.0006	0.0001	0.02	1	0.0001	0.18	0.67001	
3	-0.0116	0.0263	5.59	1	0.0263	66.27	1.6E-15	Significant
4	-0.0022	0.0009	0.19	1	0.0009	2.31	0.12908	
12	0.0027	0.0014	0.31	1	0.0014	3.62	0.05762	
13	0.0078	0.0120	2.56	1	0.0120	30.31	5E-08	Significant
14	0.0099	0.0191	4.06	1	0.0191	48.09	8.7E-12	Significant
23	-0.0083	0.0136	2.89	1	0.0136	34.27	7.1E-09	Significant
24	0.0078	0.0119	2.53	1	0.0119	29.99	5.9E-08	Significant
34	0.0109	0.0234	4.96	1	0.0234	58.81	5.3E-14	Significant
123	0.0001	0.0000	0.00	1	0.0000	0.01	0.94189	
124	-0.0008	0.0001	0.03	1	0.0001	0.31	0.5777	
134	-0.0082	0.0133	2.82	1	0.0133	33.46	1.1E-08	Significant
234	-0.0053	0.0055	1.17	1	0.0055	13.81	0.00022	Fairly significant
1234	0.0073	0.0105	2.24	1	0.0105	26.50	3.3E-07	Significant
Model		0.1658	35.19	15	0.0111	27.80	1.9E-62	Significant
Error		0.3052	64.81	768	0.0004			
Total		0.4710		783				

Table 13(b). ANOVA: DOE for the TCB 2012th cycle.

Factor	Effect	SS	% contri- bution	DOF	MS	F0	P-value	Conclusion
1	-0.0149	0.0434	7.26	1	0.0434	88.94	4.7E-20	Significant
2	0.0015	0.0004	0.07	1	0.0004	0.90	0.34284	
3	-0.0154	0.0467	7.81	1	0.0467	95.79	2.1E-21	Significant
4	-0.0010	0.0002	0.03	1	0.0002	0.37	0.54387	
12	0.0042	0.0034	0.58	1	0.0034	7.06	0.00804	Fairly significant
13	0.0094	0.0174	2.91	1	0.0174	35.67	3.6E-09	Significant
14	0.0073	0.0106	1.77	1	0.0106	21.69	3.8E-06	Significant
23	-0.0073	0.0105	1.76	1	0.0105	21.62	3.9E-06	Significant
24	0.0092	0.0164	2.75	1	0.0164	33.66	9.6E-09	Significant
34	0.0147	0.0422	7.06	1	0.0422	86.55	1.4E-19	Significant
123	-0.0026	0.0013	0.21	1	0.0013	2.62	0.10622	
124	-0.0022	0.0009	0.16	1	0.0009	1.94	0.16405	
134	-0.0031	0.0019	0.32	1	0.0019	3.87	0.04946	Fairly significant
234	-0.0053	0.0055	0.92	1	0.0055	11.31	0.00081	Fairly significant
1234	0.0107	0.0223	3.73	1	0.0223	45.78	2.6E-11	Significant
Model		0.2232	37.35	15	0.0149	30.52	6.5E-68	Significant
Error		0.3745	62.65	768	0.0005			
Total		0.5978		783				

Table 13(c). ANOVA: DOE for the TCC 300th cycle.

Factor	Effect	SS	% contri- bution	DOF	MS	F0	P-value	Conclusion
1	-0.0223	0.0975	11.17	1	0.0975	177.12	1.6E-36	Significant
2	-0.0041	0.0033	0.37	1	0.0033	5.94	0.01506	Fairly significant
3	-0.0210	0.0867	9.94	1	0.0867	157.64	5.1E-33	Significant
4	-0.0010	0.0002	0.02	1	0.0002	0.35	0.55512	
12	-0.0002	1E-05	0.00	1	1E-05	0.02	0.89247	
13	0.0072	0.0102	1.17	1	0.0102	18.56	1.9E-05	Significant
14	0.0068	0.0091	1.04	1	0.0091	16.52	5.3E-05	Significant
23	-0.0109	0.0232	2.66	1	0.0232	42.17	1.5E-10	Significant
24	0.0182	0.0650	7.45	1	0.0650	118.17	1.1E-25	Significant
34	0.0166	0.0538	6.16	1	0.0538	97.70	9.1E-22	Significant
123	-0.0013	0.0003	0.04	1	0.0003	0.56	0.45446	
124	-0.0060	0.0070	0.80	1	0.0070	12.68	0.00039	Fairly significant
134	-0.0012	0.0003	0.03	1	0.0003	0.47	0.49104	
234	-0.0174	0.0595	6.82	1	0.0595	108.15	8.7E-24	Significant
1234	0.0132	0.0343	3.93	1	0.0343	62.27	1E-14	Significant
Model		0.4503	51.59	15	0.0300	54.55	5E-110	Significant
Error		0.4226	48.41	768	0.0006			
Total		0.8729		783				

Table 13(d). ANOVA: DOE for the TCC 500th cycle.

Factor	Effect	SS	% contri- bution	DOF	MS	F0	P-value	Conclusion
1	-0.0661	0.8564	24.15	1	0.8564	1355.89	8E-172	Significant
2	-0.0035	0.0023	0.07	1	0.0023	3.70	0.05493	
3	0.0170	0.0569	1.60	1	0.0569	90.03	2.9E-20	Significant
4	-0.0479	0.4499	12.69	1	0.4499	712.35	2E-111	Significant
12	0.0101	0.0199	0.56	1	0.0199	31.43	2.9E-08	Significant
13	0.0142	0.0396	1.12	1	0.0396	62.73	8.3E-15	Significant
14	0.0661	0.8567	24.16	1	0.8567	1356.45	7E-172	Significant
23	0.0152	0.0455	1.28	1	0.0455	72.08	1.1E-16	Significant
24	-0.0002	1.1E-05	0.00	1	1.1E-05	0.02	0.89358	
34	-0.0016	0.0005	0.01	1	0.0005	0.80	0.37182	
123	-0.0302	0.1793	5.06	1	0.1793	283.93	1.9E-54	Significant
124	-0.0161	0.0506	1.43	1	0.0506	80.17	2.6E-18	Significant
134	0.0041	0.0033	0.09	1	0.0033	5.18	0.02315	Fairly significant
234	-0.0245	0.1181	3.33	1	0.1181	186.93	3E-38	Significant
1234	0.0441	0.3818	10.77	1	0.3818	604.44	7E-99	Significant
Model		3.0608	86.32	15	0.2041	323.07	0	Significant
Error		0.4851	13.68	768	0.0006			
Total		3.5458		783				

5.4 Failure Analysis

After the TCC 500 cycles, cross-sectioning was used to verify whether the net resistance change was related to the via crack, and also to investigate the failure mechanism of the cracks. The daisy chains that were selected for cross-sectioning showed extreme net resistance change, displayed an abnormal trend of net resistance change, or had the extreme stacked via structure. For the daisy chains that contained Non-stack-on-core or Staggered vias, two packages which had the closet readings were

selected for cross-sectioning. For the daisy chains that had all the vias aligned in one axis, one package was used for cross-sectioning.

In order to understand whether the geographical locations played any roles in crack formation, each of these daisy chains was cross-sectioned in two areas: at the outer periphery and under the die.

The micrographs of all the cracked vias are shown in Appendix G. Some fractures are very obvious and some are not that noticeable. In this study, a fracture that was continuous between both corners of the via was classified as a crack and was considered a failure*. An illustration of a crack is shown in Figure 30(a), and an actual example of a crack is shown in Figure 32(a) which is a micrograph of Via 2-3. A fracture that occurred only at one corner of the via and was less than half of the diameter of the via was considered a minor crack and was not counted as a failure. An illustration of a minor crack is shown in Figure 30(b), and Figure 32(d) is a micrograph of an actual minor crack in Via 6-7. If a fracture that was longer than half of the diameter of the via, it was still considered a crack, and thus a failure. An example of such a crack is shown in Figure 32(b) which is a micrograph of Via 8-9.

* In the field of microelectronics packaging, an industrial specification that defines via failure by the extent of via crack has not been developed. In commercial usage, if a via is not fully cracked after TCB 1000 cycles, the via is still not considered to be a failure by many companies [16].

Figure 30. An illustration of a crack and a minor crack

5.4.1 Packages with High Net Resistance Change (Phase I)

Packages that had high net resistance changes in a daisy chain were first selected for cross-sectioning. The daisy chains and the packages that were selected are shown in Table 14. Their cross-section locations are shown in Figures 31(a) through 31(c).

Table 14. The daisy chains and the packages selected for cross-section in Phase I.

Daisy chains	Packages			
Daisy06	PKG36	PKG43		
Daisy04	PKG06	PKG10	PKG19	PKG47
Daisy14	PKG23	PKG26	PKG42	PKG44
Daisy08	PKG04	PKG32	PKG35	PKG48
Daisy02	PKG02	PKG39		

Daisy Chain 06 and Daisy Chain 04 were selected because they had the highest resistance increase. The cross-section report and the micrographs of one of the via sets (each via set can be represented by its ball #) of Daisy Chain 06 are shown in Table 15 and Figures 32(a) through 32(d), respectively. All of the ten cross-sectioned via sets had

failed. The failures were on V2-3, V4-5, V6-7, and V8-9 for the via sets at the outer periphery, and on the upper layers V1-2, V2-3, V3-4, and V4-5 for the via sets under the die. The cross-section report and the micrographs of one of the via sets of Daisy Chain 04 are shown in Table 16 and Figures 33(a) through 33(d), respectively. All of the five cross-sectioned via sets at the outer periphery had failed on the stack-on-core vias on V4-5 and V6-7. None of the four cross-sectioned via sets under the die failed.

Figure 31(a). Cross-section locations for Daisy Chain 04 and Daisy Chain 14.

Figure 31(b). Cross-section locations for Daisy Chain 06 and Daisy Chain 08.

Figure 31(c). Cross-section locations for Daisy Chain 02.

Table 15. The cross-section report of Daisy Chain 06 in Phase I.

Pkg 36 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
Y4	No	Crack on L3	No	Crack on L5	Crack on L6	No	Unclear micro-graph	Minor crack on L9
AA4	No	Crack on L3	No	Crack on L5	Crack on L6	No	Crack on L8	Minor crack on L9
AB4	No	Crack on L3	No	Crack on L5	Crack on L6	Minor crack on L7	Crack on L8	No
AC4	No	Crack on L3	No	Crack on L5	Crack on L6	No	Crack on L8	No
AD4	No	Crack on L3	No	Crack on L5	Crack on L6	No	Crack on L8	No
Pkg 43 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AB9	Crack on L2	Crack on L3	Crack on L4	Crack on L5	No	No	No in-line via	No in-line via
AB10	Minor crack on L2	Crack on L3	Crack on L4	Crack on L5	Minor crack on L6	Minor crack on L7	No	No
AB11	Crack on L2	Minor crack on L3	Crack on L4	Crack on L5	Minor crack on L6	No	No	No
AB12	Crack on L2	Minor crack on L3	Crack on L4	Crack on L5	No	No	No	No
AB13	Crack on L2	Crack on L3	Crack on L4	Crack on L5	Minor crack on L6	No	No	No

Daisy Chain 06, Pkg 36, Ball no. AC4, Via 1-5

Figure 32(a). The cross-section micrograph of the upper layers of Daisy 06/PKG 36.

Daisy Chain 06, Pkg 36, Ball no. AC4, Via 6-10

Figure 32(b). The cross-section micrograph of the lower layers of Daisy 06/PKG 36.

Daisy Chain 06, Pkg 43, Ball no. AB13, Via 1-5

Figure 32(c). The cross-section micrograph of the upper layers of Daisy 06/PKG 43.

Daisy Chain 06, Pkg 43, Ball no. AB13, Via 6-10

Figure 32(d). The cross-section micrograph of the lower layers of Daisy 06/PKG 43.

Table 16. The cross-section report of Daisy Chain 04.

Pkg 06 and Pkg 10 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AT39	No in-line via	No	No	Crack on L5	Crack on L6	No	No	No
AR39	No in-line via	No	No	Crack on L5	Crack on L6	No	No	No
AP39	No in-line via	No	No	Crack on L5	Crack on L6	No	No	No
AN39	No in-line via	No	No	Crack on L5	Crack on L6	No	No	No
AM39	No in-line via	No	No	Crack on L5	Crack on L6	No	No	No
Pkg 19 and Pkg 47 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AG27	No in-line via	No	No	No	No	No	No	No
AF27	No in-line via	No	No	No	No	No	No	No
AE27	No in-line via	No	No	No	No	No	No	No
AD27	No in-line via	No	No	No	No	No	No	No

Daisy Chain 04, Pkg 06/10, Ball no. AT39, Via 2-5

Figure 33(a). The cross-section micrograph of the upper layers of Daisy 04/PKG 06&10.

Daisy Chain 04, Pkg 06/10, Ball no. AT39, Via 6-10

Figure 33(b). The cross-section micrograph of the lower layers of Daisy 04/PKG 06&10.

Daisy Chain 04, Pkg 19/47, Ball no. AF27, Via 2-5

Figure 33(c). The cross-section micrograph of the upper layers of Daisy 04/PKG 19&47.

Daisy Chain 04, Pkg 19/47, Ball no. AF27, Via 6-10

Figure 33(d). The cross-section micrograph of the lower layers of Daisy 04/PKG 19&47.

Daisy Chain 14 was selected because it had the highest net resistance decrease. The cross-section report and the micrographs of one of the via sets are shown in Table 17 and Figures 34(a) to 34(d), respectively. None of the ten cross-sectioned via sets had failed.

Table 17. The cross-section report of Daisy Chain 14.

Pkg 23 and Pkg 26		At the outer periphery						
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AJ37	No	No	No	No	No	No	No	No
AH37	No	No	No	No	No	No	No	No
AG37	No	No	No	No	No	No	No	No
AF37	No	No	No	No	No	No	No	No
AE37	No	No	No	No	No	No	No	No
Pkg 42 and Pkg 44		Under the die						
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AA33	No	No	No	No	No	No	No	No
AA32	No	No	No	No	No	No	No	No
AA31	No	No	No	No	No	No	No	No
AA30	No	No	No	No	No	No	No	No
AA29	No	No	No	No	No	No	No	No

Daisy Chain 14, Pkg 26, Ball no. AJ37, Via 1-3/4-5

Daisy Chain 14, Pkg 23, Ball no. AJ37, Via 3-4

Figure 34(a). The cross-section micrograph of the upper layers of Daisy 14/PKG 23&26.

Daisy Chain 14, Pkg 26, Ball no. AJ37, Via 6-7/8-10

Daisy Chain 14, Pkg 23, Ball no. AJ37, Via 7-8

Figure 34(b). The cross-section micrograph of the lower layers of Daisy 14/PKG 23&26.

Daisy Chain 14, Pkg 42, Ball no. AA32, Via 1-3/4-5

Daisy Chain 14, Pkg 44, Ball no. AA32, Via 3-4

Figure 34(c). The cross-section micrograph of the upper layers of Daisy 14/PKG 42&44.

Daisy Chain 14, Pkg 42, Ball no. AA32, Via 6-7/8-10

Daisy Chain 14, Pkg 44, Ball no. AA32, Via 7-8

Figure 34(d). The cross-section micrograph of the lower layers of Daisy 14/PKG 42&44.

Daisy Chain 08 was selected because it showed a big jump in net resistance increase after TCC 300 cycles. This cross-section report and the micrographs of one of the via sets are shown in Table 18 and Figures 35(a) to 35(d), respectively. None of the nine cross-sectioned via sets failed. Only two minor cracks, which were not considered failures, were seen on the stack-on core vias on V4-5.

Table 18. The cross-section report of Daisy Chain 08.

Pkg 04 and Pkg 35 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AU4	No	No	No	No	No	No	No	No
AU5	No	No	No	No	No	No	No	No
AU6	No	No	No	No	No	No	No	No
AU7	No	No	No	No	No	No	No	No
AU8	No	No	No	No	No	No	No	No
Pkg 32 and Pkg 48 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AJ12	No in-line via	No	No	Minor crack on L5	No	No	No	No
AJ13	No in-line via	No	No	No	No	No	No	No
AJ14	No in-line via	No	No	No	No	No	No	No
AJ15	No in-line via	No	No	Minor crack on L5	No	No	No	No

Daisy Chain 08, Pkg 04/35, Ball no. AU5, Via 1-5

Figure 35(a). The cross-section micrograph of the upper layers of Daisy 08/PKG 04&35.

Daisy Chain 08, Pkg 04/35, Ball no. AU5, Via 6-10

Figure 35(b). The cross-section micrograph of the lower layers of Daisy 08/PKG 04&35.

Daisy Chain 08, Pkg 32/48, Ball no. AJ14, Via 2-5

Figure 35(c). The cross-section micrograph of the upper layers of Daisy 08/PKG 32&48.

Daisy Chain 08, Pkg 32/48, Ball no. AJ14, Via 6-10

Figure 35(d). The cross-section micrograph of the lower layers of Daisy 08/PKG 32&48.

Daisy Chain 02 was selected because it was one of the two “extreme” stacked via structures. The cross-section report and the micrographs of one of the via sets of Daisy Chain 02 are shown in Table 19 and Figures 36(a) to 36(d), respectively. All of the seven cross-sectioned via sets at the outer periphery failed on the stack vias on V7-8. None of the five cross-sectioned via sets under the die failed.

Table 19. The cross-section report of Daisy Chain 02 in Phase I.

Pkg 02 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
C36	No	No	No	Minor crack on L5	No	Crack on L7	No	No
C35	No	No	No	No	No	Crack on L7	No	No
C34	No	No	No	No	No	Crack on L7	No	No
C33	No	No	No	No	No	Crack on L7	No	No
C32	No	No	No	No	No	Crack on L7	No	No
C31	No	No	No	No	No	Crack on L7	No	No
C30	No	No	No	No	No	Crack on L7	No	No
Pkg 39 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
K30	No	No	No	No	No	No	No	No
K29	No	No	No	No	No	No	No	No
K28	No	No	No	No	No	No	No	No
K27	No	No	No	No	No	No	No	No
K26	No	No	No	No	No	No	No	No

Daisy Chain 02, Pkg 02, Ball no. C36, Via 1-5

Figure 36(a). The cross-section micrograph of the upper layers of Daisy 02/PKG 02.

Daisy Chain 02, Pkg 02, Ball no. C36, Via 6-10

Figure 36(b). The cross-section micrograph of the lower layers of Daisy 02/PKG 02.

Daisy Chain 02, Pkg 39, Ball no. K30, Via 1-5

Figure 36(c). The cross-section micrograph of the upper layers of Daisy 02/PKG 39.

Daisy Chain 02, Pkg 39, Ball no. K30, Via 6-10

Figure 36(d). The cross-section micrograph of the lower layers of Daisy 02/PKG 39.

5.4.2 Packages with Low Net Resistance Change (Phase II)

The purpose of Phase II was to investigate whether the failed via locations found in Phase I, which used the packages with higher net resistance change, were also found in the packages with lower net resistance changes. The packages that had very low net resistance change in Daisy Chain 06 and Daisy Chain 02 were selected for further study, as shown in Table 20. Their cross-section locations are shown in Figures 31(b) and 31(c). The cross-section report and the micrographs of one of the via sets of Daisy Chain 06 are shown in Table 21 and Figures 37(a) through 37(d), respectively. None of the twelve cross-sectioned via sets had failed. The cross-section report and the micrographs of one

of the via sets of Daisy Chain 02 are shown in Table 22 and Figures 38(a) through 38(d), respectively. None of the ten cross-sectioned via sets failed.

Table 20. The daisy chains and the packages selected for cross-section in Phase II.

Daisy chains	Packages	
Daisy06	PKG33	PKG41
Daisy02	PKG22	PKG46

Table 21. The cross-section report of Daisy Chain 06 in Phase II.

Pkg 41 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
Y4	No	No	No	No	No	No	No in-line via	No in-line via
AA4	No	No	No	No	No	No	No in-line via	No in-line via
AB4	No	No	No	No	No	No	No in-line via	No in-line via
AC4	No	No	No	No	No	No	No in-line via	No in-line via
AD4	No	No	No	No	No	No	No in-line via	No in-line via
AE4	No	No	No	No	No	No	No in-line via	No in-line via
Pkg 33 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
AB10	No in-line via	No in-line via	No	No	No	No	No	No
AB11	No in-line via	No	No	No	No	No	No	No
AB12	No in-line via	No	No	No	No	No	No	No
AB13	No in-line via	No	No	No	No	No	No	No
AB14	No	No	No	No	No	No	No	No
AB15	No	No	No	No	No	No	No	No

Daisy Chain 06, Pkg 41, Ball no. AC4, Via 1-5

Figure 37(a). The cross-section micrograph of the upper layers of Daisy 06/PKG 41.

Daisy Chain 06, Pkg 41, Ball no. AC4, Via 6-10

Figure 37(b). The cross-section micrograph of the lower layers of Daisy 06/PKG 41.

Daisy Chain 06, Pkg 33, Ball no. AB15, Via 1-5

Figure 37(c). The cross-section micrograph of the upper layers of Daisy 06/PKG 33.

Daisy Chain 06, Pkg 33, Ball no. AB15, Via 6-10

Figure 37(d). The cross-section micrograph of the lower layers of Daisy 06/PKG 33.

Table 22. The cross-section report of Daisy Chain 02 in Phase II.

Pkg 22 At the outer periphery								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
C36	No	No	No	No	No	No	No	No
C35	No	No	No	No	No	No	No	No
C34	No	No	No	No	No	No	No	No
C33	No	No	No	No	No	No	No	No
C32	No	No	No	No	No	No	No	No
Pkg 46 Under the die								
Ball No	V1-2	V2-3	V3-4	V4-5	V6-7	V7-8	V8-9	V9-10
K30	No	No	No	No	No	No	No	No
K29	No	No	No	No	No	No	No	No
K28	No	No	No	No	No	No	No	No
K27	No	No	No	No	No	No	No	No
K26	No	No	No	No	No	No	No	No

Daisy Chain 02, Pkg 22, Ball no. C32, Via 1-5

Figure 38(a). The cross-section micrograph of the upper layers of Daisy 02/PKG 22.

Figure 38(b). The cross-section micrograph of the lower layers of Daisy 02/PKG 22.

Figure 38(c). The cross-section micrograph of the upper layers of Daisy 02/PKG 46.

Daisy Chain 02, Pkg 46, Ball no. K26, Via 6-10

Figure 38(d). The cross-section micrograph of the lower layers of Daisy 02/PKG 46.

5.4.3 Summary of Failure Analysis

As can be seen from the micrographs of the vias that had cracks or minor cracks, every crack was located at the interface between the “bottom” of the laser via and the “top” surface of the copper layer below the laser via. All of the cracks were found in the laser vias that were stacked on the core via or on each other, and were located at various layers and geographical locations.

CHAPTER SIX

DISCUSSIONS OF RESULTS

The overall DOE analysis and the detailed DOE analyses at some selected temperature cycles, the failure analysis, and the correlations from these analyses are discussed in this chapter.

6.1 DOE Analyses

From a general overview of Table 12(a) through Table 12(c), it does not look like the effects are consistent from one measured cycle to the other. However, if the first three measured cycles (the TCB 238th, 457th, and 643rd cycles) and the last two measured cycles (the TCC 400th and 500th cycles) are removed, Factor 1, Factor 2, and Interaction 34 are the top three contributing effects among the 15 main factors and interactions. Their rankings in each measured cycle, from the TCB 875th cycle to the TCC 300th cycle, are listed in Table 23. Detailed DOE analyses at the TCB 1200th, TCB 2012th, and TCC 300th measured cycles are presented in Sections 6.1.1 through 6.1.3.

Table 23. The top three contributing factors and interaction and their rankings.

	TCB 875	TCB 1016	TCB 1200	TCB 1492	TCB 1724	TCB 2012	TCC 100	TCC 200	TCC 300
Factor 1	4	7	1	2	1	2	2	2	1
Factor 3	2	3	2	4	2	1	3	6	2
Interaction 34	1	4	3	1	3	3	1	1	5

The removal of the first three and the last two measured cycles is rational for the DOE analyses in this investigation. From the experiences of temperature cycling tests,

most of the failures do not appear before the TCB 500 cycles. So, it is thought that in the first two measured cycles the laser vias were not sufficiently strained to produce measurable and permanent cracks. The resistance change data may come partly from experimental error and partly from very minor inter-layer separation. As for the third measured cycle, it is thought that the experimental error might be too high. As can be seen in Figure 28, all of the statistical data of the TCB 643rd cycle were generally lower than those in the other measured cycles. Even the average net resistance of all the daisy chains is 0.12% lower than that of the 0th cycle. Therefore, the first three measured cycles were excluded in the DOE analyses. On the other hand, some daisy chains did not follow the pattern of resistance change at and after the TCC 400th cycles. For example, daisy Chain # 04, 06, and 08 had a sudden rise in resistance while Daisy Chains 09 and 14 have sudden drops in resistance at both the TCC 400th and TCC 500th cycles. These findings and the possible explanations were discussed in Section 6.1.1. Therefore, it is reasonable to exclude the last two measured cycles in the DOE analyses.

As can be seen from Table 13(a) through Table 13(d), many three- and four-factor interactions are significant in this experiment. However, in any 2⁴ DOE it is safe to assume that all of the effects from the three- and four-interactions are negligible because the higher-order interactions would predominantly measure differences from experimental error. On the other hand, significant two-factor interactions must be examined carefully because they may be real contributors or they may magnify the effects from the major factors.

Detailed 2⁴ DOE analyses for the TCB1200th, TCB2012th, TCC300th, and TCC500th cycles are presented Sections 6.1.1, 6.1.2, 6.1.3, and 6.1.4, respectively. The overall summary for the DOE is presented in Section 6.1.5.

6.1.1 DOE Analysis at the TCB 1200th Cycle

The TCB 1200th cycle was selected for further analysis because the minimum number of cycles that Xilinx uses for TCB cycling test on FCBGAs is 1,200. The minimum number of TCB cycles commonly acceptable in the industry is 1,000.

6.1.1.1 Single Factor Effects

As can be seen from the ANOVA results in Table 13(a), the main effects of Factor 1 (Stack-on-core vs. Non-stack-on-core) and Factor 3 (Staggered Via vs. Stacked Via) are significant. But which aspect of Factor 1 causes more change in the resistance and which causes less? The same question also applies to Factor 3. The effects of these two single factors were further calculated. The data are shown in Table 24 and plotted in Figure 39. It can be seen that the rate of resistance change is lower when the laser vias are not stacked on the core via (1+). On the other hand, the rate of resistance change is higher when the laser vias are stacked on the core via (1-). In the same way, it is when the laser vias are not stacked on each other (3+) that a lower resistance change is exhibited. But, if the vias are stacked on each other (3-), a higher resistance change can be seen. Also, it can be seen in Table 24 that the effects of these two factors are within 0.01% for higher resistance change and within 0.02% for lower resistance change; therefore it is not possible to determine which factor is more dominant.

Table 24. Single factor effects at the TCB 1200th cycle.

Factor 1	Stack-on-core (1-)	Non-stack-on-core (1+)
	1.41%	0.22%
Factor 3	Stacked Via (3-)	Staggered Via (3+)
	1.40%	0.24%

(a) Factor 1

Stack-on-core (1-)	Non-stack-on-core (1+)
--------------------	------------------------

(b) Factor 3

Stacked Via (3-)	Staggered Via (3+)
------------------	--------------------

Figure 39. Single factor plots at the TCB 1200th cycle.

6.1.1.2 Two-factor Interaction Effects

As can be seen from the ANOVA results in Table 13(a), Interactions 13, 14, 23, 24, and 34 are the significant two-factor interactions. Among these five significant two-factor interactions, Interactions 34 and 14 have higher contributions. These interactions were further calculated and examined. The data are shown in Table 25 and plotted in Figure 40.

As can be seen from Figure 40(a), when the laser vias are not stacked on each other (3+) and not stacked on the core via (1+), the rate of resistance change is slightly

lower. But, when the laser vias are stacked on each other (3-), the rate of resistance change is sharply higher if the laser vias are also stacked on the core via (1-). Interaction 13 substantiates and magnifies the results of the single factor effects discussed in Section 6.1.1.1.

Table 25. Two-factor interaction effects at the TCB 1200th cycle.

Interaction 13	Stack-on-core (1-)	Non-stack-on-core (1+)
Stacked Via (3-)	2.38%	0.41%
Staggered Via (3+)	0.44%	0.04%
Interaction 14	Stack-on-core (1-)	Non-stack-on-core (1+)
Non-fillet (4-)	2.01%	-0.16%
Fillet (4+)	0.81%	0.61%
Interaction 23	Stacked Via (3-)	Staggered Via (3+)
High Aspect Ratio (2-)	1.01%	0.68%
Low Aspect Ratio (2+)	1.78%	-0.21%
Interaction 24	High Aspect Ratio (2-)	Low Aspect Ratio (2+)
Non-fillet (4-)	1.34%	0.50%
Fillet (4+)	0.35%	1.07%
Interaction 34	Stacked Via (3-)	Staggered Via (3+)
Non-fillet (4-)	2.05%	-0.20%
Fillet (4+)	0.74%	0.67%

From Figure 40(b) Interaction 14 can be analyzed as: (i) the presence of a fillet (4+) has very little effect on the rate of resistance change regardless of whether the laser vias are stacked on the core via (1-) or not (1+), (ii) it is the absence of the fillet (4-) that causes the rate of resistance change to be lowered when the laser vias are not stacked on the core via (1+), and (iii) it is the absence of the fillet (4-) that results in the higher rate of resistance change when the laser vias are stacked on the core via (1-).

(a) Interaction 13

Stack-on-core (1-)	Stacked Via (3-)
Non-stack-on-core (1+)	Staggered Via (3+)

(d) Interaction 24

High Aspect Ratio (2-)	Non-fillet (4-)
Low Aspect Ratio (2+)	Fillet (4+)

(b) Interaction 14

Stack-on-core (1-)	Non-fillet (4-)
Non-stack-on-core (1+)	Fillet (4+)

(e) Interaction 34

Stacked Via (3-)	Non-fillet (4-)
Staggered Via (3+)	Fillet (4+)

(c) Interaction 23

High Aspect Ratio (2-)	Stacked Via (3-)
Low Aspect Ratio (2+)	Staggered Via (3+)

Figure 40. Two-factor interaction plots at the TCB 1200th cycle.

But, in the design, when a laser via is stacked on the core via, there is no trace required and thus there is no fillet needed. In other words, the combination of Stack-on-core (1-) and Fillet (4+) does not exist in the actual design, and thus the lower point on the left side in Figure 40(b) which represents the combination of Stack-on-core (1-) and Fillet (4+) can be ignored. In the same way, the combination of Stack-on-core (1-) and the absence of a fillet (4-) can be seen as Stack-on-core only. Therefore, the only conclusion that can be drawn is that the absence of a fillet (4-) causes the rate of resistance change to be lowered when the laser vias are not stacked on the core via (1+).

As can be seen from Figure 40(c), a high aspect ratio (2-), or smaller via, has very little effect on the rate of resistance change regardless of whether the laser vias are stacked on each other (3-) or not (3+). However, it is a low aspect ratio (2+), or larger via, that causes the rate of resistance change to be lowered when the laser vias are not stacked on each other (3+). On the contrary, it is the low aspect ratio (2+) that results in the higher rate of resistance change when the laser vias are stacked on each other (3-).

From the analysis of Interaction 24 in Table 25 and Figure 40(d), when the aspect ratio is high (2-), the presence of a fillet (4+) results in the lower rate of resistance change being lowered. But, when the aspect ratio is low (2+), it is the absence of the fillet (4-) that results in the lower rate of resistance change.

Similar to the analysis of Interaction 14, Interaction 34 in Figure 40(e) can be analyzed as: (i) the presence of a fillet (4+) has very little effect on the rate of resistance change regardless of whether the laser vias are stacked on each other (3-) or not (3+), (ii) it is the absence of the fillet (4-) that causes the rate of resistance change to be lowered

when the laser vias are not stacked on each other (3+), and (iii) it is the absence of the fillet (4-) that results in the higher rate of resistance change when the laser vias are stacked on each other (3-).

In fact, the combinations of Factor 3 (Stacked Via vs. Staggered Via) and Factor 4 (Fillet vs. Non-fillet) are quite complicated in the design. Daisy Chains 02 and 06 do not have fillets because all of the vias are stacked on each other along the same axis in a via set. Also, for Daisy Chains 01, 05, 09, 10, 13, and 14 that are labeled as having the element of Stacked Via, the laser vias are not stacked on each other on Layers 3 and 8 whereas the laser vias are stacked on each other on the remaining four built-up layers which are Layers 1, 2, 9, and 10. The reason for this was explained in Section 4.1. For the sake of simplicity, these daisy chains are still considered as having Stacked Vias because the number of Stacked Vias is greater than the number of Staggered Vias. Therefore, the lower point on the left side in Figure 40(e) which represents the combination of Stacked Via (3-) and Fillet (4+) is ignored. In the same way, the combination of Stacked Via (3-) and the absence of a fillet (4-) is seen as Stacked Via only. Therefore, the only conclusion that can be drawn is that the absence of a fillet (4-) causes the rate of resistance change to be lowered when the laser vias are not stacked on each other (3+).

6.1.2 DOE Analysis at the TCB 2012th Cycle

The TCB 2012th cycle was selected for further analysis because it was the last cycle of the TCB temperature cycling test in this experiment.

6.1.2.1 Single Factor Effects

As can be seen from Table 13(b), the main effects of Factor 1 and Factor 3 are significant. The effects of these two single factors were further analyzed. The data are shown in Table 26 and plotted in Figure 41. Similar to the findings at the TCB 1200th cycle, the rate of resistance change is lower when the laser vias are not stacked on the core via (1+). Likewise, when the laser vias are not stacked on each other (3+), the rate of resistance change is also lower. Since the effects of these two factors are very close, it is not possible to determine if either one of them is more dominant.

Table 26. Single factor effects at the TCB 2012th cycle.

Factor 1	Stack-on-core (1-)	Non-stack-on-core (1+)
	1.66%	0.17%
Factor 3	Stacked Via (3-)	Staggered Via (3+)
	1.69%	0.14%

(a) Factor 1

Stack-on-core (1-)	Non-stack-on-core (1+)
--------------------	------------------------

(b) Factor 3

Stacked Via (3-)	Staggered Via (3+)
------------------	--------------------

Figure 41. Single factor plots at the TCB 2012th cycle.

6.1.2.2 Two-factor Interaction Effects

As can be seen from Table 13(b), Interactions 13, 14, 23, 24, and 34 are significant with Interaction 34 being the largest contributor among all of the two-factor interactions. All of these interactions are also significant at the TCB 1200th cycle. These two-factor interactions were further examined. The data are shown in Table 27 and plotted in Figure 42.

Table 27. Two-factor interaction effects at the TCB 1202th cycle.

Interaction 13	Stack-on-core (1-)	Non-stack-on-core (1+)
Stacked Via (3-)	2.90%	0.47%
Staggered Via (3+)	0.42%	-0.13%
Interaction 14	Stack-on-core (1-)	Non-stack-on-core (1+)
Non-fillet (4-)	2.07%	-0.15%
Fillet (4+)	1.24%	0.49%
Interaction 23	Stacked Via (3-)	Staggered Via (3+)
High Aspect Ratio (2-)	1.25%	0.44%
Low Aspect Ratio (2+)	2.13%	-0.15%
Interaction 24	High Aspect Ratio (2-)	Low Aspect Ratio (2+)
Non-fillet (4-)	1.35%	0.58%
Fillet (4+)	0.33%	1.40%
Interaction 34	Stacked Via (3-)	Staggered Via (3+)
Non-fillet (4-)	2.47%	-0.54%
Fillet (4+)	0.91%	0.83%

Similar to the findings at the TCB 1200th cycle, Interaction 13 is in agreement with the analysis from the single factor effects. It suggests that the rate of resistance change is being lowered further when the laser vias are not stacked on the core via (1+) and on each other (3+).

Interaction 14 is also similar to that at the TCB 1200th cycle. The only conclusion that can be drawn from Figure 42(b) is that the absence of a fillet (4-) results in the lower rate of resistance change when the laser vias are not stacked on the core via (1+).

(a) Interaction 13

Stack-on-core (1-)	Stacked Via (3-)
Non-stack-on-core (1+)	Staggered Via (3+)

(d) Interaction 24

High Aspect Ratio (2-)	Non-fillet (4-)
Low Aspect Ratio (2+)	Fillet (4+)

(b) Interaction 14

Stack-on-core (1-)	Non-fillet (4-)
Non-stack-on-core (1+)	Fillet (4+)

(e) Interaction 34

Stacked Via (3-)	Non-fillet (4-)
Staggered Via (3+)	Fillet (4+)

(c) Interaction 23

High Aspect Ratio (2-)	Stacked Via (3-)
Low Aspect Ratio (2+)	Staggered Via (3+)

Figure 42. Two-factor interaction plots at the TCB 2012th cycle.

Interaction 23 is also similar to that at the TCB 1200th cycle. As can be seen from Figure 42(c), High Aspect Ratio (2-) has very little effect on the rate of resistance change whether the laser vias are stacked on each other (3-) or not (3+). However, it is the low aspect ratio (2+) that results in the lower rate of resistance change when the laser vias are not stacked on each other (3+). On the contrary, it is the low aspect ratio (2+) that results in the higher rate of resistance change when the laser vias are stacked on each other (3-).

Interaction 24 also has the pattern similar to the one at the TCB 1200th cycle. As can be seen in Figure 42(d), when the aspect ratio is high (2-), the presence of a fillet (4+) results in the lower rate of resistance change. But, when the aspect ratio is low (2+), it is the absence of the fillet (4-) that results in the lower rate of resistance change.

Once more, Interaction 34 is the same in both the TCB 1200th and TCB 2012th cycles. The only conclusion that can be drawn in Figure 42(e) is that the absence of a fillet (4-) results in the lower rate of resistance change when the laser vias are not stacked on each other (3+).

6.1.3 DOE Analysis at the TCC 300th Cycle

The TCC 300th cycle was used for further analysis because some daisy chains started to show inexplicable resistance change after this cycling test. Therefore, the TCC 300th temperature cycling test appeared to be the last temperature cycling test from which the data were reasonable.

6.1.3.1 Single Factor Effects

As can be seen from the ANOVA results in Table 13(c), the main effects of Factor 1 and Factor 3 are significant, and the main effect of Factor 2 (Low aspect ratio vs. High aspect ratio) is fairly significant. The effects of these three single factors were further calculated. The data are shown in Table 28 and plotted in Figure 43. As was the case with the single factor effects at the TCB 1200th and the TCB 20120th cycles, the rate of resistance change was lower when the laser vias were not stacked on the core via (1+). Likewise, when the laser vias were not stacked on each other (3+), the rate of resistance change was also lower. The effects of these two factors are very close and it is not possible to determine if one is more dominant than the other.

As shown in Figure 43(b), the rate of resistance change is lower when the aspect ratio is low (2+) and is higher when the aspect ratio is high (2-). But since the difference between the higher and the lower resistance changes is only 0.31%, it is suggested that the effect of Factor 2 is not distinctive. Also, as shown in Table 13(c), the contribution of Factor 2 is 0.37% which is about 30 times less than that of Factor 1 and 26 times less than that of Factor 3. Therefore, it is reasonable to exclude the effect of Factor 2, the aspect ratio, from the single factor effects in this cycle.

Table 28. Single factor effects at the TCC 300th cycle.

Factor 1	Stack-on-core (1-)	Non-stack-on-core (1+)
	3.51%	1.28%
Factor 2	High Aspect Ratio (2-)	Low Aspect Ratio (2+)
	2.60%	2.19%
Factor 3	Stacked Via (3-)	Staggered Via (3+)
	3.45%	1.35%

Figure 43. Single factor plots at the TCC 300th cycle.

6.1.3.2 Two-factor Interaction Effects

As can be seen from Table 13(c), Interactions 13, 14, 23, 24, and 34 are significant. These interactions are also significant at both the TCB 1200th and the TCB 2012th cycles. Among these five significant two-factor interactions, Interactions 34 and 24 have higher contributions. Interaction 34 is the two-factor interaction of Factor 3 (Stacked Via) and Factor 4 (Fillet), whereas Interaction 24 is the two-factor interaction of

Factor 2 (Aspect ratio) and Factor 4 (Fillet.) All the significant two-factor interactions were further calculated and examined. The data are shown in Table 29 and plotted in Figure 44.

Table 29. Two-factor interaction effects at the TCC 300th cycle.

Interaction 13	Stack-on-core (1-)	Non-stack-on-core (1+)
Stacked Via (3-)	4.93%	1.97%
Staggered Via (3+)	2.10%	0.59%
Interaction 14	Stack-on-core (1-)	Non-stack-on-core (1+)
Non-fillet (4-)	3.90%	0.99%
Fillet (4+)	3.12%	1.57%
Interaction 23	Stacked Via (3-)	Staggered Via (3+)
High Aspect Ratio (2-)	3.11%	2.09%
Low Aspect Ratio (2+)	3.79%	0.60%
Interaction 24	High Aspect Ratio (2-)	Low Aspect Ratio (2+)
Non-fillet (4-)	3.56%	1.33%
Fillet (4+)	1.64%	3.05%
Interaction 34	Stacked Via (3-)	Staggered Via (3+)
Non-fillet (4-)	4.33%	0.57%
Fillet (4+)	2.57%	2.12%

Since the patterns of the two-factor interactions in all of these three measured cycles are similar, the same observations as those noted in Sections 6.1.1.2 and 6.1.2.2 can be drawn. Furthermore, when Figure 44 is compared with Figures 40 and 42, the resistance changes for each two-factor interaction at the TCC 300th cycle are generally higher than the corresponding data at the TCB 1200th cycle and TCB 2012th cycles. Therefore, it is suggested that the TCC 300th cycle caused more stresses on the daisy chains and thus created more effects on the design factors examined than the previous cycles did.

(a) Interaction 13

Stack-on-core (1-)	Stacked Via (3-)
Non-stack-on-core (1+)	Staggered Via (3+)

(d) Interaction 24

High Aspect Ratio (2-)	Non-fillet (4-)
Low Aspect Ratio (2+)	Fillet (4+)

(b) Interaction 14

Stack-on-core (1-)	Non-fillet (4-)
Non-stack-on-core (1+)	Fillet (4+)

(e) Interaction 34

Stacked Via (3-)	Non-fillet (4-)
Staggered Via (3+)	Fillet (4+)

(c) Interaction 23

High Aspect Ratio (2-)	Stacked Via (3-)
Low Aspect Ratio (2+)	Staggered Via (3+)

Figure 44. Two-factor interaction plots at the TCC 300th cycle.

6.1.4 DOE Analysis at the TCC 500th Cycle

The TCC 500th cycle was the last cycle of the TCC temperature cycling test in this investigation. Although some daisy chains did not follow the pattern of resistance change at and after the TCC 400th cycle, the TCC 500th cycle was examined so that the data and results could be compared with the data from the other cycles that were analyzed.

6.1.4.1 Single Factor Effects

As can be seen from the ANOVA results in Table 13(d), the main effects of Factor 1 (Stack on core vs. Non-stack on core), Factor 3 (Staggered via vs. Stacked via), and Factor 4 (Fillet vs. Non-fillet) are significant. The effects of these three single factors were further calculated, and the data are shown in Table 30 and plotted in Figure 45. As was the case with the single factor effects at the TCB 1200th, TCB 2012th, and TCC 300th cycles, Non-stack-on core (1+) has low resistance changes. However, the presence of a fillet (4+) has also resulted in a lower resistance change. Factor 4 is not a major single factor in the other cycles that were analyzed. In contrast to the findings from the TCB 1200th, TCB 2012th, and TCC 300th cycles, the rate of resistance change is lower when the laser vias are stacked on each other (3-) and is higher when the laser vias are not stacked on each other (3+).

Table 30. Single factor effects at the TCC 500th cycle.

Factor 1	Stack-on-core (1-)	Non-stack-on-core (1+)
	6.67%	0.06%
Factor 3	Stacked Via (3-)	Staggered Via (3+)
	2.51%	4.21%
Factor 4	Non-Fillet (4-)	Fillet (4+)
	5.76%	0.97%

(a) Factor 1

(b) Factor 3

(c) Factor 4

Figure 45. Single factor plots at the TCC 500th cycle.

6.1.4.2 Two-factor Interaction Effects

As can be seen from Table 13(d), Interactions 12, 13, 14, and 23 are significant, with Interaction 14 being the largest contributor among all of the two-factor interactions. All of the interactions except Interaction 12 are also significant at the TCB 1200th, TCB 2012th, and TCC 300th cycles. But some of the significant interactions at these cycles, such as Interactions 24 and 34, become not significant at the TCC 500th cycle. The two-

factor interactions were further calculated and examined. The data are shown in Table 31 and plotted in Figure 46.

Table 31. Two-factor interaction effects at the TCC 500th cycle.

Interaction 12	Stack-on-core (1-)	Non-stack-on-core (1+)
High Aspect Ratio (2-)	7.34%	-0.27%
Low Aspect Ratio (2+)	5.99%	0.39%
Interaction 13	Stack-on-core (1-)	Non-stack-on-core (1+)
Stacked Via (3-)	6.53%	-1.51%
Staggered Via (3+)	6.81%	1.62%
Interaction 14	Stack-on-core (1-)	Non-stack-on-core (1+)
Non-fillet (4-)	12.37%	-0.85%
Fillet (4+)	0.97%	0.97%
Interaction 23	Stacked Via (3-)	Staggered Via (3+)
High Aspect Ratio (2-)	3.45%	3.62%
Low Aspect Ratio (2+)	1.58%	4.80%

As can be seen from Figure 46(a), when the laser vias are stacked on the core vias (1-), a low aspect ratio (2+) results in the rate of resistance change being lowered. However, when the laser vias are not stacked on the core vias (1+), it is the high aspect ratio (2-) that results in the rate of resistance change being lowered but by only a very small fraction. Therefore, it can be concluded that the dominating element of Interaction 12 in lowering the rate of resistance change is when the laser vias are not stacked on the core via (1+).

As can be seen from Figure 46(b), whether the laser vias are stacked on each other (3-) or not (3+), the rate of resistance change remains unchanged when the laser vias are stacked on the core via (1-). But, when the laser vias are not stacked on the core via (1+), the resistance change is lowered if the laser vias are stacked on each other (3-). This

phenomenon was unexpected, and the probable explanations were discussed in Section 5.2.1. However, when the laser vias are not stacked on the core via (1+), the rate of resistance change is still low if the laser vias are not stacked on each other (3+). Therefore, the only conclusion that can be made is that the dominating element of Interaction 13 in lowering the rate of resistance change is when the laser vias are not stacked on the core via (1+).

(a) Interaction 12

Stack-on-core (1-)	High Aspect Ratio (2-)
Non-stack-on-core (1+)	Low Aspect Ratio (2+)

(c) Interaction 14

Stack-on-core (1-)	Non-fillet (4-)
Non-stack-on-core (1+)	Fillet (4+)

(b) Interaction 13

Stack-on-core (1-)	Stacked Via (3-)
Non-stack-on-core (1+)	Staggered Via (3+)

(d) Interaction 23

High Aspect Ratio (2-)	Stacked Via (3-)
Low Aspect Ratio (2+)	Staggered Via (3+)

Figure 46. Two-factor interaction plots at the TCC 500th cycle.

Interaction 14 in Figure 46(c) is similar to those at the TCB 1200th, TCB 2012th, and TCC 300th cycles and it can be deduced that the absence of a fillet (4-) drives the rate of resistance change to being lower when the laser vias are not stacked on the core via (1+). However, this finding does not agree with the analysis from the main factor effects in which the presence of a fillet (4+) was a major factor for lower resistance changes. Therefore, the only conclusion that can be made is that Interaction 14 is effective in lowering the rate of resistance change when the laser vias are not stacked on the core via (1+).

From Figure 46(d) Interaction 23 can be interpreted as: (i) a high aspect ratio (2-) has very little effect on the rate of resistance change when the laser vias are stacked on each other (3-) or not (3+) because the difference between the higher and the lower resistance changes is only 0.17%, (ii) it is the low aspect ratio (2+) that results in the higher rate of resistance change when the laser vias are not stacked on each other (3+), and (iii) it is the low aspect ratio (2+) that drives the rate of resistance change to being lower when the laser vias are stacked on each other (3-).

6.1.5 Summary of the DOE Analyses

Since the analyses of TCB 1200th, TCB 2012th, and TCC 300th cycles match each other very well, it can be stated that the conclusion drawn from these analyses are applicable to the entire investigation. From the analyses of the single factor effects, it is clearly seen that if a laser via is not stacked on the core via (1+) and not on each other (3+) in a via set, it will undergo less resistance change and will be more robust. The analysis of the two-factor interactions further suggests that the absence of a fillet (4-) will

make the laser via more reliable if it is not stacked on the core via (1+) and is offset to each other (3+). When a laser via is not stacked on each other (3+), it is the low aspect ratio (2+) that makes the laser via more robust. In addition, when a low aspect ratio (2+) is used, it is the absence of a fillet (4-) that makes a laser via even more reliable.

Therefore, it can be concluded that a robust laser via set should contain the following design elements:

- Laser vias not stacked on the core via
- Laser vias not stacked on one another
- The ratio of dielectric thickness to via diameter be low
- A fillet between a via pad and a trace is not needed

From the analyses of the single factor effects at the TCC 500th cycle, it can be concluded that if a laser via is not stacked on the core via (1+) but on each other (3-) in a via set, it will undergo less resistance change. The study from the two-factor interactions suggests that a low aspect ratio (2+) will further lower the resistance change when the laser vias are stacked on each other (3-). The analysis of the TCC 500th cycle does not match with those from the TCB 1200th, TCB 2012th, and TCC 300th cycles. In particular, the inferences of Factor 3 (whether a laser via is stacked on each other or not) in these two sets of analyses are contradictory to each other. The results of failure analysis reported in Section 6.2 shows that cracks can be found on the vias that are stacked on each other but not on the vias that are offset to each other. Also, as mentioned in Section 5.2.1, five of the daisy chains had sudden resistance rises or drops on and after the TCC

400th cycles. Therefore, the results of the DOE analysis obtained at the TCC 500th cycle are not reliable.

6.2 Failure Analysis

The number of the daisy chains examined, and the number of failed daisy chains and the failure locations are summarized in Table 32. As indicated in Section 5.4, a minor crack is not regarded as a failure whereas a full crack is considered a failure.

Table 32. Summary of number of failed vias and their locations.

Daisy Chain #	At the outer periphery			Under the die		
	Package #	Failure Rate	Location	Package #	Failure Rate	Location
Daisy06	36	5/5	On V2-3, V4-5, V6-7, and V8-9	43	5/5	On V1-2, V2-3, V3-4, and V4-5
	41	0/6		33	0/6	
Daisy04	06/10	5/5	On V4-5 and V6-7	19/47	0/4	
Daisy08	04/35	0/5		32/48	0/5	
Daisy02	02	7/7	On V7-8	39	0/5	
	22	0/5		46	0/5	
Daisy14	23/26	0/5		42/44	0/5	

6.2.1 Observations from Cross-sectioned Daisy Chains

Daisy Chain 06 had the highest resistance increase from the TCB 1200th cycle up to the TCC 500th cycle. Daisy Chain 06 is one of the two daisy chains that had all of the laser vias and the core via stacked on each other along the same axis in each via set. Because all the vias were stacked on one another, a fillet was not applicable in Daisy Chain 06. The laser via diameter is small because Daisy Chain 06 was designed with a high aspect ratio. In the failure analysis, Packages #36 and #43 of Daisy chain 06, which

showed the highest resistance increase among all 49 packages, failed completely in the locations identified as “At the outer periphery” and “Under the die”. The failed vias were both stacked on the core via and on each other and were located at various layers. However, Packages #41 and #33, which showed lower resistance increase among all 49 packages, did not fail in any locations at all.

Daisy Chain 04 maintained a very low resistance change before the TCC 300th cycle. The resistance sharply increased at the TCC 400th cycle and caused Daisy Chain 04 to have the 2nd highest resistance increase at the end of the temperature cycling test. All the laser vias of Daisy Chain 04 were stacked on the core via but not on each other. A fillet was not incorporated in the intersection of a trace and a via pad. The laser via diameter was large because Daisy Chain 06 was designed with a low aspect ratio. In the failure analysis, Package combo # 06/10 failed completely in the location identified as “At the outer periphery” on V4-5 and V6-7. Both of these two laser vias were stacked directly on the core via. However, Package combo # 19/47 did not fail in the location identified as “Under the die.” These four packages showed higher resistance increase among all 49 packages.

Daisy Chain 08 had the 3rd highest resistance increase at the TCC 500th cycle. All the laser vias of Daisy Chain 08 were stacked on the core via but not on each other. A fillet was not incorporated between the trace and the via pad, and the laser via diameter was small. The cross-sections of Package combos # 04/35 and # 32/48 showed that this daisy chain did not fail at all. These four packages showed higher resistance increase among all 49 packages.

Daisy Chain 02 was the other daisy chain that had all of the laser vias and the core via stacked on each other along the same axis in each via set. The only difference between Daisy Chain 02 and Daisy Chain 06 was that Daisy Chain 02 had a larger laser via diameter. Package # 22 of Daisy Chain 02 failed completely in the location identified as “At the outer periphery” on V7-8, which was a stacked laser via. However, Package # 39 did not fail in the location identified as “Under the die”. These two packages had the highest resistance increases among all 49 packages. On the other hand, Packages # 22 and #46, which had the lowest resistance increases among all 49 packages, did not fail at any of the locations.

The average resistance change of Daisy Chain 14 was +2.9% at the TCC 300th cycle but it dropped down to -5.2% or lower at the TCC 400th and TCC 500th cycles. In fact, Daisy Chain 14 had the highest resistance decrease at the end of the temperature cycling test. All the laser vias of Daisy Chain 14 were not stacked on the core via but on each other. A fillet was not incorporated, and the laser via diameter was small. The cross-sections of Package combos # 23/26 and # 42/44, which had the highest resistance decreases among all 49 packages, did not fail at any of the locations.

6.2.2 Failure Analyses, Correlations, and Explanations

Although cross-sections were taken on selected daisy chains and on only a few of the via sets, it is still clear from the discussion in Section 6.2.1 that the greater the increase in via resistance, the higher the failure rate. This correlates with the published literature that via failure can be predicted by the increase of resistance.

None of the failed vias were from those that were not stacked on the core via or on each other. Conversely, although not all the laser vias that were stacked on the core via and on each other failed, all of the failed vias were from those that were either stacked on the core or stacked on each other. These findings correlate to the DOE analysis that Non-stack-on-core and Staggered Via resulted in lower resistance change, or a lower probability of via crack. The aspect ratio of the failed vias was either high or low. This finding also correlates to the DOE analysis that the effect of Factor 2 (High Aspect Ratio vs. Low Aspect Ratio) is not significant. Since fillets cannot be incorporated in the vias that are stacked on the core via or on each other, Factor 4 (Fillet vs. Non-fillet) cannot be examined by the failure analysis.

As can be seen from the micrographs of the failed vias in Section 5.4, all of the cracks were found at the interface between the capture pad and the bottom of the laser via. For example, a V2-3 crack always happens on L3 as the laser drill starts from L2 and ends on L3, and a V6-7 crack always happens on L6 as the laser drill starts from L7 and ends on L6. In the laser via structure, a stress concentration point is located at the intersection between the bottom via wall and the capture pad which is part of the copper layer. During the temperature cycling tests, the highest stress occurs at the intersection due to the coefficient of thermal expansion (CTE) mismatch between the different materials of the substrate. As can be seen from the micrographs of the failed vias, all the cracks have the same failure pattern. The crack initiates at the intersection and then propagates through the path of least strength which is along the interface between the copper layer and the bottom of the via. This finding correlates with the outcome

examined by Darveaux et al. [12] on the mechanically drilled vias in a Land Grid Array (LGA) package. For a minor crack, the crack does not propagate all the way through and stops somewhere in the middle of the via. For a full crack, the crack starts at the sharp corner of one side and ends at the sharp corner of the other side and splits open the interface.

Although each via had its own stress concentration points, if two or more vias of the two adjacent layers are staggered in a manner that they are offset to each other, there will be more leverage for the structure to absorb the CTE mismatch between the layers. So, the staggered via structure is more robust than the stacked via structure. The DOE results prove that Staggered Via had a lower resistance increase than Stacked Via did. In the failure analysis, via cracks were not found on the staggered via structure.

The same explanation can be applied to Factor 1 (Stack-on-core vs. Non-stack-on-core). When the laser vias and the core via are aligned in the same axis, there is less leverage for the structure to absorb the CTE mismatch between the two layers. Thus, Stack-on-core is weaker than Non-stack-on-core in terms of structure, and is easier to fail when subjected to stresses and strains from the CTE mismatch between the two layers. Moreover, as shown in Figure 47(a), Stack-on-core is surrounded by two types of materials, and they are the composite material of the dielectric layers, and the filling epoxy of the core via. As shown in Figure 47(b), Non-stack-on-core, due to its offset from the core via, only deals with one material that is the composite material of the dielectric layers, so it is subjected to less stresses and strains from the CTE mismatch. As a result, the non-stack-on-core via structure is stronger than the stack-on-core via

structure. The DOE results prove that Non-stack-on-core had lower resistance increase than Stack-on-core did. In the failure analysis, via cracks were not found on the non-stack-on-core structure.

Figure 47. Materials surrounding stack-on-core via and non-stack-on-core via.

As shown in Figure 31(a) through Figure 31(c), four to seven via sets were revealed in one cross-section. When a crack was seen at a particular via location in a cross-section, cracks were also found in all of the other via sets at the same via location of that cross-section. Furthermore, the crack pattern and the extent of the crack in the failed vias were very similar. One example is in Table 16. The cross-sectioning cut in the “Outer Periphery” of Daisy Chain 04 revealed all the via sets of Ball #AM39, AN39, AP39, AR39, and AT39 of Package 06. All the vias at the via locations of V4-5 and V6-7 of all these balls had serious cracks. As shown in the cross-section micrographs in

Appendix G, all the cracks at the via location V4-5 looked alike and so did the cracks at the via location V6-7. Another example is in Table 19. Seven via sets in Ball #C30-C36 of Package 02 of Daisy Chain 02 were revealed by one cross-sectioning cut. All of the vias at the location of V7-8 of all these balls had serious cracks. As shown in the cross-section micrographs in Appendix G, all of these cracks looked alike.

This phenomenon led to a question of whether the cracks found in these failed daisy chains in certain via locations were consistent regardless of the packages selected or not. In Phase II of the failure analysis, cross-sections were done on some other packages of Daisy Chain 02 and Daisy Chain 06 at the same cross-section locations done in Phase I. The difference between Phase I and Phase II was that in Phase I the packages selected were from those that had the highest resistance increase while in Phase II the packages selected were from those that had the lowest resistance increase. The result was that no crack was found in Daisy Chain 02 and Daisy Chain 06 of the packages selected in Phase II. So it can be concluded that for the same daisy chain, via failure happened in the packages that showed higher resistance change but not in the packages that showed lower resistance change. Also, if a package was found having failed vias, the failures happened at the same locations in a certain area of the package.

These findings suggest that the manufacturing processes have a major effect on via crack formation. In some manufacturing processes such as laser via drilling, electroless plating, and electrolytic plating, some residues may not be completely cleaned away and may remain on the substrate. If certain layers and certain areas of the substrate have more residues, those areas are more vulnerable to failure. Since the detail of the

manufacturing processes is beyond the scope of this thesis, these findings are not further explored.

The coefficient of thermal expansion (CTE) of the composite FCPBGA substrate is in the range of 16-20 ppm in the planer direction while the silicon die is about 2.6 ppm [18]. Due to the CTE mismatch of the die and the substrate, the vias above the core layer of the substrate are subjected to more stresses and strains than the vias under the core layer during the temperature cycles. Thus, a higher number of failed vias can be expected above the core layer than below the core layer. As can be seen in Table 32, a total of 35 vias above the core layer and a total of 22 vias below the core were cracked. Although not many cross-sectioned samples were done, the investigation still demonstrates that the failed vias are located more above the core layer than below the core layer.

Due to the CTE mismatch of the die and the substrate, the via sets in the region of “At the outer Periphery” of the package are subjected to more stresses and strains than the via sets in the region of “Under the die” during the temperature cycles. However, in this experiment, a failure rate of 44.7 % (17 out of 38 via sets are failed) happens in “At the outer periphery” and 14.3% (5 out of 35 via sets are failed) in “Under the die” according to Table 32. These failures are due to a combination of contributing factors, including those from the manufacturing processes, which cannot be discerned individually. Therefore, based on the limited number of cross-sectioned samples, it is not possible to separately identify the contributors to failure.

CHAPTER SEVEN

CONCLUSION

The effects of the four design parameters, which were interweaved in the sixteen daisy chains of the test vehicle, on micro-via reliability were evaluated by a 2^4 DOE approach and failure analysis. Several conclusions can be drawn from the experimental results of this investigation.

After 2012 cycles of TCB test, the average resistance increase of all the sixteen daisy chains was still within 1%, and the maximum resistance increase was not beyond 5.5%. According to the common industry acceptance level that the increase in resistance cannot be more than 10% at and after the TCB 1000th cycle, all sixteen daisy chains passed the current requirement on via reliability. In other words, each combination of the 2^4 design parameters, including the extreme situation where all the laser vias and core via were stacked on each other in this 10-layer test vehicle, passed the industry requirement. However, the objective of this experiment was to evaluate the effects of these four design factors on laser via reliability. The experiment was therefore continued with TCC tests to accelerate the stress level until a minimum resistance increase of 10% occurred in at least one daisy chain. Two daisy chains had their resistance increase beyond 10% at the TCC 400th cycle. From the statistical analysis of the resistance changes in the temperature cycling tests, it can be concluded that the higher the temperature difference in a test ($\Delta T = 180\text{ }^{\circ}\text{C}$ in the TCB test, and $\Delta T = 215\text{ }^{\circ}\text{C}$ in the TCC test), the higher the increase in via resistance.

From the 2⁴ DOE analyses, it was found that a robust laser via set is formed by: (i) laser vias not being stacked on the core via, (ii) laser vias not being stacked on one another, (iii) the ratio of dielectric thickness to via diameter being low, and (iv) the absence of a fillet between a via pad and a trace. The most dominating design factors are (i) laser vias not stacked on the core via, and (ii) laser vias not stacked on one another. Of all the vias examined in the failure analysis, no cracks were found in the vias that were not stacked on the core via and were offset to each other. Therefore, Non-stack-on-core and Staggered Vias are recommended for a FCBGA that requires long-term reliability. However, these factors require more “real-estate” and thus decrease the I/O routing density and power/ground plane integrity, which are necessary for high density and high performance chips. This conflict has to be resolved so that a reliable substrate can be provided for the next generation microelectronic devices of 45 nm gate size and ever-increasing clock speeds.

In the failure analysis, a higher number of failed vias were found in Daisy Chain 06 than in the other fifteen daisy chains. Daisy Chain 06 was constructed with laser vias of high aspect ratio, and had all the laser vias and the core vias stacked on each other along the same axis. This daisy chain displayed the highest resistance change from the TCB 1200th cycle up to the end of the TCC cycling tests.

From the failure analysis, it was concluded that the higher the increase in via resistance the higher the failure rate of micro vias. For each of the failed vias, the increase in resistance for that package and daisy chain was more than 10%. All the cracks in the failed laser vias had the same failure pattern. The crack initiated at the

stress concentration point, which is the interface between the capture pad and the bottom of the laser via, due to the CTE mismatch of the different materials in the substrate, and then propagated through the interface and finally split it open.

When comparing the data of a daisy chain from different packages, it was found that there was a discernible pattern of via failures; the failures tended to be restricted to certain vias, which were located in certain layers and areas. This indicates that the manufacturing processes can potentially have a major effect on via crack formation.

CHAPTER EIGHT

FUTURE WORK

The analyses of via cracks at different geographical locations such as “at the outer periphery”, “under the die”, “above the core layer,” and “under the core layer” could not be unequivocally identified due to the lack of sufficient data to distinguish the failures solely based on location. Therefore, it is recommended that another test vehicle and another set of temperature cycling experiments be designed so that electrical resistance measurements aimed at identifying location-specific data can be collected and analyzed.

It was identified in this study that manufacturing processes have a major effect on via crack formation. A detailed study of how the manufacturing processes affects via crack formation is needed in order to improve the long term micro-via reliability of FCBGA polymeric substrates.

As the feature sizes of the FCBGA substrates become smaller, laser vias will continue to shrink and micro-cracking can be expected to continue to be a barrier. In the 2002 ITRS roadmap presented by Sundaram et al. [8], the size of the vias may have to be shrunk to 10-30 μm in order to satisfy future FCBGA developments. The minimum size of the via that this experiment employed was 50 μm , which is the smallest via diameter that substrate manufacturers currently use for mass production. Although it is concluded that the aspect ratio was not a significant single-factor for via crack in this research, study of via cracks as related to via diameter is still needed before the next smaller via diameter can be employed for production.

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APPENDIX A

Measured Electrical Resistances at the 0th Cycle

Table A-1: Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
Starting Ball #	A14	A32	P39	AM39	H1	AF1	AW26	AW8
Ending Ball #	A18	A38	V39	AV39	B1	AB1	AW22	AW2
Conductor Length mm	204	148	295	243	234	114	285	255
Stack on core	yes	yes	yes	yes	yes	yes	yes	yes
Via/Pad size	large	large	large	large	small	small	small	small
Stacked vs Staggered	stacked	stacked	staggered	staggered	stacked	stacked	staggered	staggered
Fillet	yes	no	yes	no	yes	no	yes	no
PKG01	6.1024	5.8436	7.3194	6.1291	7.6552	5.1744	9.0060	7.6234
PKG02	6.1749	5.8979	7.5852	6.3768	7.7700	5.1200	9.5619	8.1189
PKG03	6.7187	6.5867	7.8934	6.9085	8.3319	5.5067	9.7250	8.3183
PKG04	6.0238	5.7952	7.3496	6.2439	7.4618	4.9509	9.4954	7.6718
PKG05	6.1386	6.0973	7.6336	6.2318	7.7760	5.2590	9.4471	8.1008
PKG06	5.7036	5.4388	6.9810	5.5853	7.1779	4.6125	8.7281	7.0374
PKG07	6.1326	6.0007	7.2046	5.9901	7.6431	5.0838	8.8852	7.4784
PKG08	6.6703	6.3753	8.1411	7.0414	8.4044	5.4161	10.3170	9.1219
PKG09	6.0057	5.8677	7.3617	6.3224	7.6733	5.2590	9.2900	7.8651
PKG10	6.5978	6.4538	7.7967	6.6487	8.3621	5.4040	9.6223	8.3726
PKG11	6.2715	6.0973	7.4644	6.2982	7.9271	5.0113	9.1087	7.5086
PKG12	6.6643	6.3934	7.8209	6.7272	8.4769	5.6819	9.7492	8.5177
PKG13	5.9755	5.7106	7.3315	5.9176	7.4618	4.8784	9.1027	7.8289
PKG14	7.0147	6.8707	8.1230	7.2589	8.8092	5.7424	10.1420	8.9768
PKG15	6.0661	5.7227	7.3556	6.0022	7.7156	4.9509	9.0181	7.6718
PKG16	7.0147	7.1486	8.3586	7.6033	9.2865	6.1955	10.6130	9.6173
PKG17	6.5072	6.2967	7.7121	6.4251	8.1748	5.5732	9.5861	8.6143
PKG18	6.2413	5.8919	7.5671	6.2197	7.7700	5.1442	9.3686	8.2397
PKG19	6.0117	5.7409	7.3858	6.0082	7.4739	4.8965	9.0604	7.6718
PKG20	6.1749	5.8919	7.4342	6.2439	7.4316	5.2167	9.3383	7.9799
PKG21	6.2413	6.0127	7.5731	6.2136	7.8062	5.0777	9.1813	8.0464
PKG22	6.3622	6.1517	7.6759	6.5218	7.5706	5.0536	9.3444	7.8047
PKG23	5.7157	5.4690	7.4100	6.1653	7.0268	4.7092	8.8791	7.2488
PKG24	5.9090	5.7167	7.0596	5.7484	7.3652	4.8904	8.7281	7.3213
PKG25	6.2957	6.1698	7.8027	6.7756	7.6854	5.2046	9.6284	8.6264
PKG26	6.2413	6.2061	7.7786	6.4735	7.7277	5.1502	9.6646	7.9316
PKG27	6.2897	5.9221	7.6336	6.2861	7.5887	4.8723	9.3565	7.6476
PKG28	5.9997	5.9100	7.5308	6.2620	7.3470	4.9388	9.1571	7.9678
PKG29	6.3199	6.2303	7.9236	6.7151	7.7760	5.2167	9.6404	8.2881
PKG30	6.1084	6.0550	7.4583	6.0747	7.4377	5.0536	9.2054	7.3334
PKG31	5.8003	5.4085	7.1019	5.8028	6.8999	4.8723	8.5529	7.2247
PKG32	6.1205	6.0007	7.3435	6.3345	7.3289	4.8300	8.9335	7.2247
PKG33	6.5072	6.1698	7.7000	6.5218	7.7639	5.4584	9.4411	8.2881
PKG34	6.5072	6.1698	7.7000	6.5218	7.7639	5.4584	9.4411	8.2881
PKG35	6.3320	6.0309	7.5550	6.0566	7.7156	5.3255	9.2175	7.6416
PKG36	6.5072	6.5384	8.0988	7.1683	8.0660	5.5430	9.6827	8.1008
PKG37	6.3682	6.1034	7.6698	6.2499	7.8727	5.2288	9.4350	8.3062
PKG38	6.6582	6.3088	7.8088	6.7272	8.1265	5.5974	9.4048	7.8772
PKG39	6.2232	5.9886	7.5792	6.5762	7.7398	5.5248	9.4471	8.2941
PKG40	6.1688	5.9705	7.7967	6.2680	7.5404	5.3073	9.2417	7.7201
PKG41	6.5616	6.4357	7.8934	6.7272	8.2352	5.9055	9.5982	8.7050
PKG42	6.3320	5.8859	7.7121	6.4795	7.7942	5.2227	9.4169	8.1853
PKG43	6.1447	5.9705	7.5308	6.2741	7.7096	5.0052	9.2477	8.2035
PKG44	6.1688	5.7227	7.3133	6.3768	7.4981	5.0838	8.8852	7.5207
PKG45	6.3622	6.1517	7.6698	6.7393	7.7639	5.0415	9.3625	7.8349
PKG46	6.6703	6.5505	7.9719	6.9810	8.1265	5.4765	9.6102	8.2216
PKG47	5.9997	5.9402	7.5006	6.1895	7.4618	5.2590	9.1631	7.9255
PKG48	5.9513	5.4992	7.6517	6.2378	7.0268	4.7636	9.1631	7.5811
PKG49	6.1628	5.7952	7.2831	6.0928	7.3652	4.8965	8.6435	7.0615
PKG50	6.6522	6.1396	7.8632	6.4916	8.2413	5.1623	9.8096	8.6022
Mean	6.2778	6.0549	7.6082	6.4047	7.7631	5.2041	9.3530	7.9872
SD	0.2952	0.3439	0.2861	0.3924	0.4448	0.3152	0.3985	0.5334
Max	7.0147	7.1486	8.3586	7.6033	9.2865	6.1955	10.6130	9.6173
Min	5.7036	5.4085	6.9810	5.5853	6.8999	4.6125	8.5529	7.0374
Diff	1.3111	1.7401	1.3776	2.0180	2.3866	1.5830	2.0601	2.5799

Table A-2: Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
Starting Ball #	AW38	AW19	AV1	W1	B39	AA39	A21	A2
Ending Ball #	AW29	AW11	AJ1	L1	L39	AJ39	A29	A11
Conductor. Length mm	398	271	478	316	364	266	427	372
Stack on core	no	no	no	no	no	no	no	no
Via/Pad size	large	large	large	large	small	small	small	small
Stacked vs Staggered	stacked	stacked	staggered	staggered	stacked	stacked	staggered	staggered
Fillet	yes	no	yes	no	yes	no	Yes	no
PKG01	7.5086	8.1108	8.8666	8.2564	8.9446	8.0876	9.9995	10.8230
PKG02	7.5268	8.0444	9.4467	8.5404	8.3948	7.8701	10.0600	11.0290
PKG03	8.6385	8.7634	9.1627	8.7216	9.3857	9.0181	10.4530	11.4460
PKG04	7.7987	8.1531	8.6672	8.1537	8.7513	8.2145	10.2230	10.9200
PKG05	7.4301	7.9538	8.9814	8.4437	8.6002	7.9185	10.2410	11.2820
PKG06	6.9165	7.4946	8.1778	7.7791	7.9537	7.6103	9.4376	10.1530
PKG07	7.5389	7.9356	8.6975	8.0993	8.4613	8.2085	9.7578	10.7690
PKG08	8.4452	8.9326	10.0210	9.3560	9.4763	8.7281	11.3530	12.3340
PKG09	7.5086	7.9900	8.8364	8.4014	8.3646	7.9668	9.7820	10.8110
PKG10	8.1189	8.4915	9.2352	8.8062	9.1501	8.5106	10.5490	11.6150
PKG11	8.0343	8.7271	8.5706	8.0630	9.0594	8.6435	9.9451	10.5390
PKG12	8.4633	8.9749	9.5071	8.9029	9.3736	8.6797	10.5430	11.5600
PKG13	7.1703	8.0383	8.6612	8.2926	8.4854	7.8701	9.7880	10.7930
PKG14	8.4452	8.9144	9.7004	9.1748	9.5911	8.6133	11.3470	12.4060
PKG15	7.4361	8.0565	8.6431	8.5041	8.5942	7.9305	10.1750	10.8900
PKG16	8.8621	9.2165	10.5280	9.5252	9.7543	9.1329	11.7090	12.9020
PKG17	7.9255	8.8117	9.0600	8.4558	8.9446	8.3233	10.2050	11.1430
PKG18	7.6234	8.2136	9.1083	8.7035	8.5519	8.1480	10.0180	11.0040
PKG19	7.5207	8.0927	8.6672	8.2383	8.6727	7.8822	9.9028	10.7270
PKG20	7.7382	8.2921	8.8848	8.3954	8.6788	8.0695	10.0240	10.9740
PKG21	7.5207	8.1834	8.6129	8.3531	8.6546	7.9970	9.8968	10.8170
PKG22	7.7262	8.2196	8.8062	8.5524	8.8359	8.1964	10.2290	10.8410
PKG23	6.9769	7.4825	8.5162	8.3108	8.1350	7.6828	9.8605	10.5450
PKG24	7.2670	7.8994	8.1960	8.0993	8.3465	7.8762	9.4195	10.2070
PKG25	7.9074	8.2679	8.9814	8.5404	8.9748	8.3595	10.3860	11.1620
PKG26	8.2156	8.2438	8.8123	8.4679	9.0836	8.5649	10.4710	11.1800
PKG27	7.4845	7.9356	8.5766	8.2987	8.7936	8.1360	10.2650	11.0290
PKG28	7.2549	7.7181	8.6370	8.1114	8.2377	7.4713	9.9874	10.8470
PKG29	7.9558	8.4432	9.0298	8.8968	8.9205	8.2870	10.9000	11.2760
PKG30	7.8530	8.2438	8.5222	8.2383	8.6425	7.9970	9.9934	10.6120
PKG31	6.9467	7.7483	8.1537	7.7912	7.8691	7.5499	9.1113	9.8565
PKG32	7.5328	8.2256	8.4860	7.9120	8.4371	7.8762	9.4738	10.1530
PKG33	7.8772	8.1954	9.1506	8.5706	8.6486	7.8157	10.2170	11.2040
PKG34	7.8772	8.1954	9.1506	8.5706	8.6486	7.8157	10.2170	11.2040
PKG35	7.8530	8.3344	8.7820	8.5947	8.7815	8.0393	9.9511	10.7020
PKG36	8.3243	8.5096	9.1929	8.5222	9.3796	8.5891	10.6400	11.2760
PKG37	7.6416	8.2559	9.0298	8.3591	8.6848	8.0453	10.4280	11.4640
PKG38	8.8198	9.0957	8.8666	8.3893	9.3736	8.8973	10.4830	11.0410
PKG39	7.6597	8.4129	9.0358	8.7820	8.6969	8.1360	10.0780	11.0650
PKG40	7.6295	8.0988	8.8123	8.6370	8.6727	8.0997	10.2710	10.9920
PKG41	7.9980	8.3586	9.4165	8.8908	8.9567	8.5710	10.7060	11.5910
PKG42	7.9860	8.2800	9.1989	8.4195	8.6969	8.3172	10.6040	11.4640
PKG43	7.6234	8.2559	8.9512	8.3108	8.6244	8.2447	10.2410	11.1490
PKG44	7.5389	8.1773	8.7398	7.9241	8.5036	8.2326	9.8726	10.6720
PKG45	8.0464	8.4311	8.7700	8.2624	8.9930	8.5589	10.6040	11.0530
PKG46	8.1189	8.4311	9.3802	8.8968	9.4461	8.6918	10.8940	11.7290
PKG47	7.2368	7.9356	8.8848	8.1537	8.2619	7.6284	10.4410	10.7510
PKG48	7.2488	8.0927	8.5947	8.1416	8.3888	7.8278	10.4650	10.8470
PKG49	7.3516	8.2861	8.2685	7.8153	8.4733	7.8762	10.0900	10.5570
PKG50	8.2095	8.8903	9.2715	8.7458	9.1621	8.6012	11.1290	11.9350
Mean	7.7666	8.2811	8.9250	8.4474	8.7703	8.1882	10.2568	11.0668
SD	0.4579	0.3791	0.4447	0.3724	0.4166	0.3876	0.5004	0.5608
Max	8.8621	9.2165	10.5280	9.5252	9.7543	9.1329	11.7090	12.9020
Min	6.9165	7.4825	8.1537	7.7791	7.8691	7.4713	9.1113	9.8565
Diff	1.9456	1.7340	2.3743	1.7461	1.8852	1.6616	2.5977	3.0455

Figure A-1: Average electrical resistance at the 0th cycle.

APPENDIX B

ANOVA of Electrical Resistance at the 0th Cycle

Anova: Single
Factor

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
DAISY01	49	307.3844	6.273151	0.087858
DAISY02	49	296.5759	6.052569	0.120441
DAISY03	49	372.7093	7.606312	0.083363
DAISY04	49	313.7133	6.402312	0.15691
DAISY05	49	380.3907	7.763076	0.201996
DAISY06	49	254.7486	5.198951	0.100047
DAISY07	49	458.2067	9.351157	0.161976
DAISY08	49	391.0703	7.981027	0.288474
DAISY09	49	380.4548	7.764384	0.213776
DAISY10	49	405.8602	8.282861	0.146558
DAISY11	49	437.0996	8.9204	0.200802
DAISY12	49	413.8014	8.444927	0.141219
DAISY13	49	429.864	8.772735	0.176885
DAISY14	49	401.5925	8.195765	0.15044
DAISY15	49	502.6212	10.25758	0.255598
DAISY16	49	542.1375	11.06403	0.320691

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1739.707	15	115.9805	661.0846	0	1.679419
Within Groups	134.7377	768	0.17544			
Total	1874.445	783				

APPENDIX C-1

Measured Electrical Resistances at the Measured Temperature Cycles

Table C-1-1: TCB238th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.1069	6.1724	7.4886	6.0566	8.0117	5.4282	9.1692	8.0222
PKG02	6.2519	6.0576	8.1653	6.7816	8.0117	5.7182	10.0510	8.7291
PKG03	6.6809	6.8853	8.0746	6.9931	8.6823	5.7544	10.1240	9.1037
PKG04	6.1371	6.1301	7.5429	6.6728	7.6552	5.8149	9.5921	7.7624
PKG05	6.2519	6.3234	7.8148	6.6305	7.9633	5.9236	9.6767	8.1128
PKG06	5.8592	5.6709	7.0837	5.6699	7.1839	5.4705	9.0785	7.4482
PKG07	6.1190	6.1663	7.3375	6.0626	7.6612	5.6517	9.1752	7.7926
PKG08	6.5963	6.5651	8.1955	7.1683	8.3198	5.4946	10.4140	9.4602
PKG09	6.0102	5.9609	7.5671	6.4432	7.5766	5.7967	9.6948	7.9678
PKG10	6.7534	6.7161	7.8329	6.7876	8.3500	5.9589	9.8338	8.7110
PKG11	6.3002	6.1180	7.5369	6.9810	7.8787	5.4584	9.3323	7.7987
PKG12	6.5419	6.5470	7.7967	7.2408	8.4225	5.8330	9.8882	8.5056
PKG13	5.9498	5.6709	7.4463	6.0143	7.3652	5.1079	9.3263	7.9618
PKG14	6.8742	7.1451	8.1834	7.3254	8.6944	5.6940	10.2270	9.3877
PKG15	6.0767	5.9669	7.3677	6.0082	7.5102	5.1079	9.3021	8.1491
PKG16	7.1824	7.2962	8.4372	7.6456	9.2140	6.3043	10.7700	10.0100
PKG17	6.3365	6.3415	7.7604	6.5339	8.0177	5.5248	9.5861	8.3424
PKG18	6.2459	6.1482	7.5611	6.4614	7.8123	5.2046	9.3988	8.3424
PKG19	6.0223	5.8703	7.4100	6.2257	7.4800	4.9811	9.1087	7.8772
PKG20	6.1250	6.0032	7.5308	6.5399	7.4921	5.0415	9.4229	8.2458
PKG21	6.2398	6.1784	7.5248	6.2982	7.7035	5.2167	9.2235	7.6839
PKG22	6.2036	6.0394	7.8390	6.4976	7.5706	5.0777	9.4169	8.2578
PKG23	5.8229	5.6225	7.5188	5.9901	6.9845	4.7333	8.9637	7.8409
PKG24	5.9861	5.7978	7.1683	5.5369	7.3168	4.9509	8.6375	7.4663
PKG25	6.3184	6.2509	8.2015	6.7151	7.6491	5.3134	9.5740	8.4029
PKG26	6.3425	6.3536	7.6879	6.4493	7.6431	5.1563	9.4954	8.1128
PKG27	6.2096	5.9669	7.6275	6.3405	7.5162	4.9750	9.1208	7.7564
PKG28	5.9136	5.9790	7.4644	6.2076	7.3229	5.0657	9.0906	7.8953
PKG29	6.3969	6.1784	7.8269	6.7212	7.7639	5.3255	9.5800	8.3485
PKG30	6.0102	5.8582	7.4825	6.0988	7.4135	5.3678	9.0785	7.5086
PKG31	5.6235	5.4715	7.0052	5.5551	6.9543	4.7092	8.5287	7.2549
PKG32	6.0223	6.0032	7.2106	5.8572	7.4256	4.8421	8.8973	7.1824
PKG33	6.3667	6.1784	7.6698	6.3224	7.7760	5.2530	9.4108	8.5902
PKG34	5.9619	5.8098	7.6215	6.1109	7.1779	4.7817	9.0967	7.6718
PKG35	6.2761	6.0576	7.4704	5.9720	7.6552	5.1321	9.1510	7.8832
PKG36	6.4271	6.6739	8.1834	6.8843	7.9815	5.5007	9.6707	8.4693
PKG37	6.3063	6.1240	7.7121	6.2136	7.7821	5.2771	9.2054	8.3545
PKG38	6.4694	6.3959	7.8148	6.4312	8.0721	5.2650	9.3021	8.1249
PKG39	6.1975	5.9851	7.5067	6.2076	7.6733	5.1321	9.3806	8.4089
PKG40	6.1311	5.9851	7.7363	6.2318	7.4135	4.9267	9.1873	7.6657
PKG41	6.4150	6.4745	7.9598	6.6910	8.0358	5.6336	9.5559	8.7050
PKG42	6.1915	6.0032	7.7242	6.2861	7.6431	5.2167	9.3504	8.4149
PKG43	6.1311	6.0032	7.4463	6.1170	7.5646	5.1382	9.2054	8.1128
PKG44	6.0465	5.8582	7.2590	5.9478	7.4014	4.9811	8.9214	7.7080
PKG45	6.2821	6.2328	7.7242	6.6003	7.6129	5.1200	9.3988	8.0645
PKG46	6.5359	6.4866	7.9719	6.7695	7.9754	5.4040	9.5559	8.2216
PKG47	5.9136	5.9186	7.3254	6.1109	7.3168	5.1986	9.1631	7.9437
PKG48	5.8290	5.6890	7.5308	6.0686	6.9362	4.6910	9.1087	7.6476
PKG49	6.0344	5.9065	7.1804	5.8934	7.3229	4.9629	8.6979	7.2549
PKG50	6.5842	6.2086	7.9236	6.4674	8.1446	5.2348	9.7311	8.6022
Mean	6.2322	6.1489	7.6490	6.3967	7.7210	5.2971	9.3974	8.1457
SD	0.2881	0.3641	0.3170	0.4485	0.4523	0.3569	0.4299	0.5647
Max	7.1824	7.2962	8.4372	7.6456	9.2140	6.3043	10.7700	10.0100
Min	5.6235	5.4715	7.0052	5.5369	6.9362	4.6910	8.5287	7.1824
Diff	1.5589	1.8247	1.4320	2.1087	2.2778	1.6133	2.2413	2.8276

Table C-1-2: TCB 238th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.8107	8.2498	8.9754	8.2806	8.5217	8.0514	10.3200	10.8840
PKG02	7.8168	8.6123	9.7790	8.4256	8.4371	8.1843	10.5980	11.5780
PKG03	9.0010	9.1803	9.7125	8.4497	9.4944	8.7160	10.5980	11.6450
PKG04	7.9618	8.7573	9.2050	8.1476	8.7634	8.4199	10.1570	10.8230
PKG05	7.5630	8.5519	9.2171	8.5464	8.6063	7.8157	10.8330	11.4150
PKG06	6.9769	8.0202	8.3410	7.7549	8.0383	7.4834	9.4497	10.2010
PKG07	7.5811	8.3465	8.7639	8.0328	8.6304	7.8520	10.5130	10.8290
PKG08	8.6445	9.3193	10.0870	9.1687	9.5126	8.6979	11.4980	12.6120
PKG09	7.5509	8.0927	8.9875	8.4860	8.3102	7.7070	10.0780	10.8780
PKG10	8.1551	8.7694	9.3258	8.8546	9.1863	8.5589	10.9060	11.5480
PKG11	8.0947	8.6546	8.6491	8.1960	9.1138	8.7341	10.3740	10.6660
PKG12	8.4331	8.9265	9.5796	8.7820	9.3132	8.7160	10.5800	11.5660
PKG13	7.2186	8.0625	8.7639	8.1174	8.3525	7.8157	10.1140	10.7870
PKG14	8.4452	8.7634	9.6581	9.0660	9.6153	8.7583	11.2260	12.5090
PKG15	7.4543	7.9356	8.8485	8.3349	8.4190	7.7976	9.9995	11.0230
PKG16	8.9769	9.3193	10.9030	9.4346	9.8328	8.9758	12.1260	13.0100
PKG17	8.1551	8.7996	9.3017	8.4316	8.9869	8.4985	10.5490	11.1370
PKG18	7.6537	8.4009	9.3379	8.4497	8.6788	8.2326	10.3800	11.1010
PKG19	7.5207	8.0202	9.1325	8.1356	8.4431	7.7734	9.9934	10.8050
PKG20	7.8410	8.6788	8.9512	8.2564	8.5821	8.0816	10.0780	10.9320
PKG21	7.5751	8.4432	8.6733	8.1174	8.5821	7.8701	10.1140	10.7020
PKG22	7.9195	8.4794	8.9573	8.3591	8.8419	8.1843	10.4470	10.8110
PKG23	7.0978	7.9779	8.5827	8.0812	8.0806	7.6647	10.0300	10.4370
PKG24	7.6778	7.8692	8.4558	7.8153	8.2860	7.8943	9.5645	10.1040
PKG25	8.1370	8.4129	9.1567	8.5645	8.8359	8.3958	10.5190	11.0470
PKG26	8.0283	8.4250	8.8787	8.3833	8.9990	8.4199	10.5610	11.0100
PKG27	7.5993	8.4552	8.6431	8.3349	8.6365	8.0876	10.2530	10.8900
PKG28	7.1522	7.8994	8.6491	8.1356	8.1773	7.7855	9.9874	10.7750
PKG29	7.9376	8.2800	9.3198	8.5283	8.8902	8.4320	10.5610	11.3490
PKG30	7.6234	8.6244	8.6793	8.1537	8.7211	8.2024	10.2230	10.6000
PKG31	6.8984	7.7242	8.7216	7.6099	7.7181	7.3807	9.1717	9.7961
PKG32	7.6174	8.1531	8.4920	7.8214	8.4733	7.9305	9.5826	10.1340
PKG33	7.7262	8.5519	9.2594	8.4981	8.6123	7.9064	10.2470	11.1560
PKG34	7.3576	7.8510	8.6733	8.0812	8.4190	7.7191	10.1930	10.7750
PKG35	7.6959	8.4190	8.8183	8.0449	8.7090	8.4018	10.0360	10.6120
PKG36	8.2820	8.8540	9.2171	8.4377	9.2286	8.5287	10.6880	11.1370
PKG37	7.4784	8.4250	9.1264	8.2866	8.9688	7.9789	10.2650	11.1740
PKG38	8.3727	8.9386	8.9271	8.2866	9.5005	8.7523	10.3620	10.9020
PKG39	7.7020	8.5580	9.0902	8.2745	8.9023	8.1058	10.2470	10.9740
PKG40	7.7503	8.3465	8.7881	8.2081	8.8177	8.0091	10.3440	10.8650
PKG41	7.9618	8.5398	9.4588	8.6914	8.9748	8.2447	10.9420	11.3850
PKG42	7.6778	8.2498	9.1989	8.4316	8.6304	8.0755	10.2960	11.1310
PKG43	7.5026	8.3284	8.9754	8.3047	8.5036	7.8580	10.1570	10.8780
PKG44	7.5630	8.5096	8.6552	7.9966	8.5217	7.8520	9.8061	10.5820
PKG45	8.1068	8.5036	8.8062	8.2685	8.9205	8.4381	10.4100	10.8410
PKG46	8.4572	8.8480	9.3017	8.6672	9.3615	8.6072	10.7120	11.5660
PKG47	7.3032	7.8571	8.8666	8.2685	8.2619	7.7251	9.8061	10.6780
PKG48	7.3455	7.8752	8.5766	8.0872	8.3163	7.7070	10.4650	10.8290
PKG49	7.4966	8.1411	8.5827	7.7066	8.4311	7.7614	9.7155	10.4790
PKG50	8.2156	9.1259	9.3319	8.6250	9.1440	8.6918	10.6820	11.5600
Mean	7.8023	8.4426	9.0477	8.3284	8.7461	8.1496	10.3352	11.0226
SD	0.4637	0.3933	0.4608	0.3515	0.4419	0.3906	0.5003	0.5873
Max	9.0010	9.3193	10.9030	9.4346	9.8328	8.9758	12.1260	13.0100
Min	6.8984	7.7242	8.3410	7.6099	7.7181	7.3807	9.1717	9.7961
Diff	2.1026	1.5951	2.5620	1.8247	2.1147	1.5951	2.9543	3.2139

Table C-1-3: TCB 457th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.2036	6.0213	7.4946	6.1109	7.7458	5.3557	9.2538	7.7503
PKG02	6.3365	6.4140	7.8994	7.3677	7.9633	5.4161	9.7915	8.5237
PKG03	6.7292	7.0726	8.1411	7.3677	8.4467	5.7847	9.9667	8.7231
PKG04	6.1069	6.1603	7.5369	6.7635	7.5766	5.2348	9.4652	7.9437
PKG05	6.3486	6.4866	7.7423	6.8360	7.8848	5.4584	9.5438	8.6989
PKG06	5.8410	5.7434	7.2046	6.0988	7.2262	5.1382	8.9879	7.5086
PKG07	6.1311	6.4443	7.4100	6.4312	7.7337	5.3678	9.1510	7.6476
PKG08	6.6144	6.5349	8.3103	7.3133	8.3379	5.7967	10.4620	9.1521
PKG09	6.1009	6.2751	7.5611	6.5943	7.6431	5.8934	9.5256	8.1793
PKG10	6.7413	6.6195	7.9236	6.8481	8.4406	5.6699	9.8640	8.2941
PKG11	6.3486	6.2449	7.5550	6.4432	7.8244	5.2288	9.3202	7.4180
PKG12	6.6628	6.7766	7.8813	6.9145	8.4890	5.9236	9.9063	8.7050
PKG13	6.0102	5.9790	7.3315	6.2016	7.3289	5.1925	9.2598	7.7624
PKG14	7.0072	7.2358	8.3405	7.4402	8.7730	5.9297	10.2390	8.9406
PKG15	6.1734	5.8823	7.5127	6.1895	7.7639	5.0959	9.2900	7.6416
PKG16	7.2730	7.3445	8.4855	7.9417	9.2201	6.3043	10.8370	9.8590
PKG17	6.4996	6.5409	7.6698	6.6245	8.1869	5.6457	9.7371	8.3485
PKG18	6.2761	6.0999	7.8088	6.4130	7.9573	5.3134	9.4652	8.0826
PKG19	6.0283	5.9186	7.5852	6.0626	7.4437	5.0717	9.2598	7.7926
PKG20	6.1250	5.9730	7.5490	6.2499	7.5827	5.1382	9.4773	8.1672
PKG21	6.2338	6.1542	7.5852	6.3103	7.7639	5.2590	9.2538	7.6597
PKG22	6.2338	6.0515	7.7121	6.5762	7.6250	5.1200	9.5015	7.8591
PKG23	5.7202	5.6286	7.4644	6.2439	6.9845	4.8481	9.1571	7.3697
PKG24	5.8954	5.8582	7.1019	5.6880	7.3470	5.0173	8.6979	7.0797
PKG25	6.2821	6.2509	7.9477	7.0535	7.7398	5.2650	9.7552	8.1128
PKG26	6.2942	6.3899	7.7604	6.7272	7.6431	5.2288	9.6223	7.8349
PKG27	6.3244	6.0334	7.6577	6.3768	7.5162	4.9750	9.3263	7.9678
PKG28	5.9981	6.0032	7.5188	6.2861	7.2866	5.1925	9.2054	7.7201
PKG29	6.4332	6.2207	7.9417	6.7937	7.7700	5.3255	9.7794	8.3666
PKG30	6.1431	5.9669	7.4946	6.1170	7.4800	5.1200	9.1933	7.4784
PKG31	5.7202	5.4473	6.9629	5.5430	6.9120	4.8844	8.7885	7.2065
PKG32	6.0646	5.9851	7.3435	5.8330	7.3712	4.9569	9.0181	7.3213
PKG33	6.3788	6.3476	7.7000	6.5278	7.7156	5.3859	9.5256	8.3183
PKG34	6.0042	5.8642	7.5671	6.1895	7.0933	4.8300	9.2840	7.4059
PKG35	6.3184	6.0999	7.3919	6.0203	7.7519	5.2227	9.3625	7.7322
PKG36	6.5419	6.7464	8.1532	6.9870	7.9754	5.5248	9.7915	8.2941
PKG37	6.4150	6.2026	7.6275	6.2499	7.8123	5.3496	9.4169	7.9497
PKG38	6.6023	6.3899	7.6879	6.4976	8.1023	5.2771	9.4652	7.6416
PKG39	6.2821	6.0455	7.6336	6.3768	7.7277	5.1744	9.5075	7.9980
PKG40	6.1552	6.0636	7.6940	6.3828	7.5102	4.9629	9.3988	7.7382
PKG41	6.4755	6.6618	7.8752	7.0172	8.1144	5.5913	10.0450	8.4814
PKG42	6.2640	6.1301	7.7000	6.4432	7.7881	5.2650	9.8640	8.0524
PKG43	6.1734	6.0092	7.6154	6.2922	7.5887	5.1684	9.8338	7.9376
PKG44	6.0344	5.9851	7.3133	6.1472	7.4618	5.1261	8.9758	7.4301
PKG45	6.3727	6.2992	7.7484	6.5943	7.6612	5.2288	9.5740	7.6959
PKG46	6.5661	6.6316	8.0807	6.8420	8.0600	5.4826	9.6404	8.2216
PKG47	6.0706	6.0032	7.4281	6.2439	7.3652	5.3315	9.2235	7.8168
PKG48	5.9075	5.7253	7.6034	6.2136	6.9724	4.8300	9.2296	7.4663
PKG49	6.0767	5.9549	7.1985	5.8270	7.4256	4.9690	8.7825	6.9649
PKG50	6.6023	6.2630	7.8571	6.5762	8.3138	5.2409	9.8640	8.3424
Mean	6.2828	6.2236	7.6662	6.5038	7.7490	5.3023	9.4977	7.9721
SD	0.3022	0.3825	0.3077	0.4738	0.4548	0.3126	0.4114	0.5478
Max	7.2730	7.3445	8.4855	7.9417	9.2201	6.3043	10.8370	9.8590
Min	5.7202	5.4473	6.9629	5.5430	6.9120	4.8300	8.6979	6.9649
Diff	1.5528	1.8972	1.5226	2.3987	2.3081	1.4743	2.1391	2.8941

Table C-1-4: TCB 457th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6416	8.2740	8.9814	8.3833	8.6727	8.0453	10.5980	10.9680
PKG02	7.8107	8.8782	9.4225	8.5102	8.7029	8.0635	10.5730	11.2820
PKG03	8.8318	9.2951	9.4648	8.5343	9.6032	8.9093	10.8700	11.6330
PKG04	8.1068	8.9809	8.8485	8.3229	8.9567	8.3233	10.2830	10.8410
PKG05	7.7685	8.8117	9.1687	8.5827	8.6848	8.0030	10.5310	11.5300
PKG06	7.2186	8.1954	8.3531	7.7549	8.0867	7.5922	9.4980	10.2730
PKG07	7.7262	8.0806	8.6431	8.1416	8.7150	7.9245	9.8605	10.7690
PKG08	8.8077	9.0594	10.0450	9.2292	9.5005	8.8731	11.4070	12.4180
PKG09	7.6355	8.1531	8.9693	8.3591	8.3888	7.7976	10.0420	10.8410
PKG10	8.4633	8.9326	9.3621	8.7579	9.2890	8.4502	10.7430	11.7050
PKG11	8.3062	8.7090	8.8123	8.1658	9.0896	8.5649	10.3320	10.7200
PKG12	8.5418	9.1924	9.9421	8.8485	9.2951	8.7281	10.6880	11.7600
PKG13	7.4845	8.4673	9.0600	8.4195	8.2860	7.8218	10.2110	10.8720
PKG14	8.4693	9.2045	10.0630	9.1023	9.5730	8.7281	11.4250	12.7080
PKG15	7.4120	8.4009	8.6491	8.2322	8.5398	7.8701	10.2470	11.0100
PKG16	8.8439	9.5307	10.5890	9.5917	9.8993	8.9214	11.6610	13.0350
PKG17	8.2035	8.8057	9.5615	8.4497	8.9507	8.4562	10.5010	11.3070
PKG18	7.7201	8.5036	9.3319	8.4497	8.6727	8.2206	10.4890	11.2520
PKG19	7.4905	8.3163	8.8364	8.3410	8.4915	7.9849	10.1200	11.0530
PKG20	7.8289	9.0957	9.0721	8.2503	8.5519	8.2266	10.2350	10.9680
PKG21	7.6416	8.5338	8.6854	8.0812	8.5036	7.9789	10.0780	10.8960
PKG22	7.8712	8.6123	8.7941	8.2503	8.6788	8.4260	10.9360	10.9560
PKG23	7.2609	8.0383	8.5222	7.9422	8.1531	7.7372	10.0600	10.5690
PKG24	7.3516	8.3525	8.3712	7.7972	8.2740	7.9728	9.7095	10.2250
PKG25	8.0524	8.4975	9.0600	8.3108	8.9809	8.4018	10.7250	11.2460
PKG26	8.0826	8.5580	8.9512	8.3531	8.9990	8.3958	10.7670	11.1070
PKG27	7.5932	8.4975	8.7277	8.1839	8.7211	8.1722	10.3380	11.0830
PKG28	7.3334	8.1834	8.7156	7.9845	8.1410	7.7191	10.1320	10.8720
PKG29	8.0464	8.8540	9.1989	8.5464	8.9325	8.3897	10.9180	11.6270
PKG30	7.7685	8.4855	8.6552	7.9603	8.6727	8.1964	10.2710	10.7870
PKG31	7.0555	7.8269	8.2081	7.5193	7.7664	7.4351	9.5040	10.1340
PKG32	7.9376	8.3042	8.4920	7.8032	8.4613	8.0091	9.7095	10.4430
PKG33	8.0283	8.4734	9.2715	8.5041	8.5217	8.0937	10.4710	11.4940
PKG34	7.6234	8.0867	8.8243	8.0933	8.3646	7.8459	10.4220	10.9080
PKG35	7.7805	8.9567	9.0962	8.1295	8.6848	8.1118	10.0780	10.7330
PKG36	8.4572	9.1984	9.3862	8.4377	9.2951	8.6797	10.7310	11.4210
PKG37	7.7382	8.6063	9.1325	8.2926	8.6727	8.0937	10.5310	11.5420
PKG38	8.5418	8.9809	9.1506	8.2987	9.3615	8.9214	10.6160	11.2280
PKG39	7.8833	8.8238	9.1204	8.3108	8.6788	8.1480	10.4040	11.3430
PKG40	7.7322	8.5761	9.2533	8.1778	8.6606	8.1964	10.4160	11.1800
PKG41	8.0706	8.7453	9.6763	8.6310	8.9627	8.2931	10.7250	11.8560
PKG42	7.9376	8.2861	9.5313	8.3772	8.6304	8.1541	10.3920	11.2940
PKG43	7.6476	8.4915	9.4527	8.2564	8.4854	7.9910	10.4280	11.0950
PKG44	7.6174	8.3767	8.7277	8.0147	8.5277	7.9064	9.9693	10.6300
PKG45	8.1128	8.8419	8.7820	8.1658	8.9084	8.4260	10.4830	10.8840
PKG46	8.1068	8.9990	9.4104	8.6008	9.3313	8.5710	10.8940	11.6150
PKG47	7.6234	8.4673	8.9693	8.1114	8.1894	7.6707	10.0420	10.7020
PKG48	7.6597	8.3102	8.6491	8.1416	8.3163	7.7493	10.5550	10.7630
PKG49	7.8228	8.2317	8.3229	7.7247	8.4129	7.8218	9.9028	10.3520
PKG50	8.3304	9.1138	9.2956	8.5887	9.1198	8.4622	10.7250	11.6450
Mean	7.9004	8.6239	9.0722	8.3203	8.7472	8.1895	10.4250	11.1515
SD	0.4209	0.3783	0.4818	0.3718	0.4391	0.3659	0.4463	0.5781
Max	8.8439	9.5307	10.5890	9.5917	9.8993	8.9214	11.6610	13.0350
Min	7.0555	7.8269	8.2081	7.5193	7.7664	7.4351	9.4980	10.1340
Diff	1.7884	1.7038	2.3809	2.0724	2.1329	1.4863	2.1630	2.9010

Table C-1-5: TCB 643rd cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.0223	5.9126	7.3919	6.2076	7.6612	5.2046	9.0846	7.5751
PKG02	6.2579	6.2147	7.5973	6.6608	7.7035	5.2530	9.6404	8.1551
PKG03	6.8380	6.8612	7.8571	7.0233	8.2654	5.6638	9.9003	8.3485
PKG04	6.0404	6.0697	7.4463	6.3828	7.3410	5.0294	9.2598	7.5268
PKG05	6.1734	6.2449	7.6275	6.4493	7.7096	5.3798	9.4169	7.9437
PKG06	5.7504	5.5863	6.9931	5.7061	7.0933	4.8361	8.7341	7.0494
PKG07	6.3002	6.2267	7.2771	6.0747	7.8062	5.2590	8.9637	7.4180
PKG08	6.8138	6.4866	8.1653	7.0595	8.2413	5.5128	10.2990	9.0312
PKG09	6.1129	6.0515	7.4402	6.3043	7.7337	5.5309	9.3202	7.8832
PKG10	6.7051	6.5168	7.7967	6.6305	8.4406	5.6034	9.6102	8.1974
PKG11	6.4392	6.2509	7.5188	6.2861	7.8244	5.1079	9.0604	7.3938
PKG12	6.6930	6.5832	7.7665	6.7756	8.4104	5.6155	9.6465	8.4452
PKG13	6.1311	5.8098	7.2831	5.9418	7.3893	5.0717	9.1510	7.6536
PKG14	6.9709	7.0001	8.2317	7.2952	8.9240	5.8390	10.0940	8.9406
PKG15	6.1734	5.8642	7.3798	5.9478	7.7337	5.0113	9.0967	7.4966
PKG16	7.2488	7.2056	8.4492	7.5852	9.2019	6.3405	10.6740	9.5508
PKG17	6.5721	6.3778	7.6275	6.5339	8.3621	5.5248	9.6284	8.1733
PKG18	6.2700	6.0153	7.5369	6.3405	7.8908	5.2832	9.3625	8.0524
PKG19	5.9861	5.9911	7.3919	6.0263	7.6250	5.0657	9.1510	7.5570
PKG20	6.2157	6.0334	7.4402	6.3466	7.6310	5.2530	9.3746	7.8953
PKG21	6.2821	6.0515	7.4221	6.1714	7.8787	5.1925	9.2658	7.4663
PKG22	6.3063	5.9730	7.6517	6.4432	7.7035	5.1079	9.4169	7.7201
PKG23	5.8592	5.5138	7.3375	6.0384	7.1477	4.8361	9.0785	7.3455
PKG24	6.0102	5.7253	6.9750	5.6397	7.3954	4.9690	8.6918	7.0434
PKG25	6.3727	6.2811	7.8450	6.7756	7.7035	5.2832	9.6767	8.0524
PKG26	6.4030	6.2630	7.7242	6.5157	7.5827	5.2046	9.5800	7.8591
PKG27	6.3002	5.9911	7.5973	6.4251	7.5404	4.9327	9.2054	7.6536
PKG28	6.0827	6.0032	7.4342	6.2439	7.2383	4.9448	9.1510	7.6476
PKG29	6.4634	6.2690	7.8632	6.7937	7.8123	5.2046	9.7613	8.1128
PKG30	6.3425	6.0032	7.3858	6.1411	7.4739	5.0234	9.1148	7.3515
PKG31	5.8290	5.4775	6.9992	5.5671	6.9483	4.8965	8.6918	6.9588
PKG32	6.1734	5.9669	7.1804	5.9115	7.3591	4.9931	8.9517	7.2186
PKG33	6.3546	6.4624	7.6275	6.3768	7.7519	5.5188	9.4954	8.2760
PKG34	6.0223	5.7736	7.4523	6.1351	7.2081	4.8663	9.1873	7.3757
PKG35	6.4271	6.0697	7.3979	5.9659	7.6673	5.3919	9.2598	7.6416
PKG36	6.6869	6.7403	8.0203	6.9629	8.0902	5.4584	9.7552	8.1612
PKG37	6.4030	6.0636	7.5429	6.1834	7.7942	5.3255	9.3323	7.8530
PKG38	6.5842	6.2751	7.6879	6.4009	8.3319	5.2107	9.4290	7.6536
PKG39	6.5480	5.9428	7.5369	6.3405	7.7760	5.2832	9.4411	8.1189
PKG40	6.1552	5.9488	7.6336	6.4493	7.6129	5.1200	9.3444	7.6174
PKG41	6.5782	6.5228	7.8813	6.8058	8.3681	5.9840	9.7613	8.4331
PKG42	6.2157	5.9730	7.6396	6.3647	7.7579	5.1805	9.5015	8.0947
PKG43	6.3486	5.9126	7.5308	6.2076	7.5464	5.1744	9.3504	7.7926
PKG44	6.1371	5.8219	7.2106	5.8209	7.4921	5.1382	8.9819	7.3757
PKG45	6.3848	6.1905	7.6456	6.4795	7.9029	5.1321	9.5256	7.7080
PKG46	6.8199	6.5349	7.9780	6.8058	8.1990	5.4282	9.7129	8.2095
PKG47	6.1311	5.9669	7.3194	6.0445	7.4256	5.1684	9.2538	7.7624
PKG48	5.9196	5.7978	7.5671	6.0988	7.0510	4.8179	9.2115	7.4543
PKG49	6.1734	5.9730	7.1381	5.7605	7.5646	4.9629	8.9698	6.9467
PKG50	6.6205	6.2992	7.8450	6.4493	8.3077	5.3073	9.8157	8.4149
Mean	6.3330	6.1418	7.5658	6.3579	7.7724	5.2489	9.3877	7.8321
SD	0.3071	0.3534	0.3047	0.4164	0.4563	0.3024	0.3851	0.5227
Max	7.2488	7.2056	8.4492	7.5852	9.2019	6.3405	10.6740	9.5508
Min	5.7504	5.4775	6.9750	5.5671	6.9483	4.8179	8.6918	6.9467
Diff	1.4984	1.7281	1.4742	2.0181	2.2536	1.5226	1.9822	2.6041

Table C-1-6: TCB 643rd cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.5086	8.1229	8.8485	8.5404	8.4733	7.9487	10.4220	11.1130
PKG02	7.6053	8.2136	9.0962	8.5162	8.3223	7.8822	10.5610	11.1130
PKG03	8.9164	8.8057	9.2231	8.6008	9.3917	8.8248	10.5310	11.4520
PKG04	8.1914	8.2438	8.6370	8.0328	8.7573	8.1480	10.2650	10.7020
PKG05	7.8530	8.0867	9.0600	8.3712	8.6244	7.8157	10.3020	11.3670
PKG06	7.2851	7.7362	8.2020	7.8757	7.9416	7.3868	9.3953	10.2130
PKG07	7.9195	8.0686	8.6431	8.0026	8.5579	7.9124	9.8484	10.6780
PKG08	9.1339	9.1803	10.0690	9.0962	9.6032	8.7402	11.3410	12.3760
PKG09	7.6899	7.9900	8.9150	8.0570	8.3223	7.7312	9.7820	10.7450
PKG10	8.1249	8.4673	9.3379	8.6491	9.1863	8.3595	10.6100	11.4700
PKG11	8.1249	8.5277	8.5947	8.1597	9.0775	8.5589	10.2110	10.4730
PKG12	8.4512	8.8721	9.5554	8.6672	9.2407	8.6193	10.8700	11.5420
PKG13	7.1884	7.9900	8.1839	8.0691	8.2679	7.7855	9.9693	10.6900
PKG14	8.4029	8.7211	9.0298	9.2171	9.5730	8.6314	11.3110	12.4550
PKG15	7.4361	7.9417	8.6914	8.1416	8.5036	7.8943	10.1690	10.8720
PKG16	8.8862	8.9567	10.5580	9.4406	9.7543	8.8489	11.7580	12.9020
PKG17	8.0887	8.5277	9.4285	8.2685	8.9869	8.2447	10.2230	11.1800
PKG18	7.6778	8.2256	9.4044	8.3047	8.6486	8.0091	10.1570	11.0650
PKG19	7.5147	8.0686	9.0660	8.1114	8.3888	7.8701	9.8968	10.7870
PKG20	7.6537	8.2498	9.3923	8.1174	8.5217	8.1360	10.3680	10.8840
PKG21	7.4845	8.1350	8.6370	8.0328	8.4915	8.0453	9.9693	10.7140
PKG22	7.7624	8.1652	8.7579	8.1537	8.6788	8.2085	10.5010	10.8720
PKG23	7.0736	7.6758	8.4316	7.9543	8.0323	7.6768	9.8726	10.5330
PKG24	7.2549	7.8933	8.2806	7.7005	8.2860	7.7674	9.4557	10.2070
PKG25	7.8530	8.4432	9.0419	8.3168	8.9325	8.3172	10.3920	11.2880
PKG26	7.9920	8.3404	8.2262	8.2503	9.0655	8.2931	10.5980	11.1190
PKG27	7.4543	8.0565	8.6552	8.1537	8.7754	8.1178	10.2230	11.1070
PKG28	7.0495	7.8450	8.5283	7.9301	8.1592	7.5680	10.0240	10.7870
PKG29	7.8107	8.1954	8.4981	8.4316	8.9325	8.3233	10.5490	11.3430
PKG30	7.7443	8.2317	8.5464	7.9543	8.6848	8.1360	10.1380	10.5690
PKG31	6.9588	7.5973	8.1778	7.4951	7.7846	7.3928	9.1959	9.8988
PKG32	7.7805	7.9719	8.3349	7.7066	8.3827	7.9245	9.6309	10.1830
PKG33	7.8893	8.2679	9.1929	8.4014	8.4915	7.8943	10.4160	11.3130
PKG34	7.6295	8.0625	8.6068	8.0328	8.3585	7.7916	10.1320	10.9080
PKG35	7.7020	8.4190	8.7398	8.0812	8.6788	8.0514	9.9270	10.6540
PKG36	8.5902	8.6305	8.0510	8.3531	9.2588	8.6616	10.5370	11.2880
PKG37	7.5328	8.1713	9.0237	8.3047	8.6546	7.9789	10.3200	11.2400
PKG38	8.5237	8.8540	8.8243	8.2081	9.3917	8.8610	10.3620	10.9080
PKG39	7.8228	8.4673	9.0298	8.2503	8.6002	8.2145	10.2290	11.0170
PKG40	7.6114	8.4311	7.7005	8.2322	8.5761	8.1239	10.1870	10.9440
PKG41	7.9799	8.4432	9.5856	8.7216	8.9446	8.2870	10.7180	11.6330
PKG42	7.6597	8.3404	9.1385	8.3531	8.5519	8.0393	10.1810	11.1430
PKG43	7.5872	8.4190	8.9814	8.3047	8.3706	7.9124	10.2770	11.0350
PKG44	7.5389	8.3827	8.6975	8.0026	8.3706	7.8701	9.6853	10.5820
PKG45	8.0826	8.8419	8.8062	8.1839	8.8600	8.3354	10.2710	10.8410
PKG46	8.1310	8.6184	9.3198	8.6068	9.2649	8.5770	10.7000	11.5840
PKG47	7.2609	8.2256	8.8364	7.9905	8.1471	7.5922	9.7155	10.6960
PKG48	7.2186	8.0565	8.6491	8.0933	8.2619	7.7312	10.2110	10.8960
PKG49	7.4422	8.0081	8.3893	7.6764	8.3827	7.8037	9.6007	10.3400
PKG50	8.0343	8.8298	9.2715	8.5827	9.1380	8.4079	10.6040	11.6390
Mean	7.8022	8.3003	8.8579	8.2540	8.6930	8.1050	10.2523	11.0272
SD	0.4804	0.3459	0.5156	0.3696	0.4465	0.3694	0.4779	0.5607
Max	9.1339	9.1803	10.5580	9.4406	9.7543	8.8610	11.7580	12.9020
Min	6.9588	7.5973	7.7005	7.4951	7.7846	7.3868	9.1959	9.8988
Diff	2.1751	1.5830	2.8575	1.9455	1.9697	1.4742	2.5621	3.0032

Table C-1-7: TCB 875th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.1069	6.0999	7.4644	6.0566	7.9392	5.3073	9.1933	7.7503
PKG02	6.2942	6.1724	7.7000	6.5580	7.9392	5.6578	9.7492	8.4935
PKG03	4.2218	6.8853	7.9417	6.9629	8.4165	5.8511	10.0090	8.6325
PKG04	6.0465	6.2570	7.4704	6.3284	7.7700	5.4282	9.4471	7.9135
PKG05	6.2459	6.1784	7.6275	6.3889	7.9271	5.5611	9.5679	8.1672
PKG06	5.8713	5.7555	7.0837	5.6638	7.2866	5.1079	8.8550	7.1582
PKG07	6.1311	6.1724	7.5127	6.0505	7.7579	5.5490	9.0544	7.6174
PKG08	6.6265	6.5470	8.2015	7.2952	8.4104	5.6940	10.4320	9.1944
PKG09	6.0888	6.0455	7.5188	6.3768	7.7579	5.4403	9.4350	8.1189
PKG10	6.5963	6.6316	7.8692	6.5580	8.3681	5.5430	9.7432	8.4029
PKG11	6.4452	6.1542	7.5006	6.4251	7.9331	5.1684	9.2779	7.5630
PKG12	6.6265	6.5591	7.8269	6.7997	8.5373	6.0445	9.8761	8.5116
PKG13	6.1371	5.7736	7.3617	5.9901	7.5525	5.4221	9.1631	7.7322
PKG14	6.9769	7.0364	8.2076	7.3495	8.7427	5.8934	10.2200	9.1702
PKG15	6.1311	5.9609	7.4523	6.0203	7.4618	5.0777	9.1571	7.8228
PKG16	7.1643	7.3143	8.4915	7.7242	9.4255	6.3949	10.7460	9.8650
PKG17	6.4694	6.3718	7.6638	6.5520	8.1385	5.8451	9.6586	8.3183
PKG18	6.2882	6.0636	7.6154	6.3768	7.7156	5.4100	9.4048	8.1612
PKG19	6.0404	5.8884	7.3738	6.0988	7.4679	5.0717	9.0785	7.5449
PKG20	6.1190	6.0515	7.4644	6.3284	7.5041	5.2952	9.4350	8.0524
PKG21	6.3184	6.1905	7.5308	6.1653	7.7821	5.3073	9.2719	7.5147
PKG22	6.2700	6.0999	7.7000	6.4795	7.6189	5.5671	9.3927	7.6899
PKG23	5.8592	5.6588	7.4221	5.9780	6.9906	5.1744	9.0181	7.2790
PKG24	6.0283	5.8340	7.0535	5.6699	7.4618	5.3617	8.7160	7.0615
PKG25	6.3184	6.2811	7.8873	7.1139	7.6552	5.5007	9.6223	8.0343
PKG26	6.3969	6.4322	7.7846	6.5097	7.6794	5.2952	9.6525	7.8712
PKG27	6.4030	6.0817	7.6759	6.2499	7.5766	5.1502	9.2235	7.6174
PKG28	6.0223	5.9911	7.5006	6.2680	7.3712	5.1442	9.1390	7.7564
PKG29	6.4452	6.3053	7.8632	6.6970	7.7035	5.5309	9.6284	8.1008
PKG30	6.3123	6.1180	7.4644	6.1653	7.4437	5.3073	9.0785	7.3818
PKG31	5.8169	5.4836	7.0233	5.6094	6.8939	4.9569	8.6254	6.9951
PKG32	6.2398	5.9911	7.2590	5.8874	7.4135	5.0113	9.0060	7.2790
PKG33	6.4694	6.2207	7.5913	6.4070	7.8304	5.5007	9.4773	8.2458
PKG34	6.1794	5.9730	7.4704	6.2016	7.1960	5.0113	9.2779	7.5086
PKG35	6.5117	6.1422	7.4342	6.1230	7.8667	5.6759	9.2296	7.8409
PKG36	6.6567	6.8732	8.0142	6.8904	8.0298	5.5551	9.8096	8.0947
PKG37	6.5238	6.1059	7.6275	6.2801	7.9210	5.3436	9.2840	7.9014
PKG38	6.7292	6.3657	7.7121	6.4735	8.1929	5.3255	9.3746	7.7141
PKG39	6.4332	6.1059	7.5550	6.3647	7.7337	5.5913	9.4290	7.9799
PKG40	6.3063	5.9790	7.5973	6.3164	7.4981	5.0717	9.5256	7.7564
PKG41	6.5963	6.7101	7.8632	6.7091	8.2654	5.6699	9.6707	8.4995
PKG42	6.5419	6.0576	7.6819	6.3405	7.8002	5.4765	9.4652	8.1310
PKG43	6.1552	6.0515	7.5308	6.1411	7.5766	5.4705	9.3383	7.9799
PKG44	6.1250	5.9669	7.2710	5.8572	7.4800	5.4282	8.9456	7.3576
PKG45	6.4996	6.3174	7.7786	6.5218	7.7035	5.4342	9.5740	7.7443
PKG46	6.7171	6.5470	7.9719	6.6970	8.1265	5.6638	9.7492	8.3847
PKG47	6.2217	6.0213	7.3798	6.0928	7.4135	5.4765	9.3021	7.9135
PKG48	5.8471	5.7132	7.5006	6.1653	6.9785	4.9025	9.1933	7.4663
PKG49	6.2761	5.9186	7.1200	5.7786	7.4377	5.2530	8.7825	7.3032
PKG50	6.6930	6.3053	7.9236	6.6366	8.3440	5.5369	9.8942	8.3847
Mean	6.2908	6.1952	7.6107	6.3739	7.7807	5.4291	9.4240	7.9396
SD	0.4105	0.3520	0.2944	0.4303	0.4644	0.2884	0.4108	0.5522
Max	7.1643	7.3143	8.4915	7.7242	9.4255	6.3949	10.7460	9.8650
Min	4.2218	5.4836	7.0233	5.6094	6.8939	4.9025	8.6254	6.9951
Diff	2.9425	1.8307	1.4682	2.1148	2.5316	1.4924	2.1206	2.8699

Table C-1-8: TCB 875th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6476	8.2861	9.1567	8.4256	8.7090	7.9849	10.1440	10.9920
PKG02	7.7382	8.3465	9.3379	8.4437	8.5036	8.0574	10.1510	11.1980
PKG03	8.7352	8.9869	9.4165	8.4739	9.5186	8.9698	10.5980	11.5780
PKG04	7.8953	8.4432	8.8787	8.0751	9.0353	8.4079	10.0840	10.9320
PKG05	7.7141	8.1411	9.3319	8.4316	8.6848	8.0755	10.3020	11.3910
PKG06	7.0555	7.7544	8.3410	7.8757	8.1229	7.7553	9.4376	10.2610
PKG07	7.6295	8.0867	8.7458	8.0812	8.7815	8.2810	9.8605	10.7450
PKG08	8.6023	8.9386	10.1290	9.1989	9.5549	8.8489	11.4070	12.4550
PKG09	7.5993	7.9538	8.9089	8.1960	8.4129	7.8701	9.9330	10.8350
PKG10	8.1672	8.6123	9.2533	8.6793	9.2467	8.5408	10.6520	11.6390
PKG11	8.1612	8.6365	8.6491	8.0208	9.1259	8.7160	10.3560	10.6900
PKG12	8.5479	9.0534	9.6038	8.6733	9.2890	8.6495	10.6340	11.7660
PKG13	7.2911	8.0565	8.8123	8.0570	8.3163	7.7191	9.9693	10.8410
PKG14	8.3968	8.8601	9.8273	9.0177	9.5670	8.6495	11.6670	12.6900
PKG15	7.4301	8.0444	8.6914	8.2081	8.5579	7.9547	10.1200	10.9860
PKG16	8.8198	9.1259	10.6130	9.5192	9.7965	9.0362	11.6430	13.0100
PKG17	8.3787	8.6425	9.2775	8.3772	8.9688	8.4441	10.3560	11.3910
PKG18	7.7322	8.2921	9.1627	8.3833	8.6546	8.2145	10.1930	11.1190
PKG19	7.5389	7.9900	8.6431	8.2201	8.4431	7.8278	9.9874	10.9080
PKG20	7.7020	8.3404	9.0237	8.2322	8.5579	8.1480	10.1870	11.0830
PKG21	7.5811	8.1592	8.6250	8.0933	8.5761	7.9728	9.9693	10.8840
PKG22	7.8168	8.3223	8.8485	8.2383	8.7936	8.3233	10.6940	11.1070
PKG23	7.0676	7.6758	8.5102	8.0570	8.2196	7.6466	9.9089	10.7140
PKG24	7.2851	7.9175	8.4497	7.9362	8.3163	7.8278	9.3953	10.3100
PKG25	7.9799	8.2679	9.1325	8.3651	8.9325	8.4199	10.4160	11.3070
PKG26	7.9678	8.2740	8.8123	8.2987	9.1319	8.4743	10.5310	11.1920
PKG27	7.4543	8.0323	8.6914	8.1778	8.6909	8.1360	10.2710	11.0770
PKG28	7.1340	7.9356	8.6914	7.9905	8.3042	7.6224	9.9572	10.8470
PKG29	7.8651	8.7453	9.1083	8.4799	9.0413	8.4260	10.5980	11.4880
PKG30	7.7262	8.1652	8.5766	8.0570	8.6727	8.0876	10.0060	10.6840
PKG31	6.9528	7.5912	8.1960	7.5978	7.7483	7.4713	9.2684	10.0500
PKG32	7.5328	7.9840	8.5464	7.9362	8.4673	7.9728	9.5826	10.2010
PKG33	7.5630	8.0686	9.1929	8.4799	8.5398	8.0876	10.3320	11.3490
PKG34	7.3576	7.8571	8.7458	8.0630	8.3042	7.8459	10.2230	10.9560
PKG35	7.7262	8.6063	8.8787	8.1416	8.6848	8.0937	9.9693	10.7690
PKG36	8.4572	8.6123	9.3077	8.3410	9.2709	8.6616	10.6460	11.3430
PKG37	7.6295	8.3223	9.1144	8.3168	8.6365	8.0937	10.4590	11.3970
PKG38	8.4935	8.9688	8.9512	8.2503	9.3978	8.7945	10.4040	11.0650
PKG39	7.8410	8.5096	9.0298	8.2020	8.6425	8.1480	10.2710	11.1620
PKG40	7.6114	8.1713	8.8787	8.1960	8.6304	8.0755	10.2290	11.0410
PKG41	7.9920	8.3586	9.5373	8.6672	8.8902	8.2931	10.7730	11.7110
PKG42	7.6718	8.1954	9.2412	8.4739	8.5942	8.1058	10.2410	11.2460
PKG43	7.6174	8.3042	9.0660	8.3833	8.5036	7.9547	10.1320	11.0590
PKG44	7.5751	8.1290	8.7035	7.9966	8.4371	7.9728	10.1810	10.6660
PKG45	8.0403	8.6305	8.7337	8.1053	8.8661	8.4441	10.7610	10.9860
PKG46	8.2639	8.4855	9.3983	8.6491	9.3857	8.6435	10.6940	11.5480
PKG47	7.7624	7.8571	8.9633	8.0691	8.2015	7.6526	9.8545	10.6240
PKG48	7.6053	7.8933	8.6612	8.2866	8.2679	7.7855	10.3080	10.7750
PKG49	7.5207	7.9719	8.4860	7.7549	8.3767	7.8097	10.0360	10.4060
PKG50	8.5056	8.6667	9.4285	8.5947	9.1380	8.4804	10.6340	11.6630
Mean	7.8076	8.3054	9.0062	8.2958	8.7502	8.1895	10.2885	11.1227
SD	0.4461	0.3732	0.4491	0.3412	0.4339	0.3746	0.4764	0.5679
Max	8.8198	9.1259	10.6130	9.5192	9.7965	9.0362	11.6670	13.0100
Min	6.9528	7.5912	8.1960	7.5978	7.7483	7.4713	9.2684	10.0500
Diff	1.8670	1.5347	2.4170	1.9214	2.0482	1.5649	2.3986	2.9600

Table C-1-9: TCB 1016th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	7.6718	6.0274	7.4644	6.1895	7.7216	5.4282	9.3383	7.9980
PKG02	7.7805	6.2207	7.7363	6.6849	7.7398	5.3255	9.8036	8.6445
PKG03	7.6476	6.8732	8.0263	6.9991	8.2956	5.6880	10.2690	8.4874
PKG04	6.7111	6.0757	7.5913	6.3587	7.4377	5.1200	9.6102	7.7684
PKG05	6.8199	6.2267	7.7967	6.4553	7.6310	5.3980	9.5740	8.3062
PKG06	6.4815	5.5863	7.1865	5.6638	7.0812	4.8663	8.8248	7.1522
PKG07	6.7111	6.2630	7.3375	6.1472	7.6310	5.2952	9.0060	7.5388
PKG08	7.2670	6.4866	8.2438	7.0716	8.2896	5.5974	10.3410	9.1581
PKG09	6.5963	6.1240	7.5188	6.2922	7.5706	5.3557	9.4773	8.0403
PKG10	7.0132	6.4926	7.8511	6.6668	8.2715	5.4946	11.1270	8.3243
PKG11	6.8078	6.1422	7.6215	6.2922	7.7639	5.1079	9.3081	7.5388
PKG12	6.9347	6.5530	7.8813	6.6849	8.4769	5.7424	9.8821	8.4935
PKG13	6.3486	5.8461	7.4100	5.9901	7.3410	5.1442	9.1631	7.6657
PKG14	7.3938	7.1210	8.2378	7.2468	8.8334	5.8149	10.2690	8.9225
PKG15	6.5661	5.9246	7.4402	6.0384	7.6431	5.1321	9.1994	7.5630
PKG16	7.7443	7.4231	8.4794	7.6698	9.2503	6.4009	10.7400	9.6717
PKG17	6.6869	6.4382	7.7484	6.5822	8.0056	5.7242	9.5559	8.3424
PKG18	6.8682	6.1180	7.6456	6.4070	7.6854	5.2952	9.3927	8.0947
PKG19	6.6144	5.8582	7.5127	5.9357	7.3833	5.0475	9.0846	7.6114
PKG20	6.7171	6.0334	7.4704	6.2318	7.5585	5.2590	9.4531	8.1431
PKG21	6.6688	6.2449	7.5792	6.3345	7.6854	5.4040	9.2658	7.6476
PKG22	6.4936	6.1059	7.7182	6.4614	7.6552	5.2590	9.5438	8.3062
PKG23	6.0767	5.6407	7.4100	6.0807	6.9483	4.8300	9.0785	7.8530
PKG24	6.4392	5.9367	7.0233	5.6699	7.2866	5.0354	8.6979	7.1522
PKG25	6.4211	6.3174	7.9417	6.7635	7.7096	5.3557	9.7552	8.1128
PKG26	6.4634	6.3778	7.7846	6.5943	7.5948	5.1623	9.6888	7.9376
PKG27	6.4271	6.1845	7.6638	6.3889	7.5404	5.1442	9.3202	7.7201
PKG28	6.0586	6.0092	7.5369	6.3284	7.2322	5.0354	9.3263	7.6899
PKG29	6.6688	6.3295	7.9477	6.7816	7.7035	5.2952	9.6404	8.1733
PKG30	6.3425	6.1603	7.5006	6.1351	7.3954	5.3798	9.3263	7.4482
PKG31	6.0404	5.6950	7.0294	5.6397	6.9060	4.7575	8.6435	6.9528
PKG32	6.3546	6.1965	7.2952	5.8692	7.4377	5.2530	8.9577	7.2488
PKG33	6.6265	6.3174	7.6638	6.4735	7.8244	5.5067	9.5377	8.2518
PKG34	6.3727	5.8703	7.5852	6.1714	7.1597	5.0596	9.2054	7.3757
PKG35	6.7353	6.1482	7.5550	5.9720	7.8606	5.3919	9.2840	7.6657
PKG36	6.6748	6.7403	8.0988	6.9870	8.0419	5.4765	9.7975	8.2156
PKG37	6.6144	6.2207	7.6275	6.2318	7.8667	5.3859	9.3444	8.0041
PKG38	6.8259	6.4503	7.6879	6.5278	8.0660	5.3798	9.4773	7.7805
PKG39	6.7534	6.1180	7.5550	6.2861	7.8123	5.2650	9.4108	8.1491
PKG40	6.3848	6.1482	7.6154	6.3466	7.4981	5.2167	9.3686	7.8107
PKG41	6.7896	6.7766	7.8148	6.7333	8.1204	5.6517	10.0090	8.5720
PKG42	6.6326	6.2026	7.6456	6.4009	7.8002	5.4765	9.6586	8.1551
PKG43	6.3667	6.1180	7.5308	6.2620	7.7398	5.3798	9.3142	7.9255
PKG44	6.3365	6.0274	7.2106	5.9176	7.4558	5.3315	9.2356	7.5026
PKG45	6.4452	6.4201	7.6638	6.5520	7.6914	5.3617	9.5861	7.8168
PKG46	6.9165	6.5832	7.9659	6.8178	8.1748	6.0505	9.7069	8.2156
PKG47	6.4332	6.1180	7.3617	6.2318	7.3833	5.8451	9.2900	7.8289
PKG48	6.1673	5.9367	7.7242	6.0988	7.0208	4.8723	9.2719	7.5328
PKG49	6.3244	6.0394	7.2771	5.9659	7.3652	5.1563	8.6737	7.0555
PKG50	6.7715	6.4926	7.9296	6.6185	8.2413	5.3557	9.9305	8.3726
Mean	6.6802	6.2352	7.6429	6.3850	7.7166	5.3462	9.4953	7.9588
SD	0.4093	0.3459	0.2943	0.4059	0.4524	0.3046	0.4798	0.5273
Max	7.7805	7.4231	8.4794	7.6698	9.2503	6.4009	11.1270	9.6717
Min	6.0404	5.5863	7.0233	5.6397	6.9060	4.7575	8.6435	6.9528
Diff	1.7401	1.8368	1.4561	2.0301	2.3443	1.6434	2.4835	2.7189

Table C-1-10: TCB 1016th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.8107	8.2740	9.1748	8.2262	8.7392	8.2689	10.4350	10.9200
PKG02	7.7685	8.4432	9.5192	8.4316	8.4733	8.1178	10.5550	11.1010
PKG03	8.7170	8.9567	9.4648	8.4195	9.5005	9.0725	11.1600	11.4880
PKG04	7.8470	8.2317	9.0600	8.0328	8.6909	8.3112	10.6880	10.6720
PKG05	7.6053	8.0686	9.3379	8.4074	8.5761	8.0272	10.5190	11.3490
PKG06	7.0313	7.7242	8.3349	7.7549	7.9839	7.5741	9.6672	10.0500
PKG07	7.5811	8.0746	8.8666	8.0812	8.5459	8.1480	10.2170	10.7330
PKG08	8.5841	9.2407	10.3710	9.1627	9.4582	9.0121	11.4310	12.3760
PKG09	7.5086	7.9960	9.4588	8.1899	8.2860	7.8037	10.3560	10.7990
PKG10	8.2518	8.6063	9.6038	8.5645	9.0594	8.7039	10.7180	11.5720
PKG11	8.2881	8.7090	8.8304	7.9845	9.1138	8.7100	10.5010	10.5750
PKG12	8.4149	8.8057	9.8817	9.0419	9.2346	8.9093	10.6640	11.7480
PKG13	7.3999	8.1411	9.0539	8.1778	8.2498	7.7916	10.2530	10.8050
PKG14	8.4512	8.7392	9.7427	8.9814	9.5488	8.6979	11.6730	12.6060
PKG15	7.6718	8.1592	8.7337	8.3047	8.4794	7.9728	10.5130	11.1370
PKG16	8.7835	9.2045	10.5100	9.4829	9.9174	8.9093	12.0840	13.0100
PKG17	8.0645	8.6909	9.1506	8.3651	9.0594	8.4320	10.6760	11.2580
PKG18	7.9799	8.2740	9.1567	8.4981	8.5821	8.3293	10.4160	11.0890
PKG19	8.1068	8.0988	8.6733	8.0933	8.4673	7.9185	10.0900	10.8110
PKG20	7.6657	8.4311	9.0962	8.1658	8.5700	8.1964	10.2590	10.9620
PKG21	7.5691	8.2861	8.9331	8.0691	8.6002	8.0695	10.0540	10.8410
PKG22	8.1431	8.3767	8.9331	8.0993	8.8782	8.6012	10.5610	10.9920
PKG23	7.1220	7.7967	8.6733	7.9845	8.1048	7.7070	10.3320	10.6180
PKG24	7.2428	8.0323	8.3712	7.7126	8.2317	7.8580	9.7457	10.1830
PKG25	7.9920	8.3102	9.0721	8.3470	9.0232	8.4804	10.4650	11.4390
PKG26	7.9558	8.6667	9.0298	8.3229	9.0353	8.4260	11.0210	11.0290
PKG27	7.5509	8.0202	8.7881	8.2081	8.7634	8.2024	10.4650	11.0350
PKG28	7.5026	8.1834	8.7579	8.1235	8.2498	7.7312	10.0600	10.7930
PKG29	8.0887	8.6244	9.3500	8.4860	8.8963	8.5347	10.9960	11.3490
PKG30	7.7322	8.2921	8.6793	8.1235	8.6546	8.1964	10.2900	10.5750
PKG31	6.9528	7.5550	8.2443	7.4891	7.8027	7.5136	9.5584	9.9290
PKG32	7.7322	8.1954	8.3772	7.7972	8.5519	7.9789	9.5826	10.5390
PKG33	7.8107	8.6969	9.1989	8.4739	8.7090	7.9970	10.3680	11.5780
PKG34	7.5268	7.9054	8.7277	8.3108	8.4552	7.8580	10.2290	11.0590
PKG35	7.7624	8.4069	8.7639	8.0933	8.7996	8.0453	10.0300	10.9560
PKG36	8.4391	8.6305	9.3500	8.3954	9.3132	8.7825	10.8570	11.5600
PKG37	7.7987	8.1229	9.1506	8.3229	8.7815	8.4743	10.4950	11.5600
PKG38	8.6385	8.9024	9.0781	8.2624	9.3555	8.9093	10.6460	11.2400
PKG39	7.9739	8.4975	9.0781	8.2806	8.6365	8.1903	10.2470	11.2100
PKG40	7.6718	8.2498	8.9210	8.2141	8.5519	8.1843	10.4950	11.1740
PKG41	8.0403	8.5580	9.6279	8.7277	8.9265	8.2024	11.0870	11.6750
PKG42	7.7262	8.3344	9.2896	8.4437	8.5700	8.1360	10.6460	11.3670
PKG43	7.6295	8.5580	8.9754	8.4618	8.4733	7.9547	10.2770	11.1560
PKG44	7.5389	8.7271	8.7277	8.0570	8.5579	8.2568	10.0660	10.8170
PKG45	8.1068	8.5700	8.9512	8.1416	8.9023	8.3354	10.8570	10.9740
PKG46	8.1370	8.5519	9.5010	8.6008	9.4038	8.5468	10.8390	11.6390
PKG47	7.5268	7.9658	8.9150	8.0449	8.2196	7.7070	10.2410	10.8780
PKG48	7.2730	7.9356	8.7216	8.0570	8.2860	7.8399	10.3200	11.0890
PKG49	7.4784	8.2619	8.4195	7.7126	8.5640	7.8943	10.0420	10.5270
PKG50	8.0645	9.0353	9.2231	8.5887	9.0896	8.5710	10.9660	11.7420
Mean	7.8452	8.3824	9.0770	8.2864	8.7385	8.2418	10.4943	11.1317
SD	0.4241	0.3685	0.4639	0.3648	0.4341	0.3913	0.4867	0.5727
Max	8.7835	9.2407	10.5100	9.4829	9.9174	9.0725	12.0840	13.0100
Min	6.9528	7.5550	8.2443	7.4891	7.8027	7.5136	9.5584	9.9290
Diff	1.8307	1.6857	2.2657	1.9938	2.1147	1.5589	2.5256	3.0810

Table C-1-11: TCB 1200th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.3546	6.0515	7.4704	6.1411	7.7398	5.2046	9.2719	7.8772
PKG02	6.4150	6.4020	7.5973	6.5943	7.7035	5.4282	9.7734	8.7956
PKG03	6.8017	6.8249	7.8994	7.0354	8.3440	5.7665	9.9123	8.6445
PKG04	6.6628	6.3597	7.4886	6.2620	7.4135	5.3798	9.3686	7.9980
PKG05	6.7111	6.5530	7.6215	6.4009	7.6914	5.4221	9.5498	8.2699
PKG06	6.0102	5.6769	7.1079	5.5490	6.9724	4.9448	9.0000	7.2972
PKG07	6.1794	6.3174	7.2952	6.1170	7.6008	5.3194	9.0846	7.6355
PKG08	6.7836	6.6859	8.2015	7.1079	8.2775	5.6215	10.6010	9.2729
PKG09	6.1613	6.1482	7.4100	6.2197	7.5162	5.4765	9.6646	8.0645
PKG10	6.9044	6.5832	7.7967	6.6547	8.2413	5.5248	9.9909	8.3304
PKG11	6.5842	6.1482	7.5429	6.3405	7.7821	5.5792	9.3202	7.5630
PKG12	6.8984	6.6799	7.7967	6.8178	8.4527	5.8934	9.8519	8.8439
PKG13	6.2640	5.8159	7.2952	5.9599	7.3833	5.3315	9.1933	7.8530
PKG14	7.2368	7.1089	8.1834	7.2347	8.7125	5.9538	10.3170	9.0010
PKG15	6.4875	5.9851	7.3617	5.9901	7.5041	5.1261	9.0906	7.7382
PKG16	7.4301	7.3083	8.5157	7.6819	9.1294	6.3707	10.7940	9.7019
PKG17	6.7776	6.4382	7.6275	6.6366	8.0902	5.6517	9.5861	8.3545
PKG18	6.4271	6.0817	7.6275	6.4372	6.2776	5.6457	9.3927	8.2397
PKG19	6.1311	5.9307	7.4402	6.0747	7.4135	5.3255	9.1148	7.7201
PKG20	6.2579	6.1119	7.4644	6.2439	7.4921	5.4100	9.3686	8.0343
PKG21	6.3002	6.2026	7.5550	6.1955	7.7881	5.5611	9.2598	7.6718
PKG22	6.2217	6.0757	7.6698	6.3526	7.3954	5.5188	9.6163	8.0222
PKG23	5.8229	5.6165	7.4281	6.1291	6.9906	4.8723	8.9517	7.7201
PKG24	6.0223	5.9367	7.1019	5.6336	7.3773	5.3678	8.6677	7.2428
PKG25	6.4150	6.3476	7.9477	6.7393	7.5404	5.5248	9.6948	8.1189
PKG26	6.4332	6.3476	7.7544	6.5883	7.6794	5.3919	9.5619	8.0464
PKG27	6.4332	6.1059	7.6759	6.2922	7.5162	5.1865	9.7009	7.6355
PKG28	6.0888	6.0213	7.5248	6.2922	7.3229	5.2046	9.3988	7.6114
PKG29	6.4996	6.3959	7.9175	6.8722	7.7760	5.4040	9.9123	8.1551
PKG30	6.2882	6.0999	7.5369	6.2680	7.5766	5.0717	9.5498	7.5811
PKG31	5.7444	5.5923	7.0233	5.6215	6.9845	4.9267	8.7462	6.9769
PKG32	6.2157	6.0515	7.3133	5.9418	7.5646	5.2469	9.0060	7.2367
PKG33	6.4634	6.3536	7.7242	6.4432	7.8485	5.4584	9.6102	8.3062
PKG34	6.0465	5.9609	7.6396	6.1230	7.1597	4.8723	9.2477	7.4301
PKG35	6.3425	6.2992	7.4765	5.9478	7.7277	5.3859	9.3202	7.7987
PKG36	6.6084	6.7222	8.0686	6.9447	8.0177	5.5067	9.7613	8.1793
PKG37	6.3184	6.1542	7.5792	6.2801	7.8244	5.3859	9.3686	8.0101
PKG38	6.7292	6.4261	7.7000	6.6003	8.0902	5.5490	9.5075	7.8349
PKG39	6.3123	6.1119	7.5731	6.2922	7.7096	5.3738	9.5256	8.0101
PKG40	6.1794	6.1361	7.6396	6.4009	7.5041	5.0898	9.3927	7.7987
PKG41	6.5600	6.5651	7.8209	6.7333	8.1446	5.7484	9.7734	8.6325
PKG42	6.3667	6.0817	7.6819	6.6124	7.8848	5.6880	9.4531	8.1793
PKG43	6.3727	5.9428	7.5006	6.1170	7.5585	5.5974	9.4713	7.9980
PKG44	6.1734	5.9911	7.2529	5.8692	7.4498	5.4282	9.1148	7.4663
PKG45	6.3365	6.3295	7.6819	6.5399	7.6794	6.0082	9.6646	7.8651
PKG46	6.6628	6.5772	8.0021	6.8058	8.1023	5.7665	9.7794	8.2156
PKG47	6.1915	5.9609	7.3254	6.1955	7.4981	5.3073	9.3806	7.9739
PKG48	5.9498	5.7132	7.4946	6.2076	7.0147	5.1925	9.2658	7.6718
PKG49	6.2579	6.0092	7.1804	5.8088	7.4679	5.3678	8.7764	7.1219
PKG50	6.6507	6.4201	7.8148	6.5278	8.1990	5.7182	9.9667	8.4029
Mean	6.4097	6.2352	7.6070	6.3775	7.6826	5.4419	9.4938	8.0030
SD	0.3264	0.3505	0.2925	0.4214	0.4767	0.2925	0.4202	0.5330
Max	7.4301	7.3083	8.5157	7.6819	9.1294	6.3707	10.7940	9.7019
Min	5.7444	5.5923	7.0233	5.5490	6.2776	4.8723	8.6677	6.9769
Diff	1.6857	1.7160	1.4924	2.1329	2.8518	1.4984	2.1263	2.7250

Table C-1-12: TCB 1200th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.7020	8.3042	8.7760	8.2503	8.6002	7.9910	10.5130	10.9800
PKG02	7.7443	8.1531	9.1446	8.4316	8.4129	7.9547	10.3320	11.1370
PKG03	8.7352	8.8601	9.3500	8.6310	9.4038	8.7764	10.4890	11.7290
PKG04	7.7987	8.3042	8.8243	8.0449	8.7936	8.2689	10.2530	10.7750
PKG05	7.6416	8.0988	9.1204	8.5283	8.6123	8.0635	10.3920	11.2580
PKG06	7.0857	7.6456	8.2624	7.6884	8.0564	7.5197	9.7699	10.1830
PKG07	7.5993	8.0988	8.7398	8.1537	8.6909	8.0514	9.9814	10.7750
PKG08	8.5781	8.9446	10.0810	9.2231	9.5005	8.7704	11.3290	12.3940
PKG09	7.5630	7.9840	8.8666	8.2262	8.3827	7.8037	9.9089	11.0770
PKG10	8.1370	8.5700	9.3137	8.6250	9.1803	8.4924	10.5980	11.6090
PKG11	8.1128	8.5459	8.6431	8.0389	9.0594	8.5710	10.0540	10.8900
PKG12	8.4693	8.8298	9.6461	8.7458	9.2769	8.7281	10.6340	11.7050
PKG13	7.4059	8.1350	8.7458	8.2806	8.2679	7.8399	9.9814	10.7510
PKG14	8.4633	8.7573	9.7790	9.1748	9.6334	8.7160	11.2320	12.7080
PKG15	7.3395	7.9960	8.6733	8.2262	8.5942	7.9245	10.0180	10.8780
PKG16	8.9164	9.2830	10.5830	9.4890	9.8026	9.0906	11.6490	12.8350
PKG17	8.1370	8.4734	9.1929	8.3954	8.9386	8.4260	10.6220	11.2220
PKG18	7.8168	8.2317	9.1929	8.3772	8.6546	8.1843	10.1140	11.0040
PKG19	7.5811	8.4975	8.8183	8.2987	8.4311	7.8580	9.9149	10.8410
PKG20	7.9437	8.2498	9.0539	8.3047	8.6365	8.1118	10.1260	10.9680
PKG21	7.6234	8.1834	8.7579	8.1356	8.5761	7.9728	10.0900	10.9020
PKG22	7.9316	8.3707	8.8425	8.4014	8.7392	8.4260	10.4830	10.8530
PKG23	7.7685	7.6033	8.5645	8.0751	8.1350	7.7130	10.1930	10.5940
PKG24	7.3636	7.8813	8.3712	7.8274	8.3163	7.9366	9.4436	10.2430
PKG25	8.2881	8.3102	9.1204	8.6008	8.9265	8.4381	10.5130	11.2700
PKG26	8.1612	8.3525	8.9089	8.2806	8.9869	8.5589	10.4950	11.1070
PKG27	7.5811	8.0806	8.6250	8.2201	8.7513	8.1964	10.2470	11.0230
PKG28	7.2247	8.1108	8.6250	7.9180	8.3102	7.7372	9.9934	10.8050
PKG29	7.9437	8.2075	9.0962	8.5041	8.9446	8.4502	10.6340	11.2940
PKG30	8.0766	8.3827	8.5102	8.0026	8.6848	8.1360	10.1510	10.5690
PKG31	6.9588	7.6094	8.2383	7.5978	7.7966	7.4593	9.4859	9.8988
PKG32	7.5207	8.0565	8.3349	7.8214	8.4854	7.9728	9.6853	10.3400
PKG33	7.6174	8.2136	9.2956	8.4799	8.6365	7.9910	10.2770	11.3250
PKG34	7.3455	7.9356	8.5706	8.0872	8.4311	7.9124	10.1630	10.9560
PKG35	7.7201	8.3888	8.6733	8.0933	8.7694	8.0695	9.9149	10.7930
PKG36	8.7170	8.5519	9.2231	8.5222	9.4038	8.2447	10.6040	11.3490
PKG37	7.6959	8.0927	9.0116	8.5887	8.7513	8.1541	10.2590	11.3130
PKG38	8.4633	9.3072	8.8243	8.3229	9.4280	8.5045	10.3440	10.9260
PKG39	7.8712	8.4552	8.9331	8.3289	8.6365	8.1118	10.1630	11.0350
PKG40	7.6959	8.2136	8.7700	8.2322	8.6969	8.0333	10.2110	10.9320
PKG41	8.2095	8.4734	9.6702	8.8062	9.0111	8.3051	10.6520	11.5780
PKG42	7.9980	8.2740	9.5192	8.4377	8.7754	8.2266	10.6700	11.5970
PKG43	7.9558	8.2196	9.1567	8.3531	8.5459	8.0453	10.6220	11.0040
PKG44	7.9980	8.2498	8.6552	8.0328	8.5398	7.9607	9.8424	10.8170
PKG45	8.1793	8.5459	8.8727	8.2383	8.9688	8.3897	10.3380	10.9380
PKG46	8.3243	8.5459	9.4104	8.7881	9.4038	8.7643	10.7250	11.5970
PKG47	7.4361	7.9900	9.0539	8.1718	8.2921	7.8097	10.0720	10.9140
PKG48	7.3999	7.9658	8.6370	8.1778	8.2981	7.8037	10.1140	10.7690
PKG49	7.4905	8.0927	8.3168	7.7972	8.4613	7.8580	9.7095	10.3760
PKG50	8.4995	8.7936	9.3440	8.7095	9.2165	8.6193	10.5550	11.7110
Mean	7.8766	8.3084	8.9748	8.3337	8.7570	8.1789	10.2912	11.0910
SD	0.4453	0.3618	0.4645	0.3704	0.4259	0.3542	0.4251	0.5619
Max	8.9164	9.3072	10.5830	9.4890	9.8026	9.0906	11.6490	12.8350
Min	6.9588	7.6033	8.2383	7.5978	7.7966	7.4593	9.4436	9.8988
Diff	1.9576	1.7039	2.3447	1.8912	2.0060	1.6313	2.2054	2.9362

Table C-1-13: TCB 1492nd cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.2277	5.9609	7.5006	6.1472	7.7035	5.2288	9.5559	7.9980
PKG02	6.2398	6.1784	7.7000	6.6064	7.7035	5.4040	9.7552	8.5902
PKG03	6.6930	6.8974	7.9659	6.8541	8.1990	5.7363	10.1000	8.8198
PKG04	6.0283	6.0999	7.4946	6.2076	7.3470	5.2046	9.3927	7.9980
PKG05	6.1492	6.2388	7.6336	6.3043	7.6371	5.3315	9.4652	8.4995
PKG06	5.8833	5.7132	7.0535	5.6336	6.9906	4.9750	8.9396	7.6959
PKG07	6.3063	6.1603	7.5550	6.1472	7.6189	5.3496	9.2296	8.0947
PKG08	6.7232	6.4866	8.1411	7.0474	8.2715	5.6578	10.5100	9.1400
PKG09	6.2277	6.0697	7.4463	6.1714	7.6733	5.6517	9.6223	8.0947
PKG10	6.7292	6.5228	7.8027	6.5399	8.1627	5.6155	9.7371	8.3364
PKG11	6.3002	6.1784	7.4886	6.3043	7.7639	5.1321	9.1752	7.4966
PKG12	6.6567	6.5651	7.8269	6.6970	8.3984	5.9901	9.8157	9.0433
PKG13	6.0888	5.7615	7.3556	6.0445	7.3954	5.1200	9.2477	7.8651
PKG14	6.9769	7.1089	8.1653	7.3254	8.7125	5.8451	10.2390	9.8650
PKG15	6.0646	5.8642	7.4100	6.0445	7.4679	5.5369	9.1873	7.5691
PKG16	7.1522	7.3506	8.4311	7.7000	9.1596	6.4734	10.8250	9.6536
PKG17	6.4452	6.3838	7.5913	6.5399	8.1023	5.7121	9.6948	8.3001
PKG18	6.2277	6.0394	7.6034	6.4372	7.7156	5.7121	9.5256	8.1733
PKG19	6.2217	5.9428	7.3738	6.1532	7.4981	5.4523	9.2115	7.6778
PKG20	6.2519	5.9790	7.4825	6.2922	7.5102	5.4946	9.3504	8.0343
PKG21	6.2277	6.1724	7.5550	6.1411	7.7277	5.3980	9.4169	7.5932
PKG22	6.2096	6.0817	7.6577	6.4976	7.5102	5.4765	9.5256	7.8712
PKG23	5.7988	5.5863	7.4100	6.2559	7.0449	5.0777	9.0181	7.4784
PKG24	5.9438	5.8401	6.9931	5.7182	7.3470	5.1442	8.7583	7.1340
PKG25	6.2700	6.3295	7.9236	6.7816	7.7035	4.7998	9.8882	8.1612
PKG26	6.3607	6.3959	7.7665	6.6064	7.6794	5.5248	9.5921	7.9799
PKG27	6.4513	6.0153	7.6154	6.3164	7.5464	5.1865	9.2235	7.6778
PKG28	6.1552	6.0213	7.4704	6.3768	7.2866	5.3255	9.2719	7.7080
PKG29	6.4271	6.2932	7.8813	6.7937	7.6491	5.3980	9.7250	8.1914
PKG30	6.1311	5.9730	7.5490	6.1230	7.4437	5.2107	9.2417	7.5328
PKG31	5.3154	5.5138	7.0535	5.6336	6.9422	4.9992	8.7100	6.9346
PKG32	6.0767	5.9488	7.2106	5.8511	7.3289	5.2046	9.0000	7.2609
PKG33	6.3184	6.2267	7.6456	6.4795	7.7760	5.9417	9.4834	8.2760
PKG34	5.9981	5.8461	7.5429	6.1532	7.1416	4.9509	9.1873	7.4663
PKG35	6.2942	6.1603	7.5006	6.0384	7.7881	5.3798	9.3625	7.7866
PKG36	6.5903	6.6316	8.0021	6.9689	8.0237	5.9720	9.7069	8.2518
PKG37	6.3607	6.1845	7.5188	6.2439	7.8244	5.7182	9.5196	7.8953
PKG38	6.5842	6.4080	7.7000	6.5157	8.0540	5.6819	9.8157	7.7080
PKG39	6.2398	6.0757	7.5429	6.5339	7.7277	5.2892	9.5317	7.9980
PKG40	6.1552	6.0697	7.5429	6.5278	7.5041	5.2046	9.5015	7.6778
PKG41	6.5600	6.5711	7.8088	6.7756	8.1023	6.0143	9.7613	8.5116
PKG42	6.3365	6.0999	7.5913	6.5037	7.7398	5.5309	9.5559	8.1068
PKG43	6.1431	6.0697	7.5188	6.1351	7.6189	5.4705	9.4592	7.8530
PKG44	6.0163	5.8823	7.1623	5.8572	7.5223	5.4040	8.9939	7.4361
PKG45	6.2821	6.2147	7.6819	6.4312	7.7337	5.4403	9.5438	7.7322
PKG46	6.6144	6.5651	7.9598	6.6910	8.0177	5.8269	9.7311	8.1914
PKG47	5.9800	5.9367	7.3073	6.1170	7.3712	5.3678	9.3202	7.8107
PKG48	5.7867	5.8823	7.4644	6.0807	6.9966	4.9629	9.2054	7.4482
PKG49	6.0404	5.9730	7.1865	5.6880	7.3410	5.4221	8.8489	7.0917
PKG50	6.5661	6.4020	7.8450	6.5520	8.1083	5.5188	10.0750	8.3364
Mean	6.2766	6.1774	7.5926	6.3717	7.6926	5.4493	9.4911	8.0009
SD	0.3126	0.3506	0.2879	0.4100	0.4247	0.3251	0.4120	0.5856
Max	7.1522	7.3506	8.4311	7.7000	9.1596	6.4734	10.8250	9.8650
Min	5.3154	5.5138	6.9931	5.6336	6.9422	4.7998	8.7100	6.9346
Diff	1.8368	1.8368	1.4380	2.0664	2.2174	1.6736	2.1150	2.9304

Table C-1-14: TCB 1492nd cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6295	8.4734	8.8968	8.2322	8.6727	8.0876	10.1140	10.7870
PKG02	7.5691	8.3223	9.2292	8.4195	8.5881	7.8580	10.2470	11.0040
PKG03	8.6566	9.0232	9.1929	8.5102	9.6878	8.7462	10.5860	11.3430
PKG04	7.8349	8.3223	8.6672	8.0872	8.6727	8.2810	10.2290	10.6600
PKG05	7.7745	8.6607	9.0479	8.4860	8.6123	7.8641	10.2590	11.2460
PKG06	7.0797	7.7544	8.1899	7.8395	8.1712	7.6345	9.7155	10.0620
PKG07	7.5509	8.4069	8.6370	8.1356	8.7815	8.0393	10.0780	10.7930
PKG08	8.5902	9.0957	10.0750	9.4104	9.4763	9.1933	11.3890	12.3400
PKG09	7.6053	8.1592	8.8243	8.1597	8.2860	8.0453	9.8303	10.8900
PKG10	8.1914	8.6788	9.2956	8.8364	9.0896	8.6193	10.6100	11.5420
PKG11	8.1491	8.5640	8.5766	8.0630	9.0050	8.6012	10.4220	10.6660
PKG12	8.4935	8.7936	9.6098	8.6914	9.2709	8.6677	10.6220	11.6510
PKG13	7.4784	8.0806	8.7277	8.1778	8.2196	7.9124	10.0240	10.6720
PKG14	8.4452	8.7150	9.8092	9.0358	9.5488	8.5710	11.6850	12.5150
PKG15	7.5328	8.0806	8.6975	8.1778	8.4794	7.8943	9.9995	10.8720
PKG16	8.9044	9.1682	10.5220	9.4346	9.8570	8.8671	11.9990	12.9920
PKG17	8.2276	8.6305	9.1144	8.5464	8.9023	8.4441	10.3380	11.4090
PKG18	7.8833	8.7332	9.1687	8.3229	8.5881	8.2387	10.1140	11.2580
PKG19	7.6657	8.0444	9.0962	8.2383	8.5096	8.0635	10.0480	11.0290
PKG20	7.7201	8.2861	8.9875	8.1960	8.5881	8.0997	10.0420	11.0170
PKG21	7.5509	8.1350	8.6612	8.1537	8.5579	8.1601	9.9209	10.8290
PKG22	8.1128	8.2800	8.8425	8.2926	8.6727	8.2206	10.1930	10.8780
PKG23	7.1220	7.6335	8.7458	7.9905	8.0564	7.5861	9.8001	10.5390
PKG24	7.3818	7.8148	8.3168	7.7730	8.2740	7.7855	9.4013	10.2370
PKG25	7.9860	8.2136	9.0056	8.3712	9.0594	8.5468	10.4590	11.2520
PKG26	8.0162	8.3888	8.8727	8.2322	9.0353	8.3112	10.4710	11.0590
PKG27	7.4966	8.0867	8.6491	8.1658	8.6002	8.0937	10.2350	10.9380
PKG28	7.2005	7.7242	8.8546	8.0328	8.3042	7.6586	10.0480	10.8230
PKG29	7.8470	8.4129	9.1748	8.4256	8.9507	8.3595	10.5730	11.3730
PKG30	7.7503	8.1592	8.4739	8.1295	8.7150	8.1722	9.9451	10.5330
PKG31	6.9709	7.6698	8.1778	7.5555	7.8631	7.3626	9.1717	9.9954
PKG32	7.4784	8.2317	8.3893	7.7247	8.4129	7.9185	9.9209	10.4000
PKG33	7.5872	8.1592	9.1083	8.4497	8.5579	8.0272	10.2470	11.2580
PKG34	7.3334	7.8450	8.5404	8.0691	8.6244	7.7855	10.1510	10.8350
PKG35	7.6416	8.4673	8.7277	8.2564	8.6244	8.0755	10.0420	10.7200
PKG36	8.4270	8.6305	9.1567	8.4558	9.3615	8.6677	10.5490	11.3130
PKG37	7.5691	8.1531	8.8968	8.4860	8.7513	8.0997	10.3140	11.3310
PKG38	8.3606	8.7030	8.7941	8.2322	9.3313	8.7462	10.4590	10.9560
PKG39	7.8047	8.3344	8.9633	8.3229	8.6546	8.1964	10.1320	10.9920
PKG40	7.6355	8.1894	8.8485	8.2624	8.6727	8.0635	10.1630	10.8410
PKG41	8.1672	8.3344	9.8334	8.6068	8.9627	8.2085	10.7850	11.5840
PKG42	7.8591	8.0988	9.2473	8.3591	8.6123	8.1722	10.3260	11.1980
PKG43	7.6839	8.2317	9.0419	8.3108	8.4794	7.9849	10.2650	11.1490
PKG44	7.5932	7.9779	8.6310	7.9362	8.5519	7.9305	9.8061	10.7930
PKG45	8.2941	8.4673	8.9814	8.0993	8.8721	8.3776	10.3860	10.8900
PKG46	8.1551	8.4855	9.4225	8.5464	9.3253	8.6979	10.7490	11.5420
PKG47	7.2730	8.0323	8.8062	8.0087	8.1894	7.7009	9.8484	10.5690
PKG48	7.2307	7.9356	8.6008	8.1114	8.4371	7.8157	10.1020	10.7390
PKG49	7.5147	8.0927	8.3833	7.7247	8.4311	7.8520	9.6611	10.3460
PKG50	8.0947	8.7332	9.3621	8.6431	9.0836	8.5106	10.5550	11.5780
Mean	7.8024	8.3123	8.9575	8.2946	8.7406	8.1763	10.2606	11.0448
SD	0.4374	0.3564	0.4583	0.3651	0.4249	0.3739	0.4904	0.5581
Max	8.9044	9.1682	10.5220	9.4346	9.8570	9.1933	11.9990	12.9920
Min	6.9709	7.6335	8.1778	7.5555	7.8631	7.3626	9.1717	9.9954
Diff	1.9335	1.5347	2.3442	1.8791	1.9939	1.8307	2.8273	2.9966

Table C-1-15: TCB 1724th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.2519	6.0817	7.5369	6.1955	7.8727	5.3859	9.2477	7.7564
PKG02	6.2761	6.0697	7.7665	6.6305	7.7579	5.7182	9.7673	8.2397
PKG03	6.8682	6.9216	8.0565	6.9447	8.2836	5.8390	9.8519	8.5418
PKG04	6.1734	6.1059	7.5792	6.6668	7.4014	5.3557	9.4048	7.7987
PKG05	6.3002	6.2630	7.6940	6.5157	7.7519	5.4946	9.6223	8.2699
PKG06	5.8108	5.7857	7.1079	5.6880	7.2383	5.0475	8.8006	7.1945
PKG07	6.2338	6.2751	7.3858	6.4614	7.8123	5.5913	9.1027	7.5811
PKG08	7.0011	6.5409	8.2015	7.2468	8.3742	5.8088	10.5230	9.2608
PKG09	6.2761	6.1542	7.5188	6.3768	7.6129	5.4221	9.5800	8.1310
PKG10	7.1220	6.5470	7.8752	6.7635	8.3440	5.7726	10.0150	8.3424
PKG11	6.8017	6.2267	7.5550	6.3768	7.8244	5.3073	9.2356	7.4663
PKG12	6.9709	6.5953	7.8088	6.7272	8.6521	5.8813	9.9607	8.4633
PKG13	6.3909	5.7676	7.4100	5.9357	7.3773	5.3073	9.6586	7.7322
PKG14	7.3334	7.1874	8.2317	7.2589	8.8757	5.9176	10.6620	8.9708
PKG15	6.3365	5.8582	7.4765	6.0505	7.7277	5.2348	9.4894	7.6899
PKG16	7.7987	7.4049	8.5701	7.6637	9.4557	6.5339	10.7940	9.6475
PKG17	6.5359	6.3778	7.6698	6.5339	8.1265	5.7484	9.7069	8.1551
PKG18	6.5057	6.0636	7.6034	6.3284	7.8667	5.8330	9.6102	8.0947
PKG19	6.3002	5.9488	7.3919	6.1472	7.4014	5.2409	9.3806	7.5932
PKG20	6.2640	5.9669	7.4523	6.2439	7.7398	5.3678	9.3988	7.9799
PKG21	6.5661	6.1965	7.5731	6.1653	7.8304	5.4221	9.5256	7.5751
PKG22	6.5721	6.1361	7.6336	6.4372	7.6068	5.3255	9.6525	7.7805
PKG23	5.8471	5.5863	7.4100	5.9659	7.1054	4.9629	8.9939	7.2549
PKG24	6.3184	5.7978	7.0354	5.6094	7.5041	5.1200	8.9214	7.1038
PKG25	6.6386	6.3113	7.9538	6.8420	7.8546	4.7515	10.1180	8.1128
PKG26	6.6869	6.4443	7.8571	6.6487	7.6854	5.3678	9.6525	8.1733
PKG27	6.5298	6.0636	7.7302	6.3284	7.6371	5.1200	9.4108	7.6778
PKG28	6.2398	6.1784	7.6154	6.3224	7.3591	5.2832	9.5861	7.5026
PKG29	6.6386	6.4986	8.0867	6.8118	7.9029	5.3859	9.7734	8.3968
PKG30	6.4513	6.2086	7.5671	6.2318	7.4679	5.1200	9.1571	7.3274
PKG31	5.4241	5.7132	7.0052	5.7424	7.2806	5.1382	8.7039	6.9890
PKG32	6.1734	6.0878	7.3254	5.9478	7.4014	5.1563	9.0906	7.1522
PKG33	6.3788	6.3657	7.7665	6.4976	8.0177	5.4826	9.7794	8.1914
PKG34	6.3244	6.1240	7.7363	6.2922	7.4195	5.0717	9.4229	7.3757
PKG35	6.6446	6.1603	7.5671	6.1532	7.9392	5.4523	9.4652	7.6597
PKG36	6.8863	6.8007	8.1532	7.1320	8.1748	5.5248	9.9486	8.1128
PKG37	6.5963	6.2207	7.6094	6.3526	8.0963	5.5913	9.5740	7.9135
PKG38	6.8742	6.5409	7.7484	6.6366	8.2654	5.4282	9.5377	7.7141
PKG39	6.3244	6.0636	7.6456	6.4130	7.8002	5.5007	9.7311	8.0947
PKG40	6.1854	6.0455	7.7000	6.4735	7.5827	5.2288	9.4290	7.8530
PKG41	6.8621	6.7161	7.8813	6.8239	8.1506	5.9780	9.8277	8.6989
PKG42	6.4815	6.1603	7.6819	6.3949	7.8304	5.4282	9.6163	8.1733
PKG43	6.3969	6.0394	7.5611	6.3526	7.7156	5.7001	9.3927	7.9437
PKG44	6.2761	5.9186	7.3738	5.9357	7.4014	5.3678	9.4290	7.4845
PKG45	6.5117	6.2449	7.7484	6.6970	7.7821	5.6215	9.5921	7.8832
PKG46	6.6446	6.5107	8.0867	6.8360	8.1083	5.7967	9.9063	8.2518
PKG47	6.1069	5.9065	7.4160	6.2499	7.4921	5.3798	9.3565	7.7443
PKG48	5.9256	5.7132	7.5308	6.2257	6.9966	5.0717	9.3988	7.5026
PKG49	6.4996	5.9367	7.1562	5.7484	7.5162	5.1684	8.8489	7.0434
PKG50	6.9769	6.3718	7.9115	6.6305	8.3440	5.7363	9.9848	8.3726
Mean	6.4907	6.2241	7.6592	6.4331	7.8153	5.4498	9.5728	7.9194
SD	0.3977	0.3622	0.3085	0.4173	0.4529	0.3171	0.4232	0.5441
Max	7.7987	7.4049	8.5701	7.6637	9.4557	6.5339	10.7940	9.6475
Min	5.4241	5.5863	7.0052	5.6094	6.9966	4.7515	8.7039	6.9890
Diff	2.3746	1.8186	1.5649	2.0543	2.4591	1.7824	2.0901	2.6585

Table C-1-16: TCB 1724th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.7503	8.2679	8.9150	8.2564	8.5881	8.1420	10.0060	10.8960
PKG02	7.7685	8.1713	9.3198	8.5766	8.4854	8.0997	10.2410	11.1800
PKG03	8.8016	8.8661	9.3258	8.4497	9.5428	8.8731	10.5070	11.7540
PKG04	7.9316	8.3042	8.7156	8.1597	8.8359	8.3051	10.2110	10.6240
PKG05	7.6053	8.0625	9.0841	8.4497	8.5217	7.8580	10.3200	11.2580
PKG06	7.0313	7.5852	8.3047	7.7791	8.1531	7.6043	9.7397	10.0740
PKG07	7.6053	8.0565	8.6975	8.1899	8.6727	8.0876	10.2170	10.7140
PKG08	8.7110	8.9628	10.0810	9.2352	9.4763	8.9154	11.4800	12.3760
PKG09	7.4966	8.0202	8.8848	8.2262	8.3042	7.3686	9.9451	10.8590
PKG10	8.1733	8.6063	9.3137	8.6431	9.1380	8.5831	10.8390	11.5000
PKG11	8.2639	8.5640	8.5947	8.0691	9.0111	8.5649	10.1750	10.5390
PKG12	8.8560	8.8601	9.5977	8.6733	9.2346	8.7583	10.7430	11.6990
PKG13	7.4241	8.0444	8.8183	8.0630	8.3163	7.7916	10.0420	10.7930
PKG14	8.7896	8.8540	9.7427	9.0237	9.6697	8.6375	11.5520	12.4790
PKG15	7.7926	8.0806	8.6854	8.2081	8.5579	8.1239	10.1320	10.9140
PKG16	8.9829	9.1078	10.4980	9.4950	9.8570	9.0302	11.8000	12.9920
PKG17	8.0645	8.4915	9.2292	8.4558	9.0413	8.7281	10.2900	11.3430
PKG18	7.7020	8.1894	9.2231	8.3531	8.6304	8.2206	10.1930	11.1430
PKG19	7.5147	8.0142	8.7277	8.2081	8.4975	7.9728	9.9814	10.7750
PKG20	7.6718	8.2921	9.0237	8.2806	8.5398	8.2326	10.0780	10.9920
PKG21	7.6114	8.1108	8.7216	8.1960	8.5036	8.0574	10.0060	10.7810
PKG22	7.9074	8.2559	8.8062	8.2624	8.7452	8.4139	10.6460	10.8050
PKG23	7.1461	7.7665	8.4981	8.0389	8.1048	7.6647	9.8726	10.6660
PKG24	7.4361	7.8933	8.3108	7.7670	8.2558	7.8339	9.3228	10.2310
PKG25	8.1733	8.4009	9.0358	8.3470	8.9084	8.4502	10.4710	11.3190
PKG26	8.0645	8.4673	8.9331	8.2926	9.0715	8.3293	10.4770	11.2160
PKG27	7.5932	8.0565	8.6250	8.1839	8.7090	8.1118	10.2900	11.0230
PKG28	7.2005	7.9235	8.5766	7.9362	8.2921	7.6526	10.0300	10.8590
PKG29	8.0343	8.2861	9.0781	8.4799	8.9930	8.3716	10.6760	11.4210
PKG30	7.8651	8.1713	8.7639	8.0630	8.6909	8.1601	9.9814	10.6000
PKG31	5.5994	7.6577	8.1235	7.5797	7.9114	7.7312	9.2321	10.0680
PKG32	7.7322	7.9417	8.3349	7.7972	8.5036	8.0393	9.7638	10.2790
PKG33	7.5932	8.1108	9.0962	8.4739	8.8540	8.1178	10.3020	11.3910
PKG34	7.3334	7.8027	8.7700	8.1114	8.3706	7.9064	10.2470	10.9200
PKG35	7.8289	8.4492	9.1144	8.2201	8.8540	8.2568	9.9451	10.7140
PKG36	8.4814	8.7453	9.5131	8.6733	9.5549	8.9154	10.6040	11.3010
PKG37	7.6053	8.1652	9.0116	8.3591	8.8419	8.0755	10.2770	11.3430
PKG38	8.9346	8.8419	8.8062	8.3531	9.3555	8.8066	10.3560	10.9980
PKG39	7.7805	8.3948	9.0419	8.4014	8.7996	8.4079	10.2110	11.0830
PKG40	7.7322	8.2679	8.7820	8.2383	8.7392	8.1843	10.3920	10.9800
PKG41	7.9558	8.4552	9.5977	8.7518	9.1440	8.4743	10.8210	11.6090
PKG42	7.6839	8.3042	9.4406	8.6250	8.5700	8.1058	10.3200	11.2640
PKG43	7.8289	8.2256	9.1144	8.6008	8.5579	8.0876	10.3140	11.0710
PKG44	7.5811	8.2921	8.6914	8.1053	8.5700	8.1058	9.8243	10.5390
PKG45	8.0222	8.4190	8.8062	8.3772	8.8480	8.4381	10.3620	10.8720
PKG46	8.1189	8.6244	9.3560	8.6370	9.4763	8.7764	10.7910	11.6330
PKG47	7.3153	7.8208	9.0479	8.0630	8.2437	7.7795	9.9209	10.7020
PKG48	7.2549	7.9175	8.5645	8.1537	8.3585	7.9970	10.1440	10.9800
PKG49	7.6234	8.1290	8.5404	7.7489	8.5942	8.0212	9.6430	10.4000
PKG50	8.1551	8.8057	9.5433	8.6612	9.0775	8.5227	10.6580	11.8260
Mean	7.8226	8.2821	8.9886	8.3259	8.7715	8.2339	10.2879	11.0760
SD	0.5690	0.3519	0.4555	0.3588	0.4338	0.3811	0.4826	0.5728
Max	8.9829	9.1078	10.4980	9.4950	9.8570	9.0302	11.8000	12.9920
Min	5.5994	7.5852	8.1235	7.5797	7.9114	7.3686	9.2321	10.0680
Diff	3.3835	1.5226	2.3745	1.9153	1.9456	1.6616	2.5679	2.9240

Table C-1-17: TCB 2012th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	8.0645	6.0092	7.5308	6.1774	7.7639	5.4100	9.4169	7.7201
PKG02	6.5238	6.4926	7.7363	6.7333	7.8667	5.4644	9.9728	8.2578
PKG03	7.2609	6.7041	7.9719	6.8843	8.3138	5.7363	9.9667	8.4995
PKG04	6.5359	6.2570	7.5067	9.7784	7.3229	5.4282	9.7069	7.6416
PKG05	6.3969	6.4684	7.6215	6.3828	7.7519	5.8149	9.5377	8.0041
PKG06	5.8713	5.8763	7.2046	5.7484	7.1658	4.9931	9.1510	7.0253
PKG07	6.4694	6.2992	7.3315	6.0022	7.7760	5.3919	9.0423	7.6355
PKG08	6.8682	6.6376	8.2378	7.1139	8.4950	5.8692	10.4080	9.3635
PKG09	6.4392	6.0817	7.4946	6.2499	7.6431	5.3859	9.4773	8.2699
PKG10	7.0072	6.5107	7.8994	6.6305	8.2594	5.6215	10.1300	8.4089
PKG11	6.6507	6.1965	7.5067	6.3828	7.8123	5.2892	9.2840	7.5388
PKG12	6.6446	6.6316	7.8571	6.9206	8.6400	6.0445	10.1360	8.9406
PKG13	6.3184	5.7132	7.4342	5.9297	7.5887	5.2469	9.2477	8.1733
PKG14	7.3636	7.1512	8.1834	7.3193	8.6884	5.8934	10.1720	9.2548
PKG15	6.1854	5.8703	7.3919	6.2136	7.6854	5.2530	9.2356	8.0766
PKG16	7.2307	7.2720	8.4190	7.8510	9.5222	6.4312	10.7700	9.6052
PKG17	6.8501	6.3355	7.7000	6.5157	8.0540	5.6578	9.6827	8.1431
PKG18	6.3244	6.0697	7.6034	6.3526	7.7942	5.4886	9.5438	8.0041
PKG19	6.2640	5.9549	7.4281	6.0928	7.4135	5.1140	9.1148	7.8289
PKG20	6.4875	5.9851	7.4704	6.2922	7.5525	5.3678	9.4954	7.9799
PKG21	6.2942	6.0999	7.5308	6.3043	7.7639	5.2711	9.3081	7.4905
PKG22	6.4452	6.1663	7.6698	6.4614	7.7398	5.2892	9.4471	7.9980
PKG23	5.7383	5.6225	7.4160	5.9720	6.9604	4.9086	9.1027	7.2307
PKG24	5.9921	5.8703	7.0596	5.7605	7.5706	5.1805	8.8248	7.4120
PKG25	6.3969	6.3959	7.9417	6.7997	7.7035	5.3496	9.7250	8.0947
PKG26	6.4996	6.4866	7.7967	6.4553	7.8908	5.4463	9.6646	7.8893
PKG27	6.3305	5.9851	7.6517	6.2499	7.4981	5.4282	9.2779	7.7382
PKG28	6.0706	6.1180	7.5671	6.2741	7.3168	5.2227	9.2719	7.5509
PKG29	6.5117	6.3718	7.8813	6.9387	7.7942	5.4644	9.6827	8.2216
PKG30	6.4452	5.9186	7.5550	6.1895	7.4256	5.3798	9.1208	7.5268
PKG31	5.9438	5.5561	7.0535	5.6819	7.0752	5.2711	8.7946	6.9165
PKG32	6.2459	5.9609	7.2771	5.8209	7.3954	5.4342	9.0181	7.3032
PKG33	6.6084	6.2449	7.6638	6.5520	7.8244	5.6276	9.6163	8.4210
PKG34	6.2519	5.8703	7.5067	6.1472	7.2081	5.2046	9.3565	7.3697
PKG35	6.6205	6.2872	7.4402	6.1170	7.9573	5.5611	9.3686	7.7201
PKG36	6.8078	6.7584	8.0625	6.9689	8.0117	5.7544	9.7794	8.2095
PKG37	6.4513	6.1724	7.6456	6.3828	7.8727	5.5369	9.3806	8.0464
PKG38	6.7776	6.5349	7.7363	6.3768	8.1083	5.4342	9.3686	7.7745
PKG39	6.5419	6.1965	7.5188	6.3587	7.7942	5.3798	9.5136	8.1853
PKG40	6.3969	5.9367	7.6275	6.3405	7.5102	5.1925	9.3383	7.8772
PKG41	6.7776	6.5711	7.9055	6.7393	8.1506	6.0505	9.6344	8.5358
PKG42	6.2640	6.0213	7.7363	6.4070	7.6552	5.3436	9.4773	8.2578
PKG43	6.3305	6.1845	7.5550	6.1532	7.6189	5.5671	9.3263	8.0766
PKG44	6.2640	5.9307	7.2710	5.8632	7.5223	5.3798	8.9879	7.5268
PKG45	6.3184	6.3778	7.7967	6.6064	7.6371	5.5551	9.4773	7.7805
PKG46	6.5600	6.6074	7.9236	6.6849	8.0540	5.9055	9.7069	8.4149
PKG47	6.3002	6.0153	7.3435	6.0988	7.3168	5.5248	9.2840	7.8712
PKG48	6.1190	5.7978	7.5611	6.0988	6.9785	5.0777	9.2538	7.4784
PKG49	6.1009	6.0515	7.1744	5.7665	7.3893	5.3134	8.7764	7.0434
PKG50	6.6628	6.4684	7.8511	6.6124	8.2171	5.6699	9.9969	8.3545
Mean	6.4965	6.2219	7.6250	6.4551	7.7614	5.4725	9.4875	7.9738
SD	0.4010	0.3534	0.2866	0.6409	0.4624	0.2863	0.4048	0.5599
Max	8.0645	7.2720	8.4190	9.7784	9.5222	6.4312	10.7700	9.6052
Min	5.7383	5.5561	7.0535	5.6819	6.9604	4.9086	8.7764	6.9165
Diff	2.3262	1.7159	1.3655	4.0965	2.5618	1.5226	1.9936	2.6887

Table C-1-18: TCB 2012th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.7443	8.1954	8.9029	8.4437	8.7090	8.1722	10.1690	11.0170
PKG02	7.9437	8.3707	9.2110	8.5283	8.5579	8.0635	10.4160	11.0830
PKG03	8.6143	8.9144	9.3137	8.5645	9.4280	8.9154	10.5980	11.3910
PKG04	7.7987	8.3827	8.9089	8.1778	8.8419	8.3595	10.0600	10.1590
PKG05	7.4784	8.2317	9.0600	8.3833	8.5459	7.9185	10.3080	10.5210
PKG06	7.5086	7.6939	8.6068	7.7247	8.0564	7.5620	9.3953	10.1100
PKG07	7.5570	8.1169	8.8425	8.0328	8.6002	7.8943	9.9451	10.6840
PKG08	8.5781	9.1924	10.2680	9.1748	9.4763	8.8187	11.5890	12.4120
PKG09	7.7685	8.6788	9.1567	8.1295	8.3827	7.4109	10.2960	10.8170
PKG10	8.1310	8.6969	9.2231	8.7095	9.0715	8.3837	10.5980	11.7170
PKG11	8.0706	8.6848	8.6250	7.9724	8.9205	8.4441	10.0840	10.7990
PKG12	8.4331	9.3736	9.6219	8.5947	9.3494	8.9154	10.6760	11.7420
PKG13	7.2911	8.1652	8.7760	8.0993	8.2498	7.7251	10.0060	10.6960
PKG14	8.4210	8.7634	9.7306	9.0298	9.4522	8.5529	11.4310	9.9411
PKG15	7.4059	8.2559	8.5887	8.1899	8.5096	7.9607	10.1990	10.9260
PKG16	8.8077	9.1561	10.4740	9.4829	9.7059	8.8127	11.8850	12.9140
PKG17	8.0464	8.5398	9.2231	8.2926	8.8902	8.4320	10.4470	11.2040
PKG18	7.7805	8.3344	9.2412	8.3712	8.5640	8.1964	10.2470	11.0530
PKG19	7.5630	8.2619	9.0660	8.1114	8.3767	7.8037	10.0600	10.7690
PKG20	7.8530	8.5640	9.1023	8.1053	8.5519	8.1118	10.2110	11.2940
PKG21	7.8470	8.3646	8.6914	8.0510	8.4552	8.0695	9.9693	10.7450
PKG22	7.9014	8.3646	8.8485	8.1899	8.6486	8.3414	10.5130	10.8530
PKG23	7.0555	7.6517	8.4618	7.9362	7.9960	7.5197	9.7880	10.9140
PKG24	7.3878	8.0565	8.2685	7.7912	8.2860	7.8762	9.6611	10.1530
PKG25	7.9739	8.4069	9.1748	8.3954	8.9567	8.5045	10.5190	11.3130
PKG26	8.0645	8.5942	9.0600	8.4377	8.9688	8.4199	10.6760	10.9620
PKG27	7.6234	8.0444	8.9271	8.1778	8.5640	8.1964	10.1990	10.9560
PKG28	7.5509	8.5459	8.6189	7.9060	8.2558	8.1360	9.9451	10.7140
PKG29	7.9497	8.2619	9.3802	8.3712	8.9084	8.4079	10.5370	11.5600
PKG30	7.9678	8.3888	8.5222	7.9301	8.6546	8.5529	9.9693	10.5030
PKG31	5.6054	7.7181	8.2624	7.5434	7.8994	7.8339	9.1053	10.0860
PKG32	7.5147	8.1773	8.4377	7.7247	8.5217	7.8762	9.9451	10.1830
PKG33	7.7805	8.4794	9.1083	8.4437	8.4915	8.1178	10.7250	11.2100
PKG34	7.4603	8.4250	8.6068	8.0208	8.2981	7.8218	10.3140	10.8290
PKG35	7.7987	8.5942	8.8183	8.0993	8.6788	8.0695	10.0480	10.6540
PKG36	8.4149	8.6728	9.2231	8.5404	9.3132	8.8248	10.6640	11.4030
PKG37	7.6718	8.2377	9.1567	8.3047	8.6848	7.9910	10.3980	11.3430
PKG38	8.5841	8.9930	9.1144	8.3531	9.3736	8.8489	10.3440	10.8410
PKG39	7.8289	8.6788	9.2231	8.3591	8.6909	8.1722	10.1260	11.0410
PKG40	7.7201	8.2075	8.9271	8.2141	8.6304	8.1843	10.1570	10.8590
PKG41	8.0887	8.3223	9.8092	8.7095	8.8480	8.2145	10.6100	11.5660
PKG42	7.8530	8.1592	9.2775	8.3893	8.6486	8.1118	10.1690	11.1800
PKG43	7.8530	8.3223	8.9814	8.2866	8.4431	7.9366	10.2230	11.0410
PKG44	7.7866	8.0323	8.7337	8.0630	8.4492	7.9547	9.7336	10.7750
PKG45	8.0766	8.3525	8.8062	8.1960	8.8419	8.4260	10.4890	11.0530
PKG46	8.1914	8.8721	9.3681	8.6431	9.4219	8.7281	10.6580	11.7290
PKG47	7.2609	7.8269	8.8364	8.2564	8.2619	7.6164	9.8061	10.6540
PKG48	7.2307	7.8087	8.6129	8.1960	8.2860	7.8399	10.4040	10.7750
PKG49	7.4422	7.9356	8.3772	7.7730	8.5036	7.9426	9.6793	10.4000
PKG50	8.0585	8.8721	9.2050	8.6491	9.1319	8.3897	10.5860	11.8500
Mean	7.8068	8.3988	9.0156	8.2814	8.7071	8.1876	10.2916	10.9879
SD	0.4989	0.3819	0.4489	0.3631	0.4153	0.3769	0.4880	0.5705
Max	8.8077	9.3736	10.4740	9.4829	9.7059	8.9154	11.8850	12.9140
Min	5.6054	7.6517	8.2624	7.5434	7.8994	7.4109	9.1053	9.9411
Diff	3.2023	1.7219	2.2116	1.9395	1.8065	1.5045	2.7797	2.9729

Table C-1-19: TCC 100th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.1734	6.1240	7.5550	6.3768	8.0117	5.4040	9.2779	7.6597
PKG02	6.1734	6.2026	7.7846	6.4976	7.9815	5.8028	9.6888	8.1551
PKG03	6.6084	6.7766	7.9417	6.9508	8.5857	5.9297	9.8338	8.3243
PKG04	5.9619	6.1784	7.5308	6.7635	7.3833	5.4403	9.2235	7.6839
PKG05	6.1854	6.3234	7.7061	6.4251	7.8002	5.4886	9.4652	8.0947
PKG06	5.8592	5.7373	7.1985	5.7726	7.0510	4.9992	8.7221	7.1038
PKG07	6.1975	6.2630	7.3194	6.0747	7.6794	5.4221	8.9456	7.4240
PKG08	6.7292	6.5228	8.1955	7.2710	8.3802	5.7544	10.3530	9.5146
PKG09	6.1431	6.0697	7.4583	6.2982	7.5948	5.4644	9.4954	7.9316
PKG10	6.6386	6.5168	7.8148	6.5762	8.1748	5.5913	9.7069	8.2458
PKG11	6.3969	6.2026	7.5369	6.2136	7.8244	5.7001	9.4108	7.4422
PKG12	6.6930	6.6074	7.8450	6.6728	8.3923	5.8572	9.8217	8.4633
PKG13	6.0948	5.7615	7.3556	5.8934	7.3652	5.1805	9.1813	7.7322
PKG14	7.1038	7.0787	8.1653	7.3556	8.7669	5.9901	10.2390	8.8983
PKG15	6.2096	5.8521	7.3496	5.9961	7.6310	5.1442	9.0846	7.4543
PKG16	7.2186	7.3083	8.4009	7.5368	9.3228	6.4916	10.6860	9.6233
PKG17	6.6265	6.3657	7.6154	6.4735	8.2473	5.9659	9.6284	8.1793
PKG18	6.3909	5.9971	7.6336	6.2922	7.7700	5.5611	9.4290	8.0283
PKG19	6.2157	5.8763	7.3254	5.9478	7.3591	5.2167	9.1813	7.5932
PKG20	6.2398	6.0274	7.4644	6.2680	7.4377	5.3678	9.4531	7.9980
PKG21	6.3486	6.2630	7.4886	6.0868	7.7096	5.5913	9.1994	7.5751
PKG22	6.3305	6.1784	7.7484	6.4312	7.5343	5.3798	9.3806	7.8107
PKG23	6.0404	5.6528	7.3435	6.0505	7.0026	5.0173	8.9335	7.1884
PKG24	6.0767	5.8582	7.0233	5.5369	7.3833	5.1865	8.6314	7.0434
PKG25	6.3667	6.3718	7.8934	6.7876	7.8485	5.4100	9.6102	8.1310
PKG26	6.3486	6.4866	7.8148	6.6245	7.5162	6.0505	9.4954	7.8953
PKG27	6.3848	6.0636	7.6396	6.2982	7.5041	5.2288	9.2417	7.6114
PKG28	6.1794	6.0213	7.5006	6.4916	7.3531	5.3859	9.8640	7.5268
PKG29	6.4392	6.4140	7.9598	6.9387	7.7821	5.4342	9.8157	8.0947
PKG30	6.2519	5.9911	7.4886	6.4070	7.4437	5.0959	9.6646	7.3878
PKG31	5.7383	5.4715	7.0294	5.6397	6.9301	4.9690	8.8308	7.0011
PKG32	6.2096	6.0092	7.2227	5.8511	7.4377	5.1502	8.9939	7.2549
PKG33	6.4452	6.2570	7.6879	6.3828	8.0117	5.7121	9.5438	8.2518
PKG34	6.1009	5.8401	7.5550	6.2620	7.2987	5.0536	9.2054	7.6234
PKG35	6.3607	6.0757	7.4825	6.1351	7.9089	5.4221	9.2356	8.0101
PKG36	6.6023	6.6376	8.0807	6.9749	7.9210	5.6940	9.8157	8.2156
PKG37	6.3969	6.1240	7.5973	6.2801	7.7942	5.4584	9.4350	8.1733
PKG38	6.6265	6.4020	7.7000	6.8722	8.0660	5.5248	9.3806	7.7080
PKG39	6.3184	6.0576	7.5852	6.3587	7.8304	5.3798	9.4773	8.0041
PKG40	6.1915	6.0334	7.6154	6.4432	7.5283	5.1563	9.4169	7.8289
PKG41	6.5178	6.6739	7.8511	6.7876	8.2413	5.8451	9.7552	8.5237
PKG42	6.2338	6.1240	7.6819	6.3768	no ball	5.3255	9.4834	8.1068
PKG43	6.2338	6.0334	7.5188	6.1351	7.6431	5.4100	9.3686	7.8832
PKG44	6.1734	5.8944	7.2408	6.0686	7.5404	5.4705	9.2175	7.9135
PKG45	6.3848	6.2328	7.7786	6.6003	7.6733	5.3678	9.6646	7.7080
PKG46	6.6386	6.5349	8.0686	6.9085	8.0721	6.1593	9.7492	8.4512
PKG47	6.1129	5.9428	7.5731	6.2318	7.3954	5.5430	9.3383	7.8651
PKG48	5.9498	5.6588	7.6336	6.0807	6.9543	4.9811	9.2719	7.5691
PKG49	6.1734	6.1059	7.2227	5.7061	7.5102	5.2288	8.8187	7.0374
PKG50	6.6628	6.2751	7.9175	6.5278	8.2111	5.5248	9.9123	8.4935
Mean	6.3340	6.1895	7.6228	6.3986	7.7511	5.4786	9.4516	7.9087
SD	0.2797	0.3494	0.2928	0.4284	0.4665	0.3270	0.3983	0.5433
Max	7.2186	7.3083	8.4009	7.5368	9.3228	6.4916	10.6860	9.6233
Min	5.7383	5.4715	7.0233	5.5369	6.9301	4.9690	8.6314	7.0011
Diff	1.4803	1.8368	1.3776	1.9999	2.3927	1.5226	2.0546	2.6222

Table C-1-20: TCC 100th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.5691	8.2921	8.8606	8.4195	8.5821	8.0695	10.0300	10.9200
PKG02	7.9739	8.6305	9.1506	8.6431	8.4371	8.1662	10.2590	11.1370
PKG03	8.7654	8.9628	9.3440	8.4195	9.6455	9.0906	10.6520	11.3970
PKG04	8.2518	8.1954	8.6370	8.0328	8.7815	8.3837	10.1690	10.6780
PKG05	7.4603	8.0383	8.9935	8.3833	8.6244	8.1058	10.2470	11.2880
PKG06	6.9165	7.5973	8.2866	7.6703	8.0021	7.8459	9.3651	10.0260
PKG07	7.5509	8.0625	8.9754	8.0449	8.5459	8.0272	9.8424	10.7390
PKG08	8.5841	8.9990	10.0750	9.2050	9.6395	8.8550	11.6310	12.5030
PKG09	7.5691	7.9779	9.0116	8.1053	8.2558	7.3686	9.9934	10.8230
PKG10	8.1068	8.5821	9.3681	8.6068	9.1017	8.3172	10.6760	11.5970
PKG11	8.2699	8.6607	8.9512	8.0872	9.0594	8.7281	10.1020	10.6060
PKG12	8.6385	8.7453	9.9240	8.6854	9.1923	8.7462	10.7610	11.7360
PKG13	7.3818	8.0565	9.2231	8.0328	8.1712	7.7795	9.8907	10.7390
PKG14	8.6627	8.7090	10.1480	8.9271	9.5911	8.7462	11.3050	12.6780
PKG15	7.4059	7.8450	8.8787	8.1597	8.4069	8.0030	10.0300	10.8720
PKG16	8.8500	8.9990	10.7940	9.4406	9.7724	9.0423	11.6250	12.9560
PKG17	8.1370	8.5096	9.2292	8.3833	8.8963	8.4864	10.5550	11.2040
PKG18	7.6234	8.2438	9.2835	8.3229	8.5881	8.2810	10.2110	11.0290
PKG19	7.3938	7.9779	8.9633	8.4195	8.3827	8.0393	9.9391	10.7930
PKG20	7.6295	8.2861	9.1506	8.1295	8.5459	8.1903	10.1630	10.9560
PKG21	7.5268	8.3888	8.8968	8.0087	8.5338	8.1239	9.9330	10.7200
PKG22	7.7503	8.5942	8.8425	8.2806	8.7150	8.4864	10.6520	10.9020
PKG23	7.1038	7.5308	8.7458	7.9724	8.0685	7.6889	9.8726	10.5330
PKG24	7.2488	8.1108	8.5222	7.7307	8.3163	7.8580	9.4013	10.1590
PKG25	7.8833	8.5277	9.3137	8.4074	8.9507	8.4804	10.4830	11.2040
PKG26	7.9678	8.6184	8.9210	8.4195	8.9688	8.5529	10.5370	11.0830
PKG27	7.5328	7.9658	8.7639	8.2141	8.6727	8.0695	10.2290	11.0040
PKG28	7.2428	7.7483	8.6491	8.0147	8.2015	7.7855	9.9934	10.7450
PKG29	7.9558	8.3223	9.0479	8.4558	8.9688	8.4502	10.8450	11.3610
PKG30	7.8047	8.1834	8.4981	7.9362	8.6002	8.2447	9.9209	10.5690
PKG31	5.3396	7.5248	8.1537	7.5616	7.7846	7.4713	9.1717	9.9229
PKG32	7.8833	8.2740	8.3470	7.7368	8.4069	8.0212	9.5886	10.2010
PKG33	7.5993	8.0867	9.1446	8.3772	8.6002	8.0755	10.2710	11.2460
PKG34	7.3334	7.7725	8.4679	7.9966	8.3344	7.8157	10.1440	11.0040
PKG35	7.7262	8.3223	8.6733	8.0933	8.8057	8.0876	9.8243	10.6420
PKG36	8.3606	8.5338	9.1325	8.4195	9.3857	8.5891	10.4770	11.1980
PKG37	7.5086	8.0444	8.9633	8.2806	8.5761	8.0695	10.2830	11.2580
PKG38	8.4331	8.8057	8.7700	8.2383	9.2951	8.8066	10.3440	10.9560
PKG39	7.8168	8.4915	9.0539	8.3047	8.6002	8.0997	10.2290	11.0710
PKG40	7.9497	8.6425	8.7095	8.1899	8.5821	8.1601	10.1930	10.9200
PKG41	8.0947	8.3344	9.4406	8.6672	8.9265	8.2508	10.9900	11.5840
PKG42	7.6778	8.1531	9.1627	8.4437	8.5036	8.1360	10.3140	11.1860
PKG43	7.6234	8.1592	8.8546	8.2443	8.4794	7.9124	10.1380	11.0350
PKG44	7.5268	8.0625	8.5827	7.9966	8.3888	7.9366	9.7518	10.6780
PKG45	8.2397	8.3525	8.7398	8.3229	8.8600	8.3414	10.3560	10.9080
PKG46	8.1189	8.4673	9.3681	8.6189	9.2830	8.8127	10.7610	11.5360
PKG47	7.2186	7.7725	8.8425	8.0087	8.2377	7.7312	10.1200	10.6300
PKG48	7.3093	7.9840	8.5827	8.0570	8.3465	7.7553	10.1320	10.7450
PKG49	7.3818	8.1229	8.3229	7.6522	8.4190	7.9305	9.7095	10.4120
PKG50	8.0706	8.6788	9.2171	8.6310	9.1078	8.6012	10.9180	11.7660
Mean	7.7594	8.2789	8.9996	8.2680	8.7028	8.2123	10.2606	11.0371
SD	0.5729	0.3690	0.4867	0.3632	0.4464	0.3903	0.5047	0.5879
Max	8.8500	8.9990	10.7940	9.4406	9.7724	9.0906	11.6310	12.9560
Min	5.3396	7.5248	8.1537	7.5616	7.7846	7.3686	9.1717	9.9229
Diff	3.5104	1.4742	2.6403	1.8790	1.9878	1.7220	2.4593	3.0331

Table C-1-21: TCC 200th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.3184	6.0394	7.4281	6.1714	7.6673	5.5732	9.1752	7.7503
PKG02	6.4090	6.2811	7.6577	6.5762	7.6612	5.7061	9.6586	8.3001
PKG03	6.8380	6.8007	7.9477	6.9206	8.2413	6.1290	9.9425	8.8681
PKG04	6.3727	6.0697	7.6577	6.9689	7.2866	5.5430	9.4048	7.7322
PKG05	6.4634	6.2267	7.6275	6.4191	7.6310	5.8149	9.6767	8.1793
PKG06	5.9196	5.8401	7.0354	5.6940	7.0026	5.2107	8.8187	7.1642
PKG07	6.2640	6.2570	7.3315	6.1472	7.6431	5.7121	8.9577	7.4845
PKG08	6.7474	6.6195	8.2438	7.1502	8.3138	5.9780	10.3530	9.1158
PKG09	6.1734	6.1784	7.4825	6.2136	7.5706	5.8934	9.3565	8.0766
PKG10	6.7776	6.5651	7.8329	6.6849	8.2594	5.9236	9.7613	8.4452
PKG11	6.4271	6.2992	7.5188	6.3103	7.7760	5.5732	9.1933	7.4180
PKG12	6.7776	6.6618	7.8632	6.7635	8.5373	6.1230	9.7855	8.5660
PKG13	6.1854	5.7736	7.4523	6.1351	7.3350	5.2832	9.1631	7.7382
PKG14	7.1522	7.0787	8.3042	7.3375	8.7246	5.9297	10.2270	8.9768
PKG15	6.2096	5.8461	7.5671	6.3284	7.4921	5.3013	9.0967	7.4845
PKG16	7.2186	7.2841	8.6909	7.9537	9.3772	6.5399	10.6740	9.7019
PKG17	6.6084	6.3597	7.6879	6.7333	7.9754	5.7605	9.6465	8.2518
PKG18	6.4452	6.0274	7.6336	6.3405	7.8485	5.9599	9.3988	8.0585
PKG19	6.1975	5.8582	7.3435	6.2318	7.4377	5.3496	9.3021	7.5811
PKG20	6.3727	5.9367	7.5671	6.3103	7.4679	5.4403	10.3590	8.0222
PKG21	6.3727	6.1965	7.5852	6.2499	7.7881	5.5067	9.6888	7.5207
PKG22	6.3909	6.0636	7.7302	6.6064	7.5948	5.5913	9.5256	7.7382
PKG23	5.8410	5.6165	7.4402	6.0082	7.0147	5.2348	9.1208	7.3999
PKG24	5.9679	5.8582	7.1985	5.6094	7.3893	5.3919	8.8066	7.0676
PKG25	6.2821	6.3053	7.9296	6.7937	7.6552	5.7242	9.6888	8.1008
PKG26	6.3546	6.4684	7.8209	6.5278	7.6612	5.9115	9.7190	7.9437
PKG27	6.2700	6.0213	7.7302	6.3889	7.4981	5.4342	9.2356	7.6355
PKG28	6.0646	6.1301	7.5671	6.2620	7.2141	5.5128	9.1329	7.6476
PKG29	6.6809	6.4866	8.0444	6.7876	7.7035	6.0263	9.6948	8.1793
PKG30	6.3969	5.9911	7.4463	6.2318	7.3712	5.2046	9.2054	7.4784
PKG31	5.8954	5.5138	6.9750	5.7545	6.9060	5.0415	8.9094	6.9346
PKG32	6.1975	6.0999	7.2469	5.8270	7.3954	5.3738	8.9275	7.3878
PKG33	6.3425	6.2570	7.6698	6.2982	7.6310	5.5430	9.7613	8.2941
PKG34	6.0767	5.9549	7.5792	6.0686	7.0208	5.0173	9.3625	7.3213
PKG35	6.4211	6.1905	7.4523	5.9357	7.5766	5.5188	9.2960	7.6416
PKG36	6.6205	6.6678	8.0323	6.8904	7.8667	5.6880	10.1240	8.4693
PKG37	6.3184	6.2630	7.5127	6.1834	7.7821	5.4886	9.7492	8.0464
PKG38	6.8078	6.4503	7.6456	6.5037	7.9996	5.6578	9.4954	7.8409
PKG39	6.3607	6.0153	7.5429	6.4312	7.6552	5.2952	10.0390	8.1128
PKG40	6.1975	6.0153	7.6275	6.4070	7.4014	5.2409	9.3383	7.9195
PKG41	6.5661	6.6316	7.8390	6.7453	8.0902	5.7847	9.6767	8.5841
PKG42	6.2519	6.0274	7.6456	6.3526	no ball	5.4523	9.4652	8.3183
PKG43	6.0948	5.9246	7.5188	6.2499	7.4981	5.5611	9.2235	8.0766
PKG44	6.1915	6.0576	7.2046	5.9478	7.3954	5.5732	8.9758	7.5388
PKG45	6.4694	6.3234	7.5973	6.5037	7.7639	5.6759	9.4108	7.9135
PKG46	6.5419	6.6497	7.9598	6.6487	8.0902	6.1593	9.6586	8.2760
PKG47	5.4967	6.0576	7.3738	6.0566	7.4377	5.5430	9.2960	7.8168
PKG48	5.3335	5.6648	7.4583	6.1472	6.9906	5.1684	9.1692	7.4966
PKG49	6.1190	5.9126	7.1502	5.6699	7.3229	5.3557	8.7281	7.1099
PKG50	6.7171	6.3174	7.8511	6.4795	8.2352	5.5309	9.9546	8.3847
Mean	6.3504	6.2027	7.6250	6.3991	7.6775	5.5990	9.4866	7.9422
SD	0.3479	0.3535	0.3160	0.4360	0.4665	0.3129	0.4314	0.5509
Max	7.2186	7.2841	8.6909	7.9537	9.3772	6.5399	10.6740	9.7019
Min	5.3335	5.5138	6.9750	5.6094	6.9060	5.0173	8.7281	6.9346
Diff	1.8851	1.7703	1.7159	2.3443	2.4712	1.5226	1.9459	2.7673

Table C-1-22: TCC 200th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6295	8.1350	8.8243	8.4860	8.6848	8.1541	10.0060	10.8110
PKG02	7.7322	8.1350	9.2050	8.5283	8.5398	8.0333	10.6100	11.1070
PKG03	8.7533	8.8117	9.2533	8.6310	9.4763	8.7402	10.9180	11.3550
PKG04	7.9437	8.2256	8.7639	8.0751	8.6365	8.2568	9.9693	10.7510
PKG05	7.7745	8.0323	9.0962	8.4316	8.5519	7.8641	10.3380	11.2880
PKG06	7.0555	7.5308	8.2926	7.7912	8.0202	7.5076	10.3560	10.0500
PKG07	7.8470	7.8873	8.6491	8.1174	8.4733	8.0030	10.3560	10.6960
PKG08	8.5056	8.9990	10.0870	9.1567	9.3978	8.8006	11.6970	12.3400
PKG09	7.5328	8.0142	8.9029	8.2322	8.4673	7.3928	10.4590	10.7510
PKG10	8.1189	8.7634	9.3379	8.7095	9.1501	8.3716	10.8760	11.5360
PKG11	8.1491	8.4190	8.6431	8.0147	8.9688	8.5710	10.0780	10.6660
PKG12	8.5358	9.6757	9.6098	8.6854	9.1923	8.6737	10.7430	11.5240
PKG13	7.1884	7.9417	8.7337	8.1839	8.2860	7.8762	9.9089	10.7270
PKG14	8.4089	8.6788	9.8394	9.1023	9.4703	8.6797	11.2560	12.6780
PKG15	7.3334	8.0686	8.8666	8.1899	8.3767	7.9547	10.0960	10.7870
PKG16	8.8802	9.4461	10.6250	9.5010	9.6636	8.9637	11.9090	12.8900
PKG17	8.0343	8.6969	9.3137	8.4074	8.9386	8.3958	10.3920	11.1740
PKG18	7.6355	8.2861	9.1808	8.3772	8.5821	8.2689	10.4100	11.0350
PKG19	7.4180	8.0021	8.7820	8.1839	8.4250	8.0030	10.5010	10.8230
PKG20	7.8893	8.4794	9.0660	8.1899	8.5398	8.0453	10.3980	10.8780
PKG21	7.5207	8.1652	8.8606	8.1174	8.4915	8.0755	10.1810	10.8780
PKG22	7.7685	8.5157	8.8787	8.1416	8.6365	8.3776	10.4280	10.9140
PKG23	7.0917	7.5006	8.4739	7.9422	8.0021	7.7734	10.4040	10.5940
PKG24	7.2972	7.7785	8.3108	7.7368	8.2015	7.7191	9.8424	10.1530
PKG25	7.9255	8.3042	9.0539	8.2987	8.8359	8.4683	10.7060	11.1980
PKG26	7.9497	8.4311	8.9331	8.2503	8.9990	8.2991	10.6100	11.1920
PKG27	7.4905	7.9719	8.6129	8.1356	8.6244	8.4622	10.2290	10.9140
PKG28	7.1159	7.6698	8.6370	7.9482	8.2679	7.7009	10.0600	10.7270
PKG29	8.1008	8.1592	9.6823	8.4618	8.9386	8.4139	10.6100	11.2160
PKG30	7.7020	8.2075	8.5706	8.0087	8.5579	8.0151	10.2170	10.5690
PKG31	5.2187	7.5248	8.0630	7.5193	7.7121	7.4834	9.1657	9.8202
PKG32	7.4905	7.9719	8.2987	7.7912	8.4854	7.9426	9.6551	10.1830
PKG33	7.5872	8.0565	9.0781	8.5041	8.5036	7.9728	10.6160	11.2700
PKG34	7.2851	7.8571	8.5404	8.0570	8.4129	7.8580	10.5070	10.8050
PKG35	7.8651	8.3525	8.7156	8.1295	8.6184	7.9366	9.8666	10.6540
PKG36	8.2699	8.7090	9.1506	8.4558	9.2105	8.5770	10.6640	11.1860
PKG37	7.6355	8.2317	8.9573	8.3531	8.6244	7.9849	10.2770	11.1980
PKG38	8.3122	8.8842	8.7639	8.3893	9.2769	8.7160	10.2350	10.7930
PKG39	7.7624	8.8298	8.9573	8.2987	8.5700	8.2326	10.3140	10.9560
PKG40	7.9316	8.6909	8.7579	8.2806	8.4733	8.1360	10.2230	10.8290
PKG41	7.9014	8.3284	9.3923	8.7398	8.8721	8.2568	10.5310	11.5060
PKG42	7.8772	8.1108	9.1627	8.3349	8.4311	8.0272	10.4350	11.2520
PKG43	7.7987	8.0806	8.8546	8.5041	8.4431	7.8701	10.5490	10.9560
PKG44	7.6355	8.0383	8.5464	7.9845	8.3344	7.8580	9.7699	10.5270
PKG45	8.0706	8.6546	8.7095	8.1839	8.7936	8.3233	11.1900	10.8290
PKG46	8.2881	8.3344	9.3500	8.7035	9.1742	8.6314	10.7910	11.5970
PKG47	7.4724	7.7846	8.8183	8.2564	8.0625	7.6889	9.9028	10.8230
PKG48	7.3757	7.7846	8.4981	8.0751	8.2075	7.8943	10.0420	10.6900
PKG49	7.3818	7.8027	8.2624	7.7187	8.4190	7.8762	9.7095	10.3760
PKG50	8.0645	8.6244	9.4708	8.7277	8.9930	8.5468	10.5980	11.6630
Mean	7.7511	8.2717	8.9487	8.3009	8.6603	8.1535	10.3921	11.0027
SD	0.5556	0.4591	0.4805	0.3707	0.4151	0.3668	0.4854	0.5723
Max	8.8802	9.6757	10.6250	9.5010	9.6636	8.9637	11.9090	12.8900
Min	5.2187	7.5006	8.0630	7.5193	7.7121	7.3928	9.1657	9.8202
Diff	3.6615	2.1751	2.5620	1.9817	1.9515	1.5709	2.7433	3.0698

Table C-1-23: TCC 300th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	7.3999	6.1603	7.8088	6.3768	7.7277	5.5188	9.6163	7.8107
PKG02	6.9226	6.2751	7.7544	6.7937	8.0781	5.5913	10.1060	8.6808
PKG03	7.2609	6.9216	8.0505	7.0837	8.4527	5.9297	10.1960	8.7352
PKG04	6.3788	6.1784	7.6577	no ball	7.5646	5.6517	9.7129	7.9014
PKG05	6.7776	6.4020	7.8813	6.4855	7.8304	5.7726	9.6707	11.3760
PKG06	6.3425	5.8582	7.1683	5.7605	7.1054	5.0838	8.9879	8.7473
PKG07	6.5903	6.3234	7.4583	6.2378	7.6371	5.5611	9.2477	7.7805
PKG08	7.1220	6.6618	8.4432	7.1502	8.2654	5.8330	10.4380	9.6898
PKG09	6.7776	6.1965	7.6396	6.5762	7.6612	5.5913	9.6344	8.0826
PKG10	6.9588	6.6557	7.9175	6.7453	8.3138	5.8874	10.0390	8.5116
PKG11	6.5661	6.2811	7.7302	6.3768	8.1385	5.6034	9.5619	7.6839
PKG12	7.0797	6.6316	7.8934	6.7816	8.7367	6.1713	10.1300	9.0735
PKG13	6.5359	5.8038	7.4342	6.1955	7.5585	5.5309	9.5075	8.7533
PKG14	7.4664	7.0968	8.3284	7.3979	8.8878	5.9840	10.4800	9.6052
PKG15	6.5117	6.0032	7.5067	6.0807	7.6068	5.4040	9.2477	7.7322
PKG16	7.6295	7.5077	8.5942	7.7242	9.4074	6.5339	10.9520	9.8892
PKG17	6.9528	6.4443	7.8088	6.6426	8.1990	6.0263	10.0570	8.3847
PKG18	6.6446	6.0334	7.6698	6.4493	7.8485	5.5671	9.5982	8.3666
PKG19	6.4875	6.0213	7.6034	6.1170	7.5827	5.3255	9.3988	8.5116
PKG20	6.2640	6.0092	7.5429	6.2559	7.5404	5.5430	9.5377	8.1853
PKG21	6.8199	6.2872	7.5550	6.5037	7.7700	5.5128	9.3263	7.9255
PKG22	6.5480	6.1724	7.8692	6.5278	7.6371	5.5551	9.6223	8.0947
PKG23	6.1250	5.6709	7.5792	6.3889	7.0147	5.2469	9.1390	7.5570
PKG24	6.4211	6.0274	7.1744	5.6759	7.3229	5.3013	9.2477	7.5449
PKG25	6.6446	6.3718	8.0142	6.8541	7.7579	5.5128	9.8519	8.2639
PKG26	6.5359	6.5711	7.8269	6.5883	7.7216	5.8934	9.8338	8.0343
PKG27	6.6144	6.0999	7.7967	6.3345	7.6431	5.3859	9.5317	7.7080
PKG28	6.4030	6.2267	7.6034	6.4070	7.4316	5.4221	9.7371	7.7503
PKG29	6.8742	6.4080	7.9719	6.8601	7.7337	5.7544	10.0390	8.1733
PKG30	6.5238	6.0636	7.7061	6.1955	7.4498	5.3496	9.7673	7.4301
PKG31	6.1371	5.6346	7.1321	5.8088	6.9966	5.0717	9.4531	7.4422
PKG32	6.4694	6.0394	7.3496	6.0505	7.4014	5.3134	9.1148	7.4543
PKG33	6.8199	6.3295	7.8209	6.6789	8.0298	5.7182	9.8821	8.4089
PKG34	6.4875	5.9669	7.6275	6.2197	7.3168	5.1563	9.4652	7.5388
PKG35	6.8199	6.1965	7.5067	6.0626	7.8123	5.7484	9.4048	7.8107
PKG36	7.1038	6.7947	8.0988	7.0535	8.2654	5.7605	9.9365	8.3847
PKG37	7.0011	6.2811	7.7363	6.3889	8.0479	5.6215	9.6284	8.0766
PKG38	6.9769	6.4866	7.8088	6.5641	8.2171	5.6457	9.5619	7.8289
PKG39	6.7655	6.0576	7.6275	6.3828	7.6552	5.6155	9.6707	8.1128
PKG40	6.3184	6.1603	7.6698	6.3949	7.5041	5.5067	9.5256	7.7624
PKG41	7.0132	6.6678	7.9780	6.8843	8.2594	6.1532	9.8640	8.5358
PKG42	6.6326	6.1119	7.8692	6.4614	no ball	5.6094	9.9425	8.1733
PKG43	6.4936	6.0697	7.6275	6.3345	7.7337	5.5611	9.4290	8.0162
PKG44	6.4513	5.9911	7.3375	5.9901	7.4195	5.7303	9.1390	7.5147
PKG45	6.6688	6.3899	7.7725	6.6668	7.7519	5.5913	9.6042	7.8289
PKG46	6.8621	6.7041	8.0505	6.8360	8.1265	6.4130	9.9667	8.4149
PKG47	6.3184	6.0455	7.4704	6.2076	7.5343	5.8692	9.6404	8.0585
PKG48	6.0767	5.8944	7.5671	6.4009	6.9664	5.3255	9.3263	7.5388
PKG49	6.5600	6.0153	7.2046	5.9176	7.3410	5.3496	8.9939	7.4240
PKG50	7.0917	6.3959	8.0263	6.5883	8.2594	5.8995	10.2690	8.5237
Mean	6.7049	6.2719	7.7254	6.4788	7.8013	5.6341	9.6807	8.2167
SD	0.3449	0.3536	0.3028	0.4045	0.4826	0.3045	0.3969	0.7325
Max	7.6295	7.5077	8.5942	7.7242	9.4074	6.5339	10.9520	11.3760
Min	6.0767	5.6346	7.1321	5.6759	6.9664	5.0717	8.9879	7.4240
Diff	1.5528	1.8731	1.4621	2.0483	2.4410	1.4622	1.9641	3.9520

Table C-1-24: TCC 300th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.7443	8.5217	9.0539	8.3712	8.8298	8.6072	10.6040	11.0100
PKG02	7.7805	8.5580	9.4285	8.5645	8.4733	8.1903	10.5130	11.2940
PKG03	8.7412	9.0957	9.4165	8.6189	9.4461	9.1027	11.2860	11.5000
PKG04	7.9739	8.4855	9.2594	8.2081	8.7694	8.6556	10.2170	10.6960
PKG05	7.6657	8.2619	9.2775	8.6431	8.6365	8.1360	10.3980	11.6570
PKG06	7.0978	8.2075	8.4074	7.7187	7.9960	7.7312	9.4617	10.0920
PKG07	7.8228	8.4009	9.0841	8.0993	8.6184	8.0695	9.9814	10.9200
PKG08	8.7533	9.2165	10.2500	9.5192	9.4340	9.0725	11.6070	12.4790
PKG09	7.5751	8.6184	9.0116	8.1416	8.3465	7.5982	10.2170	10.9380
PKG10	8.2518	8.8178	8.8062	8.7156	9.2105	8.5227	10.7250	11.8560
PKG11	8.2820	9.0413	8.7458	8.2685	8.9990	8.7764	10.0900	10.9380
PKG12	8.6083	9.0534	9.6763	8.7035	9.3011	8.9577	10.6880	11.6450
PKG13	7.4603	8.1290	no ball	8.0449	8.2921	8.2326	9.9330	10.9200
PKG14	8.7110	8.8057	9.8817	8.9633	9.5488	8.8610	11.4920	12.6240
PKG15	7.6597	8.8117	8.8062	8.1658	8.6063	8.0212	10.1260	11.0410
PKG16	9.3273	9.3495	10.6190	9.4648	9.8086	9.1571	12.2110	13.3190
PKG17	8.5600	9.0957	9.2775	8.3651	8.9748	8.6133	10.3560	11.3730
PKG18	7.8107	8.4250	9.5433	8.3410	8.8480	8.4683	10.9840	11.2580
PKG19	7.8470	8.2317	8.8546	8.1476	8.6063	8.1601	9.9814	10.9320
PKG20	8.1914	8.4250	9.1264	8.2201	8.6304	8.6072	10.9480	11.1190
PKG21	7.7866	8.2982	8.7035	8.0933	8.6727	8.4320	10.4890	10.9200
PKG22	7.9920	8.5036	8.8243	8.3470	8.7694	8.4924	10.5430	11.0230
PKG23	7.4784	7.8752	8.6068	7.9664	8.0867	8.0393	10.1630	10.5940
PKG24	7.5993	7.9356	8.6914	7.7912	8.3102	8.0695	9.6551	10.3280
PKG25	8.2156	8.4552	9.1446	8.3229	8.9446	8.9154	10.6580	11.2160
PKG26	8.1128	8.5459	9.0298	8.2564	9.0413	8.6677	10.4830	11.2040
PKG27	7.5389	8.1169	7.5736	8.1658	8.7694	8.5106	10.2170	11.1190
PKG28	7.2488	8.0142	8.2383	8.0026	8.4431	8.0393	10.0480	10.7990
PKG29	7.9497	8.2256	11.2410	8.4497	9.2467	8.6072	10.5980	11.4640
PKG30	7.8107	8.2982	8.6612	7.9422	8.8480	8.4622	10.5130	10.7750
PKG31	5.4000	7.6819	8.3591	7.5313	7.8208	7.6164	9.6128	10.0200
PKG32	7.9376	8.0806	8.4497	7.7912	8.6304	8.1058	10.0120	10.2670
PKG33	7.9739	8.2740	8.4679	8.4437	8.7754	8.4804	10.8150	11.4270
PKG34	7.7685	7.8510	9.0116	8.0570	8.3767	8.2266	10.6220	10.9680
PKG35	7.8893	8.3707	8.8727	8.0389	8.8480	8.3656	10.3860	10.7630
PKG36	8.6506	8.7453	9.3440	8.3893	9.4219	8.8550	10.9840	11.3610
PKG37	8.0101	8.2256	9.2231	8.3229	8.8600	8.3293	10.5250	11.4090
PKG38	8.5902	8.8540	8.4195	8.2383	9.5126	9.3504	10.7120	10.9860
PKG39	7.8107	8.4552	9.0116	8.3047	8.6969	8.3535	10.2590	11.1310
PKG40	7.7503	8.2740	8.8062	8.3047	8.7754	8.3354	10.5010	10.9440
PKG41	8.1310	8.3827	9.5917	8.7337	9.1078	8.7160	11.0810	11.6030
PKG42	7.9014	8.2438	9.3017	8.3772	8.6244	8.2206	10.2710	11.2520
PKG43	7.7382	8.2256	9.1083	8.3108	8.5156	8.0876	10.2590	11.0770
PKG44	7.6839	8.2256	8.7700	7.9905	8.5096	8.0997	9.9089	10.6660
PKG45	8.2639	8.5821	8.9150	8.1778	8.8661	8.5468	10.5980	10.8900
PKG46	8.2881	8.7150	9.4829	8.6068	9.4703	9.0362	11.0390	11.7360
PKG47	7.6839	7.8994	9.2171	8.0449	8.2135	7.9185	9.9209	10.6840
PKG48	7.3938	7.9658	8.7458	8.1476	8.3163	7.9547	10.2110	10.8170
PKG49	7.7624	8.1048	8.4679	7.7428	8.4311	8.2991	9.8001	10.4610
PKG50	8.4270	8.7453	8.8123	8.6129	9.1561	8.6012	10.7430	11.6990
Mean	7.9330	8.4345	9.0534	8.2958	8.7887	8.4255	10.4689	11.1443
SD	0.5687	0.3795	0.6049	0.3786	0.4311	0.3983	0.5225	0.5949
Max	9.3273	9.3495	11.2410	9.5192	9.8086	9.3504	12.2110	13.3190
Min	5.4000	7.6819	7.5736	7.5313	7.8208	7.5982	9.4617	10.0200
Diff	3.9273	1.6676	3.6674	1.9879	1.9878	1.7522	2.7493	3.2990

Table C-1-25: TCC 400th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.1646	5.9884	7.4306	7.1946	8.0933	5.7939	9.6812	8.4324
PKG02	6.2552	6.2845	7.7389	7.4363	7.8213	6.1927	10.1650	9.2301
PKG03	6.7508	6.8223	7.9383	7.9500	8.4801	6.5372	9.7778	9.2362
PKG04	6.0256	6.1213	7.5636	no ball	7.3681	5.9631	9.2944	8.4445
PKG05	6.4003	6.4477	7.5757	7.3940	7.7488	6.2652	9.6026	8.8676
PKG06	5.6932	5.9158	7.1647	6.6144	7.2412	5.6186	8.7324	7.7918
PKG07	6.1283	6.3691	7.3642	7.0616	7.8093	5.8845	9.0829	8.2451
PKG08	6.6601	6.7680	8.2344	8.2280	8.2806	6.4647	10.5820	10.2030
PKG09	6.1465	6.2966	7.5696	7.5666	7.5977	6.1685	9.3246	8.6983
PKG10	6.7266	6.6350	7.8355	7.6418	8.2021	6.1988	9.6691	9.3268
PKG11	6.3882	6.3147	7.5817	7.3940	7.8032	6.1202	9.5301	8.1726
PKG12	6.6481	6.6713	8.0048	7.7626	8.4317	6.3196	9.9471	9.1939
PKG13	6.0981	5.8796	7.4548	7.2248	7.3983	5.7939	9.5784	8.4626
PKG14	7.0711	7.1849	8.4217	8.3549	8.7157	6.4949	10.2430	9.7317
PKG15	6.1888	5.9038	7.3581	7.1462	7.4467	5.8362	9.2219	8.4445
PKG16	7.6754	7.5536	8.5487	9.5937	9.1932	7.0630	10.8410	10.3780
PKG17	6.5151	6.6290	7.6059	7.9500	8.0268	6.5614	9.9591	9.0609
PKG18	6.3459	6.2482	7.7389	7.4000	7.6823	5.9993	9.3790	8.8192
PKG19	6.0921	6.0428	7.4367	6.9830	7.3620	5.8180	9.2944	8.3418
PKG20	6.1948	6.0246	7.4971	7.2610	7.4648	5.9329	9.4757	8.7467
PKG21	6.3822	6.1878	7.6059	7.3336	7.7065	6.0295	9.0889	8.2149
PKG22	6.3701	6.2482	7.8960	7.4544	7.5313	6.4586	9.4032	8.4808
PKG23	5.9531	5.7648	7.5515	7.1039	7.0055	6.2894	9.3911	8.1665
PKG24	6.0800	6.0428	7.1768	6.5902	7.3318	6.1988	8.6961	7.7677
PKG25	6.5151	6.3570	7.9866	7.6780	7.7005	6.5070	9.6993	8.6319
PKG26	6.4547	6.7075	7.7389	7.4061	7.6038	6.6097	9.5240	8.5956
PKG27	6.5151	6.2180	7.6119	7.2731	7.5192	6.2229	9.2642	8.2451
PKG28	6.1948	6.4295	7.5696	7.4242	7.2291	5.9933	9.4817	8.2753
PKG29	6.4607	6.4597	7.8718	8.1917	7.7246	6.5251	9.8987	9.1697
PKG30	6.4668	6.0428	7.5153	7.3336	7.3983	5.8664	9.5663	8.4566
PKG31	6.3036	5.7466	7.1104	5.1459	6.8302	5.6911	8.7142	7.6105
PKG32	6.6239	6.0730	7.2433	5.4118	7.3862	5.8603	9.0043	7.8704
PKG33	6.6541	6.4477	7.6784	5.8832	7.6884	6.2773	9.5724	8.9461
PKG34	6.2492	6.1455	7.6059	7.4242	7.2593	5.6851	9.3669	8.1303
PKG35	6.4668	6.2482	7.4669	7.0858	7.6280	6.2048	9.2944	8.3660
PKG36	6.6239	6.8284	8.1981	8.0406	7.9180	6.3619	10.1280	8.8857
PKG37	7.1497	6.3087	7.5938	7.4907	8.1295	6.4586	9.4938	8.7286
PKG38	6.8717	6.5323	7.7207	7.5088	8.2685	6.2713	9.5240	8.4022
PKG39	6.6058	6.0730	7.5938	7.3456	7.6642	5.9933	9.5542	8.7286
PKG40	6.8535	6.1334	7.5696	7.4544	7.7669	5.8301	9.2702	8.4203
PKG41	7.5002	6.8405	7.9202	7.8774	8.1054	6.6460	9.6872	9.1516
PKG42	6.7629	6.1999	7.6422	7.4907	no ball	5.9691	9.7597	8.8434
PKG43	6.4305	6.1394	7.5817	7.1583	7.6521	6.1262	9.3548	8.6319
PKG44	6.2432	6.3147	7.2856	6.9589	7.4467	6.2834	8.9378	8.1424
PKG45	6.7085	6.5625	7.7389	7.5511	7.7005	6.4344	9.5542	8.4868
PKG46	6.8112	6.6833	8.1558	7.7868	8.1900	6.9542	9.6570	9.0065
PKG47	6.3399	6.0488	7.4911	7.7324	7.6280	6.7124	9.4576	8.5654
PKG48	6.2613	6.0548	7.5999	7.2973	6.9692	6.1021	9.2219	8.1242
PKG49	6.3580	6.2784	7.2252	6.7836	7.6159	5.9389	8.8170	7.7375
PKG50	6.8294	6.5504	7.9806	7.5692	8.4982	6.2592	10.1890	8.9763
Mean	6.4842	6.3354	7.6598	7.3701	7.7401	6.1957	9.5191	8.6317
SD	0.3693	0.3536	0.3090	0.6905	0.4597	0.3247	0.4391	0.5662
Max	7.6754	7.5536	8.5487	9.5937	9.1932	7.0630	10.8410	10.3780
Min	5.6932	5.7466	7.1104	5.1459	6.8302	5.6186	8.6961	7.6105
Diff	1.9822	1.8070	1.4383	4.4478	2.3630	1.4444	2.1449	2.7675

Table C-1-26: TCC 400th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6447	8.2118	8.9919	8.3267	8.8466	7.6778	10.7060	11.3060
PKG02	7.5843	8.2904	9.3485	8.6046	8.4598	7.6658	10.7600	11.3250
PKG03	8.6781	8.9491	9.4995	8.5200	9.4570	8.3849	10.7540	11.6750
PKG04	7.8139	8.3145	8.9315	8.2420	8.7499	7.9558	10.5240	10.7380
PKG05	7.6870	8.1453	9.3485	8.5080	8.6290	7.5328	10.5970	11.4820
PKG06	6.9799	7.6679	8.4238	7.7707	8.0307	7.1219	9.5513	10.2910
PKG07	7.3909	8.0728	8.8287	8.1272	8.6169	7.4603	10.0530	10.8890
PKG08	8.4606	9.0518	10.2970	9.3298	9.4630	8.3245	11.4490	12.5450
PKG09	7.5722	7.9882	9.0826	8.2481	8.2604	6.7593	10.3730	10.9140
PKG10	8.0557	8.5019	9.4572	8.7739	9.0702	7.9558	11.1710	11.6210
PKG11	7.9710	8.5502	8.8046	8.1574	8.9674	8.0586	11.1350	10.6240
PKG12	8.2913	8.8464	9.8017	8.9008	9.1910	8.2399	10.9530	11.8810
PKG13	7.2217	8.1574	no ball	8.3206	8.2664	7.5086	10.5000	10.9500
PKG14	no ball	8.9068	10.0560	9.1606	9.5597	8.2036	11.6420	12.6660
PKG15	7.4392	8.1453	8.9254	8.4113	8.4598	7.4361	10.2100	10.9500
PKG16	8.7929	9.2331	10.7810	9.7650	9.8437	8.5239	11.9750	13.2160
PKG17	7.9227	8.6651	9.4512	8.5623	8.9554	8.1553	10.4340	11.6630
PKG18	7.5178	8.2662	9.2880	8.4052	8.5263	7.6778	10.2520	11.3610
PKG19	7.3667	8.0607	8.9436	8.3267	8.4538	7.6114	10.1190	10.9740
PKG20	7.6628	8.4233	9.1370	8.3387	8.5686	7.5993	10.2700	11.2700
PKG21	7.4755	8.1453	8.9073	8.1997	8.5686	7.5086	10.1620	10.8470
PKG22	7.7958	8.3206	9.0161	8.3146	8.7076	7.7504	10.5240	10.9680
PKG23	7.0162	7.6619	8.7683	8.0728	8.0610	7.1400	10.7060	10.6240
PKG24	7.2821	8.0184	8.3815	7.8432	8.2785	7.5570	9.5453	10.6360
PKG25	7.9831	8.1574	9.2518	8.4596	8.9312	8.2338	10.6210	11.3190
PKG26	7.9408	8.4898	9.1128	8.4113	8.9735	7.8954	10.7540	11.3120
PKG27	7.6991	8.2239	9.0221	8.3992	8.6713	7.7020	10.3610	11.4450
PKG28	7.1492	7.7586	no ball	8.1695	8.2966	7.3576	10.1130	10.9740
PKG29	8.0194	8.5744	10.6300	8.5261	8.9372	8.0888	10.6690	11.5540
PKG30	7.5843	8.3206	8.8529	7.9882	8.7680	7.5993	10.0710	10.6900
PKG31	6.8228	7.9338	8.5870	7.7223	8.2664	6.9829	9.3459	10.0130
PKG32	7.3244	7.9942	8.8227	8.0064	8.5807	7.5691	9.6480	10.3520
PKG33	7.5782	8.1755	9.3726	8.6651	8.7922	7.7020	10.5730	11.4450
PKG34	7.2459	7.8794	8.8529	8.1816	8.6290	7.4603	10.4880	11.0040
PKG35	7.6991	8.4898	8.9436	8.2783	8.9554	7.7262	10.2040	10.7380
PKG36	8.3457	8.6288	9.6688	8.5744	9.5536	8.4393	11.0560	11.4760
PKG37	7.4695	8.2239	9.2699	8.5321	8.7801	7.7141	10.5060	11.4330
PKG38	8.4726	8.9189	9.0705	8.5623	9.4993	8.3184	10.5420	11.0160
PKG39	7.9529	8.4112	9.1611	8.3750	8.9493	7.7202	10.3790	11.1490
PKG40	7.5903	8.3145	9.0282	8.2602	8.6169	7.6235	10.5060	11.0280
PKG41	7.9046	8.6771	9.7171	8.7436	9.2575	7.7987	10.7660	11.7110
PKG42	7.6931	8.4415	9.4633	8.4838	8.8466	7.5449	10.5480	11.5600
PKG43	7.5661	8.5502	9.1249	8.4415	8.6290	7.5086	10.7840	11.1130
PKG44	7.4392	8.1635	8.8650	8.1151	8.8043	7.4240	10.0710	10.6480
PKG45	8.0375	8.7255	9.2880	8.3508	8.8889	7.9558	10.5730	10.9800
PKG46	8.1100	9.0156	9.7715	8.7316	9.5113	8.0767	11.2250	11.6390
PKG47	7.1552	8.0486	9.0161	8.1877	8.3510	7.2125	10.1620	10.7930
PKG48	7.1129	8.1514	8.7320	8.2964	8.5021	7.3334	10.3730	10.8170
PKG49	7.3063	8.1876	8.4661	8.0728	8.5867	7.4180	10.1860	10.4600
PKG50	8.0859	8.7497	9.3908	8.7678	9.2273	8.0646	10.8140	11.9590
Mean	7.6921	8.3560	9.2073	8.4107	8.7959	7.7256	10.5141	11.2009
SD	0.4406	0.3627	0.5062	0.3656	0.4170	0.3883	0.5006	0.5948
Max	8.7929	9.2331	10.7810	9.7650	9.8437	8.5239	11.9750	13.2160
Min	6.8228	7.6619	8.3815	7.7223	8.0307	6.7593	9.3459	10.0130
Diff	1.9701	1.5712	2.3995	2.0427	1.8130	1.7646	2.6291	3.2030

Table C-1-27: TCC 500th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	6.9684	6.4054	7.6905	7.2912	7.9845	5.9389	9.0829	8.7346
PKG02	6.5272	6.6290	7.7872	7.5572	7.6823	6.0235	9.7295	9.2664
PKG03	6.9140	6.8163	7.9564	7.8835	8.2504	6.3982	9.7295	9.1758
PKG04	6.1162	6.2059	7.4609	no ball	7.2956	6.0960	9.2158	8.6439
PKG05	7.0046	6.2905	7.6422	7.6720	7.6461	6.5553	9.4999	8.8555
PKG06	6.0196	5.8252	7.1164	6.8017	7.2835	5.6851	8.8230	8.0638
PKG07	6.5030	6.3328	7.3823	7.1160	7.5977	6.0839	8.9197	8.2451
PKG08	7.0288	6.7559	8.2646	8.2703	8.2927	6.5009	10.3820	9.8647
PKG09	6.2129	6.1274	7.4548	7.4423	7.5313	6.2169	9.4576	8.7346
PKG10	6.7629	6.6592	7.7872	8.3186	6.8000	6.4284	9.7355	8.8796
PKG11	7.0892	6.3147	7.5334	7.3879	7.7609	6.1746	9.1433	8.1544
PKG12	6.8777	6.5867	7.7630	7.7385	8.4015	6.4586	9.8020	9.2845
PKG13	6.3640	5.9521	7.2675	7.0133	7.3137	5.9268	9.1675	8.5775
PKG14	7.1678	7.1124	8.1317	8.3065	8.6432	6.6037	10.0920	9.6713
PKG15	6.1465	6.0125	7.4850	7.0918	7.4104	5.8422	9.7295	8.3841
PKG16	7.1134	7.4267	8.3855	8.8262	9.1569	7.1778	10.9320	10.4150
PKG17	6.5091	6.5746	7.6482	7.6418	7.9966	6.4768	9.5361	9.0488
PKG18	6.2855	6.1032	7.5757	7.3759	7.6280	6.1202	9.7718	8.7950
PKG19	6.1223	5.9158	7.2554	7.4242	7.4648	5.9752	9.1675	8.3478
PKG20	6.1888	6.1092	7.3581	7.2671	7.3862	6.0839	9.4817	8.7286
PKG21	6.3036	6.2422	7.5696	7.2187	7.7005	5.9389	9.3186	8.3357
PKG22	6.2492	6.1938	7.6301	7.4967	7.4467	6.2592	9.4999	8.4022
PKG23	5.8080	5.7527	7.3279	7.3517	6.9330	5.6972	9.2883	8.1242
PKG24	5.9410	5.9702	7.0439	6.7050	7.3802	5.8543	8.7263	7.7918
PKG25	6.3580	6.4900	7.8476	7.8835	7.6703	6.1746	10.0920	8.8676
PKG26	6.2855	6.7800	7.6724	7.4302	7.6461	6.2955	9.8141	8.5896
PKG27	6.2734	6.2059	7.6119	7.3456	7.4346	5.8059	10.4490	8.1967
PKG28	6.0135	6.3812	7.5032	7.3456	7.2412	5.9631	9.4273	8.2209
PKG29	6.3580	6.5141	7.8597	7.7868	7.6884	6.2894	10.0500	8.8676
PKG30	6.1586	6.2059	7.5153	7.2308	7.6461	5.9329	9.2098	8.0638
PKG31	5.7295	5.6862	6.9411	6.7474	7.0055	5.6549	8.6659	7.7314
PKG32	6.1042	6.1515	7.2554	6.8440	7.7669	5.9389	8.9620	8.1424
PKG33	6.2915	6.3026	7.5999	7.5330	8.1054	6.0356	9.9350	8.9642
PKG34	5.9410	6.2059	7.4609	7.2489	5.8996	5.5884	9.3488	8.0759
PKG35	6.2915	6.3570	7.4004	7.0556	8.0026	6.2713	9.3246	9.6532
PKG36	6.5272	6.7800	8.0652	8.1675	8.1295	6.9481	10.3520	8.8555
PKG37	6.5091	6.2845	7.6059	7.2308	8.0208	6.3680	8.7263	8.5231
PKG38	6.9140	6.6169	7.7389	7.6599	8.4921	6.3438	8.7082	8.3660
PKG39	6.6058	6.5504	7.5213	7.7203	7.6461	6.1262	8.7324	8.8071
PKG40	6.1948	6.2120	7.6180	7.5028	7.4648	5.9993	9.3669	8.6258
PKG41	6.5997	6.6894	7.7932	7.8170	8.1416	6.5372	9.8081	9.2362
PKG42	6.2432	6.3026	7.6422	7.6478	no ball	5.9752	9.6086	8.9219
PKG43	6.4124	6.1153	7.5213	7.4061	7.5010	6.3861	9.6268	8.9461
PKG44	6.1888	6.2482	7.2373	6.9830	7.3379	6.1383	9.0285	8.1665
PKG45	6.4970	6.2603	7.6724	7.7143	7.6400	6.0114	9.4273	8.4264
PKG46	6.6783	6.6592	8.0108	7.9500	8.0087	6.8212	9.6751	8.9280
PKG47	6.1646	6.0911	7.3400	7.4544	7.5433	6.3861	9.1252	8.5110
PKG48	5.8443	5.7889	7.4729	7.3879	6.9753	5.7516	9.2642	8.5654
PKG49	6.3036	6.0911	7.0741	6.8320	7.6642	5.9752	8.7082	7.7254
PKG50	6.9019	6.5141	7.8295	7.7747	8.6009	6.4949	9.7960	9.1395
Mean	6.4123	6.3360	7.5866	7.4877	7.6788	6.1746	9.4693	8.6728
SD	0.3663	0.3417	0.2980	0.4382	0.5346	0.3310	0.5032	0.5454
Max	7.1678	7.4267	8.3855	8.8262	9.1569	7.1778	10.9320	10.4150
Min	5.7295	5.6862	6.9411	6.7050	5.8996	5.5884	8.6659	7.7254
Diff	1.4383	1.7405	1.4444	2.1212	3.2573	1.5894	2.2661	2.6896

Table C-1-28: TCC 500th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	7.6387	8.2178	9.0644	8.3810	8.7620	7.6899	10.6270	11.3310
PKG02	7.5118	8.1755	9.2941	8.5261	8.5686	7.5630	10.8260	11.2340
PKG03	8.5572	9.0881	9.6808	8.6349	9.4630	8.4272	11.2010	11.6150
PKG04	7.7172	8.3750	9.0282	8.3448	8.7378	7.9196	10.9290	10.8290
PKG05	7.6447	8.5804	9.4572	8.4717	8.6169	7.6899	10.5730	11.5600
PKG06	6.8833	7.7223	8.4843	8.0970	8.1093	7.1521	10.2770	10.1400
PKG07	7.3728	7.9701	9.3122	8.2239	8.5505	7.6053	10.7840	10.9980
PKG08	8.4303	9.2089	10.5030	9.2996	9.4751	8.3487	11.9990	12.7450
PKG09	7.4876	8.1816	9.1853	8.3750	8.2906	6.9164	10.5240	11.0950
PKG10	7.9831	8.5804	9.4693	8.6893	9.0702	8.1009	10.8870	11.8990
PKG11	7.9771	8.6348	8.8771	8.1816	9.0097	8.1613	10.3670	10.9800
PKG12	8.3034	8.8826	9.6385	8.7316	9.1487	8.2520	10.8690	11.7840
PKG13	7.0525	8.1091	no ball	8.3327	8.3087	7.4240	10.2830	10.7500
PKG14	no ball	8.8222	9.8803	9.1304	9.5355	8.2761	11.8480	10.5570
PKG15	7.3909	8.2178	9.1551	8.5684	8.5444	7.4905	10.4400	11.0350
PKG16	8.6781	9.1002	10.6840	9.5051	9.7893	8.5360	11.9810	13.1920
PKG17	7.8985	9.1666	9.3908	8.7195	8.9312	8.1674	10.7660	11.2940
PKG18	7.4695	8.8101	9.3062	8.4898	8.6290	7.7625	10.4700	11.0890
PKG19	7.3546	8.1695	8.9677	8.3931	8.4900	7.4724	10.3070	8.7078
PKG20	7.4936	8.3327	9.3545	8.3992	8.6169	7.7987	10.2890	11.2760
PKG21	7.3425	8.1393	8.8046	8.2239	8.5021	7.6235	10.2460	10.8530
PKG22	7.6145	8.7074	8.9919	8.4596	8.6532	7.8652	10.4280	10.9980
PKG23	6.9497	7.6196	8.6595	8.0003	8.0610	7.0735	10.1620	10.5930
PKG24	7.0766	7.9399	8.4238	7.9701	8.2302	7.5691	9.5272	10.4000
PKG25	7.7414	8.2420	9.4089	8.5200	8.9493	8.3366	10.6870	11.4270
PKG26	7.7897	8.3145	9.1188	8.5080	9.0037	7.9135	10.6690	11.3190
PKG27	7.3425	8.3568	8.6958	8.3569	8.7136	7.5509	10.4640	11.1190
PKG28	6.9799	7.9399	no ball	8.2179	8.2483	7.1581	10.1500	10.9140
PKG29	7.7112	8.1876	9.3606	8.5382	8.9856	8.1251	10.8570	11.4700
PKG30	7.5238	8.3991	8.6293	8.1151	8.8043	7.7866	10.1500	10.6600
PKG31	5.1488	7.6860	8.2667	7.7344	7.9824	7.0735	9.7024	10.1100
PKG32	7.3667	7.9882	8.4964	8.0245	8.5867	7.5812	9.8293	10.2550
PKG33	7.4695	8.0365	9.2941	8.6288	8.8164	7.5086	10.4760	11.3850
PKG34	7.3123	7.8915	8.7502	8.2360	8.6169	7.5570	10.4280	11.0590
PKG35	7.5299	8.4354	9.0221	8.1272	9.0883	7.7866	10.1560	10.9500
PKG36	8.4666	8.5381	9.2820	8.5503	9.4872	8.3184	10.7120	11.4330
PKG37	7.5178	8.1091	9.1370	8.5563	8.7741	7.6114	10.6030	11.4210
PKG38	8.4183	8.7678	9.0705	8.6469	9.4811	8.5481	10.5910	11.0530
PKG39	7.6568	8.3508	9.1007	8.5321	8.7982	7.6537	10.4160	11.1550
PKG40	7.7233	8.0547	8.9073	8.2904	8.7076	7.6235	10.4640	11.0470
PKG41	8.0980	8.3629	9.6083	8.7195	8.9554	7.8410	10.7960	11.8680
PKG42	7.5420	8.1453	9.2518	8.4777	8.6290	7.6476	10.4760	11.3490
PKG43	7.5843	8.2481	9.0100	8.3629	8.5565	7.4784	10.7480	11.0950
PKG44	7.6749	8.0728	8.6837	8.1997	8.4779	7.4059	9.9441	10.6540
PKG45	8.0315	8.4777	8.9375	8.7134	8.9795	7.9377	10.5360	11.0160
PKG46	8.0738	8.4535	9.4754	8.7013	9.4207	8.2036	10.9650	11.7480
PKG47	7.2277	7.8553	8.9496	8.1514	8.3027	7.2850	9.9562	10.7440
PKG48	7.0585	7.7706	8.7441	8.1937	8.3571	7.3273	10.3070	10.9140
PKG49	7.3425	7.8915	8.4238	7.9459	8.4779	7.4784	9.8414	10.5690
PKG50	8.0557	8.6651	9.3424	8.6590	9.1246	8.1009	10.8690	11.7170
Mean	7.5962	8.3199	9.1371	8.4371	8.7684	7.7545	10.5481	11.1081
SD	0.5581	0.3904	0.4736	0.3262	0.4148	0.4010	0.4951	0.6613
Max	8.6781	9.2089	10.6840	9.5051	9.7893	8.5481	11.9990	13.1920
Min	5.1488	7.6196	8.2667	7.7344	7.9824	6.9164	9.5272	8.7078
Diff	3.5293	1.5893	2.4173	1.7707	1.8069	1.6317	2.4718	4.4842

APPENDIX C-2

Derived Resistance Changes at the Measured Temperature Cycles

Table C-2-1: TCB238th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	0.07%	5.63%	2.31%	-1.18%	4.66%	4.90%	1.81%	5.23%
PKG02	1.25%	2.71%	7.65%	6.35%	3.11%	11.68%	5.12%	7.52%
PKG03	-0.56%	4.53%	2.30%	1.22%	4.21%	4.50%	4.10%	9.44%
PKG04	1.88%	5.78%	2.63%	6.87%	2.59%	17.45%	1.02%	1.18%
PKG05	1.85%	3.71%	2.37%	6.40%	2.41%	12.64%	2.43%	0.15%
PKG06	2.73%	4.27%	1.47%	1.51%	0.08%	18.60%	4.01%	5.84%
PKG07	-0.22%	2.76%	1.84%	1.21%	0.24%	11.17%	3.26%	4.20%
PKG08	-1.11%	2.98%	0.67%	1.80%	-1.01%	1.45%	0.94%	3.71%
PKG09	0.07%	1.59%	2.79%	1.91%	-1.26%	10.22%	4.36%	1.31%
PKG10	2.36%	4.06%	0.46%	2.09%	-0.14%	10.29%	2.20%	4.04%
PKG11	0.46%	0.34%	0.97%	10.84%	-0.61%	8.92%	2.45%	3.86%
PKG12	-1.84%	2.40%	-0.31%	7.63%	-0.64%	2.66%	1.43%	-0.14%
PKG13	-0.43%	-0.70%	1.57%	1.63%	-1.29%	4.70%	2.46%	1.70%
PKG14	-2.00%	3.99%	0.74%	0.92%	-1.30%	-0.84%	0.84%	4.58%
PKG15	0.17%	4.27%	0.16%	0.10%	-2.66%	3.17%	3.15%	6.22%
PKG16	2.39%	2.06%	0.94%	0.56%	-0.78%	1.76%	1.48%	4.08%
PKG17	-2.62%	0.71%	0.63%	1.69%	-1.92%	-0.87%	0.00%	-3.16%
PKG18	0.07%	4.35%	-0.08%	3.89%	0.54%	1.17%	0.32%	1.25%
PKG19	0.18%	2.25%	0.33%	3.62%	0.08%	1.73%	0.53%	2.68%
PKG20	-0.81%	1.89%	1.30%	4.74%	0.81%	-3.36%	0.91%	3.33%
PKG21	-0.02%	2.76%	-0.64%	1.36%	-1.32%	2.74%	0.46%	-4.51%
PKG22	-2.49%	-1.83%	2.12%	-0.37%	0.00%	0.48%	0.78%	5.81%
PKG23	1.88%	2.81%	1.47%	-2.84%	-0.60%	0.51%	0.95%	8.17%
PKG24	1.30%	1.42%	1.54%	-3.68%	-0.66%	1.24%	-1.04%	1.98%
PKG25	0.36%	1.31%	5.11%	-0.89%	-0.47%	2.09%	-0.56%	-2.59%
PKG26	1.62%	2.38%	-1.17%	-0.37%	-1.09%	0.12%	-1.75%	2.28%
PKG27	-1.27%	0.76%	-0.08%	0.87%	-0.96%	2.11%	-2.52%	1.42%
PKG28	-1.44%	1.17%	-0.88%	-0.87%	-0.33%	2.57%	-0.73%	-0.91%
PKG29	1.22%	-0.83%	-1.22%	0.09%	-0.16%	2.09%	-0.63%	0.73%
PKG30	-1.61%	-3.25%	0.32%	0.40%	-0.33%	6.22%	-1.38%	2.39%
PKG31	-3.05%	1.16%	-1.36%	-4.27%	0.79%	-3.35%	-0.28%	0.42%
PKG32	-1.60%	0.04%	-1.81%	-7.53%	1.32%	0.25%	-0.41%	-0.59%
PKG33	-2.16%	0.14%	-0.39%	-3.06%	0.16%	-3.76%	-0.32%	3.64%
PKG35	-0.88%	0.44%	-1.12%	-1.40%	-0.78%	-3.63%	-0.72%	3.16%
PKG36	-1.23%	2.07%	1.04%	-3.96%	-1.05%	-0.76%	-0.12%	4.55%
PKG37	-0.97%	0.34%	0.55%	-0.58%	-1.15%	0.92%	-2.43%	0.58%
PKG38	-2.84%	1.38%	0.08%	-4.40%	-0.67%	-5.94%	-1.09%	3.14%
PKG39	-0.41%	-0.06%	-0.96%	-5.61%	-0.86%	-7.11%	-0.70%	1.38%
PKG40	-0.61%	0.24%	-0.77%	-0.58%	-1.68%	-7.17%	-0.59%	-0.70%
PKG41	-2.23%	0.60%	0.84%	-0.54%	-2.42%	-4.60%	-0.44%	0.00%
PKG42	-2.22%	1.99%	0.16%	-2.98%	-1.94%	-0.11%	-0.71%	2.81%
PKG43	-0.22%	0.55%	-1.12%	-2.50%	-1.88%	2.66%	-0.46%	-1.11%
PKG44	-1.98%	2.37%	-0.74%	-6.73%	-1.29%	-2.02%	0.41%	2.49%
PKG45	-1.26%	1.32%	0.71%	-2.06%	-1.94%	1.56%	0.39%	2.93%
PKG46	-2.01%	-0.98%	0.00%	-3.03%	-1.86%	-1.32%	-0.57%	0.00%
PKG47	-1.44%	-0.36%	-2.34%	-1.27%	-1.94%	-1.15%	0.00%	0.23%
PKG48	-2.06%	3.45%	-1.58%	-2.71%	-1.29%	-1.52%	-0.59%	0.88%
PKG49	-2.08%	1.92%	-1.41%	-3.27%	-0.57%	1.36%	0.63%	2.74%
PKG50	-1.02%	1.12%	0.77%	-0.37%	-1.17%	1.40%	-0.80%	0.00%
Mean	-0.55%	1.71%	0.57%	0.01%	-0.39%	2.20%	0.56%	2.21%
SD	1.52%	1.87%	1.76%	3.69%	1.56%	5.63%	1.73%	2.80%
Max	2.73%	5.78%	7.65%	10.84%	4.66%	18.60%	5.12%	9.44%
Min	-3.05%	-3.25%	-2.34%	-7.53%	-2.66%	-7.17%	-2.52%	-4.51%
Diff	5.78%	9.03%	9.98%	18.38%	7.32%	25.77%	7.63%	13.95%

Table C-2-2: TCB 238th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	4.02%	1.71%	1.23%	0.29%	-4.73%	-0.45%	3.21%	0.56%
PKG02	3.85%	7.06%	3.52%	-1.34%	0.50%	3.99%	5.35%	4.98%
PKG03	4.20%	4.76%	6.00%	-3.12%	1.16%	-3.35%	1.39%	1.74%
PKG04	2.09%	7.41%	6.21%	-0.07%	0.14%	2.50%	-0.65%	-0.89%
PKG05	1.79%	7.52%	2.62%	1.22%	0.07%	-1.30%	5.78%	1.18%
PKG06	0.87%	7.01%	2.00%	-0.31%	1.06%	-1.67%	0.13%	0.47%
PKG07	0.56%	5.18%	0.76%	-0.82%	2.00%	-4.34%	7.74%	0.56%
PKG08	2.36%	4.33%	0.66%	-2.00%	0.38%	-0.35%	1.28%	2.25%
PKG09	0.56%	1.29%	1.71%	1.01%	-0.65%	-3.26%	3.03%	0.62%
PKG10	0.45%	3.27%	0.98%	0.55%	0.40%	0.57%	3.38%	-0.58%
PKG11	0.75%	-0.83%	0.92%	1.65%	0.60%	1.05%	4.31%	1.21%
PKG12	-0.36%	-0.54%	0.76%	-1.36%	-0.64%	0.42%	0.35%	0.05%
PKG13	0.67%	0.30%	1.19%	-2.11%	-1.57%	-0.69%	3.33%	-0.06%
PKG14	0.00%	-1.69%	-0.44%	-1.19%	0.25%	1.68%	-1.07%	0.83%
PKG15	0.24%	-1.50%	2.38%	-1.99%	-2.04%	-1.68%	-1.72%	1.22%
PKG16	1.30%	1.12%	3.56%	-0.95%	0.80%	-1.72%	3.56%	0.84%
PKG17	2.90%	-0.14%	2.67%	-0.29%	0.47%	2.10%	3.37%	-0.05%
PKG18	0.40%	2.28%	2.52%	-2.92%	1.48%	1.04%	3.61%	0.88%
PKG19	0.00%	-0.90%	5.37%	-1.25%	-2.65%	-1.38%	0.91%	0.73%
PKG20	1.33%	4.66%	0.75%	-1.66%	-1.11%	0.15%	0.54%	-0.38%
PKG21	0.72%	3.17%	0.70%	-2.82%	-0.84%	-1.59%	2.19%	-1.06%
PKG22	2.50%	3.16%	1.72%	-2.26%	0.07%	-0.15%	2.13%	-0.28%
PKG23	1.73%	6.62%	0.78%	-2.76%	-0.67%	-0.24%	1.72%	-1.02%
PKG24	5.65%	-0.38%	3.17%	-3.51%	-0.72%	0.23%	1.54%	-1.01%
PKG25	2.90%	1.75%	1.95%	0.28%	-1.55%	0.43%	1.28%	-1.03%
PKG26	-2.28%	2.20%	0.75%	-1.00%	-0.93%	-1.69%	0.86%	-1.52%
PKG27	1.53%	6.55%	0.78%	0.44%	-1.79%	-0.59%	-0.12%	-1.26%
PKG28	-1.42%	2.35%	0.14%	0.30%	-0.73%	4.21%	0.00%	-0.66%
PKG29	-0.23%	-1.93%	3.21%	-4.14%	-0.34%	1.75%	-3.11%	0.65%
PKG30	-2.92%	4.62%	1.84%	-1.03%	0.91%	2.57%	2.30%	-0.11%
PKG31	-0.70%	-0.31%	6.96%	-2.33%	-1.92%	-2.24%	0.66%	-0.61%
PKG32	1.12%	-0.88%	0.07%	-1.15%	0.43%	0.69%	1.15%	-0.19%
PKG33	-1.92%	4.35%	1.19%	-0.85%	-0.42%	1.16%	0.29%	-0.43%
PKG35	-2.00%	1.02%	0.41%	-6.40%	-0.83%	4.51%	0.85%	-0.84%
PKG36	-0.51%	4.05%	0.26%	-0.99%	-1.61%	-0.70%	0.45%	-1.23%
PKG37	-2.14%	2.05%	1.07%	-0.87%	3.27%	-0.83%	-1.56%	-2.53%
PKG38	-5.07%	-1.73%	0.68%	-1.22%	1.35%	-1.63%	-1.15%	-1.26%
PKG39	0.55%	1.72%	0.60%	-5.78%	2.36%	-0.37%	1.68%	-0.82%
PKG40	1.58%	3.06%	-0.27%	-4.97%	1.67%	-1.12%	0.71%	-1.16%
PKG41	-0.45%	2.17%	0.45%	-2.24%	0.20%	-3.81%	2.20%	-1.78%
PKG42	-3.86%	-0.36%	0.00%	0.14%	-0.76%	-2.91%	-2.90%	-2.90%
PKG43	-1.58%	0.88%	0.27%	-0.07%	-1.40%	-4.69%	-0.82%	-2.43%
PKG44	0.32%	4.06%	-0.97%	0.91%	0.21%	-4.62%	-0.67%	-0.84%
PKG45	0.75%	0.86%	0.41%	0.07%	-0.81%	-1.41%	-1.83%	-1.92%
PKG46	4.17%	4.94%	-0.84%	-2.58%	-0.90%	-0.97%	-1.67%	-1.39%
PKG47	0.92%	-0.99%	-0.20%	1.41%	0.00%	1.27%	-6.08%	-0.68%
PKG48	1.33%	-2.69%	-0.21%	-0.67%	-0.86%	-1.54%	0.00%	-0.17%
PKG49	1.97%	-1.75%	3.80%	-1.39%	-0.50%	-1.46%	-3.71%	-0.74%
PKG50	0.07%	2.65%	0.65%	-1.38%	-0.20%	1.05%	-4.02%	-3.14%
Mean	0.63%	2.11%	1.53%	-1.30%	-0.23%	-0.44%	0.82%	-0.33%
SD	2.09%	2.81%	1.81%	1.74%	1.36%	2.13%	2.60%	1.40%
Max	5.65%	7.52%	6.96%	1.65%	3.27%	4.51%	7.74%	4.98%
Min	-5.07%	-2.69%	-0.97%	-6.40%	-4.73%	-4.69%	-6.08%	-3.14%
Diff	10.72%	10.21%	7.93%	8.05%	8.00%	9.20%	13.82%	8.12%

Table C-2-3: TCB 457th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	1.66%	3.04%	2.39%	-0.30%	1.18%	3.50%	2.75%	1.66%
PKG02	2.62%	8.75%	4.14%	outliner	2.49%	5.78%	2.40%	4.99%
PKG03	0.16%	7.38%	3.14%	6.65%	1.38%	5.05%	2.49%	4.87%
PKG04	1.38%	6.30%	2.55%	8.32%	1.54%	5.73%	-0.32%	3.54%
PKG05	3.42%	6.38%	1.42%	9.70%	1.40%	3.79%	1.02%	7.38%
PKG06	2.41%	5.60%	3.20%	9.19%	0.67%	11.40%	2.98%	6.70%
PKG07	-0.02%	7.39%	2.85%	7.36%	1.19%	5.59%	2.99%	2.26%
PKG08	-0.84%	2.50%	2.08%	3.86%	-0.79%	7.03%	1.41%	0.33%
PKG09	1.59%	6.94%	2.71%	4.30%	-0.39%	12.06%	2.54%	3.99%
PKG10	2.17%	2.57%	1.63%	3.00%	0.94%	4.92%	2.51%	-0.94%
PKG11	1.23%	2.42%	1.21%	2.30%	-1.30%	4.34%	2.32%	-1.21%
PKG12	-0.02%	5.99%	0.77%	2.78%	0.14%	4.25%	1.61%	2.20%
PKG13	0.58%	4.70%	0.00%	4.80%	-1.78%	6.44%	1.73%	-0.85%
PKG14	-0.11%	5.31%	2.68%	2.50%	-0.41%	3.26%	0.96%	-0.40%
PKG15	1.77%	2.79%	2.14%	3.12%	0.63%	2.93%	3.02%	-0.39%
PKG16	3.68%	2.74%	1.52%	4.45%	-0.72%	1.76%	2.11%	2.51%
PKG17	-0.12%	3.88%	-0.55%	3.10%	0.15%	1.30%	1.58%	-3.09%
PKG18	0.56%	3.53%	3.19%	3.11%	2.41%	3.29%	1.03%	-1.91%
PKG19	0.28%	3.10%	2.70%	0.91%	-0.40%	3.58%	2.20%	1.57%
PKG20	-0.81%	1.38%	1.54%	0.10%	2.03%	-1.50%	1.49%	2.35%
PKG21	-0.12%	2.35%	0.16%	1.56%	-0.54%	3.57%	0.79%	-4.81%
PKG22	-2.02%	-1.63%	0.47%	0.83%	0.72%	1.31%	1.68%	0.70%
PKG23	0.08%	2.92%	0.73%	1.27%	-0.60%	2.95%	3.13%	1.67%
PKG24	-0.23%	2.48%	0.60%	-1.05%	-0.25%	2.59%	-0.35%	-3.30%
PKG25	-0.22%	1.31%	1.86%	4.10%	0.71%	1.16%	1.32%	-5.95%
PKG26	0.85%	2.96%	-0.23%	3.92%	-1.09%	1.53%	-0.44%	-1.22%
PKG27	0.55%	1.88%	0.32%	1.44%	-0.96%	2.11%	-0.32%	4.19%
PKG28	-0.03%	1.58%	-0.16%	0.38%	-0.82%	5.14%	0.53%	-3.11%
PKG29	1.79%	-0.15%	0.23%	1.17%	-0.08%	2.09%	1.44%	0.95%
PKG30	0.57%	-1.45%	0.49%	0.70%	0.57%	1.31%	-0.13%	1.98%
PKG31	-1.38%	0.72%	-1.96%	-4.48%	0.18%	0.25%	2.75%	-0.25%
PKG32	-0.91%	-0.26%	0.00%	-7.92%	0.58%	2.63%	0.95%	1.34%
PKG33	-1.97%	2.88%	0.00%	0.09%	-0.62%	-1.33%	0.90%	0.36%
PKG35	-0.21%	1.14%	-2.16%	-0.60%	0.47%	-1.93%	1.57%	1.19%
PKG36	0.53%	3.18%	0.67%	-2.53%	-1.12%	-0.33%	1.12%	2.39%
PKG37	0.73%	1.63%	-0.55%	0.00%	-0.77%	2.31%	-0.19%	-4.29%
PKG38	-0.84%	1.29%	-1.55%	-3.41%	-0.30%	-5.72%	0.64%	-2.99%
PKG39	0.95%	0.95%	0.72%	-3.03%	-0.16%	-6.34%	0.64%	-3.57%
PKG40	-0.22%	1.56%	-1.32%	1.83%	-0.40%	-6.49%	1.70%	0.23%
PKG41	-1.31%	3.51%	-0.23%	4.31%	-1.47%	-5.32%	4.66%	-2.57%
PKG42	-1.07%	4.15%	-0.16%	-0.56%	-0.08%	0.81%	4.75%	-1.62%
PKG43	0.47%	0.65%	1.12%	0.29%	-1.57%	3.26%	6.34%	-3.24%
PKG44	-2.18%	4.59%	0.00%	-3.60%	-0.48%	0.83%	1.02%	-1.20%
PKG45	0.17%	2.40%	1.02%	-2.15%	-1.32%	3.72%	2.26%	-1.77%
PKG46	-1.56%	1.24%	1.36%	-1.99%	-0.82%	0.11%	0.31%	0.00%
PKG47	1.18%	1.06%	-0.97%	0.88%	-1.29%	1.38%	0.66%	-1.37%
PKG48	-0.74%	4.11%	-0.63%	-0.39%	-0.77%	1.39%	0.73%	-1.51%
PKG49	-1.40%	2.76%	-1.16%	-4.36%	0.82%	1.48%	1.61%	-1.37%
PKG50	-0.75%	2.01%	-0.08%	1.30%	0.88%	1.52%	0.55%	-3.02%
Mean	0.25%	2.95%	0.81%	1.40%	0.00%	2.25%	1.62%	0.07%
SD	1.34%	2.26%	1.47%	3.59%	1.04%	3.66%	1.37%	2.94%
Max	3.68%	8.75%	4.14%	9.70%	2.49%	12.06%	6.34%	7.38%
Min	-2.18%	-1.63%	-2.16%	-7.92%	-1.78%	-6.49%	-0.44%	-5.95%
Diff	5.86%	10.38%	6.30%	17.61%	4.27%	18.55%	6.78%	13.34%

Table C-2-4: TCB 457th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.77%	2.01%	1.29%	1.54%	-3.04%	-0.52%	5.99%	1.34%
PKG02	3.77%	10.36%	-0.26%	-0.35%	3.67%	2.46%	5.10%	2.29%
PKG03	2.24%	6.07%	3.30%	-2.15%	2.32%	-1.21%	3.99%	1.63%
PKG04	3.95%	10.15%	2.09%	2.08%	2.35%	1.32%	0.59%	-0.72%
PKG05	4.55%	10.79%	2.09%	1.65%	0.98%	1.07%	2.83%	2.20%
PKG06	4.37%	9.35%	2.14%	-0.31%	1.67%	-0.24%	0.64%	1.18%
PKG07	2.48%	1.83%	-0.63%	0.52%	3.00%	-3.46%	1.05%	0.00%
PKG08	4.29%	1.42%	0.24%	-1.36%	0.26%	1.66%	0.48%	0.68%
PKG09	1.69%	2.04%	1.50%	-0.50%	0.29%	-2.12%	2.66%	0.28%
PKG10	4.24%	5.19%	1.37%	-0.55%	1.52%	-0.71%	1.84%	0.77%
PKG11	3.38%	-0.21%	2.82%	1.27%	0.33%	-0.91%	3.89%	1.72%
PKG12	0.93%	2.42%	4.58%	-0.61%	-0.84%	0.56%	1.38%	1.73%
PKG13	4.38%	5.34%	4.60%	1.53%	-2.35%	-0.61%	4.32%	0.73%
PKG14	0.29%	3.25%	3.74%	-0.79%	-0.19%	1.33%	0.69%	2.43%
PKG15	-0.32%	4.27%	0.07%	-3.20%	-0.63%	-0.76%	0.71%	1.10%
PKG16	-0.21%	3.41%	0.58%	0.70%	1.49%	-2.32%	-0.41%	1.03%
PKG17	3.51%	-0.07%	5.54%	-0.07%	0.07%	1.60%	2.90%	1.47%
PKG18	1.27%	3.53%	2.45%	-2.92%	1.41%	0.89%	4.70%	2.25%
PKG19	-0.40%	2.76%	1.95%	1.25%	-2.09%	1.30%	2.19%	3.04%
PKG20	1.17%	9.69%	2.11%	-1.73%	-1.46%	1.95%	2.10%	-0.05%
PKG21	1.61%	4.28%	0.84%	-3.26%	-1.74%	-0.23%	1.83%	0.73%
PKG22	1.88%	4.78%	-0.14%	-3.53%	-1.78%	2.80%	6.91%	1.06%
PKG23	4.07%	7.43%	0.07%	-4.44%	0.22%	0.71%	2.02%	0.23%
PKG24	1.16%	5.74%	2.14%	-3.73%	-0.87%	1.23%	3.08%	0.18%
PKG25	1.83%	2.78%	0.88%	-2.69%	0.07%	0.51%	3.26%	0.75%
PKG26	-1.62%	3.81%	1.58%	-1.36%	-0.93%	-1.97%	2.83%	-0.65%
PKG27	1.45%	7.08%	1.76%	-1.38%	-0.82%	0.44%	0.71%	0.49%
PKG28	1.08%	6.03%	0.91%	-1.56%	-1.17%	3.32%	1.45%	0.23%
PKG29	1.14%	4.87%	1.87%	-3.94%	0.13%	1.24%	0.17%	3.11%
PKG30	-1.08%	2.93%	1.56%	-3.37%	0.35%	2.49%	2.78%	1.65%
PKG31	1.57%	1.01%	0.67%	-3.49%	-1.31%	-1.52%	4.31%	2.82%
PKG32	5.37%	0.96%	0.07%	-1.38%	0.29%	1.69%	2.49%	2.86%
PKG33	1.92%	3.39%	1.32%	-0.78%	-1.47%	3.56%	2.49%	2.59%
PKG35	-0.92%	7.47%	3.58%	-5.41%	-1.10%	0.90%	1.28%	0.29%
PKG36	1.60%	8.09%	2.10%	-0.99%	-0.90%	1.05%	0.86%	1.29%
PKG37	1.26%	4.24%	1.14%	-0.80%	-0.14%	0.60%	0.99%	0.68%
PKG38	-3.15%	-1.26%	3.20%	-1.08%	-0.13%	0.27%	1.27%	1.69%
PKG39	2.92%	4.88%	0.94%	-5.37%	-0.21%	0.15%	3.23%	2.51%
PKG40	1.35%	5.89%	5.00%	-5.32%	-0.14%	1.19%	1.41%	1.71%
PKG41	0.91%	4.63%	2.76%	-2.92%	0.07%	-3.24%	0.18%	2.29%
PKG42	-0.61%	0.07%	3.61%	-0.50%	-0.76%	-1.96%	-2.00%	-1.48%
PKG43	0.32%	2.85%	5.60%	-0.65%	-1.61%	-3.08%	1.83%	-0.48%
PKG44	1.04%	2.44%	-0.14%	1.14%	0.28%	-3.96%	0.98%	-0.39%
PKG45	0.83%	4.87%	0.14%	-1.17%	-0.94%	-1.55%	-1.14%	-1.53%
PKG46	-0.15%	6.74%	0.32%	-3.33%	-1.22%	-1.39%	0.00%	-0.97%
PKG47	5.34%	6.70%	0.95%	-0.52%	-0.88%	0.55%	-3.82%	-0.46%
PKG48	5.67%	2.69%	0.63%	0.00%	-0.86%	-1.00%	0.86%	-0.77%
PKG49	6.41%	-0.66%	0.66%	-1.16%	-0.71%	-0.69%	-1.86%	-1.94%
PKG50	1.47%	2.51%	0.26%	-1.80%	-0.46%	-1.62%	-3.63%	-2.43%
Mean	1.88%	4.30%	1.75%	-1.40%	-0.20%	0.04%	1.68%	0.84%
SD	2.04%	2.96%	1.57%	1.92%	1.36%	1.78%	2.14%	1.36%
Max	6.41%	10.79%	5.60%	2.08%	3.67%	3.56%	6.91%	3.11%
Min	-3.15%	-1.26%	-0.63%	-5.41%	-3.04%	-3.96%	-3.82%	-2.43%
Diff	9.56%	12.05%	6.23%	7.49%	6.71%	7.52%	10.73%	5.54%

Table C-2-5: TCB 643rd cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	-1.31%	1.18%	0.99%	1.28%	0.08%	0.58%	0.87%	-0.63%
PKG02	1.34%	5.37%	0.16%	4.45%	-0.86%	2.60%	0.82%	0.45%
PKG03	1.78%	4.17%	-0.46%	1.66%	-0.80%	2.85%	1.80%	0.36%
PKG04	0.28%	4.74%	1.32%	2.22%	-1.62%	1.59%	-2.48%	-1.89%
PKG05	0.57%	2.42%	-0.08%	3.49%	-0.85%	2.30%	-0.32%	-1.94%
PKG06	0.82%	2.71%	0.17%	2.16%	-1.18%	4.85%	0.07%	0.17%
PKG07	2.73%	3.77%	1.01%	1.41%	2.13%	3.45%	0.88%	-0.81%
PKG08	2.15%	1.75%	0.30%	0.26%	-1.94%	1.79%	-0.17%	-0.99%
PKG09	1.78%	3.13%	1.07%	-0.29%	0.79%	5.17%	0.33%	0.23%
PKG10	1.63%	0.98%	0.00%	-0.27%	0.94%	3.69%	-0.13%	-2.09%
PKG11	2.67%	2.52%	0.73%	-0.19%	-1.30%	1.93%	-0.53%	-1.53%
PKG12	0.43%	2.97%	-0.70%	0.72%	-0.78%	-1.17%	-1.05%	-0.85%
PKG13	2.60%	1.74%	-0.66%	0.41%	-0.97%	3.96%	0.53%	-2.24%
PKG14	-0.62%	1.88%	1.34%	0.50%	1.30%	1.68%	-0.47%	-0.40%
PKG15	1.77%	2.47%	0.33%	-0.91%	0.23%	1.22%	0.87%	-2.28%
PKG16	3.34%	0.80%	1.08%	-0.24%	-0.91%	2.34%	0.57%	-0.69%
PKG17	1.00%	1.29%	-1.10%	1.69%	2.29%	-0.87%	0.44%	-5.12%
PKG18	0.46%	2.09%	-0.40%	1.94%	1.55%	2.70%	-0.07%	-2.27%
PKG19	-0.43%	4.36%	0.08%	0.30%	2.02%	3.46%	1.00%	-1.50%
PKG20	0.66%	2.40%	0.08%	1.64%	2.68%	0.70%	0.39%	-1.06%
PKG21	0.65%	0.65%	-1.99%	-0.68%	0.93%	2.26%	0.92%	-7.21%
PKG22	-0.88%	-2.90%	-0.32%	-1.21%	1.76%	1.07%	0.78%	-1.08%
PKG23	2.51%	0.82%	-0.98%	-2.06%	1.72%	2.69%	2.25%	1.33%
PKG24	1.71%	0.15%	-1.20%	-1.89%	0.41%	1.61%	-0.42%	-3.80%
PKG25	1.22%	1.80%	0.54%	0.00%	0.24%	1.51%	0.50%	-6.65%
PKG26	2.59%	0.92%	-0.70%	0.65%	-1.88%	1.06%	-0.88%	-0.91%
PKG27	0.17%	1.17%	-0.48%	2.21%	-0.64%	1.24%	-1.61%	0.08%
PKG28	1.38%	1.58%	-1.28%	-0.29%	-1.48%	0.12%	-0.07%	-4.02%
PKG29	2.27%	0.62%	-0.76%	1.17%	0.47%	-0.23%	1.25%	-2.12%
PKG30	3.83%	-0.86%	-0.97%	1.09%	0.49%	-0.60%	-0.98%	0.25%
PKG31	0.49%	1.28%	-1.45%	-4.06%	0.70%	0.50%	1.62%	-3.68%
PKG32	0.86%	-0.56%	-2.22%	-6.68%	0.41%	3.38%	0.20%	-0.08%
PKG33	-2.35%	4.74%	-0.94%	-2.22%	-0.15%	1.11%	0.58%	-0.15%
PKG35	1.50%	0.64%	-2.08%	-1.50%	-0.63%	1.25%	0.46%	0.00%
PKG36	2.76%	3.09%	-0.97%	-2.87%	0.30%	-1.53%	0.75%	0.75%
PKG37	0.55%	-0.65%	-1.65%	-1.06%	-1.00%	1.85%	-1.09%	-5.46%
PKG38	-1.11%	-0.53%	-1.55%	-4.85%	2.53%	-6.91%	0.26%	-2.84%
PKG39	5.22%	-0.76%	-0.56%	-3.58%	0.47%	-4.37%	-0.06%	-2.11%
PKG40	-0.22%	-0.36%	-2.09%	2.89%	0.96%	-3.53%	1.11%	-1.33%
PKG41	0.25%	1.35%	-0.15%	1.17%	1.61%	1.33%	1.70%	-3.12%
PKG42	-1.84%	1.48%	-0.94%	-1.77%	-0.47%	-0.81%	0.90%	-1.11%
PKG43	3.32%	-0.97%	0.00%	-1.06%	-2.12%	3.38%	1.11%	-5.01%
PKG44	-0.51%	1.73%	-1.40%	-8.72%	-0.08%	1.07%	1.09%	-1.93%
PKG45	0.36%	0.63%	-0.32%	-3.85%	1.79%	1.80%	1.74%	-1.62%
PKG46	2.24%	-0.24%	0.08%	-2.51%	0.89%	-0.88%	1.07%	-0.15%
PKG47	2.19%	0.45%	-2.42%	-2.34%	-0.49%	-1.72%	0.99%	-2.06%
PKG48	-0.53%	5.43%	-1.11%	-2.23%	0.34%	1.14%	0.53%	-1.67%
PKG49	0.17%	3.07%	-1.99%	-5.45%	2.71%	1.36%	3.78%	-1.63%
PKG50	-0.48%	2.60%	-0.23%	-0.65%	0.81%	2.81%	0.06%	-2.18%
Mean	1.06%	1.61%	-0.51%	-0.61%	0.27%	1.16%	0.45%	-1.73%
SD	1.53%	1.78%	0.98%	2.60%	1.29%	2.24%	1.03%	1.87%
Max	5.22%	5.43%	1.34%	4.45%	2.71%	5.17%	3.78%	1.33%
Min	-2.35%	-2.90%	-2.42%	-8.72%	-2.12%	-6.91%	-2.48%	-7.21%
Diff	7.56%	8.33%	3.75%	13.17%	4.82%	12.08%	6.26%	8.54%

Table C-2-6: TCB 643rd cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	0.00%	0.15%	-0.20%	3.44%	-5.27%	-1.72%	4.23%	2.68%
PKG02	1.04%	2.10%	-3.71%	-0.28%	-0.86%	0.15%	4.98%	0.76%
PKG03	3.22%	0.48%	0.66%	-1.39%	0.06%	-2.14%	0.75%	0.05%
PKG04	5.04%	1.11%	-0.35%	-1.48%	0.07%	-0.81%	0.41%	-2.00%
PKG05	5.69%	1.67%	0.88%	-0.86%	0.28%	-1.30%	0.60%	0.75%
PKG06	5.33%	3.22%	0.30%	1.24%	-0.15%	-2.94%	-0.45%	0.59%
PKG07	5.05%	1.68%	-0.63%	-1.19%	1.14%	-3.61%	0.93%	-0.85%
PKG08	8.15%	2.77%	0.48%	-2.78%	1.34%	0.14%	-0.11%	0.34%
PKG09	2.41%	0.00%	0.89%	-4.10%	-0.51%	-2.96%	0.00%	-0.61%
PKG10	0.07%	-0.28%	1.11%	-1.78%	0.40%	-1.78%	0.58%	-1.25%
PKG11	1.13%	-2.28%	0.28%	1.20%	0.20%	-0.98%	2.67%	-0.63%
PKG12	-0.14%	-1.15%	0.51%	-2.65%	-1.42%	-0.70%	3.10%	-0.16%
PKG13	0.25%	-0.60%	-5.51%	-2.70%	-2.56%	-1.07%	1.85%	-0.95%
PKG14	-0.50%	-2.17%	-6.91%	0.46%	-0.19%	0.21%	-0.32%	0.39%
PKG15	0.00%	-1.42%	0.56%	-4.26%	-1.05%	-0.46%	-0.06%	-0.17%
PKG16	0.27%	-2.82%	0.28%	-0.89%	0.00%	-3.11%	0.42%	0.00%
PKG17	2.06%	-3.22%	4.07%	-2.22%	0.47%	-0.94%	0.18%	0.33%
PKG18	0.71%	0.15%	3.25%	-4.58%	1.13%	-1.70%	1.39%	0.55%
PKG19	-0.08%	-0.30%	4.60%	-1.54%	-3.27%	-0.15%	-0.06%	0.56%
PKG20	-1.09%	-0.51%	5.71%	-3.31%	-1.81%	0.82%	3.43%	-0.82%
PKG21	-0.48%	-0.59%	0.28%	-3.83%	-1.88%	0.60%	0.73%	-0.95%
PKG22	0.47%	-0.66%	-0.55%	-4.66%	-1.78%	0.15%	2.66%	0.29%
PKG23	1.39%	2.58%	-0.99%	-4.29%	-1.26%	-0.08%	0.12%	-0.11%
PKG24	-0.17%	-0.08%	1.03%	-4.92%	-0.72%	-1.38%	0.38%	0.00%
PKG25	-0.69%	2.12%	0.67%	-2.62%	-0.47%	-0.51%	0.06%	1.13%
PKG26	-2.72%	1.17%	-6.65%	-2.57%	-0.20%	-3.17%	1.21%	-0.55%
PKG27	-0.40%	1.52%	0.92%	-1.75%	-0.21%	-0.22%	-0.41%	0.71%
PKG28	-2.83%	1.64%	-1.26%	-2.24%	-0.95%	1.29%	0.37%	-0.55%
PKG29	-1.82%	-2.93%	-5.89%	-5.23%	0.13%	0.44%	-3.22%	0.59%
PKG30	-1.38%	-0.15%	0.28%	-3.45%	0.49%	1.74%	1.45%	-0.41%
PKG31	0.17%	-1.95%	0.30%	-3.80%	-1.07%	-2.08%	0.93%	0.43%
PKG32	3.29%	-3.08%	-1.78%	-2.60%	-0.64%	0.61%	1.66%	0.30%
PKG33	0.15%	0.88%	0.46%	-1.97%	-1.82%	1.01%	1.95%	0.97%
PKG35	-1.92%	1.02%	-0.48%	-5.97%	-1.17%	0.15%	-0.24%	-0.45%
PKG36	3.19%	1.42%	outliner	-1.98%	-1.29%	0.84%	-0.97%	0.11%
PKG37	-1.42%	-1.02%	-0.07%	-0.65%	-0.35%	-0.83%	-1.04%	-1.95%
PKG38	-3.36%	-2.66%	-0.48%	-2.16%	0.19%	-0.41%	-1.15%	-1.20%
PKG39	2.13%	0.65%	-0.07%	-6.05%	-1.11%	0.96%	1.50%	-0.43%
PKG40	-0.24%	4.10%	outliner	-4.69%	-1.11%	0.30%	-0.82%	-0.44%
PKG41	-0.23%	1.01%	1.80%	-1.90%	-0.14%	-3.31%	0.11%	0.36%
PKG42	-4.09%	0.73%	-0.66%	-0.79%	-1.67%	-3.34%	-3.99%	-2.80%
PKG43	-0.47%	1.98%	0.34%	-0.07%	-2.94%	-4.03%	0.35%	-1.02%
PKG44	0.00%	2.51%	-0.48%	0.99%	-1.56%	-4.40%	-1.90%	-0.84%
PKG45	0.45%	4.87%	0.41%	-0.95%	-1.48%	-2.61%	-3.14%	-1.92%
PKG46	0.15%	2.22%	-0.64%	-3.26%	-1.92%	-1.32%	-1.78%	-1.24%
PKG47	0.33%	3.65%	-0.54%	-2.00%	-1.39%	-0.47%	-6.95%	-0.51%
PKG48	-0.42%	-0.45%	0.63%	-0.59%	-1.51%	-1.23%	-2.43%	0.45%
PKG49	1.23%	-3.36%	1.46%	-1.78%	-1.07%	-0.92%	-4.85%	-2.06%
PKG50	-2.13%	-0.68%	0.00%	-1.86%	-0.26%	-2.25%	-4.72%	-2.48%
Mean	0.55%	0.31%	-0.12%	-2.19%	-0.84%	-1.01%	0.01%	-0.31%
SD	2.41%	2.00%	2.43%	1.95%	1.20%	1.52%	2.27%	1.03%
Max	8.15%	4.87%	5.71%	3.44%	1.34%	1.74%	4.98%	2.68%
Min	-4.09%	-3.36%	-6.91%	-6.05%	-5.27%	-4.40%	-6.95%	-2.80%
Diff	12.24%	8.23%	12.63%	9.49%	6.61%	6.14%	11.93%	5.48%

Table C-2-7: TCB 875th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	0.07%	4.39%	1.98%	-1.18%	3.71%	2.57%	2.08%	1.66%
PKG02	1.93%	4.65%	1.51%	2.84%	2.18%	10.50%	1.96%	4.61%
PKG03	outliner	4.53%	0.61%	0.79%	1.02%	6.25%	2.92%	3.78%
PKG04	0.38%	7.97%	1.64%	1.35%	4.13%	9.64%	-0.51%	3.15%
PKG05	1.75%	1.33%	-0.08%	2.52%	1.94%	5.74%	1.28%	0.82%
PKG06	2.94%	5.82%	1.47%	1.41%	1.51%	10.74%	1.45%	1.72%
PKG07	-0.02%	2.86%	4.28%	1.01%	1.50%	9.15%	1.90%	1.86%
PKG08	-0.66%	2.69%	0.74%	3.60%	0.07%	5.13%	1.11%	0.79%
PKG09	1.38%	3.03%	2.13%	0.86%	1.10%	3.45%	1.56%	3.23%
PKG10	-0.02%	2.75%	0.93%	-1.36%	0.07%	2.57%	1.26%	0.36%
PKG11	2.77%	0.93%	0.48%	2.01%	0.08%	3.13%	1.86%	0.72%
PKG12	-0.57%	2.59%	0.08%	1.08%	0.71%	6.38%	1.30%	-0.07%
PKG13	2.70%	1.10%	0.41%	1.23%	1.22%	11.15%	0.66%	-1.24%
PKG14	-0.54%	2.41%	1.04%	1.25%	-0.75%	2.63%	0.77%	2.15%
PKG15	1.07%	4.16%	1.31%	0.30%	-3.29%	2.56%	1.54%	1.97%
PKG16	2.13%	2.32%	1.59%	1.59%	1.50%	3.22%	1.25%	2.58%
PKG17	-0.58%	1.19%	-0.63%	1.98%	-0.44%	4.88%	0.76%	-3.44%
PKG18	0.75%	2.91%	0.64%	2.53%	-0.70%	5.17%	0.39%	-0.95%
PKG19	0.48%	2.57%	-0.16%	1.51%	-0.08%	3.58%	0.20%	-1.65%
PKG20	-0.91%	2.71%	0.41%	1.35%	0.98%	1.50%	1.04%	0.91%
PKG21	1.24%	2.96%	-0.56%	-0.78%	-0.31%	4.52%	0.99%	-6.61%
PKG22	-1.45%	-0.84%	0.31%	-0.65%	0.64%	10.16%	0.52%	-1.47%
PKG23	2.51%	3.47%	0.16%	-3.04%	-0.52%	9.88%	1.57%	0.42%
PKG24	2.02%	2.05%	-0.09%	-1.37%	1.31%	9.64%	-0.14%	-3.55%
PKG25	0.36%	1.80%	1.08%	4.99%	-0.39%	5.69%	-0.06%	-6.86%
PKG26	2.49%	3.64%	0.08%	0.56%	-0.63%	2.82%	-0.13%	-0.76%
PKG27	1.80%	2.69%	0.55%	-0.58%	-0.16%	5.70%	-1.42%	-0.39%
PKG28	0.38%	1.37%	-0.40%	0.10%	0.33%	4.16%	-0.20%	-2.65%
PKG29	1.98%	1.20%	-0.76%	-0.27%	-0.93%	6.02%	-0.12%	-2.26%
PKG30	3.34%	1.04%	0.08%	1.49%	0.08%	5.02%	-1.38%	0.66%
PKG31	0.29%	1.39%	-1.11%	-3.33%	-0.09%	1.74%	0.85%	-3.18%
PKG32	1.95%	-0.16%	-1.15%	-7.06%	1.15%	3.75%	0.81%	0.75%
PKG33	-0.58%	0.82%	-1.41%	-1.76%	0.86%	0.77%	0.38%	-0.51%
PKG35	2.84%	1.85%	-1.60%	1.10%	1.96%	6.58%	0.13%	2.61%
PKG36	2.30%	5.12%	-1.04%	-3.88%	-0.45%	0.22%	1.31%	-0.08%
PKG37	2.44%	0.04%	-0.55%	0.48%	0.61%	2.20%	-1.60%	-4.87%
PKG38	1.07%	0.90%	-1.24%	-3.77%	0.82%	-4.86%	-0.32%	-2.07%
PKG39	3.37%	1.96%	-0.32%	-3.22%	-0.08%	1.20%	-0.19%	-3.79%
PKG40	2.23%	0.14%	-2.56%	0.77%	-0.56%	-4.44%	3.07%	0.47%
PKG41	0.53%	4.26%	-0.38%	-0.27%	0.37%	-3.99%	0.76%	-2.36%
PKG42	3.31%	2.92%	-0.39%	-2.15%	0.08%	4.86%	0.51%	-0.66%
PKG43	0.17%	1.36%	0.00%	-2.12%	-1.73%	9.30%	0.98%	-2.73%
PKG44	-0.71%	4.27%	-0.58%	-8.15%	-0.24%	6.77%	0.68%	-2.17%
PKG45	2.16%	2.69%	1.42%	-3.23%	-0.78%	7.79%	2.26%	-1.16%
PKG46	0.70%	-0.05%	0.00%	-4.07%	0.00%	3.42%	1.45%	1.98%
PKG47	3.70%	1.37%	-1.61%	-1.56%	-0.65%	4.14%	1.52%	-0.15%
PKG48	-1.75%	3.89%	-1.97%	-1.16%	-0.69%	2.92%	0.33%	-1.51%
PKG49	1.84%	2.13%	-2.24%	-5.16%	0.98%	7.28%	1.61%	3.42%
PKG50	0.61%	2.70%	0.77%	2.23%	1.25%	7.26%	0.86%	-2.53%
Mean	1.17%	2.45%	0.10%	-0.39%	0.38%	4.70%	0.81%	-0.39%
SD	1.40%	1.67%	1.26%	2.65%	1.25%	3.70%	0.99%	2.56%
Max	3.70%	7.97%	4.28%	4.99%	4.13%	11.15%	3.07%	4.61%
Min	-1.75%	-0.84%	-2.56%	-8.15%	-3.29%	-4.86%	-1.60%	-6.86%
Diff	5.45%	8.81%	6.83%	13.14%	7.42%	16.00%	4.67%	11.48%

Table C-2-8: TCB 875th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.85%	2.16%	3.27%	2.05%	-2.63%	-1.27%	1.45%	1.56%
PKG02	2.81%	3.76%	-1.15%	-1.13%	1.30%	2.38%	0.90%	1.53%
PKG03	1.12%	2.55%	2.77%	-2.84%	1.42%	-0.54%	1.39%	1.15%
PKG04	1.24%	3.56%	2.44%	-0.96%	3.25%	2.35%	-1.36%	0.11%
PKG05	3.82%	2.35%	3.90%	-0.14%	0.98%	1.98%	0.60%	0.97%
PKG06	2.01%	3.47%	2.00%	1.24%	2.13%	1.91%	0.00%	1.06%
PKG07	1.20%	1.90%	0.56%	-0.22%	3.78%	0.88%	1.05%	-0.22%
PKG08	1.86%	0.07%	1.08%	-1.68%	0.83%	1.38%	0.48%	0.98%
PKG09	1.21%	-0.45%	0.82%	-2.44%	0.58%	-1.21%	1.54%	0.22%
PKG10	0.59%	1.42%	0.20%	-1.44%	1.06%	0.35%	0.98%	0.21%
PKG11	1.58%	-1.04%	0.92%	-0.52%	0.73%	0.84%	4.13%	1.43%
PKG12	1.00%	0.87%	1.02%	-2.58%	-0.90%	-0.35%	0.86%	1.78%
PKG13	1.68%	0.23%	1.74%	-2.84%	-1.99%	-1.92%	1.85%	0.44%
PKG14	-0.57%	-0.61%	1.31%	-1.71%	-0.25%	0.42%	2.82%	2.29%
PKG15	-0.08%	-0.15%	0.56%	-3.48%	-0.42%	0.31%	-0.54%	0.88%
PKG16	-0.48%	-0.98%	0.81%	-0.06%	0.43%	-1.06%	-0.56%	0.84%
PKG17	5.72%	-1.92%	2.40%	-0.93%	0.27%	1.45%	1.48%	2.23%
PKG18	1.43%	0.96%	0.60%	-3.68%	1.20%	0.82%	1.75%	1.05%
PKG19	0.24%	-1.27%	-0.28%	-0.22%	-2.65%	-0.69%	0.85%	1.69%
PKG20	-0.47%	0.58%	1.56%	-1.94%	-1.39%	0.97%	1.63%	0.99%
PKG21	0.80%	-0.30%	0.14%	-3.11%	-0.91%	-0.30%	0.73%	0.62%
PKG22	1.17%	1.25%	0.48%	-3.67%	-0.48%	1.55%	4.55%	2.45%
PKG23	1.30%	2.58%	-0.07%	-3.05%	1.04%	-0.47%	0.49%	1.60%
PKG24	0.25%	0.23%	3.10%	-2.01%	-0.36%	-0.61%	-0.26%	1.01%
PKG25	0.92%	0.00%	1.68%	-2.05%	-0.47%	0.72%	0.29%	1.30%
PKG26	-3.02%	0.37%	0.00%	-2.00%	0.53%	-1.06%	0.57%	0.11%
PKG27	-0.40%	1.22%	1.34%	-1.46%	-1.17%	0.00%	0.06%	0.44%
PKG28	-1.67%	2.82%	0.63%	-1.49%	0.81%	2.02%	-0.30%	0.00%
PKG29	-1.14%	3.58%	0.87%	-4.69%	1.35%	1.68%	-2.77%	1.88%
PKG30	-1.61%	-0.95%	0.64%	-2.20%	0.35%	1.13%	0.13%	0.68%
PKG31	0.09%	-2.03%	0.52%	-2.48%	-1.54%	-1.04%	1.72%	1.96%
PKG32	0.00%	-2.94%	0.71%	0.31%	0.36%	1.23%	1.15%	0.47%
PKG33	-3.99%	-1.55%	0.46%	-1.06%	-1.26%	3.48%	1.13%	1.29%
PKG35	-1.61%	3.26%	1.10%	-5.27%	-1.10%	0.68%	0.18%	0.63%
PKG36	1.60%	1.21%	1.25%	-2.13%	-1.16%	0.84%	0.06%	0.59%
PKG37	-0.16%	0.80%	0.94%	-0.51%	-0.56%	0.60%	0.30%	-0.58%
PKG38	-3.70%	-1.40%	0.95%	-1.66%	0.26%	-1.16%	-0.75%	0.22%
PKG39	2.37%	1.15%	-0.07%	-6.60%	-0.63%	0.15%	1.92%	0.88%
PKG40	-0.24%	0.90%	0.75%	-5.11%	-0.49%	-0.30%	-0.41%	0.45%
PKG41	-0.08%	0.00%	1.28%	-2.51%	-0.74%	-3.24%	0.63%	1.04%
PKG42	-3.93%	-1.02%	0.46%	0.65%	-1.18%	-2.54%	-3.42%	-1.90%
PKG43	-0.08%	0.59%	1.28%	0.87%	-1.40%	-3.52%	-1.06%	-0.81%
PKG44	0.48%	-0.59%	-0.42%	0.91%	-0.78%	-3.16%	3.12%	-0.06%
PKG45	-0.08%	2.37%	-0.41%	-1.90%	-1.41%	-1.34%	1.48%	-0.61%
PKG46	1.79%	0.65%	0.19%	-2.78%	-0.64%	-0.56%	-1.84%	-1.54%
PKG47	7.26%	-0.99%	0.88%	-1.04%	-0.73%	0.32%	-5.62%	-1.18%
PKG48	4.92%	-2.46%	0.77%	1.78%	-1.44%	-0.54%	-1.50%	-0.66%
PKG49	2.30%	-3.79%	2.63%	-0.77%	-1.14%	-0.84%	-0.54%	-1.43%
PKG50	3.61%	-2.52%	1.69%	-1.73%	-0.26%	-1.40%	-4.45%	-2.28%
Mean	0.71%	0.41%	1.03%	-1.68%	-0.15%	0.03%	0.34%	0.57%
SD	2.20%	1.84%	1.01%	1.78%	1.32%	1.51%	1.86%	1.08%
Max	7.26%	3.76%	3.90%	2.05%	3.78%	3.48%	4.55%	2.45%
Min	-3.99%	-3.79%	-1.15%	-6.60%	-2.65%	-3.52%	-5.62%	-2.28%
Diff	11.25%	7.55%	5.05%	8.65%	6.43%	7.00%	10.16%	4.73%

Table C-2-9: TCB 1016th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	outliner	3.15%	1.98%	0.99%	0.87%	4.90%	3.69%	4.91%
PKG02	outliner	5.47%	1.99%	4.83%	-0.39%	4.01%	2.53%	6.47%
PKG03	13.83%	4.35%	1.68%	1.31%	-0.44%	3.29%	5.59%	2.03%
PKG04	11.41%	4.84%	3.29%	1.84%	-0.32%	3.42%	1.21%	1.26%
PKG05	11.10%	2.12%	2.14%	3.59%	-1.86%	2.64%	1.34%	2.54%
PKG06	13.64%	2.71%	2.94%	1.41%	-1.35%	5.50%	1.11%	1.63%
PKG07	9.43%	4.37%	1.84%	2.62%	-0.16%	4.16%	1.36%	0.81%
PKG08	8.95%	1.75%	1.26%	0.43%	-1.37%	3.35%	0.23%	0.40%
PKG09	9.83%	4.37%	2.13%	-0.48%	-1.34%	1.84%	2.02%	2.23%
PKG10	6.30%	0.60%	0.70%	0.27%	-1.08%	1.68%	outliner	-0.58%
PKG11	8.55%	0.74%	2.10%	-0.10%	-2.06%	1.93%	2.19%	0.40%
PKG12	4.06%	2.50%	0.77%	-0.63%	0.00%	1.06%	1.36%	-0.28%
PKG13	6.24%	2.37%	1.07%	1.23%	-1.62%	5.45%	0.66%	-2.08%
PKG14	5.40%	3.64%	1.41%	-0.17%	0.27%	1.26%	1.25%	-0.60%
PKG15	8.24%	3.53%	1.15%	0.60%	-0.94%	3.66%	2.01%	-1.42%
PKG16	10.40%	3.84%	1.45%	0.87%	-0.39%	3.32%	1.20%	0.57%
PKG17	2.76%	2.25%	0.47%	2.45%	-2.07%	2.71%	-0.32%	-3.16%
PKG18	10.04%	3.84%	1.04%	3.01%	-1.09%	2.94%	0.26%	-1.76%
PKG19	10.03%	2.04%	1.72%	-1.21%	-1.21%	3.08%	0.27%	-0.79%
PKG20	8.78%	2.40%	0.49%	-0.19%	1.71%	0.81%	1.23%	2.05%
PKG21	6.85%	3.86%	0.08%	1.95%	-1.55%	6.43%	0.92%	-4.96%
PKG22	2.07%	-0.74%	0.55%	-0.93%	1.12%	4.06%	2.13%	6.43%
PKG23	6.32%	3.14%	0.00%	-1.37%	-1.12%	2.57%	2.25%	8.34%
PKG24	8.97%	3.85%	-0.51%	-1.37%	-1.07%	2.96%	-0.35%	-2.31%
PKG25	1.99%	2.39%	1.78%	-0.18%	0.31%	2.90%	1.32%	-5.95%
PKG26	3.56%	2.77%	0.08%	1.87%	-1.72%	0.23%	0.25%	0.08%
PKG27	2.18%	4.43%	0.40%	1.64%	-0.64%	5.58%	-0.39%	0.95%
PKG28	0.98%	1.68%	0.08%	1.06%	-1.56%	1.96%	1.85%	-3.49%
PKG29	5.52%	1.59%	0.30%	0.99%	-0.93%	1.50%	0.00%	-1.39%
PKG30	3.83%	1.74%	0.57%	0.99%	-0.57%	6.45%	1.31%	1.57%
PKG31	4.14%	5.30%	-1.02%	-2.81%	0.09%	-2.36%	1.06%	-3.76%
PKG32	3.82%	3.26%	-0.66%	-7.35%	1.48%	8.76%	0.27%	0.33%
PKG33	1.83%	2.39%	-0.47%	-0.74%	0.78%	0.88%	1.02%	-0.44%
PKG35	6.37%	1.94%	0.00%	-1.40%	1.88%	1.25%	0.72%	0.32%
PKG36	2.58%	3.09%	0.00%	-2.53%	-0.30%	-1.20%	1.19%	1.42%
PKG37	3.87%	1.92%	-0.55%	-0.29%	-0.08%	3.00%	-0.96%	-3.64%
PKG38	2.52%	2.24%	-1.55%	-2.96%	-0.74%	-3.89%	0.77%	-1.23%
PKG39	8.52%	2.16%	-0.32%	-4.41%	0.94%	-4.70%	-0.38%	-1.75%
PKG40	3.50%	2.98%	-2.33%	1.25%	-0.56%	-1.71%	1.37%	1.17%
PKG41	3.47%	5.30%	-1.00%	0.09%	-1.39%	-4.30%	4.28%	-1.53%
PKG42	4.75%	5.38%	-0.86%	-1.21%	0.08%	4.86%	2.57%	-0.37%
PKG43	3.61%	2.47%	0.00%	-0.19%	0.39%	7.48%	0.72%	-3.39%
PKG44	2.72%	5.32%	-1.40%	-7.20%	-0.56%	4.87%	3.94%	-0.24%
PKG45	1.30%	4.36%	-0.08%	-2.78%	-0.93%	6.35%	2.39%	-0.23%
PKG46	3.69%	0.50%	-0.08%	-2.34%	0.59%	10.48%	1.01%	-0.07%
PKG47	7.23%	2.99%	-1.85%	0.68%	-1.05%	11.14%	1.38%	-1.22%
PKG48	3.63%	7.96%	0.95%	-2.23%	-0.09%	2.28%	1.19%	-0.64%
PKG49	2.62%	4.21%	-0.08%	-2.08%	0.00%	5.31%	0.35%	-0.08%
PKG50	1.79%	5.75%	0.84%	1.95%	0.00%	3.75%	1.23%	-2.67%
Mean	5.81%	3.17%	0.50%	-0.19%	-0.45%	3.02%	1.30%	-0.08%
SD	3.43%	1.60%	1.22%	2.36%	0.97%	3.27%	1.25%	2.75%
Max	13.83%	7.96%	3.29%	4.83%	1.88%	11.14%	5.59%	8.34%
Min	0.98%	-0.74%	-2.33%	-7.35%	-2.07%	-4.70%	-0.96%	-5.95%
Diff	12.84%	8.70%	5.61%	12.18%	3.95%	15.85%	6.55%	14.29%

Table C-2-10: TCB 1016th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	4.02%	2.01%	3.48%	-0.37%	-2.30%	2.24%	4.36%	0.90%
PKG02	3.21%	4.96%	0.77%	-1.27%	0.94%	3.15%	4.92%	0.65%
PKG03	0.91%	2.21%	3.30%	-3.46%	1.22%	0.60%	6.76%	0.37%
PKG04	0.62%	0.96%	4.53%	-1.48%	-0.69%	1.18%	4.55%	-2.27%
PKG05	2.36%	1.44%	3.97%	-0.43%	-0.28%	1.37%	2.71%	0.59%
PKG06	1.66%	3.06%	1.92%	-0.31%	0.38%	-0.48%	2.43%	-1.01%
PKG07	0.56%	1.75%	1.94%	-0.22%	1.00%	-0.74%	4.71%	-0.33%
PKG08	1.64%	3.45%	3.49%	-2.07%	-0.19%	3.25%	0.69%	0.34%
PKG09	0.00%	0.08%	7.04%	-2.52%	-0.94%	-2.05%	5.87%	-0.11%
PKG10	1.64%	1.35%	3.99%	-2.74%	-0.99%	2.27%	1.60%	-0.37%
PKG11	3.16%	-0.21%	3.03%	-0.97%	0.60%	0.77%	5.59%	0.34%
PKG12	-0.57%	-1.89%	3.94%	1.56%	-1.48%	2.65%	1.15%	1.63%
PKG13	3.20%	1.28%	4.53%	-1.38%	-2.78%	-1.00%	4.75%	0.11%
PKG14	0.07%	-1.97%	0.44%	-2.11%	-0.44%	0.98%	2.87%	1.61%
PKG15	3.17%	1.27%	1.05%	-2.34%	-1.34%	0.53%	3.32%	2.27%
PKG16	-0.89%	-0.13%	-0.17%	-0.44%	1.67%	-2.45%	3.20%	0.84%
PKG17	1.75%	-1.37%	1.00%	-1.07%	1.28%	1.31%	4.62%	1.03%
PKG18	4.68%	0.74%	0.53%	-2.36%	0.35%	2.23%	3.97%	0.77%
PKG19	7.79%	0.08%	0.07%	-1.76%	-2.37%	0.46%	1.89%	0.78%
PKG20	-0.94%	1.68%	2.38%	-2.73%	-1.25%	1.57%	2.34%	-0.11%
PKG21	0.64%	1.25%	3.72%	-3.40%	-0.63%	0.91%	1.59%	0.22%
PKG22	5.40%	1.91%	1.44%	-5.30%	0.48%	4.94%	3.25%	1.39%
PKG23	2.08%	4.20%	1.84%	-3.93%	-0.37%	0.31%	4.78%	0.69%
PKG24	-0.33%	1.68%	2.14%	-4.77%	-1.38%	-0.23%	3.46%	-0.24%
PKG25	1.07%	0.51%	1.01%	-2.26%	0.54%	1.45%	0.76%	2.48%
PKG26	-3.16%	5.13%	2.47%	-1.71%	-0.53%	-1.62%	5.25%	-1.35%
PKG27	0.89%	1.07%	2.47%	-1.09%	-0.34%	0.82%	1.95%	0.05%
PKG28	3.41%	6.03%	1.40%	0.15%	0.15%	3.48%	0.73%	-0.50%
PKG29	1.67%	2.15%	3.55%	-4.62%	-0.27%	2.99%	0.88%	0.65%
PKG30	-1.54%	0.59%	1.84%	-1.39%	0.14%	2.49%	2.97%	-0.35%
PKG31	0.09%	-2.49%	1.11%	-3.88%	-0.84%	-0.48%	4.91%	0.74%
PKG32	2.65%	-0.37%	-1.28%	-1.45%	1.36%	1.30%	1.15%	3.80%
PKG33	-0.84%	6.12%	0.53%	-1.13%	0.70%	2.32%	1.48%	3.34%
PKG35	-1.15%	0.87%	-0.21%	-5.83%	0.21%	0.07%	0.79%	2.37%
PKG36	1.38%	1.42%	1.71%	-1.49%	-0.71%	2.25%	2.04%	2.52%
PKG37	2.06%	-1.61%	1.34%	-0.43%	1.11%	5.33%	0.64%	0.84%
PKG38	-2.06%	-2.13%	2.39%	-1.51%	-0.19%	0.13%	1.55%	1.80%
PKG39	4.10%	1.01%	0.47%	-5.71%	-0.69%	0.67%	1.68%	1.31%
PKG40	0.55%	1.86%	1.23%	-4.90%	-1.39%	1.04%	2.18%	1.66%
PKG41	0.53%	2.39%	2.24%	-1.83%	-0.34%	-4.30%	3.56%	0.72%
PKG42	-3.25%	0.66%	0.99%	0.29%	-1.46%	-2.18%	0.40%	-0.85%
PKG43	0.08%	3.66%	0.27%	1.82%	-1.75%	-3.52%	0.35%	0.06%
PKG44	0.00%	6.72%	-0.14%	1.68%	0.64%	0.29%	1.96%	1.36%
PKG45	0.75%	1.65%	2.07%	-1.46%	-1.01%	-2.61%	2.39%	-0.71%
PKG46	0.22%	1.43%	1.29%	-3.33%	-0.45%	-1.67%	-0.50%	-0.77%
PKG47	4.01%	0.38%	0.34%	-1.33%	-0.51%	1.03%	-1.92%	1.18%
PKG48	0.33%	-1.94%	1.48%	-1.04%	-1.23%	0.15%	-1.39%	2.23%
PKG49	1.72%	-0.29%	1.83%	-1.31%	1.07%	0.23%	-0.48%	-0.28%
PKG50	-1.77%	1.63%	-0.52%	-1.80%	-0.79%	-0.35%	-1.46%	-1.62%
Mean	1.18%	1.35%	1.84%	-1.87%	-0.33%	0.68%	2.39%	0.63%
SD	2.17%	2.13%	1.59%	1.77%	1.03%	1.98%	2.02%	1.24%
Max	7.79%	6.72%	7.04%	1.82%	1.67%	5.33%	6.76%	3.80%
Min	-3.25%	-2.49%	-1.28%	-5.83%	-2.78%	-4.30%	-1.92%	-2.27%
Diff	11.05%	9.22%	8.33%	7.65%	4.45%	9.63%	8.68%	6.07%

Table C-2-11: TCB 1200th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	4.13%	3.56%	2.06%	0.20%	1.11%	0.58%	2.95%	3.33%
PKG02	3.89%	8.55%	0.16%	3.41%	-0.86%	6.02%	2.21%	8.33%
PKG03	1.24%	3.62%	0.08%	1.84%	0.15%	4.72%	1.93%	3.92%
PKG04	outliner	9.74%	1.89%	0.29%	-0.65%	8.66%	-1.34%	4.25%
PKG05	9.33%	7.47%	-0.16%	2.71%	-1.09%	3.10%	1.09%	2.09%
PKG06	5.38%	4.38%	1.82%	-0.65%	-2.86%	7.20%	3.12%	3.69%
PKG07	0.76%	5.28%	1.26%	2.12%	-0.55%	4.63%	2.24%	2.10%
PKG08	1.70%	4.87%	0.74%	0.94%	-1.51%	3.79%	2.75%	1.66%
PKG09	2.59%	4.78%	0.66%	-1.62%	-2.05%	4.14%	4.03%	2.54%
PKG10	4.65%	2.01%	0.00%	0.09%	-1.44%	2.24%	3.83%	-0.50%
PKG11	4.99%	0.83%	1.05%	0.67%	-1.83%	11.33%	2.32%	0.72%
PKG12	3.51%	4.48%	-0.31%	1.35%	-0.29%	3.72%	1.05%	3.83%
PKG13	4.83%	1.84%	-0.50%	0.71%	-1.05%	9.29%	1.00%	0.31%
PKG14	3.17%	3.47%	0.74%	-0.33%	-1.10%	3.68%	1.73%	0.27%
PKG15	6.95%	4.59%	0.08%	-0.20%	-2.74%	3.54%	0.80%	0.87%
PKG16	5.92%	2.23%	1.88%	1.03%	-1.69%	2.83%	1.71%	0.88%
PKG17	4.16%	2.25%	-1.10%	3.29%	-1.03%	1.41%	0.00%	-3.02%
PKG18	2.98%	3.22%	0.80%	3.50%	outliner	9.75%	0.26%	0.00%
PKG19	1.99%	3.31%	0.74%	1.11%	-0.81%	8.76%	0.60%	0.63%
PKG20	1.34%	3.73%	0.41%	0.00%	0.81%	3.71%	0.32%	0.68%
PKG21	0.94%	3.16%	-0.24%	-0.29%	-0.23%	9.52%	0.85%	-4.66%
PKG22	-2.21%	-1.24%	-0.08%	-2.59%	-2.31%	9.21%	2.91%	2.79%
PKG23	1.88%	2.70%	0.24%	-0.59%	-0.52%	3.46%	0.82%	6.50%
PKG24	1.92%	3.85%	0.60%	-2.00%	0.16%	9.76%	-0.69%	-1.07%
PKG25	1.89%	2.88%	1.86%	-0.54%	-1.89%	6.15%	0.69%	-5.88%
PKG26	3.07%	2.28%	-0.31%	1.77%	-0.63%	4.69%	-1.06%	1.45%
PKG27	2.28%	3.10%	0.55%	0.10%	-0.96%	6.45%	3.68%	-0.16%
PKG28	1.49%	1.88%	-0.08%	0.48%	-0.33%	5.38%	2.64%	-4.47%
PKG29	2.84%	2.66%	-0.08%	2.34%	0.00%	3.59%	2.82%	-1.60%
PKG30	2.94%	0.74%	1.05%	3.18%	1.87%	0.36%	3.74%	3.38%
PKG31	-0.96%	3.40%	-1.11%	-3.12%	1.23%	1.12%	2.26%	-3.43%
PKG32	1.56%	0.85%	-0.41%	-6.20%	3.22%	8.63%	0.81%	0.17%
PKG33	-0.67%	2.98%	0.31%	-1.21%	1.09%	0.00%	1.79%	0.22%
PKG35	0.17%	4.45%	-1.04%	-1.80%	0.16%	1.13%	1.11%	2.06%
PKG36	1.56%	2.81%	-0.37%	-3.12%	-0.60%	-0.65%	0.81%	0.97%
PKG37	-0.78%	0.83%	-1.18%	0.48%	-0.61%	3.00%	-0.70%	-3.56%
PKG38	1.07%	1.86%	-1.39%	-1.89%	-0.45%	-0.86%	1.09%	-0.54%
PKG39	1.43%	2.06%	-0.08%	-4.32%	-0.39%	-2.73%	0.83%	-3.42%
PKG40	0.17%	2.77%	-2.01%	2.12%	-0.48%	-4.10%	1.63%	1.02%
PKG41	-0.02%	2.01%	-0.92%	0.09%	-1.10%	-2.66%	1.83%	-0.83%
PKG42	0.55%	3.33%	-0.39%	2.05%	1.16%	8.91%	0.38%	-0.07%
PKG43	3.71%	-0.46%	-0.40%	-2.50%	-1.96%	11.83%	2.42%	-2.51%
PKG44	0.07%	4.69%	-0.83%	-7.96%	-0.64%	6.77%	2.58%	-0.72%
PKG45	-0.40%	2.89%	0.16%	-2.96%	-1.09%	outliner	3.23%	0.39%
PKG46	-0.11%	0.41%	0.38%	-2.51%	-0.30%	5.30%	1.76%	-0.07%
PKG47	3.20%	0.35%	-2.34%	0.10%	0.49%	0.92%	2.37%	0.61%
PKG48	-0.03%	3.89%	-2.05%	-0.48%	-0.17%	9.00%	1.12%	1.20%
PKG49	1.54%	3.69%	-1.41%	-4.66%	1.39%	9.63%	1.54%	0.86%
PKG50	-0.02%	4.57%	-0.62%	0.56%	-0.51%	10.77%	1.60%	-2.32%
Mean	2.14%	3.13%	0.00%	-0.31%	-0.50%	4.74%	1.58%	0.47%
SD	2.24%	2.02%	1.04%	2.44%	1.19%	4.00%	1.27%	2.75%
Max	9.33%	9.74%	2.06%	3.50%	3.22%	11.83%	4.03%	8.33%
Min	-2.21%	-1.24%	-2.34%	-7.96%	-2.86%	-4.10%	-1.34%	-5.88%
Diff	11.53%	10.98%	4.40%	11.46%	6.08%	15.93%	5.37%	14.22%

Table C-2-12: TCB 1200th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	2.58%	2.38%	-1.02%	-0.07%	-3.85%	-1.19%	5.14%	1.45%
PKG02	2.89%	1.35%	-3.20%	-1.27%	0.22%	1.07%	2.70%	0.98%
PKG03	1.12%	1.10%	2.04%	-1.04%	0.19%	-2.68%	0.34%	2.47%
PKG04	0.00%	1.85%	1.81%	-1.33%	0.48%	0.66%	0.29%	-1.33%
PKG05	2.85%	1.82%	1.55%	1.00%	0.14%	1.83%	1.47%	-0.21%
PKG06	2.45%	2.01%	1.03%	-1.17%	1.29%	-1.19%	3.52%	0.30%
PKG07	0.80%	2.06%	0.49%	0.67%	2.71%	-1.91%	2.29%	0.06%
PKG08	1.57%	0.13%	0.60%	-1.42%	0.26%	0.48%	-0.21%	0.49%
PKG09	0.72%	-0.08%	0.34%	-2.09%	0.22%	-2.05%	1.30%	2.46%
PKG10	0.22%	0.92%	0.85%	-2.06%	0.33%	-0.21%	0.46%	-0.05%
PKG11	0.98%	-2.08%	0.85%	-0.30%	0.00%	-0.84%	1.10%	3.33%
PKG12	0.07%	-1.62%	1.46%	-1.76%	-1.03%	0.56%	0.86%	1.25%
PKG13	3.29%	1.20%	0.98%	-0.14%	-2.56%	-0.38%	1.98%	-0.39%
PKG14	0.21%	-1.76%	0.81%	0.00%	0.44%	1.19%	-1.01%	2.43%
PKG15	-1.30%	-0.75%	0.35%	-3.27%	0.00%	-0.08%	-1.54%	-0.11%
PKG16	0.61%	0.72%	0.52%	-0.38%	0.50%	-0.46%	-0.51%	-0.52%
PKG17	2.67%	-3.84%	1.47%	-0.71%	-0.07%	1.23%	4.09%	0.71%
PKG18	2.54%	0.22%	0.93%	-3.75%	1.20%	0.45%	0.96%	0.00%
PKG19	0.80%	5.00%	1.74%	0.73%	-2.79%	-0.31%	0.12%	1.06%
PKG20	2.66%	-0.51%	1.90%	-1.08%	-0.49%	0.52%	1.02%	-0.05%
PKG21	1.37%	0.00%	1.68%	-2.60%	-0.91%	-0.30%	1.95%	0.79%
PKG22	2.66%	1.84%	0.41%	-1.77%	-1.09%	2.80%	2.48%	0.11%
PKG23	outliner	1.61%	0.57%	-2.84%	0.00%	0.39%	3.37%	0.46%
PKG24	1.33%	-0.23%	2.14%	-3.36%	-0.36%	0.77%	0.26%	0.35%
PKG25	4.81%	0.51%	1.55%	0.71%	-0.54%	0.94%	1.22%	0.97%
PKG26	-0.66%	1.32%	1.10%	-2.21%	-1.06%	-0.07%	0.23%	-0.65%
PKG27	1.29%	1.83%	0.56%	-0.95%	-0.48%	0.74%	-0.18%	-0.05%
PKG28	-0.42%	5.09%	-0.14%	-2.38%	0.88%	3.56%	0.06%	-0.39%
PKG29	-0.15%	-2.79%	0.74%	-4.41%	0.27%	1.97%	-2.44%	0.16%
PKG30	2.85%	1.68%	-0.14%	-2.86%	0.49%	1.74%	1.58%	-0.41%
PKG31	0.17%	-1.79%	1.04%	-2.48%	-0.92%	-1.20%	4.11%	0.43%
PKG32	-0.16%	-2.06%	-1.78%	-1.15%	0.57%	1.23%	2.23%	1.84%
PKG33	-3.30%	0.22%	1.58%	-1.06%	-0.14%	2.24%	0.59%	1.08%
PKG35	-1.69%	0.65%	-1.24%	-5.83%	-0.14%	0.38%	-0.36%	0.85%
PKG36	4.72%	0.50%	0.33%	0.00%	0.26%	-4.01%	-0.34%	0.65%
PKG37	0.71%	-1.98%	-0.20%	2.75%	0.77%	1.35%	-1.62%	-1.32%
PKG38	-4.04%	2.33%	-0.48%	-0.79%	0.58%	-4.41%	-1.33%	-1.04%
PKG39	2.76%	0.50%	-1.14%	-5.16%	-0.69%	-0.30%	0.84%	-0.27%
PKG40	0.87%	1.42%	-0.48%	-4.69%	0.28%	-0.82%	-0.58%	-0.55%
PKG41	2.64%	1.37%	2.69%	-0.95%	0.61%	-3.10%	-0.50%	-0.11%
PKG42	0.15%	-0.07%	3.48%	0.22%	0.90%	-1.09%	0.62%	1.16%
PKG43	4.36%	-0.44%	2.30%	0.51%	-0.91%	-2.42%	3.72%	-1.30%
PKG44	6.09%	0.89%	-0.97%	1.37%	0.43%	-3.30%	-0.31%	1.36%
PKG45	1.65%	1.36%	1.17%	-0.29%	-0.27%	-1.98%	-2.51%	-1.04%
PKG46	2.53%	1.36%	0.32%	-1.22%	-0.45%	0.83%	-1.55%	-1.13%
PKG47	2.75%	0.69%	1.90%	0.22%	0.37%	2.38%	-3.53%	1.52%
PKG48	2.08%	-1.57%	0.49%	0.44%	-1.08%	-0.31%	-3.35%	-0.72%
PKG49	1.89%	-2.33%	0.58%	-0.23%	-0.14%	-0.23%	-3.77%	-1.71%
PKG50	3.53%	-1.09%	0.78%	-0.42%	0.59%	0.21%	-5.16%	-1.88%
Mean	1.43%	0.43%	0.70%	-1.24%	-0.10%	-0.11%	0.41%	0.28%
SD	1.94%	1.78%	1.19%	1.74%	1.05%	1.72%	2.15%	1.14%
Max	6.09%	5.09%	3.48%	2.75%	2.71%	3.56%	5.14%	3.33%
Min	-4.04%	-3.84%	-3.20%	-5.83%	-3.85%	-4.41%	-5.16%	-1.88%
Diff	10.13%	8.93%	6.68%	8.58%	6.56%	7.97%	10.29%	5.21%

Table C-2-13: TCB 1492nd cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	2.05%	2.01%	2.48%	0.30%	0.63%	1.05%	6.11%	4.91%
PKG02	1.05%	4.76%	1.51%	3.60%	-0.86%	5.55%	2.02%	5.80%
PKG03	-0.38%	4.72%	0.92%	-0.79%	-1.60%	4.17%	3.86%	6.03%
PKG04	0.07%	5.26%	1.97%	-0.58%	-1.54%	5.12%	-1.08%	4.25%
PKG05	0.17%	2.32%	0.00%	1.16%	-1.79%	1.38%	0.19%	4.92%
PKG06	3.15%	5.05%	1.04%	0.86%	-2.61%	7.86%	2.42%	9.36%
PKG07	2.83%	2.66%	4.86%	2.62%	-0.32%	5.23%	3.88%	8.24%
PKG08	0.79%	1.75%	0.00%	0.09%	-1.58%	4.46%	1.87%	0.20%
PKG09	3.70%	3.44%	1.15%	-2.39%	0.00%	7.47%	3.58%	2.92%
PKG10	1.99%	1.07%	0.08%	-1.64%	-2.38%	3.91%	1.19%	-0.43%
PKG11	0.46%	1.33%	0.32%	0.10%	-2.06%	2.41%	0.73%	-0.16%
PKG12	-0.11%	2.69%	0.08%	-0.45%	-0.93%	5.42%	0.68%	6.17%
PKG13	1.90%	0.89%	0.33%	2.14%	-0.89%	4.95%	1.59%	0.46%
PKG14	-0.54%	3.47%	0.52%	0.92%	-1.10%	1.79%	0.96%	9.89%
PKG15	-0.02%	2.47%	0.74%	0.70%	-3.21%	11.84%	1.88%	-1.34%
PKG16	1.96%	2.83%	0.87%	1.27%	-1.37%	4.49%	2.00%	0.38%
PKG17	-0.95%	1.38%	-1.57%	1.79%	-0.89%	2.49%	1.13%	-3.65%
PKG18	-0.22%	2.50%	0.48%	3.50%	-0.70%	11.04%	1.68%	-0.81%
PKG19	3.49%	3.52%	-0.16%	2.41%	0.32%	11.35%	1.67%	0.08%
PKG20	1.25%	1.48%	0.65%	0.77%	1.06%	5.33%	0.13%	0.68%
PKG21	-0.22%	2.66%	-0.24%	-1.17%	-1.01%	6.31%	2.57%	-5.63%
PKG22	-2.40%	-1.14%	-0.24%	-0.37%	-0.80%	8.37%	1.94%	0.85%
PKG23	1.45%	2.14%	0.00%	1.47%	0.26%	7.83%	1.57%	3.17%
PKG24	0.59%	2.16%	-0.94%	-0.53%	-0.25%	5.19%	0.35%	-2.56%
PKG25	-0.41%	2.59%	1.55%	0.09%	0.24%	-7.78%	2.70%	-5.39%
PKG26	1.91%	3.06%	-0.16%	2.05%	-0.63%	7.27%	-0.75%	0.61%
PKG27	2.57%	1.57%	-0.24%	0.48%	-0.56%	6.45%	-1.42%	0.39%
PKG28	2.59%	1.88%	-0.80%	1.83%	-0.82%	7.83%	1.25%	-3.26%
PKG29	1.70%	1.01%	-0.53%	1.17%	-1.63%	3.48%	0.88%	-1.17%
PKG30	0.37%	-1.35%	1.22%	0.80%	0.08%	3.11%	0.39%	2.72%
PKG31	outliner	1.95%	-0.68%	-2.92%	0.61%	2.60%	1.84%	-4.02%
PKG32	-0.72%	-0.86%	-1.81%	-7.63%	0.00%	7.76%	0.74%	0.50%
PKG33	-2.90%	0.92%	-0.71%	-0.65%	0.16%	8.85%	0.45%	-0.15%
PKG35	-0.60%	2.15%	-0.72%	-0.30%	0.94%	1.02%	1.57%	1.90%
PKG36	1.28%	1.43%	-1.19%	-2.78%	-0.52%	7.74%	0.25%	1.86%
PKG37	-0.12%	1.33%	-1.97%	-0.10%	-0.61%	9.36%	0.90%	-4.95%
PKG38	-1.11%	1.57%	-1.39%	-3.14%	-0.89%	1.51%	4.37%	-2.15%
PKG39	0.27%	1.45%	-0.48%	-0.64%	-0.16%	-4.26%	0.90%	-3.57%
PKG40	-0.22%	1.66%	-3.26%	4.14%	-0.48%	-1.94%	2.81%	-0.55%
PKG41	-0.02%	2.10%	-1.07%	0.72%	-1.61%	1.84%	1.70%	-2.22%
PKG42	0.07%	3.64%	-1.57%	0.37%	-0.70%	5.90%	1.48%	-0.96%
PKG43	-0.03%	1.66%	-0.16%	-2.22%	-1.18%	9.30%	2.29%	-4.27%
PKG44	-2.47%	2.79%	-2.06%	-8.15%	0.32%	6.30%	1.22%	-1.12%
PKG45	-1.26%	1.02%	0.16%	-4.57%	-0.39%	7.91%	1.94%	-1.31%
PKG46	-0.84%	0.22%	-0.15%	-4.15%	-1.34%	6.40%	1.26%	-0.37%
PKG47	-0.33%	-0.06%	-2.58%	-1.17%	-1.21%	2.07%	1.71%	-1.45%
PKG48	-2.77%	6.97%	-2.45%	-2.52%	-0.43%	4.18%	0.46%	-1.75%
PKG49	-1.99%	3.07%	-1.33%	-6.64%	-0.33%	10.73%	2.38%	0.43%
PKG50	-1.29%	4.27%	-0.23%	0.93%	-1.61%	6.91%	2.71%	-3.09%
Mean	0.33%	2.19%	-0.16%	-0.39%	-0.74%	5.09%	1.57%	0.42%
SD	1.61%	1.60%	1.40%	2.63%	0.90%	3.82%	1.35%	3.68%
Max	3.70%	6.97%	4.86%	4.14%	1.06%	11.84%	6.11%	9.89%
Min	-2.90%	-1.35%	-3.26%	-8.15%	-3.21%	-7.78%	-1.42%	-5.63%
Diff	6.60%	8.32%	8.12%	12.29%	4.27%	19.61%	7.53%	15.53%

Table C-2-14: TCB 1492nd cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.61%	4.47%	0.34%	-0.29%	-3.04%	0.00%	1.15%	-0.33%
PKG02	0.56%	3.45%	-2.30%	-1.42%	2.30%	-0.15%	1.86%	-0.23%
PKG03	0.21%	2.96%	0.33%	-2.42%	3.22%	-3.02%	1.27%	-0.90%
PKG04	0.46%	2.08%	0.00%	-0.82%	-0.90%	0.81%	0.06%	-2.38%
PKG05	4.64%	8.89%	0.74%	0.50%	0.14%	-0.69%	0.18%	-0.32%
PKG06	2.36%	3.47%	0.15%	0.78%	2.73%	0.32%	2.94%	-0.90%
PKG07	0.16%	5.94%	-0.70%	0.45%	3.78%	-2.06%	3.28%	0.22%
PKG08	1.72%	1.83%	0.54%	0.58%	0.00%	5.33%	0.32%	0.05%
PKG09	1.29%	2.12%	-0.14%	-2.88%	-0.94%	0.99%	0.49%	0.73%
PKG10	0.89%	2.21%	0.65%	0.34%	-0.66%	1.28%	0.58%	-0.63%
PKG11	1.43%	-1.87%	0.07%	0.00%	-0.60%	-0.49%	4.80%	1.21%
PKG12	0.36%	-2.02%	1.08%	-2.38%	-1.10%	-0.14%	0.75%	0.79%
PKG13	4.30%	0.53%	0.77%	-1.38%	-3.13%	0.54%	2.41%	-1.12%
PKG14	0.00%	-2.24%	1.12%	-1.52%	-0.44%	-0.49%	2.98%	0.88%
PKG15	1.30%	0.30%	0.63%	-3.84%	-1.34%	-0.46%	-1.72%	-0.17%
PKG16	0.48%	-0.52%	-0.06%	-0.95%	1.05%	-2.91%	2.48%	0.70%
PKG17	3.81%	-2.06%	0.60%	1.07%	-0.47%	1.45%	1.30%	2.39%
PKG18	3.41%	6.33%	0.66%	-4.37%	0.42%	1.11%	0.96%	2.31%
PKG19	1.93%	-0.60%	4.95%	0.00%	-1.88%	2.30%	1.47%	2.82%
PKG20	-0.23%	-0.07%	1.16%	-2.38%	-1.05%	0.37%	0.18%	0.39%
PKG21	0.40%	-0.59%	0.56%	-2.39%	-1.12%	2.04%	0.24%	0.11%
PKG22	5.00%	0.73%	0.41%	-3.04%	-1.85%	0.30%	-0.35%	0.34%
PKG23	2.08%	2.02%	2.70%	-3.85%	-0.97%	-1.26%	-0.61%	-0.06%
PKG24	1.58%	-1.07%	1.47%	-4.03%	-0.87%	-1.15%	-0.19%	0.29%
PKG25	0.99%	-0.66%	0.27%	-1.98%	0.94%	2.24%	0.70%	0.81%
PKG26	-2.43%	1.76%	0.69%	-2.78%	-0.53%	-2.96%	0.00%	-1.08%
PKG27	0.16%	1.90%	0.85%	-1.60%	-2.20%	-0.52%	-0.29%	-0.83%
PKG28	-0.75%	0.08%	2.52%	-0.97%	0.81%	2.51%	0.61%	-0.22%
PKG29	-1.37%	-0.36%	1.61%	-5.30%	0.34%	0.87%	-3.00%	0.86%
PKG30	-1.31%	-1.03%	-0.57%	-1.32%	0.84%	2.19%	-0.48%	-0.74%
PKG31	0.35%	-1.01%	0.30%	-3.03%	-0.08%	-2.48%	0.66%	1.41%
PKG32	-0.72%	0.07%	-1.14%	-2.37%	-0.29%	0.54%	4.72%	2.43%
PKG33	-3.68%	-0.44%	-0.46%	-1.41%	-1.05%	2.71%	0.29%	0.48%
PKG35	-2.69%	1.59%	-0.62%	-3.94%	-1.79%	0.45%	0.91%	0.17%
PKG36	1.23%	1.42%	-0.39%	-0.78%	-0.19%	0.92%	-0.86%	0.33%
PKG37	-0.95%	-1.25%	-1.47%	1.52%	0.77%	0.68%	-1.09%	-1.16%
PKG38	-5.21%	-4.32%	-0.82%	-1.87%	-0.45%	-1.70%	-0.23%	-0.77%
PKG39	1.89%	-0.93%	-0.80%	-5.23%	-0.49%	0.74%	0.54%	-0.66%
PKG40	0.08%	1.12%	0.41%	-4.34%	0.00%	-0.45%	-1.05%	-1.37%
PKG41	2.12%	-0.29%	4.43%	-3.19%	0.07%	-4.23%	0.74%	-0.06%
PKG42	-1.59%	-2.19%	0.53%	-0.72%	-0.97%	-1.74%	-2.62%	-2.32%
PKG43	0.79%	-0.29%	1.01%	0.00%	-1.68%	-3.15%	0.23%	0.00%
PKG44	0.72%	-2.44%	-1.24%	0.15%	0.57%	-3.67%	-0.67%	1.13%
PKG45	3.08%	0.43%	2.41%	-1.97%	-1.34%	-2.12%	-2.06%	-1.47%
PKG46	0.45%	0.65%	0.45%	-3.94%	-1.28%	0.07%	-1.33%	-1.59%
PKG47	0.50%	1.22%	-0.88%	-1.78%	-0.88%	0.95%	-5.68%	-1.69%
PKG48	-0.25%	-1.94%	0.07%	-0.37%	0.58%	-0.15%	-3.47%	-1.00%
PKG49	2.22%	-2.33%	1.39%	-1.16%	-0.50%	-0.31%	-4.25%	-2.00%
PKG50	-1.40%	-1.77%	0.98%	-1.17%	-0.86%	-1.05%	-5.16%	-2.99%
Mean	0.65%	0.52%	0.51%	-1.71%	-0.33%	-0.12%	0.08%	-0.13%
SD	1.99%	2.49%	1.31%	1.70%	1.38%	1.86%	2.14%	1.26%
Max	5.00%	8.89%	4.95%	1.52%	3.78%	5.33%	4.80%	2.82%
Min	-5.21%	-4.32%	-2.30%	-5.30%	-3.13%	-4.23%	-5.68%	-2.99%
Diff	10.21%	13.21%	7.25%	6.81%	6.92%	9.56%	10.47%	5.81%

Table C-2-15: TCB 1724th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	2.45%	4.07%	2.97%	1.08%	2.84%	4.09%	2.68%	1.74%
PKG02	1.64%	2.91%	2.39%	3.98%	-0.16%	11.68%	2.15%	1.49%
PKG03	2.23%	5.08%	2.07%	0.52%	-0.58%	6.03%	1.30%	2.69%
PKG04	2.48%	5.36%	3.12%	6.77%	-0.81%	8.18%	-0.95%	1.65%
PKG05	2.63%	2.72%	0.79%	4.56%	-0.31%	4.48%	1.85%	2.09%
PKG06	1.88%	6.38%	1.82%	1.84%	0.84%	9.43%	0.83%	2.23%
PKG07	1.65%	4.57%	2.52%	7.87%	2.21%	9.98%	2.45%	1.37%
PKG08	4.96%	2.60%	0.74%	2.92%	-0.36%	7.25%	2.00%	1.52%
PKG09	4.50%	4.88%	2.13%	0.86%	-0.79%	3.10%	3.12%	3.38%
PKG10	7.95%	1.44%	1.01%	1.73%	-0.22%	6.82%	4.08%	-0.36%
PKG11	8.45%	2.12%	1.21%	1.25%	-1.30%	5.91%	1.39%	-0.56%
PKG12	4.60%	3.16%	-0.15%	0.00%	2.07%	3.51%	2.17%	-0.64%
PKG13	6.95%	1.00%	1.07%	0.31%	-1.13%	8.79%	6.11%	-1.24%
PKG14	4.54%	4.61%	1.34%	0.00%	0.75%	3.05%	5.13%	-0.07%
PKG15	4.46%	2.37%	1.64%	0.80%	0.16%	5.73%	5.23%	0.24%
PKG16	11.18%	3.59%	2.53%	0.79%	1.82%	5.46%	1.71%	0.31%
PKG17	0.44%	1.29%	-0.55%	1.69%	-0.59%	3.14%	1.26%	-5.33%
PKG18	4.24%	2.91%	0.48%	1.75%	1.24%	13.39%	2.58%	-1.76%
PKG19	4.80%	3.62%	0.08%	2.31%	-0.97%	7.03%	3.53%	-1.02%
PKG20	1.44%	1.27%	0.24%	0.00%	4.15%	2.90%	0.65%	0.00%
PKG21	5.20%	3.06%	0.00%	-0.78%	0.31%	6.78%	3.75%	-5.86%
PKG22	3.30%	-0.25%	-0.55%	-1.30%	0.48%	5.38%	3.30%	-0.31%
PKG23	2.30%	2.14%	0.00%	-3.23%	1.12%	5.39%	1.29%	0.08%
PKG24	6.93%	1.42%	-0.34%	-2.42%	1.89%	4.69%	2.21%	-2.97%
PKG25	5.45%	2.29%	1.94%	0.98%	2.20%	outliner	5.08%	-5.95%
PKG26	7.14%	3.84%	1.01%	2.71%	-0.55%	4.23%	-0.13%	3.05%
PKG27	3.82%	2.39%	1.27%	0.67%	0.64%	5.08%	0.58%	0.39%
PKG28	4.00%	4.54%	1.12%	0.96%	0.16%	6.97%	4.68%	-5.84%
PKG29	5.04%	4.31%	2.06%	1.44%	1.63%	3.24%	1.38%	1.31%
PKG30	5.61%	2.54%	1.46%	2.59%	0.41%	1.31%	-0.52%	-0.08%
PKG31	outliner	5.63%	-1.36%	-1.04%	5.52%	5.46%	1.77%	-3.26%
PKG32	0.86%	1.45%	-0.25%	-6.10%	0.99%	6.76%	1.76%	-1.00%
PKG33	-1.97%	3.18%	0.86%	-0.37%	3.27%	0.44%	3.58%	-1.17%
PKG35	4.94%	2.15%	0.16%	1.59%	2.90%	2.38%	2.69%	0.24%
PKG36	5.83%	4.01%	0.67%	-0.51%	1.35%	-0.33%	2.75%	0.15%
PKG37	3.58%	1.92%	-0.79%	1.64%	2.84%	6.93%	1.47%	-4.73%
PKG38	3.24%	3.68%	-0.77%	-1.35%	1.71%	-3.02%	1.41%	-2.07%
PKG39	1.63%	1.25%	0.88%	-2.48%	0.78%	-0.44%	3.01%	-2.40%
PKG40	0.27%	1.26%	-1.24%	3.28%	0.56%	-1.48%	2.03%	1.72%
PKG41	4.58%	4.36%	-0.15%	1.44%	-1.03%	1.23%	2.39%	-0.07%
PKG42	2.36%	4.66%	-0.39%	-1.31%	0.46%	3.93%	2.12%	-0.15%
PKG43	4.10%	1.15%	0.40%	1.25%	0.08%	13.88%	1.57%	-3.17%
PKG44	1.74%	3.42%	0.83%	-6.92%	-1.29%	5.59%	6.12%	-0.48%
PKG45	2.35%	1.52%	1.02%	-0.63%	0.23%	11.50%	2.45%	0.62%
PKG46	-0.39%	-0.61%	1.44%	-2.08%	-0.22%	5.85%	3.08%	0.37%
PKG47	1.79%	-0.57%	-1.13%	0.98%	0.41%	2.30%	2.11%	-2.29%
PKG48	-0.43%	3.89%	-1.58%	-0.19%	-0.43%	6.47%	2.57%	-1.04%
PKG49	5.47%	2.44%	-1.74%	-5.65%	2.05%	5.55%	2.38%	-0.26%
PKG50	4.88%	3.78%	0.61%	2.14%	1.25%	11.12%	1.79%	-2.67%
Mean	3.69%	2.87%	0.67%	0.54%	0.79%	5.36%	2.41%	-0.61%
SD	2.50%	1.59%	1.20%	2.73%	1.47%	3.63%	1.52%	2.30%
Max	11.18%	6.38%	3.12%	7.87%	5.52%	13.88%	6.12%	3.38%
Min	-1.97%	-0.61%	-1.74%	-6.92%	-1.30%	-3.02%	-0.95%	-5.95%
Diff	13.15%	6.99%	4.87%	14.79%	6.81%	16.91%	7.07%	9.33%

Table C-2-16: TCB 1724th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	3.22%	1.94%	0.55%	0.00%	-3.99%	0.67%	0.07%	0.67%
PKG02	3.21%	1.58%	-1.34%	0.42%	1.08%	2.92%	1.80%	1.37%
PKG03	1.89%	1.17%	1.78%	-3.12%	1.67%	-1.61%	0.52%	2.69%
PKG04	1.70%	1.85%	0.56%	0.07%	0.97%	1.10%	-0.12%	-2.71%
PKG05	2.36%	1.37%	1.14%	0.07%	-0.91%	-0.76%	0.77%	-0.21%
PKG06	1.66%	1.21%	1.55%	0.00%	2.51%	-0.08%	3.20%	-0.78%
PKG07	0.88%	1.52%	0.00%	1.12%	2.50%	-1.47%	4.71%	-0.51%
PKG08	3.15%	0.34%	0.60%	-1.29%	0.00%	2.15%	1.12%	0.34%
PKG09	-0.16%	0.38%	0.55%	-2.09%	-0.72%	outliner	1.67%	0.44%
PKG10	0.67%	1.35%	0.85%	-1.85%	-0.13%	0.85%	2.75%	-0.99%
PKG11	2.86%	-1.87%	0.28%	0.08%	-0.53%	-0.91%	2.31%	0.00%
PKG12	4.64%	-1.28%	0.95%	-2.58%	-1.48%	0.91%	1.90%	1.20%
PKG13	3.54%	0.08%	1.81%	-2.77%	-1.99%	-1.00%	2.60%	0.00%
PKG14	4.08%	-0.68%	0.44%	-1.65%	0.82%	0.28%	1.81%	0.59%
PKG15	4.79%	0.30%	0.49%	-3.48%	-0.42%	2.44%	-0.42%	0.22%
PKG16	1.36%	-1.18%	-0.28%	-0.32%	1.05%	-1.12%	0.78%	0.70%
PKG17	1.75%	-3.63%	1.87%	0.00%	1.08%	4.86%	0.83%	1.79%
PKG18	1.03%	-0.29%	1.26%	-4.03%	0.92%	0.89%	1.75%	1.26%
PKG19	-0.08%	-0.97%	0.70%	-0.37%	-2.02%	1.15%	0.79%	0.45%
PKG20	-0.86%	0.00%	1.56%	-1.37%	-1.60%	2.02%	0.54%	0.16%
PKG21	1.21%	-0.89%	1.26%	-1.88%	-1.74%	0.76%	1.10%	-0.33%
PKG22	2.35%	0.44%	0.00%	-3.39%	-1.03%	2.65%	4.08%	-0.33%
PKG23	2.43%	3.80%	-0.21%	-3.27%	-0.37%	-0.24%	0.12%	1.15%
PKG24	2.33%	-0.08%	1.40%	-4.10%	-1.09%	-0.54%	-1.03%	0.24%
PKG25	3.36%	1.61%	0.61%	-2.26%	-0.74%	1.08%	0.82%	1.41%
PKG26	-1.84%	2.71%	1.37%	-2.07%	-0.13%	-2.75%	0.06%	0.32%
PKG27	1.45%	1.52%	0.56%	-1.38%	-0.96%	-0.30%	0.24%	-0.05%
PKG28	-0.75%	2.66%	-0.70%	-2.16%	0.66%	2.43%	0.43%	0.11%
PKG29	0.99%	-1.86%	0.53%	-4.69%	0.81%	1.02%	-2.06%	1.29%
PKG30	0.15%	-0.88%	2.84%	-2.13%	0.56%	2.04%	-0.12%	-0.11%
PKG31	outliner	-1.17%	-0.37%	-2.71%	0.54%	2.40%	1.33%	2.15%
PKG32	2.65%	-3.45%	-1.78%	-1.45%	0.79%	2.07%	3.06%	1.24%
PKG33	-3.61%	-1.03%	-0.59%	-1.13%	2.37%	3.87%	0.83%	1.67%
PKG35	-0.31%	1.38%	3.79%	-4.36%	0.83%	2.71%	-0.06%	0.11%
PKG36	1.89%	2.77%	3.48%	1.77%	1.87%	3.80%	-0.34%	0.22%
PKG37	-0.48%	-1.10%	-0.20%	0.00%	1.81%	0.38%	-1.45%	-1.06%
PKG38	1.30%	-2.79%	-0.68%	-0.43%	-0.19%	-1.02%	-1.21%	-0.39%
PKG39	1.58%	-0.22%	0.07%	-4.33%	1.18%	3.34%	1.32%	0.16%
PKG40	1.35%	2.09%	-0.34%	-4.62%	0.77%	1.04%	1.18%	-0.11%
PKG41	-0.53%	1.16%	1.92%	-1.56%	2.09%	-1.13%	1.07%	0.16%
PKG42	-3.78%	0.29%	2.63%	2.44%	-1.46%	-2.54%	-2.68%	-1.74%
PKG43	2.70%	-0.37%	1.82%	3.49%	-0.77%	-1.91%	0.71%	-0.70%
PKG44	0.56%	1.40%	-0.55%	2.29%	0.78%	-1.54%	-0.49%	-1.25%
PKG45	-0.30%	-0.14%	0.41%	1.39%	-1.61%	-1.41%	-2.28%	-1.64%
PKG46	0.00%	2.29%	-0.26%	-2.92%	0.32%	0.97%	-0.95%	-0.82%
PKG47	1.08%	-1.45%	1.84%	-1.11%	-0.22%	1.98%	-4.98%	-0.46%
PKG48	0.08%	-2.16%	-0.35%	0.15%	-0.36%	2.16%	-3.07%	1.23%
PKG49	3.70%	-1.90%	3.29%	-0.85%	1.43%	1.84%	-4.43%	-1.49%
PKG50	-0.66%	-0.95%	2.93%	-0.97%	-0.92%	-0.91%	-4.23%	-0.91%
Mean	1.26%	0.14%	0.82%	-1.33%	0.08%	0.74%	0.33%	0.14%
SD	1.86%	1.68%	1.24%	1.93%	1.36%	1.80%	2.02%	1.06%
Max	4.79%	3.80%	3.79%	3.49%	2.51%	4.86%	4.71%	2.69%
Min	-3.78%	-3.63%	-1.78%	-4.69%	-3.99%	-2.75%	-4.98%	-2.71%
Diff	8.58%	7.43%	5.57%	8.18%	6.49%	7.61%	9.69%	5.40%

Table C-2-17: TCB 2012th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	outliner	2.83%	2.89%	0.79%	1.42%	4.55%	4.56%	1.27%
PKG02	5.65%	10.08%	1.99%	5.59%	1.24%	6.73%	4.30%	1.71%
PKG03	8.07%	1.78%	0.99%	-0.35%	-0.22%	4.17%	2.49%	2.18%
PKG04	8.50%	7.97%	2.14%	outliner	-1.86%	9.64%	2.23%	-0.39%
PKG05	4.21%	6.09%	-0.16%	2.42%	-0.31%	10.57%	0.96%	-1.19%
PKG06	2.94%	8.04%	3.20%	2.92%	-0.17%	8.25%	4.85%	-0.17%
PKG07	5.49%	4.97%	1.76%	0.20%	1.74%	6.06%	1.77%	2.10%
PKG08	2.97%	4.11%	1.19%	1.03%	1.08%	8.37%	0.88%	2.65%
PKG09	7.22%	3.65%	1.81%	-1.15%	-0.39%	2.41%	2.02%	5.15%
PKG10	6.21%	0.88%	1.32%	-0.27%	-1.23%	4.02%	5.28%	0.43%
PKG11	6.05%	1.63%	0.57%	1.34%	-1.45%	5.55%	1.92%	0.40%
PKG12	-0.30%	3.73%	0.46%	2.87%	1.92%	6.38%	3.97%	4.96%
PKG13	5.74%	0.05%	1.40%	0.20%	1.70%	7.55%	1.59%	4.40%
PKG14	4.97%	4.08%	0.74%	0.83%	-1.37%	2.63%	0.30%	3.10%
PKG15	1.97%	2.58%	0.49%	3.52%	-0.39%	6.10%	2.41%	5.28%
PKG16	3.08%	1.73%	0.72%	3.26%	2.54%	3.80%	1.48%	-0.13%
PKG17	5.27%	0.62%	-0.16%	1.41%	-1.48%	1.52%	1.01%	-5.47%
PKG18	1.33%	3.02%	0.48%	2.14%	0.31%	6.69%	1.87%	-2.86%
PKG19	4.20%	3.73%	0.57%	1.41%	-0.81%	4.44%	0.60%	2.05%
PKG20	5.06%	1.58%	0.49%	0.77%	1.63%	2.90%	1.68%	0.00%
PKG21	0.85%	1.45%	-0.56%	1.46%	-0.54%	3.81%	1.38%	-6.91%
PKG22	1.30%	0.24%	-0.08%	-0.93%	2.23%	4.66%	1.10%	2.48%
PKG23	0.40%	2.81%	0.08%	-3.14%	-0.94%	4.23%	2.52%	-0.25%
PKG24	1.41%	2.69%	0.00%	0.21%	2.79%	5.93%	1.11%	1.24%
PKG25	1.61%	3.66%	1.78%	0.36%	0.24%	2.79%	1.00%	-6.16%
PKG26	4.14%	4.52%	0.23%	-0.28%	2.11%	5.75%	0.00%	-0.53%
PKG27	0.65%	1.06%	0.24%	-0.58%	-1.19%	11.41%	-0.84%	1.18%
PKG28	1.18%	3.52%	0.48%	0.19%	-0.41%	5.75%	1.25%	-5.23%
PKG29	3.03%	2.27%	-0.53%	3.33%	0.23%	4.75%	0.44%	-0.80%
PKG30	5.51%	-2.25%	1.30%	1.89%	-0.16%	6.45%	-0.92%	2.64%
PKG31	2.47%	2.73%	-0.68%	-2.08%	2.54%	8.19%	2.83%	-4.27%
PKG32	2.05%	-0.66%	-0.90%	-8.11%	0.91%	12.51%	0.95%	1.09%
PKG33	1.56%	1.22%	-0.47%	0.46%	0.78%	3.10%	1.86%	1.60%
PKG35	4.56%	4.25%	-1.52%	1.00%	3.13%	4.42%	1.64%	1.03%
PKG36	4.62%	3.36%	-0.45%	-2.78%	-0.67%	3.81%	1.00%	1.34%
PKG37	1.30%	1.13%	-0.32%	2.13%	0.00%	5.89%	-0.58%	-3.13%
PKG38	1.79%	3.58%	-0.93%	-5.21%	-0.22%	-2.92%	-0.38%	-1.30%
PKG39	5.12%	3.47%	-0.80%	-3.31%	0.70%	-2.62%	0.70%	-1.31%
PKG40	3.70%	-0.57%	-2.17%	1.16%	-0.40%	-2.16%	1.05%	2.03%
PKG41	3.29%	2.10%	0.15%	0.18%	-1.03%	2.46%	0.38%	-1.94%
PKG42	-1.07%	2.30%	0.31%	-1.12%	-1.78%	2.31%	0.64%	0.89%
PKG43	3.02%	3.58%	0.32%	-1.93%	-1.18%	11.23%	0.85%	-1.55%
PKG44	1.54%	3.63%	-0.58%	-8.05%	0.32%	5.82%	1.16%	0.08%
PKG45	-0.69%	3.68%	1.65%	-1.97%	-1.63%	10.19%	1.23%	-0.69%
PKG46	-1.65%	0.87%	-0.61%	-4.24%	-0.89%	7.83%	1.01%	2.35%
PKG47	5.01%	1.26%	-2.09%	-1.47%	-1.94%	5.05%	1.32%	-0.69%
PKG48	2.82%	5.43%	-1.18%	-2.23%	-0.69%	6.59%	0.99%	-1.35%
PKG49	-1.00%	4.42%	-1.49%	-5.36%	0.33%	8.51%	1.54%	-0.26%
PKG50	0.16%	5.36%	-0.15%	1.86%	-0.29%	9.83%	1.91%	-2.88%
Mean	3.07%	2.94%	0.28%	-0.20%	0.13%	5.47%	1.50%	0.08%
SD	2.44%	2.27%	1.17%	2.81%	1.35%	3.34%	1.34%	2.77%
Max	8.50%	10.08%	3.20%	5.59%	3.13%	12.51%	5.28%	5.28%
Min	-1.65%	-2.25%	-2.17%	-8.11%	-1.94%	-2.92%	-0.92%	-6.91%
Diff	10.15%	12.34%	5.37%	13.70%	5.08%	15.42%	6.20%	12.19%

Table C-2-18: TCB 2012th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	3.14%	1.04%	0.41%	2.27%	-2.63%	1.05%	1.70%	1.79%
PKG02	5.54%	4.06%	-2.50%	-0.14%	1.94%	2.46%	3.54%	0.49%
PKG03	-0.28%	1.72%	1.65%	-1.80%	0.45%	-1.14%	1.39%	-0.48%
PKG04	0.00%	2.82%	2.79%	0.30%	1.04%	1.77%	-1.59%	-6.97%
PKG05	0.65%	3.49%	0.88%	-0.72%	-0.63%	0.00%	0.65%	-6.75%
PKG06	8.56%	2.66%	5.25%	-0.70%	1.29%	-0.63%	-0.45%	-0.42%
PKG07	0.24%	2.28%	1.67%	-0.82%	1.64%	-3.83%	1.92%	-0.79%
PKG08	1.57%	2.91%	2.46%	-1.94%	0.00%	1.04%	2.08%	0.63%
PKG09	3.46%	8.62%	3.62%	-3.24%	0.22%	-6.98%	5.25%	0.06%
PKG10	0.15%	2.42%	-0.13%	-1.10%	-0.86%	-1.49%	0.46%	0.88%
PKG11	0.45%	-0.48%	0.63%	-1.12%	-1.53%	-2.31%	1.40%	2.47%
PKG12	-0.36%	4.44%	1.21%	-3.46%	-0.26%	2.72%	1.26%	1.57%
PKG13	1.68%	1.58%	1.33%	-2.33%	-2.78%	-1.84%	2.23%	-0.90%
PKG14	-0.29%	-1.69%	0.31%	-1.58%	-1.45%	-0.70%	0.74%	outliner
PKG15	-0.41%	2.48%	-0.63%	-3.69%	-0.98%	0.38%	0.24%	0.33%
PKG16	-0.61%	-0.66%	-0.51%	-0.44%	-0.50%	-3.51%	1.50%	0.09%
PKG17	1.53%	-3.09%	1.80%	-1.93%	-0.61%	1.31%	2.37%	0.55%
PKG18	2.06%	1.47%	1.46%	-3.82%	0.14%	0.59%	2.29%	0.45%
PKG19	0.56%	2.09%	4.60%	-1.54%	-3.41%	-1.00%	1.59%	0.39%
PKG20	1.48%	3.28%	2.45%	-3.46%	-1.46%	0.52%	1.87%	2.92%
PKG21	4.34%	2.21%	0.91%	-3.62%	-2.30%	0.91%	0.73%	-0.67%
PKG22	2.27%	1.76%	0.48%	-4.24%	-2.12%	1.77%	2.78%	0.11%
PKG23	1.13%	2.26%	-0.64%	-4.51%	-1.71%	-2.12%	-0.74%	3.50%
PKG24	1.66%	1.99%	0.88%	-3.80%	-0.72%	0.00%	2.56%	-0.53%
PKG25	0.84%	1.68%	2.15%	-1.70%	-0.20%	1.73%	1.28%	1.35%
PKG26	-1.84%	4.25%	2.81%	-0.36%	-1.26%	-1.69%	1.96%	-1.95%
PKG27	1.86%	1.37%	4.09%	-1.46%	-2.61%	0.74%	-0.64%	-0.66%
PKG28	4.08%	10.73%	-0.21%	-2.53%	0.22%	8.90%	-0.42%	-1.23%
PKG29	-0.08%	-2.15%	3.88%	-5.91%	-0.14%	1.46%	-3.33%	2.52%
PKG30	1.46%	1.76%	0.00%	-3.74%	0.14%	6.95%	-0.24%	-1.03%
PKG31	outliner	-0.39%	1.33%	-3.18%	0.39%	3.76%	-0.07%	2.33%
PKG32	-0.24%	-0.59%	-0.57%	-2.37%	1.00%	0.00%	4.97%	0.30%
PKG33	-1.23%	3.47%	-0.46%	-1.48%	-1.82%	3.87%	4.97%	0.05%
PKG35	-0.69%	3.12%	0.41%	-5.76%	-1.17%	0.38%	0.97%	-0.45%
PKG36	1.09%	1.92%	0.33%	0.21%	-0.71%	2.74%	0.23%	1.13%
PKG37	0.40%	-0.22%	1.41%	-0.65%	0.00%	-0.67%	-0.29%	-1.06%
PKG38	-2.67%	-1.13%	2.79%	-0.43%	0.00%	-0.54%	-1.33%	-1.81%
PKG39	2.21%	3.16%	2.07%	-4.82%	-0.07%	0.44%	0.48%	-0.22%
PKG40	1.19%	1.34%	1.30%	-4.90%	-0.49%	1.04%	-1.11%	-1.21%
PKG41	1.13%	-0.43%	4.17%	-2.04%	-1.21%	-4.16%	-0.90%	-0.22%
PKG42	-1.67%	-1.46%	0.85%	-0.36%	-0.56%	-2.47%	-4.10%	-2.48%
PKG43	3.01%	0.80%	0.34%	-0.29%	-2.10%	-3.74%	-0.18%	-0.97%
PKG44	3.29%	-1.77%	-0.07%	1.75%	-0.64%	-3.38%	-1.41%	0.97%
PKG45	0.38%	-0.93%	0.41%	-0.80%	-1.68%	-1.55%	-1.08%	0.00%
PKG46	0.89%	5.23%	-0.13%	-2.85%	-0.26%	0.42%	-2.17%	0.00%
PKG47	0.33%	-1.37%	-0.54%	1.26%	0.00%	-0.16%	-6.08%	-0.90%
PKG48	-0.25%	-3.51%	0.21%	0.67%	-1.23%	0.15%	-0.58%	-0.66%
PKG49	1.23%	-4.23%	1.31%	-0.54%	0.36%	0.84%	-4.07%	-1.49%
PKG50	-1.84%	-0.20%	-0.72%	-1.11%	-0.33%	-2.46%	-4.88%	-0.71%
Mean	1.07%	1.43%	1.17%	-1.85%	-0.64%	0.03%	0.36%	-0.20%
SD	2.00%	2.77%	1.60%	1.88%	1.16%	2.71%	2.36%	1.90%
Max	8.56%	10.73%	5.25%	2.27%	1.94%	8.90%	5.25%	3.50%
Min	-2.67%	-4.23%	-2.50%	-5.91%	-3.41%	-6.98%	-6.08%	-6.97%
Diff	11.23%	14.96%	7.74%	8.18%	5.36%	15.87%	11.34%	10.47%

Table C-2-19: TCC 100th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	1.16%	4.80%	3.22%	4.04%	4.66%	4.44%	3.02%	0.48%
PKG02	-0.02%	5.17%	2.63%	1.89%	2.72%	13.34%	1.33%	0.45%
PKG03	-1.64%	2.88%	0.61%	0.61%	3.05%	7.68%	1.12%	0.07%
PKG04	-1.03%	6.61%	2.47%	8.32%	-1.05%	9.89%	-2.86%	0.16%
PKG05	0.76%	3.71%	0.95%	3.10%	0.31%	4.37%	0.19%	-0.08%
PKG06	2.73%	5.49%	3.12%	3.35%	-1.77%	8.38%	-0.07%	0.94%
PKG07	1.06%	4.37%	1.59%	1.41%	0.47%	6.65%	0.68%	-0.73%
PKG08	0.88%	2.31%	0.67%	3.26%	-0.29%	6.25%	0.35%	4.31%
PKG09	2.29%	3.44%	1.31%	-0.38%	-1.02%	3.91%	2.21%	0.85%
PKG10	0.62%	0.98%	0.23%	-1.09%	-2.24%	3.47%	0.88%	-1.51%
PKG11	2.00%	1.73%	0.97%	-1.34%	-1.30%	13.74%	3.32%	-0.88%
PKG12	0.43%	3.35%	0.31%	-0.81%	-1.00%	3.09%	0.74%	-0.64%
PKG13	2.00%	0.89%	0.33%	-0.41%	-1.29%	6.19%	0.86%	-1.24%
PKG14	1.27%	3.03%	0.52%	1.33%	-0.48%	4.31%	0.96%	-0.87%
PKG15	2.37%	2.26%	-0.08%	-0.10%	-1.10%	3.90%	0.74%	-2.84%
PKG16	2.91%	2.23%	0.51%	-0.87%	0.39%	4.78%	0.69%	0.06%
PKG17	1.83%	1.10%	-1.25%	0.75%	0.89%	7.05%	0.44%	-5.05%
PKG18	2.40%	1.79%	0.88%	1.17%	0.00%	8.10%	0.64%	-2.57%
PKG19	3.39%	2.36%	-0.82%	-1.01%	-1.54%	6.54%	1.33%	-1.02%
PKG20	1.05%	2.30%	0.41%	0.39%	0.08%	2.90%	1.23%	0.23%
PKG21	1.72%	4.16%	-1.12%	-2.04%	-1.24%	10.11%	0.20%	-5.86%
PKG22	-0.50%	0.43%	0.94%	-1.39%	-0.48%	6.45%	0.39%	0.08%
PKG23	5.68%	3.36%	-0.90%	-1.86%	-0.34%	6.54%	0.61%	-0.83%
PKG24	2.84%	2.48%	-0.51%	-3.68%	0.25%	6.05%	-1.11%	-3.80%
PKG25	1.13%	3.27%	1.16%	0.18%	2.12%	3.95%	-0.19%	-5.74%
PKG26	1.72%	4.52%	0.47%	2.33%	-2.74%	17.48%	-1.75%	-0.46%
PKG27	1.51%	2.39%	0.08%	0.19%	-1.11%	7.32%	-1.23%	-0.47%
PKG28	3.00%	1.88%	-0.40%	3.67%	0.08%	9.05%	7.72%	-5.53%
PKG29	1.89%	2.95%	0.46%	3.33%	0.08%	4.17%	1.82%	-2.33%
PKG30	2.35%	-1.06%	0.41%	5.47%	0.08%	0.84%	4.99%	0.74%
PKG31	-1.07%	1.16%	-1.02%	-2.81%	0.44%	1.98%	3.25%	-3.09%
PKG32	1.46%	0.14%	-1.64%	-7.63%	1.48%	6.63%	0.68%	0.42%
PKG33	-0.95%	1.41%	-0.16%	-2.13%	3.19%	4.65%	1.09%	-0.44%
PKG35	0.45%	0.74%	-0.96%	1.30%	2.51%	1.81%	0.20%	4.82%
PKG36	1.46%	1.52%	-0.22%	-2.70%	-1.80%	2.72%	1.37%	1.42%
PKG37	0.45%	0.34%	-0.95%	0.48%	-1.00%	4.39%	0.00%	-1.60%
PKG38	-0.48%	1.48%	-1.39%	2.16%	-0.74%	-1.30%	-0.26%	-2.15%
PKG39	1.53%	1.15%	0.08%	-3.31%	1.17%	-2.62%	0.32%	-3.50%
PKG40	0.37%	1.05%	-2.33%	2.80%	-0.16%	-2.85%	1.90%	1.41%
PKG41	-0.67%	3.70%	-0.54%	0.90%	0.07%	-1.02%	1.64%	-2.08%
PKG42	-1.55%	4.05%	-0.39%	-1.58%	no ball	1.97%	0.71%	-0.96%
PKG43	1.45%	1.05%	-0.16%	-2.22%	-0.86%	8.09%	1.31%	-3.90%
PKG44	0.07%	3.00%	-0.99%	-4.83%	0.56%	7.61%	3.74%	5.22%
PKG45	0.36%	1.32%	1.42%	-2.06%	-1.17%	6.47%	3.23%	-1.62%
PKG46	-0.48%	-0.24%	1.21%	-1.04%	-0.67%	12.47%	1.45%	2.79%
PKG47	1.89%	0.04%	0.97%	0.68%	-0.89%	5.40%	1.91%	-0.76%
PKG48	-0.03%	2.90%	-0.24%	-2.52%	-1.03%	4.57%	1.19%	-0.16%
PKG49	0.17%	5.36%	-0.83%	-6.35%	1.97%	6.79%	2.03%	-0.34%
PKG50	0.16%	2.21%	0.69%	0.56%	-0.37%	7.02%	1.05%	-1.26%
Mean	1.07%	2.40%	0.24%	-0.01%	-0.02%	5.63%	1.14%	-0.81%
SD	1.42%	1.65%	1.18%	2.90%	1.51%	3.95%	1.67%	2.38%
Max	5.68%	6.61%	3.22%	8.32%	4.66%	17.48%	7.72%	5.22%
Min	-1.64%	-1.06%	-2.33%	-7.63%	-2.74%	-2.85%	-2.86%	-5.86%
Diff	7.32%	7.67%	5.54%	15.95%	7.39%	20.33%	10.58%	11.08%

Table C-2-20: TCC 100th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	0.81%	2.24%	-0.07%	1.98%	-4.05%	-0.22%	0.31%	0.90%
PKG02	5.94%	7.29%	-3.13%	1.20%	0.50%	3.76%	1.98%	0.98%
PKG03	1.47%	2.28%	1.98%	-3.46%	2.77%	0.80%	1.90%	-0.43%
PKG04	5.81%	0.52%	-0.35%	-1.48%	0.35%	2.06%	-0.53%	-2.22%
PKG05	0.41%	1.06%	0.13%	-0.72%	0.28%	2.37%	0.06%	0.05%
PKG06	0.00%	1.37%	1.33%	-1.40%	0.61%	3.10%	-0.77%	-1.25%
PKG07	0.16%	1.60%	3.20%	-0.67%	1.00%	-2.21%	0.87%	-0.28%
PKG08	1.64%	0.74%	0.54%	-1.61%	1.72%	1.45%	2.45%	1.37%
PKG09	0.81%	-0.15%	1.98%	-3.52%	-1.30%	outliner	2.16%	0.11%
PKG10	-0.15%	1.07%	1.44%	-2.26%	-0.53%	-2.27%	1.20%	-0.15%
PKG11	2.93%	-0.76%	4.44%	0.30%	0.00%	0.98%	1.58%	0.64%
PKG12	2.07%	-2.56%	4.39%	-2.44%	-1.93%	0.77%	2.07%	1.52%
PKG13	2.95%	0.23%	6.49%	-3.13%	-3.70%	-1.15%	1.05%	-0.50%
PKG14	2.58%	-2.30%	4.61%	-2.70%	0.00%	1.54%	-0.37%	2.19%
PKG15	-0.41%	-2.63%	2.73%	-4.05%	-2.18%	0.91%	-1.43%	-0.17%
PKG16	-0.14%	-2.36%	2.53%	-0.89%	0.19%	-0.99%	-0.72%	0.42%
PKG17	2.67%	-3.43%	1.87%	-0.86%	-0.54%	1.96%	3.43%	0.55%
PKG18	0.00%	0.37%	1.92%	-4.37%	0.42%	1.63%	1.93%	0.23%
PKG19	-1.69%	-1.42%	3.42%	2.20%	-3.34%	1.99%	0.37%	0.62%
PKG20	-1.40%	-0.07%	2.99%	-3.17%	-1.53%	1.50%	1.39%	-0.16%
PKG21	0.08%	2.51%	3.30%	-4.12%	-1.40%	1.59%	0.37%	-0.90%
PKG22	0.31%	4.56%	0.41%	-3.18%	-1.37%	3.54%	4.14%	0.56%
PKG23	1.82%	0.65%	2.70%	-4.07%	-0.82%	0.08%	0.12%	-0.11%
PKG24	-0.25%	2.68%	3.98%	-4.55%	-0.36%	-0.23%	-0.19%	-0.47%
PKG25	-0.30%	3.14%	3.70%	-1.56%	-0.27%	1.45%	0.93%	0.38%
PKG26	-3.02%	4.54%	1.23%	-0.57%	-1.26%	-0.14%	0.63%	-0.87%
PKG27	0.65%	0.38%	2.18%	-1.02%	-1.37%	-0.82%	-0.35%	-0.23%
PKG28	-0.17%	0.39%	0.14%	-1.19%	-0.44%	4.21%	0.06%	-0.94%
PKG29	0.00%	-1.43%	0.20%	-4.96%	0.54%	1.97%	-0.50%	0.75%
PKG30	-0.62%	-0.73%	-0.28%	-3.67%	-0.49%	3.10%	-0.73%	-0.41%
PKG31	outliner	-2.88%	0.00%	-2.95%	-1.07%	-1.04%	0.66%	0.67%
PKG32	4.65%	0.59%	-1.64%	-2.21%	-0.36%	1.84%	1.21%	0.47%
PKG33	-3.53%	-1.33%	-0.07%	-2.26%	-0.56%	3.32%	0.53%	0.37%
PKG35	-1.61%	-0.15%	-1.24%	-5.83%	0.28%	0.60%	-1.27%	-0.56%
PKG36	0.44%	0.28%	-0.66%	-1.21%	0.07%	0.00%	-1.53%	-0.69%
PKG37	-1.74%	-2.56%	-0.74%	-0.94%	-1.25%	0.30%	-1.39%	-1.80%
PKG38	-4.38%	-3.19%	-1.09%	-1.80%	-0.84%	-1.02%	-1.33%	-0.77%
PKG39	2.05%	0.93%	0.20%	-5.43%	-1.11%	-0.45%	1.50%	0.05%
PKG40	4.20%	6.71%	-1.17%	-5.18%	-1.04%	0.75%	-0.76%	-0.66%
PKG41	1.21%	-0.29%	0.26%	-2.51%	-0.34%	-3.74%	2.65%	-0.06%
PKG42	-3.86%	-1.53%	-0.39%	0.29%	-2.22%	-2.18%	-2.73%	-2.42%
PKG43	0.00%	-1.17%	-1.08%	-0.80%	-1.68%	-4.03%	-1.01%	-1.02%
PKG44	-0.16%	-1.40%	-1.80%	0.91%	-1.35%	-3.60%	-1.22%	0.06%
PKG45	2.40%	-0.93%	-0.34%	0.73%	-1.48%	-2.54%	-2.34%	-1.31%
PKG46	0.00%	0.43%	-0.13%	-3.12%	-1.73%	1.39%	-1.22%	-1.65%
PKG47	-0.25%	-2.06%	-0.48%	-1.78%	-0.29%	1.35%	-3.07%	-1.13%
PKG48	0.83%	-1.34%	-0.14%	-1.04%	-0.50%	-0.93%	-3.18%	-0.94%
PKG49	0.41%	-1.97%	0.66%	-2.09%	-0.64%	0.69%	-3.77%	-1.37%
PKG50	-1.69%	-2.38%	-0.59%	-1.31%	-0.59%	0.00%	-1.90%	-1.42%
Mean	0.50%	0.11%	1.01%	-2.01%	-0.72%	0.49%	0.07%	-0.24%
SD	2.18%	2.38%	2.01%	1.88%	1.23%	1.96%	1.72%	0.95%
Max	5.94%	7.29%	6.49%	2.20%	2.77%	4.21%	4.14%	2.19%
Min	-4.38%	-3.43%	-3.13%	-5.83%	-4.05%	-4.03%	-3.77%	-2.42%
Diff	10.32%	10.71%	9.62%	8.03%	6.82%	8.24%	7.91%	4.62%

Table C-2-21: TCC 200th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	3.54%	3.35%	1.49%	0.69%	0.16%	7.71%	1.88%	1.66%
PKG02	3.79%	6.50%	0.96%	3.13%	-1.40%	11.45%	1.01%	2.23%
PKG03	1.78%	3.25%	0.69%	0.18%	-1.09%	11.30%	2.24%	6.61%
PKG04	5.79%	4.74%	4.19%	11.61%	-2.35%	11.96%	-0.95%	0.79%
PKG05	5.29%	2.12%	-0.08%	3.01%	-1.86%	10.57%	2.43%	0.97%
PKG06	3.79%	7.38%	0.78%	1.95%	-2.44%	12.97%	1.04%	1.80%
PKG07	2.14%	4.27%	1.76%	2.62%	0.00%	12.36%	0.82%	0.08%
PKG08	1.16%	3.83%	1.26%	1.55%	-1.08%	10.37%	0.35%	-0.07%
PKG09	2.79%	5.30%	1.64%	-1.72%	-1.34%	12.06%	0.72%	2.69%
PKG10	2.73%	1.72%	0.46%	0.54%	-1.23%	9.62%	1.44%	0.87%
PKG11	2.48%	3.31%	0.73%	0.19%	-1.91%	11.21%	0.93%	-1.21%
PKG12	1.70%	4.20%	0.54%	0.54%	0.71%	7.76%	0.37%	0.57%
PKG13	3.51%	1.10%	1.65%	3.68%	-1.70%	8.30%	0.66%	-1.16%
PKG14	1.96%	3.03%	2.23%	1.08%	-0.96%	3.26%	0.84%	0.00%
PKG15	2.37%	2.16%	2.88%	5.43%	-2.90%	7.08%	0.87%	-2.44%
PKG16	2.91%	1.90%	3.98%	4.61%	0.98%	5.56%	0.57%	0.88%
PKG17	1.56%	1.00%	-0.31%	4.80%	-2.44%	3.36%	0.63%	-4.21%
PKG18	3.27%	2.30%	0.88%	1.94%	1.01%	15.86%	0.32%	-2.20%
PKG19	3.09%	2.04%	-0.57%	3.72%	-0.48%	9.25%	2.67%	-1.18%
PKG20	3.20%	0.76%	1.79%	1.06%	0.49%	4.29%	outliner	0.53%
PKG21	2.11%	3.06%	0.16%	0.58%	-0.23%	8.45%	5.53%	-6.53%
PKG22	0.45%	-1.43%	0.71%	1.30%	0.32%	10.64%	1.94%	-0.85%
PKG23	2.19%	2.70%	0.41%	-2.55%	-0.17%	11.16%	2.72%	2.08%
PKG24	1.00%	2.48%	1.97%	-2.42%	0.33%	10.25%	0.90%	-3.47%
PKG25	-0.22%	2.20%	1.63%	0.27%	-0.39%	9.98%	0.63%	-6.09%
PKG26	1.82%	4.23%	0.54%	0.84%	-0.86%	14.78%	0.56%	0.15%
PKG27	-0.31%	1.68%	1.27%	1.64%	-1.19%	11.53%	-1.29%	-0.16%
PKG28	1.08%	3.72%	0.48%	0.00%	-1.81%	11.62%	-0.26%	-4.02%
PKG29	5.71%	4.11%	1.52%	1.08%	-0.93%	15.52%	0.56%	-1.31%
PKG30	4.72%	-1.06%	-0.16%	2.59%	-0.89%	2.99%	0.00%	1.98%
PKG31	1.64%	1.95%	-1.79%	-0.83%	0.09%	3.47%	4.17%	-4.02%
PKG32	1.26%	1.65%	-1.32%	-8.01%	0.91%	11.26%	-0.07%	2.26%
PKG33	-2.53%	1.41%	-0.39%	-3.43%	-1.71%	1.55%	3.39%	0.07%
PKG35	1.41%	2.65%	-1.36%	-2.00%	-1.80%	3.63%	0.85%	0.00%
PKG36	1.74%	1.98%	-0.82%	-3.88%	-2.47%	2.62%	4.56%	4.55%
PKG37	-0.78%	2.61%	-2.05%	-1.06%	-1.15%	4.97%	3.33%	-3.13%
PKG38	2.25%	2.24%	-2.09%	-3.32%	-1.56%	1.08%	0.96%	-0.46%
PKG39	2.21%	0.45%	-0.48%	-2.20%	-1.09%	-4.16%	6.27%	-2.19%
PKG40	0.47%	0.75%	-2.17%	2.22%	-1.84%	-1.25%	1.05%	2.58%
PKG41	0.07%	3.04%	-0.69%	0.27%	-1.76%	-2.05%	0.82%	-1.39%
PKG42	-1.27%	2.40%	-0.86%	-1.96%	no ball	4.40%	0.51%	1.62%
PKG43	-0.81%	-0.77%	-0.16%	-0.39%	-2.74%	11.11%	-0.26%	-1.55%
PKG44	0.37%	5.85%	-1.49%	-6.73%	-1.37%	9.63%	1.02%	0.24%
PKG45	1.68%	2.79%	-0.95%	-3.50%	0.00%	12.58%	0.52%	1.00%
PKG46	-1.92%	1.51%	-0.15%	-4.76%	-0.45%	12.47%	0.50%	0.66%
PKG47	outliner	1.98%	-1.69%	-2.15%	-0.32%	5.40%	1.45%	-1.37%
PKG48	outliner	3.01%	-2.53%	-1.45%	-0.52%	8.50%	0.07%	-1.11%
PKG49	-0.71%	2.03%	-1.82%	-6.94%	-0.57%	9.38%	0.98%	0.69%
PKG50	0.98%	2.90%	-0.15%	-0.19%	-0.07%	7.14%	1.48%	-2.53%
Mean	1.77%	2.58%	0.26%	0.07%	-0.92%	8.06%	1.29%	-0.31%
SD	1.85%	1.72%	1.53%	3.42%	1.02%	4.61%	1.52%	2.48%
Max	5.79%	7.38%	4.19%	11.61%	1.01%	15.86%	6.27%	6.61%
Min	-2.53%	-1.43%	-2.53%	-8.01%	-2.90%	-4.16%	-1.29%	-6.53%
Diff	8.32%	8.81%	6.72%	19.62%	3.91%	20.01%	7.56%	13.14%

Table C-2-22: TCC 200th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.61%	0.30%	-0.48%	2.78%	-2.90%	0.82%	0.07%	-0.11%
PKG02	2.73%	1.13%	-2.56%	-0.14%	1.73%	2.07%	5.47%	0.71%
PKG03	1.33%	0.55%	0.99%	-1.04%	0.97%	-3.08%	4.45%	-0.80%
PKG04	1.86%	0.89%	1.12%	-0.96%	-1.31%	0.51%	-2.48%	-1.55%
PKG05	4.64%	0.99%	1.28%	-0.14%	-0.56%	-0.69%	0.95%	0.05%
PKG06	2.01%	0.48%	1.40%	0.16%	0.84%	-1.35%	9.73%	-1.01%
PKG07	4.09%	-0.61%	-0.56%	0.22%	0.14%	-2.50%	6.13%	-0.68%
PKG08	0.72%	0.74%	0.66%	-2.13%	-0.83%	0.83%	3.03%	0.05%
PKG09	0.32%	0.30%	0.75%	-2.01%	1.23%	outliner	6.92%	-0.55%
PKG10	0.00%	3.20%	1.11%	-1.10%	0.00%	-1.63%	3.10%	-0.68%
PKG11	1.43%	-3.53%	0.85%	-0.60%	-1.00%	-0.84%	1.34%	1.21%
PKG12	0.86%	7.81%	1.08%	-2.44%	-1.93%	-0.07%	1.90%	-0.31%
PKG13	0.25%	-1.20%	0.84%	-1.31%	-2.35%	0.08%	1.24%	-0.61%
PKG14	-0.43%	-2.64%	1.43%	-0.79%	-1.26%	0.77%	-0.80%	2.19%
PKG15	-1.38%	0.15%	2.59%	-3.69%	-2.53%	0.31%	-0.78%	-0.95%
PKG16	0.20%	2.49%	0.92%	-0.25%	-0.93%	-1.85%	1.71%	-0.09%
PKG17	1.37%	-1.30%	2.80%	-0.57%	-0.07%	0.87%	1.83%	0.28%
PKG18	0.16%	0.88%	0.80%	-3.75%	0.35%	1.48%	3.91%	0.28%
PKG19	-1.37%	-1.12%	1.32%	-0.66%	-2.86%	1.53%	6.04%	0.89%
PKG20	1.95%	2.26%	2.04%	-2.45%	-1.60%	-0.30%	3.73%	-0.87%
PKG21	0.00%	-0.22%	2.88%	-2.82%	-1.88%	0.98%	2.87%	0.56%
PKG22	0.55%	3.60%	0.82%	-4.80%	-2.26%	2.21%	1.95%	0.67%
PKG23	1.65%	0.24%	-0.50%	-4.44%	-1.63%	1.18%	5.51%	0.46%
PKG24	0.42%	-1.53%	1.40%	-4.48%	-1.74%	-1.99%	4.49%	-0.53%
PKG25	0.23%	0.44%	0.81%	-2.83%	-1.55%	1.30%	3.08%	0.32%
PKG26	-3.24%	2.27%	1.37%	-2.57%	-0.93%	-3.10%	1.33%	0.11%
PKG27	0.08%	0.46%	0.42%	-1.97%	-1.92%	4.01%	-0.35%	-1.04%
PKG28	-1.92%	-0.63%	0.00%	-2.01%	0.37%	3.07%	0.73%	-1.11%
PKG29	1.82%	-3.36%	outliner	-4.89%	0.20%	1.53%	-2.66%	-0.53%
PKG30	-1.92%	-0.44%	0.57%	-2.79%	-0.98%	0.23%	2.24%	-0.41%
PKG31	outliner	-2.88%	-1.11%	-3.49%	-2.00%	-0.88%	0.60%	-0.37%
PKG32	-0.56%	-3.08%	-2.21%	-1.53%	0.57%	0.84%	1.91%	0.30%
PKG33	-3.68%	-1.69%	-0.79%	-0.78%	-1.68%	2.01%	3.91%	0.59%
PKG35	0.15%	0.22%	-0.76%	-5.41%	-1.86%	-1.28%	-0.85%	-0.45%
PKG36	-0.65%	2.34%	-0.46%	-0.78%	-1.80%	-0.14%	0.23%	-0.80%
PKG37	-0.08%	-0.29%	-0.80%	-0.07%	-0.70%	-0.75%	-1.45%	-2.32%
PKG38	-5.76%	-2.33%	-1.16%	0.00%	-1.03%	-2.04%	-2.37%	-2.25%
PKG39	1.34%	4.96%	-0.87%	-5.50%	-1.46%	1.19%	2.34%	-0.99%
PKG40	3.96%	7.31%	-0.62%	-4.13%	-2.30%	0.45%	-0.47%	-1.48%
PKG41	-1.21%	-0.36%	-0.26%	-1.70%	-0.94%	-3.67%	-1.63%	-0.73%
PKG42	-1.36%	-2.04%	-0.39%	-1.00%	-3.06%	-3.49%	-1.59%	-1.85%
PKG43	2.30%	-2.12%	-1.08%	2.33%	-2.10%	-4.54%	3.01%	-1.73%
PKG44	1.28%	-1.70%	-2.21%	0.76%	-1.99%	-4.55%	-1.04%	-1.36%
PKG45	0.30%	2.65%	-0.69%	-0.95%	-2.22%	-2.75%	5.53%	-2.03%
PKG46	2.08%	-1.15%	-0.32%	-2.17%	-2.88%	-0.69%	-0.95%	-1.13%
PKG47	3.26%	-1.90%	-0.75%	1.26%	-2.41%	0.79%	-5.15%	0.67%
PKG48	1.75%	-3.81%	-1.12%	-0.82%	-2.16%	0.85%	-4.04%	-1.45%
PKG49	0.41%	-5.83%	-0.07%	-1.24%	-0.64%	0.00%	-3.77%	-1.71%
PKG50	-1.77%	-2.99%	2.15%	-0.21%	-1.85%	-0.63%	-4.77%	-2.28%
Mean	0.45%	-0.04%	0.26%	-1.63%	-1.22%	-0.27%	1.35%	-0.52%
SD	1.97%	2.64%	1.28%	1.88%	1.17%	1.92%	3.21%	0.98%
Max	4.64%	7.81%	2.88%	2.78%	1.73%	4.01%	9.73%	2.19%
Min	-5.76%	-5.83%	-2.56%	-5.50%	-3.06%	-4.55%	-5.15%	-2.32%
Diff	10.39%	13.64%	5.43%	8.28%	4.78%	8.56%	14.89%	4.51%

Table C-2-23: TCC 300th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	outliner	5.42%	6.69%	4.04%	0.95%	6.66%	6.78%	2.46%
PKG02	12.11%	6.40%	2.23%	6.54%	3.97%	9.21%	5.69%	6.92%
PKG03	8.07%	5.08%	1.99%	2.54%	1.45%	7.68%	4.84%	5.01%
PKG04	5.89%	6.61%	4.19%	no ball	1.38%	14.16%	2.29%	2.99%
PKG05	10.41%	5.00%	3.24%	4.07%	0.70%	9.77%	2.37%	outliner
PKG06	11.20%	7.71%	2.68%	3.14%	-1.01%	10.22%	2.98%	outliner
PKG07	7.46%	5.38%	3.52%	4.14%	-0.08%	9.39%	4.08%	4.04%
PKG08	6.77%	4.49%	3.71%	1.55%	-1.65%	7.70%	1.17%	6.23%
PKG09	12.85%	5.60%	3.77%	4.01%	-0.16%	6.32%	3.71%	2.77%
PKG10	5.47%	3.13%	1.55%	1.45%	-0.58%	8.95%	4.33%	1.66%
PKG11	4.70%	3.01%	3.56%	1.25%	2.67%	11.82%	4.98%	2.33%
PKG12	6.23%	3.73%	0.93%	0.81%	3.06%	8.61%	3.91%	6.53%
PKG13	9.38%	1.63%	1.40%	4.70%	1.30%	13.38%	4.45%	11.81%
PKG14	6.44%	3.29%	2.53%	1.91%	0.89%	4.21%	3.33%	7.00%
PKG15	7.35%	4.90%	2.05%	1.31%	-1.41%	9.15%	2.55%	0.79%
PKG16	8.76%	5.02%	2.82%	1.59%	1.30%	5.46%	3.19%	2.83%
PKG17	6.85%	2.34%	1.25%	3.39%	0.30%	8.13%	4.91%	-2.67%
PKG18	6.46%	2.40%	1.36%	3.69%	1.01%	8.22%	2.45%	1.54%
PKG19	7.91%	4.88%	2.95%	1.81%	1.46%	8.76%	3.73%	10.95%
PKG20	1.44%	1.99%	1.46%	0.19%	1.46%	6.25%	2.14%	2.57%
PKG21	9.27%	4.57%	-0.24%	4.67%	-0.46%	8.57%	1.58%	-1.50%
PKG22	2.92%	0.34%	2.52%	0.09%	0.88%	9.92%	2.97%	3.72%
PKG23	7.16%	3.69%	2.28%	3.63%	-0.17%	11.42%	2.93%	4.25%
PKG24	8.67%	5.43%	1.63%	-1.26%	-0.57%	8.40%	5.95%	3.05%
PKG25	5.54%	3.27%	2.71%	1.16%	0.94%	5.92%	2.32%	-4.20%
PKG26	4.72%	5.88%	0.62%	1.77%	-0.08%	14.43%	1.75%	1.29%
PKG27	5.16%	3.00%	2.14%	0.77%	0.72%	10.54%	1.87%	0.79%
PKG28	6.72%	5.36%	0.96%	2.32%	1.15%	9.79%	6.33%	-2.73%
PKG29	8.77%	2.85%	0.61%	2.16%	-0.54%	10.31%	4.13%	-1.39%
PKG30	6.80%	0.14%	3.32%	1.99%	0.16%	5.86%	6.10%	1.32%
PKG31	5.81%	4.18%	0.43%	0.10%	1.40%	4.09%	10.53%	3.01%
PKG32	5.70%	0.64%	0.08%	-4.48%	0.99%	10.01%	2.03%	3.18%
PKG33	4.81%	2.59%	1.57%	2.41%	3.42%	4.76%	4.67%	1.46%
PKG35	7.71%	2.75%	-0.64%	0.10%	1.25%	7.94%	2.03%	2.21%
PKG36	9.17%	3.92%	0.00%	-1.60%	2.47%	3.92%	2.62%	3.50%
PKG37	9.94%	2.91%	0.87%	2.22%	2.23%	7.51%	2.05%	-2.76%
PKG38	4.79%	2.82%	0.00%	-2.42%	1.11%	0.86%	1.67%	-0.61%
PKG39	8.71%	1.15%	0.64%	-2.94%	-1.09%	1.64%	2.37%	-2.19%
PKG40	2.43%	3.18%	-1.63%	2.02%	-0.48%	3.76%	3.07%	0.55%
PKG41	6.88%	3.61%	1.07%	2.34%	0.29%	4.19%	2.77%	-1.94%
PKG42	4.75%	3.84%	2.04%	-0.28%	no ball	7.40%	5.58%	-0.15%
PKG43	5.68%	1.66%	1.28%	0.96%	0.31%	11.11%	1.96%	-2.28%
PKG44	4.58%	4.69%	0.33%	-6.06%	-1.05%	12.72%	2.86%	-0.08%
PKG45	4.82%	3.87%	1.34%	-1.08%	-0.15%	10.91%	2.58%	-0.08%
PKG46	2.88%	2.34%	0.99%	-2.08%	0.00%	17.10%	3.71%	2.35%
PKG47	5.31%	1.77%	-0.40%	0.29%	0.97%	11.60%	5.21%	1.68%
PKG48	2.11%	7.19%	-1.11%	2.61%	-0.86%	11.80%	1.78%	-0.56%
PKG49	6.45%	3.80%	-1.08%	-2.88%	-0.33%	9.25%	4.05%	5.13%
PKG50	6.61%	4.17%	2.07%	1.49%	0.22%	14.28%	4.68%	-0.91%
Mean	6.68%	3.75%	1.60%	1.25%	0.62%	8.65%	3.59%	1.95%
SD	2.47%	1.72%	1.56%	2.48%	1.24%	3.38%	1.75%	3.38%
Max	12.85%	7.71%	6.69%	6.54%	3.97%	17.10%	10.53%	11.81%
Min	1.44%	0.14%	-1.63%	-6.06%	-1.65%	0.86%	1.17%	-4.20%
Diff	11.41%	7.57%	8.31%	12.60%	5.62%	16.24%	9.35%	16.01%

Table C-2-24: TCC 300th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	3.14%	5.07%	2.11%	1.39%	-1.28%	6.42%	6.05%	1.73%
PKG02	3.37%	6.38%	-0.19%	0.28%	0.94%	4.07%	4.50%	2.40%
PKG03	1.19%	3.79%	2.77%	-1.18%	0.64%	0.94%	7.97%	0.47%
PKG04	2.25%	4.08%	6.83%	0.67%	0.21%	5.37%	-0.06%	-2.05%
PKG05	3.17%	3.87%	3.30%	2.36%	0.42%	2.75%	1.53%	3.32%
PKG06	2.62%	9.51%	2.81%	-0.78%	0.53%	1.59%	0.26%	-0.60%
PKG07	3.77%	5.86%	4.44%	0.00%	1.86%	-1.69%	2.29%	1.40%
PKG08	3.65%	3.18%	2.29%	1.74%	-0.45%	3.95%	2.24%	1.18%
PKG09	0.89%	7.86%	1.98%	-3.09%	-0.22%	-4.63%	4.45%	1.17%
PKG10	1.64%	3.84%	-4.65%	-1.03%	0.66%	0.14%	1.67%	2.07%
PKG11	3.08%	3.60%	2.04%	2.55%	-0.67%	1.54%	1.46%	3.79%
PKG12	1.71%	0.87%	1.78%	-2.24%	-0.77%	3.20%	1.38%	0.74%
PKG13	4.04%	1.13%	no ball	-2.99%	-2.28%	4.61%	1.48%	1.18%
PKG14	3.15%	-1.22%	1.87%	-2.31%	-0.44%	2.88%	1.28%	1.76%
PKG15	3.01%	9.37%	1.89%	-3.98%	0.14%	1.14%	-0.48%	1.39%
PKG16	5.25%	1.44%	0.86%	-0.63%	0.56%	0.26%	4.29%	3.23%
PKG17	8.01%	3.22%	2.40%	-1.07%	0.34%	3.48%	1.48%	2.06%
PKG18	2.46%	2.57%	4.78%	-4.16%	3.46%	3.93%	9.64%	2.31%
PKG19	4.34%	1.72%	2.16%	-1.10%	-0.77%	3.53%	0.79%	1.91%
PKG20	5.86%	1.60%	2.72%	-2.09%	-0.56%	6.66%	9.22%	1.32%
PKG21	3.54%	1.40%	1.05%	-3.11%	0.21%	5.44%	5.98%	0.95%
PKG22	3.44%	3.46%	0.21%	-2.40%	-0.75%	3.61%	3.07%	1.68%
PKG23	7.19%	5.25%	1.06%	-4.14%	-0.59%	4.64%	3.07%	0.46%
PKG24	4.57%	0.46%	6.04%	-3.80%	-0.43%	2.45%	2.50%	1.19%
PKG25	3.90%	2.27%	1.82%	-2.55%	-0.34%	6.65%	2.62%	0.48%
PKG26	-1.25%	3.66%	2.47%	-2.50%	-0.47%	1.20%	0.11%	0.21%
PKG27	0.73%	2.28%	outliner	-1.60%	-0.28%	4.60%	-0.47%	0.82%
PKG28	-0.08%	3.84%	-4.62%	-1.34%	2.49%	7.60%	0.61%	-0.44%
PKG29	-0.08%	-2.58%	outliner	-5.03%	3.66%	3.86%	-2.77%	1.67%
PKG30	-0.54%	0.66%	1.63%	-3.59%	2.38%	5.82%	5.20%	1.54%
PKG31	outliner	-0.86%	2.52%	-3.34%	-0.61%	0.88%	5.50%	1.66%
PKG32	5.37%	-1.76%	-0.43%	-1.53%	2.29%	2.92%	5.68%	1.12%
PKG33	1.23%	0.96%	-7.46%	-1.48%	1.47%	8.50%	5.85%	1.99%
PKG35	0.46%	0.44%	1.03%	-6.47%	0.76%	4.06%	4.37%	0.57%
PKG36	3.92%	2.77%	1.64%	-1.56%	0.45%	3.10%	3.23%	0.75%
PKG37	4.82%	-0.37%	2.14%	-0.43%	2.02%	3.53%	0.93%	-0.48%
PKG38	-2.60%	-2.66%	-5.04%	-1.80%	1.48%	5.09%	2.18%	-0.50%
PKG39	1.97%	0.50%	-0.27%	-5.43%	0.00%	2.67%	1.80%	0.60%
PKG40	1.58%	2.16%	-0.07%	-3.85%	1.18%	2.91%	2.24%	-0.44%
PKG41	1.66%	0.29%	1.86%	-1.77%	1.69%	1.69%	3.50%	0.10%
PKG42	-1.06%	-0.44%	1.12%	-0.50%	-0.83%	-1.16%	-3.14%	-1.85%
PKG43	1.51%	-0.37%	1.76%	0.00%	-1.26%	-1.91%	0.18%	-0.65%
PKG44	1.92%	0.59%	0.35%	0.84%	0.07%	-1.61%	0.37%	-0.06%
PKG45	2.70%	1.79%	1.65%	-1.02%	-1.41%	-0.14%	-0.06%	-1.47%
PKG46	2.08%	3.37%	1.09%	-3.26%	0.26%	3.96%	1.33%	0.06%
PKG47	6.18%	-0.46%	3.74%	-1.33%	-0.59%	3.80%	-4.98%	-0.62%
PKG48	2.00%	-1.57%	1.76%	0.07%	-0.86%	1.62%	-2.43%	-0.28%
PKG49	5.59%	-2.19%	2.41%	-0.93%	-0.50%	5.37%	-2.87%	-0.91%
PKG50	2.65%	-1.63%	-4.95%	-1.52%	-0.07%	0.00%	-3.47%	-1.98%
Mean	2.71%	2.02%	1.23%	-1.69%	0.28%	2.88%	2.07%	0.75%
SD	2.17%	2.85%	2.75%	1.94%	1.25%	2.64%	3.13%	1.33%
Max	8.01%	9.51%	6.83%	2.55%	3.66%	8.50%	9.64%	3.79%
Min	-2.60%	-2.66%	-7.46%	-6.47%	-2.28%	-4.63%	-4.98%	-2.05%
Diff	10.61%	12.17%	14.29%	9.02%	5.93%	13.13%	14.62%	5.84%

Table C-2-25: TCC 400th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	1.02%	2.48%	1.52%	17.38%	5.72%	11.97%	7.50%	10.61%
PKG02	1.30%	6.55%	2.03%	16.61%	0.66%	20.95%	6.31%	13.69%
PKG03	0.48%	3.58%	0.57%	15.08%	1.78%	18.71%	0.54%	11.03%
PKG04	0.03%	5.63%	2.91%	no ball	-1.26%	20.44%	-2.12%	10.07%
PKG05	4.26%	5.75%	-0.76%	18.65%	-0.35%	19.13%	1.65%	9.47%
PKG06	-0.18%	8.77%	2.63%	18.43%	0.88%	21.81%	0.05%	10.72%
PKG07	-0.07%	6.14%	2.22%	17.89%	2.17%	15.75%	2.23%	10.25%
PKG08	-0.15%	6.16%	1.15%	16.85%	-1.47%	19.36%	2.57%	11.85%
PKG09	2.34%	7.31%	2.82%	22.68%	-0.99%	17.29%	0.37%	10.59%
PKG10	1.95%	2.81%	0.50%	14.94%	-1.91%	14.71%	0.49%	11.40%
PKG11	1.86%	3.57%	1.57%	17.40%	-1.56%	22.13%	4.63%	8.84%
PKG12	-0.24%	4.35%	2.35%	15.39%	-0.53%	11.22%	2.03%	7.94%
PKG13	2.05%	2.96%	1.68%	22.09%	-0.85%	18.77%	5.23%	8.09%
PKG14	0.80%	4.57%	3.68%	15.10%	-1.06%	13.10%	1.00%	8.41%
PKG15	2.02%	3.16%	0.03%	19.06%	-3.49%	17.88%	2.26%	10.07%
PKG16	9.42%	5.67%	2.27%	26.18%	-1.00%	14.00%	2.15%	7.91%
PKG17	0.12%	5.28%	-1.38%	23.73%	-1.81%	17.73%	3.89%	5.18%
PKG18	1.68%	6.05%	2.27%	18.98%	-1.13%	16.62%	0.11%	7.03%
PKG19	1.34%	5.26%	0.69%	16.22%	-1.50%	18.82%	2.58%	8.73%
PKG20	0.32%	2.25%	0.85%	16.29%	0.45%	13.73%	1.47%	9.61%
PKG21	2.26%	2.91%	0.43%	18.02%	-1.28%	18.74%	-1.01%	2.09%
PKG22	0.12%	1.57%	2.87%	14.30%	-0.52%	27.80%	0.63%	8.66%
PKG23	4.15%	5.41%	1.91%	15.22%	-0.30%	33.56%	5.77%	12.66%
PKG24	2.89%	5.70%	1.66%	14.64%	-0.45%	26.75%	-0.37%	6.10%
PKG25	3.48%	3.03%	2.36%	13.32%	0.20%	25.02%	0.74%	0.06%
PKG26	3.42%	8.08%	-0.51%	14.41%	-1.60%	28.34%	-1.45%	8.37%
PKG27	3.58%	5.00%	-0.28%	15.70%	-0.92%	27.72%	-0.99%	7.81%
PKG28	3.25%	8.79%	0.52%	18.56%	-1.60%	21.35%	3.54%	3.86%
PKG29	2.23%	3.68%	-0.65%	21.99%	-0.66%	25.08%	2.68%	10.64%
PKG30	5.87%	-0.20%	0.76%	20.72%	-0.53%	16.08%	3.92%	15.32%
PKG31	8.68%	6.25%	0.12%	outliner	-1.01%	16.81%	1.89%	5.34%
PKG32	8.22%	1.20%	-1.36%	outliner	0.78%	21.33%	0.79%	8.94%
PKG33	2.26%	4.50%	-0.28%	outliner	-0.97%	15.00%	1.39%	7.94%
PKG35	2.13%	3.60%	-1.17%	16.99%	-1.14%	16.51%	0.83%	9.48%
PKG36	1.79%	4.44%	1.23%	12.17%	-1.83%	14.77%	4.60%	9.69%
PKG37	12.27%	3.36%	-0.99%	19.85%	3.26%	23.52%	0.62%	5.09%
PKG38	3.21%	3.54%	-1.13%	11.62%	1.75%	12.04%	1.27%	6.66%
PKG39	6.15%	1.41%	0.19%	11.70%	-0.98%	8.48%	1.13%	5.24%
PKG40	11.10%	2.73%	-2.91%	18.93%	3.00%	9.85%	0.31%	9.07%
PKG41	14.30%	6.29%	0.34%	17.10%	-1.58%	12.54%	0.93%	5.13%
PKG42	6.81%	5.33%	-0.91%	15.61%	no ball	14.29%	3.64%	8.04%
PKG43	4.65%	2.83%	0.68%	14.09%	-0.75%	22.40%	1.16%	5.22%
PKG44	1.21%	10.34%	-0.38%	9.13%	-0.69%	23.60%	0.59%	8.27%
PKG45	5.44%	6.68%	0.90%	12.05%	-0.82%	27.63%	2.05%	8.32%
PKG46	2.11%	2.03%	2.31%	11.54%	0.78%	26.98%	0.49%	9.55%
PKG47	5.67%	1.83%	-0.13%	24.93%	2.23%	27.64%	3.21%	8.07%
PKG48	5.21%	10.10%	-0.68%	16.99%	-0.82%	28.10%	0.64%	7.16%
PKG49	3.17%	8.34%	-0.79%	11.34%	3.40%	21.29%	2.01%	9.57%
PKG50	2.66%	6.69%	1.49%	16.60%	3.12%	21.25%	3.87%	4.35%
Mean	3.44%	4.77%	0.72%	16.81%	-0.15%	19.56%	1.83%	8.33%
SD	3.34%	2.36%	1.43%	3.72%	1.76%	5.70%	2.01%	2.82%
Max	14.30%	10.34%	3.68%	26.18%	5.72%	33.56%	7.50%	15.32%
Min	-0.24%	-0.20%	-2.91%	9.13%	-3.49%	8.48%	-2.12%	0.06%
Diff	14.55%	10.55%	6.59%	17.05%	9.21%	25.08%	9.61%	15.25%

Table C-2-26: TCC 400th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.81%	1.25%	1.41%	0.85%	-1.10%	-5.07%	7.07%	4.46%
PKG02	0.76%	3.06%	-1.04%	0.75%	0.77%	-2.60%	6.96%	2.68%
PKG03	0.46%	2.12%	3.68%	-2.31%	0.76%	-7.02%	2.88%	2.00%
PKG04	0.19%	1.98%	3.05%	1.08%	-0.02%	-3.15%	2.94%	-1.67%
PKG05	3.46%	2.41%	4.09%	0.76%	0.33%	-4.87%	3.48%	1.77%
PKG06	0.92%	2.31%	3.01%	-0.11%	0.97%	-6.42%	1.20%	1.36%
PKG07	-1.96%	1.73%	1.51%	0.34%	1.84%	-9.11%	3.03%	1.11%
PKG08	0.18%	1.33%	2.75%	-0.28%	-0.14%	-4.62%	0.85%	1.71%
PKG09	0.85%	-0.02%	2.79%	-1.82%	-1.25%	outliner	6.04%	0.95%
PKG10	-0.78%	0.12%	2.40%	-0.37%	-0.87%	-6.52%	5.90%	0.05%
PKG11	-0.79%	-2.03%	2.73%	1.17%	-1.02%	-6.77%	11.96%	0.81%
PKG12	-2.03%	-1.43%	3.10%	-0.02%	-1.95%	-5.07%	3.89%	2.78%
PKG13	0.72%	1.48%	no ball	0.34%	-2.58%	-4.59%	7.27%	1.45%
PKG14	no ball	-0.09%	3.67%	-0.15%	-0.33%	-4.76%	2.60%	2.10%
PKG15	0.04%	1.10%	3.27%	-1.09%	-1.56%	-6.23%	0.34%	0.55%
PKG16	-0.78%	0.18%	2.40%	2.52%	0.92%	-6.67%	2.27%	2.43%
PKG17	-0.04%	-1.66%	4.32%	1.26%	0.12%	-2.02%	2.24%	4.67%
PKG18	-1.39%	0.64%	1.97%	-3.43%	-0.30%	-5.77%	2.34%	3.24%
PKG19	-2.05%	-0.40%	3.19%	1.07%	-2.52%	-3.44%	2.18%	2.30%
PKG20	-0.97%	1.58%	2.84%	-0.68%	-1.27%	-5.83%	2.45%	2.70%
PKG21	-0.60%	-0.47%	3.42%	-1.84%	-0.99%	-6.11%	2.68%	0.28%
PKG22	0.90%	1.23%	2.38%	-2.78%	-1.45%	-5.44%	2.88%	1.17%
PKG23	0.56%	2.40%	2.96%	-2.86%	-0.91%	-7.07%	8.57%	0.75%
PKG24	0.21%	1.51%	2.26%	-3.16%	-0.81%	-4.05%	1.34%	4.20%
PKG25	0.96%	-1.34%	3.01%	-0.95%	-0.49%	-1.50%	2.26%	1.41%
PKG26	-3.34%	2.98%	3.41%	-0.67%	-1.21%	-7.82%	2.70%	1.18%
PKG27	2.87%	3.63%	5.19%	1.21%	-1.39%	-5.33%	0.94%	3.77%
PKG28	-1.46%	0.52%	no ball	0.72%	0.72%	-1.52%	1.26%	1.17%
PKG29	0.80%	1.55%	outliner	-4.17%	0.19%	-2.39%	-2.12%	2.47%
PKG30	-3.42%	0.93%	3.88%	-3.04%	1.45%	-4.97%	0.78%	0.74%
PKG31	-1.78%	2.39%	5.31%	-0.88%	5.05%	-7.51%	2.57%	1.59%
PKG32	-2.77%	-2.81%	3.97%	1.19%	1.70%	-3.90%	1.84%	1.96%
PKG33	-3.80%	-0.24%	2.43%	1.10%	1.66%	-1.45%	3.48%	2.15%
PKG35	-1.96%	1.86%	1.84%	-3.68%	1.98%	-3.89%	2.54%	0.34%
PKG36	0.26%	1.40%	5.18%	0.61%	1.86%	-1.74%	3.91%	1.77%
PKG37	-2.25%	-0.39%	2.66%	2.07%	1.10%	-4.12%	0.75%	-0.27%
PKG38	-3.94%	-1.94%	2.30%	2.06%	1.34%	-6.51%	0.56%	-0.23%
PKG39	3.83%	-0.02%	1.39%	-4.63%	2.90%	-5.11%	2.99%	0.76%
PKG40	-0.51%	2.66%	2.45%	-4.36%	-0.64%	-5.88%	2.29%	0.33%
PKG41	-1.17%	3.81%	3.19%	-1.66%	3.36%	-9.01%	0.56%	1.04%
PKG42	-3.67%	1.95%	2.87%	0.76%	1.72%	-9.29%	-0.53%	0.84%
PKG43	-0.75%	3.56%	1.94%	1.57%	0.05%	-8.93%	5.30%	-0.32%
PKG44	-1.32%	-0.17%	1.43%	2.41%	3.54%	-9.82%	2.01%	-0.22%
PKG45	-0.11%	3.49%	5.91%	1.07%	-1.16%	-7.05%	-0.29%	-0.66%
PKG46	-0.11%	6.93%	4.17%	-1.86%	0.69%	-7.08%	3.04%	-0.77%
PKG47	-1.13%	1.42%	1.48%	0.42%	1.08%	-5.45%	-2.67%	0.39%
PKG48	-1.87%	0.73%	1.60%	1.90%	1.35%	-6.32%	-0.88%	-0.28%
PKG49	-0.62%	-1.19%	2.39%	3.29%	1.34%	-5.82%	0.95%	-0.92%
PKG50	-1.51%	-1.58%	1.29%	0.25%	0.71%	-6.24%	-2.83%	0.20%
Mean	-0.61%	1.03%	2.86%	-0.33%	0.32%	-5.45%	2.55%	1.27%
SD	1.74%	1.85%	1.25%	1.98%	1.60%	2.13%	2.76%	1.41%
Max	3.83%	6.93%	5.91%	3.29%	5.05%	-1.45%	11.96%	4.67%
Min	-3.94%	-2.81%	-1.04%	-4.63%	-2.58%	-9.82%	-2.83%	-1.67%
Diff	7.76%	9.75%	6.95%	7.93%	7.63%	8.37%	14.80%	6.33%

Table C-2-27: TCC 500th cycle; Daisy01 – Daisy08.

	DAISY01	DAISY02	DAISY03	DAISY04	DAISY05	DAISY06	DAISY07	DAISY08
PKG01	14.19%	9.61%	5.07%	18.96%	4.30%	14.77%	0.85%	14.58%
PKG02	5.71%	12.40%	2.66%	18.51%	-1.13%	17.65%	1.75%	14.13%
PKG03	2.91%	3.49%	0.80%	14.11%	-0.98%	16.19%	0.05%	10.31%
PKG04	1.53%	7.09%	1.51%	no ball	-2.23%	23.13%	-2.94%	12.67%
PKG05	14.11%	3.17%	0.11%	23.11%	-1.67%	24.65%	0.56%	9.32%
PKG06	5.54%	7.10%	1.94%	21.78%	1.47%	23.25%	1.09%	14.58%
PKG07	6.04%	5.53%	2.47%	18.80%	-0.59%	19.67%	0.39%	10.25%
PKG08	5.37%	5.97%	1.52%	17.45%	-1.33%	20.03%	0.63%	8.14%
PKG09	3.45%	4.43%	1.26%	17.71%	-1.85%	18.21%	1.80%	11.06%
PKG10	2.50%	3.18%	-0.12%	25.12%	outliner	18.96%	1.18%	6.06%
PKG11	13.04%	3.57%	0.92%	17.30%	-2.10%	23.21%	0.38%	8.60%
PKG12	3.20%	3.02%	-0.74%	15.03%	-0.89%	13.67%	0.54%	9.00%
PKG13	6.50%	4.23%	-0.87%	18.52%	-1.98%	21.49%	0.71%	9.56%
PKG14	2.18%	3.52%	0.11%	14.43%	-1.88%	15.00%	-0.49%	7.74%
PKG15	1.33%	5.06%	1.76%	18.15%	-3.96%	18.00%	7.89%	9.28%
PKG16	1.41%	3.89%	0.32%	16.08%	-1.40%	15.86%	3.01%	8.29%
PKG17	0.03%	4.41%	-0.83%	18.94%	-2.18%	16.21%	-0.52%	5.04%
PKG18	0.71%	3.59%	0.11%	18.59%	-1.83%	18.97%	4.30%	6.74%
PKG19	1.84%	3.05%	-1.77%	23.57%	-0.12%	22.03%	1.18%	8.81%
PKG20	0.23%	3.69%	-1.02%	16.39%	-0.61%	16.62%	1.54%	9.38%
PKG21	1.00%	3.82%	-0.05%	16.18%	-1.35%	16.96%	1.50%	3.60%
PKG22	-1.78%	0.68%	-0.60%	14.95%	-1.64%	23.86%	1.66%	7.66%
PKG23	1.61%	5.19%	-1.11%	19.24%	-1.33%	20.98%	4.61%	12.08%
PKG24	0.54%	4.43%	-0.22%	16.64%	0.20%	19.71%	-0.02%	6.43%
PKG25	0.99%	5.19%	0.58%	16.35%	-0.20%	18.64%	4.81%	2.80%
PKG26	0.71%	9.25%	-1.37%	14.78%	-1.06%	22.24%	1.55%	8.30%
PKG27	-0.26%	4.79%	-0.28%	16.85%	-2.03%	19.16%	11.68%	7.18%
PKG28	0.23%	7.97%	-0.37%	17.30%	-1.44%	20.74%	2.95%	3.18%
PKG29	0.60%	4.56%	-0.81%	15.96%	-1.13%	20.56%	4.25%	6.99%
PKG30	0.82%	2.49%	0.76%	19.03%	2.80%	17.40%	0.05%	9.96%
PKG31	-1.22%	5.13%	-2.26%	16.28%	1.53%	16.06%	1.32%	7.01%
PKG32	-0.27%	2.51%	-1.20%	8.04%	5.98%	22.96%	0.32%	12.70%
PKG33	-3.31%	2.15%	-1.30%	15.50%	4.40%	10.57%	5.23%	8.16%
PKG35	-0.64%	5.41%	-2.05%	16.49%	3.72%	17.76%	1.16%	outliner
PKG36	0.31%	3.70%	-0.41%	13.94%	0.79%	25.35%	6.91%	9.32%
PKG37	2.21%	2.97%	-0.83%	15.69%	1.88%	21.79%	outliner	2.61%
PKG38	3.84%	4.88%	-0.90%	13.86%	4.50%	13.33%	outliner	6.21%
PKG39	6.15%	9.38%	-0.76%	17.40%	-1.21%	10.89%	outliner	6.19%
PKG40	0.42%	4.04%	-2.29%	19.70%	-1.00%	13.04%	1.35%	11.73%
PKG41	0.58%	3.94%	-1.27%	16.20%	-1.14%	10.70%	2.19%	6.10%
PKG42	-1.40%	7.08%	-0.91%	18.03%	no ball	14.41%	2.04%	9.00%
PKG43	4.36%	2.43%	-0.13%	18.04%	-2.71%	27.59%	4.10%	9.05%
PKG44	0.32%	9.18%	-1.04%	9.51%	-2.14%	20.74%	1.61%	8.59%
PKG45	2.12%	1.77%	0.03%	14.47%	-1.60%	19.24%	0.69%	7.55%
PKG46	0.12%	1.66%	0.49%	13.88%	-1.45%	24.55%	0.68%	8.59%
PKG47	2.75%	2.54%	-2.14%	20.44%	1.09%	21.43%	-0.41%	7.39%
PKG48	-1.80%	5.27%	-2.34%	18.44%	-0.73%	20.74%	1.10%	12.98%
PKG49	2.28%	5.11%	-2.87%	12.13%	4.06%	22.03%	0.75%	9.40%
PKG50	3.75%	6.10%	-0.43%	19.77%	4.36%	25.81%	-0.14%	6.25%
Mean	2.38%	4.77%	-0.22%	17.03%	-0.17%	19.12%	1.87%	8.55%
SD	3.68%	2.34%	1.48%	3.13%	2.33%	4.06%	2.50%	2.85%
Max	14.19%	12.40%	5.07%	25.12%	5.98%	27.59%	11.68%	14.58%
Min	-3.31%	0.68%	-2.87%	8.04%	-3.96%	10.57%	-2.94%	2.61%
Diff	17.51%	11.71%	7.94%	17.07%	9.93%	17.01%	14.62%	11.97%

Table C-2-28: TCC 500th cycle; Daisy09 – Daisy16.

	DAISY09	DAISY10	DAISY11	DAISY12	DAISY13	DAISY14	DAISY15	DAISY16
PKG01	1.73%	1.32%	2.23%	1.51%	-2.04%	-4.92%	6.28%	4.69%
PKG02	-0.20%	1.63%	-1.62%	-0.17%	2.07%	-3.90%	7.61%	1.86%
PKG03	-0.94%	3.71%	5.65%	-0.99%	0.82%	-6.55%	7.16%	1.48%
PKG04	-1.05%	2.72%	4.17%	2.34%	-0.15%	-3.59%	6.91%	-0.83%
PKG05	2.89%	7.88%	5.30%	0.33%	0.19%	-2.89%	3.24%	2.46%
PKG06	-0.48%	3.04%	3.75%	4.09%	1.96%	-6.02%	8.89%	-0.13%
PKG07	-2.20%	0.43%	7.07%	1.54%	1.05%	-7.35%	10.52%	2.13%
PKG08	-0.18%	3.09%	4.81%	-0.60%	-0.01%	-4.35%	5.69%	3.33%
PKG09	-0.28%	2.40%	3.95%	-0.31%	-0.88%	outliner	7.59%	2.63%
PKG10	-1.67%	1.05%	2.53%	-1.33%	-0.87%	-4.81%	3.20%	2.45%
PKG11	-0.71%	-1.06%	3.58%	1.47%	-0.55%	-5.58%	4.24%	4.18%
PKG12	-1.89%	-1.03%	1.38%	-1.92%	-2.40%	-4.93%	3.09%	1.94%
PKG13	-1.64%	0.88%	no ball	0.48%	-2.08%	-5.67%	5.06%	-0.40%
PKG14	no ball	-1.03%	1.85%	-0.48%	-0.58%	-3.91%	4.42%	outliner
PKG15	-0.61%	2.00%	5.92%	0.76%	-0.58%	-5.55%	2.60%	1.33%
PKG16	-2.08%	-1.26%	1.48%	-0.21%	0.36%	-6.54%	2.32%	2.25%
PKG17	-0.34%	4.03%	3.65%	3.12%	-0.15%	-1.87%	5.50%	1.36%
PKG18	-2.02%	7.26%	2.17%	-2.46%	0.90%	-4.73%	4.51%	0.77%
PKG19	-2.21%	0.95%	3.47%	1.88%	-2.11%	-5.20%	4.08%	outliner
PKG20	-3.16%	0.49%	5.29%	0.05%	-0.71%	-3.36%	2.64%	2.75%
PKG21	-2.37%	-0.54%	2.23%	-1.55%	-1.76%	-4.67%	3.53%	0.33%
PKG22	-1.45%	5.93%	2.11%	-1.09%	-2.07%	-4.04%	1.95%	1.45%
PKG23	-0.39%	1.83%	1.68%	-3.74%	-0.91%	-7.93%	3.06%	0.46%
PKG24	-2.62%	0.51%	2.78%	-1.60%	-1.39%	-3.90%	1.14%	1.89%
PKG25	-2.10%	-0.31%	4.76%	-0.24%	-0.28%	-0.27%	2.90%	2.37%
PKG26	-5.18%	0.86%	3.48%	0.47%	-0.88%	-7.61%	1.89%	1.24%
PKG27	-1.90%	5.31%	1.39%	0.70%	-0.91%	-7.19%	1.94%	0.82%
PKG28	-3.79%	2.87%	no ball	1.31%	0.13%	-4.19%	1.63%	0.62%
PKG29	-3.07%	-3.03%	3.66%	-4.03%	0.73%	-1.95%	-0.39%	1.72%
PKG30	-4.19%	1.88%	1.26%	-1.50%	1.87%	-2.63%	1.57%	0.45%
PKG31	outliner	-0.80%	1.39%	-0.73%	1.44%	-6.31%	6.49%	2.57%
PKG32	-2.21%	-2.89%	0.12%	1.42%	1.77%	-3.75%	3.75%	1.00%
PKG33	-5.18%	-1.94%	1.57%	0.68%	1.94%	-3.93%	2.53%	1.62%
PKG35	-4.11%	1.21%	2.73%	-5.44%	3.49%	-3.14%	2.06%	2.32%
PKG36	1.71%	0.33%	0.97%	0.33%	1.15%	-3.15%	0.68%	1.39%
PKG37	-1.62%	-1.78%	1.19%	2.36%	1.03%	-5.39%	1.68%	-0.38%
PKG38	-4.55%	-3.61%	2.30%	3.07%	1.15%	-3.92%	1.03%	0.11%
PKG39	-0.04%	-0.74%	0.72%	-2.85%	1.16%	-5.93%	3.35%	0.81%
PKG40	1.23%	-0.54%	1.08%	-4.01%	0.40%	-5.88%	1.88%	0.50%
PKG41	1.25%	0.05%	2.04%	-1.93%	-0.01%	-8.52%	0.84%	2.39%
PKG42	-5.56%	-1.63%	0.58%	0.69%	-0.78%	-8.05%	-1.21%	-1.00%
PKG43	-0.51%	-0.09%	0.66%	0.63%	-0.79%	-9.29%	4.95%	-0.48%
PKG44	1.80%	-1.28%	-0.64%	3.48%	-0.30%	-10.04%	0.72%	-0.17%
PKG45	-0.19%	0.55%	1.91%	5.46%	-0.15%	-7.26%	-0.64%	-0.33%
PKG46	-0.56%	0.27%	1.01%	-2.20%	-0.27%	-5.62%	0.65%	0.16%
PKG47	-0.13%	-1.01%	0.73%	-0.03%	0.49%	-4.50%	-4.64%	-0.07%
PKG48	-2.63%	-3.98%	1.74%	0.64%	-0.38%	-6.39%	-1.51%	0.62%
PKG49	-0.12%	-4.76%	1.88%	1.67%	0.05%	-5.05%	-2.46%	0.11%
PKG50	-1.87%	-2.53%	0.76%	-0.99%	-0.41%	-5.82%	-2.34%	-1.83%
Mean	-1.43%	0.58%	2.40%	0.00%	-0.01%	-5.17%	2.91%	1.17%
SD	1.92%	2.69%	1.79%	2.16%	1.27%	1.96%	3.02%	1.35%
Max	2.89%	7.88%	7.07%	5.46%	3.49%	-0.27%	10.52%	4.69%
Min	-5.56%	-4.76%	-1.62%	-5.44%	-2.40%	-10.04%	-4.64%	-1.83%
Diff	8.45%	12.64%	8.68%	10.90%	5.89%	9.77%	15.16%	6.52%

APPENDIX D

Average Resistance Changes for Each Measured Temperature Cycling Test

Figure D-1: Average resistance changes for each measured temperature cycling test.

APPENDIX E

Average Resistance Changes for Each Daisy Chain

Figure E-1: Average resistance changes for each daisy chain.

APPENDIX F-1

Calculated Effects at the Measured Temperature Cycles

Table F-1-1: TCB 238th cycle.

		1	2	3	4	12	13	14	23
DAISY06	2.20%	-2.20%	-2.20%	-2.20%	-2.20%	2.20%	2.20%	2.20%	2.20%
DAISY14	-0.44%	-0.44%	0.44%	0.44%	0.44%	0.44%	0.44%	0.44%	-0.44%
DAISY02	1.71%	-1.71%	1.71%	-1.71%	-1.71%	-1.71%	1.71%	1.71%	-1.71%
DAISY10	2.11%	2.11%	2.11%	-2.11%	-2.11%	2.11%	-2.11%	-2.11%	-2.11%
DAISY08	2.21%	-2.21%	-2.21%	2.21%	-2.21%	2.21%	-2.21%	2.21%	-2.21%
DAISY16	-0.33%	-0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%
DAISY04	0.01%	-0.01%	0.01%	0.01%	-0.01%	-0.01%	-0.01%	0.01%	0.01%
DAISY12	-1.30%	-1.30%	-1.30%	-1.30%	1.30%	-1.30%	-1.30%	1.30%	-1.30%
DAISY05	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%	-0.39%	0.39%	-0.39%
DAISY13	-0.23%	-0.23%	0.23%	0.23%	-0.23%	0.23%	0.23%	-0.23%	-0.23%
DAISY01	-0.55%	0.55%	-0.55%	0.55%	-0.55%	0.55%	-0.55%	0.55%	0.55%
DAISY09	0.63%	0.63%	0.63%	-0.63%	0.63%	0.63%	-0.63%	0.63%	-0.63%
DAISY07	0.56%	-0.56%	-0.56%	0.56%	0.56%	0.56%	-0.56%	-0.56%	-0.56%
DAISY15	0.82%	0.82%	-0.82%	0.82%	0.82%	-0.82%	0.82%	0.82%	-0.82%
DAISY03	0.57%	-0.57%	0.57%	0.57%	0.57%	-0.57%	-0.57%	-0.57%	0.57%
DAISY11	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%
	Contrast	-3.54%	0.31%	-0.98%	-3.25%	5.98%	-1.73%	8.64%	-5.22%
	Effect	-0.44%	0.04%	-0.12%	-0.41%	0.75%	-0.22%	1.08%	-0.65%

		24	34	123	124	134	234	1234
DAISY06	2.20%	2.20%	2.20%	-2.20%	-2.20%	-2.20%	-2.20%	2.20%
DAISY14	-0.44%	-0.44%	-0.44%	-0.44%	-0.44%	-0.44%	0.44%	0.44%
DAISY02	1.71%	-1.71%	1.71%	1.71%	1.71%	-1.71%	1.71%	-1.71%
DAISY10	2.11%	-2.11%	2.11%	-2.11%	-2.11%	2.11%	2.11%	2.11%
DAISY08	2.21%	2.21%	-2.21%	2.21%	-2.21%	2.21%	2.21%	-2.21%
DAISY16	-0.33%	-0.33%	0.33%	0.33%	-0.33%	0.33%	-0.33%	-0.33%
DAISY04	0.01%	-0.01%	-0.01%	-0.01%	0.01%	0.01%	-0.01%	0.01%
DAISY12	-1.30%	1.30%	1.30%	-1.30%	1.30%	1.30%	1.30%	1.30%
DAISY05	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%	-0.39%	0.39%
DAISY13	-0.23%	0.23%	0.23%	-0.23%	0.23%	0.23%	-0.23%	-0.23%
DAISY01	-0.55%	-0.55%	0.55%	-0.55%	0.55%	-0.55%	0.55%	-0.55%
DAISY09	0.63%	0.63%	-0.63%	-0.63%	0.63%	-0.63%	-0.63%	-0.63%
DAISY07	0.56%	-0.56%	0.56%	0.56%	0.56%	-0.56%	-0.56%	0.56%
DAISY15	0.82%	-0.82%	0.82%	-0.82%	-0.82%	0.82%	-0.82%	-0.82%
DAISY03	0.57%	0.57%	0.57%	-0.57%	-0.57%	-0.57%	0.57%	-0.57%
DAISY11	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%	1.53%
	Contrast	2.51%	9.01%	-2.12%	-2.55%	1.49%	5.24%	1.48%
	Effect	0.31%	1.13%	-0.27%	-0.32%	0.19%	0.65%	0.19%

Table F-1-2: TCB 457th cycle.

		1	2	3	4	12	13	14	23
DAISY06	2.25%	-2.25%	-2.25%	-2.25%	-2.25%	2.25%	2.25%	2.25%	2.25%
DAISY14	0.04%	0.04%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%	0.04%
DAISY02	2.95%	-2.95%	2.95%	-2.95%	-2.95%	-2.95%	2.95%	2.95%	-2.95%
DAISY10	4.30%	4.30%	4.30%	-4.30%	-4.30%	4.30%	-4.30%	-4.30%	-4.30%
DAISY08	0.07%	-0.07%	-0.07%	0.07%	-0.07%	0.07%	-0.07%	0.07%	-0.07%
DAISY16	0.84%	0.84%	-0.84%	0.84%	-0.84%	-0.84%	0.84%	-0.84%	-0.84%
DAISY04	1.40%	-1.40%	1.40%	1.40%	-1.40%	-1.40%	-1.40%	1.40%	1.40%
DAISY12	-1.40%	-1.40%	-1.40%	-1.40%	1.40%	-1.40%	-1.40%	1.40%	-1.40%
DAISY05	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY13	-0.20%	-0.20%	0.20%	0.20%	-0.20%	0.20%	0.20%	-0.20%	-0.20%
DAISY01	0.25%	-0.25%	0.25%	-0.25%	0.25%	-0.25%	0.25%	-0.25%	-0.25%
DAISY09	1.88%	1.88%	1.88%	-1.88%	1.88%	1.88%	-1.88%	1.88%	-1.88%
DAISY07	1.62%	-1.62%	-1.62%	1.62%	1.62%	1.62%	-1.62%	-1.62%	-1.62%
DAISY15	1.68%	1.68%	-1.68%	1.68%	1.68%	-1.68%	1.68%	1.68%	-1.68%
DAISY03	0.81%	-0.81%	0.81%	0.81%	0.81%	-0.81%	-0.81%	-0.81%	0.81%
DAISY11	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%
	Contrast	-0.47%	5.65%	-4.69%	-2.66%	2.70%	-1.60%	5.32%	-8.94%
	Effect	-0.06%	0.71%	-0.59%	-0.33%	0.34%	-0.20%	0.67%	-1.12%

		24	34	123	124	134	234	1234
DAISY06	2.25%	2.25%	2.25%	-2.25%	-2.25%	-2.25%	-2.25%	2.25%
DAISY14	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	-0.04%	-0.04%
DAISY02	2.95%	-2.95%	2.95%	2.95%	2.95%	-2.95%	2.95%	-2.95%
DAISY10	4.30%	-4.30%	4.30%	-4.30%	-4.30%	4.30%	4.30%	4.30%
DAISY08	0.07%	0.07%	-0.07%	0.07%	-0.07%	0.07%	0.07%	-0.07%
DAISY16	0.84%	0.84%	-0.84%	-0.84%	0.84%	-0.84%	0.84%	0.84%
DAISY04	1.40%	-1.40%	-1.40%	-1.40%	1.40%	1.40%	-1.40%	1.40%
DAISY12	-1.40%	1.40%	1.40%	-1.40%	1.40%	1.40%	1.40%	1.40%
DAISY05	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY13	-0.20%	0.20%	0.20%	-0.20%	0.20%	0.20%	-0.20%	-0.20%
DAISY01	0.25%	0.25%	-0.25%	0.25%	-0.25%	0.25%	-0.25%	0.25%
DAISY09	1.88%	1.88%	-1.88%	-1.88%	1.88%	-1.88%	-1.88%	-1.88%
DAISY07	1.62%	-1.62%	1.62%	1.62%	1.62%	-1.62%	-1.62%	1.62%
DAISY15	1.68%	-1.68%	1.68%	-1.68%	-1.68%	1.68%	-1.68%	-1.68%
DAISY03	0.81%	0.81%	0.81%	-0.81%	-0.81%	-0.81%	0.81%	-0.81%
DAISY11	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%	1.75%
	Contrast	-2.45%	12.59%	-8.10%	2.71%	0.74%	2.80%	6.20%
	Effect	-0.31%	1.57%	-1.01%	0.34%	0.09%	0.35%	0.77%

Table F-1-3: TCB 643rd cycle.

		1	2	3	4	12	13	14	23
DAISY06	1.16%	-1.16%	-1.16%	-1.16%	-1.16%	1.16%	1.16%	1.16%	1.16%
DAISY14	-1.01%	-1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	-1.01%
DAISY02	1.61%	-1.61%	1.61%	-1.61%	-1.61%	-1.61%	1.61%	1.61%	-1.61%
DAISY10	0.31%	0.31%	0.31%	-0.31%	-0.31%	0.31%	-0.31%	-0.31%	-0.31%
DAISY08	-1.73%	1.73%	1.73%	-1.73%	1.73%	-1.73%	1.73%	-1.73%	1.73%
DAISY16	-0.31%	-0.31%	0.31%	-0.31%	0.31%	0.31%	-0.31%	0.31%	0.31%
DAISY04	-0.61%	0.61%	-0.61%	-0.61%	0.61%	0.61%	0.61%	-0.61%	-0.61%
DAISY12	-2.19%	-2.19%	-2.19%	-2.19%	2.19%	-2.19%	-2.19%	2.19%	-2.19%
DAISY05	0.27%	-0.27%	-0.27%	-0.27%	0.27%	0.27%	0.27%	-0.27%	0.27%
DAISY13	-0.84%	-0.84%	0.84%	0.84%	-0.84%	0.84%	0.84%	-0.84%	-0.84%
DAISY01	1.06%	-1.06%	1.06%	-1.06%	1.06%	-1.06%	1.06%	-1.06%	-1.06%
DAISY09	0.55%	0.55%	0.55%	-0.55%	0.55%	0.55%	-0.55%	0.55%	-0.55%
DAISY07	0.45%	-0.45%	-0.45%	0.45%	0.45%	0.45%	-0.45%	-0.45%	-0.45%
DAISY15	0.01%	0.01%	-0.01%	0.01%	0.01%	-0.01%	0.01%	0.01%	-0.01%
DAISY03	-0.51%	0.51%	-0.51%	-0.51%	-0.51%	0.51%	0.51%	0.51%	-0.51%
DAISY11	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%
	Contrast	-5.31%	2.09%	-8.12%	3.64%	-0.71%	4.90%	1.95%	-5.80%
	Effect	-0.66%	0.26%	-1.02%	0.45%	-0.09%	0.61%	0.24%	-0.73%

		24	34	123	124	134	234	1234
DAISY06	1.16%	1.16%	1.16%	-1.16%	-1.16%	-1.16%	-1.16%	1.16%
DAISY14	-1.01%	-1.01%	-1.01%	-1.01%	-1.01%	-1.01%	1.01%	1.01%
DAISY02	1.61%	-1.61%	1.61%	1.61%	1.61%	-1.61%	1.61%	-1.61%
DAISY10	0.31%	-0.31%	0.31%	-0.31%	-0.31%	0.31%	0.31%	0.31%
DAISY08	-1.73%	-1.73%	1.73%	-1.73%	1.73%	-1.73%	-1.73%	1.73%
DAISY16	-0.31%	-0.31%	0.31%	0.31%	-0.31%	0.31%	-0.31%	-0.31%
DAISY04	-0.61%	0.61%	0.61%	0.61%	-0.61%	-0.61%	0.61%	-0.61%
DAISY12	-2.19%	2.19%	2.19%	-2.19%	2.19%	2.19%	2.19%	2.19%
DAISY05	0.27%	-0.27%	-0.27%	-0.27%	0.27%	0.27%	0.27%	-0.27%
DAISY13	-0.84%	0.84%	0.84%	-0.84%	0.84%	0.84%	-0.84%	-0.84%
DAISY01	1.06%	1.06%	-1.06%	1.06%	-1.06%	1.06%	-1.06%	1.06%
DAISY09	0.55%	0.55%	-0.55%	-0.55%	0.55%	-0.55%	-0.55%	-0.55%
DAISY07	0.45%	-0.45%	0.45%	0.45%	0.45%	-0.45%	-0.45%	0.45%
DAISY15	0.01%	-0.01%	0.01%	-0.01%	-0.01%	0.01%	-0.01%	-0.01%
DAISY03	-0.51%	-0.51%	-0.51%	0.51%	0.51%	0.51%	-0.51%	0.51%
DAISY11	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%
	Contrast	0.09%	5.69%	-3.63%	3.56%	-1.74%	-0.71%	4.08%
	Effect	0.01%	0.71%	-0.45%	0.44%	-0.22%	-0.09%	0.51%

Table F-1-4: TCB 875th cycle.

		1	2	3	4	12	13	14	23
DAISY06	4.70%	-4.70%	-4.70%	-4.70%	-4.70%	4.70%	4.70%	4.70%	4.70%
DAISY14	0.03%	0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	0.03%
DAISY02	2.45%	-2.45%	2.45%	-2.45%	-2.45%	-2.45%	2.45%	2.45%	-2.45%
DAISY10	0.41%	0.41%	0.41%	-0.41%	-0.41%	0.41%	-0.41%	-0.41%	-0.41%
DAISY08	-0.39%	0.39%	0.39%	-0.39%	0.39%	-0.39%	0.39%	-0.39%	0.39%
DAISY16	0.57%	0.57%	-0.57%	0.57%	-0.57%	-0.57%	0.57%	-0.57%	-0.57%
DAISY04	-0.39%	0.39%	-0.39%	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%
DAISY12	-1.68%	-1.68%	-1.68%	-1.68%	1.68%	-1.68%	-1.68%	1.68%	-1.68%
DAISY05	0.38%	-0.38%	-0.38%	-0.38%	0.38%	0.38%	0.38%	-0.38%	0.38%
DAISY13	-0.15%	-0.15%	0.15%	0.15%	-0.15%	0.15%	0.15%	-0.15%	-0.15%
DAISY01	1.17%	-1.17%	1.17%	-1.17%	1.17%	-1.17%	1.17%	-1.17%	-1.17%
DAISY09	0.71%	0.71%	0.71%	-0.71%	0.71%	0.71%	-0.71%	0.71%	-0.71%
DAISY07	0.81%	-0.81%	-0.81%	0.81%	0.81%	0.81%	-0.81%	-0.81%	-0.81%
DAISY15	0.34%	0.34%	-0.34%	0.34%	0.34%	-0.34%	0.34%	0.34%	-0.34%
DAISY03	0.10%	-0.10%	0.10%	0.10%	0.10%	-0.10%	-0.10%	-0.10%	0.10%
DAISY11	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%
	Contrast	-7.58%	-2.50%	-9.31%	-1.29%	1.86%	7.83%	6.52%	-2.06%
	Effect	-0.95%	-0.31%	-1.16%	-0.16%	0.23%	0.98%	0.81%	-0.26%

		24	34	123	124	134	234	1234
DAISY06	4.70%	4.70%	4.70%	-4.70%	-4.70%	-4.70%	-4.70%	4.70%
DAISY14	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	-0.03%	-0.03%
DAISY02	2.45%	-2.45%	2.45%	2.45%	2.45%	-2.45%	2.45%	-2.45%
DAISY10	0.41%	-0.41%	0.41%	-0.41%	-0.41%	0.41%	0.41%	0.41%
DAISY08	-0.39%	-0.39%	0.39%	-0.39%	0.39%	-0.39%	-0.39%	0.39%
DAISY16	0.57%	0.57%	-0.57%	-0.57%	0.57%	-0.57%	0.57%	0.57%
DAISY04	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%	0.39%	-0.39%
DAISY12	-1.68%	1.68%	1.68%	-1.68%	1.68%	1.68%	1.68%	1.68%
DAISY05	0.38%	-0.38%	-0.38%	-0.38%	0.38%	0.38%	0.38%	-0.38%
DAISY13	-0.15%	0.15%	0.15%	-0.15%	0.15%	0.15%	-0.15%	-0.15%
DAISY01	1.17%	1.17%	-1.17%	1.17%	-1.17%	1.17%	-1.17%	1.17%
DAISY09	0.71%	0.71%	-0.71%	-0.71%	0.71%	-0.71%	-0.71%	-0.71%
DAISY07	0.81%	-0.81%	0.81%	0.81%	0.81%	-0.81%	-0.81%	0.81%
DAISY15	0.34%	-0.34%	0.34%	-0.34%	-0.34%	0.34%	-0.34%	-0.34%
DAISY03	0.10%	0.10%	0.10%	-0.10%	-0.10%	-0.10%	0.10%	-0.10%
DAISY11	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%	1.03%
	Contrast	5.75%	9.65%	-3.56%	1.08%	-4.93%	-1.31%	6.20%
	Effect	0.72%	1.21%	-0.44%	0.13%	-0.62%	-0.16%	0.77%

Table F-1-5: TCB 1016th cycle.

		1	2	3	4	12	13	14	23
DAISY06	3.02%	-3.02%	-3.02%	-3.02%	-3.02%	3.02%	3.02%	3.02%	3.02%
DAISY14	0.68%	0.68%	-0.68%	-0.68%	-0.68%	-0.68%	-0.68%	-0.68%	0.68%
DAISY02	3.17%	-3.17%	3.17%	-3.17%	-3.17%	-3.17%	3.17%	3.17%	-3.17%
DAISY10	1.35%	1.35%	1.35%	-1.35%	-1.35%	1.35%	-1.35%	-1.35%	-1.35%
DAISY08	-0.08%	0.08%	0.08%	-0.08%	0.08%	-0.08%	0.08%	-0.08%	0.08%
DAISY16	0.63%	0.63%	-0.63%	0.63%	-0.63%	-0.63%	0.63%	-0.63%	-0.63%
DAISY04	-0.19%	0.19%	-0.19%	-0.19%	0.19%	0.19%	0.19%	-0.19%	-0.19%
DAISY12	-1.87%	-1.87%	-1.87%	-1.87%	1.87%	-1.87%	-1.87%	1.87%	-1.87%
DAISY05	-0.45%	0.45%	0.45%	0.45%	-0.45%	-0.45%	-0.45%	0.45%	-0.45%
DAISY13	-0.33%	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	-0.33%
DAISY01	5.81%	-5.81%	5.81%	-5.81%	5.81%	-5.81%	5.81%	-5.81%	-5.81%
DAISY09	1.18%	1.18%	1.18%	-1.18%	1.18%	1.18%	-1.18%	1.18%	-1.18%
DAISY07	1.30%	-1.30%	-1.30%	1.30%	1.30%	1.30%	-1.30%	-1.30%	-1.30%
DAISY15	2.39%	2.39%	-2.39%	2.39%	2.39%	-2.39%	2.39%	2.39%	-2.39%
DAISY03	0.50%	-0.50%	0.50%	0.50%	0.50%	-0.50%	-0.50%	-0.50%	0.50%
DAISY11	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%
	Contrast	-7.21%	4.63%	-9.90%	5.55%	-6.37%	10.14%	3.04%	-12.54%
	Effect	-0.90%	0.58%	-1.24%	0.69%	-0.80%	1.27%	0.38%	-1.57%

		24	34	123	124	134	234	1234
DAISY06	3.02%	3.02%	3.02%	-3.02%	-3.02%	-3.02%	-3.02%	3.02%
DAISY14	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%	-0.68%	-0.68%
DAISY02	3.17%	-3.17%	3.17%	3.17%	3.17%	-3.17%	3.17%	-3.17%
DAISY10	1.35%	-1.35%	1.35%	-1.35%	-1.35%	1.35%	1.35%	1.35%
DAISY08	-0.08%	-0.08%	0.08%	-0.08%	0.08%	-0.08%	-0.08%	0.08%
DAISY16	0.63%	0.63%	-0.63%	-0.63%	0.63%	-0.63%	0.63%	0.63%
DAISY04	-0.19%	0.19%	0.19%	0.19%	-0.19%	-0.19%	0.19%	-0.19%
DAISY12	-1.87%	1.87%	1.87%	-1.87%	1.87%	1.87%	1.87%	1.87%
DAISY05	-0.45%	0.45%	0.45%	0.45%	-0.45%	-0.45%	-0.45%	0.45%
DAISY13	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	-0.33%
DAISY01	5.81%	5.81%	-5.81%	5.81%	-5.81%	5.81%	-5.81%	5.81%
DAISY09	1.18%	1.18%	-1.18%	-1.18%	1.18%	-1.18%	-1.18%	-1.18%
DAISY07	1.30%	-1.30%	1.30%	1.30%	1.30%	-1.30%	-1.30%	1.30%
DAISY15	2.39%	-2.39%	2.39%	-2.39%	-2.39%	2.39%	-2.39%	-2.39%
DAISY03	0.50%	0.50%	0.50%	-0.50%	-0.50%	-0.50%	0.50%	-0.50%
DAISY11	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%	1.84%
	Contrast	8.19%	9.55%	2.09%	-2.64%	3.76%	-5.70%	7.93%
	Effect	1.02%	1.19%	0.26%	-0.33%	0.47%	-0.71%	0.99%

Table F-1-6: TCB 1200th cycle.

		1	2	3	4	12	13	14	23
DAISY06	4.74%	-4.74%	-4.74%	-4.74%	-4.74%	4.74%	4.74%	4.74%	4.74%
DAISY14	-0.11%	-0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	-0.11%
DAISY02	3.13%	-3.13%	3.13%	-3.13%	-3.13%	-3.13%	3.13%	3.13%	-3.13%
DAISY10	0.43%	0.43%	0.43%	-0.43%	-0.43%	0.43%	-0.43%	-0.43%	-0.43%
DAISY08	0.47%	-0.47%	-0.47%	0.47%	-0.47%	0.47%	-0.47%	0.47%	-0.47%
DAISY16	0.28%	0.28%	-0.28%	0.28%	-0.28%	-0.28%	0.28%	-0.28%	-0.28%
DAISY04	-0.31%	0.31%	-0.31%	-0.31%	0.31%	0.31%	0.31%	-0.31%	-0.31%
DAISY12	-1.24%	-1.24%	-1.24%	-1.24%	1.24%	-1.24%	-1.24%	1.24%	-1.24%
DAISY05	-0.50%	0.50%	0.50%	0.50%	-0.50%	-0.50%	-0.50%	0.50%	-0.50%
DAISY13	-0.10%	-0.10%	0.10%	0.10%	-0.10%	0.10%	0.10%	-0.10%	-0.10%
DAISY01	2.14%	-2.14%	2.14%	-2.14%	2.14%	-2.14%	2.14%	-2.14%	-2.14%
DAISY09	1.43%	1.43%	1.43%	-1.43%	1.43%	1.43%	-1.43%	1.43%	-1.43%
DAISY07	1.58%	-1.58%	-1.58%	1.58%	1.58%	1.58%	-1.58%	-1.58%	-1.58%
DAISY15	0.41%	0.41%	-0.41%	0.41%	0.41%	-0.41%	0.41%	0.41%	-0.41%
DAISY03	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY11	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
	Contrast	-9.47%	-0.49%	-9.27%	-1.73%	2.17%	6.27%	7.90%	-6.67%
	Effect	-1.18%	-0.06%	-1.16%	-0.22%	0.27%	0.78%	0.99%	-0.83%

		24	34	123	124	134	234	1234
DAISY06	4.74%	4.74%	4.74%	-4.74%	-4.74%	-4.74%	-4.74%	4.74%
DAISY14	-0.11%	-0.11%	-0.11%	-0.11%	-0.11%	-0.11%	0.11%	0.11%
DAISY02	3.13%	-3.13%	3.13%	3.13%	3.13%	-3.13%	3.13%	-3.13%
DAISY10	0.43%	-0.43%	0.43%	-0.43%	-0.43%	0.43%	0.43%	0.43%
DAISY08	0.47%	0.47%	-0.47%	0.47%	-0.47%	0.47%	0.47%	-0.47%
DAISY16	0.28%	0.28%	-0.28%	-0.28%	0.28%	-0.28%	0.28%	0.28%
DAISY04	-0.31%	0.31%	0.31%	0.31%	-0.31%	-0.31%	0.31%	-0.31%
DAISY12	-1.24%	1.24%	1.24%	-1.24%	1.24%	1.24%	1.24%	1.24%
DAISY05	-0.50%	0.50%	0.50%	0.50%	-0.50%	-0.50%	-0.50%	0.50%
DAISY13	-0.10%	0.10%	0.10%	-0.10%	0.10%	0.10%	-0.10%	-0.10%
DAISY01	2.14%	2.14%	-2.14%	2.14%	-2.14%	2.14%	-2.14%	2.14%
DAISY09	1.43%	1.43%	-1.43%	-1.43%	1.43%	-1.43%	-1.43%	-1.43%
DAISY07	1.58%	-1.58%	1.58%	1.58%	1.58%	-1.58%	-1.58%	1.58%
DAISY15	0.41%	-0.41%	0.41%	-0.41%	-0.41%	0.41%	-0.41%	-0.41%
DAISY03	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY11	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
	Contrast	6.24%	8.74%	0.08%	-0.63%	-6.59%	-4.23%	5.86%
	Effect	0.78%	1.09%	0.01%	-0.08%	-0.82%	-0.53%	0.73%

Table F-1-7: TCB 1492nd cycle.

		1	2	3	4	12	13	14	23
DAISY06	5.09%	-5.09%	-5.09%	-5.09%	-5.09%	5.09%	5.09%	5.09%	5.09%
DAISY14	-0.12%	-0.12%	0.12%	0.12%	0.12%	0.12%	0.12%	0.12%	-0.12%
DAISY02	2.19%	-2.19%	2.19%	-2.19%	-2.19%	-2.19%	2.19%	2.19%	-2.19%
DAISY10	0.52%	0.52%	0.52%	-0.52%	-0.52%	0.52%	-0.52%	-0.52%	-0.52%
DAISY08	0.42%	-0.42%	-0.42%	0.42%	-0.42%	0.42%	-0.42%	0.42%	-0.42%
DAISY16	-0.13%	-0.13%	0.13%	-0.13%	0.13%	0.13%	-0.13%	0.13%	0.13%
DAISY04	-0.39%	0.39%	-0.39%	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%
DAISY12	-1.71%	-1.71%	-1.71%	-1.71%	1.71%	-1.71%	-1.71%	1.71%	-1.71%
DAISY05	-0.74%	0.74%	0.74%	0.74%	-0.74%	-0.74%	-0.74%	0.74%	-0.74%
DAISY13	-0.33%	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	-0.33%
DAISY01	0.33%	-0.33%	0.33%	-0.33%	0.33%	-0.33%	0.33%	-0.33%	-0.33%
DAISY09	0.65%	0.65%	0.65%	-0.65%	0.65%	0.65%	-0.65%	0.65%	-0.65%
DAISY07	1.57%	-1.57%	-1.57%	1.57%	1.57%	1.57%	-1.57%	-1.57%	-1.57%
DAISY15	0.08%	0.08%	-0.08%	0.08%	0.08%	-0.08%	0.08%	0.08%	-0.08%
DAISY03	-0.16%	0.16%	-0.16%	-0.16%	-0.16%	0.16%	0.16%	0.16%	-0.16%
DAISY11	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%
	Contrast	-8.83%	-3.90%	-7.39%	-3.96%	4.83%	3.48%	8.66%	-3.47%
	Effect	-1.10%	-0.49%	-0.92%	-0.50%	0.60%	0.43%	1.08%	-0.43%

		24	34	123	124	134	234	1234
DAISY06	5.09%	5.09%	5.09%	-5.09%	-5.09%	-5.09%	-5.09%	5.09%
DAISY14	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	0.12%	0.12%
DAISY02	2.19%	-2.19%	2.19%	2.19%	2.19%	-2.19%	2.19%	-2.19%
DAISY10	0.52%	-0.52%	0.52%	-0.52%	-0.52%	0.52%	0.52%	0.52%
DAISY08	0.42%	0.42%	-0.42%	0.42%	-0.42%	0.42%	0.42%	-0.42%
DAISY16	-0.13%	-0.13%	0.13%	0.13%	-0.13%	0.13%	-0.13%	-0.13%
DAISY04	-0.39%	0.39%	0.39%	0.39%	-0.39%	-0.39%	0.39%	-0.39%
DAISY12	-1.71%	1.71%	1.71%	-1.71%	1.71%	1.71%	1.71%	1.71%
DAISY05	-0.74%	0.74%	0.74%	0.74%	-0.74%	-0.74%	-0.74%	0.74%
DAISY13	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	-0.33%
DAISY01	0.33%	0.33%	-0.33%	0.33%	-0.33%	0.33%	-0.33%	0.33%
DAISY09	0.65%	0.65%	-0.65%	-0.65%	0.65%	-0.65%	-0.65%	-0.65%
DAISY07	1.57%	-1.57%	1.57%	1.57%	1.57%	-1.57%	-1.57%	1.57%
DAISY15	0.08%	-0.08%	0.08%	-0.08%	-0.08%	0.08%	-0.08%	-0.08%
DAISY03	-0.16%	-0.16%	-0.16%	0.16%	0.16%	0.16%	-0.16%	0.16%
DAISY11	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%
	Contrast	5.42%	11.60%	-2.06%	-0.68%	-6.57%	-3.23%	6.55%
	Effect	0.68%	1.45%	-0.26%	-0.08%	-0.82%	-0.40%	0.82%

Table F-1-8: TCB 1724th cycle.

		1	2	3	4	12	13	14	23
DAISY06	5.36%	-5.36%	-5.36%	-5.36%	-5.36%	5.36%	5.36%	5.36%	5.36%
DAISY14	0.74%	0.74%	-0.74%	-0.74%	-0.74%	-0.74%	-0.74%	-0.74%	0.74%
DAISY02	2.87%	-2.87%	2.87%	-2.87%	-2.87%	-2.87%	2.87%	2.87%	-2.87%
DAISY10	0.14%	0.14%	0.14%	-0.14%	-0.14%	0.14%	-0.14%	-0.14%	-0.14%
DAISY08	-0.61%	0.61%	0.61%	-0.61%	0.61%	-0.61%	0.61%	-0.61%	0.61%
DAISY16	0.14%	0.14%	-0.14%	0.14%	-0.14%	-0.14%	0.14%	-0.14%	-0.14%
DAISY04	0.54%	-0.54%	0.54%	0.54%	-0.54%	-0.54%	-0.54%	0.54%	0.54%
DAISY12	-1.33%	-1.33%	-1.33%	-1.33%	1.33%	-1.33%	-1.33%	1.33%	-1.33%
DAISY05	0.79%	-0.79%	-0.79%	-0.79%	0.79%	0.79%	0.79%	-0.79%	0.79%
DAISY13	0.08%	0.08%	-0.08%	-0.08%	0.08%	-0.08%	-0.08%	0.08%	0.08%
DAISY01	3.69%	-3.69%	3.69%	-3.69%	3.69%	-3.69%	3.69%	-3.69%	-3.69%
DAISY09	1.26%	1.26%	1.26%	-1.26%	1.26%	1.26%	-1.26%	1.26%	-1.26%
DAISY07	2.41%	-2.41%	-2.41%	2.41%	2.41%	2.41%	-2.41%	-2.41%	-2.41%
DAISY15	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	-0.33%
DAISY03	0.67%	-0.67%	0.67%	0.67%	0.67%	-0.67%	-0.67%	-0.67%	0.67%
DAISY11	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%
	Contrast	-13.53%	-0.57%	-11.98%	2.21%	-0.24%	7.44%	3.41%	-2.57%
	Effect	-1.69%	-0.07%	-1.50%	0.28%	-0.03%	0.93%	0.43%	-0.32%

		24	34	123	124	134	234	1234
DAISY06	5.36%	5.36%	5.36%	-5.36%	-5.36%	-5.36%	-5.36%	5.36%
DAISY14	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	-0.74%	-0.74%
DAISY02	2.87%	-2.87%	2.87%	2.87%	2.87%	-2.87%	2.87%	-2.87%
DAISY10	0.14%	-0.14%	0.14%	-0.14%	-0.14%	0.14%	0.14%	0.14%
DAISY08	-0.61%	-0.61%	0.61%	-0.61%	0.61%	-0.61%	-0.61%	0.61%
DAISY16	0.14%	0.14%	-0.14%	-0.14%	0.14%	-0.14%	0.14%	0.14%
DAISY04	0.54%	-0.54%	-0.54%	-0.54%	0.54%	0.54%	-0.54%	0.54%
DAISY12	-1.33%	1.33%	1.33%	-1.33%	1.33%	1.33%	1.33%	1.33%
DAISY05	0.79%	-0.79%	-0.79%	-0.79%	0.79%	0.79%	0.79%	-0.79%
DAISY13	0.08%	-0.08%	-0.08%	0.08%	-0.08%	-0.08%	0.08%	0.08%
DAISY01	3.69%	3.69%	-3.69%	3.69%	-3.69%	3.69%	-3.69%	3.69%
DAISY09	1.26%	1.26%	-1.26%	-1.26%	1.26%	-1.26%	-1.26%	-1.26%
DAISY07	2.41%	-2.41%	2.41%	2.41%	2.41%	-2.41%	-2.41%	2.41%
DAISY15	0.33%	-0.33%	0.33%	-0.33%	-0.33%	0.33%	-0.33%	-0.33%
DAISY03	0.67%	0.67%	0.67%	-0.67%	-0.67%	-0.67%	0.67%	-0.67%
DAISY11	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%	0.82%
	Contrast	6.24%	8.79%	-0.57%	1.24%	-5.03%	-8.10%	8.45%
	Effect	0.78%	1.10%	-0.07%	0.15%	-0.63%	-1.01%	1.06%

Table F-1-9: TCB 2012th cycle.

		1	2	3	4	12	13	14	23
DAISY06	5.47%	-5.47%	-5.47%	-5.47%	-5.47%	5.47%	5.47%	5.47%	5.47%
DAISY14	0.03%	0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	0.03%
DAISY02	2.94%	-2.94%	2.94%	-2.94%	-2.94%	-2.94%	2.94%	2.94%	-2.94%
DAISY10	1.43%	1.43%	1.43%	-1.43%	-1.43%	1.43%	-1.43%	-1.43%	-1.43%
DAISY08	0.08%	-0.08%	-0.08%	0.08%	-0.08%	0.08%	-0.08%	0.08%	-0.08%
DAISY16	-0.20%	-0.20%	0.20%	-0.20%	0.20%	0.20%	-0.20%	0.20%	0.20%
DAISY04	-0.20%	0.20%	-0.20%	-0.20%	0.20%	0.20%	0.20%	-0.20%	-0.20%
DAISY12	-1.85%	-1.85%	-1.85%	-1.85%	1.85%	-1.85%	-1.85%	1.85%	-1.85%
DAISY05	0.13%	-0.13%	-0.13%	-0.13%	0.13%	0.13%	0.13%	-0.13%	0.13%
DAISY13	-0.64%	-0.64%	0.64%	0.64%	-0.64%	0.64%	0.64%	-0.64%	-0.64%
DAISY01	3.07%	-3.07%	3.07%	-3.07%	3.07%	-3.07%	3.07%	-3.07%	-3.07%
DAISY09	1.07%	1.07%	1.07%	-1.07%	1.07%	1.07%	-1.07%	1.07%	-1.07%
DAISY07	1.50%	-1.50%	-1.50%	1.50%	1.50%	1.50%	-1.50%	-1.50%	-1.50%
DAISY15	0.36%	0.36%	-0.36%	0.36%	0.36%	-0.36%	0.36%	0.36%	-0.36%
DAISY03	0.28%	-0.28%	0.28%	0.28%	0.28%	-0.28%	-0.28%	-0.28%	0.28%
DAISY11	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%
	Contrast	-11.90%	1.20%	-12.35%	-0.77%	3.35%	7.54%	5.88%	-5.87%
	Effect	-1.49%	0.15%	-1.54%	-0.10%	0.42%	0.94%	0.73%	-0.73%

		24	34	123	124	134	234	1234
DAISY06	5.47%	5.47%	5.47%	-5.47%	-5.47%	-5.47%	-5.47%	5.47%
DAISY14	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	-0.03%	-0.03%
DAISY02	2.94%	-2.94%	2.94%	2.94%	2.94%	-2.94%	2.94%	-2.94%
DAISY10	1.43%	-1.43%	1.43%	-1.43%	-1.43%	1.43%	1.43%	1.43%
DAISY08	0.08%	0.08%	-0.08%	0.08%	-0.08%	0.08%	0.08%	-0.08%
DAISY16	-0.20%	-0.20%	0.20%	0.20%	-0.20%	0.20%	-0.20%	-0.20%
DAISY04	-0.20%	0.20%	0.20%	0.20%	-0.20%	-0.20%	0.20%	-0.20%
DAISY12	-1.85%	1.85%	1.85%	-1.85%	1.85%	1.85%	1.85%	1.85%
DAISY05	0.13%	-0.13%	-0.13%	-0.13%	0.13%	0.13%	0.13%	-0.13%
DAISY13	-0.64%	0.64%	0.64%	-0.64%	0.64%	0.64%	-0.64%	-0.64%
DAISY01	3.07%	3.07%	-3.07%	3.07%	-3.07%	3.07%	-3.07%	3.07%
DAISY09	1.07%	1.07%	-1.07%	-1.07%	1.07%	-1.07%	-1.07%	-1.07%
DAISY07	1.50%	-1.50%	1.50%	1.50%	1.50%	-1.50%	-1.50%	1.50%
DAISY15	0.36%	-0.36%	0.36%	-0.36%	-0.36%	0.36%	-0.36%	-0.36%
DAISY03	0.28%	0.28%	0.28%	-0.28%	-0.28%	-0.28%	0.28%	-0.28%
DAISY11	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%	1.17%
	Contrast	7.32%	11.74%	-2.04%	-1.76%	-2.48%	-4.24%	8.54%
	Effect	0.92%	1.47%	-0.26%	-0.22%	-0.31%	-0.53%	1.07%

Table F-1-10: TCC 100th cycle.

		1	2	3	4	12	13	14	23	24
DAISY06	5.63%	-5.63%	-5.63%	-5.63%	-5.63%	5.63%	5.63%	5.63%	5.63%	5.63%
DAISY14	0.49%	0.49%	-0.49%	-0.49%	-0.49%	-0.49%	-0.49%	-0.49%	0.49%	0.49%
DAISY02	2.40%	-2.40%	2.40%	-2.40%	-2.40%	-2.40%	2.40%	2.40%	-2.40%	-2.40%
DAISY10	0.11%	0.11%	0.11%	-0.11%	-0.11%	0.11%	-0.11%	-0.11%	-0.11%	-0.11%
DAISY08	-0.81%	0.81%	0.81%	-0.81%	0.81%	-0.81%	0.81%	-0.81%	0.81%	-0.81%
DAISY16	-0.24%	-0.24%	0.24%	-0.24%	0.24%	0.24%	-0.24%	0.24%	0.24%	-0.24%
DAISY04	-0.01%	0.01%	-0.01%	-0.01%	0.01%	0.01%	0.01%	-0.01%	-0.01%	0.01%
DAISY12	-2.01%	-2.01%	-2.01%	-2.01%	2.01%	-2.01%	-2.01%	2.01%	-2.01%	2.01%
DAISY05	-0.02%	0.02%	0.02%	0.02%	-0.02%	-0.02%	-0.02%	0.02%	-0.02%	0.02%
DAISY13	-0.72%	-0.72%	0.72%	0.72%	-0.72%	0.72%	0.72%	-0.72%	-0.72%	0.72%
DAISY01	1.07%	-1.07%	1.07%	-1.07%	1.07%	-1.07%	1.07%	-1.07%	-1.07%	1.07%
DAISY09	0.50%	0.50%	0.50%	-0.50%	0.50%	0.50%	-0.50%	0.50%	-0.50%	0.50%
DAISY07	1.14%	-1.14%	-1.14%	1.14%	1.14%	1.14%	-1.14%	-1.14%	-1.14%	-1.14%
DAISY15	0.07%	0.07%	-0.07%	0.07%	0.07%	-0.07%	0.07%	0.07%	-0.07%	-0.07%
DAISY03	0.24%	-0.24%	0.24%	0.24%	0.24%	-0.24%	-0.24%	-0.24%	0.24%	0.24%
DAISY11	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%
	Contrast	-10.43%	-2.21%	-10.07%	-2.26%	2.26%	6.96%	7.28%	0.37%	6.92%
	Effect	-1.30%	-0.28%	-1.26%	-0.28%	0.28%	0.87%	0.91%	0.05%	0.86%

		24	34	123	124	134	234	1234
DAISY06	5.63%	5.63%	5.63%	-5.63%	-5.63%	-5.63%	-5.63%	5.63%
DAISY14	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	-0.49%	-0.49%
DAISY02	2.40%	-2.40%	2.40%	2.40%	2.40%	-2.40%	2.40%	-2.40%
DAISY10	0.11%	-0.11%	0.11%	-0.11%	-0.11%	0.11%	0.11%	0.11%
DAISY08	-0.81%	-0.81%	0.81%	-0.81%	0.81%	-0.81%	-0.81%	0.81%
DAISY16	-0.24%	-0.24%	0.24%	0.24%	-0.24%	0.24%	-0.24%	-0.24%
DAISY04	-0.01%	0.01%	0.01%	0.01%	-0.01%	-0.01%	0.01%	-0.01%
DAISY12	-2.01%	2.01%	2.01%	-2.01%	2.01%	2.01%	2.01%	2.01%
DAISY05	-0.02%	0.02%	0.02%	0.02%	-0.02%	-0.02%	-0.02%	0.02%
DAISY13	-0.72%	0.72%	0.72%	-0.72%	0.72%	0.72%	-0.72%	-0.72%
DAISY01	1.07%	1.07%	-1.07%	1.07%	-1.07%	1.07%	-1.07%	1.07%
DAISY09	0.50%	0.50%	-0.50%	-0.50%	0.50%	-0.50%	-0.50%	-0.50%
DAISY07	1.14%	-1.14%	1.14%	1.14%	1.14%	-1.14%	-1.14%	1.14%
DAISY15	0.07%	-0.07%	0.07%	-0.07%	-0.07%	0.07%	-0.07%	-0.07%
DAISY03	0.24%	0.24%	0.24%	-0.24%	-0.24%	-0.24%	0.24%	-0.24%
DAISY11	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%	1.01%
	Contrast	6.92%	13.34%	-3.70%	1.69%	-5.03%	-4.91%	7.15%
	Effect	0.86%	1.67%	-0.46%	0.21%	-0.63%	-0.61%	0.89%

Table F-1-11: TCC 200th cycle.

		1	2	3	4	12	13	14	23
DAISY06	8.06%	-8.06%	-8.06%	-8.06%	-8.06%	8.06%	8.06%	8.06%	8.06%
DAISY14	-0.27%	-0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	-0.27%
DAISY02	2.58%	-2.58%	2.58%	-2.58%	-2.58%	-2.58%	2.58%	2.58%	-2.58%
DAISY10	-0.04%	-0.04%	-0.04%	0.04%	0.04%	-0.04%	0.04%	0.04%	0.04%
DAISY08	-0.31%	0.31%	0.31%	-0.31%	0.31%	-0.31%	0.31%	-0.31%	0.31%
DAISY16	-0.52%	-0.52%	0.52%	-0.52%	0.52%	0.52%	-0.52%	0.52%	0.52%
DAISY04	0.07%	-0.07%	0.07%	0.07%	-0.07%	-0.07%	-0.07%	0.07%	0.07%
DAISY12	-1.63%	-1.63%	-1.63%	-1.63%	1.63%	-1.63%	-1.63%	1.63%	-1.63%
DAISY05	-0.92%	0.92%	0.92%	0.92%	-0.92%	-0.92%	-0.92%	0.92%	-0.92%
DAISY13	-1.22%	-1.22%	1.22%	1.22%	-1.22%	1.22%	1.22%	-1.22%	-1.22%
DAISY01	1.77%	-1.77%	1.77%	-1.77%	1.77%	-1.77%	1.77%	-1.77%	-1.77%
DAISY09	0.45%	0.45%	0.45%	-0.45%	0.45%	0.45%	-0.45%	0.45%	-0.45%
DAISY07	1.29%	-1.29%	-1.29%	1.29%	1.29%	1.29%	-1.29%	-1.29%	-1.29%
DAISY15	1.35%	1.35%	-1.35%	1.35%	1.35%	-1.35%	1.35%	1.35%	-1.35%
DAISY03	0.26%	-0.26%	0.26%	0.26%	0.26%	-0.26%	-0.26%	-0.26%	0.26%
DAISY11	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%
	Contrast	-14.42%	-3.74%	-9.65%	-4.70%	3.14%	10.73%	11.32%	-1.96%
	Effect	-1.80%	-0.47%	-1.21%	-0.59%	0.39%	1.34%	1.41%	-0.24%

		24	34	123	124	134	234	1234
DAISY06	8.06%	8.06%	8.06%	-8.06%	-8.06%	-8.06%	-8.06%	8.06%
DAISY14	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	0.27%	0.27%
DAISY02	2.58%	-2.58%	2.58%	2.58%	2.58%	-2.58%	2.58%	-2.58%
DAISY10	-0.04%	0.04%	-0.04%	0.04%	0.04%	-0.04%	-0.04%	-0.04%
DAISY08	-0.31%	-0.31%	0.31%	-0.31%	0.31%	-0.31%	-0.31%	0.31%
DAISY16	-0.52%	-0.52%	0.52%	0.52%	-0.52%	0.52%	-0.52%	-0.52%
DAISY04	0.07%	-0.07%	-0.07%	-0.07%	0.07%	0.07%	-0.07%	0.07%
DAISY12	-1.63%	1.63%	1.63%	-1.63%	1.63%	1.63%	1.63%	1.63%
DAISY05	-0.92%	0.92%	0.92%	0.92%	-0.92%	-0.92%	-0.92%	0.92%
DAISY13	-1.22%	1.22%	1.22%	-1.22%	1.22%	1.22%	-1.22%	-1.22%
DAISY01	1.77%	1.77%	-1.77%	1.77%	-1.77%	1.77%	-1.77%	1.77%
DAISY09	0.45%	0.45%	-0.45%	-0.45%	0.45%	-0.45%	-0.45%	-0.45%
DAISY07	1.29%	-1.29%	1.29%	1.29%	1.29%	-1.29%	-1.29%	1.29%
DAISY15	1.35%	-1.35%	1.35%	-1.35%	-1.35%	1.35%	-1.35%	-1.35%
DAISY03	0.26%	0.26%	0.26%	-0.26%	-0.26%	-0.26%	0.26%	-0.26%
DAISY11	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%
	Contrast	8.24%	15.77%	-6.23%	-5.29%	-7.34%	-11.01%	8.17%
	Effect	1.03%	1.97%	-0.78%	-0.66%	-0.92%	-1.38%	1.02%

Table F-1-12: TCC 300th cycle.

		1	2	3	4	12	13	14	23
DAISY06	8.65%	-8.65%	-8.65%	-8.65%	-8.65%	8.65%	8.65%	8.65%	8.65%
DAISY14	2.88%	2.88%	-2.88%	-2.88%	-2.88%	-2.88%	-2.88%	-2.88%	2.88%
DAISY02	3.75%	-3.75%	3.75%	-3.75%	-3.75%	-3.75%	3.75%	3.75%	-3.75%
DAISY10	2.02%	2.02%	2.02%	-2.02%	-2.02%	2.02%	-2.02%	-2.02%	-2.02%
DAISY08	1.95%	-1.95%	-1.95%	1.95%	-1.95%	1.95%	-1.95%	1.95%	-1.95%
DAISY16	0.75%	0.75%	-0.75%	0.75%	-0.75%	-0.75%	0.75%	-0.75%	-0.75%
DAISY04	1.25%	-1.25%	1.25%	1.25%	-1.25%	-1.25%	-1.25%	1.25%	1.25%
DAISY12	-1.69%	-1.69%	-1.69%	-1.69%	1.69%	-1.69%	-1.69%	1.69%	-1.69%
DAISY05	0.62%	-0.62%	-0.62%	-0.62%	0.62%	0.62%	0.62%	-0.62%	0.62%
DAISY13	0.28%	0.28%	-0.28%	-0.28%	0.28%	-0.28%	-0.28%	0.28%	0.28%
DAISY01	6.68%	-6.68%	6.68%	-6.68%	6.68%	-6.68%	6.68%	-6.68%	-6.68%
DAISY09	2.71%	2.71%	2.71%	-2.71%	2.71%	2.71%	-2.71%	2.71%	-2.71%
DAISY07	3.59%	-3.59%	-3.59%	3.59%	3.59%	3.59%	-3.59%	-3.59%	-3.59%
DAISY15	2.07%	2.07%	-2.07%	2.07%	2.07%	-2.07%	2.07%	2.07%	-2.07%
DAISY03	1.60%	-1.60%	1.60%	1.60%	1.60%	-1.60%	-1.60%	-1.60%	1.60%
DAISY11	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%
	Contrast	-17.84%	-3.27%	-16.83%	-0.79%	-0.18%	5.77%	5.45%	-8.70%
	Effect	-2.23%	-0.41%	-2.10%	-0.10%	-0.02%	0.72%	0.68%	-1.09%

		24	34	123	124	134	234	1234
DAISY06	8.65%	8.65%	8.65%	-8.65%	-8.65%	-8.65%	-8.65%	8.65%
DAISY14	2.88%	2.88%	2.88%	2.88%	2.88%	2.88%	-2.88%	-2.88%
DAISY02	3.75%	-3.75%	3.75%	3.75%	3.75%	-3.75%	3.75%	-3.75%
DAISY10	2.02%	-2.02%	2.02%	-2.02%	-2.02%	2.02%	2.02%	2.02%
DAISY08	1.95%	1.95%	-1.95%	1.95%	-1.95%	1.95%	1.95%	-1.95%
DAISY16	0.75%	0.75%	-0.75%	-0.75%	0.75%	-0.75%	0.75%	0.75%
DAISY04	1.25%	-1.25%	-1.25%	-1.25%	1.25%	1.25%	-1.25%	1.25%
DAISY12	-1.69%	1.69%	1.69%	-1.69%	1.69%	1.69%	1.69%	1.69%
DAISY05	0.62%	-0.62%	-0.62%	-0.62%	0.62%	0.62%	0.62%	-0.62%
DAISY13	0.28%	-0.28%	-0.28%	0.28%	-0.28%	-0.28%	0.28%	0.28%
DAISY01	6.68%	6.68%	-6.68%	6.68%	-6.68%	6.68%	-6.68%	6.68%
DAISY09	2.71%	2.71%	-2.71%	-2.71%	2.71%	-2.71%	-2.71%	-2.71%
DAISY07	3.59%	-3.59%	3.59%	3.59%	3.59%	-3.59%	-3.59%	3.59%
DAISY15	2.07%	-2.07%	2.07%	-2.07%	-2.07%	2.07%	-2.07%	-2.07%
DAISY03	1.60%	1.60%	1.60%	-1.60%	-1.60%	-1.60%	1.60%	-1.60%
DAISY11	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%	1.23%
	Contrast	14.57%	13.25%	-1.00%	-4.77%	-0.92%	-13.94%	10.58%
	Effect	1.82%	1.66%	-0.13%	-0.60%	-0.12%	-1.74%	1.32%

Table F-1-13: TCC 400th cycle.

		1	2	3	4	12	13	14	23
DAISY06	19.56%	-19.56%	-19.56%	-19.56%	-19.56%	19.56%	19.56%	19.56%	19.56%
DAISY14	-5.45%	-5.45%	5.45%	5.45%	5.45%	5.45%	5.45%	5.45%	-5.45%
DAISY02	4.77%	-4.77%	4.77%	-4.77%	-4.77%	-4.77%	4.77%	4.77%	-4.77%
DAISY10	1.03%	1.03%	1.03%	-1.03%	-1.03%	1.03%	-1.03%	-1.03%	-1.03%
DAISY08	8.33%	-8.33%	-8.33%	8.33%	-8.33%	8.33%	-8.33%	8.33%	-8.33%
DAISY16	1.27%	1.27%	-1.27%	1.27%	-1.27%	-1.27%	1.27%	-1.27%	-1.27%
DAISY04	16.81%	-16.81%	16.81%	16.81%	-16.81%	-16.81%	-16.81%	16.81%	16.81%
DAISY12	-0.33%	-0.33%	-0.33%	-0.33%	0.33%	-0.33%	-0.33%	0.33%	-0.33%
DAISY05	-0.15%	0.15%	0.15%	0.15%	-0.15%	-0.15%	-0.15%	0.15%	-0.15%
DAISY13	0.32%	0.32%	-0.32%	-0.32%	0.32%	-0.32%	-0.32%	0.32%	0.32%
DAISY01	3.44%	-3.44%	3.44%	-3.44%	3.44%	-3.44%	3.44%	-3.44%	-3.44%
DAISY09	-0.61%	-0.61%	-0.61%	0.61%	-0.61%	-0.61%	0.61%	-0.61%	0.61%
DAISY07	1.83%	-1.83%	-1.83%	1.83%	1.83%	1.83%	-1.83%	-1.83%	-1.83%
DAISY15	2.55%	2.55%	-2.55%	2.55%	2.55%	-2.55%	2.55%	2.55%	-2.55%
DAISY03	0.72%	-0.72%	0.72%	0.72%	0.72%	-0.72%	-0.72%	-0.72%	0.72%
DAISY11	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%
	Contrast	-53.68%	0.44%	11.13%	-35.04%	8.11%	11.00%	52.23%	11.72%
	Effect	-6.71%	0.05%	1.39%	-4.38%	1.01%	1.37%	6.53%	1.46%

		24	34	123	124	134	234	1234
DAISY06	19.56%	19.56%	19.56%	-19.56%	-19.56%	-19.56%	-19.56%	19.56%
DAISY14	-5.45%	-5.45%	-5.45%	-5.45%	-5.45%	-5.45%	5.45%	5.45%
DAISY02	4.77%	-4.77%	4.77%	4.77%	4.77%	-4.77%	4.77%	-4.77%
DAISY10	1.03%	-1.03%	1.03%	-1.03%	-1.03%	1.03%	1.03%	1.03%
DAISY08	8.33%	8.33%	-8.33%	8.33%	-8.33%	8.33%	8.33%	-8.33%
DAISY16	1.27%	1.27%	-1.27%	-1.27%	1.27%	-1.27%	1.27%	1.27%
DAISY04	16.81%	-16.81%	-16.81%	-16.81%	16.81%	16.81%	-16.81%	16.81%
DAISY12	-0.33%	0.33%	0.33%	-0.33%	0.33%	0.33%	0.33%	0.33%
DAISY05	-0.15%	0.15%	0.15%	0.15%	-0.15%	-0.15%	-0.15%	0.15%
DAISY13	0.32%	-0.32%	-0.32%	0.32%	-0.32%	-0.32%	0.32%	0.32%
DAISY01	3.44%	3.44%	-3.44%	3.44%	-3.44%	3.44%	-3.44%	3.44%
DAISY09	-0.61%	-0.61%	0.61%	0.61%	-0.61%	0.61%	0.61%	0.61%
DAISY07	1.83%	-1.83%	1.83%	1.83%	1.83%	-1.83%	-1.83%	1.83%
DAISY15	2.55%	-2.55%	2.55%	-2.55%	-2.55%	2.55%	-2.55%	-2.55%
DAISY03	0.72%	0.72%	0.72%	-0.72%	-0.72%	-0.72%	0.72%	-0.72%
DAISY11	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%	2.86%
	Contrast	3.29%	-1.22%	-25.42%	-14.29%	1.87%	-18.66%	37.30%
	Effect	0.41%	-0.15%	-3.18%	-1.79%	0.23%	-2.33%	4.66%

Table F-1-14: TCC 500th cycle.

		1	2	3	4	12	13	14	23
DAISY06	19.12%	-19.12%	-19.12%	-19.12%	-19.12%	19.12%	19.12%	19.12%	19.12%
DAISY14	-5.17%	-5.17%	5.17%	5.17%	5.17%	5.17%	5.17%	5.17%	-5.17%
DAISY02	4.77%	-4.77%	4.77%	-4.77%	-4.77%	-4.77%	4.77%	4.77%	-4.77%
DAISY10	0.58%	0.58%	0.58%	-0.58%	-0.58%	0.58%	-0.58%	-0.58%	-0.58%
DAISY08	8.55%	-8.55%	-8.55%	8.55%	-8.55%	8.55%	-8.55%	8.55%	-8.55%
DAISY16	1.17%	1.17%	-1.17%	1.17%	-1.17%	-1.17%	1.17%	-1.17%	-1.17%
DAISY04	17.03%	-17.03%	17.03%	17.03%	-17.03%	-17.03%	-17.03%	17.03%	17.03%
DAISY12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY05	-0.17%	0.17%	0.17%	0.17%	-0.17%	-0.17%	-0.17%	0.17%	-0.17%
DAISY13	-0.01%	-0.01%	0.01%	0.01%	-0.01%	0.01%	0.01%	-0.01%	-0.01%
DAISY01	2.38%	-2.38%	2.38%	-2.38%	2.38%	-2.38%	2.38%	-2.38%	-2.38%
DAISY09	-1.43%	-1.43%	-1.43%	1.43%	-1.43%	-1.43%	1.43%	-1.43%	1.43%
DAISY07	1.87%	-1.87%	-1.87%	1.87%	1.87%	1.87%	-1.87%	-1.87%	-1.87%
DAISY15	2.91%	2.91%	-2.91%	2.91%	2.91%	-2.91%	2.91%	2.91%	-2.91%
DAISY03	-0.22%	0.22%	-0.22%	-0.22%	-0.22%	0.22%	0.22%	0.22%	-0.22%
DAISY11	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%
	Contrast	-52.88%	-2.76%	13.63%	-38.33%	8.05%	11.37%	52.89%	12.19%
	Effect	-6.61%	-0.35%	1.70%	-4.79%	1.01%	1.42%	6.61%	1.52%

		24	34	123	124	134	234	1234
DAISY06	19.12%	19.12%	19.12%	-19.12%	-19.12%	-19.12%	-19.12%	19.12%
DAISY14	-5.17%	-5.17%	-5.17%	-5.17%	-5.17%	-5.17%	5.17%	5.17%
DAISY02	4.77%	-4.77%	4.77%	4.77%	4.77%	-4.77%	4.77%	-4.77%
DAISY10	0.58%	-0.58%	0.58%	-0.58%	-0.58%	0.58%	0.58%	0.58%
DAISY08	8.55%	8.55%	-8.55%	8.55%	-8.55%	8.55%	8.55%	-8.55%
DAISY16	1.17%	1.17%	-1.17%	-1.17%	1.17%	-1.17%	1.17%	1.17%
DAISY04	17.03%	-17.03%	-17.03%	-17.03%	17.03%	17.03%	-17.03%	17.03%
DAISY12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
DAISY05	-0.17%	0.17%	0.17%	0.17%	-0.17%	-0.17%	-0.17%	0.17%
DAISY13	-0.01%	0.01%	0.01%	-0.01%	0.01%	0.01%	-0.01%	-0.01%
DAISY01	2.38%	2.38%	-2.38%	2.38%	-2.38%	2.38%	-2.38%	2.38%
DAISY09	-1.43%	-1.43%	1.43%	1.43%	-1.43%	1.43%	1.43%	1.43%
DAISY07	1.87%	-1.87%	1.87%	1.87%	1.87%	-1.87%	-1.87%	1.87%
DAISY15	2.91%	-2.91%	2.91%	-2.91%	-2.91%	2.91%	-2.91%	-2.91%
DAISY03	-0.22%	-0.22%	-0.22%	0.22%	0.22%	0.22%	-0.22%	0.22%
DAISY11	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%	2.40%
	Contrast	-0.19%	-1.28%	-24.20%	-12.86%	3.27%	-19.63%	35.31%
	Effect	-0.02%	-0.16%	-3.02%	-1.61%	0.41%	-2.45%	4.41%

APPENDIX F-2

Detailed Effect and Sum of Square (SS) at the Measured Temperature Cycles

Table F-2-1: TCB 1200th cycle.

		1	2	3	4	12	13	14	23
DAISY06	2.32423	-2.32423	-2.32423	-2.32423	-2.32423	2.32423	2.32423	2.32423	2.32423
DAISY14	-0.05316	-0.05316	0.05316	0.05316	0.05316	0.05316	0.05316	0.05316	-0.05316
DAISY02	1.53590	-1.53590	1.53590	-1.53590	-1.53590	-1.53590	1.53590	1.53590	-1.53590
DAISY10	0.20983	0.20983	0.20983	-0.20983	-0.20983	0.20983	-0.20983	-0.20983	-0.20983
DAISY08	0.22838	-0.22838	-0.22838	0.22838	-0.22838	0.22838	-0.22838	0.22838	-0.22838
DAISY16	0.13486	0.13486	-0.13486	0.13486	-0.13486	-0.13486	0.13486	-0.13486	-0.13486
DAISY04	-0.15006	0.15006	-0.15006	-0.15006	0.15006	0.15006	0.15006	-0.15006	-0.15006
DAISY12	-0.60876	-0.60876	-0.60876	-0.60876	0.60876	-0.60876	-0.60876	0.60876	-0.60876
DAISY05	-0.24382	0.24382	0.24382	0.24382	-0.24382	-0.24382	-0.24382	0.24382	-0.24382
DAISY13	-0.05009	-0.05009	0.05009	0.05009	-0.05009	0.05009	0.05009	-0.05009	-0.05009
DAISY01	1.04682	-1.04682	1.04682	-1.04682	1.04682	-1.04682	1.04682	-1.04682	-1.04682
DAISY09	0.69956	0.69956	0.69956	-0.69956	0.69956	0.69956	-0.69956	0.69956	-0.69956
DAISY07	0.77479	-0.77479	-0.77479	0.77479	0.77479	0.77479	-0.77479	-0.77479	-0.77479
DAISY15	0.20098	0.20098	-0.20098	0.20098	0.20098	-0.20098	0.20098	0.20098	-0.20098
DAISY03	0.00125	-0.00125	0.00125	0.00125	0.00125	-0.00125	-0.00125	-0.00125	0.00125
DAISY11	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365
	Contrast	-4.64063	-0.23796	-4.54419	-0.84811	1.06137	3.07337	3.87075	-3.26789
	Effect	-0.01184	-0.00061	-0.01159	-0.00216	0.00271	0.00784	0.00987	-0.00834
	SS	0.02747	0.00007	0.02634	0.00092	0.00144	0.01205	0.01911	0.01362

		24	34	123	124	134	234	1234
DAISY06	2.32423	2.32423	2.32423	-2.32423	-2.32423	-2.32423	-2.32423	2.32423
DAISY14	-0.05316	-0.05316	-0.05316	-0.05316	-0.05316	-0.05316	0.05316	0.05316
DAISY02	1.53590	-1.53590	1.53590	1.53590	1.53590	-1.53590	1.53590	-1.53590
DAISY10	0.20983	-0.20983	0.20983	-0.20983	-0.20983	0.20983	0.20983	0.20983
DAISY08	0.22838	0.22838	-0.22838	0.22838	-0.22838	0.22838	0.22838	-0.22838
DAISY16	0.13486	0.13486	-0.13486	-0.13486	0.13486	-0.13486	0.13486	0.13486
DAISY04	-0.15006	0.15006	0.15006	0.15006	-0.15006	-0.15006	0.15006	-0.15006
DAISY12	-0.60876	0.60876	0.60876	-0.60876	0.60876	0.60876	0.60876	0.60876
DAISY05	-0.24382	0.24382	0.24382	0.24382	-0.24382	-0.24382	-0.24382	0.24382
DAISY13	-0.05009	0.05009	0.05009	-0.05009	0.05009	0.05009	-0.05009	-0.05009
DAISY01	1.04682	1.04682	-1.04682	1.04682	-1.04682	1.04682	-1.04682	1.04682
DAISY09	0.69956	0.69956	-0.69956	-0.69956	0.69956	-0.69956	-0.69956	-0.69956
DAISY07	0.77479	-0.77479	0.77479	0.77479	0.77479	-0.77479	-0.77479	0.77479
DAISY15	0.20098	-0.20098	0.20098	-0.20098	-0.20098	0.20098	-0.20098	-0.20098
DAISY03	0.00125	0.00125	0.00125	-0.00125	-0.00125	-0.00125	0.00125	-0.00125
DAISY11	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365	0.34365
	Contrast	3.05682	4.28057	0.04070	-0.31091	-3.22912	-2.07444	2.87370
	Effect	0.00780	0.01092	0.00010	-0.00079	-0.00824	-0.00529	0.00733
	SS	0.01192	0.02337	0.00000	0.00012	0.01330	0.00549	0.01053

Table F-2-2: TCB 2012th cycle.

		1	2	3	4	12	13	14	23
DAISY06	2.67933	-2.67933	-2.67933	-2.67933	-2.67933	2.67933	2.67933	2.67933	2.67933
DAISY14	0.01570	0.01570	-0.01570	-0.01570	-0.01570	-0.01570	-0.01570	-0.01570	0.01570
DAISY02	1.44270	-1.44270	1.44270	-1.44270	-1.44270	-1.44270	1.44270	1.44270	-1.44270
DAISY10	0.70109	0.70109	0.70109	-0.70109	-0.70109	0.70109	-0.70109	-0.70109	-0.70109
DAISY08	0.04150	-0.04150	-0.04150	0.04150	-0.04150	0.04150	-0.04150	0.04150	-0.04150
DAISY16	-0.09873	-0.09873	0.09873	-0.09873	0.09873	0.09873	-0.09873	0.09873	0.09873
DAISY04	-0.09807	0.09807	-0.09807	-0.09807	0.09807	0.09807	0.09807	-0.09807	-0.09807
DAISY12	-0.90808	-0.90808	-0.90808	-0.90808	0.90808	-0.90808	-0.90808	0.90808	-0.90808
DAISY05	0.06234	-0.06234	-0.06234	-0.06234	0.06234	0.06234	0.06234	-0.06234	0.06234
DAISY13	-0.31602	-0.31602	0.31602	0.31602	-0.31602	0.31602	0.31602	-0.31602	-0.31602
DAISY01	1.50364	-1.50364	1.50364	-1.50364	1.50364	-1.50364	1.50364	-1.50364	-1.50364
DAISY09	0.52486	0.52486	0.52486	-0.52486	0.52486	0.52486	-0.52486	0.52486	-0.52486
DAISY07	0.73262	-0.73262	-0.73262	0.73262	0.73262	0.73262	-0.73262	-0.73262	-0.73262
DAISY15	0.17750	0.17750	-0.17750	0.17750	0.17750	-0.17750	0.17750	0.17750	-0.17750
DAISY03	0.13939	-0.13939	0.13939	0.13939	0.13939	-0.13939	-0.13939	-0.13939	0.13939
DAISY11	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562
	Contrast	-5.83151	0.58690	-6.05188	-0.37549	1.64318	3.69325	2.87946	-2.87495
	Effect	-0.01488	0.00150	-0.01544	-0.00096	0.00419	0.00942	0.00735	-0.00733
	SS	0.04338	0.00044	0.04672	0.00018	0.00344	0.01740	0.01058	0.01054

		24	34	123	124	134	234	1234
DAISY06	2.67933	2.67933	2.67933	-2.67933	-2.67933	-2.67933	-2.67933	2.67933
DAISY14	0.01570	0.01570	0.01570	0.01570	0.01570	0.01570	-0.01570	-0.01570
DAISY02	1.44270	-1.44270	1.44270	1.44270	1.44270	-1.44270	1.44270	-1.44270
DAISY10	0.70109	-0.70109	0.70109	-0.70109	-0.70109	0.70109	0.70109	0.70109
DAISY08	0.04150	0.04150	-0.04150	0.04150	-0.04150	0.04150	0.04150	-0.04150
DAISY16	-0.09873	-0.09873	0.09873	0.09873	-0.09873	0.09873	-0.09873	-0.09873
DAISY04	-0.09807	0.09807	0.09807	0.09807	-0.09807	-0.09807	0.09807	-0.09807
DAISY12	-0.90808	0.90808	0.90808	-0.90808	0.90808	0.90808	0.90808	0.90808
DAISY05	0.06234	-0.06234	-0.06234	-0.06234	0.06234	0.06234	0.06234	-0.06234
DAISY13	-0.31602	0.31602	0.31602	-0.31602	0.31602	0.31602	-0.31602	-0.31602
DAISY01	1.50364	1.50364	-1.50364	1.50364	-1.50364	1.50364	-1.50364	1.50364
DAISY09	0.52486	0.52486	-0.52486	-0.52486	0.52486	-0.52486	-0.52486	-0.52486
DAISY07	0.73262	-0.73262	0.73262	0.73262	0.73262	-0.73262	-0.73262	0.73262
DAISY15	0.17750	-0.17750	0.17750	-0.17750	-0.17750	0.17750	-0.17750	-0.17750
DAISY03	0.13939	0.13939	0.13939	-0.13939	-0.13939	-0.13939	0.13939	-0.13939
DAISY11	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562	0.57562
	Contrast	3.58723	5.75251	-1.00004	-0.86129	-1.21674	-2.07962	4.18356
	Effect	0.00915	0.01467	-0.00255	-0.00220	-0.00310	-0.00531	0.01067
	SS	0.01641	0.04221	0.00128	0.00095	0.00189	0.00552	0.02232

Table F-2-3: TCC 300th cycle.

		1	2	3	4	12	13	14	23
DAISY06	4.24038	-4.24038	-4.24038	-4.24038	-4.24038	4.24038	4.24038	4.24038	4.24038
DAISY14	1.41309	1.41309	-1.41309	-1.41309	-1.41309	-1.41309	-1.41309	-1.41309	1.41309
DAISY02	1.83659	-1.83659	1.83659	-1.83659	-1.83659	-1.83659	1.83659	1.83659	-1.83659
DAISY10	0.99047	0.99047	0.99047	-0.99047	-0.99047	0.99047	-0.99047	-0.99047	-0.99047
DAISY08	0.95776	-0.95776	-0.95776	0.95776	-0.95776	0.95776	-0.95776	0.95776	-0.95776
DAISY16	0.36965	0.36965	-0.36965	0.36965	-0.36965	-0.36965	0.36965	-0.36965	-0.36965
DAISY04	0.61393	-0.61393	0.61393	0.61393	-0.61393	-0.61393	-0.61393	0.61393	0.61393
DAISY12	-0.83026	-0.83026	-0.83026	-0.83026	0.83026	-0.83026	-0.83026	0.83026	-0.83026
DAISY05	0.30352	-0.30352	-0.30352	-0.30352	0.30352	0.30352	0.30352	-0.30352	0.30352
DAISY13	0.13733	0.13733	-0.13733	-0.13733	0.13733	-0.13733	-0.13733	0.13733	0.13733
DAISY01	3.27287	-3.27287	3.27287	-3.27287	3.27287	-3.27287	3.27287	-3.27287	-3.27287
DAISY09	1.32687	1.32687	1.32687	-1.32687	1.32687	1.32687	-1.32687	1.32687	-1.32687
DAISY07	1.76043	-1.76043	-1.76043	1.76043	1.76043	1.76043	-1.76043	-1.76043	-1.76043
DAISY15	1.01568	1.01568	-1.01568	1.01568	1.01568	-1.01568	1.01568	1.01568	-1.01568
DAISY03	0.78299	-0.78299	0.78299	0.78299	0.78299	-0.78299	-0.78299	-0.78299	0.78299
DAISY11	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413
	Contrast	-8.74150	-1.60025	-8.24681	-0.38776	-0.08882	2.82968	2.66991	-4.26521
	Effect	-0.02230	-0.00408	-0.02104	-0.00099	-0.00023	0.00722	0.00681	-0.01088
	SS	0.09747	0.00327	0.08675	0.00019	0.00001	0.01021	0.00909	0.02320

		24	34	123	124	134	234	1234
DAISY06	4.24038	4.24038	4.24038	-4.24038	-4.24038	-4.24038	-4.24038	4.24038
DAISY14	1.41309	1.41309	1.41309	1.41309	1.41309	1.41309	-1.41309	-1.41309
DAISY02	1.83659	-1.83659	1.83659	1.83659	1.83659	-1.83659	1.83659	-1.83659
DAISY10	0.99047	-0.99047	0.99047	-0.99047	-0.99047	0.99047	0.99047	0.99047
DAISY08	0.95776	0.95776	-0.95776	0.95776	-0.95776	0.95776	0.95776	-0.95776
DAISY16	0.36965	0.36965	-0.36965	-0.36965	0.36965	-0.36965	0.36965	0.36965
DAISY04	0.61393	-0.61393	-0.61393	-0.61393	0.61393	0.61393	-0.61393	0.61393
DAISY12	-0.83026	0.83026	0.83026	-0.83026	0.83026	0.83026	0.83026	0.83026
DAISY05	0.30352	-0.30352	-0.30352	-0.30352	0.30352	0.30352	0.30352	-0.30352
DAISY13	0.13733	-0.13733	-0.13733	0.13733	-0.13733	-0.13733	0.13733	0.13733
DAISY01	3.27287	3.27287	-3.27287	3.27287	-3.27287	3.27287	-3.27287	3.27287
DAISY09	1.32687	1.32687	-1.32687	-1.32687	1.32687	-1.32687	-1.32687	-1.32687
DAISY07	1.76043	-1.76043	1.76043	1.76043	1.76043	-1.76043	-1.76043	1.76043
DAISY15	1.01568	-1.01568	1.01568	-1.01568	-1.01568	1.01568	-1.01568	-1.01568
DAISY03	0.78299	0.78299	0.78299	-0.78299	-0.78299	-0.78299	0.78299	-0.78299
DAISY11	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413	0.60413
	Contrast	7.14005	6.49209	-0.49155	-2.33901	-0.45254	-6.83056	5.18296
	Effect	0.01821	0.01656	-0.00125	-0.00597	-0.00115	-0.01742	0.01322
	SS	0.06503	0.05376	0.00031	0.00698	0.00026	0.05951	0.03426

Table F-2-4: TCC 500th cycle.

		1	2	3	4	12	13	14	23
DAISY06	9.36827	-9.36827	-9.36827	-9.36827	-9.36827	9.36827	9.36827	9.36827	9.36827
DAISY14	-2.53214	-2.53214	2.53214	2.53214	2.53214	2.53214	2.53214	2.53214	-2.53214
DAISY02	2.33613	-2.33613	2.33613	-2.33613	-2.33613	-2.33613	2.33613	2.33613	-2.33613
DAISY10	0.28652	0.28652	0.28652	-0.28652	-0.28652	0.28652	-0.28652	-0.28652	-0.28652
DAISY08	4.19086	-4.19086	-4.19086	4.19086	-4.19086	4.19086	-4.19086	4.19086	-4.19086
DAISY16	0.57284	0.57284	-0.57284	0.57284	-0.57284	-0.57284	0.57284	-0.57284	-0.57284
DAISY04	8.34691	-8.34691	8.34691	8.34691	-8.34691	-8.34691	-8.34691	8.34691	8.34691
DAISY12	0.00096	0.00096	0.00096	0.00096	-0.00096	0.00096	0.00096	-0.00096	0.00096
DAISY05	-0.08116	0.08116	0.08116	0.08116	-0.08116	-0.08116	-0.08116	0.08116	-0.08116
DAISY13	-0.00249	-0.00249	0.00249	0.00249	-0.00249	0.00249	0.00249	-0.00249	-0.00249
DAISY01	1.16859	-1.16859	1.16859	-1.16859	1.16859	-1.16859	1.16859	-1.16859	-1.16859
DAISY09	-0.70237	-0.70237	-0.70237	0.70237	-0.70237	-0.70237	0.70237	-0.70237	0.70237
DAISY07	0.91420	-0.91420	-0.91420	0.91420	0.91420	0.91420	-0.91420	-0.91420	-0.91420
DAISY15	1.42574	1.42574	-1.42574	1.42574	1.42574	-1.42574	1.42574	1.42574	-1.42574
DAISY03	-0.10841	0.10841	-0.10841	-0.10841	-0.10841	0.10841	0.10841	0.10841	-0.10841
DAISY11	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503
	Contrast	-25.9113	-1.35275	6.67676	-18.7812	3.94516	5.57333	25.91668	5.97446
	Effect	-0.06610	-0.00345	0.01703	-0.04791	0.01006	0.01422	0.06611	0.01524
	SS	0.85637	0.00233	0.05686	0.44992	0.01985	0.03962	0.85673	0.04553

		24	34	123	124	134	234	1234
DAISY06	9.36827	9.36827	9.36827	-9.36827	-9.36827	-9.36827	-9.36827	9.36827
DAISY14	-2.53214	-2.53214	-2.53214	-2.53214	-2.53214	-2.53214	2.53214	2.53214
DAISY02	2.33613	-2.33613	2.33613	2.33613	2.33613	-2.33613	2.33613	-2.33613
DAISY10	0.28652	-0.28652	0.28652	-0.28652	-0.28652	0.28652	0.28652	0.28652
DAISY08	4.19086	4.19086	-4.19086	4.19086	-4.19086	4.19086	4.19086	-4.19086
DAISY16	0.57284	0.57284	-0.57284	-0.57284	0.57284	-0.57284	0.57284	0.57284
DAISY04	8.34691	-8.34691	-8.34691	-8.34691	8.34691	8.34691	-8.34691	8.34691
DAISY12	0.00096	-0.00096	-0.00096	0.00096	-0.00096	-0.00096	-0.00096	-0.00096
DAISY05	-0.08116	0.08116	0.08116	0.08116	-0.08116	-0.08116	-0.08116	0.08116
DAISY13	-0.00249	0.00249	0.00249	-0.00249	0.00249	0.00249	-0.00249	-0.00249
DAISY01	1.16859	1.16859	-1.16859	1.16859	-1.16859	1.16859	-1.16859	1.16859
DAISY09	-0.70237	-0.70237	0.70237	0.70237	-0.70237	0.70237	0.70237	0.70237
DAISY07	0.91420	-0.91420	0.91420	0.91420	0.91420	-0.91420	-0.91420	0.91420
DAISY15	1.42574	-1.42574	1.42574	-1.42574	-1.42574	1.42574	-1.42574	-1.42574
DAISY03	-0.10841	-0.10841	-0.10841	0.10841	0.10841	0.10841	-0.10841	0.10841
DAISY11	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503	1.17503
	Contrast	-0.09417	-0.62881	-11.8572	-6.30060	1.60122	-9.62084	17.30028
	Effect	-0.00024	-0.00160	-0.03025	-0.01607	0.00408	-0.02454	0.04413
	SS	0.00001	0.00050	0.17933	0.05063	0.00327	0.11806	0.38176

APPENDIX G

Cracked Via Cross-section Micrographs

PKG#36_DC#06_Ball#Y4_V2-3

PKG#36_DC#06_Ball#Y4_V9-10

PKG#36_DC#06_Ball#Y4_V4-5

PKG#36_DC#06_Ball#AA4_V2-3

PKG#36_DC#06_Ball#Y4_V6-7

PKG#36_DC#06_Ball#AA4_V4-5

PKG#36_DC#06_Ball#AA4_V6-7

PKG#36_DC#06_Ball#AB4_V6-7

PKG#36_DC#06_Ball#AA4_V9-10

PKG#36_DC#06_Ball#AB4_V7-8

PKG#36_DC#06_Ball#AB4_V2-3

PKG#36_DC#06_Ball#AB4_V8-9

PKG#36_DC#06_Ball#AB4_V4-5

PKG#36_DC#06_Ball#AC4_V2-3

PKG#36_DC#06_Ball#AC4_V4-5

PKG#36_DC#06_Ball#AD4_V4-5

PKG#36_DC#06_Ball#AC4_V6-7

PKG#36_DC#06_Ball#AD4_V6-7

PKG#36_DC#06_Ball#AC4_V8-9

PKG#36_DC#06_Ball#AD4_V8-9

PKG#36_DC#06_Ball#AD4_V2-3

PKG#43_DC#06_Ball#AB9_V1-2

PKG#43_DC#06_Ball#AB9_V2-3

PKG#43_DC#06_Ball#AB10_V2-3

PKG#43_DC#06_Ball#AB9_V3-4

PKG#43_DC#06_Ball#AB10_V3-4

PKG#43_DC#06_Ball#AB9_V4-5

PKG#43_DC#06_Ball#AB10_V4-5

PKG#43_DC#06_Ball#AB10_V1-2

PKG#43_DC#06_Ball#AB10_V6-7

PKG#43_DC#06_Ball#AB10_V7-8

PKG#43_DC#06_Ball#AB11_V4-5

PKG#43_DC#06_Ball#AB11_V1-2

PKG#43_DC#06_Ball#AB11_V6-7

PKG#43_DC#06_Ball#AB11_V2-3

PKG#43_DC#06_Ball#AB12_V1-2

PKG#43_DC#06_Ball#AB11_V3-4

PKG#43_DC#06_Ball#AB12_V2-3

PKG#43_DC#06_Ball#AB12_V3-4

PKG#43_DC#06_Ball#AB13_V3-4

PKG#43_DC#06_Ball#AB12_V4-5

PKG#43_DC#06_Ball#AB13_V4-5

PKG#43_DC#06_Ball#AB13_V1-2

PKG#43_DC#06_Ball#AB13_V6-7

PKG#43_DC#06_Ball#AB13_V2-3

PKG#06_DC#04_Ball#AT39_V4-5

PKG#06_DC#04_Ball#AT39_V6-7

PKG#06_DC#04_Ball#AP39_V6-7

PKG#06_DC#04_Ball#AR39_V4-5

PKG#06_DC#04_Ball#AN39_V4-5

PKG#06_DC#04_Ball#AR39_V6-7

PKG#06_DC#04_Ball#AN39_V6-7

PKG#06_DC#04_Ball#AP39_V4-5

PKG#06_DC#04_Ball#AM39_V4-5

PKG#06_DC#04_Ball#AM39_V6-7

PKG#02_DC#02_Ball#C35_V7-8

PKG#48_DC#08_Ball#AJ12_V4-5

PKG#02_DC#02_Ball#C34_V7-8

PKG#48_DC#08_Ball#AJ15_V4-5

PKG#02_DC#02_Ball#C33_V7-8

PKG#02_DC#02_Ball#C36_V7-8

PKG#02_DC#02_Ball#C32_V7-8

PKG#02_DC#02_Ball#C31_V7-8

PKG#02_DC#02_Ball#C30_V7-8